6th Annual CMMI Technology Conference & User Group

Denver, Colorado

November 11 - 17, 2006

TUTORIAL SESSIONS - MONDAY, NOVEMBER 13, 2006

TRACK 1

- 1A1 Tutorial, CMMI v1.2 Tutorial, Mr. Mike Phillips, SEI
- 1C1 Tutorial, Are We Ready for CMMI? If Not, Let's Fix Ourselves, Mr. Al Florence, The MITRE Corporation

TRACK 2

- 1C2 Tutorial, Calculating CMMI-based ROI: How, What, When and Why?, Mr. Rolf Reitzig, Cognence, Inc.

TRACK 3

- 1A3 Tutorial Addressing High-Value Project Management Activities Using Process Simulation & Supporting CMMI for Process Areas, Dr. David Raffo, Portland State University
- 1C3 Tutorial, Into the Future, Part 1: Process Definition on Steroids, Ms. Kathy Reid, 96th Communications Group/TYBRIN, USAF

TRACK 4

- 1A4 Tutorial, Integrated Project Management (IPM) - The CMMI and Collaborative Product Development, Mr. William Deibler, II, Software Systems Quality Consulting
- 1C4 Tutorial, CMMI Crash Course: What the SEI Won't Teach You, Mr. Hillel Glazer, Entinex, Inc.

TRACK 5

- 1A5 Tutorial, A Practical Guide to Implementing Levels 4 and 5, Dr. Rick Hefner, Northrop Grumman Corporation
- 1C5 Tutorial, Basics of PSP and TSP for Systems Engineering, Mr. James McHale, SEI

TRACK 6

- 1C6 Tutorial, Requirements Engineering: A Practical Approach to Modeling and Managing Requirements, Mr. William Deibler, II, Software Systems Quality Consulting

TRACK 7

- 1A7 Tutorial, Lessons Learned in Implementing CMMI in a Large Systems Engineering Organization, Mr. Michael Kutch, Jr., SPAWAR, Charleston

TRACK 8

- 1A8 Tutorial Lean Process Improvement, Mr. Jeffrey Dutton, Jacobs Technology

TUESDAY, NOVEMBER 14, 2006

KEYNOTE

- VADM Walter B. Massenburg, USN, Commander, Naval Air Systems Command CMMI® Into the Future
- Mr. Clyde Chittister, Chief Operating Office, SEI
- Mr. Bob Rassa, Director, Systems Support, Raytheon Company

EXECUTIVE PANEL

Moderator: Mr. Mark Schaeffer, Director, Systems & Software Engineering, OSD (AT&L)

- Mr. Roger Fujii, Vice President, Communications and Systems Technology, Defense Mission
- Mr. Dev Banerjee, Division Director, Systems & Flight Engineering, Integrated Defense Systems St. Louis, The Boeing Company
- Mr. Mark Schaeffer, Director, Systems & Software Engineering, OSD (AT&L)

TECHNICAL SESSIONS

TRACK 1 - CMMI and Process Improvement

- The Continuous Representation: Cultivating Process Improvement from Grassroots Efforts Ms. Jennifer Turgeon, Sandia National Laboratories
- Who Needs that Process Stuff Anyway? A Practical Example of Process Discipline to Improve Deployment, Mr. William Borokowski, Jr., Raytheon Company, Missile Systems
- 2D1 FASTrack to CMMI, Mr. Al Florence, The MITRE Corporation
- 2D1 Implementing CMMI-based Process Improvement Using RUP, Mr. John Miller, Cognence, Inc.

TRACK 2 - High Maturity

- 2C2 Business Value of CMMI Level 5, Dr. Gene Miluk, SEI
- 2C2 Demonstrating CMMI-based Process Improvement, Ms. Elizabeth Clark, Lockheed Martin Corporation, IS&S
- 2D2 Report to OSD: NDIA Top 5 Software Issues, Mr. Bob Rassa, Raytheon Company
- 2D2 Right Turns and Wrong Turns to Level 5, Mr. Timothy Davis, Raytheon Company, Missile Systems

TRACK 3 - Appraisals

- 2C3 Improving SCAMPISM Efficiency, Mr. Roland Weiss, Lockheed Martin Corporation
- 2C3 SCAMPI A Appraisals - Preparation in100 Hours; Execution in a Week, Mr. Ronald Ulrich, Northrop Grumman Corporation, Mission Systems
- 2D3 ISO and CMMI: How to Perform SCAMPI Appraisals and ISO Audits in a Syncronized, Simultaneous, Stupendous One Fell Swoop, Ms. Margaret Glover, SEI
- 2D3 Experience Report - An ISO/IEC 15504-conformant SCAMPI Appraisal, Mr. David Kitson, SEI

TRACK 4 - ROI & Benefits of CMMI

- 2C4 CMMI-based Process Improvement: How and When Does Success Happen?, Dr. Dennis Goldenson, SEI
- 2D4 The Rosetta Stone CMMI ROI Model - Translating Between ROI, CMMI and Metrics, Mr. Fionbarr McLoughlin, University of Limerick
- 2D4 Quick Win Strategies in CMMI Transition, Ms. Angel (Qi) Liu, Motorola GSG, China

TRACK 5 - CMMI Extensions: Acquisition

- 2C5 CMMI for Acquisition: Introducing the CMMI for Acquisition Constellation, Ms. Kristen Baldwin, Office of the Secretary of Defense
- 2D5 The Hidden Truths of Being a Successful Acquirer, Dr. Hubert Hofmann, General Motors
- 2D5 When CMMI-AM No Longer Suffices, Mr. Claude Marais, TPI, Inc.

TRACK 6 - Systems Engineering

- 2C6 Developing Systems Engineering Processes from Existing Software Processes, Ms. Lee Sheiner, Georgia Tech Research Institute
- 2C6 Extending the Team Software Process (TSP) for Systems Engineering, Mr. Timothy Chick, Naval Air Warfare Center, Weapons Division
- 2D6 No Doubt: The LRAS3/FS3 Story of Mission Assurance, Mrs. Jill Brooks, Raytheon Company

TRACK 7 - Lean, Six Sigma and Agile

- 2C7 Rapidly Defining a Lean CMMI Maturity Level 3 Process, Ms. Julie Kellum, Hewlett Packard Company
- 2D7 Using Business Process Management Technology to Implement CMMI-compliant Agile Software Development, Mr. Robert Moore, III, Business Transformation Institute
- 2D7 Using “Voice of Customer” Tools to Advance Organizational Innovation and Deployment, Mr. Donald Corpron, Northrop Grumman Corporation

TECHNICAL SESSIONS - WEDNESDAY, NOVEMBER 15, 2006

TRACK 1 - CMMI and Process Improvement

- 3A1 Communication Loops Within the CMMI, Mr. Shawn Presson, Apogen Services, LLC
- 3A1 Knowledge Management at the Heart of CMMI ML3 at RAFAEL, Dr. Amir Tomer, RAFAEL, Ltd.
- 3B1 Organizational Synthesis: CMMI The Glue that Binds, Ms. Eileen Arnold, BAE Systems, L&A
- 3B1 Operations and Maintenance - More Than Just a Scaling Issue, Mr. Laurence Gill, BAE Systems
- 3C1 Program Management Office (PMO) and CMMI - Paving the Road to Optimized IT Value: Case Study, Mr. Terry Jabali, Applied Enterprise Dynamics, Inc.
- 3C1 How to Sell CMMI to Your CEO in His Own Language, Ms. Lemis Altan, Cognence, Inc.

- 3D1 Make Middle Managers the Process Owners, Mr. Tim Kasse, Kasse Initiatives, LLC
- 3D1 You Shouldn't Have to Be an Engineer to Understand Your Process, Ms. Leticia Santillan, Raytheon Company, Missile Systems

TRACK 2 - High Maturity

- 3A2 What is the Performance Effect of the CMMI-based Process Improvement in Motorola?, Ms. Angel (Qi) Liu, Motorola GSG, China
- 3A2 Learning to Count - Do You Understand Why Level 3 Comes Before Level 4 Which Comes Before Level 5?, Ms. Nancy Raymond, Raytheon Corporation
- 3B2 Making OID Effective, Ms. Diane Mizukami Williams, Northrop Grumman Corporation, Mission Systems
- 3B2 When OID Crosses Time Zones, Disciplines and Customer Base, Ms. Laurie Haack, Raytheon Company
- 3C2 Looking Beyond Quantitative Defect Management, Mr. Anil Midha, BAE Systems
- 3D2 Statistical Control of System and Software Design Activities, Dr. Richard Welch, Northrup Grumman Corporation
- 3D2 I Have Had My CMMI Appraisal... What Do I Do Now? How to Establish a Process Improvement Work Breakdown Structure, Dr. Aldo Dagnino, SAS Institute

TRACK 3 - Appraisals

- 3B3 Lessons Learned from Conducting Scampi B and C Appraisals, Mr. Itzhak Lavi, Israel Aircraft Industries, Ltd
- 3B3 Practical Advice on Picking the Right Projects for an Appraisal,Mr. Robert Moore, III, Business Transformation Institute
- 3C3 Lessons Learned: Getting Ready for a SEI Maturity Level 5, Mr. Dennis Ring, Lockheed Martin Corporation, IS&S
- 3C3 Indicators of Reliable SCAMPI Appraisal Results, Mr. Bruce Boyd, The Boeing Company
- 3D3 Project Implementation Strategies in the CMMI, Dr. Rick Hefner, Northrop Grumman Corporation
- 3D3 Patterns: An Approach for CMMI Adoption, Dr. Rick Hefner, Northrop Grumman Corporation

TRACK 4 - ROI & Benefi ts of CMMI

- 3A4 Evaluating the Impact the QuARS Requirements Analysis Tool Using Simulation, Dr. David Raffo, Portland State University
- 3A4 Measuring the Value of Systems Engineering Processes, Mr. Allan Mink, II, Systems Value

TRACK 4 - Measurement

- 3B4 Practical Earned Value Management Integrated with CMMI-compliant Processes, Dr. Donn Milton, Pragma Systems Corporation
- 3B4 Extracting Strategic Value from CMMI, Dr. Rick Hefner, Northrop Grumman Corporation
- 3C4 Performance Benchmarking Consortium, Mr. Mark Kasunic, SEI
- 3D4 2006 State of Software Measurement Practice Survey, Mr. Mark Kasunic, SEI
- 3D4 Measures and Lessons from a CMMI Guided Process Improvement Project, Dr. Ruth Buys, 3H Technology, LLC

TRACK 5 - CMMI Extensions: Acquisition

- 3A5 Using CMMI-AM to Measure AF System Program Office Implementation of Systems Engineering, Mr. Ian Talbot, US Air Force, Air Armament Center
- 3A5 Understanding and Leveraging a Supplier's CMMI Efforts:A Guidebook for Acquirers, Mr. Lawrence Osiecki, OUSD (AT&L) SSE/SSA
- 3B5 SCAMPI B's for Contract Monitoring - A Case Study of the Mission Planning Enterprise Contractors, Ms. Lorraine Adams, SEI
- 3B5 DCMA CMMI-related Data Collection: A Maturity Model-based Reflecction of Practice Strengths and Weaknesses Mr. John Eget, DCMA
- 3C5 Practical Use of DCMA's CMMIbased Risk Management Methodology, Mr. Gary Sigmund, DCMA
- 3C5 The Issue of Performance - Why Do You Need a Maturity Level 5 Supplier?, Mr. Tim Kasse, Kasse Initiatives, LLC

TRACK 5 - CMMI Extensions: Services

- 3D5 CMMI for Services: Introducing the CMMI for Services Constellation, Mr. Craig Hollenbach, Northrop Grumman Corporation
- 3D5 CMMI Implementation in Manufacturing Processes, Mr. Itzhak Lavi, Israel Aircraft Industries, Ltd.

TRACK 6 - Systems Engineering

- 3A6 Risk Management Beyond CMMI Level 5, Dr. Rick Hefner, Northrop Grumman Coproration
  3A6 CMMI Opens the Gate - The Practical Relationship between CMMI and Stage-Gate Decision Models, Mr. Andrew Cordes, ABB US Corporate Research
- 3B6 Mission Assurance of Software Suppliers - A Partnership Between Software Supplier Managers and Quality Engineering, Mrs. Jill Brooks, Raytheon Company3B6 Systems Engineering Revitalization Using CCMI, Mr. Michael Kutch, Jr., SPAWAR, Charleston

TRACK 6 - CMMI v1.2 and Beyond

- 3C6 CMMI V1.2 Overview, Mr. Mike Phillips, SEI
- 3C6 SCAMPI 1.2 Updates, Dr. Jack Ferguson, SEI
- 3D6 Strengthening the Credibility of Level 4/5 Appraisals, Mr. Will Hayes, SEI
- 3D6 Lead Appraiser Training for V1.2, Dr. Jack Ferguson, SEI

TRACK 7 - Lean, Six Sigma and Agile

- 2C7 Rapidly Defi ning a Lean CMMI Maturity Level 3 Process, Ms. Julie Kellum, Hewlett Packard Company
- 2D7 Using Business Process Management Technology to Implement CMMI-compliant Agile Software Development, Mr. Robert Moore, III, Business Transformation Institute
- 2D7 Using "Voice of Customer" Tools to Advance Organizational Innovation and Deployment, Mr. Donald Corpron, Northrop Grumman Corporation

- 3C7 Lean Process Design - A Concept of Process Quality, Mr. David Card, Q-Labs

TRACK 7 - CMMI in Small Settings

- 3D7 Easing Project Planning for Small Programs, Mr. Kenneth Weinberg, Raytheon Company
- 3D7 The Road to Lean CMMI in a Small Federal Organization, Ms. Susan Bassham, US Army, Aviation and Missile Command

Technical Sessions - Thursday, November 16, 2006

TRACK 1 - CMMI and Process Improvement

- 4A1 Moving from Level 2 to Level 3 Risk Management, Ms. Susan Byrnes, Natural SPI, Inc.
- 4A1 Interfaced vs. Integrated Process, Mr. Robert Rice, BAE Systems

TRACK 2 - Sustaining Improvement

- 4A2 Motivating the Team to Continuously Improve After the CMMI Rating, Ms. Leticia Santillan, Raytheon Company, Missile Systems
- 4A2 King of the Mountain - Staying Atop Mt. CMMI After the Initial Assent, Mr. Timothy Davis, Raytheon Company, Missile Systems
- 4B2 Sustaining CMMI Compliance, Dr. Rick Hefner, Northrop Grumman Corporation
- 4B2 Maintaining Institutionalization After the Appraisal Team Leaves, Mr. John Johnston, PMP, BAE Systems

TRACK 3 - Implementation Guidance

- 4A3 An Enterprise Approach to Process Improvement - Ms. Linda Kovar, Raytheon Company
- 4A3 CMMI and ISO 9001- A Registrar's Perspective, Mr. Matt Leiphart, Platinum Registration
- 4B3 It's a #$*!>% Mess: How to Leverage Today's Process into Tomorrow's Initiatives, Ms.Terri Bryant, Raytheon Company, Missile Systems
- 4B3 Systematically Tailoring the Organization's Standard Process for a Project, Dr. Kenneth Nidiffer, Systems and Software Consortium

TRACK 4 - Measurement

- 4A4 Integrating Planning, Control, Measurement & Analysis CMMI Process Areas to Achieve More Successful Software Projects, Mr. Daniel Galorath, Galorath Incorporated
- 4A4 The Unseen Benefi ts of the Change Request Process, Mr. Scott Banks, Georgia Tech Research Institute
- 4B4 Measuring the Impact of RD and REQM CMMI Process Areas, Dr. Aldo Dagnino, SAS Institute
- 4B4 Untethered Activities - The Real Reason for Schedule Slips, Mr. Rolf Reitzig, Cognence, Inc.

TRACK 5 - CMMI Extensions: Services

- 4A5 Lessons in Integrating Nonengineering Organizations with Engineering Using the CMMI, Mr. Joseph Vandeville, Northrop Grumman Corporation
- 4A5 Engineering in a Non-development Environment, Ms. Kathy King, BAE Systems
- 4B5 Achieving Delivery Excellence Using CMMI, Mr. Keith Heston, Accenture

TRACK 6 - CMMI v1.2 and Beyond

- 4A6 Implications of Combining SAM and ISM in CMMI V1.2, Mr. Mike Phillips, SEI
- 4A6 A Practical Roadmap for Transitioning to CMMI V1.2, Dr. Rick Hefner, Northrop Grumman Corporation
- 4B6 Resolving CMMI Issues, Dr. Karen Richter, Institute for Defense Analyses

TRACK 7 - CMMI in Small Settings

- 4A7 CMMI Applications in Small Setting Finance Organization for Process Performance Optimization, Dr. Mary Anne Herndon, Transdyne Corporation
- 4A7 Small Project Challenges of CMMI in Large Organizations, Mr. John Bethmann, Concurrent Technologies Corporation
- 4B7 Why Choose Between CMMI, ISTO, ITIL and Six Sigma? Why Not Leverage All!, Ms. Lemis Altan, Cognence, Inc.

CONFERENCE AGENDA

SUNDAY, NOVEMBER 12, 2006

3:00 PM - 6:00 PM	Conference Registration Open	Grand Mesa Foyer

MONDAY, NOVEMBER 13, 2006

5:30 PM - 7:00 PM	Reception	Atrium Display Area

TUESDAY, NOVEMBER 14, 2006

7:00 AM - 5:00 PM	Conference Registration Open	Grand Mesa Foyer
7:00 AM - 8:00 AM	Continental Breakfast	Atrium Display Area
8:00 AM - 8:15 AM	Welcome & Opening Remarks ◆ *Mr. Sam Campagna, Director, Operations, NDIA* ◆ *Mr. Bob Rassa, Director, Systems Support, Raytheon Company*	Grand Mesa DEF
8:15 AM - 9:00 AM	Keynote ◆ *VADM Walter B. Massenburg, USN, Commander, Naval Air Systems Command*	Grand Mesa DEF
9:00 AM - 9:45 AM	CMMI® Into the Future ◆ *Mr. Clyde Chittister, Chief Operating Office, SEI* ◆ *Mr. Bob Rassa, Director, Systems Support, Raytheon Company*	Grand Mesa DEF
9:45 AM - 10:15 AM	Break	Atrium Display Area
10:15 AM - 11:45 AM	Executive Panel ◆ *Moderator: Mr. Mark Schaeffer, Director, Systems & Software Engineering, OSD (AT&L)* ◆ *Mr. Roger Fujii, Vice President, Communications and Systems Technology, Defense Mission Systems Division, Mission Systems Sector, Northrop Grumman Corporation* ◆ *Mr. Dev Banerjee, Division Director, Systems & Flight Engineering, Integrated Defense Systems St. Louis, The Boeing Company*	Grand Mesa DEF
12:00 PM - 1:30 PM	Lunch with Guest Speaker ◆ *Mr. Mark Schaeffer, Director, Systems & Software Engineering, OSD (AT&L)*	Grand Mesa ABC Corridor
1:30 PM - 5:00 PM	Technical Sessions	Refer to Following Pages
3:00 PM - 3:30 PM	Break	Atrium Display Area
5:00 PM - 6:30 PM	Reception	Atrium Display Area

WEDNESDAY, NOVEMBER 15, 2006

7:15 AM - 5:00 PM	Conference Registration Open	Grand Mesa Foyer
7:15 AM - 8:15 AM	Continental Breakfast	Atrium Display Area
8:15 AM - 11:45 AM	Technical Sessions	Refer to Following Pages
9:45 AM - 10:15 AM	Break	Atrium Display Area
12:00 PM - 1:30 PM	Lunch	Grand Mesa ABC Corridor
1:30 PM - 5:00 PM	Technical Sessions	Refer to Following Pages
3:00 PM - 3:30 PM	Break	Atrium Display Area

THURSDAY, NOVEMBER 16, 2006

7:15 AM - 11:45 AM	Conference Registration Open	Grand Mesa Foyer
7:15 AM - 8:15 AM	Continental Breakfast	Atrium Display Aera
8:15 AM - 11:45 AM	Technical Sessions	Refer to Following Pages
9:45 AM - 10:15 AM	Break	Atrium Display Area
11:45 AM	Conference Adjourns	

Technical Sessions - Tuesday, November 14, 2006

	Session/Chair	Session C	Session C	Session/Chair	Session D	Session D
		1:30 PM	2:15 PM		3:30 PM	4:15 PM
Track 1 Grand Mesa D/E	***CMMI and Process Improvement*** **Dr. Gene Miluk, SEI**	2C1 The Continuous Representation: Cultivating Process Improvement from Grassroots Efforts ***Ms. Jennifer Turgeon, Sandia National Laboratories***	2C1 Who Needs that Process Stuff Anyway? A Practical Example of Process Discipline to Improve Deployment ***Mr. William Borokowski, Jr., Raytheon Company, Missile Systems***	***CMMI and Process Improvement*** **Dr. Gene Miluk, SEI**	2D1 FAS*Track* to CMMI ***Mr. Al Florence, The MITRE Corporation***	2D1 Implementing CMMI-based Process Improvement Using RUP ***Mr. John Miller, Cognence, Inc.***
Track 2 Grand Mesa F	***High Maturity*** **Dr. Richard Turner, Systems and Software Consortium, Inc.**	2C2 Business Value of CMMI Level 5 ***Dr. Gene Miluk, SEI***	2C2 Demonstrating CMMI-based Process Improvement ***Ms. Elizabeth Clark, Lockheed Martin Corporation, IS&S***	***High Maturity*** **Dr. Richard Turner, Systems and Software Consortium, Inc.**	2D2 Report to OSD: NDIA Top 5 Software Issues ***Mr. Bob Rassa, Raytheon Company***	2D2 Right Turns and Wrong Turns to Level 5 ***Mr. Timothy Davis, Raytheon Company, Missile Systems***
Track 3 Highlands	***Appraisals*** **Mr. Geoff Draper, Harris Corporation**	2C3 Improving SCAMPISM Efficiency ***Mr. Roland Weiss, Lockheed Martin Corporation***	2C3 SCAMPI A Appraisals - Preparation in100 Hours; Execution in a Week ***Mr. Ronald Ulrich, Northrop Grumman Corporation, Mission Systems***	***Appraisals*** **Mr. Geoff Draper, Harris Corporation**	2D3 ISO and CMMI: How to Perform SCAMPI Appraisals and ISO Audits in a Syncronized, Simultaneous, Stupendous One Fell Swoop ***Ms. Margaret Glover, SEI***	2D3 Experience Report - An ISO/IEC 15504-conformant SCAMPI Appraisal ***Mr. David Kitson, SEI***
Track 4 Chasm Creek	***ROI & Benefits of CMMI*** **Dr. Dennis Goldenson, SEI**	2C4 CMMI-based Process Improvement: How and When Does Success Happen? ***Dr. Dennis Goldenson, SEI***		***ROI & Benefits of CMMI*** **Dr. Dennis Goldenson, SEI**	2D4 The Rosetta Stone CMMI ROI Model - Translating Between ROI, CMMI and Metrics ***Mr. Fionbarr McLoughlin, University of Limerick***	2D4 Quick Win Strategies in CMMI Transition ***Ms. Angel (Qi) Liu, Motorola GSG, China***
Track 5 Mesa Verde	***CMMI Extensions: Acquisition*** **Mr. Jeffrey Dutton, Jacobs Technology**	2C5 CMMI for Acquisition: Introducing the CMMI for Acquisition Constellation ***Ms. Kristen Baldwin, Office of the Secretary of Defense***		***CMMI Extensions: Acquisition*** **Mr. Jeffrey Dutton, Jacobs Technology**	2D5 The Hidden Truths of Being a Successful Acquirer ***Dr. Hubert Hofmann, General Motors***	2D5 When CMMI-AM No Longer Suffices ***Mr. Claude Marais, TPI, Inc.***
Track 6 Wind River	***Systems Engineering*** **Mr. Jerry Fisher, Aerospace Corporation**	2C6 Developing Systems Engineering Processes from Existing Software Processes ***Ms. Lee Sheiner, Georgia Tech Research Institute***	2C6 Extending the Team Software Process (TSP) for Systems Engineering ***Mr. Timothy Chick, Naval Air Warfare Center, Weapons Division***	***Systems Engineering*** **Mr. Jerry Fisher, Aerospace Corporation**		2D6 No Doubt: The LRAS3/FS3 Story of Mission Assurance ***Mrs. Jill Brooks, Raytheon Company***
Track 7 Wind Star	***Lean, Six Sigma and Agile*** **Ms. Susan Bassham, US Army**	2C7 Defining a Lean Configuration Management Process at NASA JPL ***Mr. Tim Olson, Quality Improvement Consultants, Inc.***	2C7 Rapidly Defining a Lean CMMI Maturity Level 3 Process ***Ms. Julie Kellum, Hewlett Packard Company***	***Lean, Six Sigma and Agile*** **Ms. Susan Bassham, US Army**	2D7 Using Business Process Management Technology to Implement CMMI-compliant Agile Software Development ***Mr. Robert Moore, III, Business Transformation Institute***	2D7 Using “Voice of Customer” Tools to Advance Organizational Innovation and Deployment ***Mr. Donald Corpron, Northrop Grumman Corporation***

BREAK (3:00 PM - 3:30 PM)

RECEPTION (5:00 PM - 6:30 PM)

Technical Sessions - Wednesday, November 15, 2006

	Session/Chair	Session A	Session A	Session/Chair	Session B	Session B
		8:15 AM	9:00 AM		10:15 AM	11:00 AM
Track 1 Grand Mesa D/E	***CMMI and Process Improvement*** **Dr. Gene Miluk, SEI**	3A1 Communication Loops Within the CMMI ***Mr. Shawn Presson, Apogen Services, LLC***	3A1 Knowledge Management at the Heart of CMMI ML3 at RAFAEL ***Dr. Amir Tomer, RAFAEL, Ltd.***	***CMMI and Process Improvement*** **Dr. Gene Miluk, SEI**	3B1 Organizational Synthesis: CMMI-The Glue that Binds ***Ms. Eileen Arnold, BAE Systems, L&A***	3B1 Operations and Maintenance - More Than Just a Scaling Issue ***Mr. Laurence Gill, BAE Systems***
Track 2 Grand Mesa F	***High Maturity*** **Mr. Joe Elm, SEI**	3A2 What is the Performance Effect of the CMMI-based Process Improvement in Motorola? ***Ms. Angel (Qi) Liu, Motorola GSG, China***	3A2 Learning to Count - Do You Understand Why Level 3 Comes Before Level 4 Which Comes Before Level 5? ***Ms. Nancy Raymond, Raytheon Corporation***	***High Maturity*** **Mr. Joe Elm, SEI**	3B2 Making OID Effective ***Ms. Diane Mizukami Williams, Northrop Grumman Corporation, Mission Systems***	3B2 When OID Crosses Time Zones, Disciplines and Customer Base ***Ms. Laurie Haack, Raytheon Company***
Track 3 Highlands	***Appraisals*** **Mr. Geoff Draper, Harris Corporation**	3A3 Passing an Appraisal Without Preparation ***Mr. Kent McClurg, Raytheon Company***		***Appraisals*** **Mr. Geoff Draper, Harris Corporation**	3B3 Lessons Learned from Conducting Scampi B and C Appraisals ***Mr. Itzhak Lavi, Israel Aircraft Industries, Ltd.***	3B3 Practical Advice on Picking the Right Projects for an Appraisal ***Mr. Robert Moore, III, Business Transformation Institute***
Track 4 Chasm Creek	***ROI & Benefits of CMMI*** **Dr. Dennis Goldenson, SEI**	3A4 Evaluating the Impact the QuARS Requirements Analysis Tool Using Simulation ***Dr. David Raffo, Portland State University***	3A4 Measuring the Value of Systems Engineering Processes ***Mr. Allan Mink, II, Systems Value***	***Measurement*** **Dr. Dennis Goldenson, SEI**	3B4 Practical Earned Value Management Integrated with CMMI-compliant Processes ***Dr. Donn Milton, Pragma Systems Corporation***	3B4 Extracting Strategic Value from CMMI ***Dr. Rick Hefner, Northrop Grumman Corporation***
Track 5 Mesa Verde	***CMMI Extensions: Acquisition*** **Mr. Jeffrey Dutton, Jacobs Technology**	3A5 Using CMMI-AM to Measure AF System Program Office Implementation of Systems Engineering ***Mr. Ian Talbot, US Air Force, Air Armament Center***	3A5 Understanding and Leveraging a Supplier's CMMI Efforts:A Guidebook for Acquirers ***Mr. Lawrence Osiecki, OUSD (AT&L) SSE/SSA***	***CMMI Extensions: Acquisition*** **Mr. Jeffrey Dutton, Jacobs Technology**	3B5 SCAMPI B's for Contract Monitoring - A Case Study of the Mission Planning Enterprise Contractors ***Ms. Lorraine Adams, SEI***	3B5 DCMA CMMI-related Data Collection: A Maturity Model-based Reflection of Practice Strengths and Weaknesses ***Mr. John Eget, DCMA***
Track 6 Wind River	***Systems Engineering*** **Mr. Jerry Fisher, Aerospace Corporation**	3A6 Risk Management Beyond CMMI Level 5 ***Dr. Rick Hefner, Northrop Grumman Coprporation***	3A6 CMMI Opens the Gate - The Practical Relationship between CMMI and Stage-Gate Decision Models ***Mr. Andrew Cordes, ABB US Corporate Research***	***Systems Engineering*** **Mr. Jerry Fisher, Aerospace Corporation**	3B6 Mission Assurance of Software Suppliers - A Partnership Between Software Supplier Managers and Quality Engineering ***Mrs. Jill Brooks, Raytheon Company***	3B6 Systems Engineering Revitalization Using CCMI ***Mr. Michael Kutch, Jr., SPAWAR, Charleston***
Track 7 Wind Star	***Lean, Six Sigma and Agile*** **Ms. Susan Bassham, US Army**	3A7 Use of SCAMPISM C for Agile Methodology ***Ms. Mary Lynn Penn, Lockheed Martin Corporation, IS&S***	3A7 My Agile Life with CMMI ***Mr. Hillel Glazer, Entinex, Inc.***	***Lean, Six Sigma and Agile*** **Ms. Susan Bassham, US Army**	3B7 Improving Software Development: Starting & Sustaining Lean & CMMI in Federal Agencies ***Dr. Mel Adams, University of Alabama, Huntsville***	3B7 Using Design for Six Sigma (DFSS) to Improve the Ease-of-use of a Process Asset Library (PAL) ***Mr. Fred Roberts, General Dynamics, Advanced Information Systems***

BREAK (9:45 AM - 10:15 AM)

LUNCH (12:00 PM - 1:30 PM)

Technical Sessions - Wednesday, November 15, 2006

	Session/Chair	Session C	Session C	Session/Chair	Session D	Session D
		1:30 PM	2:15 PM		3:30 PM	4:15 PM
Track 1 Grand Mesa D/E	***CMMI and Process Improvement*** **Dr. Gene Miluk, SEI**	3C1 Program Management Office (PMO) and CMMI - Paving the Road to Optimized IT Value: Case Study ***Mr. Terry Jabali, Applied Enterprise Dynamics, Inc.***	3C1 How to Sell CMMI to Your CEO in His Own Language ***Ms. Lemis Altan, Cognence, Inc.***	***CMMI and Process Improvement*** **Dr. Gene Miluk, SEI**	3D1 Make Middle Managers the Process Owners ***Mr. Tim Kasse, Kasse Initiatives, LLC***	3D1 You Shouldn't Have to Be an Engineer to Understand Your Process ***Ms. Leticia Santillan, Raytheon Company, Missile Systems***
Track 2 Grand Mesa F	***High Maturity*** **Mr. Joe Elm, SEI**	3C2 Looking Beyond Quantitative Defect Management ***Mr. Anil Midha, BAE Systems***	3C2 Defect Analysis - The Devil is in the Details, or Lack Therof ***Mr. Tobias Cahoon, 96th Communications Group, USAF***	***High Maturity/ Sustaining Improvement*** **Mr. Joe Elm, SEI**	3D2 Statistical Control of System and Software Design Activities ***Dr. Richard Welch, Northrup Grumman Corporation***	3D2 I Have Had My CMMI Appraisal... What Do I Do Now? How to Establish a Process Improvement Work Breakdown Structure ***Dr. Aldo Dagnino, SAS Institute***
Track 3 Highlands	***Appraisals*** **Mr. Geoff Draper, Harris Corporation**	3C3 Lessons Learned: Getting Ready for a SEI Maturity Level 5 ***Mr. Dennis Ring, Lockheed Martin Corporation, IS&S***	3C3 Indicators of Reliable SCAMPI Appraisal Results ***Mr. Bruce Boyd, The Boeing Company***	***Implementation Guidance*** **Mr. Geoff Draper, Harris Corporation**	3D3 Project Implementation Strategies in the CMMI ***Dr. Rick Hefner, Northrop Grumman Corporation***	3D3 Patterns: An Approach for CMMI Adoption ***Dr. Rick Hefner, Northrop Grumman Corporation***
Track 4 Chasm Creek	***Measurement*** **Dr. Dennis Goldenson, SEI**		3C4 Performance Benchmarking Consortium ***Mr. Mark Kasunic, SEI***	***Measurement*** **Dr. Dennis Goldenson, SEI**	3D4 2006 State of Software Measurement Practice Survey ***Mr. Mark Kasunic, SEI***	3D4 Measures and Lessons from a CMMI Guided Process Improvement Project ***Dr. Ruth Buys, 3H Technology, LLC***
Track 5 Mesa Verde	***CMMI Extensions: Acquisition*** **Mr. Jeffrey Dutton, Jacobs Technology**	3C5 Practical Use of DCMA's CMMI-based Risk Management Methodology ***Mr. Gary Sigmund, DCMA***	3C5 The Issue of Performance - Why Do You Need a Maturity Level 5 Supplier? ***Mr. Tim Kasse, Kasse Initiatives, LLC***	***CMMI Extensions: Services*** **Mr. Jeffrey Dutton, Jacobs Technology**	3D5 CMMI for Services: Introducing the CMMI for Services Constellation ***Mr. Craig Hollenbach, Northrop Grumman Corporation***	3D5 CMMI Implementation in Manufacturing Processes ***Mr. Itzhak Lavi, Israel Aircraft Industries, Ltd.***
Track 6 Wind River	***CMMI v1.2 and Beyond*** **Mr. Hal Wilson, Northrop Grumman Corporation**	3C6 CMMI V1.2 Overview ***Mr. Mike Phillips, SEI***	3C6 SCAMPI 1.2 Updates ***Dr. Jack Ferguson, SEI***	***CMMI v1.2 and Beyond*** **Mr. Hal Wilson, Northrop Grumman Corporation**	3D6 Strengthening the Credibility of Level 4/5 Appraisals ***Mr. Will Hayes, SEI***	3D6 Lead Appraiser Training for V1.2 ***Dr. Jack Ferguson, SEI***
Track 7 Wind Star	***Lean, Six Sigma and Agile*** **Ms. Susan Bassham, US Army**		3C7 Lean Process Design - A Concept of Process Quality ***Mr. David Card, Q-Labs***	***CMMI in Small Settings*** **Ms. Susan Bassham, US Army**	3D7 Easing Project Planning for Small Programs ***Mr. Kenneth Weinberg, Raytheon Company***	3D7 The Road to Lean CMMI in a Small Federal Organization ***Ms. Susan Bassham, US Army, Aviation and Missile Command***

BREAK (3:00 PM - 3:30 PM)

CONFERENCE ADJOURNS FOR THE DAY (5:00 PM)

Technical Sessions - Thursday, November 16, 2006

	Session/Chair	Session A	Session A	Session/Chair	Session B	Session B
		8:15 AM	9:00 AM		10:15 AM	11:00 AM
Track 1 Grand Mesa D/E	***CMMI and Process Improvement*** **Dr. Gene Miluk, SEI**	4A1 Moving from Level 2 to Level 3 Risk Management ***Ms. Susan Byrnes, Natural SPI, Inc.***	4A1 Interfaced vs. Integrated Process ***Mr. Robert Rice, BAE Systems***	***CMMI and Process Improvement*** **Dr. Gene Miluk, SEI**	4B1 Using Best Practices at NASA to Define a CMMI DAR Process that Addresses Dissent ***Mr. Tim Olson, Quality Improvement Consultants, Inc.***	
Track 2 Grand Mesa F	***Sustaining Improvement*** **Ms. Lorraine Adams, SEI**	4A2 Motivating the Team to Continuously Improve After the CMMI Rating ***Ms. Leticia Santillan, Raytheon Company, Missile Systems***	4A2 King of the Mountain - Staying Atop Mt. CMMI After the Initial Assent ***Mr. Timothy Davis, Raytheon Company, Missile Systems***	***Sustaining Improvement*** **Ms. Lorraine Adams, SEI**	4B2 Sustaining CMMI Compliance ***Dr. Rick Hefner, Northrop Grumman Corporation***	4B2 Maintaining Institutionalization After the Appraisal Team Leaves ***Mr. John Johnston, PMP, BAE Systems***
Track 3 Highlands	***Implementation Guidance*** **Mr. Geoff Draper, Harris Corporation**	4A3 An Enterprise Approach to Process Improvement ***Ms. Linda Kovar, Raytheon Company***	4A3 CMMI and ISO 9001- A Registrar's Perspective ***Mr. Matt Leiphart, Platinum Registration***	***Implementation Guidance*** **Mr. Geoff Draper, Harris Corporation**	4B3 It's a #$*!>% Mess: How to Leverage Today's Process into Tomorrow's Initiatives ***Ms.Terri Bryant, Raytheon Company, Missile Systems***	4B3 Systematically Tailoring the Organization's Standard Process for a Project ***Dr. Kenneth Nidiffer, Systems and Software Consortium***
Track 4 Chasm Creek	***Measurement*** **Dr. Dennis Goldenson, SEI**	4A4 Integrating Planning, Control, Measurement & Analysis CMMI Process Areas to Achieve More Successful Software Projects ***Mr. Daniel Galorath, Galorath Incorporated***	4A4 The Unseen Benefits of the Change Request Process ***Mr. Scott Banks, Georgia Tech Research Institute***	***Measurement*** **Dr. Dennis Goldenson, SEI**	4B4 Measuring the Impact of RD and REQM CMMI Process Areas ***Dr. Aldo Dagnino, SAS Institute***	4B4 Untethered Activities - The Real Reason for Schedule Slips ***Mr. Rolf Reitzig, Cognence, Inc.***
Track 5 Mesa Verde	***CMMI Extensions: Services*** **Mr. Jeffrey Dutton, Jacobs Technology**	4A5 Lessons in Integrating Non-engineering Organizations with Engineering Using the CMMI ***Mr. Joseph Vandeville, Northrop Grumman Corporation***	4A5 Engineering in a Non-development Environment ***Ms. Kathy King, BAE Systems***	***CMMI Extensions: Services*** **Mr. Jeffrey Dutton, Jacobs Technology**	4B5 Achieving Delivery Excellence Using CMMI ***Mr. Keith Heston, Accenture***	
Track 6 Wind River	***CMMI v1.2 and Beyond*** **Mr. Hal Wilson, Northrop Grumman Corporation**	4A6 Implications of Combining SAM and ISM in CMMI V1.2 ***Mr. Mike Phillips, SEI***	4A6 A Practical Roadmap for Transitioning to CMMI V1.2 ***Dr. Rick Hefner, Northrop Grumman Corporation***	***CMMI v1.2 and Beyond*** **Mr. Hal Wilson, Northrop Grumman Corporation**	4B6 Resolving CMMI Issues ***Dr. Karen Richter, Institute for Defense Analyses***	
Track 7 Wind Star	***CMMI in Small Settings*** **Ms. Susan Bassham, US Army**	4A7 CMMI Applications in Small Setting Finance Organization for Process Performance Optimization ***Dr. Mary Anne Herndon, Transdyne Corporation***	4A7 Small Project Challenges of CMMI in Large Organizations ***Mr. John Bethmann, Concurrent Technologies Corporation***	***CMMI and Standards*** **Ms. SusanBassham, US Army**	4B7 Why Choose Between CMMI, ISTO, ITIL and Six Sigma? Why Not Leverage All! ***Ms. Lemis Altan, Cognence, Inc.***	

BREAK (9:45 AM - 10:15 AM)

CONFERENCE ADJOURNS (11:45 AM)

Tutorial Sessions - Monday, November 13, 2006

	Session A	Session B	Session C	Session D
	8:00 AM	10:15 AM	1:00 PM	3:15 PM
Track 1 Grand Mesa D/E	1A1 Tutorial CMMI v1.2 Tutorial ***Mr. Mike Phillips, SEI***	1B1 Tutorial CMMI v1.2 Tutorial (continued) ***Mr. Mike Phillips, SEI***	1C1 Tutorial Are We Ready for CMMI? If Not, Let's Fix Ourselves ***Mr. Al Florence, The MITRE Corporation***	1D1 Tutorial Are We Ready for CMMI? If Not, Let's Fix Ourselves (continued) ***Mr. Al Florence, The MITRE Corporation***
Track 2 Grand Mesa F	1A2 Tutorial The Return on Investment from CMMI and Other Best Practices: An Introduction ***Mr. Thomas McGibbon, ITT AES***	1B2 Tutorial The Return on Investment from CMMI and Other Best Practices: An Introduction (continued) ***Mr. Thomas McGibbon, ITT AES***	1C2 Tutorial Calculating CMMI-based ROI: How, What, When and Why? ***Mr. Rolf Reitzig, Cognence, Inc.***	1D2 Tutorial Calculating CMMI-based ROI: How, What, When and Why? (continued) ***Mr. Rolf Reitzig, Cognence, Inc.***
Track 3 Highlands	1A3 Tutorial Addressing High-Value Project Management Activities Using Process Simulation & Supporting CMMI for Process Areas ***Dr. David Raffo, Portland State University***	1B3 Tutorial Addressing High-Value Project Management Activities Using Process Simulation & Supporting CMMI for Process Areas (continued) ***Dr. David Raffo, Portland State University***	1C3 Tutorial Into the Future, Part 1: Process Definition on Steroids ***Ms. Kathy Reid, 96th Communications Group/TYBRIN, USAF***	1D3 Tutorial Into the Future, Part 1: Process Definition on Steroids (continued) ***Ms. Kathy Reid, 96th Communications Group/TYBRIN, USAF***
Track 4 Chasm Creek A	1A4 Tutorial Integrated Project Management (IPM) - The CMMI and Collaborative Product Development ***Mr. William Deibler, II, Software Systems Quality Consulting***	1B4 Tutorial Integrated Project Management (IPM) - The CMMI and Collaborative Product Development (continued) ***Mr. William Deibler, II, Software Systems Quality Consulting***	1C4 Tutorial CMMI Crash Course: What the SEI Won't Teach You ***Mr. Hillel Glazer, Entinex, Inc.***	1D4 Tutorial CMMI Crash Course: What the SEI Won't Teach You (continued) ***Mr. Hillel Glazer, Entinex, Inc.***
Track 5 Mesa Verde	1A5 Tutorial A Practical Guide to Implementing Levels 4 and 5 ***Dr. Rick Hefner, Northrop Grumman Corporation***	1B5 Tutorial A Practical Guide to Implementing Levels 4 and 5 (continued) ***Dr. Rick Hefner, Northrop Grumman Corporation***	1C5 Tutorial Basics of PSP and TSP for Systems Engineering ***Mr. James McHale, SEI***	1D5 Tutorial Basics of PSP and TSP for Systems Engineering (continued) ***Mr. James McHale, SEI***
Track 6 Wind River	1A6 Tutorial How to Measurably Improve Your Requirements ***Mr. Tim Olson, Quality Improvement Consultants, Inc.***	1B6 Tutorial How to Measurably Improve Your Requirements (continued) ***Mr. Tim Olson, Quality Improvement Consultants, Inc.***	1C6 Tutorial Requirements Engineering: A Practical Approach to Modeling and Managing Requirements ***Mr. William Deibler, II, Software Systems Quality Consulting***	1D6 Tutorial Requirements Engineering: A Practical Approach to Modeling and Managing Requirements (continued) ***Mr. William Deibler, II, Software Systems Quality Consulting***
Track 7 Wind Star	1A7 Tutorial Lessons Learned in Implementing CMMI in a Large Systems Engineering Organization ***Mr. Michael Kutch, Jr., SPAWAR, Charleston***	1B7 Tutorial Lessons Learned in Implementing CMMI in a Large Systems Engineering Organization (continued) ***Mr. Michael Kutch, Jr., SPAWAR, Charleston***	1C7 Tutorial ISO/IES 15288 and CMMI(SM): Systems Engineering Similarities & Differences ***Mr. David Walden, Sysnovation, LLC***	1D7 Tutorial ISO/IES 15288 and CMMI(SM): Systems Engineering Similarities & Differences (continued) ***Mr. David Walden, Sysnovation, LLC***
Track 8 Chasm Creek B	1A8 Tutorial Lean Process Improvement ***Mr. Jeffrey Dutton, Jacobs Technology***	1B8 Tutorial Lean Process Improvement (continued) ***Mr. Jeffrey Dutton, Jacobs Technology***	1C8 Tutorial How to Define Lean Processes that are CMMI-compliant ***Mr. Tim Olson, Quality Improvement Consultants, Inc.***	1D8 Tutorial How to Define Lean Processes that are CMMI-compliant (continued) ***Mr. Tim Olson, Quality Improvement Consultants, Inc.***

BREAK (9:45 AM - 10:15 AM) (TUTORIAL & SCAMPI ATTENDEES)

LUNCH (12:00 PM - 1:00 PM) (TUTORIAL & SCAMPI ATTENDEES)

BREAK (2:45 PM - 3:15 PM) (TUTORIAL & SCAMPI ATTENDEES)

RECEPTION (5:30 PM - 7:00 PM) (ALL ATTENDEES)

Carnegie Mellon
Software Engineering Institute

Pittsburgh, PA 15213-3890

CMMI® Version 1.2 and Beyond

NDIA CMMI Technology Conference
November 13, 2006

Mike Phillips
Software Engineering Institute
Carnegie Mellon University

® CMMI is registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.
Thanks to Gary Wolf and D'Ann Hunt from Raytheon, Denise Cattan of SPIRULA

CMMI Today

Selected CMMI® Data (FY06)

17,630 Trained in Introduction to CMMI

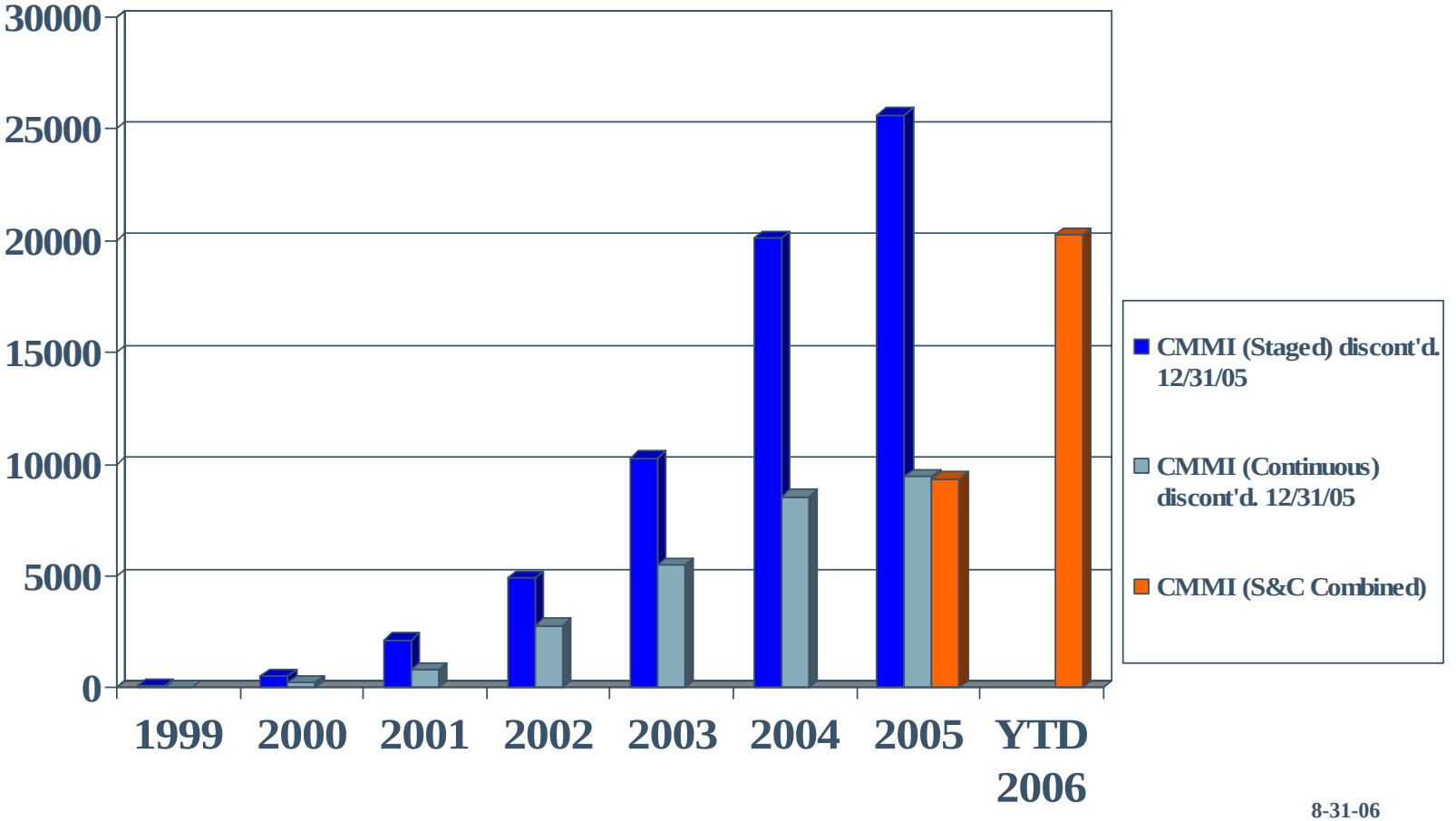
Net increase of:

- **-108 Authorized Introduction to CMMI Instructors**
- **45 Authorized SCAMPI Lead Appraisers**
- **84 Authorized SCAMPI B/C Team Leads**

744 SCAMPI V1.1 Class A Appraisals conducted and reported to the SEI

417 Publicly Reported SCAMPI V1.1 Class A Appraisals on the SEI Web Site

Number of CMMI Students Trained (Cumulative)



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Transition from V1.1 to V1.2 Status - 10-12-06

Introduction to CMMI Students
- Registered for Upgrade Training – 464
- Upgrades Complete – 190

Lead Appraisers and Instructors
- Registered for Upgrade Training – 561
- Upgrade Training Complete – 256
- Exams
  - Passed – 159
  - Failed (and not yet retaken) – 7

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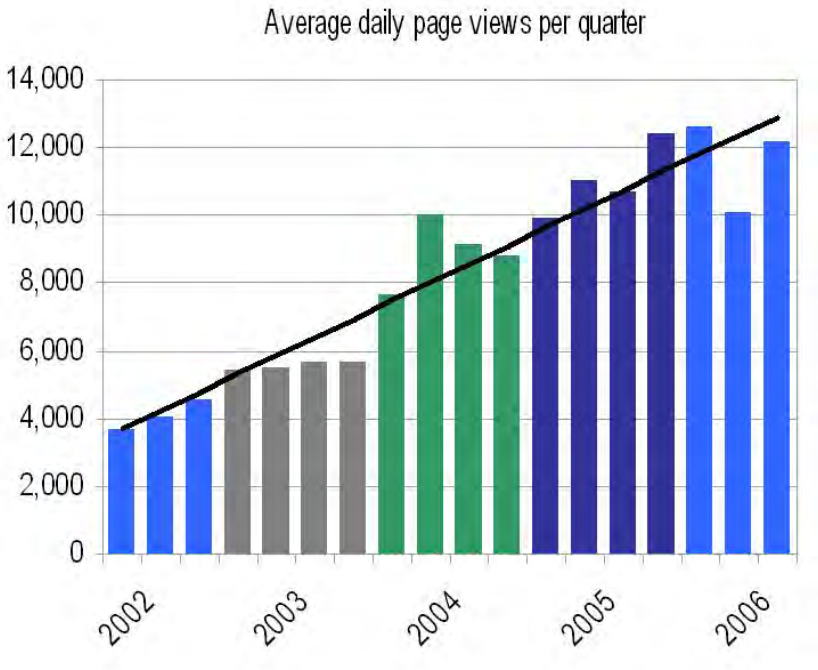
CMMI Adoption Trends

CMMI Web pages views in September 2006

- 360K/month
- Exceeded 24K/day

The following were the most downloaded files on the SEI Web site in September 2006:

- CMMI-DEV, V1.2 (PDF Version)
- CMMI V1.1 Overview Presentation
- CMMI V1.2 Overview Presentation
- CMMI-DEV, V1.2 (Word Version)
- CMMI V1.2 Model Changes Presentation



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CMMI Transition Status – 10/31/06

Training

- Introduction to CMMI – 58,178 trained
- Intermediate CMMI – 2,280 trained
- Introduction to CMMI Instructors – 449
- SCAMPI Lead Appraisers – 630 trained
- SCAMPI B&C-Only Team Lead -- 33

Authorized

- Introduction to CMMI V1.1 Instructors – 404
- SCAMPI V1.1 Lead Appraisers – 451
- SCAMPI B&C Team Leads -- 432

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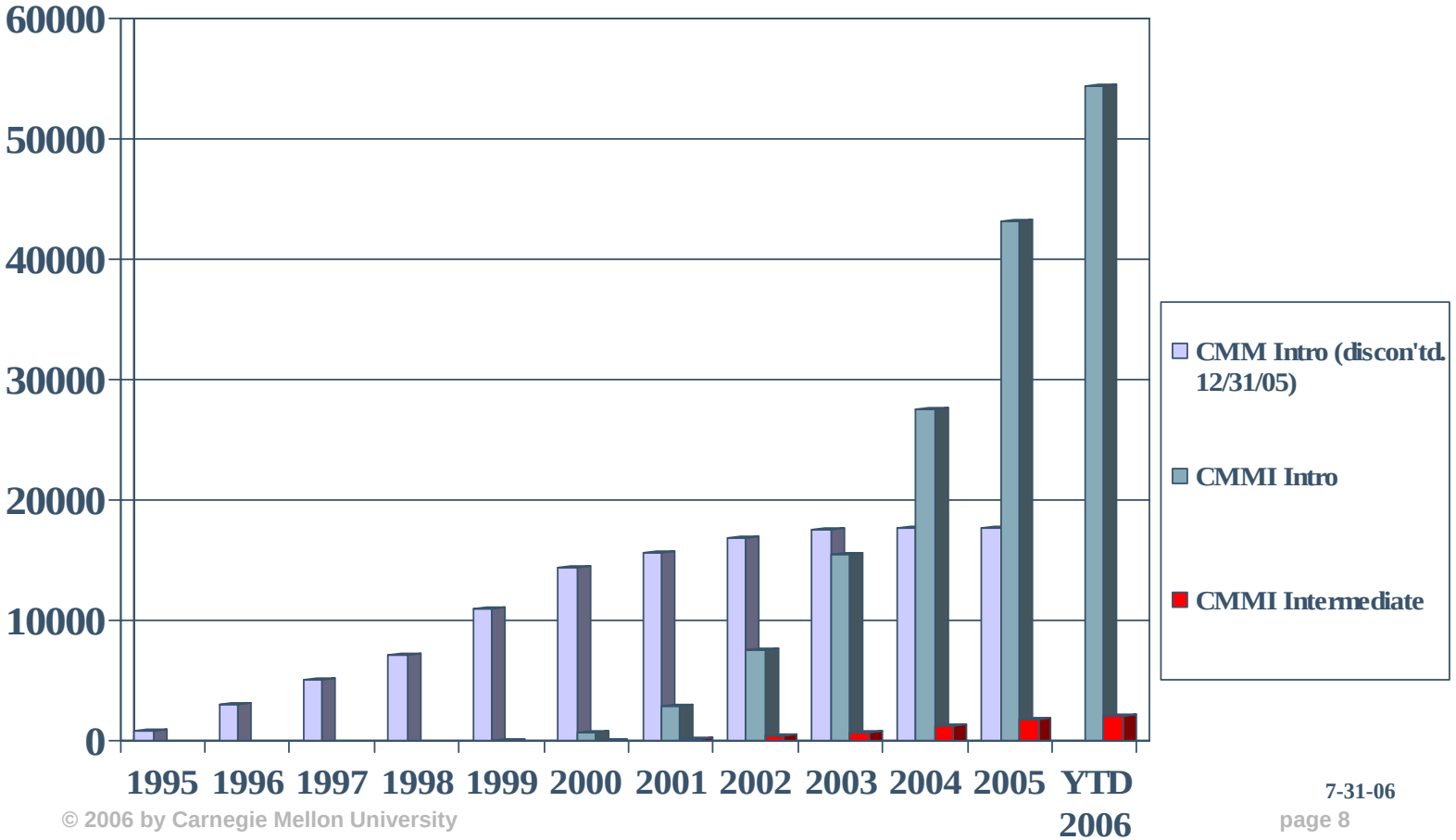
Intro to the CMM and CMMI Attendees (Cumulative)



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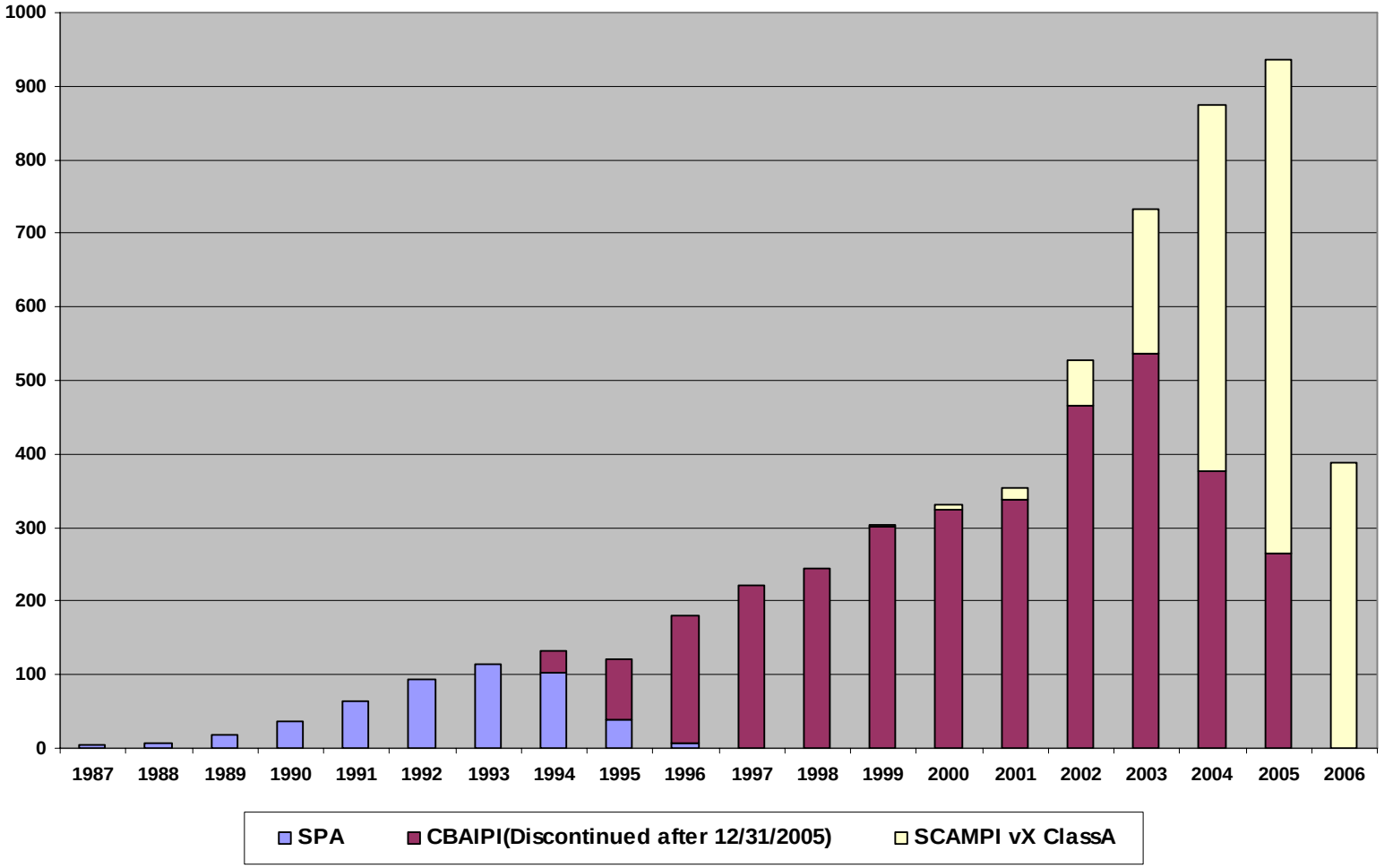
Number of Appraisals Conducted by Year
Reported as of 31 August 2006



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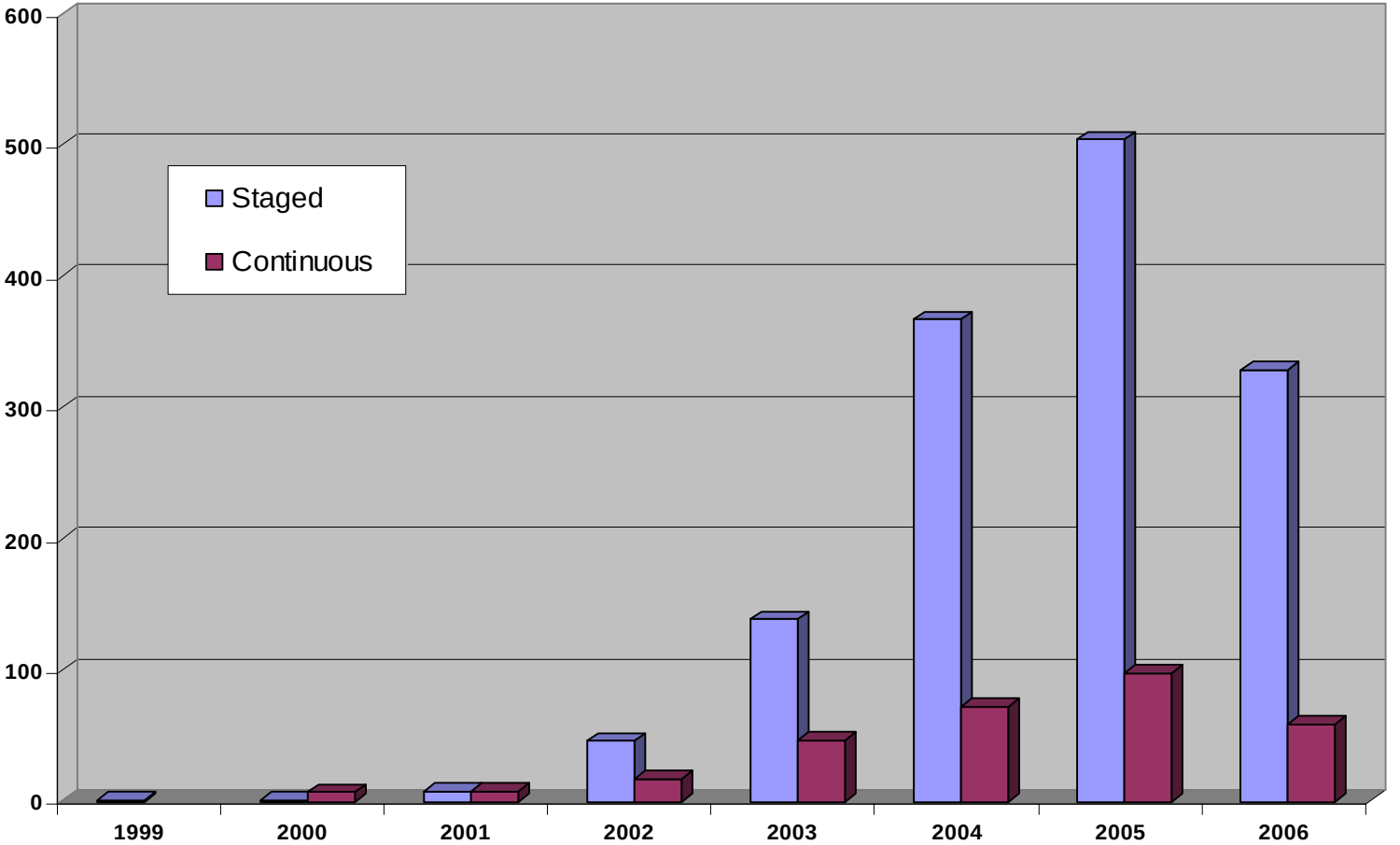
Number of SCAMPI vX Class A Appraisals Conducted by Year by Model Representation*
Reported as of 31 August 2006
*Where Representation is reported



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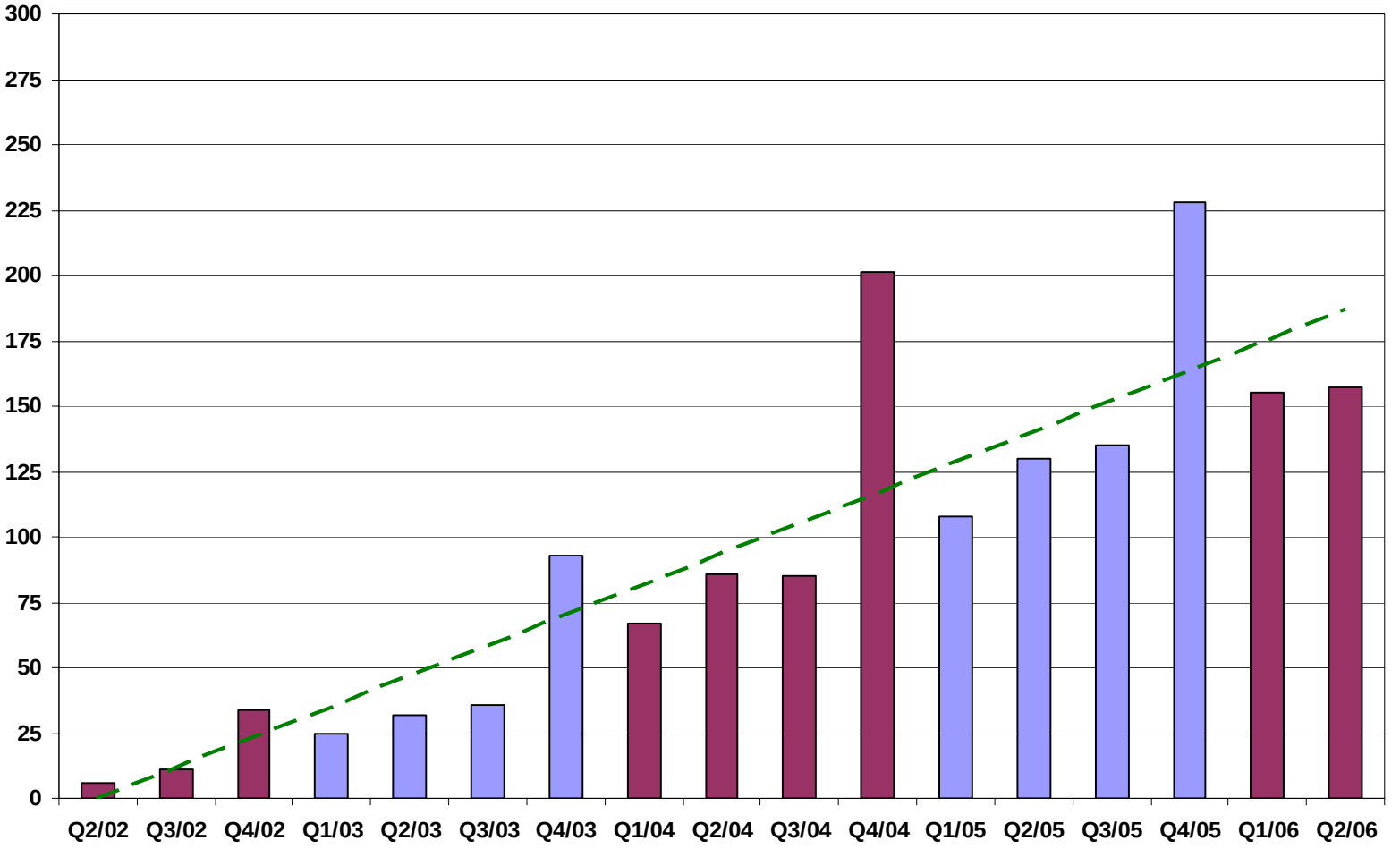
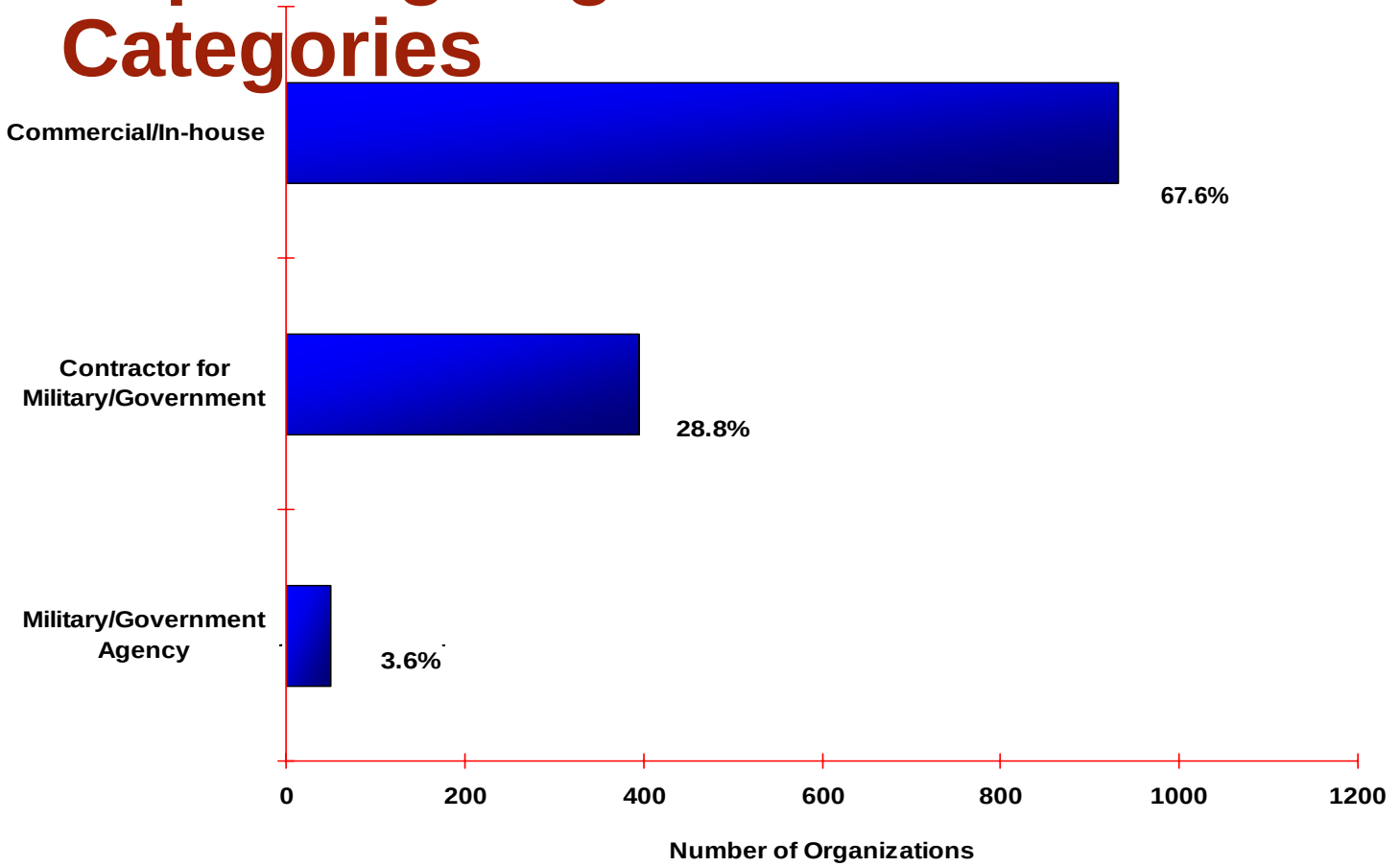
Software Engineering Institute

Number of SCAMPI v1.1 Class A Appraisals Conducted by Quarter
Reported as of 31 August 2006



Reporting Organizational Categories



Based on **1,377** organizations

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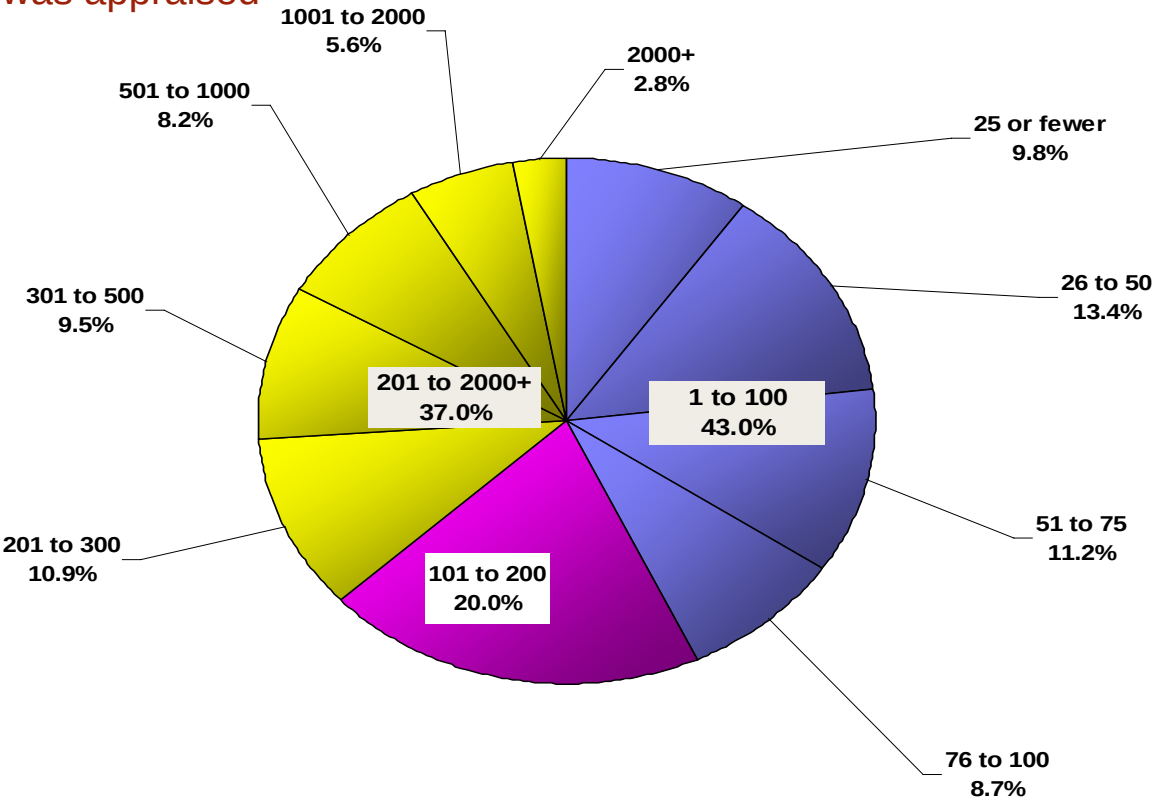
Organization Size

Based on the total number of employees within the area of the organization that was appraised



Based on **1,348** organizations reporting size data

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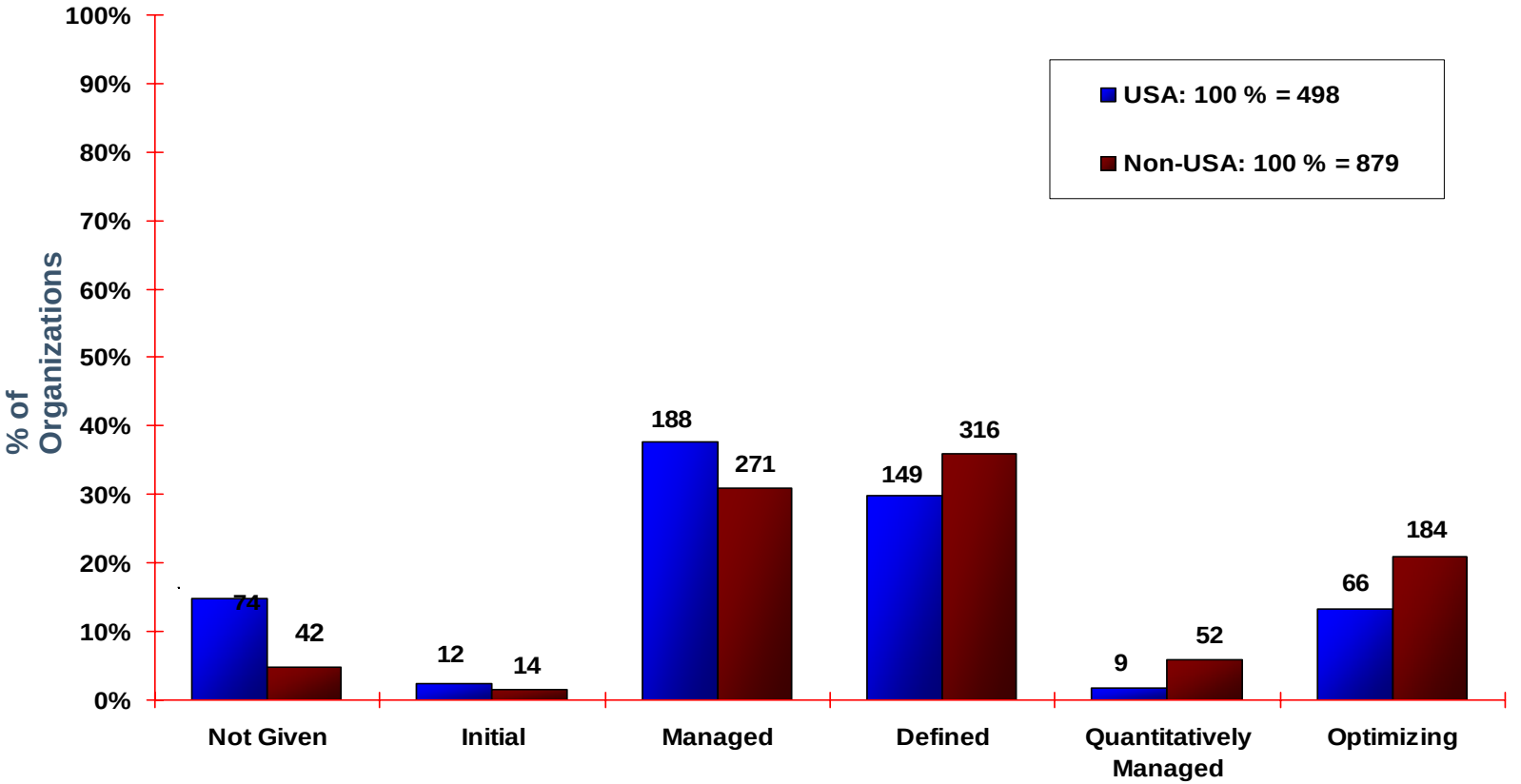
Maturity Profile by All Reporting USA and Non-USA Organizations



Based on **498** USA organizations and **879** Non-USA organizations

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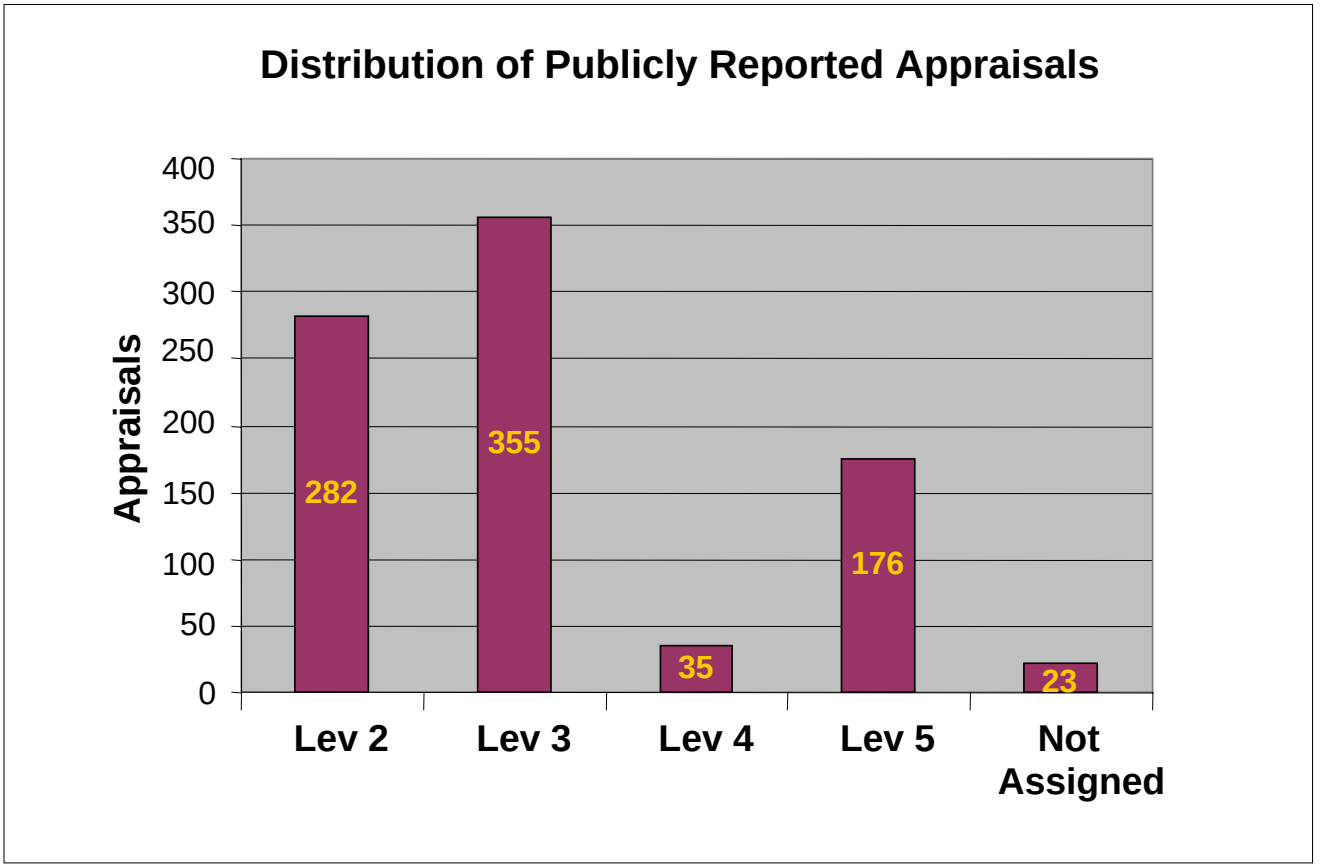
Publicly Reported SCAMPI V1.1 Class A Appraisals – 9/30/06



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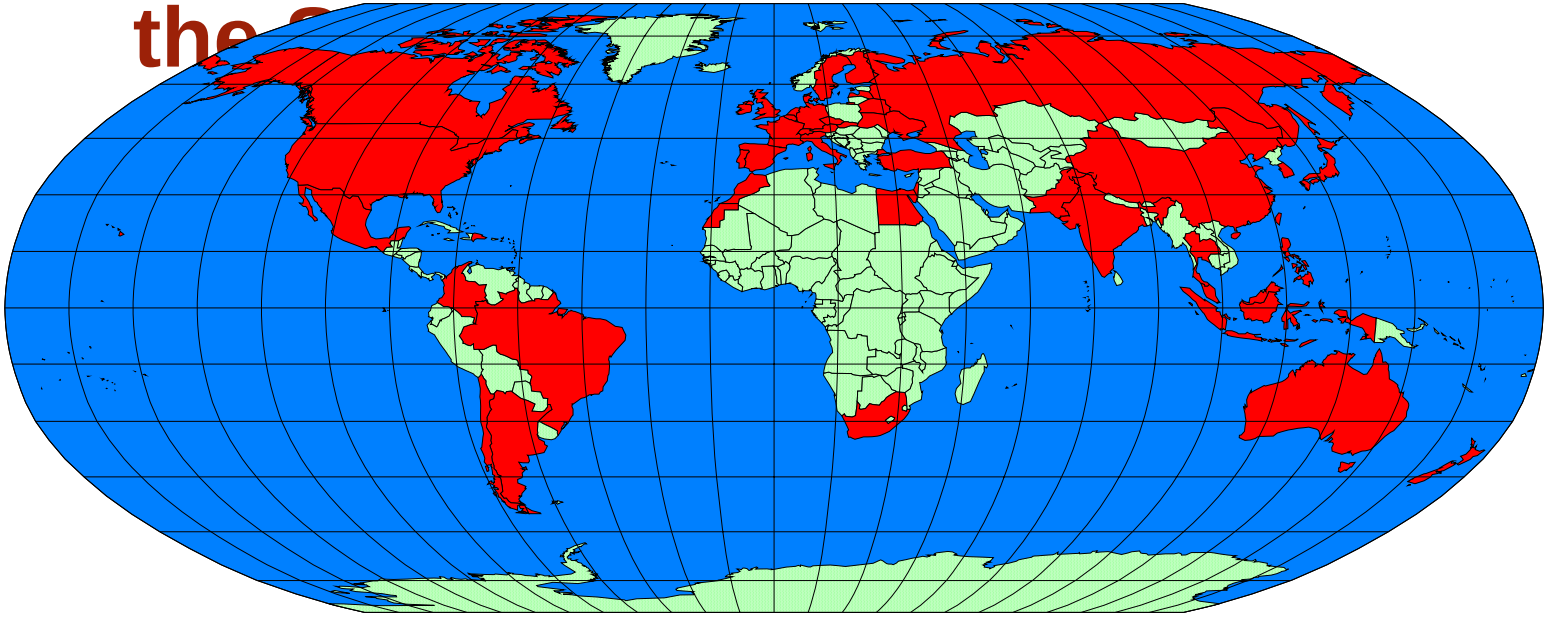
Countries where Appraisals have been Performed and Reported to the S



Argentina	Australia	Austria	Bahrain	Belarus	Belgium	Brazil	Canada
Chile	China	Colombia	Czech Republic	Denmark	Dominican Republic	Egypt	Finland
France	Germany	Hong Kong	India	Indonesia	Ireland	Israel	Italy
Japan	Korea, Republic of	Latvia	Malaysia	Mauritius	Mexico	Morocco	Netherlands
New Zealand	Pakistan	Philippines	Portugal	Russia	Singapore	Slovakia	South Africa
Spain	Sweden	Switzerland	Taiwan	Thailand	Turkey	Ukraine	United Kingdom
United States	Vietnam						

Red country name: New additions with this reporting

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Number of Appraisals and Maturity Levels Reported to the SEI by Country

Country	Number of Appraisals	Maturity Level 1 Reported	Maturity Level 2 Reported	Maturity Level 3 Reported	Maturity Level 4 Reported	Maturity Level 5 Reported	Country	Number of Appraisals	Maturity Level 1 Reported	Maturity Level 2 Reported	Maturity Level 3 Reported	Maturity Level 4 Reported	Maturity Level 5 Reported
Argentina	15	No	Yes	Yes	Yes	Yes	Korea, Republic of	56	Yes	Yes	Yes	Yes	Yes
Australia	23	Yes	Yes	Yes	Yes	Yes	Latvia	10 or fewer					
Austria	10 or fewer						Malaysia	15	No	No	Yes	No	Yes
Bahrain	10 or fewer						Mauritius	10 or fewer					
Belarus	10 or fewer						Mexico	10 or fewer					
Belgium	10 or fewer						Morocco	10 or fewer					
Brazil	39	No	Yes	Yes	Yes	Yes	Netherlands	10 or fewer					
Canada	18	No	Yes	Yes	No	Yes	New Zealand	10 or fewer					
Chile	10 or fewer						Pakistan	10 or fewer					
China	158	Yes	Yes	Yes	Yes	Yes	Philippines	14	No	Yes	Yes	No	Yes
Colombia	10 or fewer						Portugal	10 or fewer					
Czech Republic	10 or fewer						Russia	10 or fewer					
Denmark	10 or fewer						Singapore	10 or fewer					
Dominican Republic	10 or fewer						Slovakia	10 or fewer					
Egypt	10						South Africa	10 or fewer					
Finland	10 or fewer						Spain	25	No	Yes	Yes	No	Yes
France	65	Yes	Yes	Yes	Yes	Yes	Sweden	10 or fewer					
Germany	28	Yes	Yes	Yes	Yes	Yes	Switzerland	10 or fewer					
Hong Kong	10 or fewer						Taiwan	31	No	Yes	Yes	No	No
India	177	No	Yes	Yes	Yes	Yes	Thailand	10 or fewer					
Indonesia	10 or fewer						Turkey	10 or fewer					
Ireland	10 or fewer						Ukraine	10 or fewer					
Israel	10 or fewer						United Kingdom	42	Yes	Yes	Yes	Yes	No
Italy	10 or fewer						United States	598	Yes	Yes	Yes	Yes	Yes
Japan	155	Yes	Yes	Yes	Yes	Yes	Vietnam	10 or fewer					

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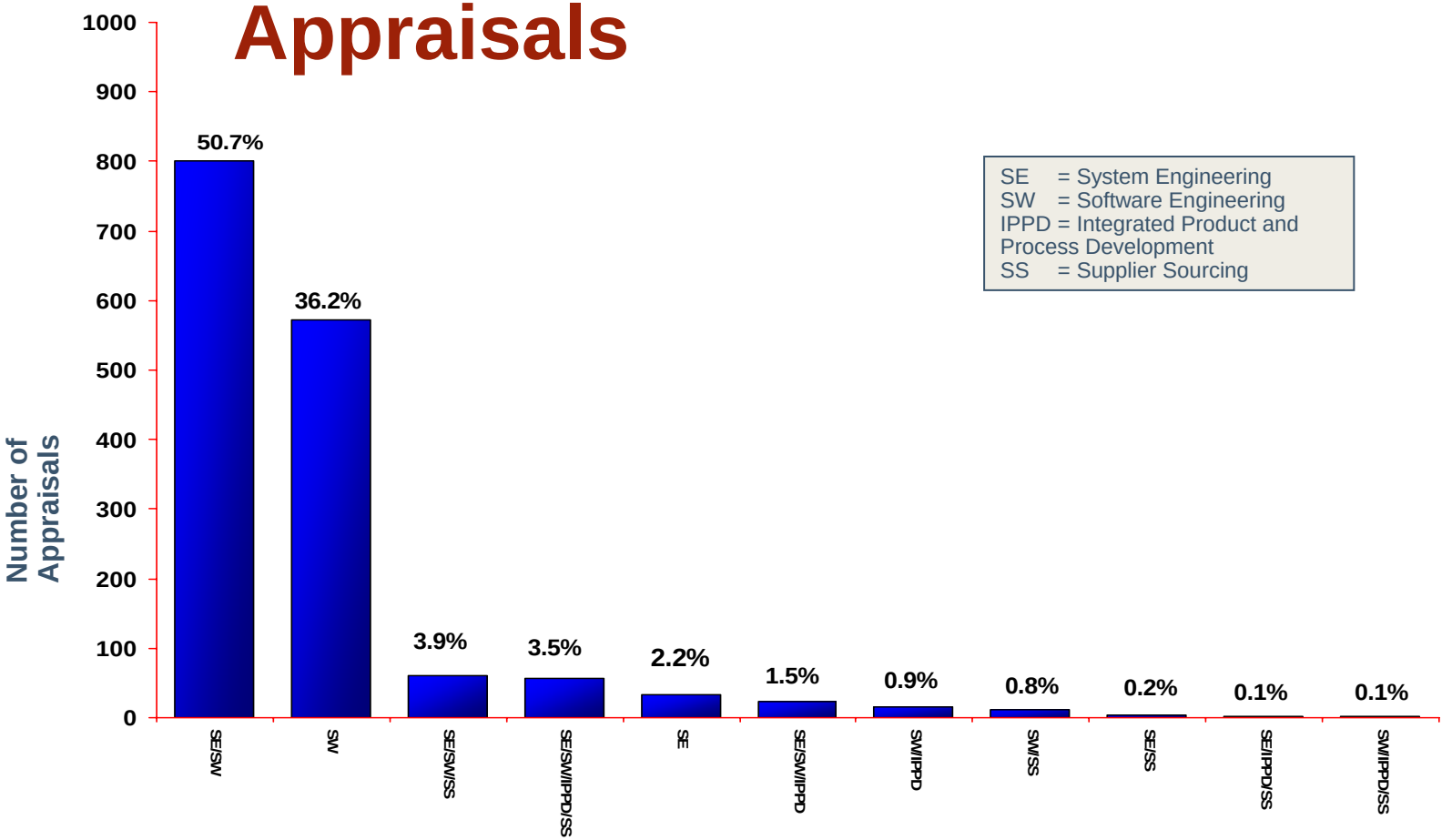
Disciplines Selected for Appraisals



Based on **1,581** appraisals

For more information about Allowable Models & Combinations, visit: http://www.sei.cmu.edu/cmmi/background/aspec.html

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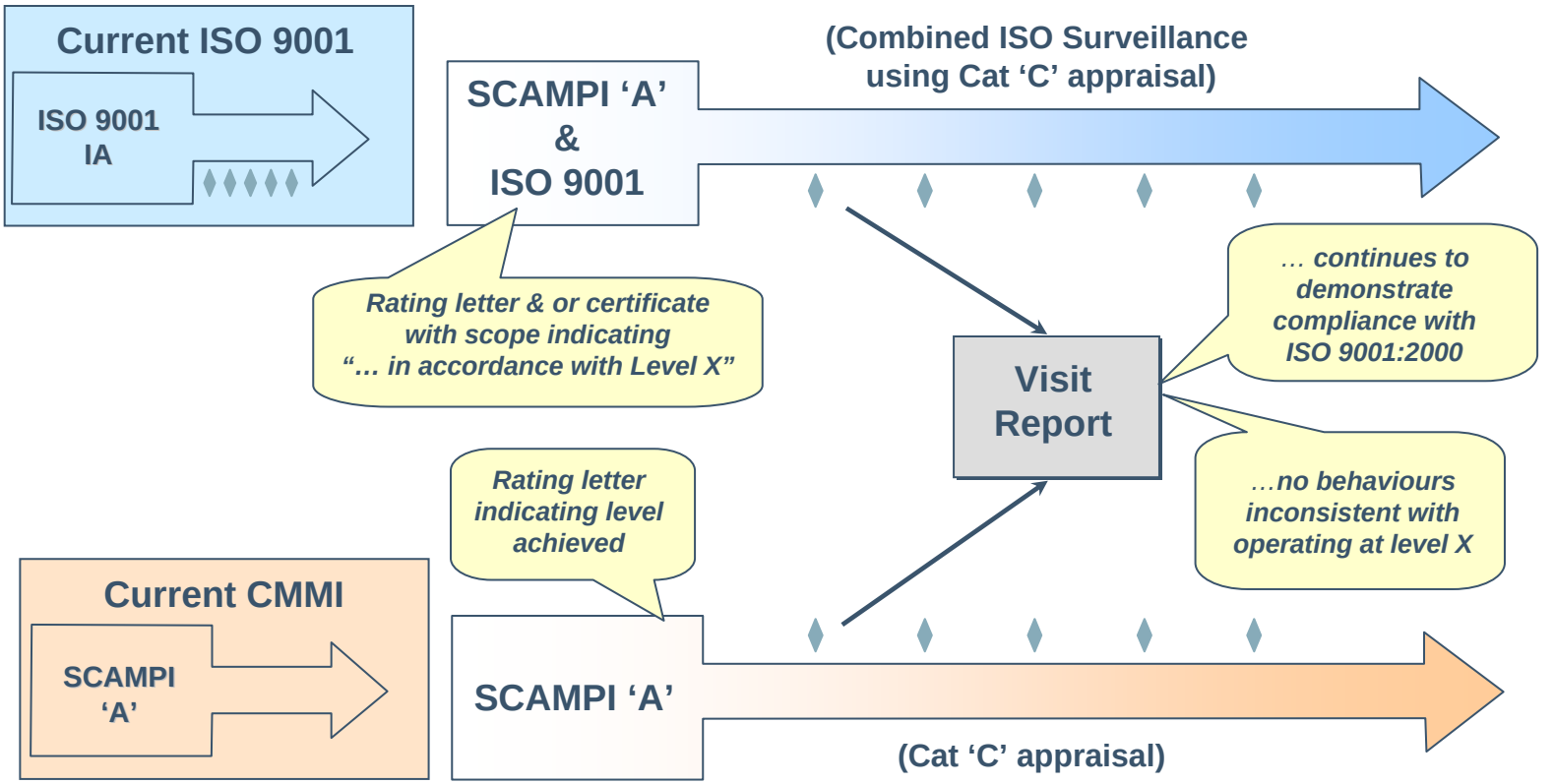
Combined Appraisal Opportunities



The possible options for assessment and surveillance

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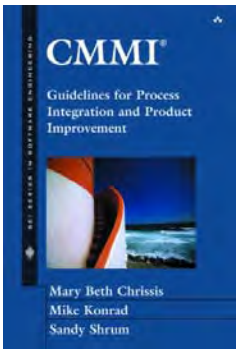
Adoption: What Else Is Happening?

The Addison-Wesley SEI Series Book and:



- A Guide to the CMMI
- CMMI: A Framework…
- CMMI Assessments
- CMMI Distilled: Second Edition
- CMMI SCAMPI Distilled
- CMMI: Un Itinéraire Fléché
- De kleine CMMI
- Interpreting the CMMI
- Making Process Improvement Work
- Practical Insight into CMMI
- CMMI Survival Guide
- Real Process Improvement Using the CMMI
- Systematic Process Improvement Using ISO 9001:2000 and CMMI
- Balancing Agility and Discipline

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How about SEI Publications?

Technical notes and special reports:

- Interpreting CMMI:
  - for Operational Organizations
  - for COTS Based Systems
  - for Service Organizations
  - for Marketing (in progress)
- Using CMMI with:
  - Earned Value Management
  - Product Line Practices
  - Six Sigma
- Supplementing CMMI for Safety Critical Development (in progress)
- Demonstrating the Impact and Benefits of CMMI (and web pages – www.sei.cmu.edu/cmmi/results)

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Performance Results Summary

Improvements	Median	# of data points	Low	High
Cost	34%	29	3%	87%
Schedule	50%	22	2%	95%
Productivity	61%	20	11%	329%
Quality	48%	34	2%	132%
Customer Satisfaction	14%	7	-4%	55%
Return on Investment	4.0 : 1	22	1.7 : 1	27.7 : 1

- N = 30, as of August 2006
- Organizations with results expressed as change over time

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CMMI Today

Version 1.1 CMMI Product Suite was released January 2002.

- **CMMI Web site visits average over 12,000/day**
- **Over 58,000 people have been trained**
- **Almost 1600 “class A” appraisals have been reported to the SEI**

Now we want to continuously improve…

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CMMI V1.2…and Beyond

Major Themes

Reduce complexity & size

Increase coverage

Increase confidence in appraisal results

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Reduced Model Complexity & Size

Eliminated the concepts of advanced practices and common features

Incorporated ISM into SAM; eliminated Supplier Sourcing (SS) addition

Consolidated and simplified the IPPD material

All definitions consolidated in the glossary

Adopted a single book approach (i.e., will no longer provide separate development models)

Report size reduced 15% from either predecessor; PAs reduced 12%

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Increased Model Coverage

Added hardware amplifications

Added two work environment practices (i.e., one in OPD and one in IPM)

Added goal and two practices in OPF to emphasize importance of project startup

Updated notes (including examples) where appropriate so that they also address service development and acquisition of critical elements

Updated name to CMMI for Development (CMMI-DEV) to reflect the expanded coverage

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Model Changes - Other

Improved the Overview section (Part One)

Improved clarity of how GPs are used

- Moved generic goals and practices to Part Two
- Added explanation of how process areas support the implementation of GPs
- Added GP elaborations for GP 3.2

Improved the glossary (e.g., higher level management, bidirectional traceability, subprocess)

Limited the process areas that can be considered "not applicable" to SAM.

Clarified material throughout the model based on over 1000 change requests

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Integrated Product and Process Development (IPPD) Changes

IPPD material is being revised significantly.

- Organization Environment for Integration PA removed and material moved to Organizational Process Definition (OPD) PA.
- Integrated Teaming PA removed and material moved to Integrated Project Management (IPM) PA.
- IPPD goals have been consolidated.
  - "Enable IPPD Management" in OPD
  - "Apply IPPD Principles" in IPM
- Overall material condensed and revised to be more consistent with other PAs.

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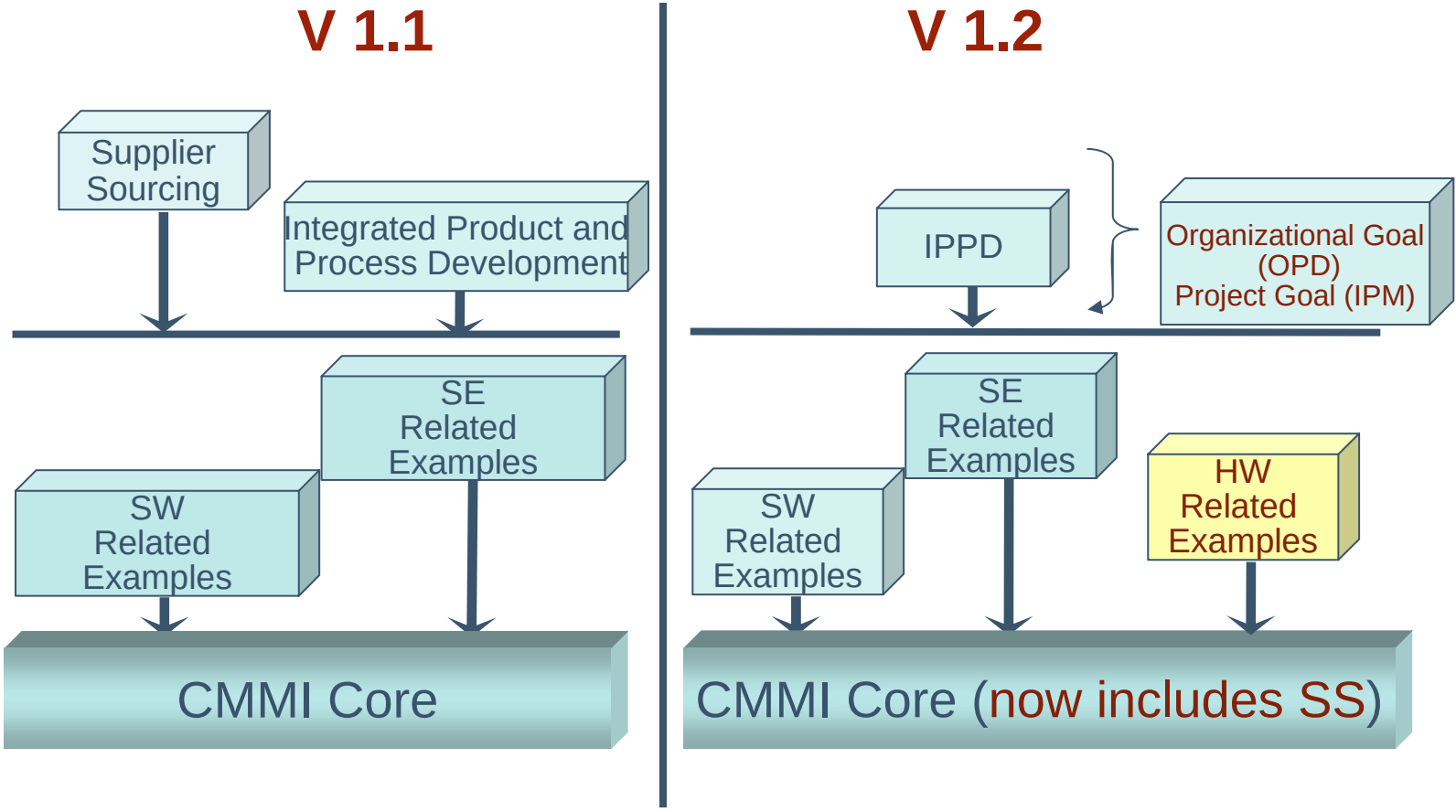
CMMI Model Combinations



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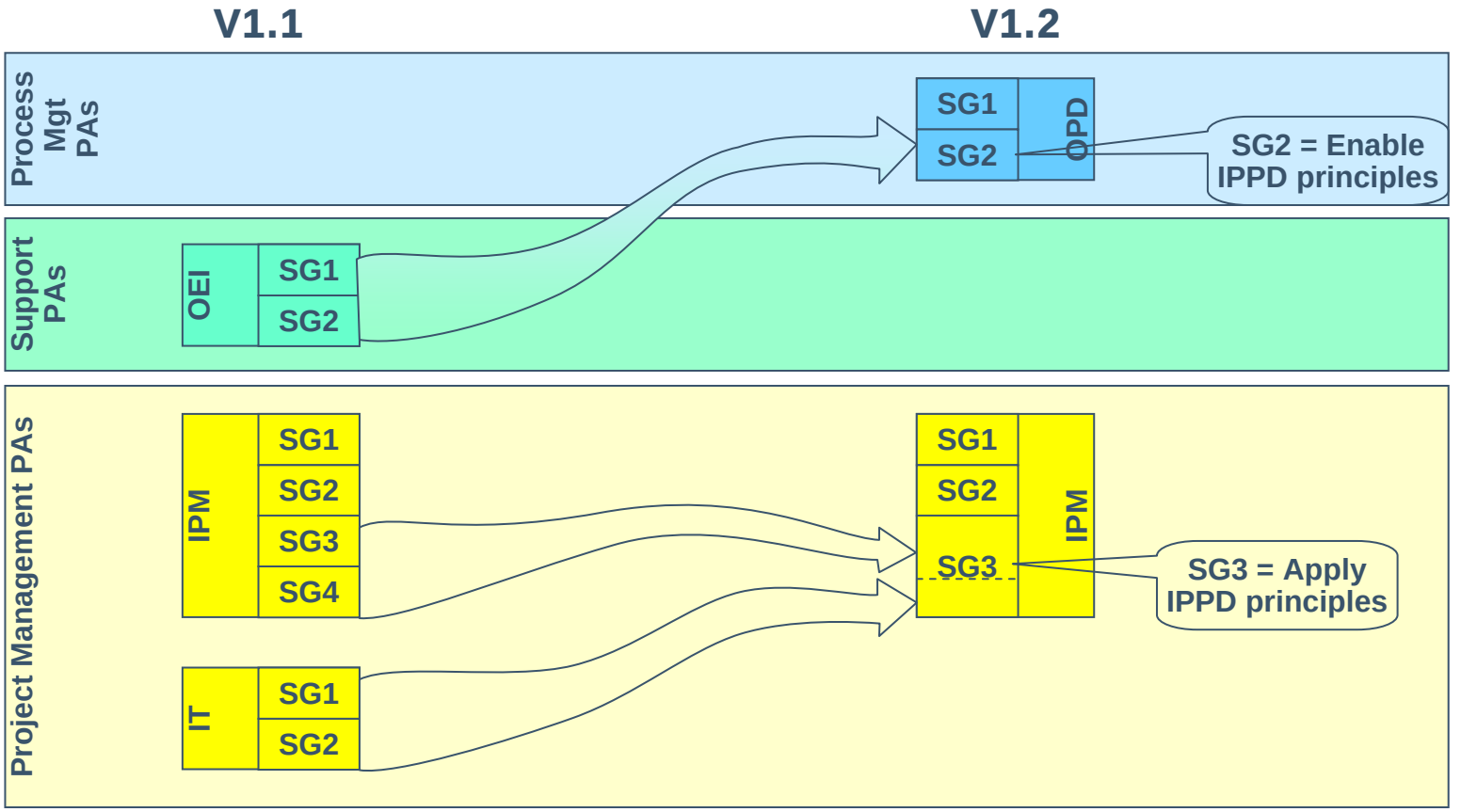
IPPD Changes



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Supplier Agreement Management

Specific Goal	Specific Practice
Establish Supplier Agreements	**1.1 – Determine Acquisition Type** **1.2 – Select Suppliers** **1.3 – Establish Supplier Agreements**
Satisfy Supplier Agreements	**2.1 – Execute the Supplier Agreement** **2.2 – Monitor Selected Supplier Processes** **2.3 – Evaluate Selected Supplier Work Products** **2.4 – Accept the Acquired Product** **2.5 – Transition Products**

v1.1 SP2.1 “Review COTS Products,” was eliminated. “Identify candidate COTS products that satisfy requirements” is a new subpractice under the Technical Solutions Process Area SP1.1, “Develop Alternative Solutions and Selection Criteria.”

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Organizational Process Focus

V1.1

SG1 – Determine Process Improvement Opportunities

1.1 – Establish Organizational Process Needs

1.2 – Appraise the Organization's Processes

1.3 – Identify the Organization's Process Improvements

SG2 – Plan and Implement Process Improvement Activities

2.1 – Establish Process Action Plans

2.2 – Implement Process Action Plans

2.3 – Deploy Organizational Process Assets

2.4 – Incorporate Process-Related Experiences into the Organizational Process Assets

V1.2

SG1 – Determine Process Improvement Opportunities

1.1 – Establish Organizational Process Needs

1.2 – Appraise the Organization's Processes

1.3 – Identify the Organization's Process Improvements

SG2 – Plan and Implement Process Improvement

2.1 – Establish Process Action Plans

2.2 – Implement Process Action Plans

New

SG3 – Deploy Organizational Process Assets and Incorporate Lessons Learned

3.1 – Deploy Organizational Process Assets

3.2 -- Deploy Standard Processes

3.3 -- Monitor Implementation

3.4 -- Incorporate Process Related Experiences into the Organizational Process Assets

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SCAMPI A Changes for V1.2

Method implementation clarifications
- interviews in “virtual” organizations
- practice characterization rules
- organizational unit sampling options

Appraisal Disclosure Statement (ADS) improvements
- reduce redundancy with other appraisal documents
- improve usability for sponsor and government
- Level 4,5 mapping to business objectives
- require sponsor’s signature on the ADS
- require all team members to show agreement on findings
- Both V1,1 and V1.2 ADS reflect these today

Appraisal team will have responsibility for determination of “applicability” for SAM

Maturity level and capability level shelf life – 3 years, given 1 year of V1.2 availability

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Published Appraisal Results

List of Published SCAMPI Appraisal Results

ORGANIZATION NAME:	Satyam Computer Services Ltd.
SPONSOR NAME:	Nagaraj Chevour
LEAD APPRAISER NAME:	Raghavan Nandyal
SEI PARTNER:	SITARA Technologies Pvt. Ltd.
APPRAISAL END DATE:	4/3/2004
MATURITY LEVEL ASSIGNED:	5
APPRAISED ORGANIZATIONAL UNIT:	
Entity Name:	SRU GE-GDC
Location(s):	Secunderabad, AP, India
CMMI MODEL USED:	CMMI-SW/IPPD, V1.1, Continuous
APPRAISAL METHOD USED:	SCAMPI v1.1

MODEL SCOPE & CAPABILITY RATINGS ASSIGNED:

Process Management		Project Management		Engineering		Support	
OPF	Capability Level 3	PP	Capability Level 4	REQM	Capability Level 3	CM	Capability Level 3
OPD	Capability Level 3	PMC	Capability Level 4	RD	Capability Level 4	PPQA	Capability Level 3
OT	Capability Level 3	SAM	Not Applicable	TS	Capability Level 5	MA	Capability Level 3
OPP	Capability Level 3	IPM	Capability Level 3	PI	Capability Level 3	DAR	Capability Level 3
OID	Capability Level 3	RSKM	Capability Level 4	VER	Capability Level 5	OEI	Capability Level 3
		IT	Capability Level 3	VAL	Capability Level 3	CAR	Capability Level 3
		ISM	Not Rated				
		QPM	Capability Level 3				

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CMMI Training v1.2

Introduction to CMMI (Staged and Continuous)
- Editorial update released 9/05
- Updated v1.2 phased in this fall

Intermediate Concepts of CMMI
- Being updated for v1.2
- will better prepare students for SCAMPI training

CMMI Instructor Training
- Being updated to reflect v1.2 changes

"Delta" training from V1.1 to V1.2
- Will be available on-line for free
- More extensive upgrade course for fee
  - Appraisal Team members
  - Lead Appraisers, Instructors, candidates

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CMMI V1.2 Schedules

Version 1.2 CMMI Product Suite release	August 25, 2006
Update material available	August 25, 2006
Upgrade course available on-line	August 25, 2006
First Lead Appraiser “face to face”	October 16, 2006
V1.2 ADS required for all SCAMPIs	October, 2006
Last V1.1 Intro training	December, 2006
First expiration of V1.1 appraisals (3 year validity)	August 25, 2007
Last V1.1 appraisal	August 31, 2007

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Beyond V1.2$_1$

Improved architecture will allow post-V1.2 expansion.

- Extensions of the life cycle (Services, Outsourcing/Acquisition) could expand use of a common organizational framework:
  - allows coverage of more of the enterprise or potential partnering organizations
  - adapts model features to fit non-developmental efforts (e.g., CMMI Services, CMMI Acquisition)

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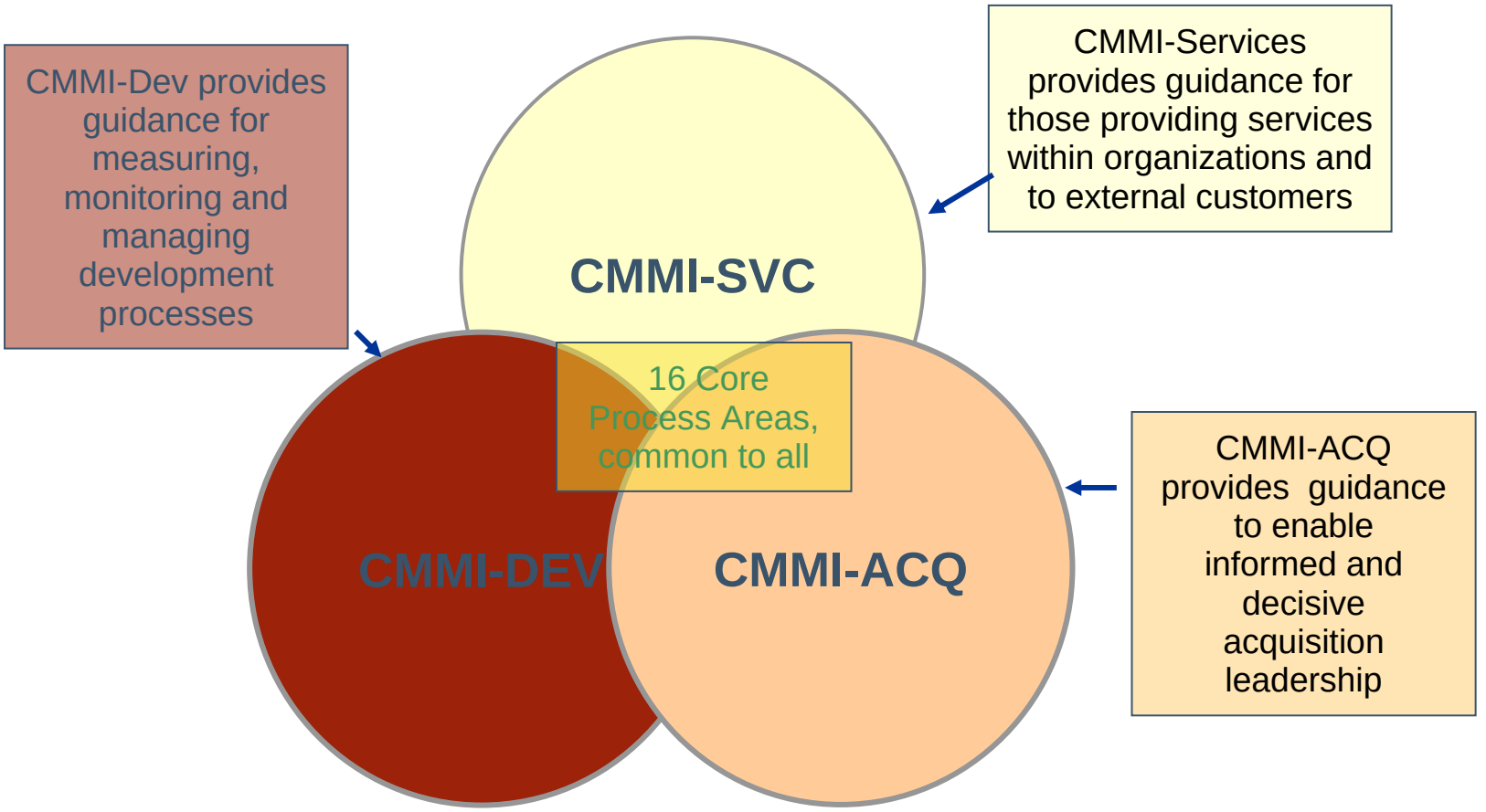
3 Complementary "Constellations"



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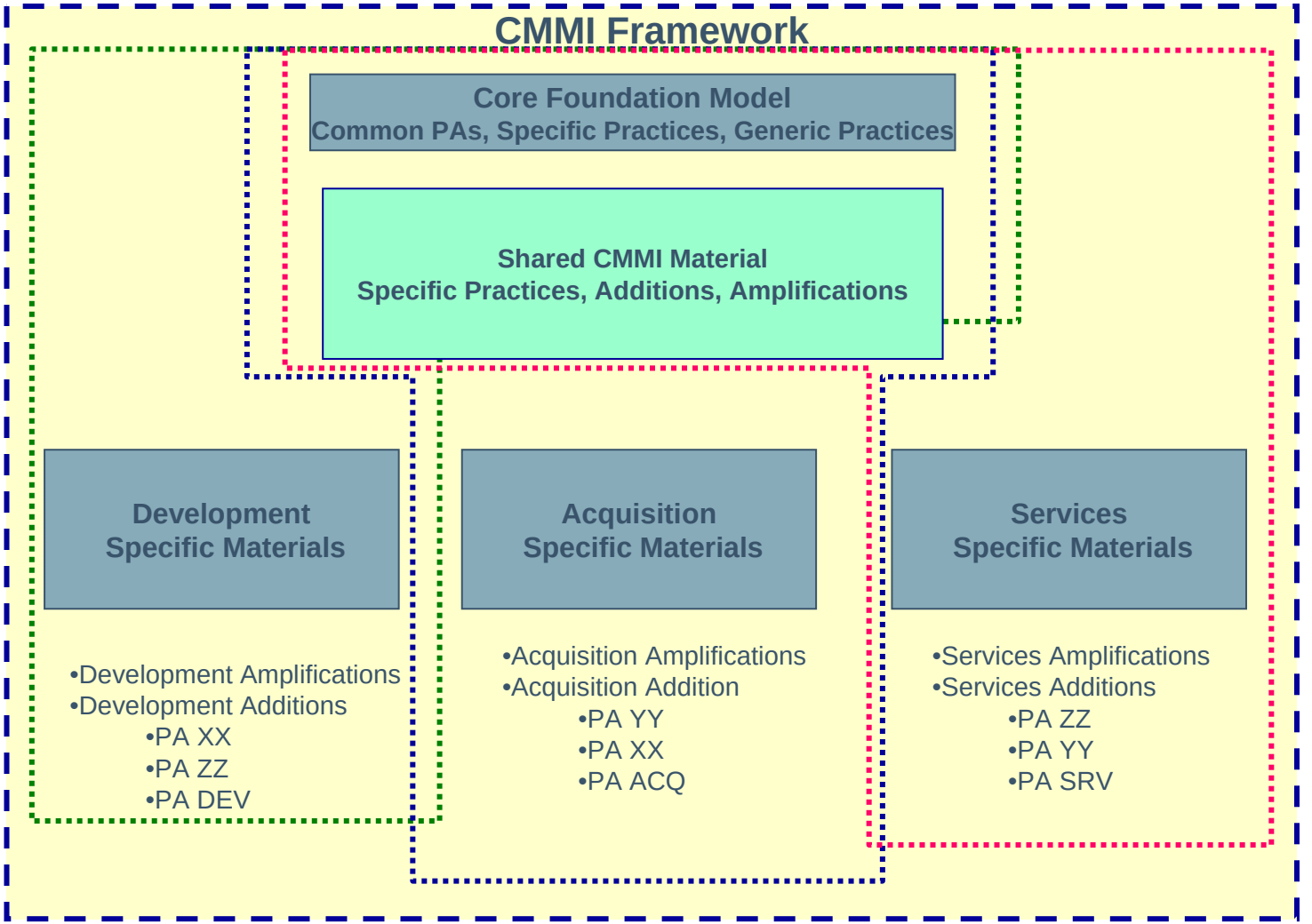
Architecture & Constellations



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Beyond V1.2$_2$

First two new “constellations,” CMMI for Services and CMMI for Acquisition, have been “commissioned” by CMMI Steering Group. Development will be in parallel with V1.2 effort; publication sequenced after V1.2 rollout.

Northrop-Grumman is leading industry group for CMMI Services.

- Initial focus will be for organizations providing “DoD services” as well as internal IT:
  - System maintenance
  - Network Management, IT Services
  - IV&V

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Beyond V1.2$_3$

SEI is coordinating development of CMMI-ACQ.

- Will build upon General Motors IT Sourcing expansion
- Will add government perspectives from both DoD and civil agencies

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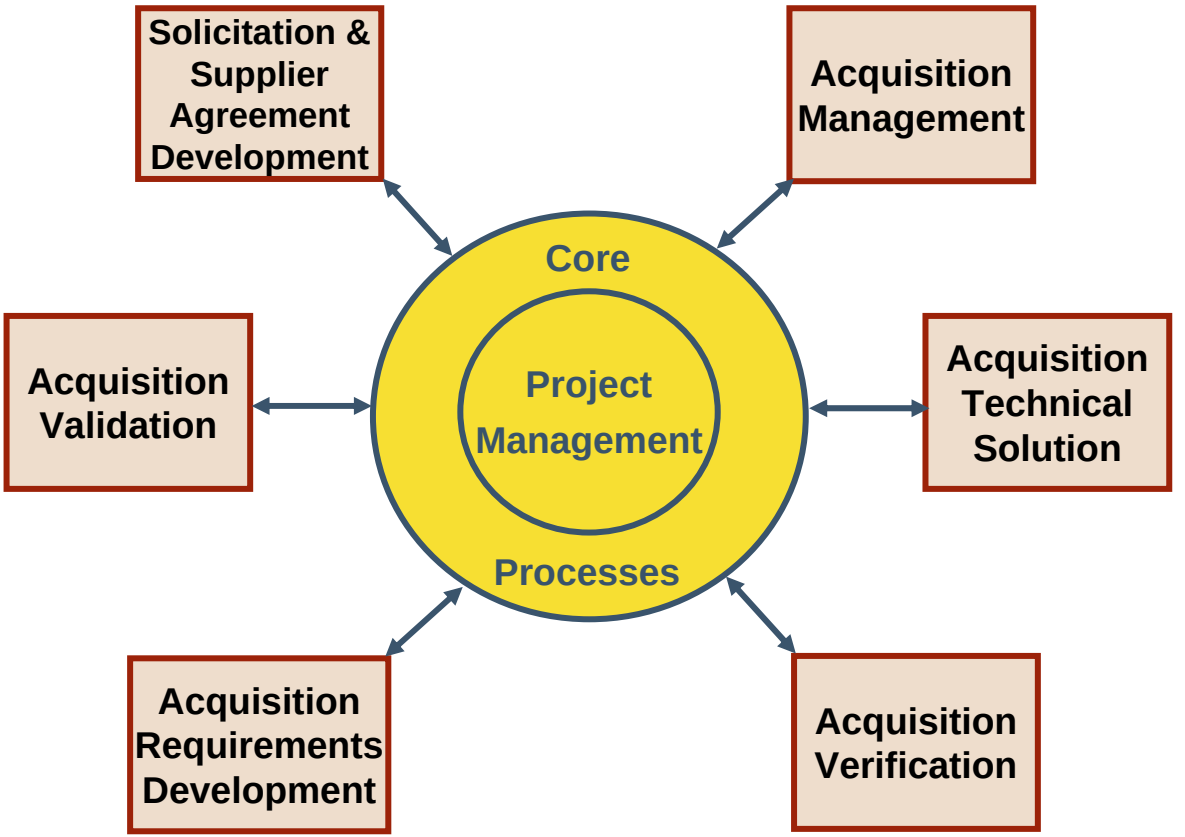
Initial CMMI-ACQ Key Acquisition Processes*



*based on initial CMMI-ACQ model developed by General Motors/SEI

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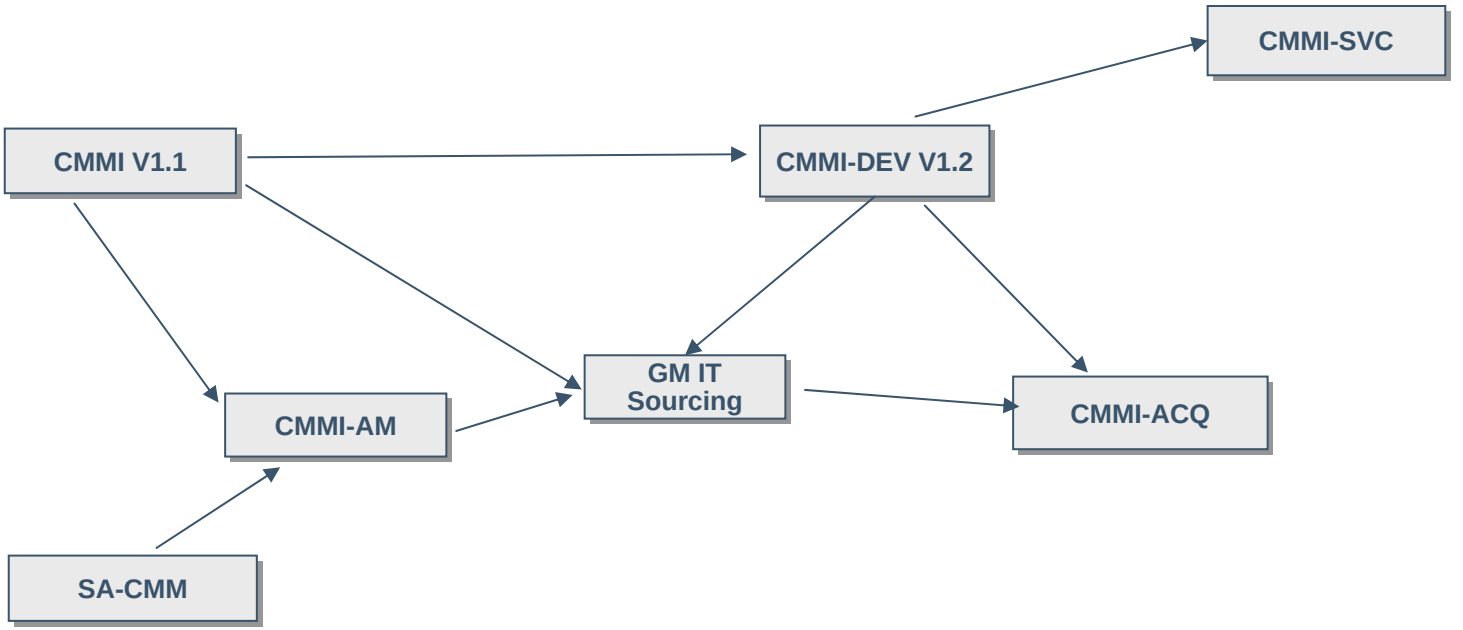
Planned Sequence of Models



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CMMI V1.2…and Beyond …the details

Topics

Overview of Model Changes

Detailed Changes

Glossary Changes

Process Area Changes

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Model Changes

The model was changed mainly due to the following:

- Reduce complexity and size
- Expand model coverage

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Reduce Complexity and Size

To reduce model complexity and size, the following changes were made:

- eliminated advanced practices and common features
- eliminated the Supplier Sourcing (SS) addition
- incorporated Integrated Supplier Management (ISM) into Supplier Agreement Management (SAM)
- consolidated and simplified the IPPD material
- added, modified, and consolidated definitions in the glossary (e.g., bidirectional traceability, subprocess)
- adopted a single book approach (i.e., both representations are published in one document)

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Expand Model Coverage

To expand model coverage, the following changes were made:

- added hardware amplifications
- added two work environment specific practices —one in Organizational Process Definition (OPD) and one in Integrated Project Management (IPM)
- updated notes and examples to address service development and acquisition
- updated the model name to CMMI for Development (CMMI-DEV) to reflect the new CMMI architecture

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Other Significant Model Changes

Other significant model changes made include

- improved the clarity of the Overview section (Part One)
- added information about and clarified how generic practices (GPs) are used
- moved the generic goals and practices to Part Two
- explained how process areas support the implementation of the GPs
- added GP elaborations for GP 3.2
- restricted the process areas that can be considered “not applicable” to SAM
- added emphasis on project startup in OPF and IPM

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Topics

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Advanced Practices Eliminated

There were two types of advanced practices in v1.1:

- those paired with a base practice
- those that stood alone

To eliminate advanced practices, the following strategies were used:

- Where a base and advance practice covered the same topic, the practices were combined.
- Where there was only an advanced practice, the advanced practice was retained as a specific practice.
- Specific practice numbering was simplified to exclude the capability level.

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Base and Advanced Practices Combined

The following base and advanced practices were combined to form specific practices in v1.2.

Requirements Development

- SP 1.1: Elicit Needs (combined with “Collect Stakeholder Needs”)
- SP 3.5: Validate Requirements (combined with “Validate Requirements with Comprehensive Methods”)

Technical Solution

- SP 1.1: Develop Alternative Solutions and Selection Criteria (combined with “Develop Detailed Alternative Solutions and Selection Criteria”)
- SP 2.3: Design Interfaces Using Criteria (combined with “Establish Interface Descriptions”)

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Advanced Practices Converted[1]

The following advanced practices were retained as specific practices in v1.2.

Requirements Management

- SP 1.2: Obtain Commitment to Requirements
- SP 1.4: Maintain Bidirectional Traceability of Requirements

Requirements Development

- SP 3.4: Analyze Requirements to Achieve Balance

Technical Solution

- SP 1.2: Select Product Component Solutions
- SP 2.2: Establish a Technical Data Package
- SP 2.4: Perform Make, Buy, or Reuse Analyses

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Advanced Practices Converted[2]

Product Integration

- SP 1.2: Establish the Product Integration Environment
- SP 1.3: Establish Product Integration Procedures and Criteria

Verification

- SP 1.2: Establish the Verification Environment
- SP 1.3: Establish Verification Procedures and Criteria
- SP 2.3: Analyze Peer Review Data
- SP 3.2: Analyze Verification Results

Validation

- SP 1.2: Establish the Validation Environment
- SP 1.3: Establish Validation Procedures and Criteria

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No More Common Features

Discussion of common features was removed from Part 1.

GPs are no longer organized by common features.

The common feature headings were removed.

The generic practices in v1.2 are presented by generic goal and are sequentially numbered.

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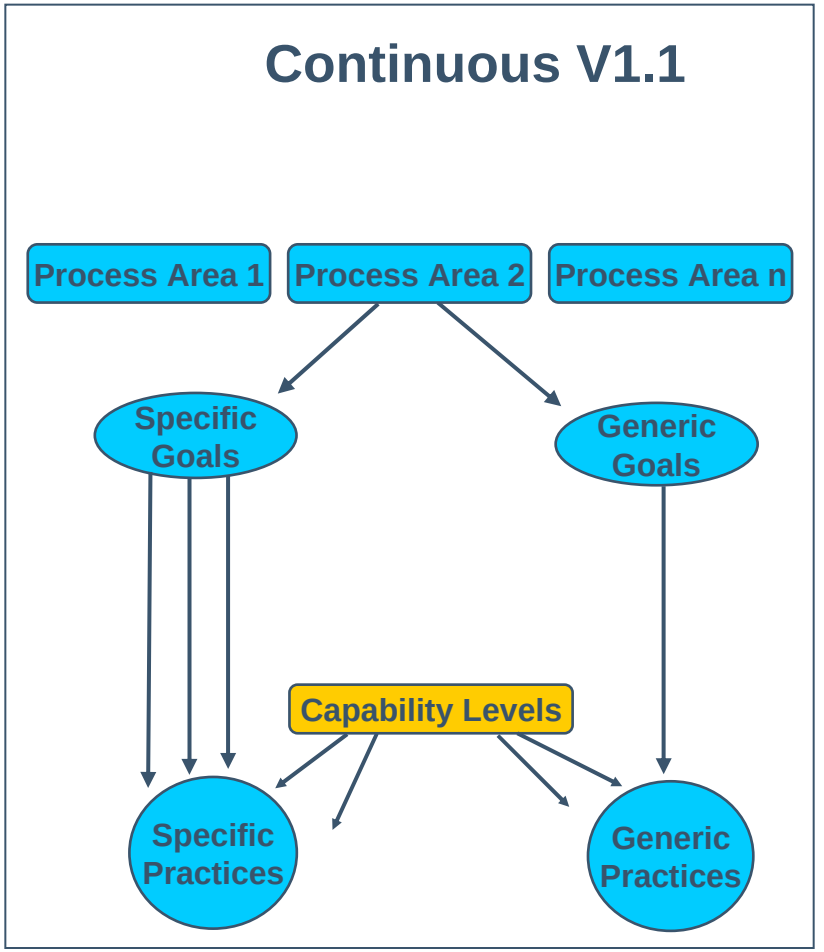
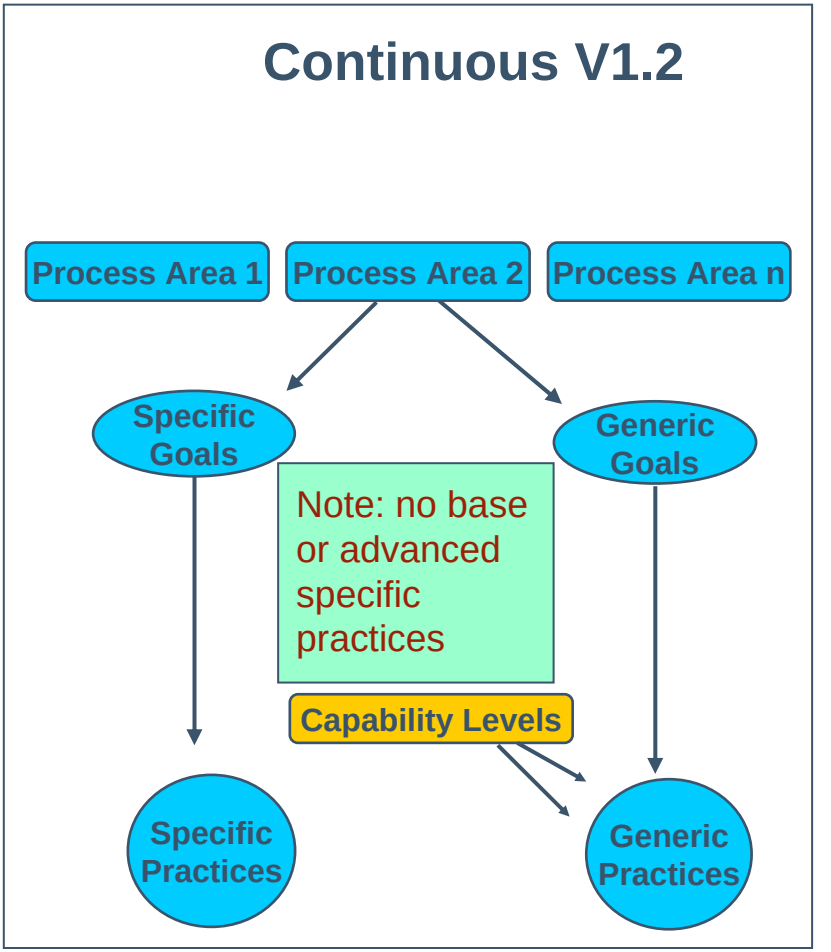
Model Structure[1]





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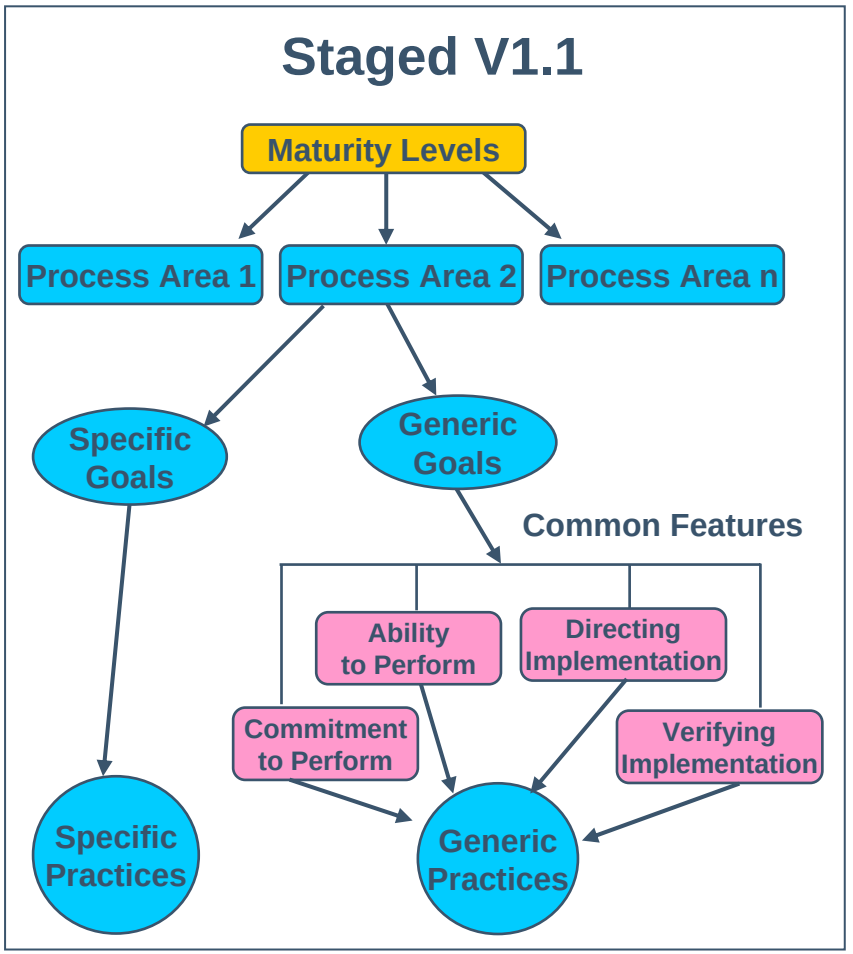
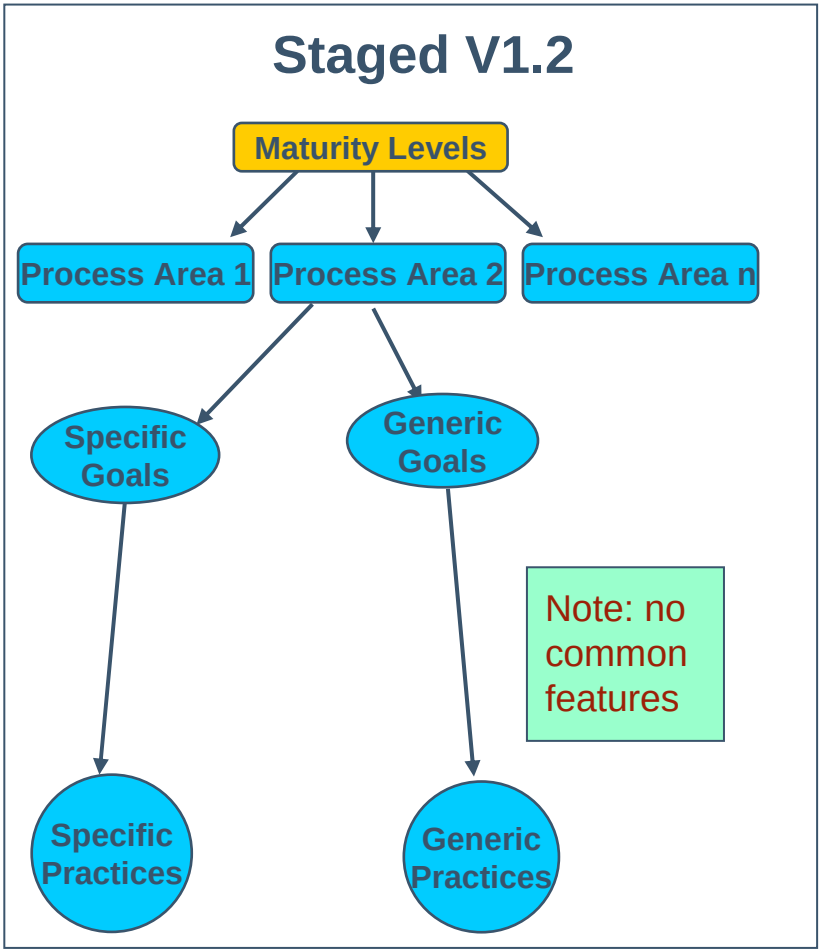
Model Structure[2]





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No More Supplier Sourcing Addition

Supplier Sourcing was eliminated as an addition.

ISM has been eliminated.

SAM has been enhanced to contain the unique material from ISM.

Two specific practices were added to Goal 2 in SAM:

- SP 2.2 - Monitor Selected Supplier Processes
- SP 2.3 - Evaluate Selected Supplier Work Products

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Simplified IPPD Material

There are no longer whole process areas that address IPPD:

- removed OEI and moved material to OPD
- removed IT and moved material to IPM

Information that addressed “Enable IPPD Management” was moved to OPD.

Information that addressed “Apply IPPD Principles” was moved to IPM.

All IPPD material was condensed and revised to be more consistent with the other model material.

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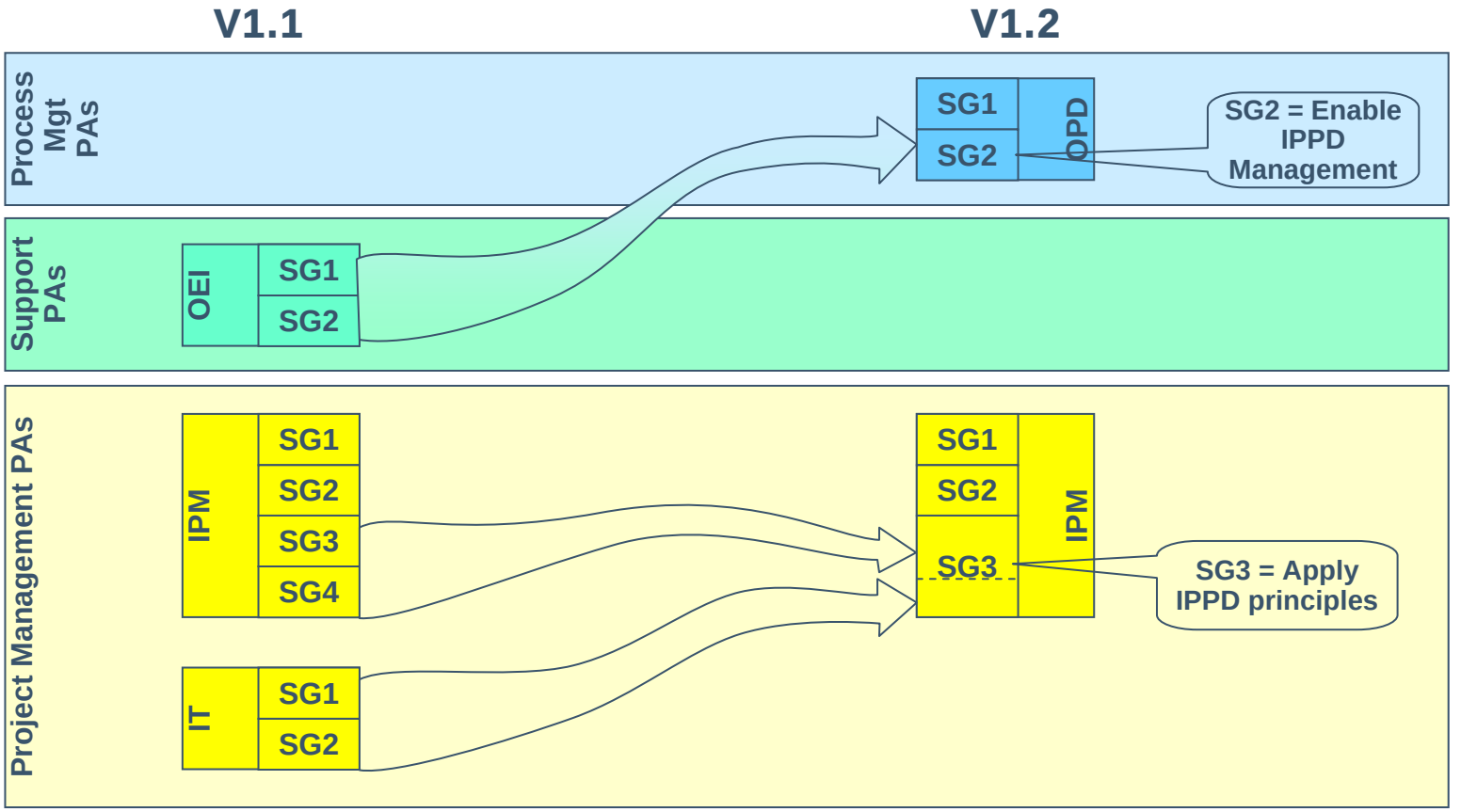
IPPD Changes Illustrated



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The Model Is a Single Document

All representations, additions, and disciplines are in one document.

Users can choose to use:

- representation-specific content (i.e., continuous, staged)
- addition-specific content (i.e., IPPD)
- amplifications (i.e., hardware engineering, software engineering, systems engineering)

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Added Hardware Amplifications and Examples

Six hardware amplifications were created to add emphasis on hardware engineering. Here is an example from TS.

SP 2.1 Design the Product or Product Component

Develop a design for the product or product component.

For Hardware Engineering
Detailed design is focused on product development of electronic, mechanical, electro-optical, and other hardware products and their components. Electrical schematics and interconnection diagrams are developed, mechanical and optical assembly models are generated, and fabrication and assembly processes are developed.

Hardware examples were also added to emphasize hardware engineering.

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Added Work Environment Coverage

Work environment standards are established at the organizational level in OPD.

SP 1.6 Establish Work Environment Standards
Establish and maintain work environment standards.

The project's work environment is established at the project level in IPM.

SP 1.3 Establish the Project's Work Environment
Establish and maintain the project's work environment based on the organization's work environment standards.

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Other Specific Practice Changes

OID, SP 1.4

Select process and technology improvements [not "improvement proposals"] for deployment across the organization.

OPP, SP 1.1

Select the processes or subprocesses [not "process elements"] in the organization's set of standard processes that are to be included in the organization's process-performance analysis.

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Overview Section Improvements

The following improvements were made to the model overview (i.e., Part One):

- The chapter containing the generic goals and practices was moved to Part Two with the process areas.
- All definitions are consolidated into the glossary.
- Chapters were reordered into a more logical sequence.
- The Preface and Using CMMI Models chapter were rewritten and updated.
- Descriptions were updated to reflect the new CMMI architecture:
  - Added descriptions of constellations and additions
  - Removed descriptions of base and advanced practices and common features

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Improved Generic Practices[1]

Editorial changes were made to the generic practices. These slides highlight the changes that affect the content.

GP 1.1: Perform Specific Practices

The practice title and statement changed from “perform base practices” to “perform specific practices.”

GP 2.2: Plan the Process

The informative material was condensed to be consistent with the other generic practices.

GP 2.4: Assign Responsibility

In the informative material “and authority” was added.

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Improved Generic Practices²

GP 2.6: Manage Configurations

In the GP statement, “levels of configuration management” was changed to “levels of control.”

GP 2.9 Objectively Evaluate Adherence

Added informative material to emphasize work products also.

GP 5.2: Correct Root Causes of Problems

Added notes that the focus of this GP is on a quantitatively managed process, though root causes may be found outside of that process.

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Explained Generic Practices Better

Moved generic goals and practices to Part Two with the process areas so that all normative elements of the model are consolidated in one place

Added information about how process areas support the implementation of generic practices (GPs)

Added GP elaborations for GP 3.2

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"Not Applicable" Process Areas

The set of PAs evaluated to achieve a maturity level is an important variable when conducting an appraisal. In v1.1 it was not clear which PAs could be considered "not applicable."

In v1.2, the guidance for appraisals exists in both SCAMPI[SM] MDD Appendix A and SCAMPI A Appraisal Disclosure Statement (ADS):

- Only SAM can be declared not applicable.
- Decisions on PAs included in the appraisal must be made by the lead appraiser in conjunction with the appraisal sponsor.
- Rationale for declaring SAM to be "not applicable" must be provided in the Appraisal Disclosure Statement.

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Topics

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Glossary Changes

The following slides contain significant changes to glossary definitions. Definitions that only had editorial changes are not included.

New definitions: addition, amplification, bidirectional traceability, customer requirement, data, functional configuration audit, hardware engineering, higher level management, physical configuration audit, project startup, and service.

Revised definitions: acquisition, appraisal, appraisal findings, appraisal scope, audit, capability evaluation, configuration audit, customer, data management, establish and maintain, generic goal, objective evidence, process element, product, product component, project, quality- and process-performance objectives, requirements traceability, shared vision, subprocess, traceability, and work product.

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Definitions Deleted From the Glossary

Deleted definitions: ability to perform, advanced practices, agreement/contract requirements, appraisal tailoring, appraisal team leader, base practices, CMMI model tailoring, commitment to perform, directing implementation, discipline amplification, lead appraiser, process context, solicitation package, strength, verifying implementation, weakness

Many of these definitions were deleted because the term wasn't used in the model or the overall concept was removed.

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New Definitions[1]

addition
In the CMMI Product Suite, a clearly marked model component that contains information of interest to particular users. In a CMMI model, all additions bearing the same name (e.g., the IPPD addition) may be optionally selected as a group for use.

amplification
Amplifications are informative model components that contain information relevant to a particular discipline. For example, to find an amplification for software engineering, you would look in the model for items labeled “For Software Engineering.” The same is true for other disciplines.

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New Definitions[2]

bidirectional traceability
An association among two or more logical entities that is discernable in either direction (i.e., to and from an entity). (See also "requirements traceability" and "traceability.")

customer requirement
The result of eliciting, consolidating, and resolving conflicts among the needs, expectations, constraints, and interfaces of the product's relevant stakeholders in a way that is acceptable to the customer. (See also “customer.”)

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New Definitions[3]

data
Recorded information, regardless of the form or method of recording, including technical data, computer software documents, financial information, management information, representation of facts, numbers, or datum of any nature that can be communicated, stored, and processed.

functional configuration audit
An audit conducted to verify that the development of a configuration item has been completed satisfactorily, that the item has achieved the performance and functional characteristics specified in the functional or allocated configuration identification, and that its operational and support documents are complete and satisfactory. (See also "configuration audit," "configuration management," and "physical configuration audit.")

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New Definitions[4]

hardware engineering

The application of a systematic, disciplined, and quantifiable approach to transform a set of requirements representing the collection of stakeholder needs, expectations, and constraints using documented techniques and technology to design, implement, and maintain a tangible product. (See also "software engineering" and "systems engineering.")

In CMMI, hardware engineering represents all technical fields (e.g., electrical or mechanical) that transform requirements and ideas into tangible and producible products .

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New Definitions[5]

higher level management
The person or persons who provide the policy and overall guidance for the process, but do not provide the direct day-to-day monitoring and controlling of the process. Such persons belong to a level of management in the organization above the immediate level responsible for the process and can be (but are not necessarily) senior managers. (See also "senior manager.")

physical configuration audit
An audit conducted to verify that a configuration item, as built, conforms to the technical documentation that defines and describes it. (See also, "configuration audit," "configuration management," and "functional configuration audit.")

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New Definitions[6]

project startup
When a set of interrelated resources are directed to develop or deliver one or more products for a customer or end user. (See also “project.”)

service
In the CMMI Product Suite, a service is a product that is intangible and non-storable. (See also "product," "customer," and "work product.")

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Revised Definitions[1]

acquisition
The process of obtaining products (goods and services) through contract.

appraisal
In the CMMI Product Suite, an examination of one or more processes by a trained team of professionals using an appraisal reference model as the basis for determining, at a minimum, strengths and weaknesses. (See also “assessment” and “capability evaluation.”)

appraisal findings
The results of an appraisal that identify the most important issues, problems, or opportunities for process improvement within the appraisal scope. Appraisal findings are inferences drawn from corroborated objective evidence.

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Revised Definitions[2]

appraisal scope
The definition of the boundaries of the appraisal encompassing the organizational limits and the CMMI model limits within which the processes to be investigated operate.

audit
In CMMI process improvement work, an objective examination of a work product or set of work products against specific criteria (e.g., requirements).

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Revised Definitions[3]

capability evaluation
An appraisal by a trained team of professionals used as a discriminator to select suppliers, to monitor suppliers against the contract, or to determine and enforce incentives. Evaluations are used to gain insight into the process capability of a supplier organization and are intended to help decision makers make better acquisition decisions, improve subcontractor performance, and provide insight to a purchasing organization. (See also “appraisal” and “assessment.”)

configuration audit
An audit conducted to verify that a configuration item, or a collection of configuration items that make up a baseline, conforms to a specified standard or requirement. (See also “audit,” “configuration item,” "functional configuration audit," and "physical configuration audit.")

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Revised Definitions[4]

customer
The party (individual, project, or organization) responsible for accepting the product or for authorizing payment. The customer is external to the project (except possibly when integrated teams are used, as in IPPD), but not necessarily external to the organization. The customer may be a higher level project. Customers are a subset of stakeholders. (See also “stakeholder.”)

In most cases where this term is used, the preceding definition is intended; however, in some contexts, the term "customer" is intended to include other relevant stakeholders. (See also “customer requirement.”)

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Revised Definitions[5]

data management

The disciplined processes and systems that plan for, acquire, and provide stewardship for business and technical data, consistent with data requirements, throughout the data lifecycle.

establish and maintain

In the CMMI Product Suite, you will encounter goals and practices that include the phrase “establish and maintain.” This phrase means more than a combination of its component terms; it includes documentation and usage. For example, “Establish and maintain an organizational policy for planning and performing the organizational process focus process” means that not only must a policy be formulated, but it also must be documented, and it must be used throughout the organization.

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Revised Definitions[6]

generic goal
A required model component that describes the characteristics that must be present to institutionalize the processes that implement a process area. (See also “institutionalization.”)

objective evidence
As used in CMMI appraisal materials, documents or interview results used as indicators of the implementation or institutionalization of model practices. Sources of objective evidence can include instruments, presentations, documents, and interviews.

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Revised Definitions[7]

process element
The fundamental unit of a process. A process can be defined in terms of subprocesses or process elements. A subprocess can be further decomposed into subprocesses or process elements; a process element cannot. (See also "process" and "subprocess.")

Each process element covers a closely related set of activities (e.g., estimating element and peer review element). Process elements can be portrayed using templates to be completed, abstractions to be refined, or descriptions to be modified or used. A process element can be an activity or task.

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Revised Definitions[8]

product
In the CMMI Product Suite, a work product that is intended for delivery to a customer or end user. The form of a product can vary in different contexts. (See also “customer,” "product component," "service," and “work product.”)

product component
In the CMMI Product Suite, a work product that is a lower level component of the product. Product components are integrated to produce the product. There may be multiple levels of product components. (See also “product” and “work product.”)

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Revised Definitions[9]

project

In the CMMI Product Suite, a managed set of interrelated resources which delivers one or more products to a customer or end user. A project has a definite beginning (i.e., project startup) and typically operates according to a plan. Such a plan is frequently documented and specifies what is to be delivered or implemented, the resources and funds to be used, the work to be done, and a schedule for doing the work. A project can be composed of projects. (See also “project startup.”)

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Revised Definitions[10]

quality and process-performance objectives
Objectives and requirements for product quality, service quality, and process performance. Process-performance objectives include quality; however, to emphasize the importance of quality in the CMMI Product Suite, the phrase quality and process-performance objectives is used rather than just process-performance objectives.

requirements traceability
A discernable association between requirements and related requirements, implementations, and verifications. (See also "bidirectional traceability" and "traceability.")

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Revised Definitions[11]

shared vision
A common understanding of guiding principles including mission, objectives, expected behavior, values, and final outcomes, which are developed and used by a project.

subprocess
A process that is part of a larger process. A subprocess can be decomposed into subprocesses and/or process elements. (See also “process," "process description,” and "process element.")

traceability
A discernable association among two or more logical entities such as requirements, system elements, verifications, or tasks. (See also "bidirectional traceability" and “requirements traceability.”)

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Revised Definitions[12]

work product

In the CMMI Product Suite, a useful result of a process. This can include files, documents, products, parts of a product, services, process descriptions, specifications, and invoices. A key distinction between a work product and a product component is that a work product is not necessarily part of the product. (See also “product” and “product component.”)

In CMMI models, you will see the phrase work products and services. Even though the definition of work product includes services, this phrase is used to emphasize the inclusion of services in the discussion.

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Topics

Overview of Model Changes

Detailed Changes

Glossary Changes

Process Area Changes

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Process Area Improvements[1]

Improvements were made to all process areas; some process areas changed more than others. Only the process areas that were changed significantly will be addressed.

Many of these changes were discussed earlier. However, these slides show you significant changes by process area.

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Process Area Improvements[2]

The following process areas were improved significantly:

- Integrated Project Management +IPPD (IPM+IPPD)
- Organizational Process Definition +IPPD (OPD+IPPD)
- Organizational Process Focus (OPF)
- Requirements Management (REQM)
- Requirements Development (RD)
- Supplier Agreement Management (SAM)
- Technical Solution (TS)
- Validation (VAL)
- Verification (VER)

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Integrated Project Management +IPPD[1]

Specific Goal	Specific Practice
Use the Project's Defined Process	1.1 – Establish the Project's Defined Process
	1.2 – Use Organizational Process Assets for Planning Project Activities
	1.3 – Establish the Project's Work Environment
	1.4 – Integrate Plans
	1.5 – Manage the Project Using the Integrated Plans
	1.6 – Contribute to the Organizational Process Assets

- Modified SP 1.1 from "Establish and maintain the project's defined process" to "Establish and maintain the project's defined process from project startup through the life of the project."
- Added SP 1.3 "Establish the Project's Work Environment." (This practice is new to CMMI.)

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Integrated Project Management +IPPD^2

Specific Goal	Specific Practice
Coordinate and Collaborate with Relevant Stakeholders	2.1 – Manage Stakeholder Involvement 2.2 – Manage Dependencies 2.3 – Resolve Coordination Issues
Apply IPPD Principles	3.1 – Establish the Project's Shared Vision 3.2 – Establish the Integrated Team Structure 3.3 – Allocate Requirements to Integrated Teams 3.4 – Establish Integrated Teams 3.5 – Ensure Collaboration among Interfacing Teams

- Reduced the IPPD Addition to one goal (SG3 "Apply IPPD Principles") and its practices.
- To emphasize the IPPD Addition, the name of this process area is now "Integrated Project Management +IPPD" or "IPM +IPPD."

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Organizational Process Definition +IPPD[1]

Specific Goal	Specific Practice
Establish Organizational Process Assets	1.1 – Establish Standard Processes 1.2 – Establish Lifecycle Model Descriptions 1.3 – Establish Tailoring Criteria and Guidelines 1.4 – Establish the Organization's Measurement Repository 1.5 – Establish the Organization's Process Asset Library **1.6 – Establish Work Environment Standards**

- Added "and work environment standards" to the purpose statement.
- Added SP 1.6 "Establish Work Environment Standards." (This practice is new to CMMI.)

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Organizational Process Definition +IPPD[2]

Specific Goal	Specific Practice
Enable IPPD Management	2.1 – Establish Empowerment Mechanisms
	2.2 – Establish Rules and Guidelines for Integrated Teams
	2.3 – Balance Team and Home Organization Responsibilities

- Added an IPPD Addition to OPD (SG2 “Enable IPPD Management” and its practices).
- To emphasize the IPPD Addition, the name the process area is now “Organizational Process Definition +IPPD” or “OPD +IPPD.”

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Organizational Process Focus[1]

Specific Goal	Specific Practice
Determine Process Improvement Opportunities	1.1 – Establish Organizational Process Needs
	1.2 – Appraise the Organization's Processes
	1.3 – Identify the Organization's Process Improvements

- Modified the purpose statement to emphasize deployment.
- SP 1.2 "Appraise the organization's processes periodically and as needed to maintain an understanding of their strengths and weaknesses." uses "organization's processes" instead of "processes of the organization."

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Organizational Process Focus[2]

Specific Goal	Specific Practice
Plan and Implement Process Improvements	**2.1 – Establish Process Action Plans** **2.2 – Implement Process Action Plans**

- Modified SG2 from “Plan and Implement Process Improvement Activities” to “Plan and Implement Process Improvements.”
- Moved to a new SG3 and modified what were SP 2.3 and SP 2.4 in v1.1.

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Organizational Process Focus[3]

Specific Goal	Specific Practice
Deploy Organizational Process Assets and Incorporate Lessons Learned	**3.1 – Deploy Organizational Process Assets** **3.2 – Deploy Standard Processes** **3.3 – Monitor Implementation** **3.4 – Incorporate Process-Related Experiences into the Organizational Process Assets**

- Added new SG3, "Deploy Organizational Process Assets and Incorporate Lessons Learned."
- Moved what were SP 2.3 and SP 2.4 in v1.1 to the new SG3 as SP 3.1 and SP 3.4.
- Added two new SPs: SP 3.2 "Deploy Standard Processes," and SP 3.3 "Monitor Implementation."

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Requirements Management

Specific Goal	Specific Practice
Manage Requirements	1.1 – Obtain an Understanding of Requirements
	1.2 – Obtain Commitment to Requirements
	1.3 – Manage Requirements Changes
	1.4 – Maintain Bidirectional Traceability of Requirements
	1.5 – Identify Inconsistencies Between Project Work and Requirements

- V1.2 REQM SP 1.4 practice statement now reads, “Maintain bidirectional traceability among the requirements and work products.”
- Project plans are no longer mentioned in this SP statement.
- The description of bidirectional traceability is improved as is its definition in the glossary.

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Requirements Development[1]

Specific Goal	Specific Practice
Develop Customer Requirements	1.1 – Elicit Needs 1.2 – Develop the Customer Requirements
Develop Product Requirements	2.1 – Establish Product and Product Component Requirements 2.2 – Allocate Product Component Requirements 2.3 – Identify Interface Requirements

- Former base practice “Collect Stakeholder Needs” is eliminated and former advanced practice, “Elicit Needs” is kept.
- Informative text is added to the introductory notes about applying RD to maintenance projects.

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Requirements Development[2]

Specific Goal	Specific Practice
Analyze and Validate Requirements	**3.1 – Establish Operational Concepts and Scenarios**
	3.2 – Establish a Definition of Required Functionality
	3.3 – Analyze Requirements
	3.4 – Analyze Requirements to Achieve Balance
	3.5 – Validate Requirements

- Material from V1.1 TS SP 1.2, “Evolve Operational Concepts and Scenarios,” is incorporated into RD SP 3.1.
- Material from V1.1 RD SP 3.5-1, “Validate Requirements,” and RD SP 3.5-2, “Validate Requirements with Comprehensive Methods” were consolidated into a single practice.

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Supplier Agreement Management

Specific Goal	Specific Practice
Establish Supplier Agreements	1.1 – Determine Acquisition Type 1.2 – Select Suppliers 1.3 – Establish Supplier Agreements
Satisfy Supplier Agreements	2.1 – Execute the Supplier Agreement 2.2 – Monitor Selected Supplier Processes 2.3 – Evaluate Selected Supplier Work Products 2.4 – Accept the Acquired Product 2.5 – Transition Products

- V1.1 SAM SP2.1 “Review COTS Products,” was eliminated. “Identify candidate COTS products that satisfy requirements” is a new subpractice under the Technical Solutions Process Area SP1.1, “Develop Alternative Solutions and Selection Criteria.”
- SP2.2 and SP2.3 were added because ISM was eliminated.
- The purpose of SAM was also updated.

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Technical Solution[1]

Specific Goal	Specific Practice
Select Product-Component Solutions	1.1 – Develop Alternative Solutions and Selection Criteria
	1.2 – Select Product-Component Solutions

- V1.1 TS SP 1.1-1, “Develop Alternative Solutions and Selection Criteria,” and TS SP 1.1-2, “Develop Detailed Alternative Solutions and Selection Criteria” are consolidated into a single practice.
- “Identify candidate COTS products that satisfy requirements” is a new subpractice under SP1.1.
- V1.1 TS SP 1.2 “Evolve Operational Concepts and Scenarios” is incorporated into RD SP 3.1, “Establish Operational Concepts and Scenarios.”

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Technical Solution²

Specific Goal	Specific Practice
Develop the Design	2.1 – Design the Product or Product Component
	2.2 – Establish a Technical Data Package
	2.3 – Design Interfaces Using Criteria
	2.4 – Perform Make, Buy, or Reuse Analyses
Implement the Product Design	3.1 – Implement the Design
	3.2 – Develop Product Support Documentation

- V1.1 TS SP 2.3-1, “Establish Interface Descriptions,” and TS SP 2.3-3, “Design Interfaces Using Criteria” are consolidated into a single practice.

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Validation

Specific Goal	Specific Practice
Prepare for Validation	1.1 – Select Products for Validation
	1.2 – Establish the Validation Environment
	1.3 – Establish Validation Procedures and Criteria
Validate Product or Product Components	2.1 – Perform Validation
	2.2 – Analyze Validation Results

- Notes were added to VAL to stress that validation activities are performed incrementally and involve relevant stakeholders.
- The phrase “and identify issues” was deleted from the statement of SP 2.2 “Analyze Validation Results” to maintain parallelism with VER SP 3.2 “Analyze Verification Results.”

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Verification[1]

Specific Goal	Specific Practice
Prepare for Verification	1.1 – Select Work Products for Verification 1.2 – Establish the Verification Environment 1.3 – Establish Verification Procedures and Criteria
Perform Peer Reviews	2.1 – Prepare for Peer Reviews 2.2 – Conduct Peer Reviews 2.3 – Analyze Peer Review Data

- No changes to SG1, SG2, or their practices.

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Verification²

Specific Goal	Specific Practice
Verify Selected Work Products	3.1 – Perform Verification
	3.2 – Analyze Verification Results

- The phrase “and identify corrective action” was deleted from both the title and statement of SP 3.2 “Analyze Verification Results. (Corrective action is handled in PMC SG2, “Manage Corrective Action to Closure.)

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Summary

Many changes were made to the CMMI models to improve quality. The major changes include

- name changed to “CMMI for Development”
- both representations in one document
- amplifications improved; added hardware amplifications
- common features and advanced practices eliminated
- SS addition eliminated; ISM brought into SAM
- guidelines for “not applicable” process areas clarified
- overview and glossary improved
- work environment material added to OPD and IPM
- IPPD material simplified and consolidated
- process deployment strengthened in IPM and OPF

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Applying CMMI in Small Settings

Where are we with our work in small settings?

- completed technical feasibility pilots in Huntsville, Alabama with two small companies in the US Army supply chain
- posted the toolkit from this pilot for review:
  - http://www.sei.cmu.edu/ttp/publications/toolkit
- chartered a project to further research in and evolve guidance for CMMI in Small Settings (CSS)

Where are we going?

- International Research Workshop for Process Improvement in Small Settings held October 19-20, 2005
- call for Interest in CSS project is posted on SEI web:
  - http://www.sei.cmu.edu/cmmi/acss/participation.html

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Purpose

The purpose of this module is to describe the major changes to the SCAMPI A appraisal method for v1.2.

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Revision Process

The CMMI Steering Group provided a long-term strategy and the upgrade criteria for v1.2.

The SCAMPI Upgrade Team (SUT) reviewed change requests to identify possible changes for the v1.2 appraisal method documents: Appraisal Requirements for CMMI (ARC) and Method Definition Document (MDD).

The CMMI Steering Group served as the configuration control board for v1.2 changes to the ARC and MDD.

The SUT developed a draft of the ARC and MDD for review by lead appraisers in May 2006.

The ARC and MDD were released as part of the v1.2 CMMI Product Suite.

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SCAMPI A V1.2 Major Themes

Reduce complexity and ambiguity

Provide additional guidance where needed

Strengthen appraisal planning and conduct

Strengthen appraisal reporting

Define appraisal validity period

Strengthen lead appraiser requirements

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Reduce Complexity[1]

The requirement for instruments (e.g., questionnaires) was removed.

Only two types of objective evidence are now required:

- documents
- interviews

The following sections in MDD were revised:

- switched 2.2 Verify and Validate Objective Evidence and 2.3 Document Objective Evidence so that the order of tasks reflects the natural order of conducting an appraisal
- separated Verify Objective Evidence and Validate Preliminary Findings to better describe each process

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Reduce Complexity²

The use of the term instantiation was changed:

- Instantiation is now defined as “the implementation of a model practice used in the appropriate context within the boundaries of an organizational unit.”
- The word “instantiation” for project and organizational-wide entities was replaced with “project” or “support group.”

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Reduce Ambiguity

The rating Not Rated was clarified:

- Process areas outside of the model scope are rated as Out of Scope. For example, for a maturity level 3 appraisal, maturity level 4 and 5 process areas are rated as Out of Scope.
- For process areas that have insufficient data to be rated, the rating is Not Rated.
- Process areas in the model scope, but outside the organizational scope are rated as Not Applicable. The only process area that can be Not Applicable is SAM (as determined by the appraisal team).

The practice characterization tables were revised:

- clarified the use of virtual versus live interviews
- changed “face-to-face interviews” to “oral interviews”

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Provide Additional Guidance

Guidance for readiness reviews was revised to include team and logistical readiness.

Additional guidance was provided for using virtual methods (e.g., for interviews and briefings).

Additional guidance was provided for using alternative practices (i.e., Appendix C: Alternative Practice Identification and Characterization Guidance).

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Strengthen Appraisal Planning and Conduct

Organizational unit sampling was revised to*

- strengthen parameters and limits for organizational sampling (e.g., identifying a minimum number of focus projects)
- include additional criteria for reporting sampling decisions

The Conduct Appraisal Phase must now be complete within 90 days.

Appraisal team members are now required to sign final findings.

*Changes to address sampling were extensive. Refer to the MDD for details.

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Strengthen Appraisal Reporting

The Appraisal Disclosure Statement (ADS) now requires the following information.

Organizational sampling criteria and decisions (e.g., projects included, projects excluded, percentage of organization represented)

Basis for maturity/capability level 4 and 5 appraisal results
- subprocesses statistically managed
- mapping of these subprocesses to quality and process-performance objectives

Signatures of both the lead appraiser and sponsor
- The lead appraiser affirms that the appraisal scope is representative of the organizational unit.
- The sponsor affirms the accuracy of the ADS and authorizes the SEI to conduct any audits deemed necessary.

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Define Appraisal Validity Period

V1.2 appraisal results are valid for a maximum of 3 years from the date of the ADS.

V1.1 appraisals will expire on August 31, 2007 or 3 years after the date the appraisal was conducted, whichever is later.

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Strengthen Lead Appraiser Requirements

Prior to conducting a v1.2 SCAMPI appraisal, the following must occur:

- Current candidate and authorized lead appraisers and team leaders must complete CMMI v1.2 Upgrade Training.
- Candidate and authorized lead appraisers must attend SCAMPI Face-to-Face Training.
- Those who want to conduct v1.2 SCAMPI level 4 or 5 appraisals must be certified. Certification requirements address the following:
  - education, training, and experience in level 4 and 5 concepts
  - completion of an oral exam

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Summary

The SCAMPI A appraisal method was revised based on change requests received to

- reduce complexity and ambiguity
- provide additional guidance where needed
- strengthen appraisal planning and conduct
- strengthen appraisal reporting
- define the appraisal validity period
- strengthen lead appraiser requirements

The changes are intended to make appraisals more accurate, reliable, and efficient.

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Purpose

The purpose of this module is to describe the major changes to the CMMI Training for v1.2.

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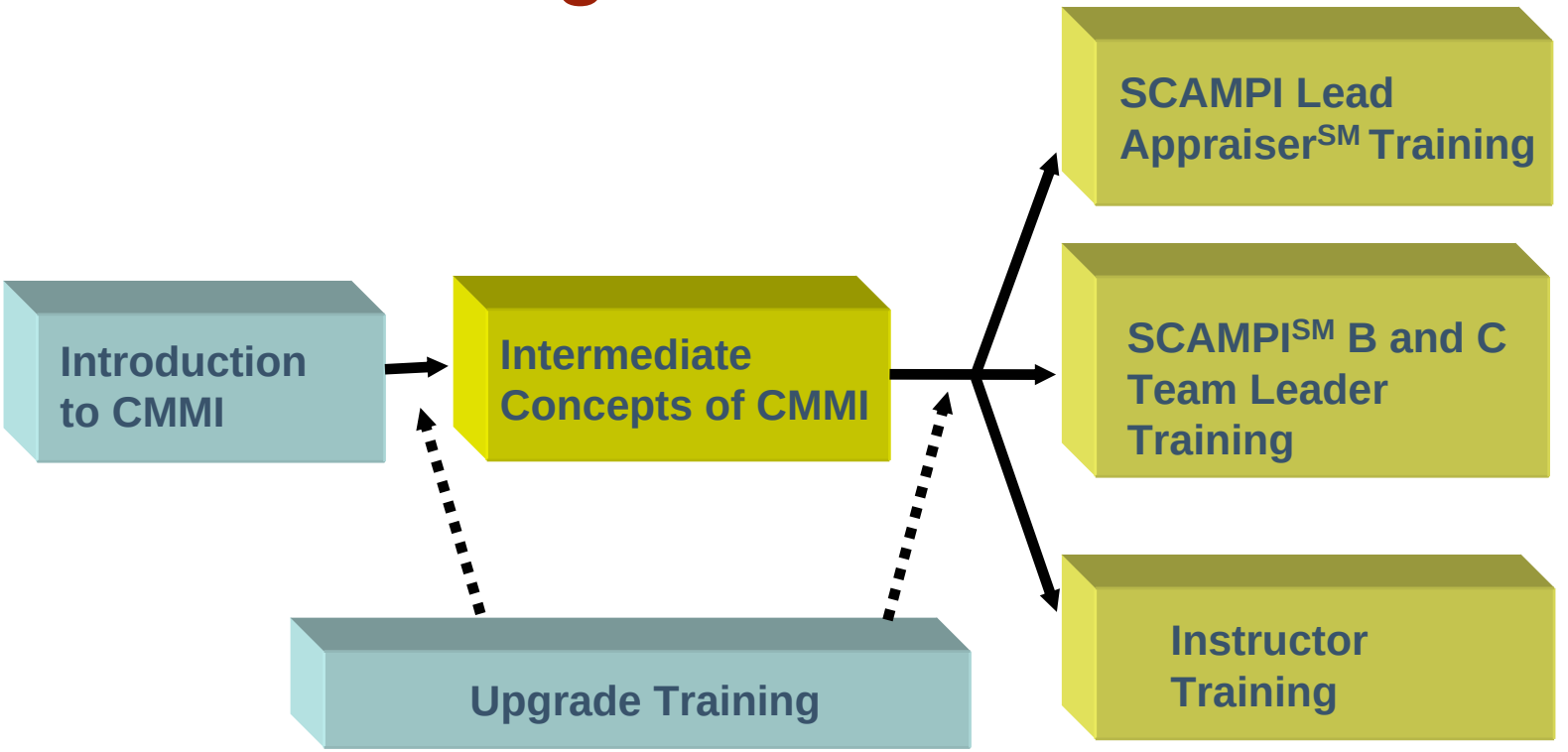
SEI Training for CMMI



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CMMI Training Changes

The Introduction to CMMI course was updated to address change requests and to address CMMI Product Suite v1.2 changes.

The following courses will be updated in Fall 2006 to address change requests and CMMI Product Suite v1.2 changes:

- Intermediate Concepts of CMMI
- CMMI Instructor Training
- SCAMPI Lead Appraiser Training
- SCAMPI B and C Team Leader Training

CMMI v1.2 Upgrade Training was also developed to help users move from v1.1 to v1.2

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Topics

Introduction to CMMI

Intermediate Concepts of CMMI

Instructor Training

SCAMPI Training

Examinations

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Major Changes to the Introduction to CMMI Course

The major changes to the Introduction to CMMI, v1.2 course focused on three areas:

- course content
- exercises
- course reference

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Course Content[1]

The benefits associated with adopting CMMI were updated.

Information about CMMI benefits is available in the SEI technical report, *Performance Results of CMMI-Based Process Improvement* (CMU/SEI-2006-TR-004). It is available on the SEI Web site at http://www.sei.cmu.edu/publications/documents/06.reports/06tr004.html.

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Course Content²

Material related to the following was removed:

- advanced and base practices
- common features

Material related to the following was added or changed:

- How PAs support the implementation of generic practices was updated. (The basis for this material can be found in Figure 6.2 in the model.)
- The "Sampling Generic Practices" slides now collectively include all generic practices, and reference capability and maturity levels.
- Information on the CMMI architecture was added.

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Course Content[3]

These changes were also made to reflect changes in the model:

- Integrated Supplier Management was removed and two specific practices were moved to Supplier Agreement Management.
- Organizational Environment for Integration and Integrated Teaming were removed and material was moved to Organizational Process Definition and Integrated Project Management.
- Two new practices were added to cover work environment–one in Organizational Process Definition and one in Integrated Project Management.
- A third goal was added to Organizational Process Focus to address the deployment of organizational process assets.

There are now 22 PAs discussed in the course.

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Exercises

Exercise 1, “Important Process Improvement Ideas,” and Exercise 7, “Measurement Implications of Your Process Improvement Goals,” were simplified.

Exercises were updated to reflect the removal of some PAs.

Other minor editorial changes were made.

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Course Reference

The course was designed so that the reference model used can be either

- the technical report, *CMMI for Development, Version 1.2*
- the Addison-Wesley book, *CMMI: Guidelines for Process Integration and Product Improvement, Second Edition*

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Topics

Introduction to CMMI

Intermediate Concepts of CMMI

Instructor Training

SCAMPI Training

Examinations

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Major Changes to Intermediate Concepts of CMMI

The major changes to the Intermediate Concepts of CMMI course will focus on four areas:

- course format
- exercises
- student presentations
- course content

Editorial changes also will be made to correct identified errors.

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Course Format

The format of the Intermediate Concepts of CMMI course will change.

In the v1.1 course, the instructor presented material the first day and on following days the students presented. In v1.2, student presentations, exercises, and SEI instructor presentations will be intermixed throughout the week to provide a better balance.

TOEFL* requirements will now be used as part of the registration process.

*Test of English as a Foreign Language

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Course Content

The majority of changes to the course slides will reflect the changes from CMMI v1.2 model.

In addition, the following changes will be made:

- Material on application and interpretation will be added.
- There will be more emphasis on institutionalization (i.e., generic goals and generic practices).

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Exercises

All exercises will be updated to better meet the course objectives.

Several exercises will be integrated with a common theme so that concepts are developed using related exercises that build on each other throughout the course.

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Student Presentations

The student presentations will be modified to better meet the course objectives.

- The process used for assigning student presentation topics will be revised. More information will be collected from students to help to better assign the PAs.
- The length of student presentations will be reduced.
- Slides for instructors will be provided to reinforce the key points of each PA.

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Topics

Introduction to CMMI

Intermediate Concepts of CMMI

Instructor Training

SCAMPI Training

Examinations

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Major Changes to Instructor Training

The major changes to the Instructor Training course will focus on two areas:

- course content
- student presentations

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Course Content

Changes to all course materials will be made to reflect the changes to:

- the Introduction to CMMI course
- the CMMI v1.2 model

The sections that will be revised include:

- the course structure and key concepts section
- the review of CMMI topics section

Editorial changes will be made to correct identified errors.

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Student Presentations

The following changes will be made:

- The assignments will be updated to reflect changes in the model (e.g., delete presentation assignments related to the PAs that were removed from the model).
- Add a teaching assignment focused on topics such as
  - model components
  - generic goals and generic practices
  - capability levels and maturity levels
  - benefits of process improvement
  - PA-to-PA relationships

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Topics

Introduction to CMMI

Intermediate Concepts of CMMI

Instructor Training

SCAMPI Training

Examinations

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Major Changes to SCAMPI Training

The changes to the SCAMPI Lead Appraiser Training and SCAMPI B and C Team Leader Training courses will focus on two areas:

- course content
- exercises

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Course Content

The majority of changes to the course slides will reflect the changes from SCAMPI v1.2.

In addition, material will be added on ethics and model interpretation.

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Exercises

The majority of changes to the course exercises will be made to reflect the CMMI for Development, Version 1.2.

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Topics

Introduction to CMMI

Intermediate Concepts of CMMI

Instructor Training

SCAMPI Training

Examinations

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Examinations

The construction and format of examinations have changed. v1.1 tests were largely short answer tests that were the same for all students.

For v1.2, tests will be generated from an item bank and now will be multiple choice. CMMI v1.2 Upgrade Training for Instructors, Lead Appraisers, and Team Leaders is the first course to use this approach. The Intermediate Concepts of CMMI and Instructor Training will follow.

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Multiple Choice Examinations

This new approach, using an item bank and multiple choice questions, allows multiple versions of examinations that can be constructed more easily:

- The sequence of multiple choice responses can vary from test to test.
- The order of questions can vary from test to test.
- The selection of questions can vary from test to test, but cover the same categories.

This new approach allows us to

- add, modify, and delete questions from the test more easily
- better evaluate the student's knowledge

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Summary

Many changes were made to the CMMI training courses to improve quality and reflect changes to the CMMI Product Suite:

- CMMI for Development, Version 1.2
- SCAMPI v1.2
- Introduction to CMMI, v1.2

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For More Information…

For more information about CMMI

- http://www.sei.cmu.edu/cmmi/ (main CMMI site)

Other Web sites of interest include

- http://seir.sei.cmu.edu/seir/ (Software Engineering Information Repository)
- http://dtic.mil/ndia (annual CMMI Technology Conferences)
- http://seir.sei.cmu.edu/pars (publicly released SCAMPI appraisal summaries)
- https://bscw.sei.cmu.edu/pub/bscw.cgi/0/79783

Or, contact

SEI Customer Relations
Phone: 412 / 268-5800
Email: customer-relations@sei.cmu.edu

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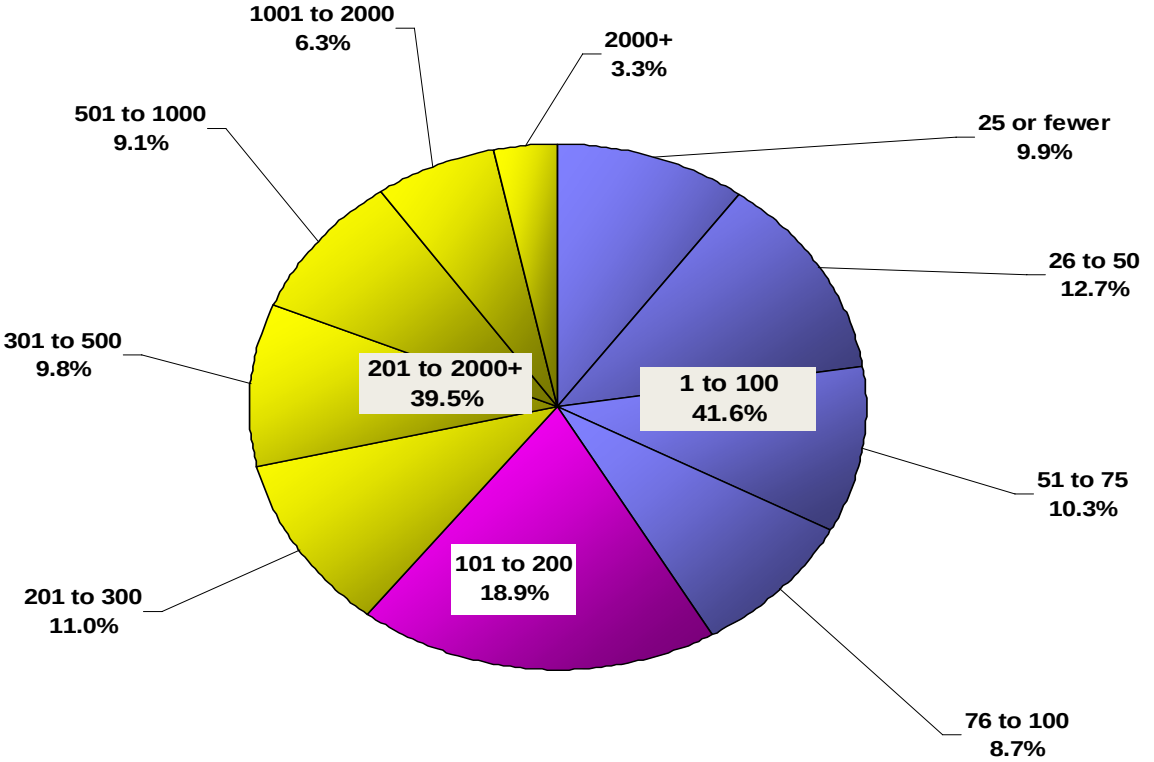
Organization Size

Based on the total number of employees within the area of the organization that was appraised



Based on **1,083** organizations reporting size data

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Appraisals and Maturity Levels by Country

Country	Number of Appraisals	Maturity Level 1 Reported	Maturity Level 2 Reported	Maturity Level 3 Reported	Maturity Level 4 Reported	Maturity Level 5 Reported	Country	Number of Appraisals	Maturity Level 1 Reported	Maturity Level 2 Reported	Maturity Level 3 Reported	Maturity Level 4 Reported	Maturity Level 5 Reported
Argentina	12	No	Yes	Yes	Yes	No	Latvia	10 or fewer					
Australia	21	Yes	Yes	Yes	Yes	Yes	Malaysia	10 or fewer					
Austria	10 or fewer						Mauritius	10 or fewer					
Belarus	10 or fewer						Mexico	10 or fewer					
Belgium	10 or fewer						Netherlands	10 or fewer					
Brazil	22	No	Yes	Yes	No	Yes	New Zealand	10 or fewer					
Canada	15	No	Yes	Yes	No	Yes	Philippines	10					
Chile	10 or fewer						Portugal	10 or fewer					
China	117	Yes	Yes	Yes	Yes	Yes	Russia	10 or fewer					
Colombia	10 or fewer						Singapore	10 or fewer					
Czech Republic	10 or fewer						Slovakia	10 or fewer					
Denmark	10 or fewer						South Africa	10 or fewer					
Egypt	10 or fewer						Spain	18	No	Yes	Yes	No	Yes
Finland	10 or fewer						Sweden	10 or fewer					
France	42	Yes	Yes	Yes	Yes	Yes	Switzerland	10 or fewer					
Germany	22	Yes	Yes	Yes	No	Yes	Taiwan	26	No	Yes	Yes	No	No
Hong Kong	10 or fewer						Thailand	10 or fewer					
India	140	No	Yes	Yes	Yes	Yes	Turkey	10 or fewer					
Ireland	10 or fewer						Ukraine	10 or fewer					
Israel	10 or fewer						United Kingdom	35	Yes	Yes	Yes	Yes	No
Italy	10 or fewer						United States	500	Yes	Yes	Yes	Yes	Yes
Japan	131	Yes	Yes	Yes	Yes	Yes	Vietnam	10 or fewer					
Korea, Republic of	50	Yes	Yes	Yes	Yes	Yes							

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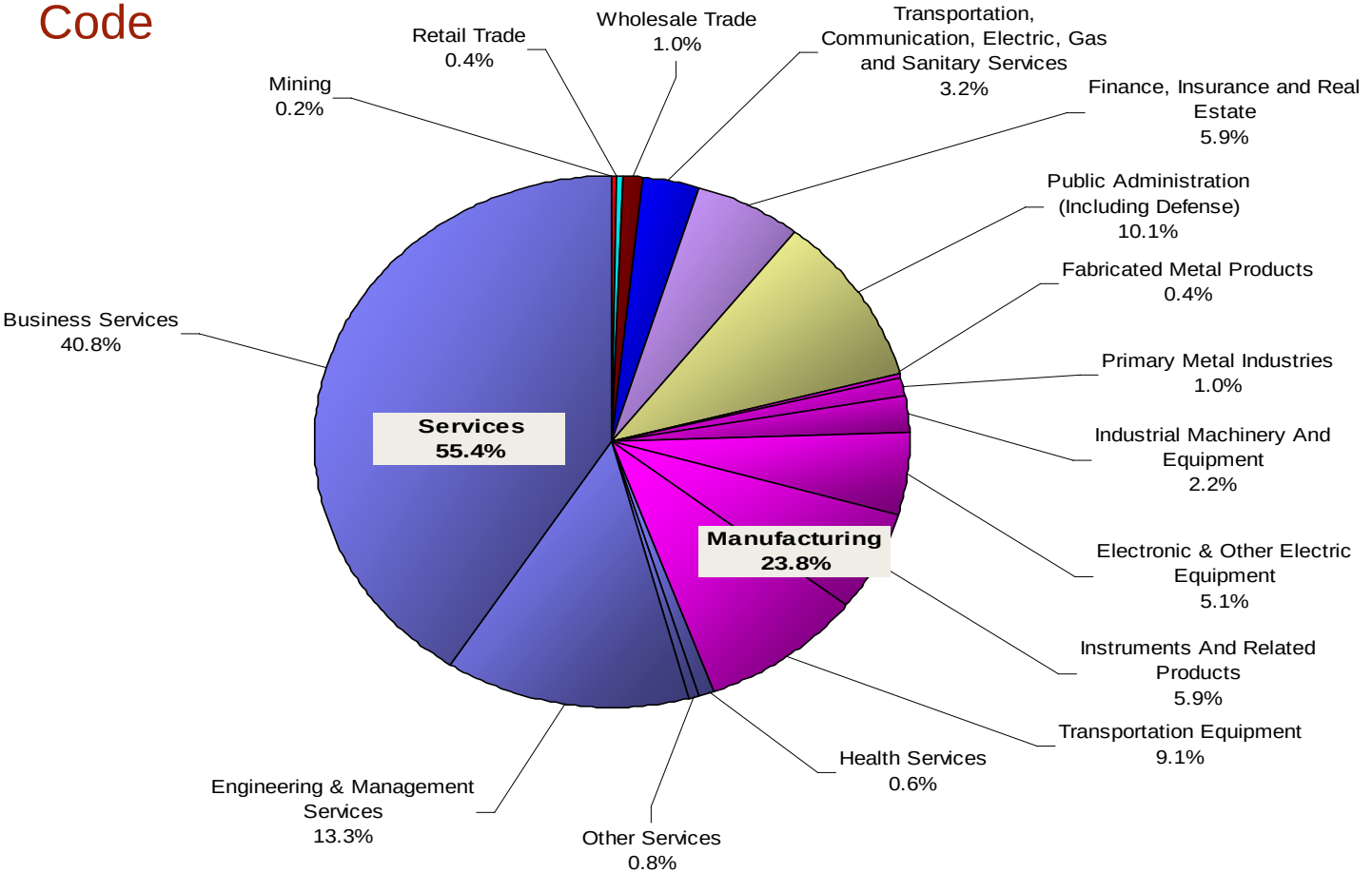
Organization Type

Based on Primary Standard Industrial Classification (SIC) Code



Based on **505** organizations reporting SIC code. For more information visit: http://www.osha.gov/oshstats/sicser.html

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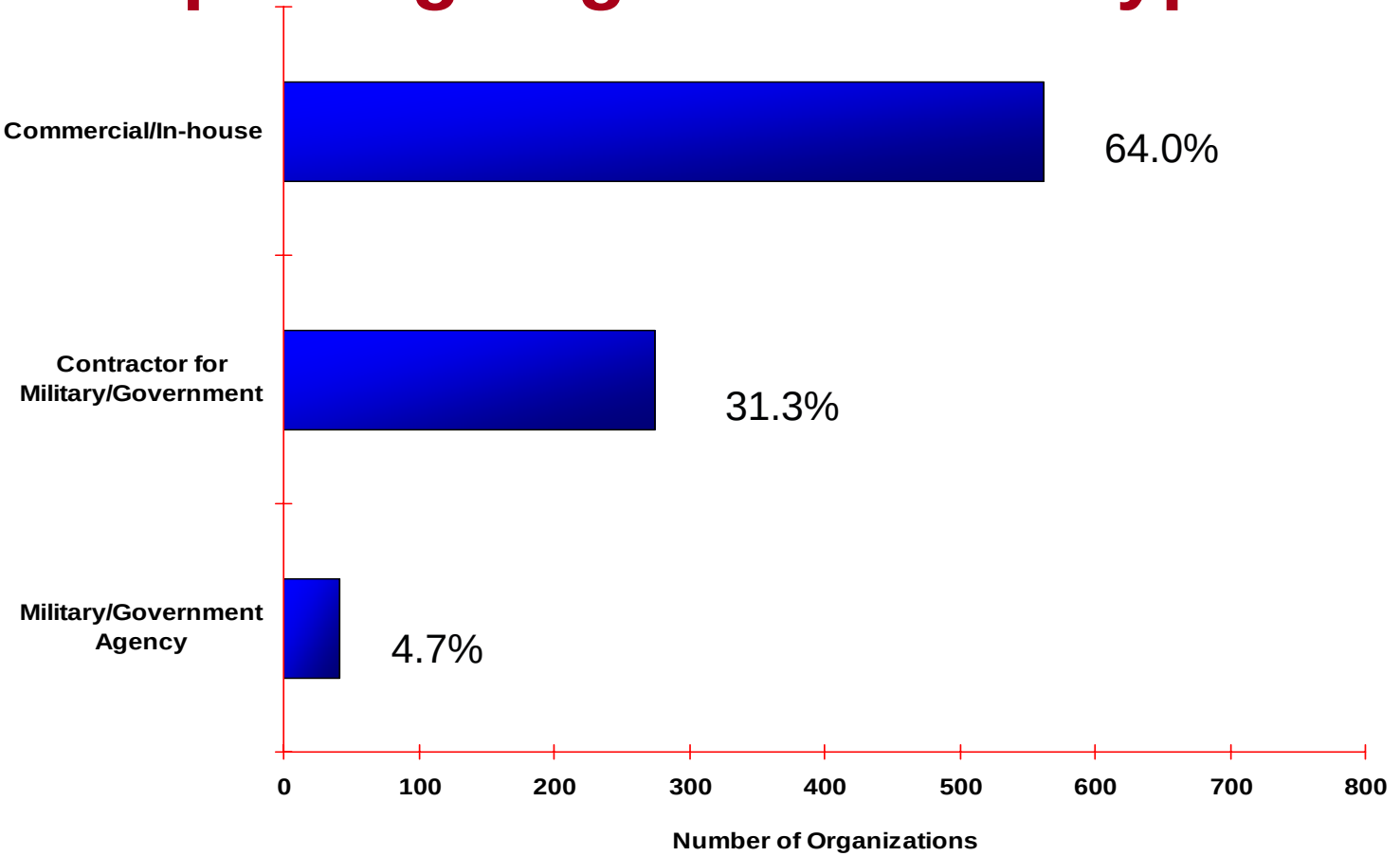
Reporting Organizational Types



Based on **878** organizations

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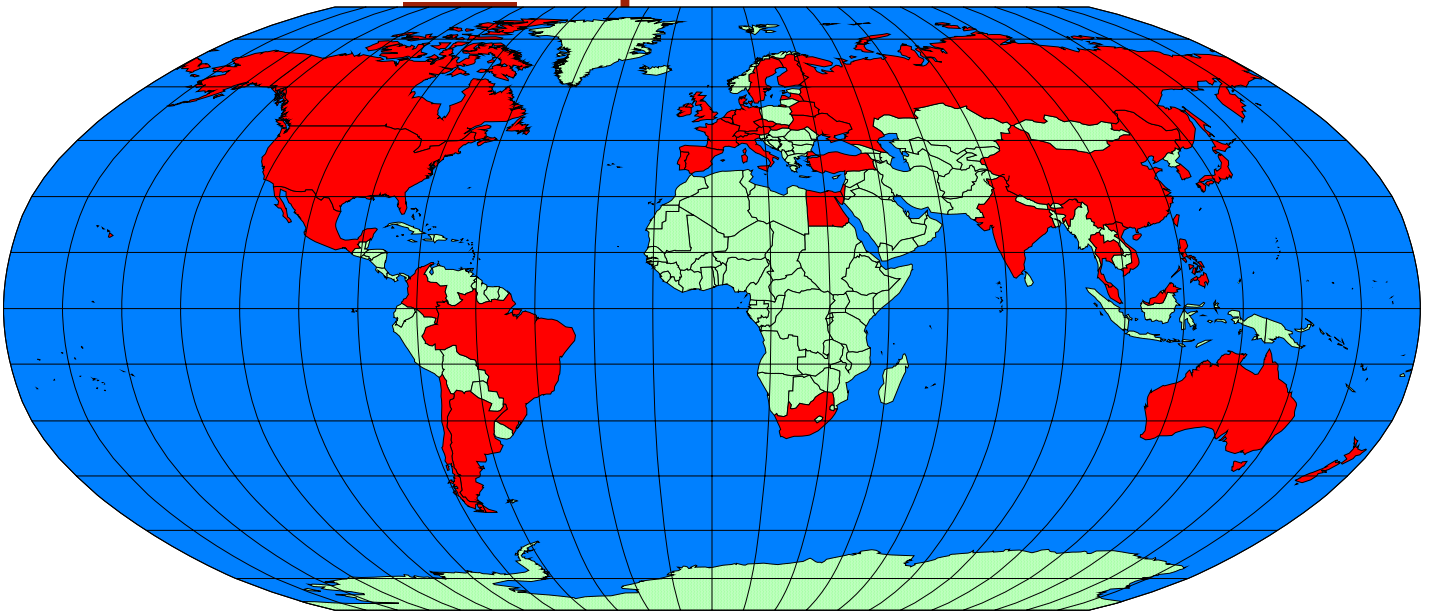
Countries where Appraisals have been Performed and Reported to the SEI



Argentina	Australia	Austria	Belarus	Belgium	Brazil	Canada
Chile	China	Colombia	Czech Republic	Denmark	Egypt	Finland
France	Germany	Hong Kong	India	Ireland	Israel	Italy
Japan	Korea, Republic of	Latvia	Malaysia	Mauritius	Mexico	Netherlands
New Zealand	Philippines	Portugal	Russia	Singapore	Slovakia	South Africa
Spain	Sweden	Switzerland	Taiwan	Thailand	Turkey	Ukraine
United Kingdom	United States	Vietnam				

Red country name: New additions since October 2005

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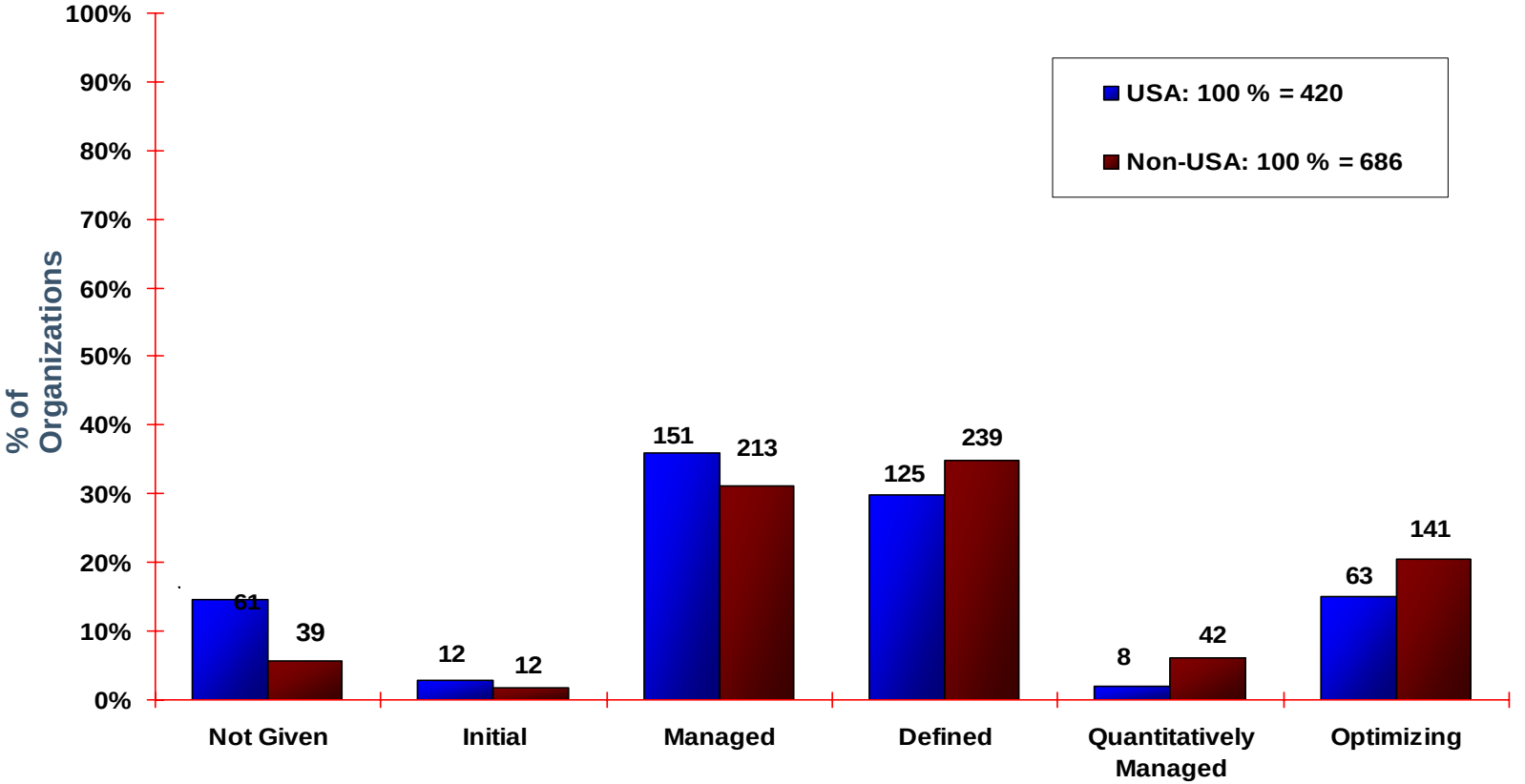
Maturity Profile by All Reporting USA and Non-USA Organizations



Based on **420** USA organizations and **686** Non-USA organizations

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Applying Process Simulation to Achieve High-Value Benefits

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Agenda: Part I

1. Introduction: What is Process Simulation?
2. Motivation: What can be done with Process Simulation Models?
3. Examples of High Value Add Ways the Process Simulation Can be applied within an organization
4. Wrap-Up/ Conclusions

What Is a Simulation Model?

- A simulation model is a computerized model (*not a maturity model*) designed to display significant features of the dynamic system it represents.
- Simulations are generally employed when
  - behavior over time is of particular interest or significance, and
  - the economics or logistics of manipulating the system being modeled are prohibitive
- Common purposes of simulation models are:
  - to provide a basis for experimentation,
  - to predict behavior,
  - to answer “what if” questions,
  - to teach about the system being modeled.

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What is Process Simulation?

- Process simulation models focus on the dynamics of ***systems*** development, maintenance and acquisition projects
- They represent the process
  - as currently implemented (as-is, as-practiced, as-documented), or
  - as planned for future implementation (to-be)
- Simulation Features
  - Use Graphical interfaces
  - Utilizes actual data/ metrics
  - Predict performance
  - Supports “What if” Analyses
  - Support business case analyses
  - Reduces risk

Applying Process Simulation = High Value Add

- Evaluate Strategic Issues
  - Quality Assurance, V&V and IV&V Strategy for a project
  - Globally Distributed Software Development
- Assess the Costs and Benefits of Applying New Tools and Technologies
- Plan Processes and make better Tradeoff Decisions
- Evaluate Process Improvement Opportunities
- Architect, Design, and Document Processes
- Estimate Project Costs from the Bottom Up
- Manage Projects Quantitatively
- Train Project Managers

Applying Process Simulation = High Value Add

- ***Evaluate Strategic Issues***
  - ***Quality Assurance, V&V, and IV&V Strategy for a project***
  - ***Globally Distributed SW Development***

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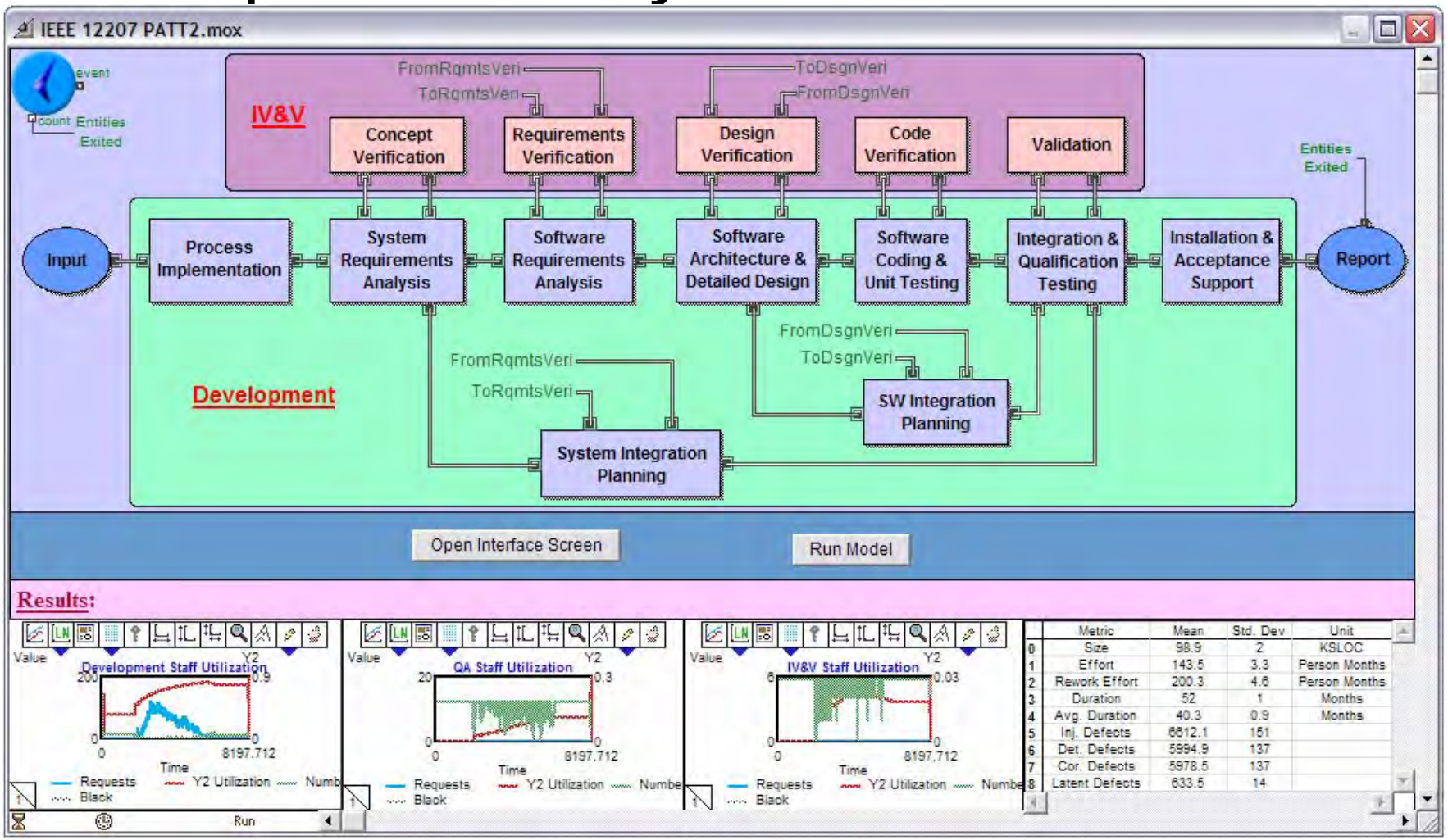
NASA Model – IEEE 12207 Software Development Lifecycle



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IV&V Layer – Select Criticality Levels for IV&V Techniques using pull-down menus

Notebook - IEEE12207_Baseline.mox

IV&V Profile: Silap-Unmanned

Save IV&V Profile

Load IV&V Profile:

Delete IV&V Profile:

		Concept Verification		Requirements Verification		Design Verification		Code Verification		Validation	
ID	IV&V Technique	Consequence	Error Potential	Consequence	Error Potential	Consequence	Error Potential	Consequence	Error Potential	Consequence	Error Potential
1.1	Management and Planning of Independent Verification and Validation	1	1	1	1	1	1	1	1	1	1
1.2	Issue and Risk Tracking	2	2	2	2	2	2	2	2	2	2
1.3	Final Report Generation	2	2	2	2	2	2	2	2	2	2
1.4	IV&V Tool Support	2	2	2	2	2	2	2	2	2	2
1.5	Management and Technical Review Support	1	1	1	1	1	1	1	1	1	1
1.6	Criticality Analysis	1	1	1	1	1	1	1	1	1	1
1.7	Identify Process Improvement Opportunities in the Conduct of IV&V	2	2	2	2	2	2	2	2	2	2
2.1	Reuse Analysis	3	None								
2.2	Software Architecture Assessment	3	None								
2.3	System Requirements Review	3	4								
2.4	Concept Document Evaluation	None	None								
2.5	Software/User Requirements Allocation Analysis	None	None								
2.6	Traceability Analysis	None	None								
3.1	Traceability Analysis – Requirements			2	4						
3.2	Software Requirements Evaluation			3	4						
3.3	Interface Analysis – Requirements			4	3						

IV&V Layer – Select Criticality Levels for IV&V Techniques using pull-down menus

Notebook - IEEE12207_Baseline.mox

2.3	System Requirements Review	None	None								
2.4	Concept Document Evaluation	None	None								
2.5	Software/User Requirements Allocation Analysis	None	None								
2.6	Traceability Analysis	None	None								
3.1	Traceability Analysis - Requirements			None	None						
3.2	Software Requirements Evaluation			None	None						
3.3	Interface Analysis - Requirements			None	None						
3.4	System test Plan Analysis			None	None						
3.5	Acceptance Test Plan Analysis			None	None						
3.6	Timing and Sizing Analysis			None	None						
4.1	Traceability Analysis - Design					None	None				
4.2	Software Design Evaluation					None	None				
4.3	Interface Analysis Design					None	None				
4.4	Software FQT Plan Analysis					None	None				
4.5	Software Integration Test Plan Analysis					None	None				
4.6	Database Analysis					None	None				
4.7	Component Test Plan Analysis					None	None				
5.1	Traceability Analysis - Code							None	None		
5.2	Source Code and Documentation Evaluation							None	None		
5.3	Interface Analysis - Code							None	None		
6.1	Traceability Analysis - Test									None	None
8.15	Project Management Oversight Support	None	None	None	None	None	None	None	None	1	1

Impact of IV&V at Different Points in the Development Process

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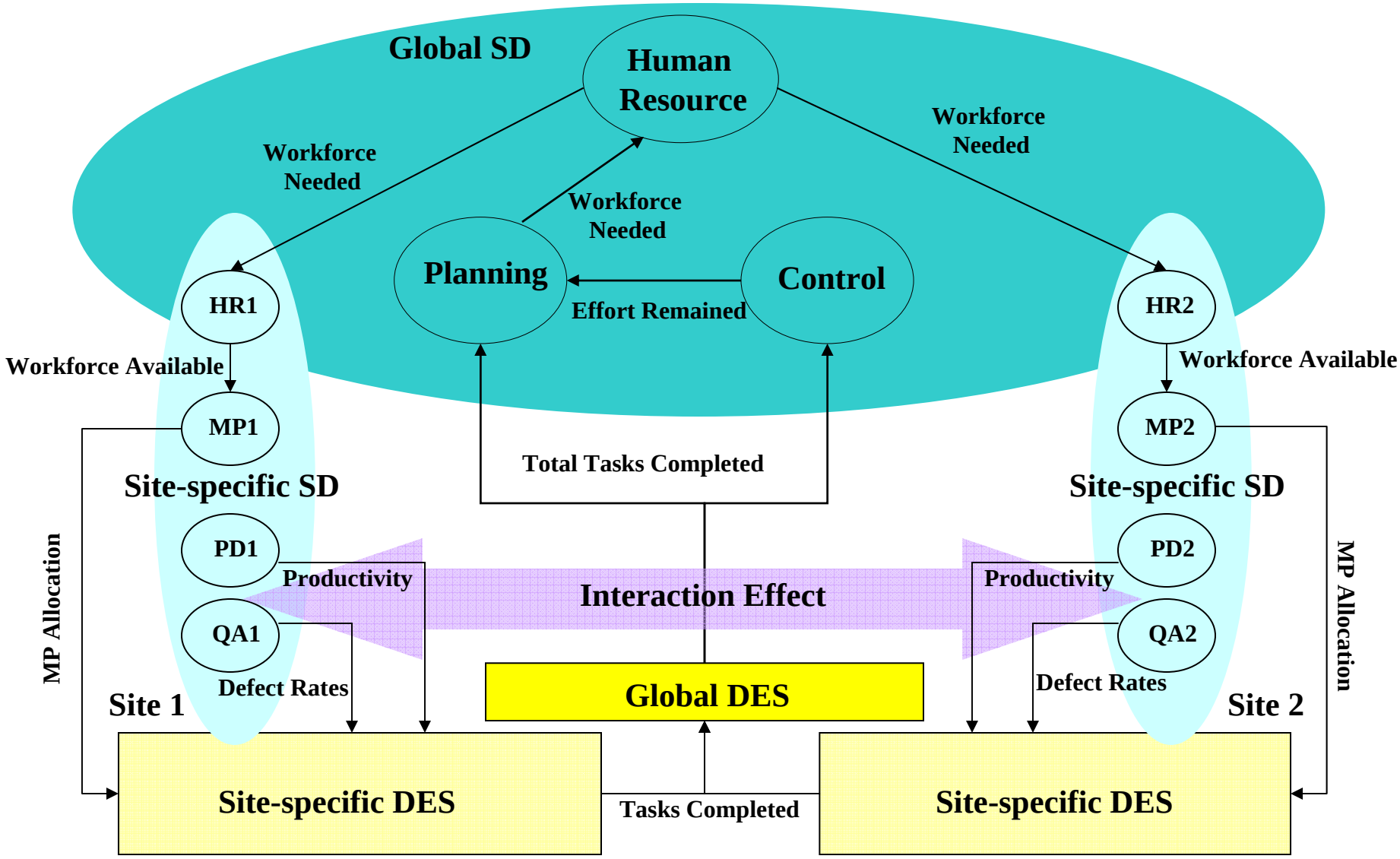
Result Comparison

Case	Configuration	Total Effort Mean (Person Months)	Rework Effort Mean (Person Months)	Duration Mean (Months)	Corrected Defects Mean (Number of Defects)	Latent Defects Mean (Number of Defects)
1	Baseline	346.26	201.65	58.42	6,038.26	629.48
2	IV&V at Validation	355.35	210.75	59.95	6,113.79	574.17
3	IV&V at Code	334.13	189.53	57.38	6,134.84	573.49
4	IV&V at Design	327.93	183.33	56.56	6,123.11	581.27
5	IV&V at Requirements	326.82	182.21	56.40	6,078.87	600.04

% Improvement Compared to the Baseline

Case	Configuration	Total Effort Mean	Rework Effort Mean	Duration Mean	Corrected Defects Mean	Latent Defects Mean
1	Baseline					
2	IV&V at Validation	-2.63%*	-4.51%*	-2.63%*	+1.25%	+8.79%*
3	IV&V at Code	+3.50%*	+6.01%*	+1.77%	+1.60%	+8.90%*
4	IV&V at Design	+5.29%*	+9.09%*	+3.17%*	+1.41%	+7.66%*
5	IV&V at Requirements	+5.62%*	+9.64%*	+3.46%*	+0.67%	+4.68%*

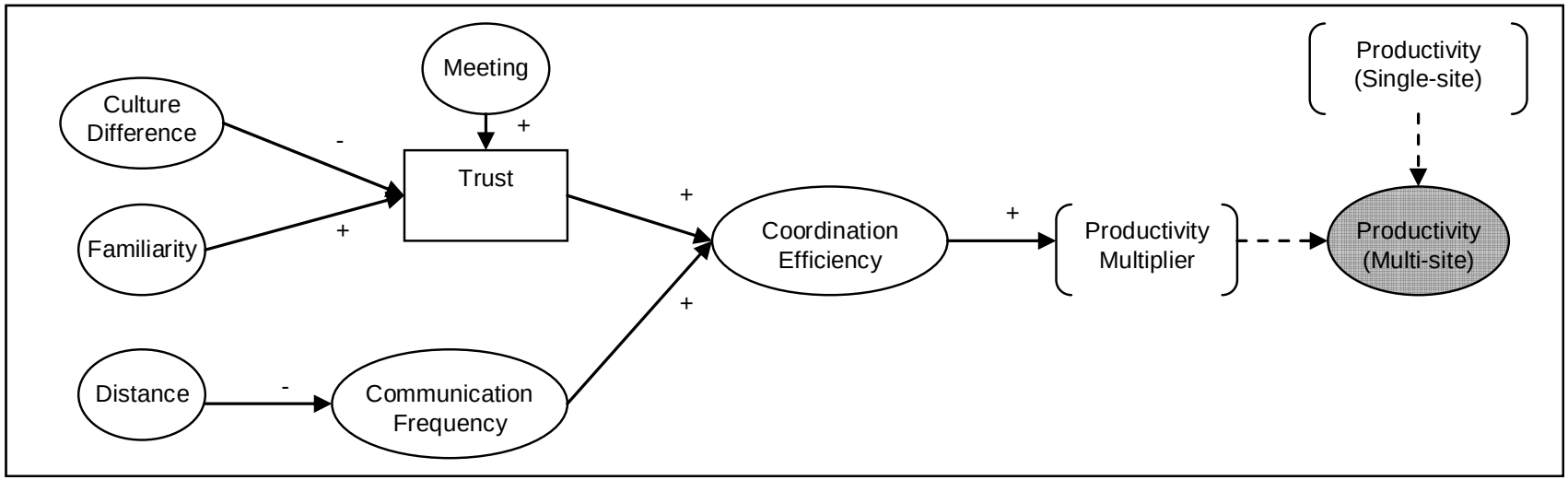
GSD Model Structure



HR = Human Resource MP = Manpower Allocation PD = Productivity QA = Quality Assurance

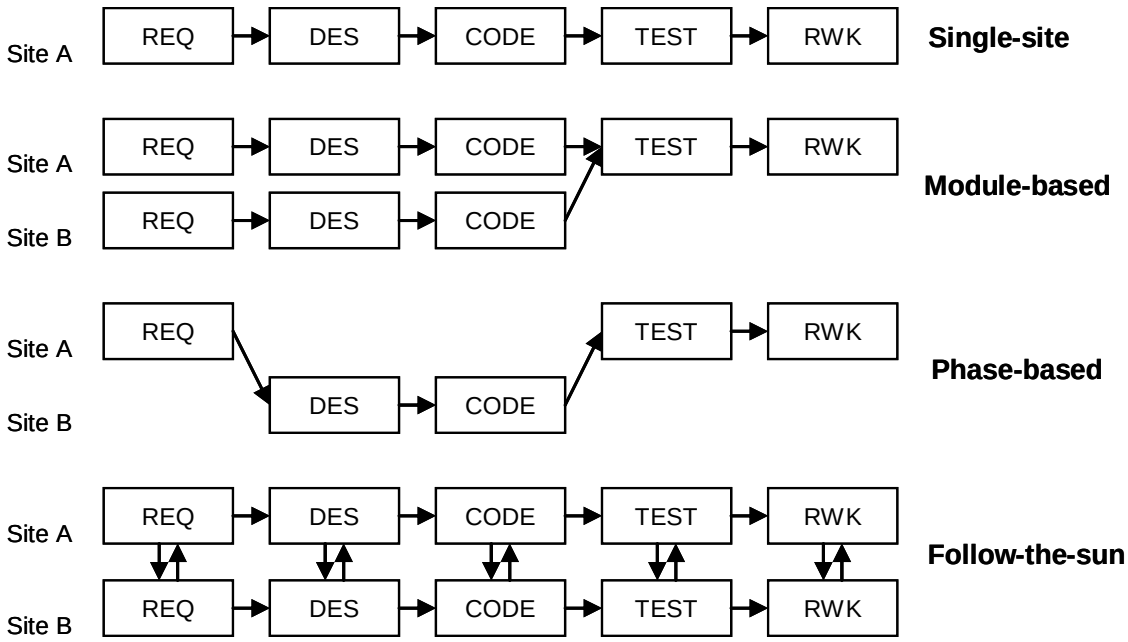
Interaction Effects (IE)

- Capture the impact of GSD factors on productivity and defect generation rate.
- Interaction effect on productivity rate

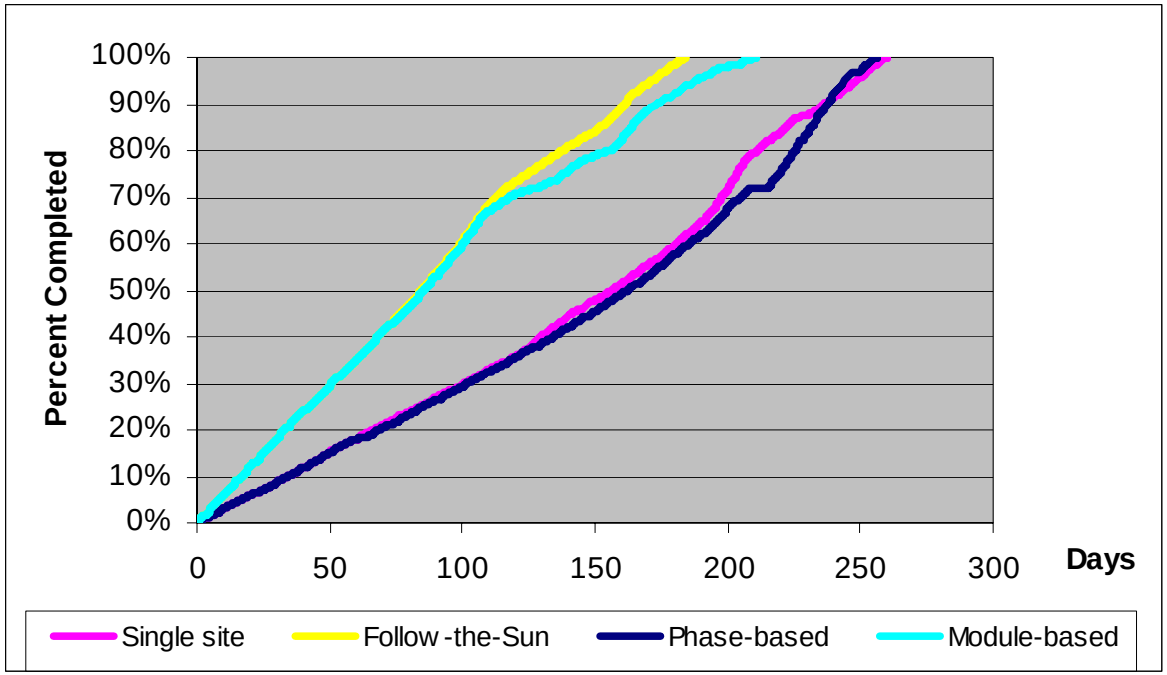


Evaluate Process Tradeoffs

- Task Allocation Strategy Alternatives

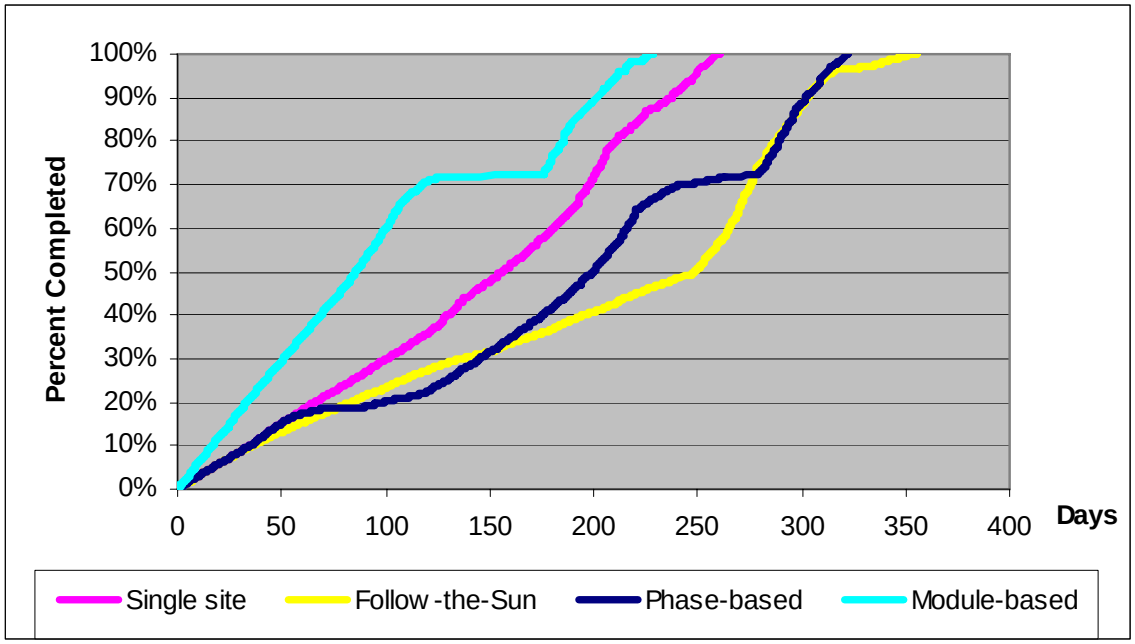


Ideal Situation



- Duration when using follow-the-sun is 70% of the time it takes using single-site
- Module-based took a little longer than follow-the-sun

Real World Situation



- Follow-the-sun took about 37% longer than single-site
- Module-based is the shortest

Key Questions GSD Models Can Address

- Impact of moving to multi-site development
- Impact of adding a new development site
- Task allocation strategy
- Multi-site QA strategy
- Impact of different development sites using different processes, people and technology
- Deals with issues due to cultural, language, time zone, productivity and cost differences
- Examines impact of personnel turnover and skills development

Applications for System Acquisition

- Can assess impact of using prime with collection of subcontractors at different sites (i.e. software acquisition model)
- Impact of short funding government projects

Applying Process Simulation = High Value Add

- Evaluate Strategic Issues
  - Quality Assurance/ V&V Strategy for a project
  - IV&V Strategy
  - Globally Distributed Software Development
- ***Assess the Costs and Benefits of Applying New Tools and Technologies***

Cost/Benefit of New Technologies

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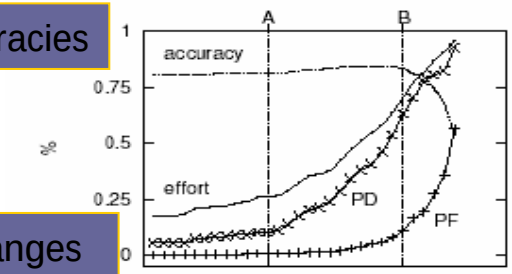
New LDD Technology

level0 *NASA*
- level1
  - CM1: 496 modules in 'C'
  - JM1: 10,885 modules in 'C'
  - PC1: 1,107 modules in 'C'
  - level2
    - level3
      - KC1: 2,107 functions in 'C++'
      - level4
        - KC2: 523 functions in 'C++'

7 level 4 sub-systems

a b c d e f g

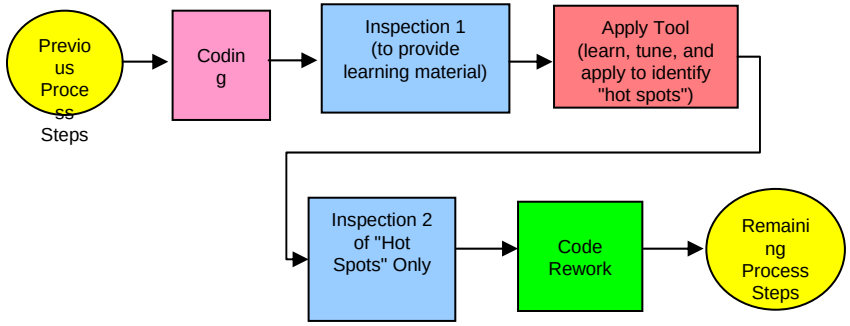
Stable accuracies



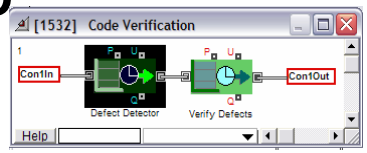
30 detectors, sorted by effort

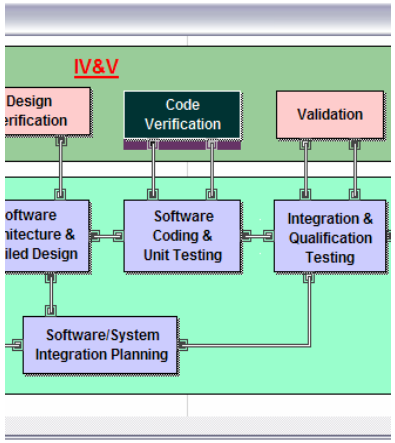
Massive changes in other measures

Changes to Process



Changes to Model Reflecting Modified Process





Results Showing Impact on NASA Projects

Total Size (KLOC)	Total Effort + IV&V (PM)	Total Effort (PM)	Total Rework Effort (PM)	Total Duration (Month)	Average Duration
50% V&V					
99.79	815.75	815.75	198.30	33.80	29.48
4.00	27.97	27.97	8.58	1.48	1.26
reinspect 50% detcap IV&V = 0.05 & inspect 10% with detcap = 0.50					
99.79	813.16	807.16	190.02	34.24	29.32
4.00	27.89	27.89	8.35	1.46	1.26
	2.59	**8.59**	**8.28**	**-0.44**	**0.16**
reinspect 50% detcap IV&V = 0.05 & inspect 10% with detcap = 0.70					
99.79	810.79	804.79	187.74	34.20	29.27
4.00	27.81	27.81	8.13	1.46	1.25
	4.96	**10.96**	**10.56**	**-0.39**	**0.20**
reinspect 50% detcap IV&V = 0.02 & inspect 10% with detcap = 0.50					
99.79	814.93	808.93	191.73	34.28	29.35
4.00	27.87	27.87	8.30	1.46	1.26
	0.82	**6.82**	**6.57**	**-0.47**	**0.12**

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General Business Case Questions

- What is the impact of applying new tools and technologies?
- What is the economic benefit or value of the tool or technology? What is the ***Return on Investment***?
- When is it ***useful*** and when might it be ***useless?***
- Under what conditions does the tool or technology perform best?
- What performance standards does the tool need to achieve in order to have a positive return?
- Are there better ways to apply the tool?

Applying Process Simulation = High Value Add

- Evaluate Strategic Issues
  - Quality Assurance/ V&V Strategy for a project
  - IV&V Strategy
- Assess the Costs and Benefits of Applying New Tools and Technologies
- ***Plan Processes and Make Better Tradeoff Decisions***
- ***Evaluate Process Improvement Opportunities***

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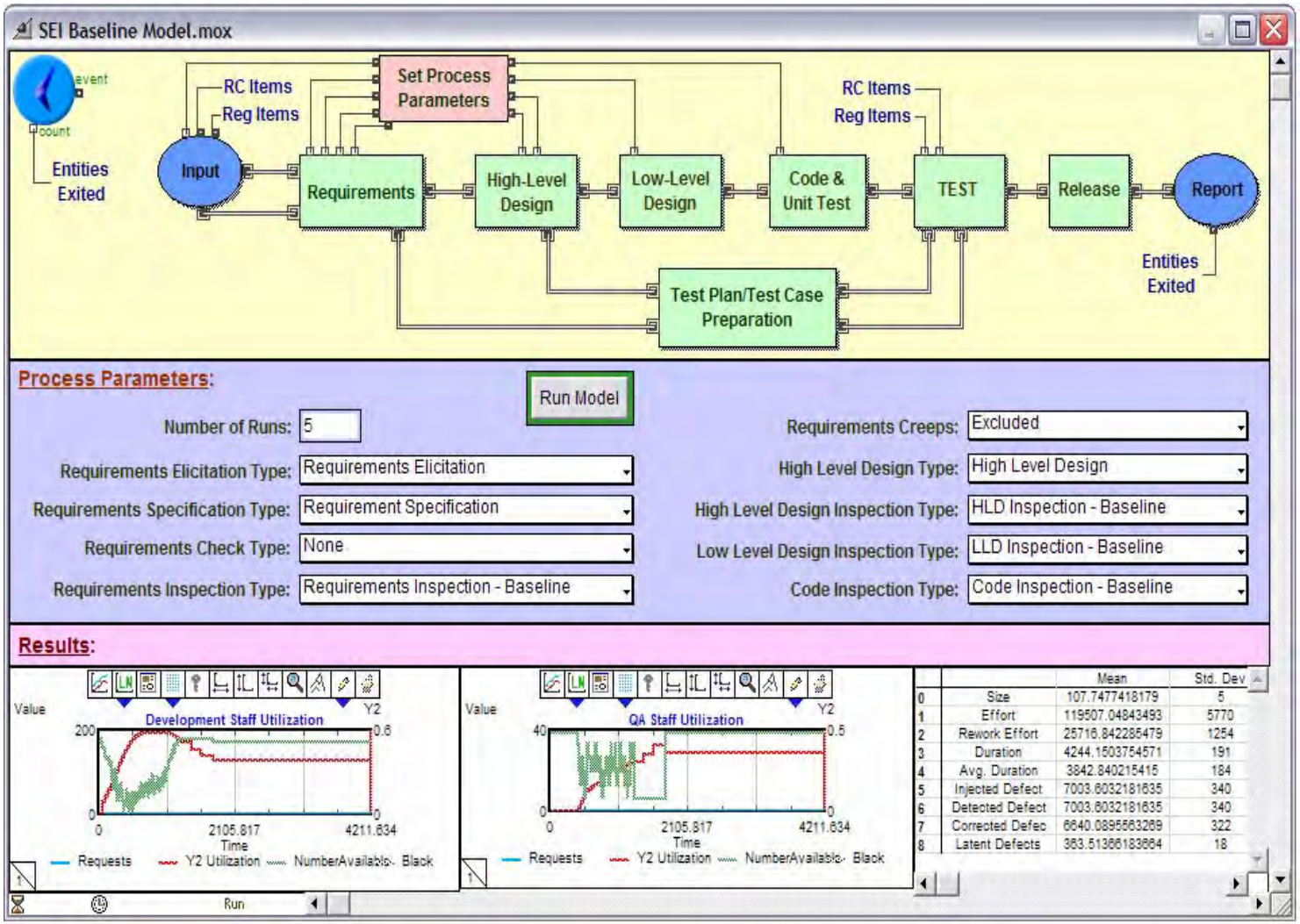
Incremental Development Model



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Benefits of Process Simulation

	Option	Project									NPV	ROI
		Total Effort (PM) Dev Eff + Dev Rwk	Rework Effort Devel Defects (PM)	Project Duration *(Calendar Months)*	Projected Cost or Revenue delta due to Duration Change	Total Injected Defects	Corrected Defects	Escapted Defects	Rework Effort for Field Defects *(PM)*	Impleme ntation Costs *($)*		
0	Base Case	200	90	18	$0.00	1150	990	160	40	$0.00	n.a.	n.a.
1	Implement QFD	190	75	17.5	$0.00	1150	1020	130	30	$100,000	$165,145	15%
2	Implement VOC	185	75	17	$ 100,000	1150	1050	100	20	$120,000	$185,231	29%
3	Add QuARS Tool	175	65	16	$ 300,000	1150	1090	60	10	$ 80,000	$289,674	88%
4	Eliminate	230	130	22	$(400,000)	1150	900	250	80	$0.00	-$378,043	-129%
5	Additional Process											

Applying Process Simulation = High Value Add

- Evaluate Strategic Issues
  - Quality Assurance/ V&V Strategy for a project
  - IV&V Strategy
  - Globally Distributed Software Development
- Assess the Costs and Benefits of Applying New Tools and Technologies
- Plan Processes and Make Better Tradeoff Decisions
- Evaluate Process Improvement Opportunities
- ***Architect, Design, and Documenting Processes***

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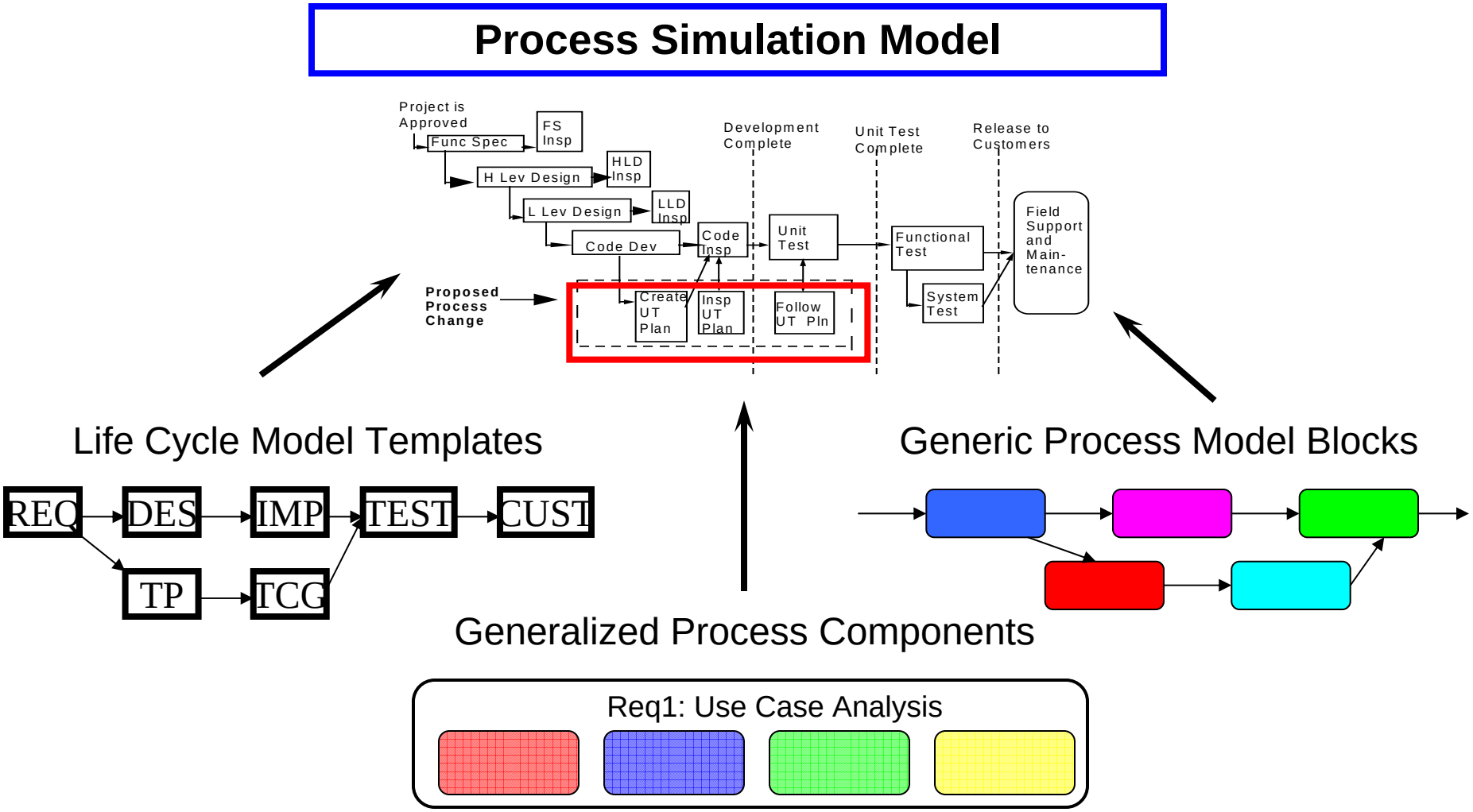
Architect, Design and Document Processes



Applying Process Simulation = High Value Add

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- Plan Processes and Make Better Tradeoff Decisions
- Evaluate Process Improvement Opportunities
- Architect, Design, and Documenting Processes
- ***Estimate Project Cost from the Bottom-Up***

Using Process Simulation to perform early stage project cost estimation

- Study Conducted by Mizell, in the Engineering Assessment Directorate at KSC
- Applied Process Simulation to provide bottom-up cost and schedule estimates at multiple stages of the project (i.e. from Concept of Operations forward)
- Utilized real project data from KSC and SEL
- Developed estimates that incorporated effects for
  - Incremental Spiral processes
  - Impact of short funding projects

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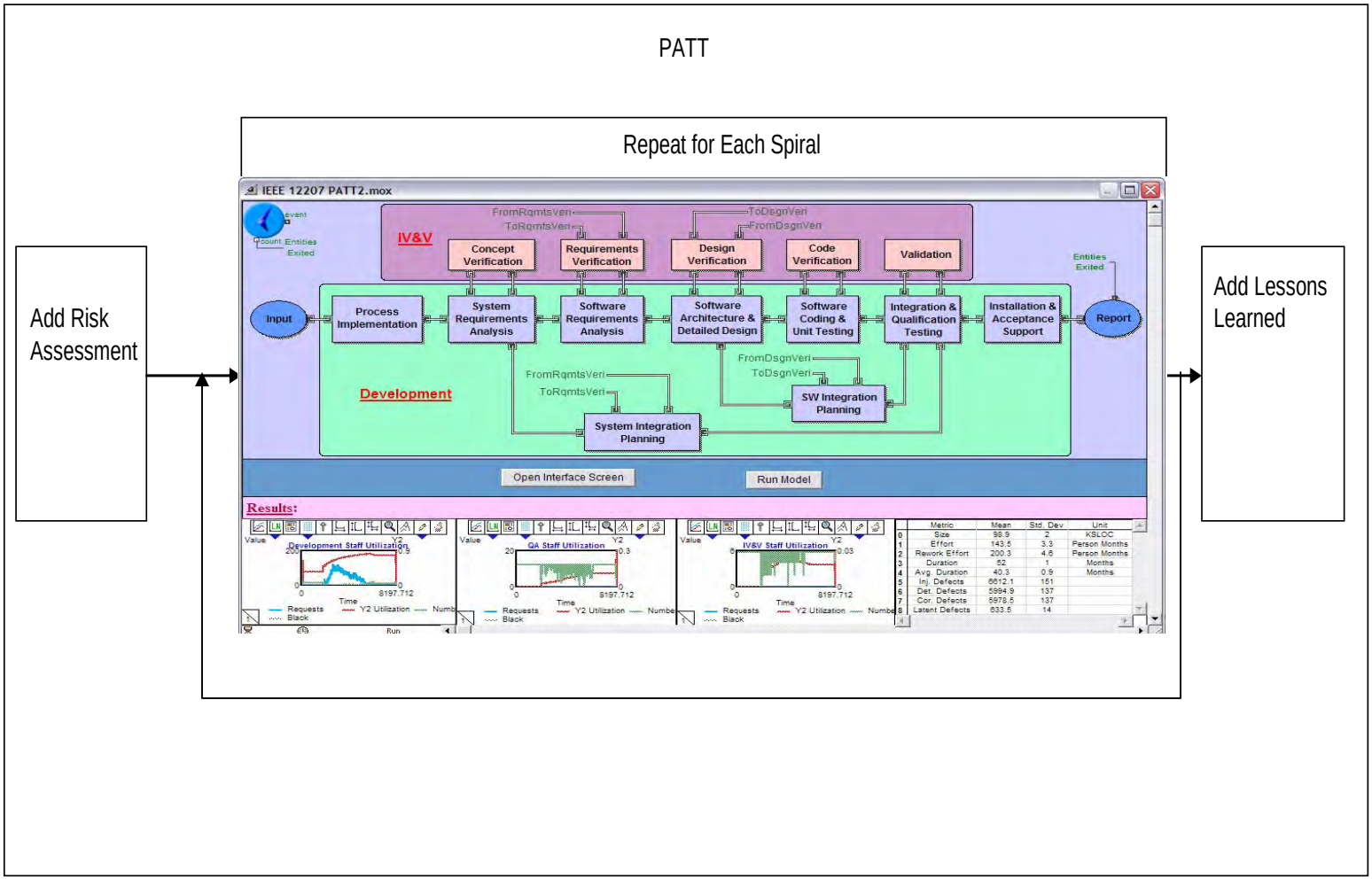
NASA Model – Incremental Spiral Lifecycle



Adapted from Mizell, 2006

Accomplishments of Mizell's Research

- Methodology to use simulation to provide interval estimates
- Developed probability distributions for size, productivity, and defects using organization specific data
- Provided confidence intervals for project estimates
- Combined system dynamics model with DES process model to analyze effects of turnover on project effort and duration
- Adapted incremental spiral process model
- Complete NASA project case study

© Mizell, 2006

Process Models Used

- IEEE 12207 being used by NASA IV&V
- Adapted for incremental development
- Adapted for spiral development
- Incorporated system dynamics portions into model
- Model development supported by Quantel

Applying Process Simulation = High Value Add

- Evaluate Strategic Issues
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  - IV&V Strategy
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- Estimate Project Costs from the Bottom-Up
- ***Manage Processes Quantitatively***

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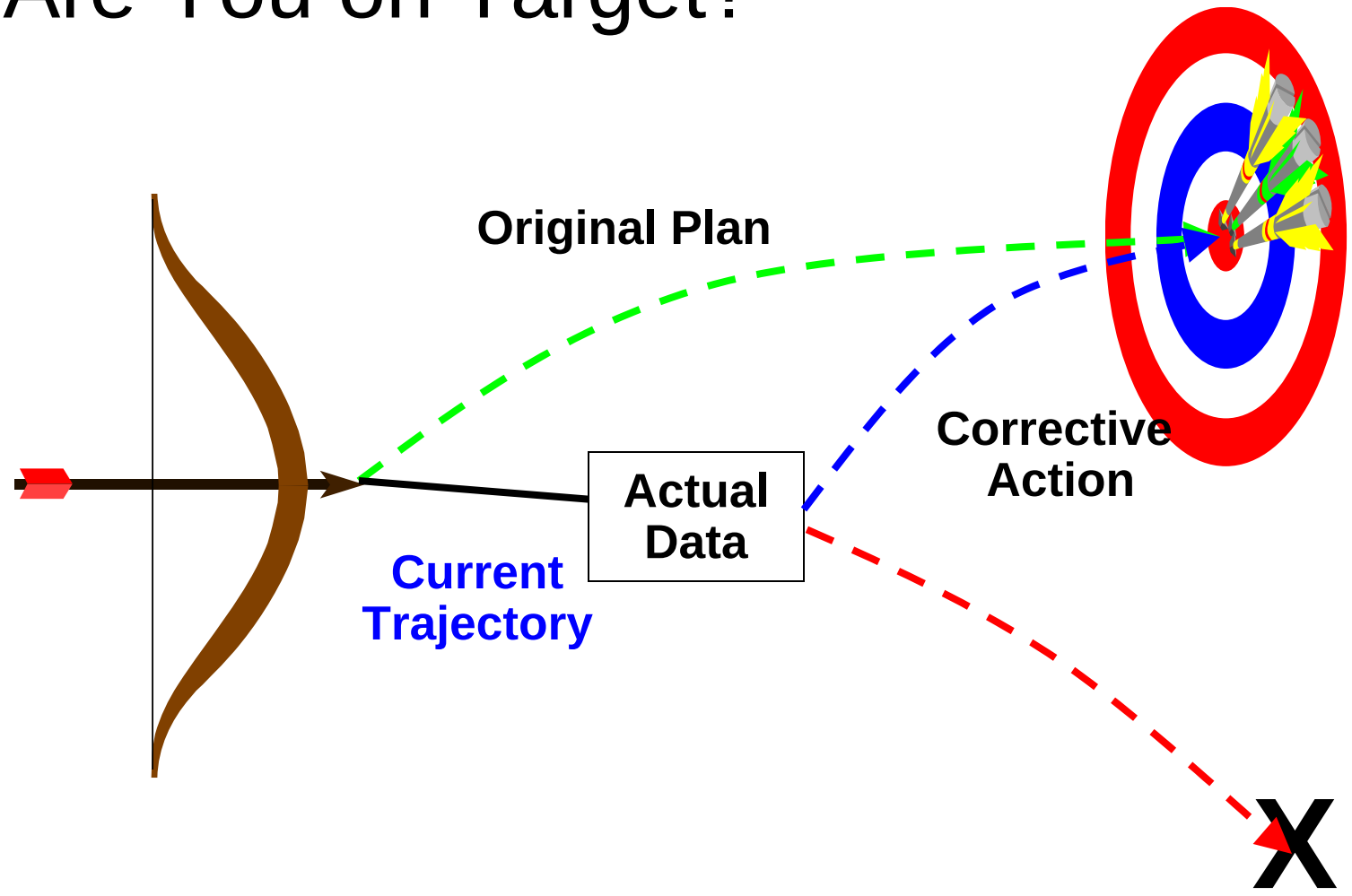
Are You on Target?



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PROMPT: Quantitative Project Management Framework

NASA SW Project and IV&V

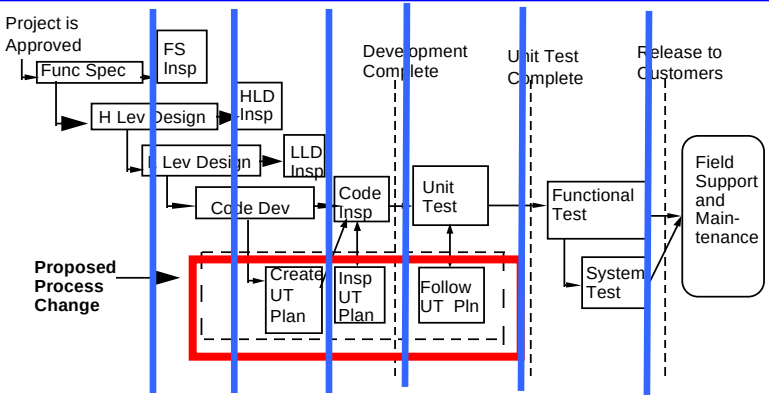
Better IV&V Decisions

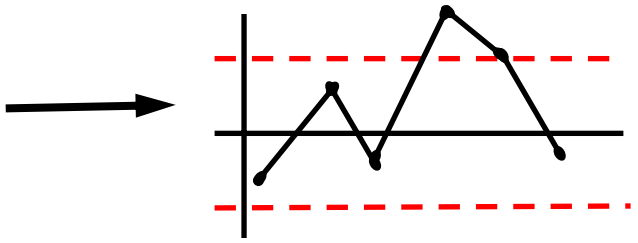
Project and IV&V Data

Track and Replan Improved Outcomes

SW Process Simulation Model

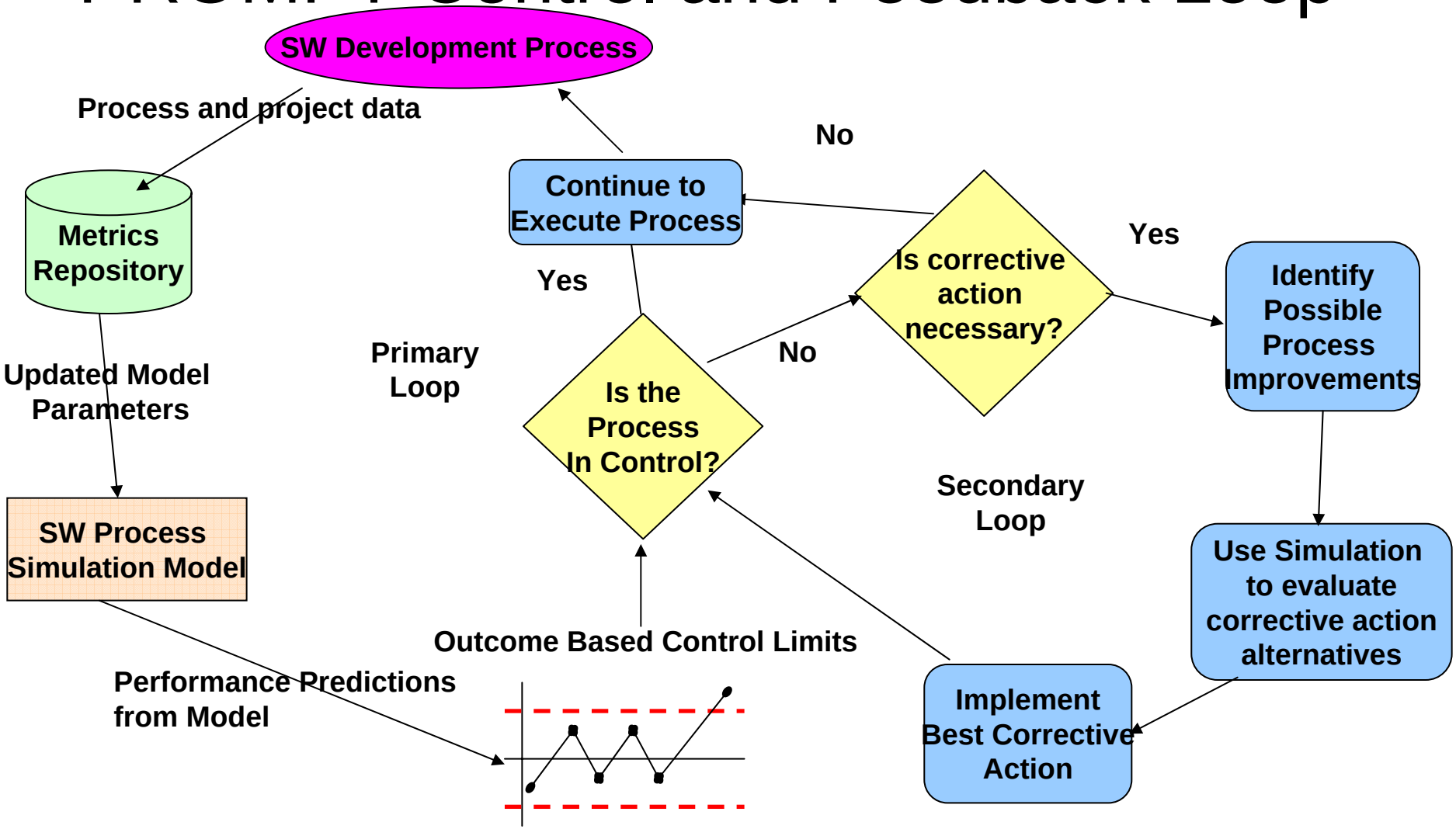
Process Performance Cost, Quality, Schedule





Outcome Based Control Limits

PROMPT Control and Feedback Loop



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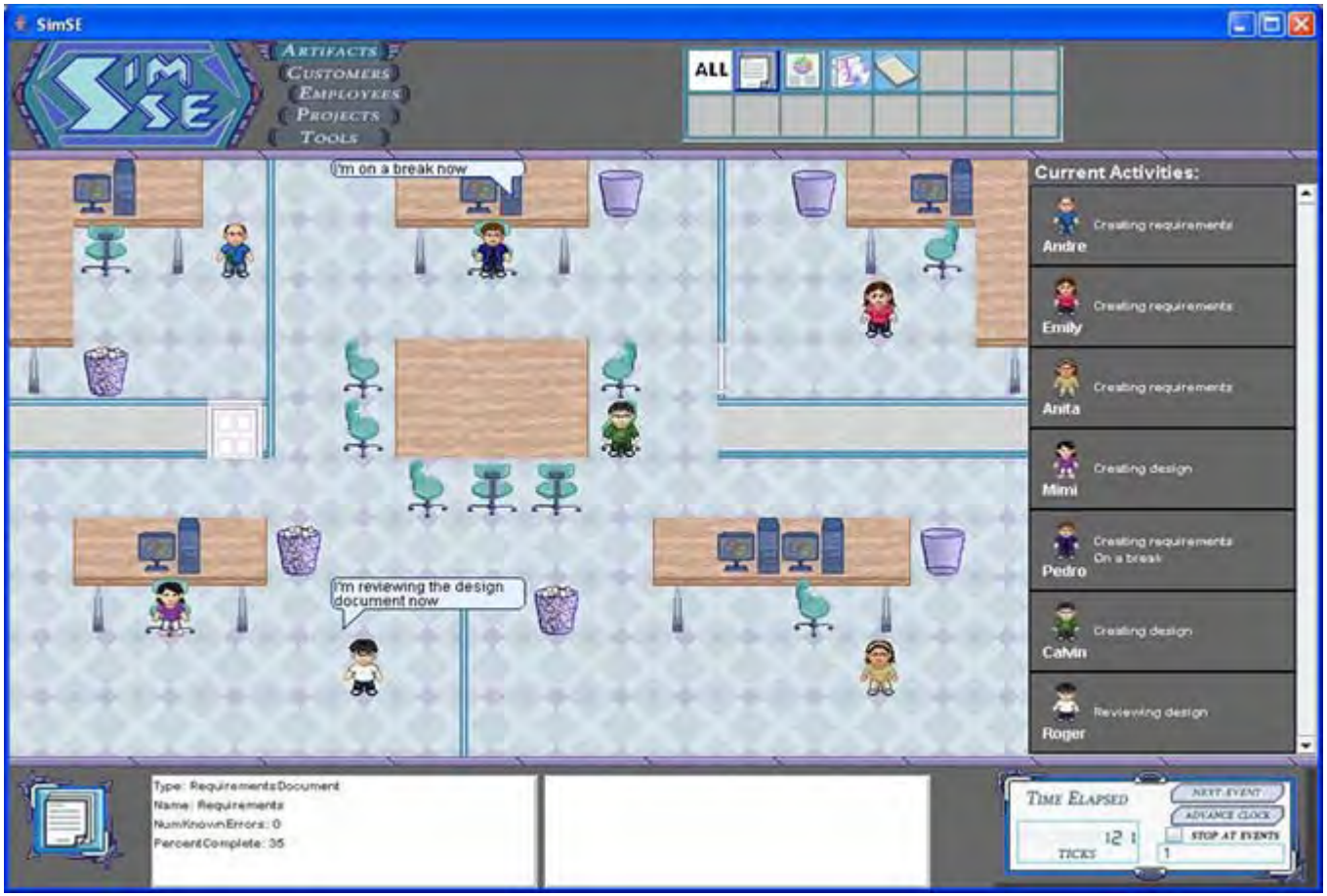
- Estimate Project Costs from the Bottom-Up
- Manage Processes Quantitatively
- ***Train Project Managers***

Teaching Software Project Management through Modeling (Navarro, et. al., 2006)



Benefits of Process Simulation

- Decision Support and Tradeoff Analysis
- Sensitivity Analysis – “What if”
- Supports Industry Certification and process improvement programs including CMMI, Six Sigma, and others
- Benchmarking
- Design and Define Processes/Metrics
- Bring Lessons Learned Repositories Alive
- Can save cost, effort, and expertise
- Many ways to achieve High Value-Add by using process simulation

Bottom-Line

- Process Simulation can make an impact on your business.
  - Improving QA strategies (defect containment, COQ, COPQ)
  - Achieving higher CMMI Levels (Fulfilling CMMI L4)
  - Implementing 6 Sigma practices
  - Adopting new technologies
  - Plan/replan projects
  - Bottom-up cost estimation
- Enables an organization to adapt to change and improve processes more quickly – beating the competition, win contracts
- Enables an organization to design processes better, train employees, implement more quickly = better performance, higher quality, faster

The End

Questions?

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Applying Process Simulation to Achieve High-Value Benefits

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Quantel, Inc.
Software Engineering Institute
Portland State University

Agenda: Part II

- Overview of Simulation Types
- Process Tradeoff Analysis Method
  - Data
  - Model Templates
  - Model Database
  - Analysis of Results
- Incremental Model tour
- Conclusions

Alternative Process Simulation Approaches

- Modeling Paradigms
  - Knowledge-Based Systems
  - Agent Based
  - State-Based
  - Discrete Event
  - System Dynamics
  - Hybrid
- Research Outlets
  - Software Process: Improvement and Practice
  - Journal of Systems and Software

- Tools
  - Arena
  - ProModel
  - Extend
  - Stella
  - VenSim
  - Research tools
- Conferences
  - Winter Simulation Conference
  - SPW/ ProSim
  - SEPG
  - SSTC

Alternative Process Simulation Approaches

- Knowledge Based Systems
  - Person-in-the loop
  - Fine level of granularity
  - Supports process enactment
- Agent Based Systems
  - Fine level of granularity
  - Supports detailed work interactions
- State Based Systems
  - Captures flow of control (work activities, parallelism) well
  - Multi-view graphical representations
  - Difficult to capture task, work package and resource details

Alternative Process Simulation Approaches

- Discrete Event Simulation
  - Able to represent richness of processes, work packages and resources
  - Good for modeling quantitative process performance
  - Good tool support
- System Dynamics
  - Captures feedback well
  - Often used for high level qualitative issues
- Hybrid
  - Captures best aspects of Discrete Event and System Dynamics
  - Models are complex
  - Being used to predict performance of multi-site development

Common Applications of Each Approach

	STRAT	PLAN	MGMT	IMPR	UNDR	TRAIN
KBS					X	X
Agent Based					X	X
State-Based		X		X	X	X
Discrete Event	**X**	**X**	**X**	**X**	**X**	**X**
System Dynamic	X	x		x	X	X
Hybrid	X	X	X	X	X	X

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Intelligence

Development Projects

Better Process Decisions

Project and Process Data

CSCI Data (Follows)

No. of CSCIs 8

CSCI names: C&DH Guidance & N EPS Ground DIVINER LAMP LOLA LROC

Estimated SLOC

C&DH

CSCname	Reuse	Re-eng	New	Lang	Totals	Ptotals	IVVTotals	EP	CP
C&DH	25000		75000		100000	120000	150000		
Total	25000	0	75000		100000	120000	150000	3	1

Guidance & Nav

CSCname									
Guidance & Nav	25000		12000		37000	37000	39000		
Total	25000	0	12000		37000	37000	39000	2	3

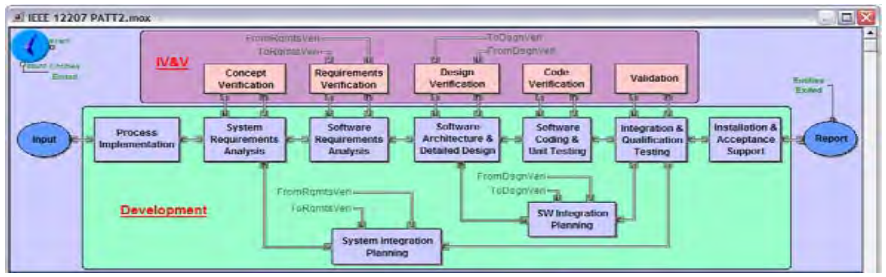
Financial Benefits NPV, ROI

- Organizational
- Site and Project
- Industry Standard

PATT Project Database

Project Performance

SW Process Simulation Model



Development Project Statistics

Project Id: 1

Run Set	Size Mean / Std. Dev	Effort Mean / Std. Dev	Rework Effort Mean / Std. Dev	Duration Mean / Std. Dev	Avg. Duration Mean / Std. Dev	Corrected Defects Mean / Std. Dev	Latent Defects Mean / Std. Dev
1	58.00 1.63	54,321.35 1,484.76	10,568.58 217.46	3,572.02 63.39	2,381.00 55.76	2,756.13 77.96	143.66 3.72
2	58.00 1.63	53,666.85 1,511.91	9,573.17 298.02	3,457.40 63.54	2,266.06 66.44	2,759.38 76.79	140.40 4.82
3	58.00 1.63	54,321.35 1,484.76	10,568.58 217.46	3,572.02 63.39	2,381.00 55.76	2,756.13 77.96	143.66 3.72
4	58.00 1.63	53,900.94 1,445.09	9,943.53 202.73	3,500.52 52.74	2,310.60 53.75	2,758.30 77.41	141.49 4.30

Where does the data come from? (1 of 2)

- Input data are used to predict the performance measures.
- Can be derived from the organization
  - Current baseline
  - Exemplary projects
  - Pilot data
- Can also be derived from
  - Expert opinion
  - Industry data from comparable organizations
- Best judgments to describe the state of your organization

Input Data (2 of 2)

- Examples:
  - process documents and assessments
  - amount of incoming work
  - effort based on size (and/ or other factors)
  - defect detection efficiency
  - effort for rework based on size and number of defects
  - defect injection, detection and removal rates
  - decision point outcomes; number of rework cycles
  - hiring rate; staff turnover rate
  - personnel capability and motivation, over time
  - resource constraints
  - frequency of product version releases

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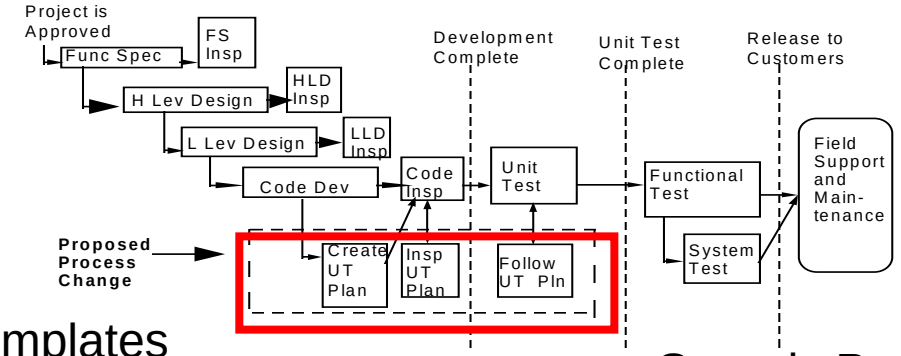
Quantitative Intelligence

Creating Process Simulation Models

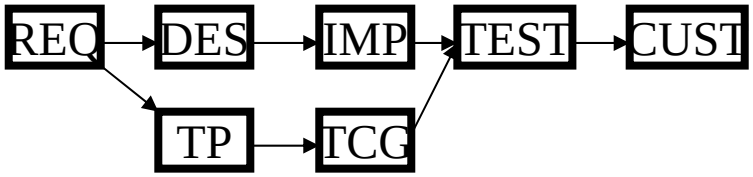
Management Dashboard

Process Simulation Model

PATT Project Database

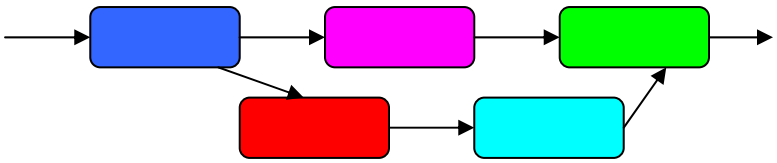


Life Cycle Model Templates



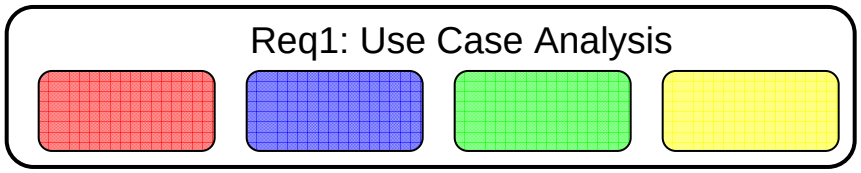
- IEEE 12207
- Spiral
- Incremental
- Product Line
- Rapid Prototyping

Generic Process Model Blocks



- Development
- Inspection
- Testing
- Rework
- IV&V
- Joint Reviews

Generalized Process Components



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Customizing PATT

Multiple block types implement SW development techniques

- Development blocks develop product and inject defects

- Inspection blocks detect defects

- Testing blocks detect defects

- Rework blocks correct and inject defects

- Joint Review blocks detect and correct defects.

- IV&V blocks detect defects.

Project Data Base

- Inputs
  - Size, productivity, error potential, consequence, defect injection, detection, and correction rates, cost, duration, etc.
- Outputs
  - Customizable reporting
  - All levels - Project, phase, activity levels
  - Costs reported using COQ format
  - Defect containment statistics
  - Special reports for IV&V

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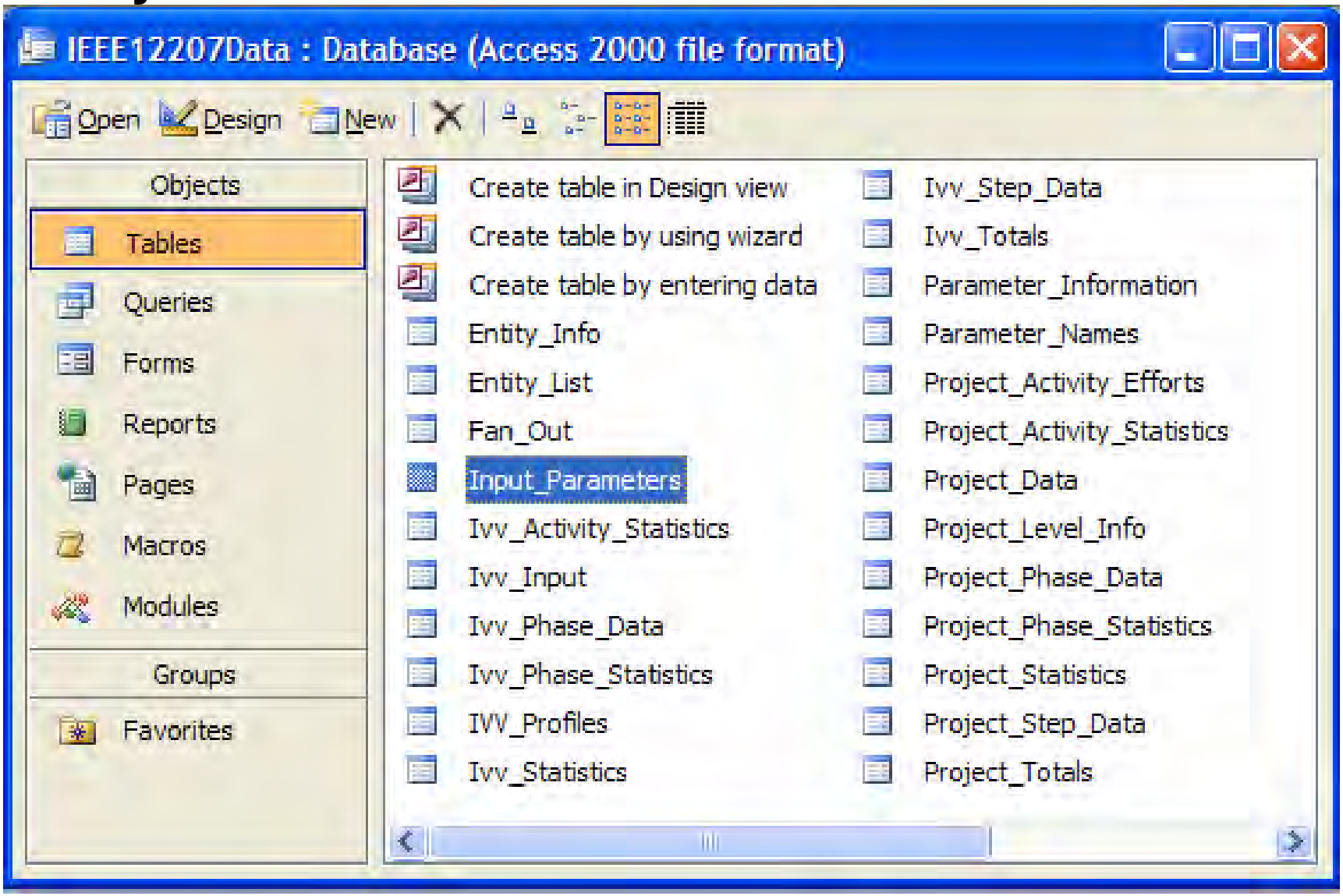
Quantitative Intelligence

Project Database



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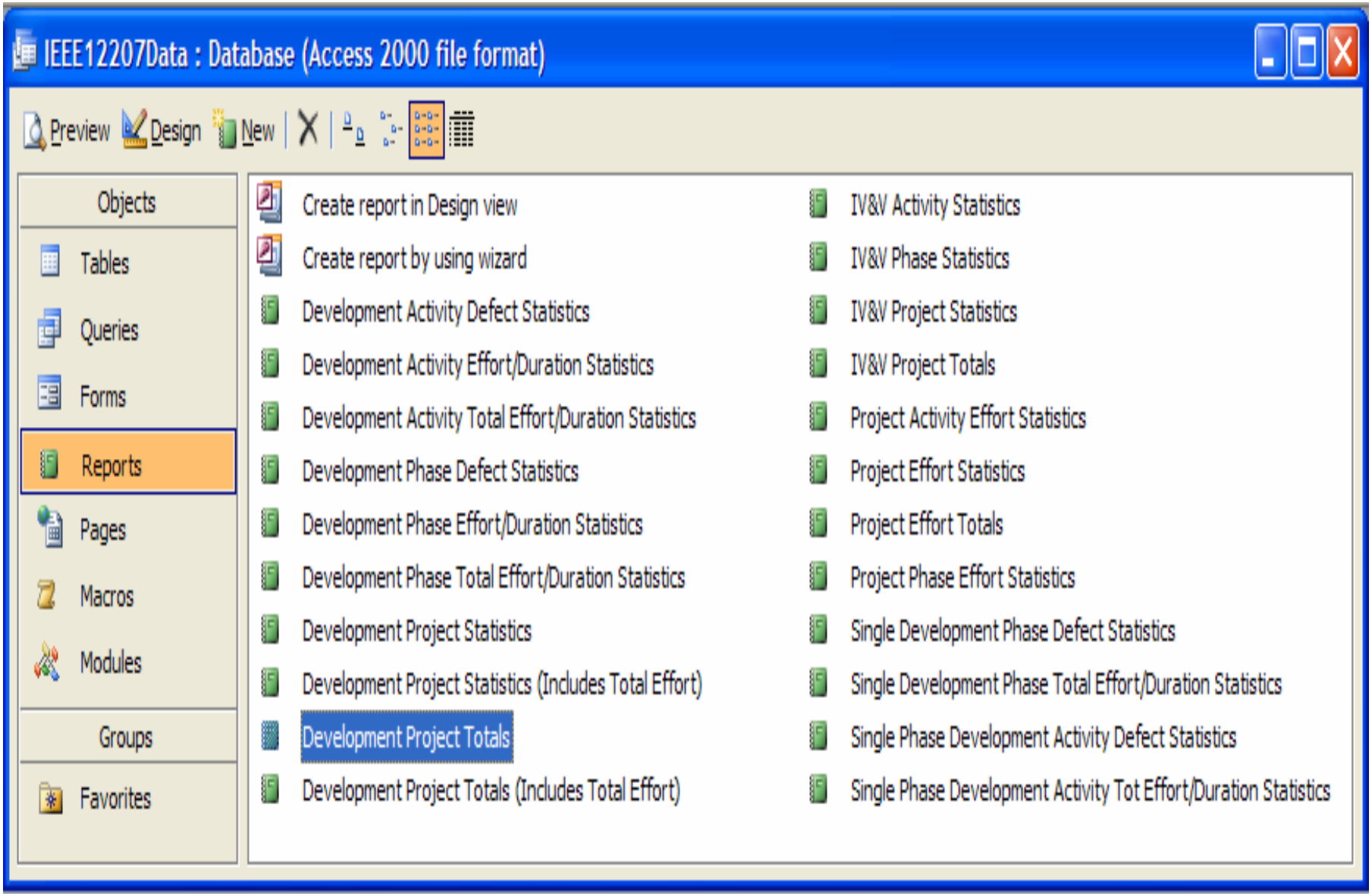
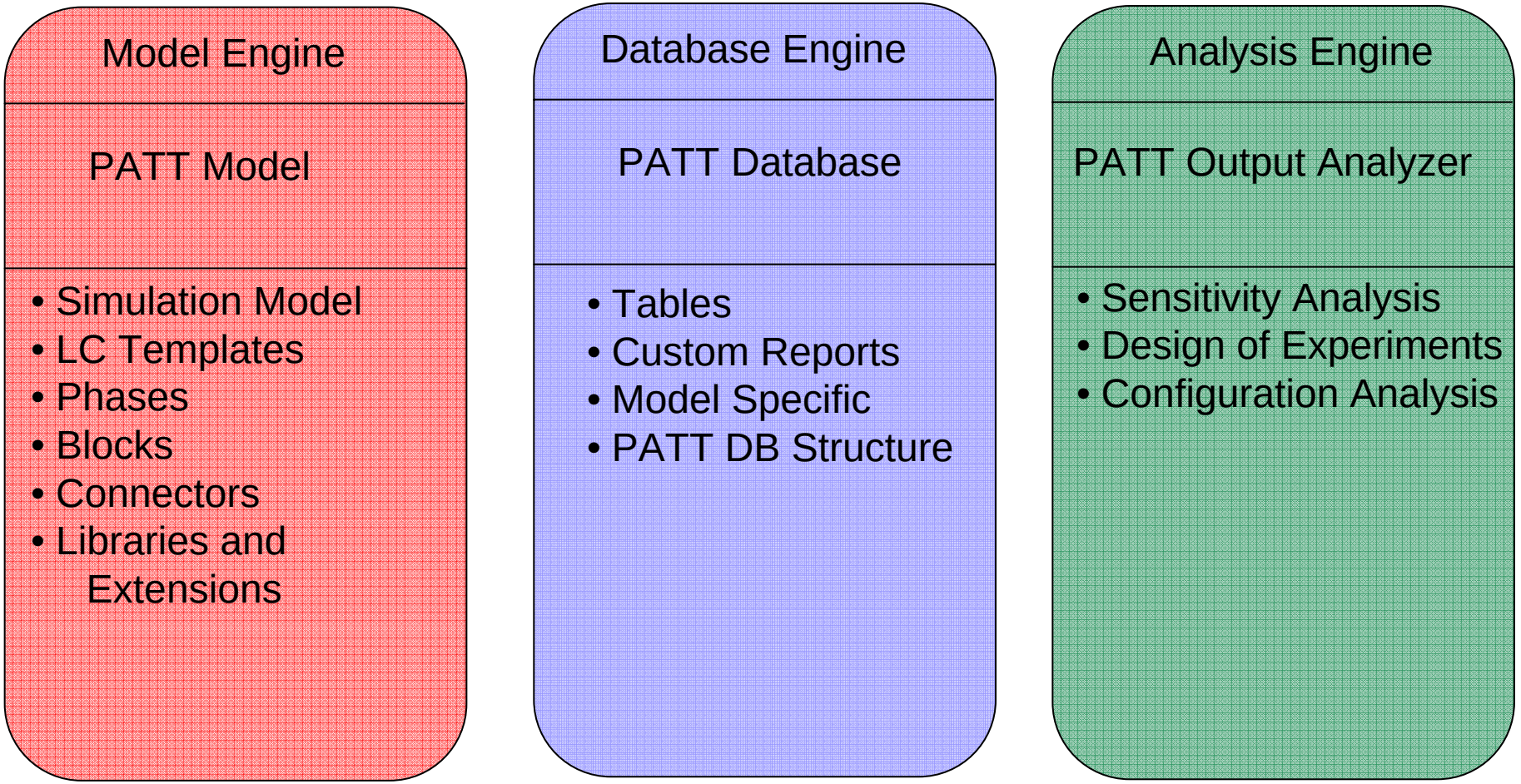


Development Project Total Effort/Duration Statistics

Project Name: IEEE1 2207 SW Development Process Model

Run Set	Size Mean Std. Dev	Total Effort Mean Std. Dev	Rework Effort Mean Std. Dev	Duration Mean Std. Dev	Avg. Duration Mean Std. Dev	Corrected Defects Mean Std. Dev	Latent Defects Mean Std. Dev
1	98.59 0.00	57,876.16 0.00	30,541.63 0.00	5,364.34 0.00	2,631.64 0.00	5,878.40 0.00	518.02 0.00
2	98.59 0.00	58,052.90 0.00	30,541.63 0.00	5,351.82 0.00	2,575.64 0.00	5,878.40 0.00	518.02 0.00
3	98.59 0.00	60,804.74 0.00	33,233.51 0.00	5,545.17 0.00	2,557.96 0.00	5,804.28 0.00	586.63 0.00
4	100.48 0.00	61,794.80 0.00	33,756.25 0.00	5,256.44 0.00	2,335.78 0.00	5,901.19 0.00	596.30 0.00
5	98.59 0.00	58,632.66 0.00	30,541.63 0.00	5,452.80 0.00	2,645.37 0.00	5,878.40 0.00	518.02 0.00
6	98.59 0.00	58,632.66 0.00	30,541.63 0.00	5,452.80 0.00	2,645.37 0.00	5,878.40 0.00	518.02 0.00

PATT Architecture



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Benefits of Process Simulation

	Option	Project									NPV	ROI
		Total Effort (PM) Dev Eff + Dev Rwk	Rework Effort Devel Defects (PM)	Project Duration *(Calendar Months)*	Projected Cost or Revenue delta due to Duration Change	Total Injected Defects	Corrected Defects	Escapted Defects	Rework Effort for Field Defects *(PM)*	Impleme ntation Costs *($)*		
0	Base Case	200	90	18	$0.00	1150	990	160	40	$0.00	n.a.	n.a.
1	Implement QFD	190	75	17.5	$0.00	1150	1020	130	30	$100,000	$165,145	15%
2	Implement VOC	185	75	17	$ 100,000	1150	1050	100	20	$120,000	$185,231	29%
3	Add QuARS Tool	175	65	16	$ 300,000	1150	1090	60	10	$ 80,000	$289,674	88%
4	Eliminate	230	130	22	$(400,000)	1150	900	250	80	$0.00	-$378,043	-129%
5	Additional Process											

Computations and Tradeoffs

- Sensitivity Analysis
- Design of Experiments
- Business Case – ROI, NPV
- Methods in use and available

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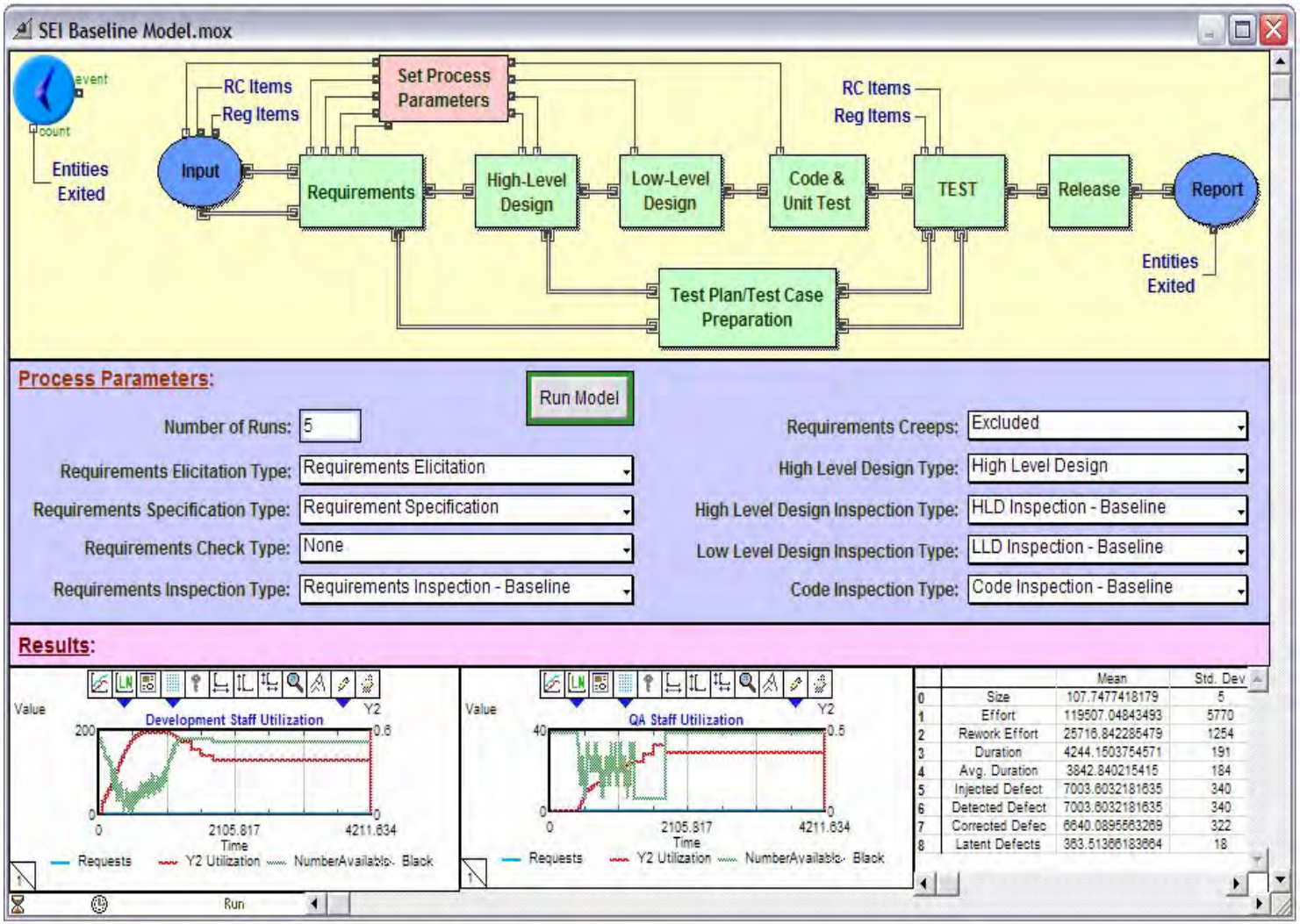
Demonstration of the Incremental Model



Simulation User-Levels

- Level 1: Manager - Runs simulations based on pre-determined options
- Level 2: Analyst - Able to add or change the process to study the impact of process changes
- Level 3: Expert - Able to create new models from scratch
- Level 4: Developer - Able to program new block and/or modify the logic of existing blocks, as allow by the security model
- Level 5: Originator – Establishes security model

Process Tradeoff Analysis Method (PTAM)

- **Based on extensive research** into Software Process Modeling conducted in academia, SEI and industry.
- **Graphical user interface** and models software processes
- **Integrates SEI methods** to define processes and supports CMMI PAs (CMMI L4 QPM)
- **Supports Industry Certification Programs** including CMMI, Six Sigma, and others
- **Benchmarking**
- **Integrates metrics** related to cost, quality, and schedule into understandable project performance picture.
- **Predicts project-level impacts** of process improvements in terms of cost, quality and cycle time

Process Tradeoff Analysis Method (PTAM)

- **Support business case analysis** of process decisions - ROI, NPV and quantitatively assessing risk.
- **Reduces risk** associated with process changes by predicting the probability of improvement
- **Saves time, effort and expertise** over other methods

Applying Process Simulation = High Value Add

- Evaluate Strategic Issues
  - Quality Assurance, V&V and IV&V Strategy for a project
  - Globally Distributed Software Development
- Assess the Costs and Benefits of Applying New Tools and Technologies
- Plan Processes and make better Tradeoff Decisions
- Evaluate Process Improvement Opportunities
- Architect, Design, and Document Processes
- Estimate Project Costs from the Bottom Up
- Manage Projects Quantitatively
- Train Project Managers
- ***Process Simulation can make a positive impact on your business!***

The End

Questions?

A Practical Guide to Implementing Levels 4 and 5

CMMI Technology Conference & User Group
13-17 November 2006

Rick Hefner, Ph.D.
Director, Process Management
Northrop Grumman Corporation

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Agenda

- **An Overview of Levels 4 and 5**
  - New Behaviors
  - Benefits – Project, Organizational, Customer
  - Making the Business Case
- **Understanding the CMMI Process Areas**
  - Organizational Process Performance
  - Quantitative Project Management
  - Causal Analysis & Resolution
  - Organizational Innovation & Deployment
- **Strategies for Adoption**
  - Lessons Learned
  - References

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Management Styles in the CMMI

Project

Organizational

Quantitative management

Proactive management

Reactive mgmt. (plan, track, and correct)

Level	Process Areas
5 Optimizing	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	Quantitative Project Management Organizational Process Performance
3 Defined	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Risk Management Integrated Project Management (for IPPD*) Integrated Teaming* Integrated Supplier Management** Decision Analysis and Resolution Organizational Environment for Integration*
2 Managed	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed	

Quantitative improvement

Qualitative improvement

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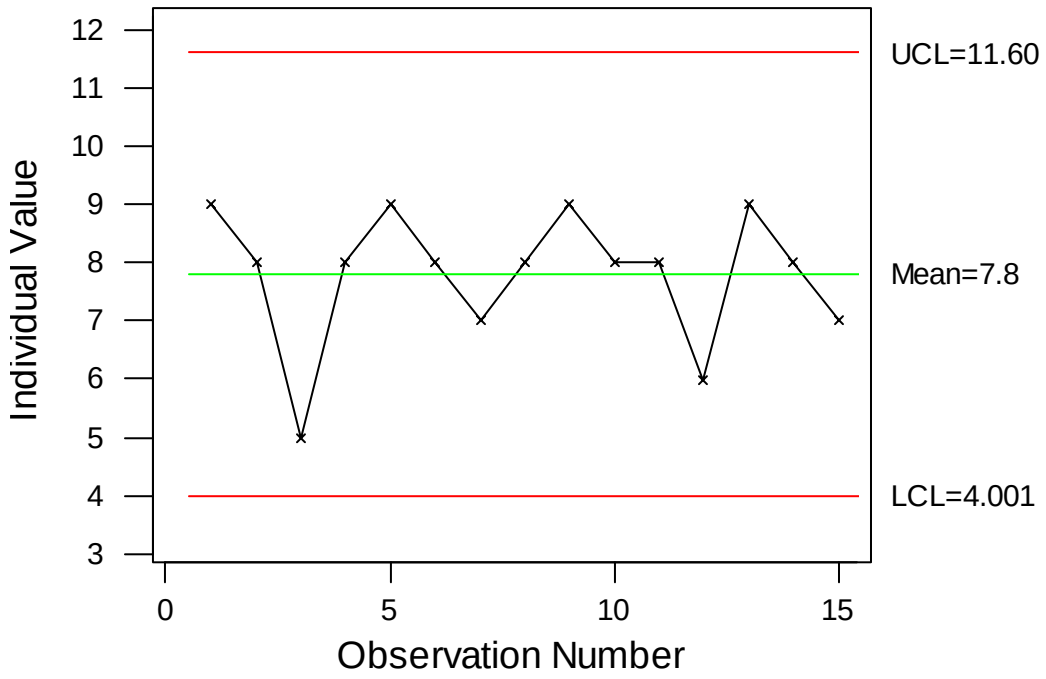
Exercise – What is Quantitative Management?

- **Suppose your project conducted several peer reviews of similar code, and analyzed the results**
  - Mean = 7.8 defects/KSLOC
  - +3σ = 11.60 defects/KSLOC
  - -3σ = 4.001 defects/KSLOC



- **What would you expect the next peer review to produce in terms of defects/ KSLOC?**
- **What would you think if a review resulted in 10 defects/KSLOC?**
- **3 defects/KSLOC?**

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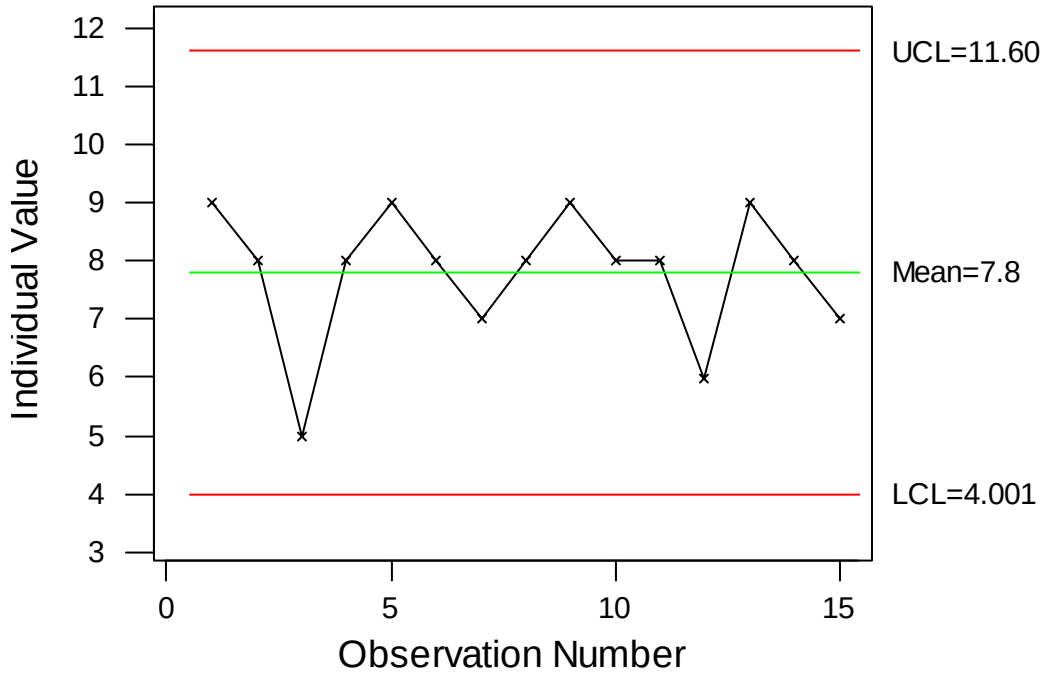
Exercise – What is Required for Quantitative Management?

- **What is needed to develop the statistical characterization of a process?**



- **The process has to be stable (predictable)**
  - Process must be consistently performed
  - Complex processes may need to be stratified (separated into simpler processes)
- **There has to be enough data points to statistically characterize the process**
  - Processes must occur frequently within a similar context (project or organization)

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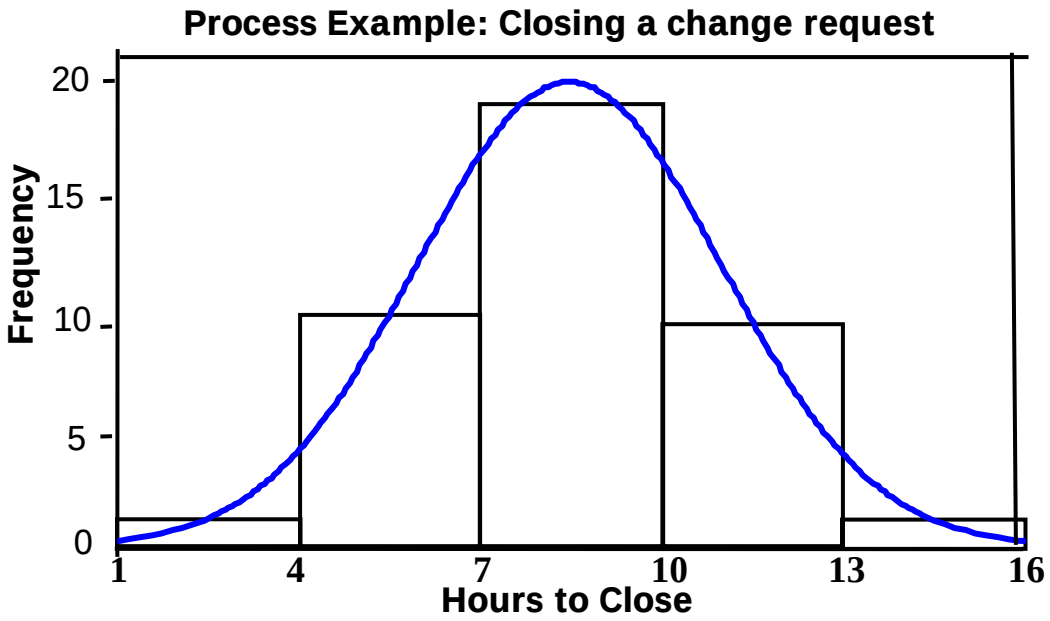
What Is a Data Distribution?



- The data distribution gives a frequency of occurrence of each value in a data set
- Once we characterize the data distribution, we can predict future values or assign a probability to any specific value
- Data distributions may represent population or process data
- When applied to process data - assumes statistical stability

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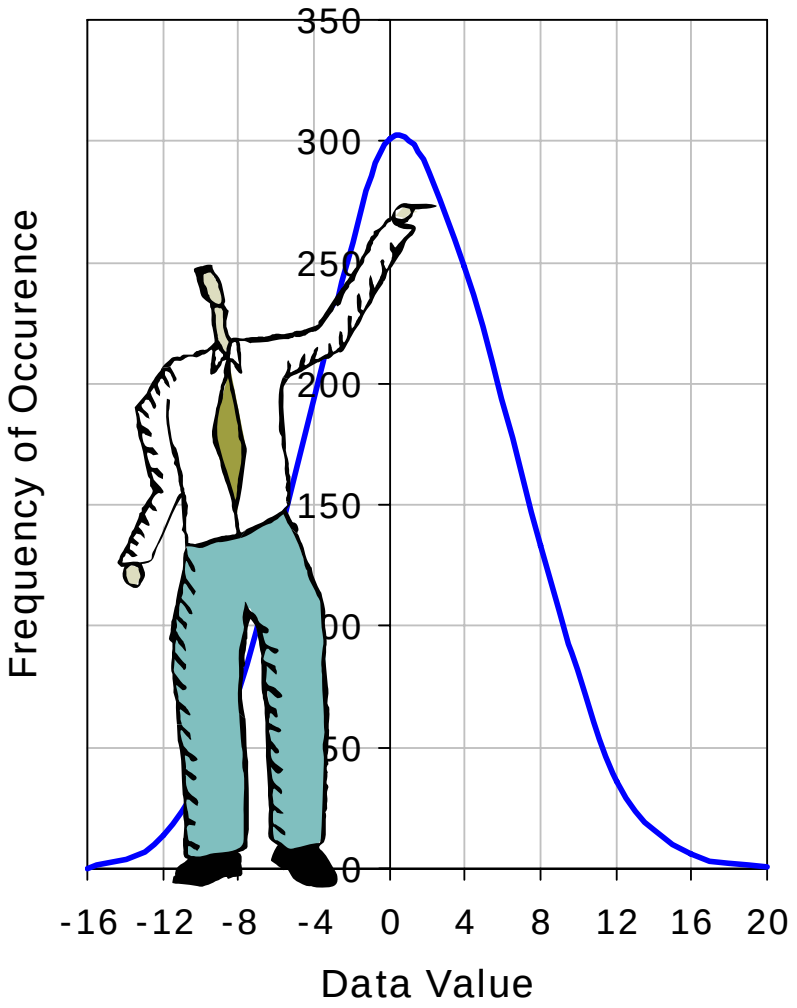
The Normal Distribution



- **Commonly called a bell curve; formally called a Gaussian distribution**
- **Applies to continuous data (e.g. time, weight, distance)**
- **Characteristic shape:**
  - Mean, mode, and median are all the same value
  - Standard deviation is independent of the mean
- **Normal distributions are not a law, but they are often observed in natural data**

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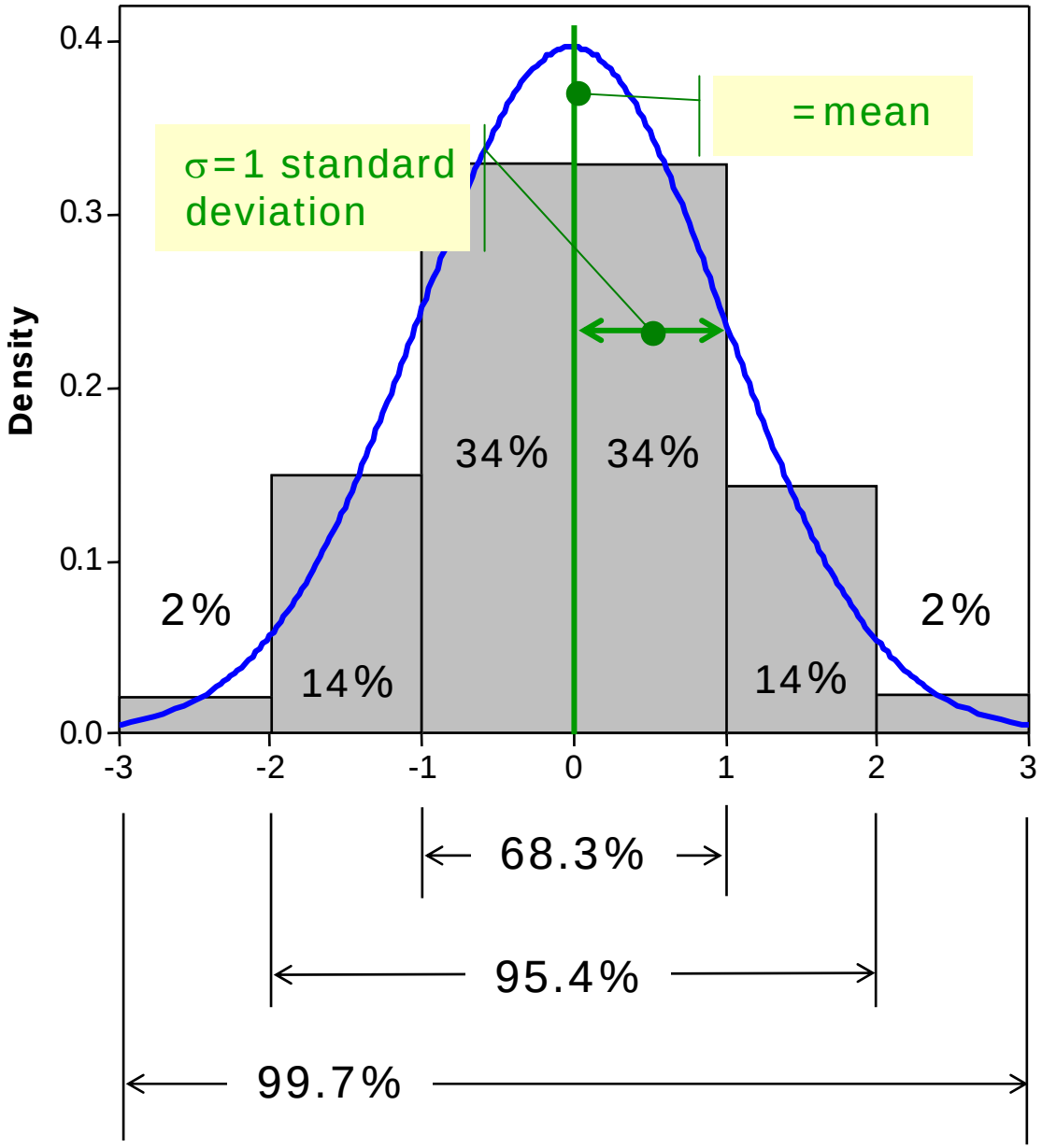
Characteristics of a Normal Curve



Once we understand what kind of distribution our data comes from, we can predict future values or assign a probability to any specific point

- **Probability x will occur**
- **Probability a value < x**
- **Probability a value > x**
- **Probability a value will occur between x and y**

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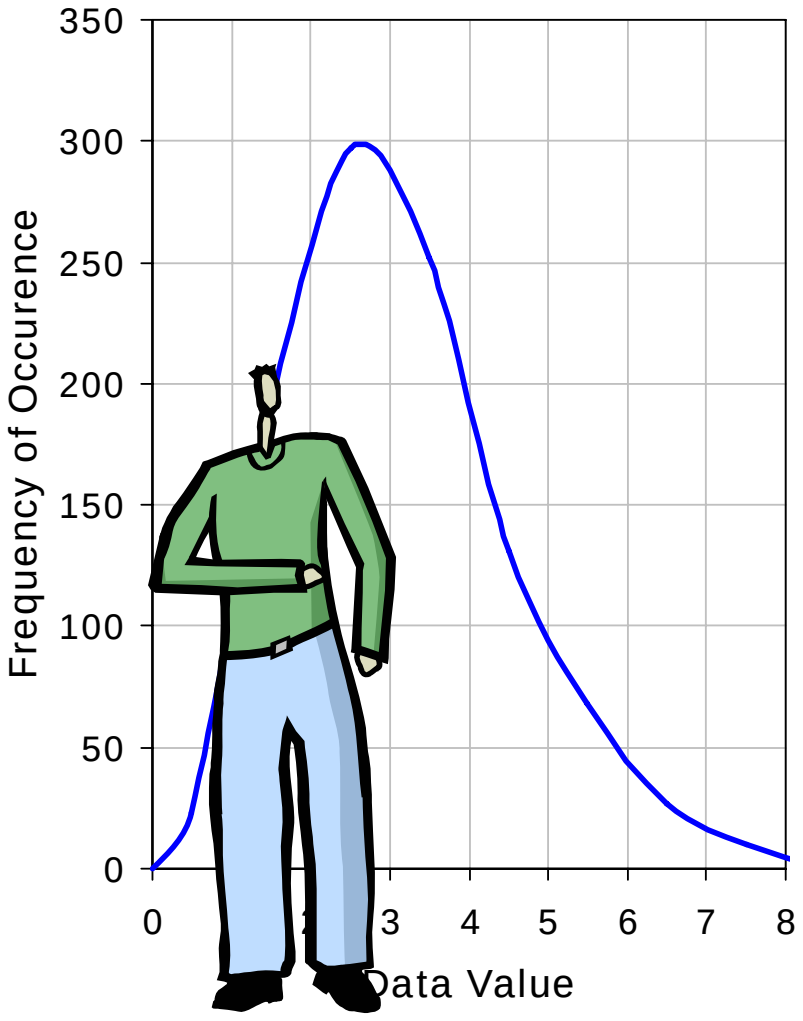
The Rayleigh Distribution…



- A skewed distribution
- Used to model effort or defect density in software development where the abscissa represents development phase if they are roughly the same duration

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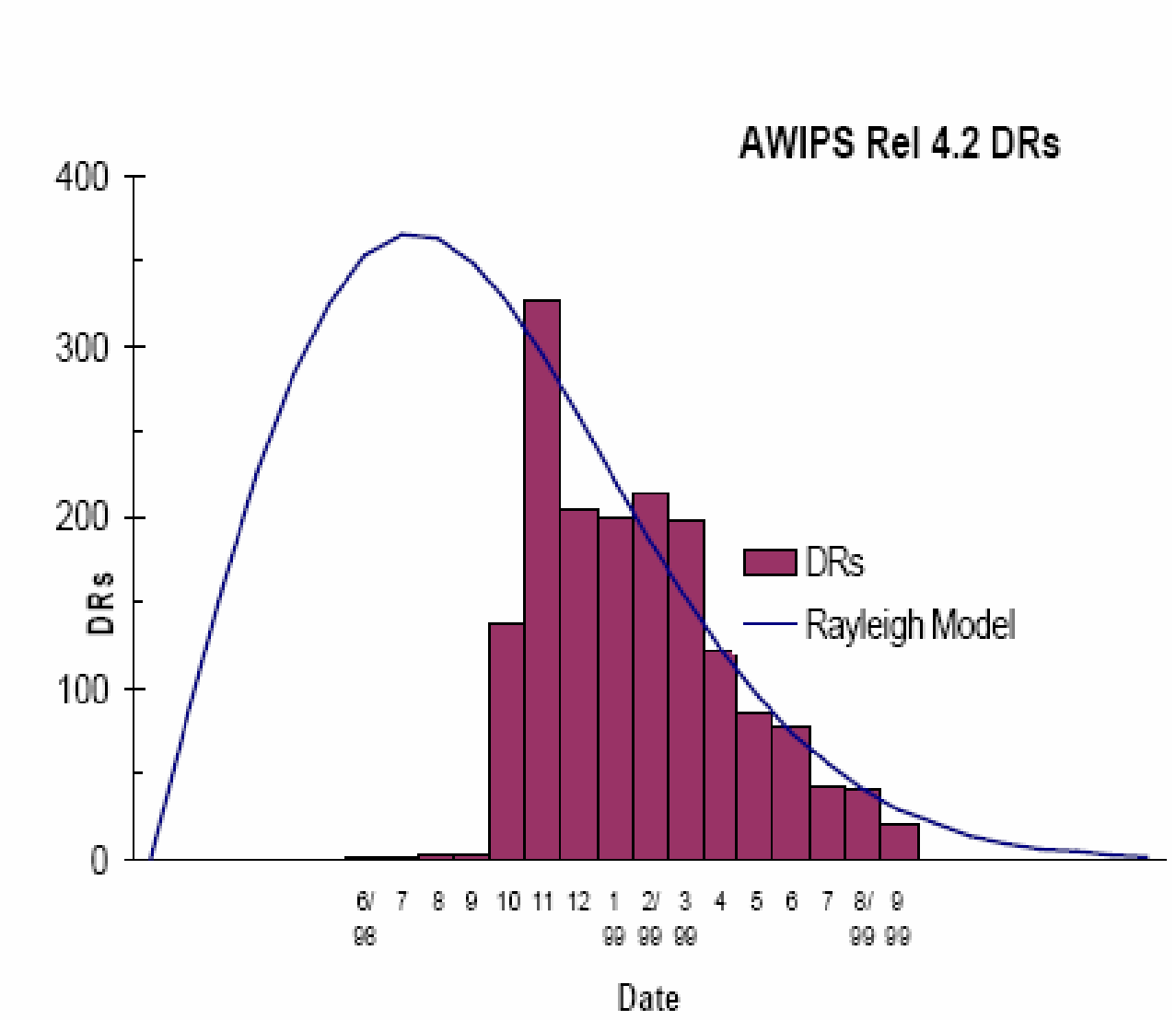
Example - Defect Detection



"Business Value and Customer Benefits Derived from High Maturity", Al Pflugrad, CMMI Technology Conference and User Group, 2002

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What Is a Control Chart?

- A time-ordered plot of process data points with a centerline based on the average and control limits that bound the expected range of variation
- Control charts are one of the most useful quantitative tools for understanding variation

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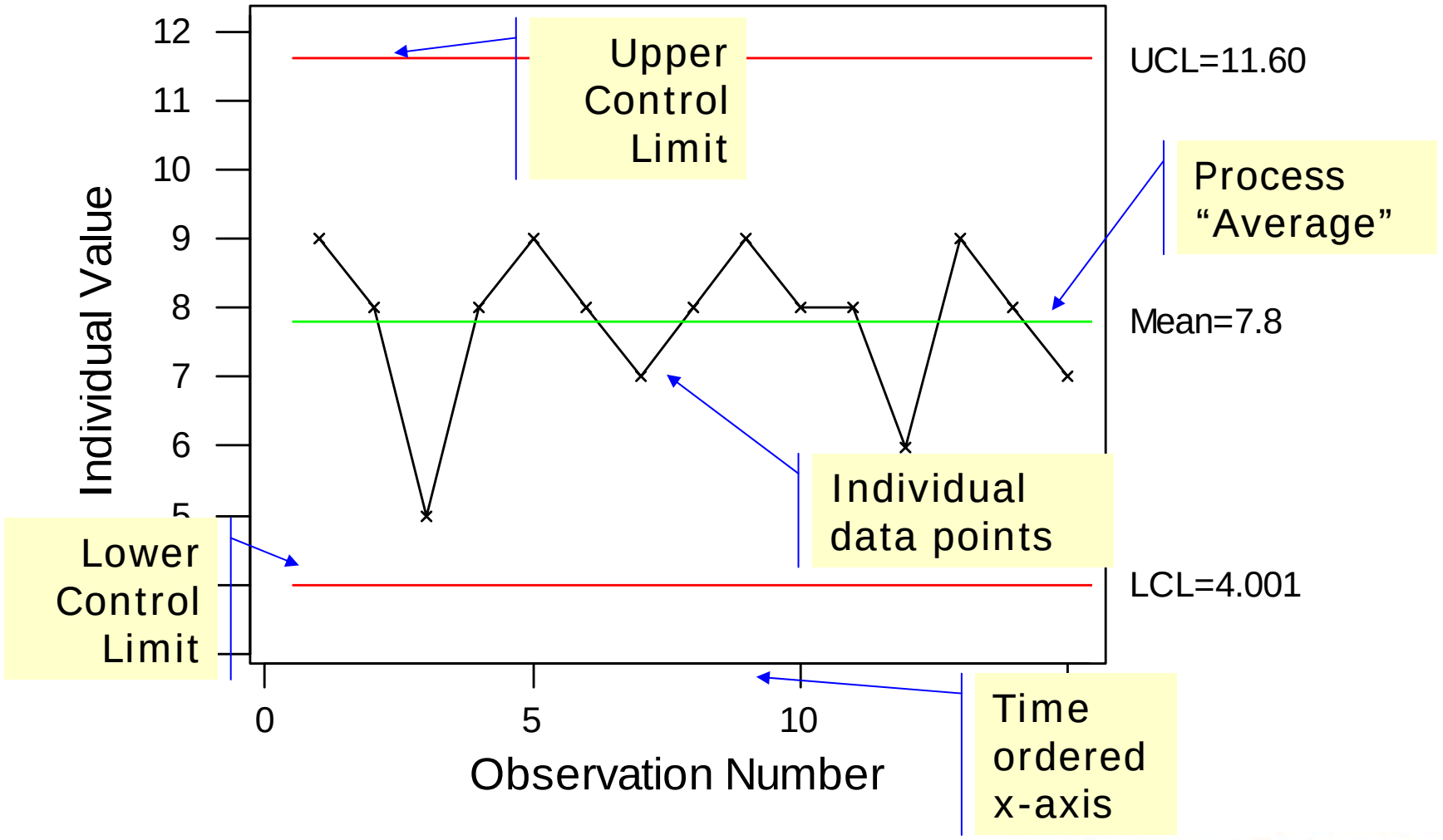
What Are the Key Features of a Control Chart?



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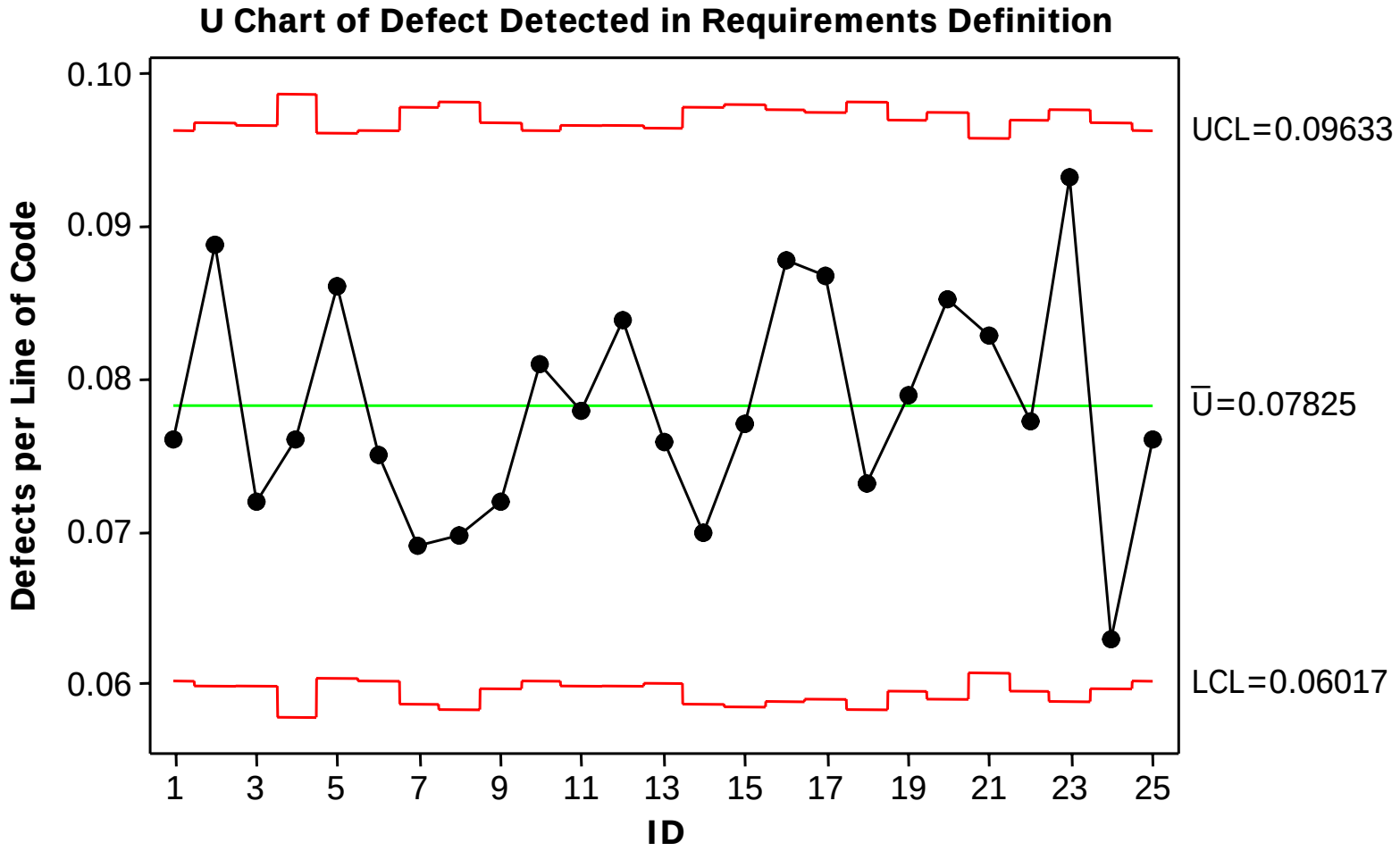
There are Many Types of Control Charts



Tests performed with unequal sample sizes

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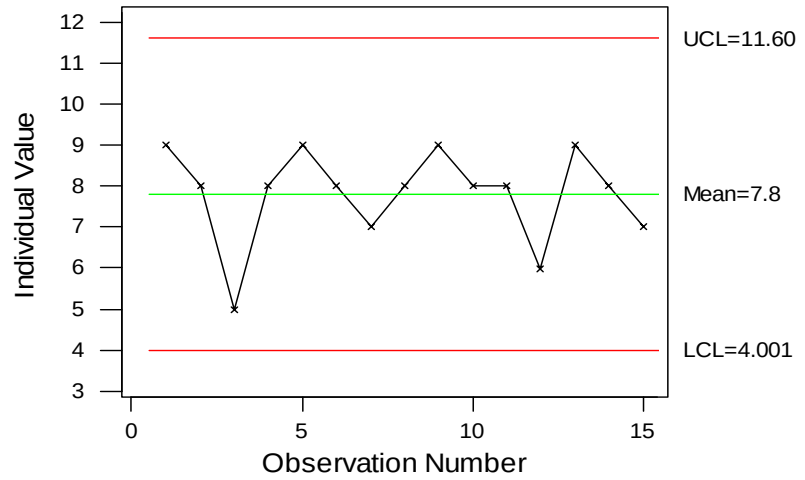
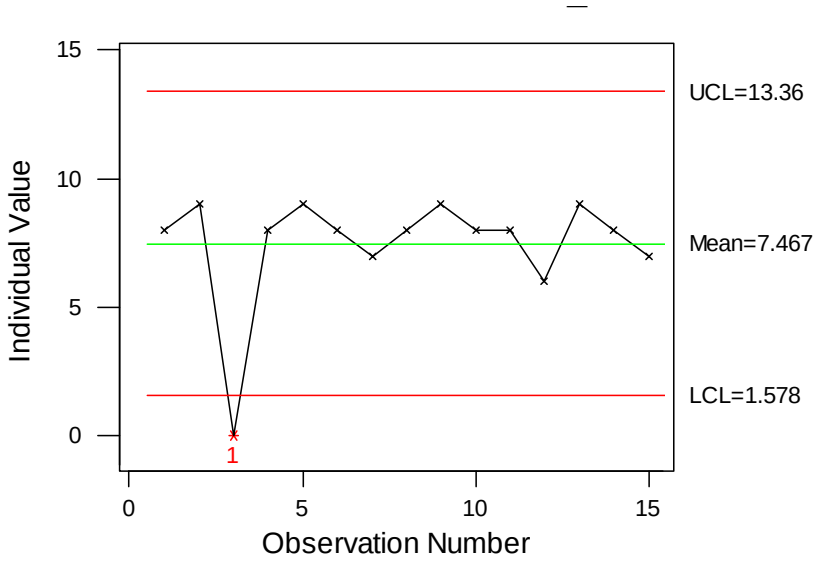
What is *Special Cause* and *Common Cause* Variation?



- **Common Cause Variation**
  - *Routine* variation that comes from within the process
  - Caused by the natural variation in the process
  - Predictable (stable) within a range



- **Special Cause Variation**
  - *Assignable* variation that comes from outside the process
  - Caused by a unexpected variation in the process
  - Unpredictable

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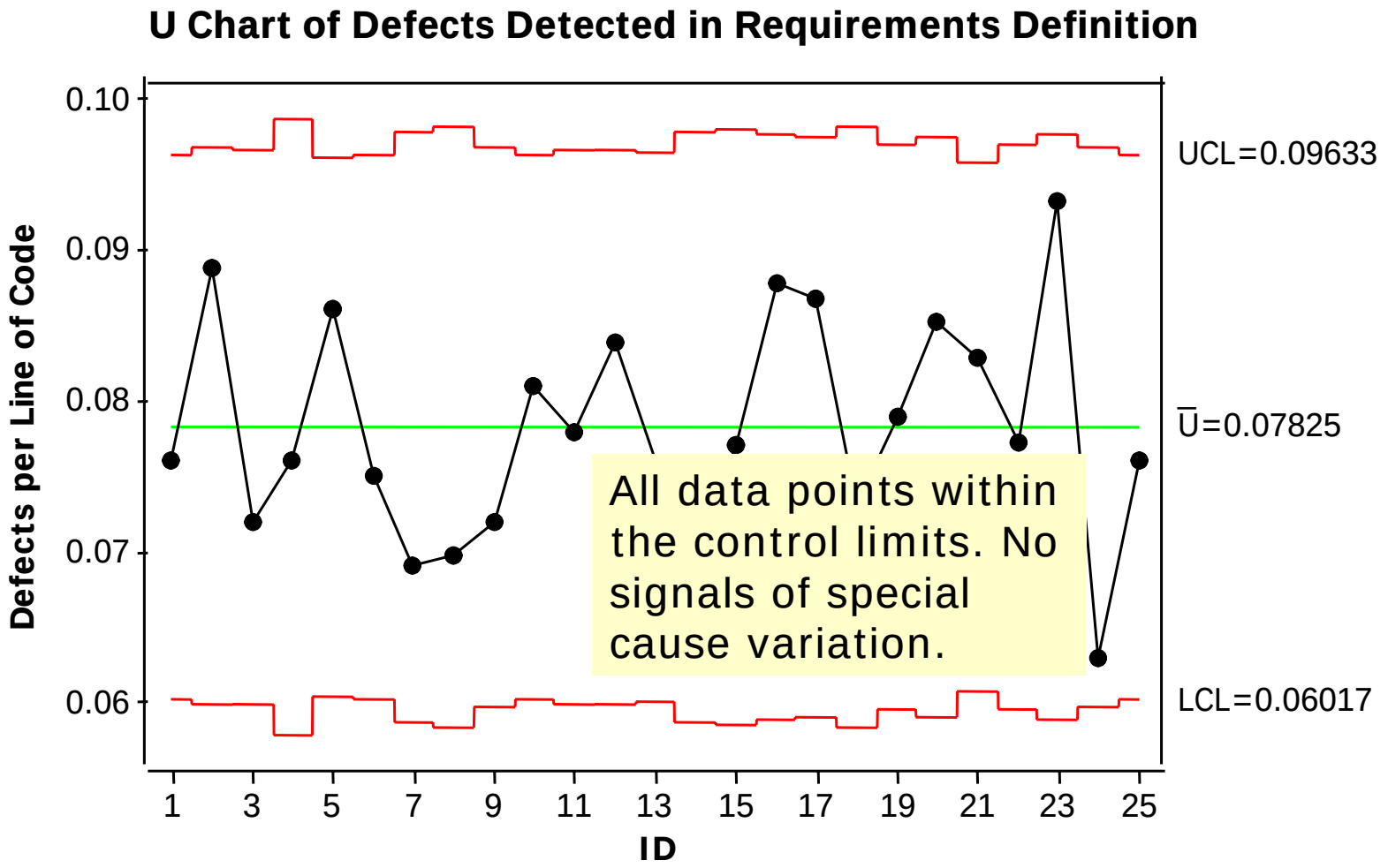
What Is a *Stable* (Predictable) Process?



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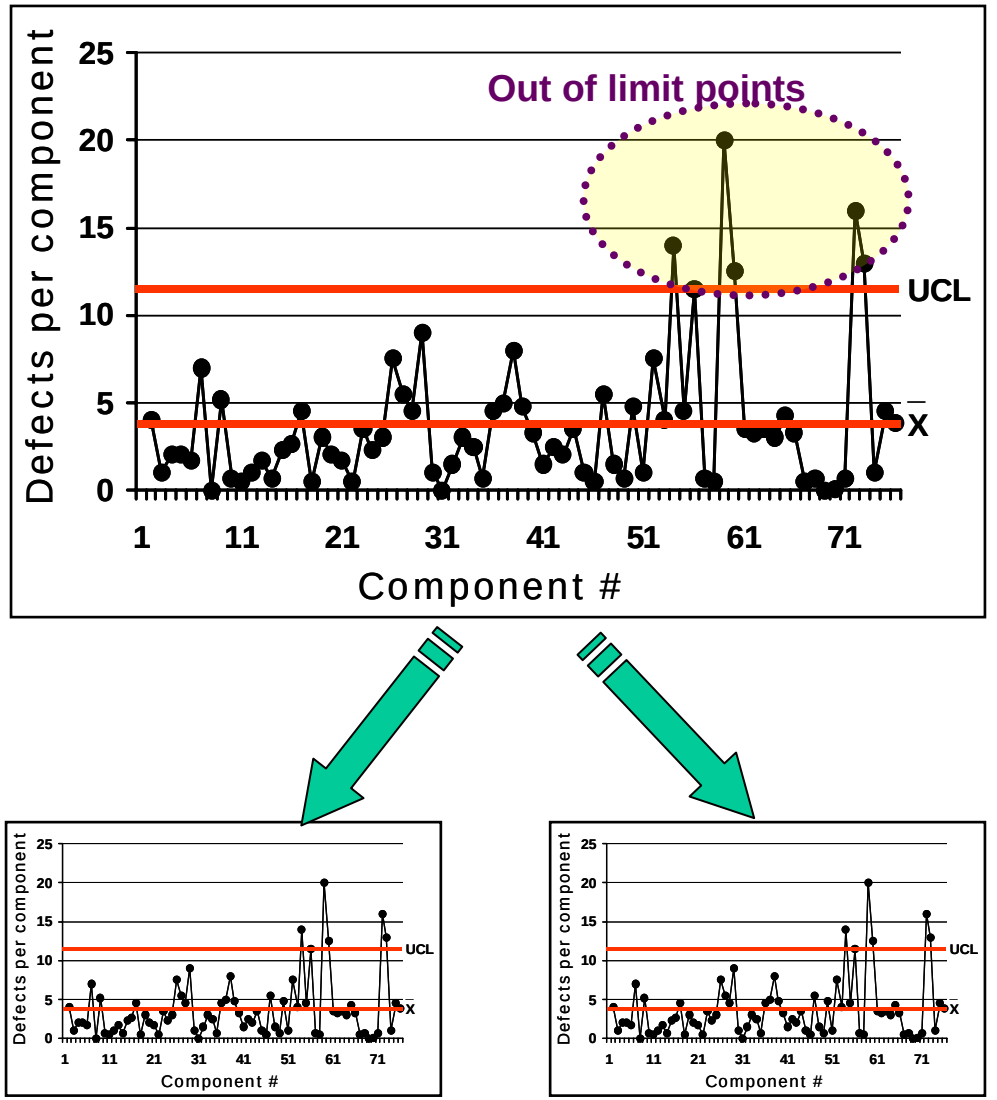
What if the Process Isn't Stable?

- **You may be able to explain out of limit points by observing that they are due to an variation in the process**
  - E.g., peer review held on Friday afternoon
  - You can eliminate the points from the data, if they are not part of the process you are trying to predict

- **You may be able to stratify the data by an attribute of the process or attribute of the corresponding work product**
  - E.g., different styles of peer reviews, peer reviews of different types of work products



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Hearing Voices

- **Voice of the process**
  = the natural bounds of process performance
- **Voice of the customer**
  = the goals established for the product/process performance
- **Voice of the business**
  = process performance needed to be competitive

- **Process capability may be determined for the**
  - Organization
  - Product line
  - Project
  - Individual
- **Typically, the higher the level of analysis, the greater the variation**

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Common Challenges for Engineering

- Data are often discrete rather than continuous, e.g., defects
- Observations often are scarce
- Processes are aperiodic
- Size of the the object often varies, e.g., software module
- Data distributions may not be normal

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How Do I Address These Challenges?

- Employ control chart types that specifically deal with discrete data distributions, e.g., *u*-charts and *p*-charts
- Use control charts that compensate for widely variable areas of opportunity
- Transform non-normal continuous data to normal data before constructing a control chart
- Cross check control charts with hypothesis tests where few data points exist

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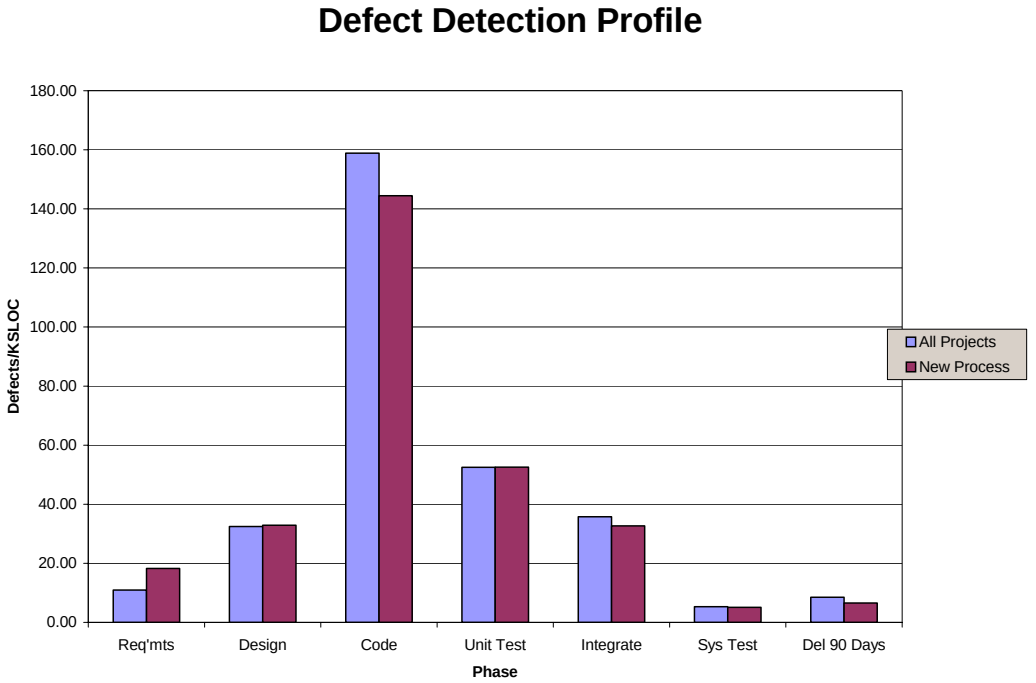
Typical Choices in Industry

- **Most customers care about:**
  - Delivered defects
  - Cost and schedule
- **So organizations try to predict:**
  - Defects found throughout the lifecycle
  - Effectiveness of peer reviews, testing
  - Cost achieved/actual (Cost Performance Index – CPI)
  - Schedule achieved/actual (Schedule Performance Index – SPI)



Process performance

- **Process measures** (e.g., effectiveness, efficiency, speed)
- **Product measures** (e.g., quality, defect density).

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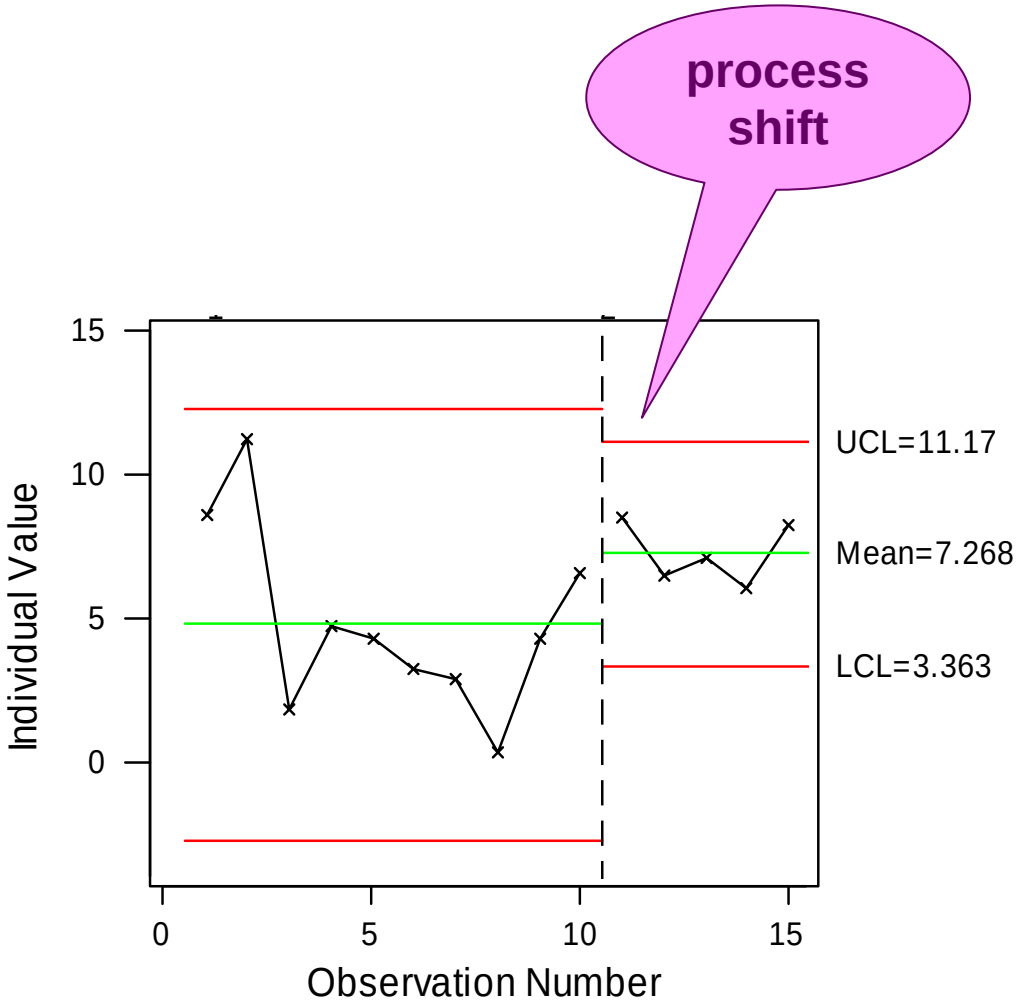
How Can High Maturity Help?

- **By measuring both the mean and variation, the project/ organization can assess the full impact of an "improvement"**
- **Can focus on reducing the variation (making the process more predictable)**
  - Train people on the process
  - Create procedures/checklists
  - Strengthen process audits
- **Can focus on increasing the mean (e.g., increase effectiveness, efficiency, etc.)**
  - Train people
  - Create checklists
  - Reduce waste and re-work
  - Replicate best practices from other projects
- **Can do both**



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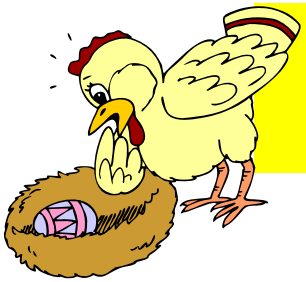
What Can a Level 4 Organization/Project Do?

- **Both can:**
  - Determine whether processes are behaving consistently or have stable trends (i.e., are predictable)
  - Eliminate special causes of variation
  - Identify processes that show unusual (e.g., unpredictable) behavior
  - Identify the implementation of a process which performs best
- **The organization can:**
  - Characterize the process performance of the organization's standard process
  - Develop models to predict process performance
- **The organization's projects can:**
  - Use this data to decide how to tailor the organization's standard process
  - Statistically manage selected subprocesses to achieve project quality and process objectives



Would your organization/projects find this valuable?

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What Does Level 5 Add?

Builds on Level 4 capabilities

Causal Analysis

- Both the project and organization can better determine cause and effect relationships
- This can be used to focus process improvements and preventive actions

Level 3

Organizational Process Focus

- Goals are qualitative (e.g., get better)
- The effects of the improvements are not estimated or measured

Level 5

Organizational Innovation & Deployment

- Goals are quantitative (e.g., reduce variation by X%, reduce mean by Y%)
- Incremental improvements
- Innovative improvements - cause a major shift in process capability
- Potential improvements are analyzed to estimate costs and impacts (benefits)
- Improvements are piloted to ensure success
- Improvements are measured in terms of variation and mean

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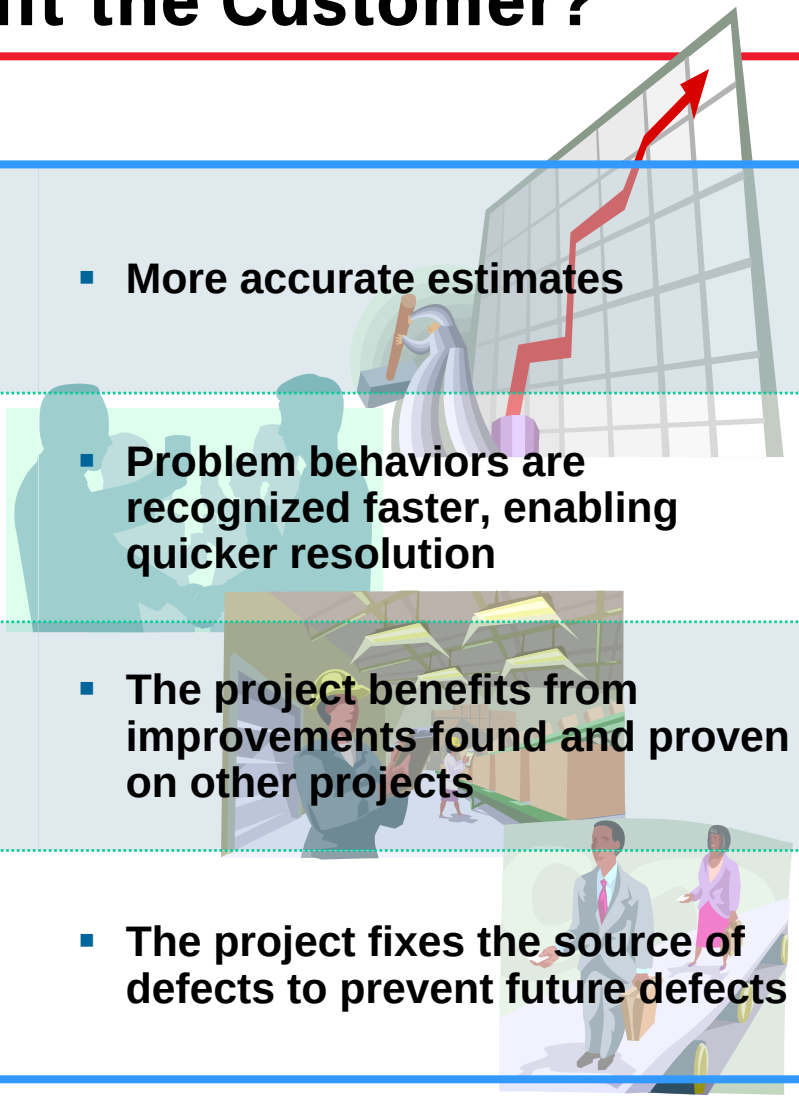
How Does Level 4 & 5 Benefit the Customer?

▪ Organizational process performance	▪ More accurate estimates
▪ Quantitative project management	▪ Problem behaviors are recognized faster, enabling quicker resolution
▪ Organizational innovation and deployment	▪ The project benefits from improvements found and proven on other projects
▪ Causal analysis	▪ The project fixes the source of defects to prevent future defects



Better Products and Services Produced Faster And Cheaper

"How Does How Does High Maturity Benefit the Customer", R. Hefner, Systems & Software Technology Conference,. 2005

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Agenda

- **An Overview of Levels 4 and 5**
  - New Behaviors
  - Benefits – Project, Organizational, Customer
  - Making the Business Case
- **Understanding the CMMI Process Areas**
  - Organizational Process Performance
  - Quantitative Project Management
  - Causal Analysis & Resolution
  - Organizational Innovation & Deployment
- **Strategies for Adoption**
  - Lessons Learned
  - Links to Six Sigma

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The Project Manager's Dilemma at Level 3

I want to use the organization's standard process, but…

… Does it's performance and quality meet my customer's expectations?

… If not, how should I tailor the process?

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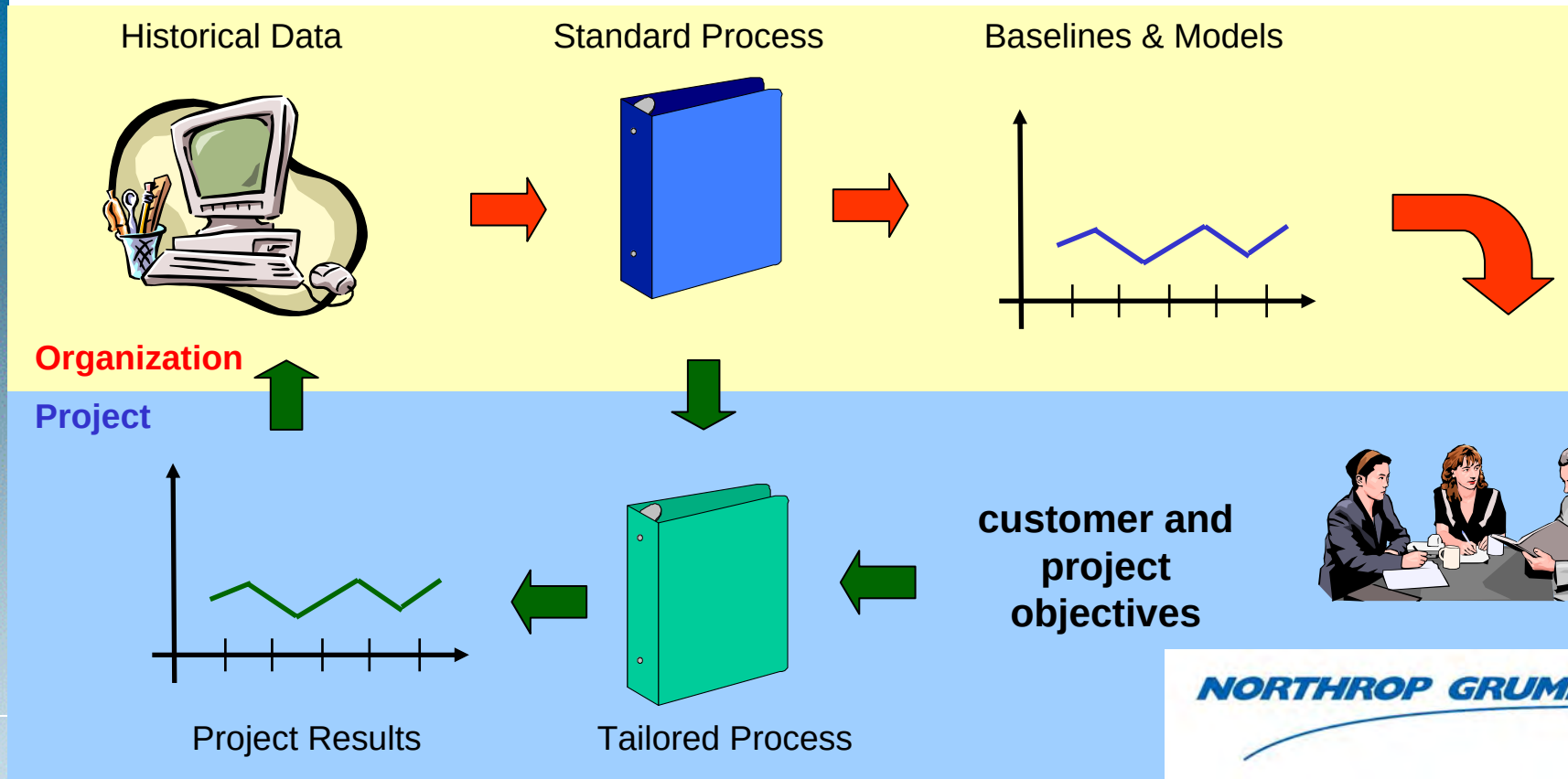
What Should the Organization Do to Help the Project Manager?

- Characterize the performance of the organization's standard process statistically
- Develop models to help a project manager determine the performance they would be likely to get by using the standard organizational process model, given their project's characteristics



Organizational Process Performance

SG 1 Establish Performance Baselines and Models

Baselines and models that characterize the expected process performance of the organization's set of standard processes are established and maintained.

SP 1.1 Select Processes

Select the processes or process elements in the organization's set of standard processes that are to be included in the organization's process performance analyses.

SP 1.2 Establish Process Performance Measures

Establish and maintain definitions of the measures that are to be included in the organization's process performance analyses.

SP 1.3 Establish Quality and Process-Performance Objectives

Establish and maintain quantitative objectives for quality and process performance for the organization.

SP 1.4 Establish Process Performance Baselines

Establish and maintain the organization's process performance baselines.

SP 1.5 Establish Process Performance Models

Establish and maintain the process performance models for the organization's set of standard processes.

Selected subprocesses, NOT the whole process

Objectives deal with eliminating sources of variation, not setting "stretch" goals

The organization meets these goals by modifying the standard process, not driving the projects

Baselines characterize the "voice of the process", based on the existing historical data

- What is the current mean and variation?

May need to subgroup the data

Models allow projects to estimate their quantitative performance based on the historical data of other projects executing the process

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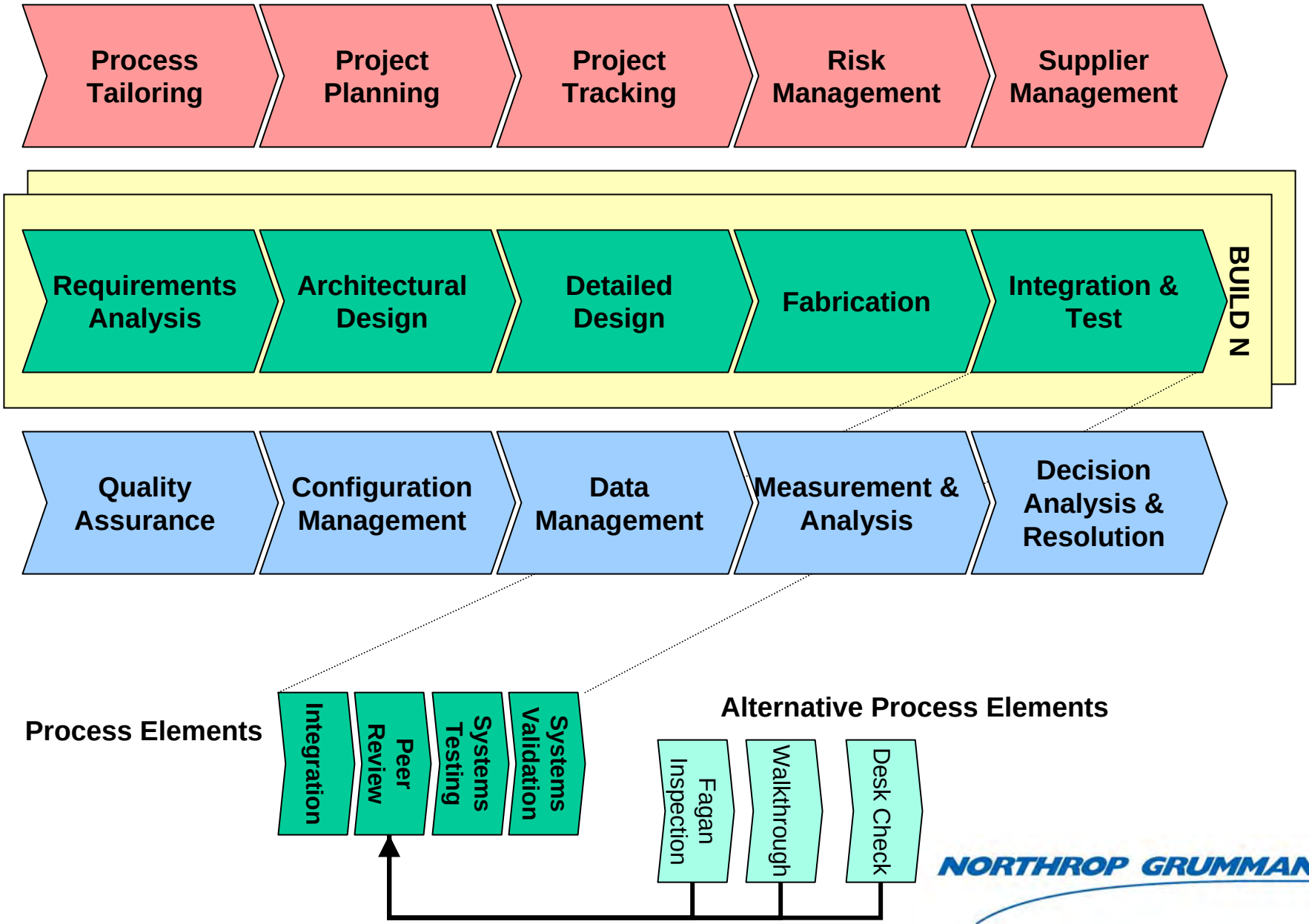
Process Architecture



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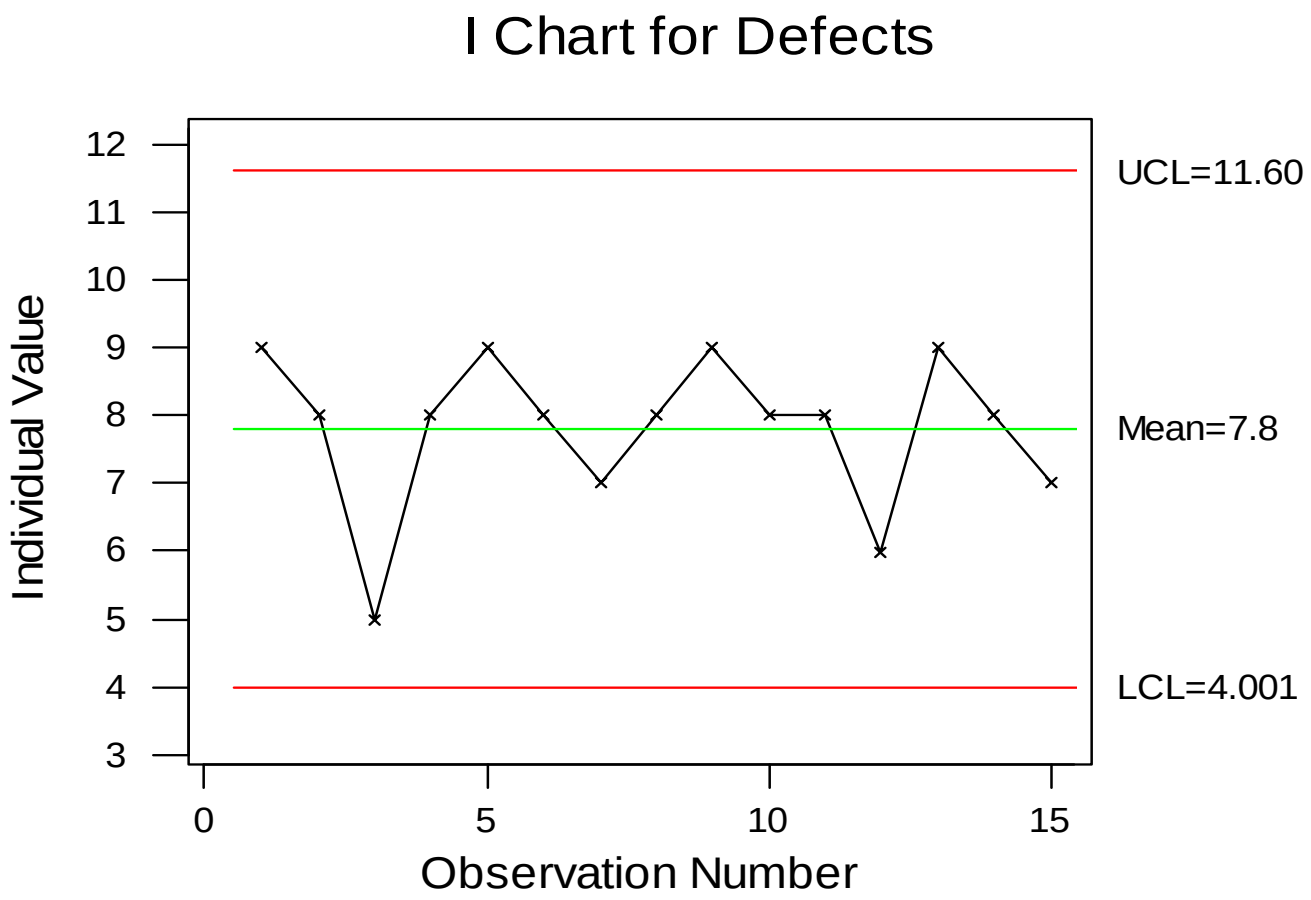
Quantitative Baselines and Models

- **From this baseline (and model), what would you predict the next peer review to produce in terms of defects/KSLOC?**
- **What other models could be developed to help predict?**



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The Project Manager's Challenge at Level 4

I understand the capabilities of the organization's standard process, but…

… What are the project's quality and process performance objectives?

… How should I tailor the process?

… What project subprocesses do I need to quantitatively manage?

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Quantitative Project Management (Goal 1)

SG 1 Quantitatively Manage the Project

The project is quantitatively managed using quality and process-performance objectives.

SP 1.1 Establish the Project's Objectives

Establish and maintain the project's quality and process performance objectives.

SP 1.2 Compose the Defined Process

Select the subprocesses that compose the project's defined process based on historical stability and capability data.

SP 1.3 Select the Subprocesses that Will Be Statistically Managed

Select the subprocesses of the project's defined process that will be statistically managed.

SP 1.4 Manage Project Performance

Monitor the project to determine whether the project's objectives for quality and process performance will be satisfied, and identify corrective action as appropriate.

Quality: defect levels of key work products or deliverables

Process: productivity, efficiency, effectiveness of the project's processes

Rationale for how the project tailored the organization's standard process, in order to meet their quality & process performance objectives

- E.g., adding procedures to reduce variation

Assumes the standard process includes subprocesses to select from

Only some subprocesses selected for statistical management

- Need not be the same as those selected by the organization, or other projects

Monitoring against the objectives established in SP 1.1

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Outer Loop

SP 1.1 Establish the Project's Objectives

Establish and maintain the project's quality and process performance objectives.

SP 1.3 Select the Subprocesses that Will Be Statistically Managed

Select the subprocesses of the project's defined process that will be statistically managed

SP 1.4 Manage Project Performance

Monitor the project to determine whether the project's objectives for quality and process performance will be satisfied, and identify corrective action as appropriate.

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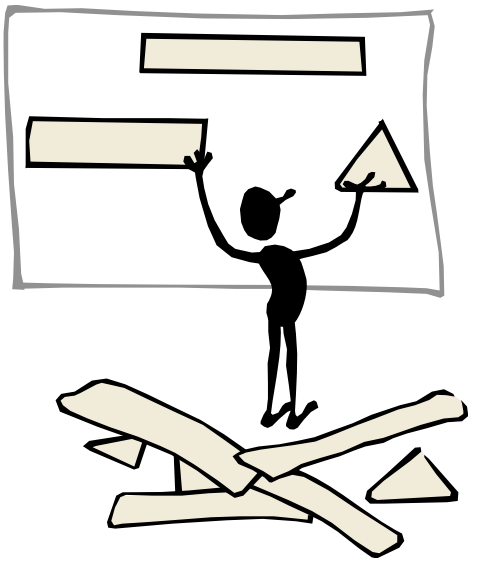
Selecting Subprocesses to be Statistically Managed

SP 1.3 Select the Subprocesses that Will Be Statistically Managed
Select the subprocesses of the project's defined process that will be statistically managed

- **Which processes do you need to be stable (predictable) in order to achieve your project's objectives?**
  - For these, eliminate special causes, characterize the process, and predicatively manage
- **The time needed to perform this practice is long and often unpredictable**
  - Many processes can not be made predictable
- **Example – objectives for delivered defects**
  - Defect detection (peer review, unit testing, system testing)
  - Defect insertion (requirement definition, architecture, design, integration)



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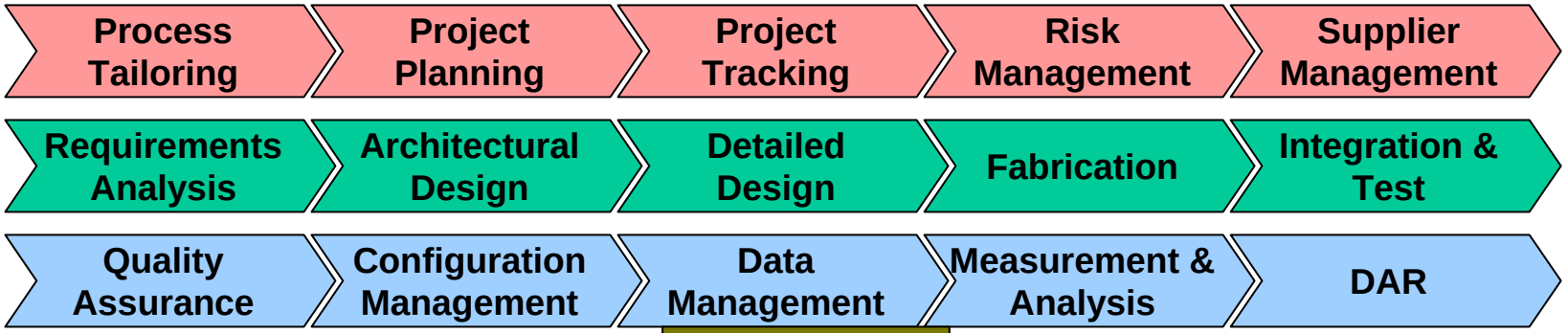
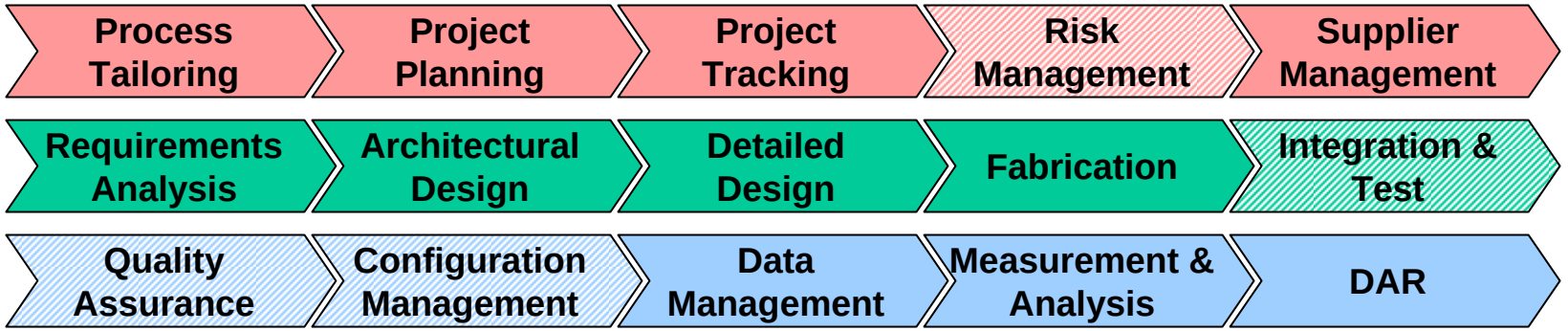
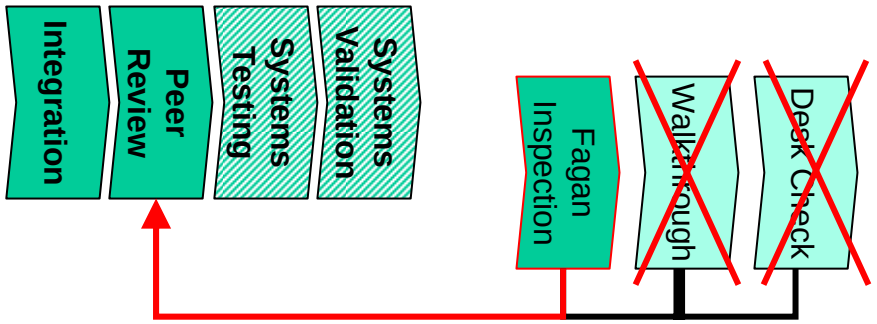
Tailoring

Organization



Project





SP 1.2 Compose the Defined Process

Select the subprocesses that compose the project's defined process based on historical stability and capability data.

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Quantitative Project Management (Goal 2)

SG 2 Statistically Manage Subprocess Performance

The performance of selected subprocesses within the project's defined process is statistically managed.

SP 2.1 Select Measures and Analytic Techniques

Select the measures and analytic techniques to be used in statistically managing the selected subprocesses.

SP 2.2 Apply Statistical Methods to Understand Variation

Establish and maintain an understanding of the variation of the selected subprocesses using the selected measures and analytic techniques.

SP 2.3 Monitor Performance of the Selected Subprocesses

Monitor the performance of the selected subprocesses to determine their capability to satisfy their quality and process performance objectives, and identify corrective action as necessary.

SP 2.4 Record Statistical Management Data

Record statistical and quality management data in the organization's measurement repository.

Type of analysis to be performed (e.g., control charts)

Key is understanding variation in the selected subprocesses (e.g., be able to compute standard deviation), NOT just metrics

Given the stability and variation in the subprocesses, will we be able to meet our project-level quality and process performance objectives?

This data is used to help select subprocesses in tailoring (SP 1.2)

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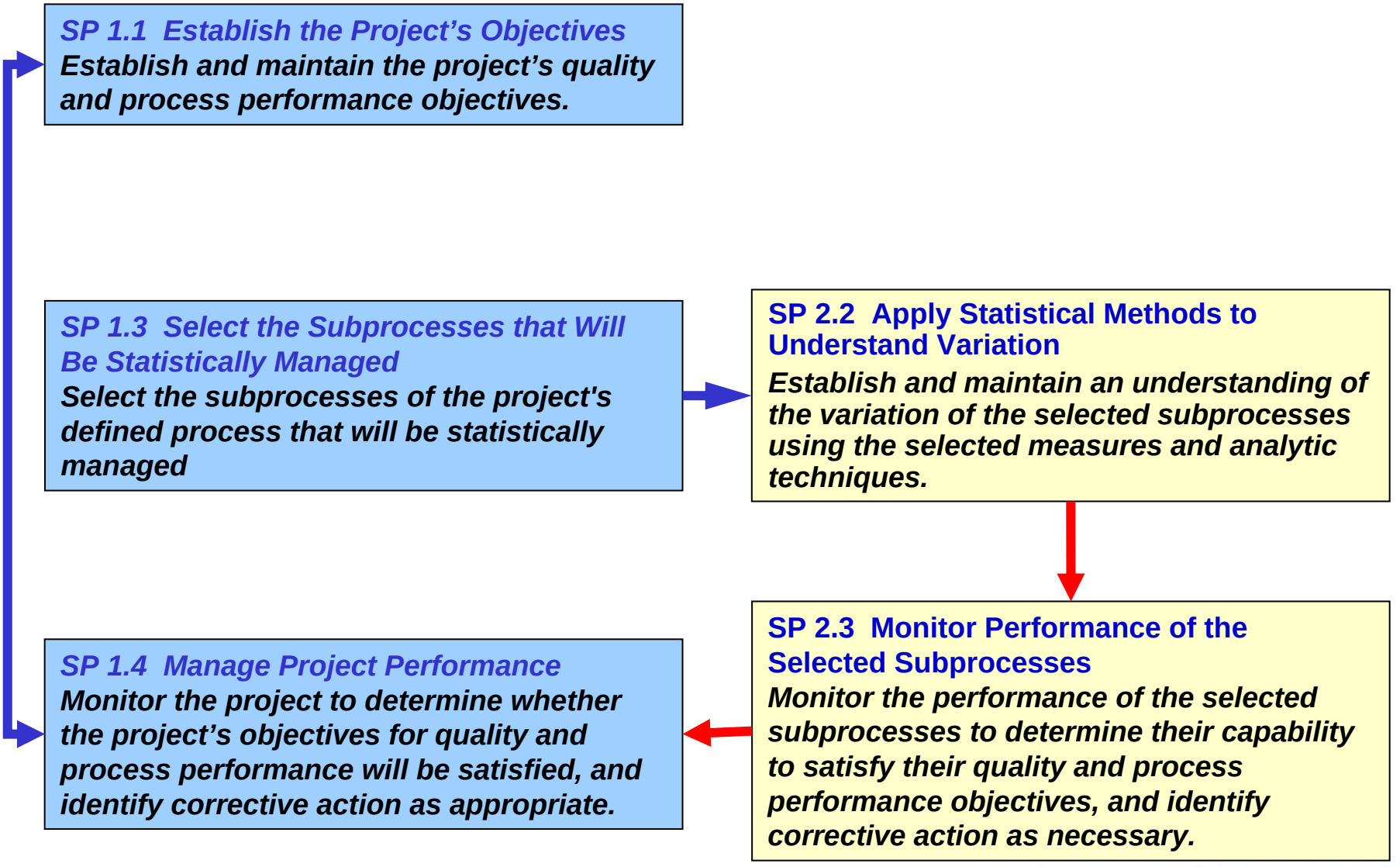
Inner Loop



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Sample Measures for Quantitative Analysis

- Time between failures
- Critical resource utilization
- Number and severity of defects in the released product
- Number and severity of customer complaints concerning the pro-vided service
- Number of defects removed by product verification activities (per-haps by type of verification, such as peer reviews and testing)
- Defect escape rates
- Number and density of defects by severity found during the first year following product delivery or start of service
- Cycle time
- Amount of rework time
- Requirements volatility (i.e., number of requirements changes per phase)
- Ratios of estimated to measured values of the planning parameters (e.g., size, cost, and schedule)
- Coverage and efficiency of peer reviews (i.e., number/amount of products reviewed compared to total, number of defects found per hour)
- Test coverage and efficiency (i.e., number/amount of products tested compared to total, number of defects found per hour)
- Effectiveness of training (i.e., percent of planned training completed and test scores)
- Reliability (i.e., mean time-to-failure usually measured during inte-gration and systems test)
- Percentage of the total defects inserted or found in the different phases of the project life cycle
- Percentage of the total effort expended in the different phases of the project life cycle
- Profile of subprocesses under statistical management (i.e., number planned to be under statistical management, number currently being statistically managed, and number that are statistically stable)
- Number of special causes of variation identified

Source: Interpreting the CMMI, Margaret Kulpa and Kent Johnson

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New Questions at Level 4

- What characteristics of the organizational standard process would be useful to understand?
- Which subprocesses would be useful to understand, for predictive purposes?
- Are these subprocesses predictable (stabilizable)?
- What data should the organization collect?
- To what level of detail should the organizational standard process go?
- What differences in project subprocesses are permissible? How do they impact the historical data?

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What Does Level 5 Add to the Project / Organization?

- **Casual Analysis & Resolution**
  - Identify and analyze causes of defects and other ~~problems~~ effects
  - Take specific actions to remove the causes

- **The project may take actions to prevent the occurrence of those types of defects and problems in the future**
- **Most projects use CAR-type methods and tools at Level 4, to identify and eliminate special cause variations, i.e., to stabilize the processes**
- **At Level 5, CAR is used to eliminate common cause variation**

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Causal Analysis & Resolution

SG 1 Determine Causes of Defects

Root causes of defects and other problems are systematically determined.

SP 1.1 Select Defect Data for Analysis

Select the defects and other problems for analysis.

SP 1.2 Analyze Causes

Perform causal analysis of selected defects and other problems and propose actions to address them.

SG 2 Address Causes of Defects

Root causes of defects and other problems are systematically addressed to prevent their future occurrence.

SP 2.1 Implement the Action Proposals

Implement the selected action proposals that were developed in causal analysis.

SP 2.2 Evaluate the Effect of Changes

Evaluate the effect of changes on process performance.

SP 2.3 Record Data

Record causal analysis and resolution data for use across the project and organization.

Can apply to any cause and effect relationship, not just defects

Typically, projects will establish a list of potential areas in which to apply CAR, and select some from that list

Determine cause and effect (e.g., fishbone diagram, brainstorming) and potential improvement action list

Select some actions on the list to implement

Implemented for each selected action
- Evidence will provide samples

Measures the effect of the change

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Organizational Innovation and Deployment

SG 1 Select Improvements

Process and technology improvements that contribute to meeting quality and process-performance objectives are selected.

SP 1.1 Collect and Analyze Improvement Proposals

Collect and analyze process- and technology-improvement proposals.

SP 1.2 Identify and Analyze Innovations

Identify and analyze innovative improvements that could increase the organization's quality and process performance.

SP 1.3 Pilot Improvements

Pilot process and technology improvements to select which ones to implement.

SP 1.4 Select Improvements for Deployment

Select process- and technology-improvement proposals for deployment across the organization.

SG 2 Deploy Improvements

Measurable improvements to the organization's processes and technologies are continually and systematically deployed.

SP 2.1 Plan the Deployment

Establish and maintain the plans for deploying the selected process and technology improvements.

SP 2.2 Manage the Deployment

Manage the deployment of the selected process and technology improvements.

SP 2.3 Measure Improvement Effects

Measure the effects of the deployed process and technology improvements.

Innovative improvements are likely to significantly change the process/quality performance

Where appropriate, a proposed improvement should be piloted

Innovative improvements often require a phase-in approach

The effects should be measured quantitatively (as opposed to qualitatively in OPF), i.e. process shift

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Agenda

- **An Overview of Levels 4 and 5**
  - New Behaviors
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- **Understanding the CMMI Process Areas**
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  - Organizational Innovation & Deployment
- **Strategies for Adoption**
  - Lessons Learned
  - Links to Six Sigma

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Achieving Levels 4 and 5 is Less Predictable

- **The time it takes to achieve Levels 2 and 3 is driven by the resources available**
  - Learn/implement new project practices
  - Create organizational assets - policies, processes, training, etc.
  - Practices are first performed; *effectiveness is improved over time*
- **The time it takes to achieve Levels 4 and 5 is driven by the ability to stabilize processes**
  - Choosing processes that can be stabilized
  - Establishing the right metrics and methods
  - Collecting enough data
  - *Effectiveness is required to perform the practices*

Level	Process Areas
5 Optimizing	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	Quantitative Project Management Organizational Process Performance
3 Defined	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Risk Management Integrated Project Management (for IPPD*) Integrated Teaming* Integrated Supplier Management** Decision Analysis and Resolution Organizational Environment for Integration*
2 Managed	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed	

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Lessons Learned

Based on 20 Northrop Grumman CMMI Level 5 organizations

- **Level 3 metrics, measurement processes, and goal setting are generally inadequate for Levels 4 and 5**
  - Better definitions of the measures
  - Lower level metrics of lower level subprocesses
  - Stratifying the data properly
- **When operating at Level 3, it is difficult to predict the measurement improvements needed**
  - Trying to understand and stabilize the key subprocesses will naturally drive you to the right metrics
- **Projects have different quality and process performance needs, and should select different subprocesses to quantitatively manage**
  - This will also slow adoption, and complicate the organizational baselines and models
- **Six Sigma is an enabler for higher maturity**
  - Focus on data, measurement systems, process improvement
  - Tying improvements to business goals
  - Tools and methods support the level 4/5 analysis tasks

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What is Six Sigma?

- **Six Sigma is a management philosophy based on meeting business objectives by striving for perfection**
  - A disciplined, data-driven methodology for decision making and process improvement
- **Six Sigma consists of several integrated methods:**
  - Process Management
  - Voice of the Customer
  - Change Management
  - Tools for Measuring Variation and Change
  - Business Metrics
- **Leading-edge companies are applying Six Sigma to engineering work**

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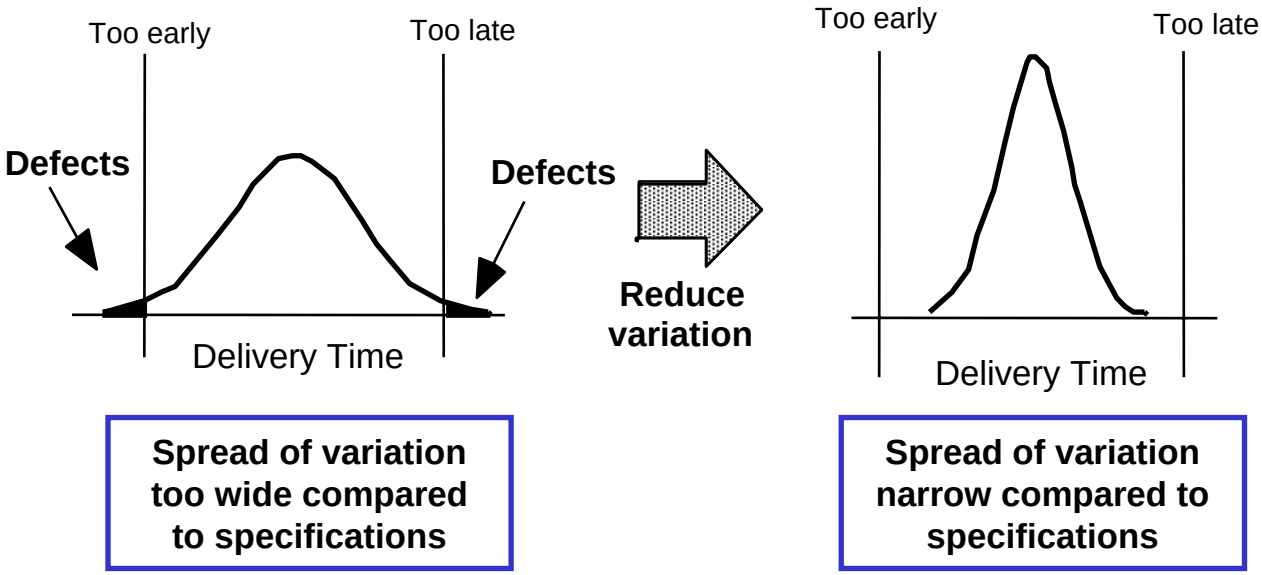
Importance of Reducing Variation

- **To increase process performance, you have to decrease variation**



- **Less variation means**
  - Greater predictability in the process
  - Less waste and rework, which lowers costs
  - Products and services that perform better and last longer
  - Happier customers

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A Typical Six Sigma Project in Engineering

- Customers express concern that software defects are causing frequent failures in the field
- A Six Sigma team is formed to scope the problem, collect data, and determine the root cause
- The team's analysis of the data determines that poorly understood interface requirements account for 90% of the problems in the field
- The interface problems are corrected
- The organization's requirements solicitation process is modified to ensure future projects do not encounter similar problems

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DMAIC Process Steps

DEFINE	**Set project goals and objectives**
MEASURE	**Narrow range of potential causes and establish baseline capability level**
ANALYZE	**Evaluate data/information for trends, patterns, causal relationships and "root causes“**
IMPROVE	**Develop, implement and evaluate solutions targeted at identified root causes**
CONTROL	**Make sure problem stays fixed and new methods can be further improved over time**

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How Six Sigma Helps Level 4-5 Organizations

- **Six Sigma provides specific methods and tools for:**
  - Quantitative process management of Level 4
  - Causal Analysis and Resolution of Level 5
- **Six Sigma projects provide a mechanism for selecting and implementing improvements**
  - Addresses Organizational Innovation and Deployment
  - Can extend beyond Level 5

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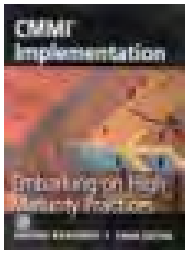
References

This Conference

- "Using 'Voice of Customer' Tools to Advance Organizational Innovation and Deployment", Don Corpron
- "Making OID Effective," Diane Mizukami
- "Statistical Control of System and Software Design Activities, " Dr. Richard Welch and Ms. April King
- "Business Value of CMMI Level 5," Gene Miluk, Lynn Penn, Rick Hefner and Rushby Craig

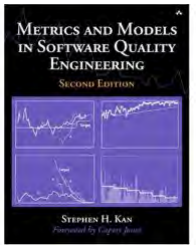
Others

- "Squeezing Variation for Profit", Don Corpron, CMMI Technology Conference and User Group, 2005
- "How Does High Maturity Benefit the Customer?," Rick Hefner, Systems & Software Technology Conference, 2005
- "Using a Process Database to Facilitate Transition to Level 4", Rick Hefner, International Conference on Applications of Software Measurement, 2002
- "Business Value and Customer Benefits Derived from High Maturity", Alan Pflugrad, CMMI Technology Conference and User Group, 2002
- http://www.isixsigma.com
- *High Maturity with Statistics*, SEI course



CMMI Implementation: Embarking on High Maturity Practices, Shivraj Kanungo, Asha Goyal

Measuring the Software Process, William A. Florac, Anita D. Carleton



Metrics and Models in Software Quality Engineering, Stephen H. Kan

Understanding Variation: The Key to Managing Chaos, Donald J. Wheeler

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Lean Process Improvement

CMMI® Technology Conference
and User Group
November 13, 2006

Jeffrey L. Dutton
Technical Director, ITSS
Jacobs Technology

Lessons Learned from…

- 5 organizations: Jacobs and Government
- About 75 projects
- Over two years

- Technical Director, Jacobs Technology/ITSS
- Candidate SCAMPI Lead Appraiser
- (lean) Six Sigma Black Belt
- Member of the Steering Committee and Chair of the Software Committee, NDIA Systems Engineering Division
- Visiting Scientist, Software Engineering Institute
- Project Manager, Software Development
- Systems Engineer, Advanced Research Center
- Program Manager – Air Force Systems Acquisition and Development
- B.S. Aerospace Engineering
- M.S. Operations Research

Problems with "Traditional" Process Improvement Approaches

Discuss

- Monolithic and cumbersome
  - Process deployment cycles of 6 months to 2 years
  - Deployed processes reflect significant changes
  - Deployed processes often (certainly?) parti d
- Contextually removed from deve eams
  - EPG "ownership" of proces
  - "Real" work is conte ate
  - Necessity fo nge
  - Freq) push-back
- Cost- ient
  - Many changes at once are difficult to "get right"
  - Latent process defects have a long(er) life
  - Training/implementation/institutionalization costs are high
  - Application to new efforts is delayed

Do we HAVE to live with this?

Objectives

- By the end of this tutorial, you will:
  - Understand what Lean SPI is
  - Understand why fast process iterations are critical to successful improvement programs
  - Understand how to apply Lean SPI in organizations that apply lean or agile development approaches
  - Understand how to apply Lean SPI in “traditional”, systemic, plan-based development organizations

But What if We're Already Lean?

- Process improvement efforts by agile and lean development organizations are often:
  - Undocumented or only partially documented
  - Not under "appropriate" configuration management
  - Difficult (impossible?) to coordinate or learn organizationally across development teams
  - Not persistent

Lean SPI

- Follows lean construct,
- within "leaned" CMMI framework,
- with Six Sigma process controls.

Lean SW Engineering Attributes

- Sharp focus on customer value
- Fast iterations? ⇐
- Workflow synchronization
- Early defect removal
- Rapid learning
- Agile project management
- Vision point architecture
- Options thinking and “decide as late as possible”
- High degree of concurrency and communication
- Waste elimination
- Agile engineering support

Aren’t these good things for process improvement as well?

Lean SPI – An Outline

- Focus on the customer
- Kaizen workflow development
- Process improvement iterations
- Lean SPI infrastructure
- Agile SPI management
- Process defect removal
- Summary of CMMI practices and compliance

Principles can be applied to Systems Engineering PI as well…

Focus on the Customer

- Lean view of customer value
  - Does the activity or product have DIRECT value in the eyes of the customer?
    - Configuration management?
    - Quality assurance?
    - Defect tracking/management?
- Lean focus on customer needs
  - Quality function deployment
  - Continuous relationship and listening to customer
  - Fast response to customer needs

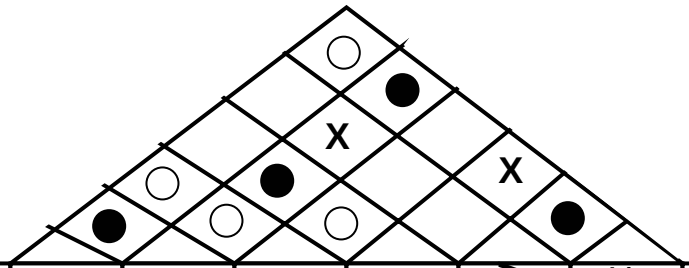
Quality Function Deployment

- Lean/Six Sigma mechanism
- Proven, high value method for understanding customer needs
- Visual mapping to derived technical requirements
- Opportunity to address process quality attributes
  - Speed (of development cycle)
  - Defect profiles
  - Technical domains
  - Deployment of new projects
  - Learning and training constructs

QFD

RELATIONSHIPS:
Strong ●
Moderate ○

INTERACTIONS:
● **Strong Positive**
○ **Mild Positive**
XX Strong negative
X Mild negative



Process Requirements / Customer Needs	Priority	SW Architect	Lean SW Dev.	Strong RSKM	Six σ SPC	Web-base Dev	Agile Proj Mgt	Competitive Evaluation
≤ 6 mo. life cycle	1		●	○	●		●	
No delivered def.	2		○		●			
EA compliant	3	●			○		○	
CMMI compliant	5			○	○			
100% on line	4					●		
Spiral dev. cycles	1	●	●	●	○		●	
Technical Difficulty (1 – 10)		2	9	2	9	5	4	
Importance Rating (1 – 10)		10	10	9	9	9	9	

Lean SPI – An Outline

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Principles can be applied to Systems Engineering PI as well…

Kaizen Workflow Development

- What is a Kaizen team?
- Workflow vs. process
- Definition of current state
- Waste identification
- Definition of ideal state
- Definition of future state
- Lean projects and tasks
- Configuration management and communications

Kaizen Team

- Kaizen is Japanese for “a change for better’”
- Team composition ➡ Process Owners
  - Principal stakeholders
    - Those who will use process
    - Those who will be directly affected by process
- Team charter
  - Chartered by senior management
  - Authority to “do what is needed”
  - Own the process…..forever
  - Resources to do job
- Trained and led/facilitated

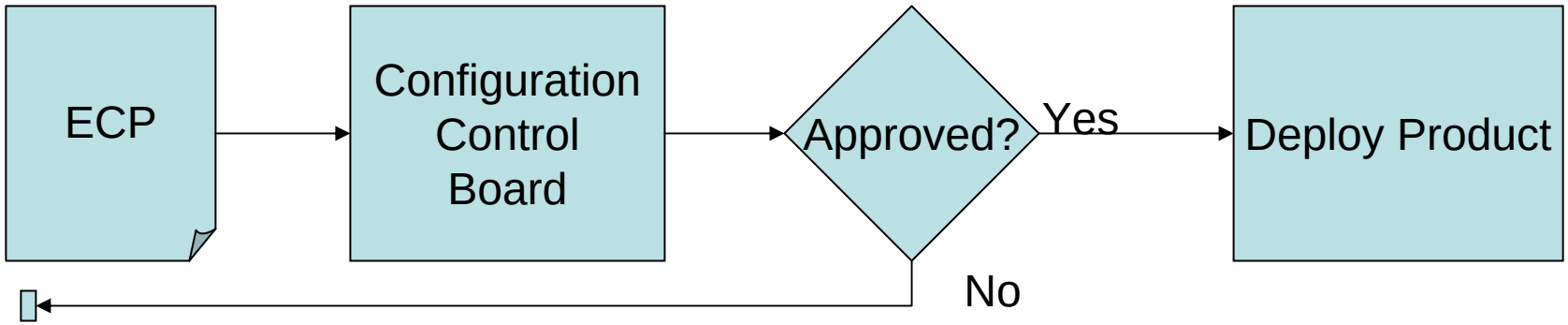
Workflow vs. Process

Discuss

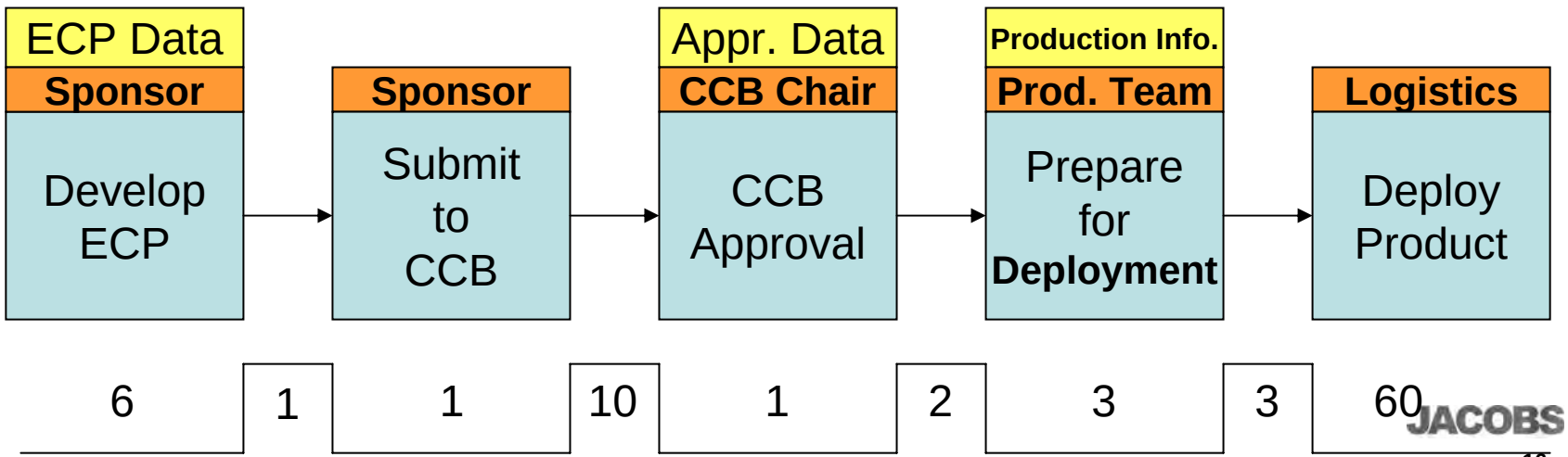
- Workflow:
  - operational aspect of a work procedure
  - describes how tasks are structured
  - who performs tasks
  - what their relative order is
  - how they are synchronized
  - how information flows to support the tasks
  - how tasks are being tracked
  - considers "throughput" as a distinct measure
- Process:
  - sequence in which properties or attributes of a system or object are changed
  - sequence of operations and involved events, taking up time, space, expertise or other resources, leading to the production of some outcome

Workflow vs. Process (CCB Action)

Process :



Workflow



Definition of the “current state”

- Workflow of how it’s being done now
- Don’t worry about warts or things that are broken
- Don’t worry about who’s “at fault”
- Starting from “the right hand side” often useful
  - Start with end product or task and work backword
  - “How did we get this?”
- Discovery:
  - May be the first time the workflow has been defined
  - May be the first time workflow participants know who really does what
- Fully define workflow
  - Who does each task
  - Resources and information used
  - Products produced
  - Performance measures
  - Time to complete (measured or estimated)
  - Takt time (calculated, not measured)
    - German for “rhythm” or “beat”
    - Takt time = Net available time in a day / customer demand per day

Discussion of Current State

- Will often represent a completion time that is (much) longer than the takt time
- Development (and discussion) will reveal some intuitively obvious opportunities for improvement
- Discussion of takt time induces focus on customer needs
- Discussion of information flow is typically revealing
- Early revelations of needs for synchronization

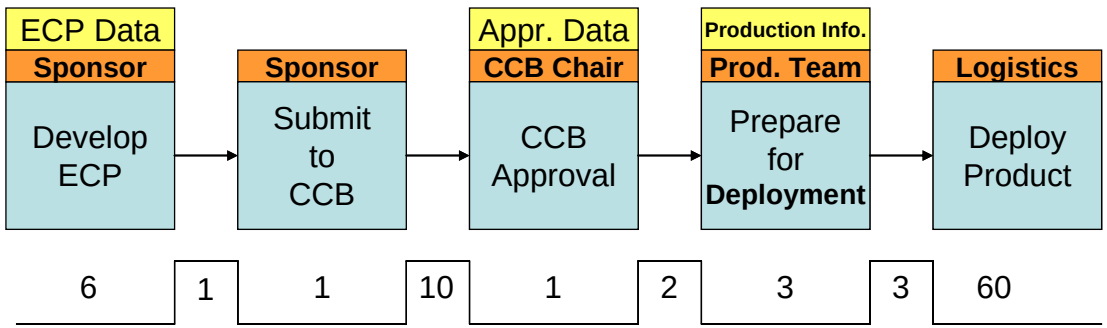
How to you identify “waste” in the workflow?

Identification of Waste (muda)

- Anything that is not of value to the customer CM and QA
- Partially done work
- Extra processes
- Extra features
- Task switching
- Waiting
- Motion
- Defects
- Management activities Lean oversight and approval

Which ones might be “waste” – but still necessary?

This information will be used in the definition of the Ideal State



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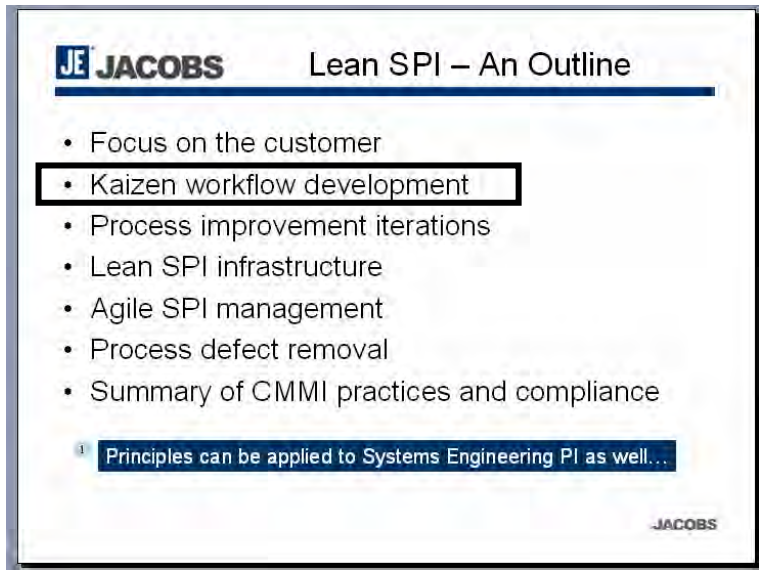

Definition of Ideal State

- Conceptually remove all constraints:
  - Assume authority to “make it the way it should be”
  - No tool or technology constraints
  - Assumes processes are fully developed and stable
  - Assumes information systems are in place and operate with no time delay
- Often requires (re)negotiation of who does what
- All identified waste should be eliminated
  - Anything that is not of value to the customer
  - Partially done work
  - Extra processes
  - Extra features
  - Task switching
  - Waiting
  - Motion
  - Defects
  - Management activities
- Takt time should be met

Which ones would be difficult for programmers?

Which ones would be difficult for managers?

Definition of the (1st) Future State

- Real-world constraints
  - Some things cannot be assumed away
  - Some tools and mechanisms take time to develop
  - Somewhere between current and ideal states
- Aim for real improvement in the near future
  - Improve key performance measures
  - Pay attention to takt time
  - Accept waste with great “regret”
- Fully define future state
- Re-estimate performance measures
- Get absolute commitment of Kaizen team members
- Define tasks, activities, and “projects” needed to put in place
- Kaizen TEAM briefs management for approval

Kaizen Workflow Development

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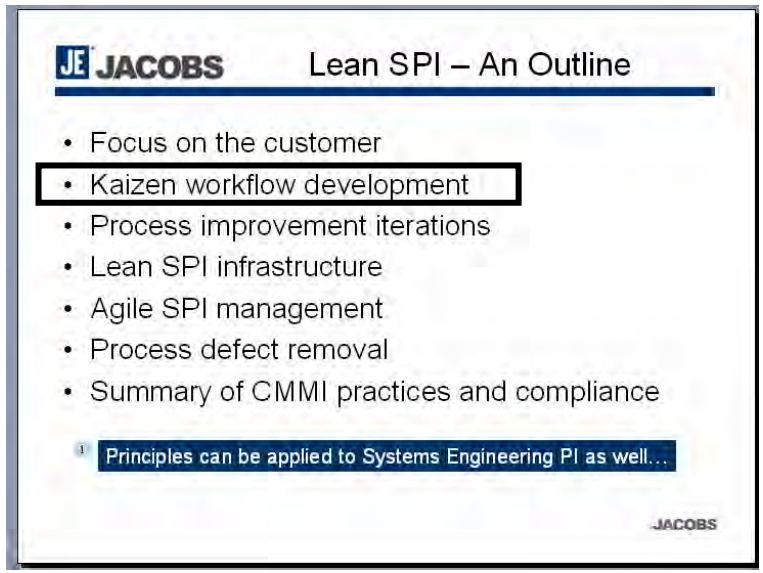

Lean Projects and Tasks

- Things to accomplish to achieve Future State
- Workflows are transformed into processes
- Lean Projects
  - Duration greater than perhaps a few weeks
  - Require significant resources/coordination
  - Complex in nature
    - Tool instantiation for the workforce
    - Definition of kanban visualization metrics
- Lean tasks
  - Simple “to-dos”
  - Track and complete
- All projects and tasks tracked to completion

Configuration Management and Communications

- Kaizen events do not occur in a vacuum
- Kaizen events:
  - Depend on the output products from other Kaizens
  - Produce products that will be used by other Kaizens
- Process configuration management is key
  - Kaizen teams provided authority to work on workflows and processes
  - Respect for CM boundaries crucial
- Communication among Kaizen teams is key:
  - Clarify timing of Kaizen events
  - Understand and manage input/output relationships
  - Respect Kaizen boundaries and “ownership”

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Process Improvement Iterations

- What IS a “process improvement iteration”?
  - A deployment of a standard organizational or define process or subprocess
  - Possible timelines (use flipchart)
    - 3 years
    - 2 years
    - 1 year
    - 6 months
    - 3 months
    - 1 month
  - Includes:
    - tools/mechanisms
    - processes/subprocesses
    - training
    - deployment instructions
- Aren’t frequent process iterations a really bad idea?
  - Don’t project personnel dislike constant change?
  - Aren’t stable processes a good idea?

Lean SPI: SYNCHRONIZE process improvements with lean software development iterations

"Stable" Processes

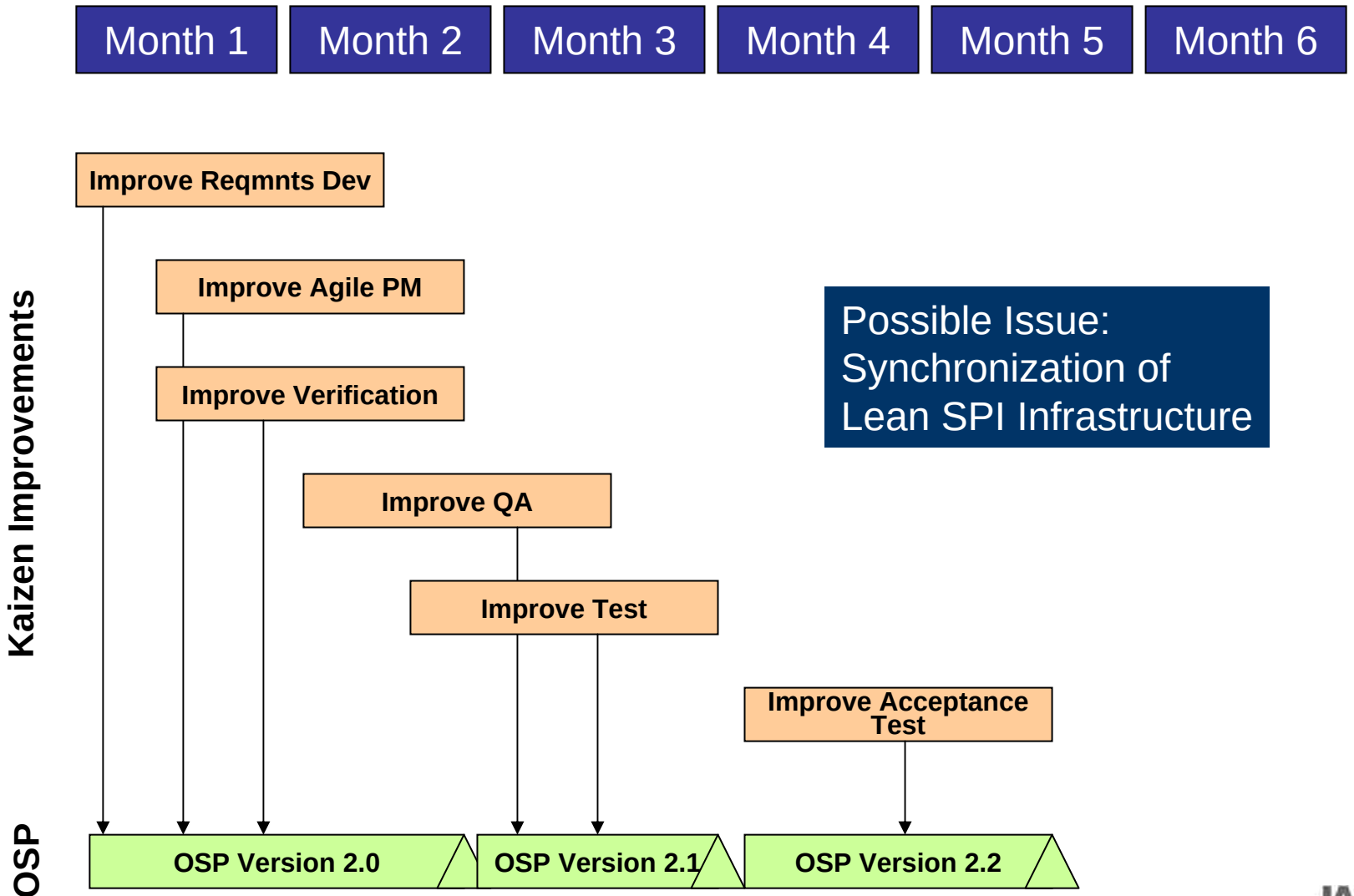
Discuss

- The "layperson's" view
  - Processes should not change, except once in a great while, and we're not so sure about that"
  - "If processes change all the time, how do I know what to do?"
  - "Doesn't constant change cause a lot of inefficiency, and indicate we don't know what we're doing?"
- The Six Sigma (and CMMI) view:
  - Process stability = removal of special causes of variation
    - (Causes that are external to and beyond the scope of the process)
  - Stable process are controlled, but there are degrees of control, e.g.:
    - Variance in defect rates
    - Variance in completion times
- The lean view:
  - Continuous, immediate, piece-meal improvement, by the process owners, is key to success

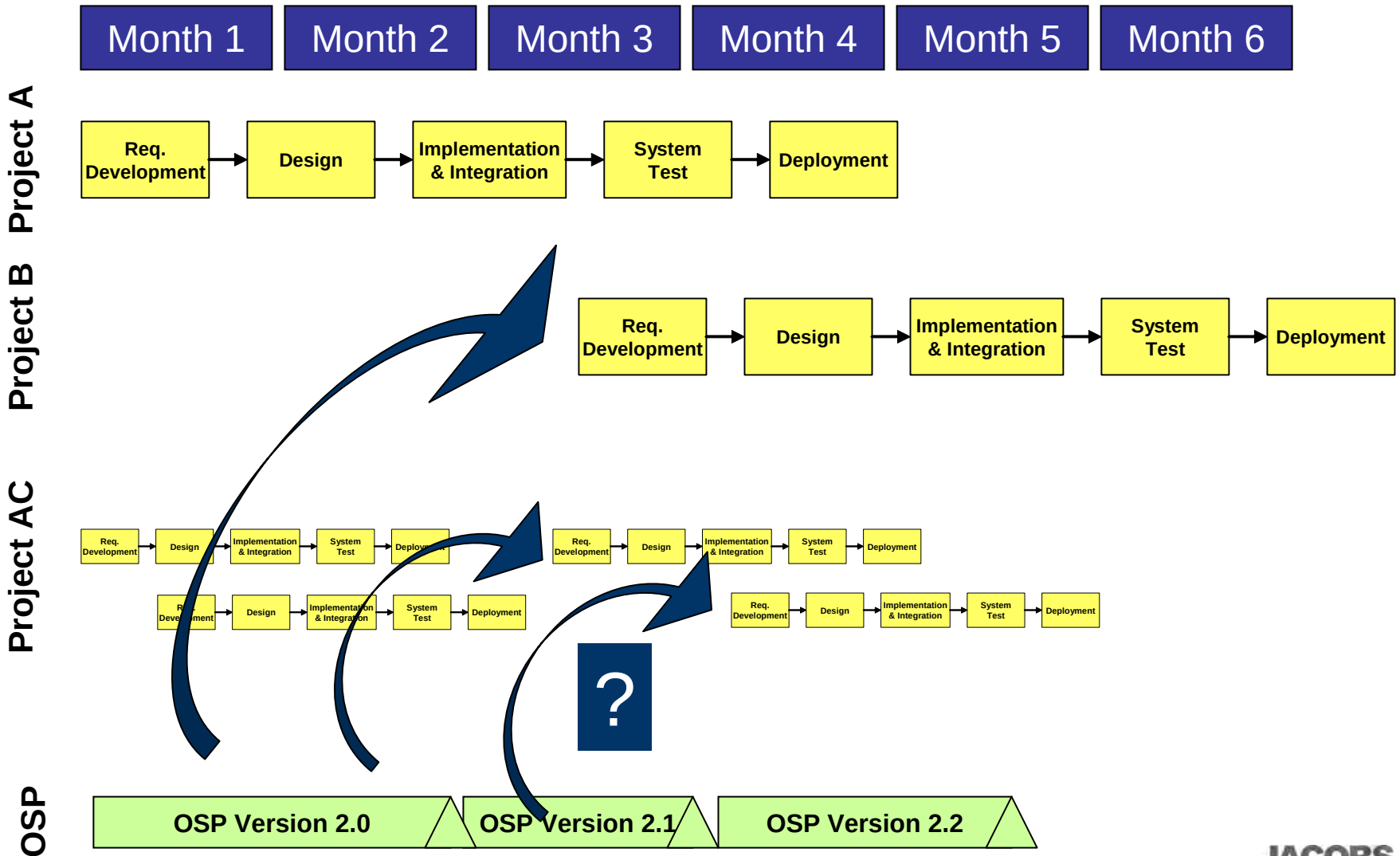
Dealing with Stability

- Education
  - From top to bottom in the organization
  - Continuous
  - Sometimes even works
- Change the expectation:
  - Off-load onerous “training” requirements for @ process iteration
    - On line, JIT training or point-of-use instructions
    - Shared knowledge mechanisms
  - Simple, absolute, unequivocal clarity on who/when will use new process/ subprocess
  - Successes and “lessons learned” in small, quick, improvements
    - Lean improvements, so buy-in is not a problem
    - Implement quickly
    - Institutionalize quickly
    - Advertise the successes
- Let the project or iteration complete the cycle with the process they started with
  - Exceptions MAY occur

Synchronization of PI Iterations (1 of 2)



Synchronization of PI Iterations (2 of 2)



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Lean SPI Infrastructure

- Why do I care about an infrastructure?
- (Organizational) process architecture
- Agile process support
- Concurrency and communications
- Organizational Learning

Why Do I Care? (about an infrastructure)

- I shouldn't care if…
  - I want to re-accomplish my rapid improvements
  - I want Kaizen teams to operate without the benefit of knowledge of other teams' work
  - I don't worry too much about confounding other parts of the process when I fix or improve something
  - I like to do things the hard way….
- I should care if…
  - I want improvements to "click in" to place
  - I want improvements to persist
  - I don't want to confuse the workforce

Lean infrastructure = agile support processes and mechanisms.

Organizational Process Architecture

- Processes
  - Processes
  - Subprocesses
  - Relationships
- Map to technologies
  - Requirements definition and management
  - Design
  - Code construction
  - Test
  - Metrics
  - Oversight……
- Map to mechanisms

The Process Architecture

- Rapid improvement efforts
  - Use to charge Kaizen teams and focus their work
  - Use to migrate input/output of Kaizen teams to the right places
  - Use to conduct process configuration audits

Agile Process Support (1 of 2)

- What is agile process support?
  - "Pulled" by kanban visualization
  - Fully prepared to act when "pulled"
    - "Pull the trigger"
  - Get
  - Cap
    - or take
    - acti
- What
  - Kaizen events
  - Improvement task or activity support
  - Strategy sessions
  - Process configuration management actions
  - Process QA actions
  - Process verification and validation actions

Who leads and executes lean SPI efforts (e.g. Kaizens)? Who "owns the process"?

Agile Process Support (2 of 2)

- Kaizen events
  - Instantiate (respond) quickly to the problem
  - Conduct in an orderly, well-prepared manner
    - (Kaizen process, mechanisms, tools, are in place)
  - Build out-brief quickly (hours) and get full consensus
  - Provide output products quickly (a day or less)
- Process configuration management actions
  - Kanban pulled trigger to accomplish configuration audit
  - Immediate reporting of CM audit results to stakeholders
  - Mechanisms and oversight to close CM defects in hours or days
- Process QA actions
  - Kanban pull process and work product audits]
  - Audit quickly, targeting planned audit items and using criteria
  - Report audit results on the spot to all affected stakeholders & mgt
  - Provide mechanisms and oversight to close defects in hours or days

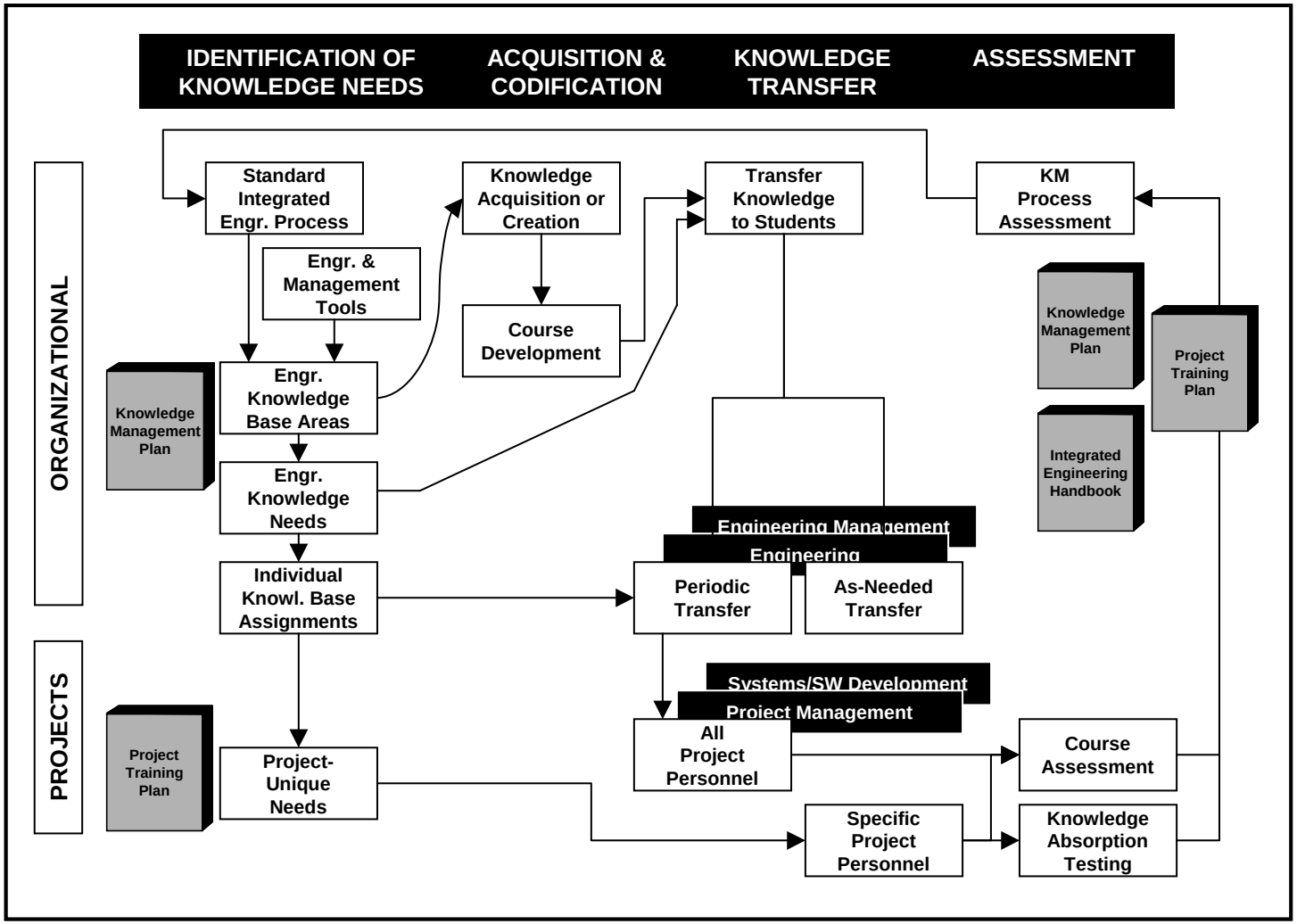
Concurrency and Communications

- Lean SPI invokes a higher standard
- Relevant stakeholders are aware of events and activities (and their roles) in minutes or hours
- Communications are pushed whenever possible
  - Supports rapid decision making
  - Enables immediate instantiation of follow-on activities
- Examples:
  - Electronic status boards
  - Email trigger for desk top notification
  - Cellular notification
- Kaizen events mandate buy-in (and support) of team members for Kaizen decision and products

Organizational Learning

- Classroom learning is an anti-pattern to lean learning constructs
  - Relatively long preparation times
  - Relatively inefficient knowledge transfer/assimilation
    - Difficult to get attention and engagement
    - Cost inefficient
  - Relatively disruptive to the flow of work
    - Let's stop and learn(!!)
- What other (faster and more continuous) ways are there to learn?
  - Learn during Kaizen events
  - Team members investigation and knowledge-sharing
  - Knowledge base development/ knowledge mgt.
  - Lessons learned sharing and implementation in process
  - Immediate sharing of quality audit results across organization
  - Immediate sharing of CM audit results across organization

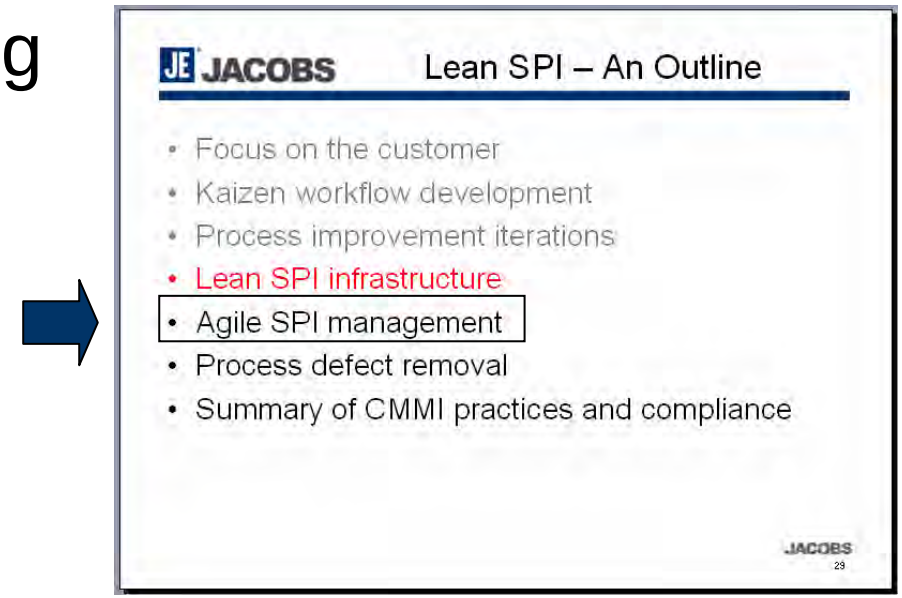
An Example


IDENTIFICATION OF KNOWLEDGE NEEDS
ACQUISITION & CODIFICATION
KNOWLEDGE TRANSFER
ASSESSMENT
ORGANIZATIONAL
PROJECTS
Standard Integrated Engr. Process
Knowledge Acquisition or Creation
Transfer Knowledge to Students
KM Process Assessment
Engr. & Management Tools
Course Development
Knowledge Management Plan
Project Training Plan
Integrated Engineering Handbook
Knowledge Management Plan
Engr. Knowledge Base Areas
Engr. Knowledge Needs
Engineering Management
Engineering
Individual Knowl. Base Assignments
Periodic Transfer
As-Needed Transfer
Systems/SW Development
Project Management
Project Training Plan
Project-Unique Needs
All Project Personnel
Course Assessment
Specific Project Personnel
Knowledge Absorption Testing

Lean SPI Infrastructure

- Why do I care about an infrastructure?
- Process architecture
- Agile process support
- Concurrency and communications
- Organizational Learning

This completes discussion of Lean SPI Infrastructure



Lean/Agile Project Management

- Seeing waste
- Value stream mapping
- Feedback
- Iteration leadership/management
- Options thinking
- Last responsible moment decision making
- Pull/Kanban systems and measurements
- Cost of delay awareness
- Self determination/team empowerment
- Motivation and leadership
- Technical expertise
- Refactoring (design against more stable architecture)

How would these apply to SPI management?

Agile SPI Management

- Remain sharply focused on the needs of the customer(s)
  - Reassess customer needs continuously
  - May (will probably) change over time
    - Sometimes quickly
  - Understanding of customer needs will get better
- Ensure development “heroes” are in lean leadership positions
- Listen to the software development workforce
  - Kaizen improvements should be initiated within the workforce
  - Support workforce resolution of problems and implementation of improvements (agile support)
- Improve and continuously tune the process architecture
- Make “last responsible moment” investment decisions
  - In Kaizens or other improvement efforts
  - In technologies

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Process Defect Removal

- Lean focuses sharply on identification and removal of defects at the earliest possible moment
- Fast, “immediate” removal of defects is the goal
  - Ver/val of process elements prior to deployment
  - QA and CM audits yield defects
  - Process simulation can reveal defects
- Rapid, continuous improvement provides continuous opportunities to remove defects
- Six Sigma defect elimination
  - DMAIC cycle
  - Process control (reduction in variation = fewer defects)
- Poka Yoke (mistake proof) – mechanisms to eliminate the possibility of defects
  - Well constructed checklists
  - Coding rules
- Muda - waste elmination

CMMI Summary

- Lean SPI processes are Managed processes
  - Process relationships are tracked
  - Voice of the customer and stakeholders are key
- Lean SPI processes under six sigma control are quantitatively managed processes
- CMMI-DEV process areas most germane to this discussion:
  - OPF
  - OPD
  - OT
  - OID

Lean SPI view of OPF

Purpose
The purpose of Organizational Process Focus (OPF) is to plan, implement, and deploy organizational process improvements based on a thorough understanding of the current strengths and weaknesses of the organization's processes and process assets.

SP 1.3 Identify the Organization's Process Improvements
Identify improvements to the organization's processes and process assets.

Improvements identified primarily by customers and process owners

SP 2.1 Establish Process Action Plans
Establish and maintain process action plans to address improvements to the organization's processes and process assets.

Kaizen team charters/plans and six sigma project plans

SP 3.4 Incorporate Process-Related Experiences into the Organizational Process Assets
Incorporate process-related work products, measures, and improvement information derived from planning and performing the process into the organizational process assets.

Near real time, thru metrics, Kaizen events, lessons learned

Lean SPI view of OPD

Purpose
The purpose of Organizational Process Definition (OPD) is to establish and maintain a usable set of organizational process assets and work environment standards.

SP 1.5 Establish the Organization's Process Asset Library
Establish and maintain the organization's process asset library.

.

The PAL is responsive and supports rapid improvement

SP 2.1 Establish Empowerment Mechanisms
Establish and maintain empowerment mechanisms to enable timely decision making.

Kaizen teams, kanban visualization, poka yoke, muda

Lean SPI view of OT

Purpose
The purpose of Organizational Training (OT) is to develop the skills and knowledge of people so they can perform their roles effectively and efficiently.

An informative element:

Certain skills may be effectively and efficiently imparted through vehicles other than in-class training experiences (e.g., informal mentoring). Other skills require more formalized training vehicles, such as in a classroom, by Web-based training, through guided self-study, or via a formalized on-the-job training program. The formal or informal training vehicles employed for each situation should be based on an assessment of the need for training and the performance gap to be addressed. The term "training" used throughout this process area is used broadly to include all of these learning options.

Lean SPI view of OID

Purpose
The purpose of Organizational Innovation and Deployment (OID) is to select and deploy incremental and innovative improvements that measurably improve the organization's processes and technologies. The improvements support the organization's quality and process performance objectives as derived from the organization's business objectives.

SP 1.1 Collect and Analyze Improvement Proposals
Collect and analyze process- and technology-improvement proposals.
.

"Collect" – some over time, most perhaps near-real-time

SP 1.2 Identify and Analyze Innovations
Identify and analyze innovative improvements that could increase the organization's quality and process performance.

But keep it Lean – focused on customer value and fast

SP 1.3 Pilot Improvements
Pilot process and technology improvements to select which ones to implement.

High risk improvements or technologies, Design of Experiments process control

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- Process i
- Lean SPI
- Agile SPI
- Process c
- Summary of CMMI practices and compliance

We are done!

Questions?

Contact Information

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Please see our web site for additional information and references.
http://www.jacobstechnology.com/cmmi/welcome.htm

Are we Ready for CMMI®? If not, Let's Fix Ourselves

CMMI®
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Agenda

- Introduction
- Dysfunctional/Stove Piped Organizations - Associated Problems
- A Solution - Organizational Analysis
- Organizational Structures
- Organizational Analysis Elements
- The Big Picture - How an Organizational Analysis is Conducted
- Organizational Analysis Example 1
- Organizational Analysis Example 2
- Summary
- Reference
- Questions/Answers/Discussion/Comments
- Contact Information

Introduction

- In order for organizations to change and improve the way they conduct business they have to be ready to accept change
- Before attempting process improvement, or other initiatives such as integrating systems of systems, organizations need to determine if they are ready for change
- When new initiatives are attempted in organizations that are not prepared to accept change the efforts are doomed to fail
- This is demonstrated by many recent incidences of:
  - Failures while developing large complex systems
  - Lack of information sharing among agencies
  - Inability to integrate large weapons system
  - Etc., etc., etc.

The problems tend to be SOCIAL rather than TECHNICAL

Introduction (cont.)

- Many commercial and Government organizations and agencies are stove piped and dysfunctional
- Organizations may be in chaos and disarray and may not function as cohesive, seamless units
- Problems may include the inability of organizations to communicate, take responsibility and ownership, synchronize and synergize, communicate and share information
- Many times organizations reorganize when they encounter issues and problems
  - This really does not fix the problems
    - They remain and become the problems of the new organizational structure and of new management
    - They may be further hidden where they become graver and are more difficult to identify

[1] In a recent interview concerning intelligence sharing, Marine Corps General James Cartwright, Commander USSTRATCOM, stated that the greatest obstacle is not technology but culture - "It's not a technical issue any more," he said. "It's really more about culture and the need to share rather than the need to know." A critical aspect of the net-centric environment involves the human interface component.

Introduction (concl.)

- When integrating stove piped legacy **systems-of-systems** we tend to concentrate on technical issues associated with:
  - Interoperability
  - Interfaces
- We are not recognizing that major problems are associated with organizations that own these stove piped systems that are:
  - Themselves stove piped
  - Many times dysfunctional
- What needs to happen first is that organizations need to:
  - Get rid of this stove piping
  - Fix their dysfunctional states
- Only then can legacy systems be integrated into systems-of-systems

The problems tend to be SOCIAL rather than TECHNICAL

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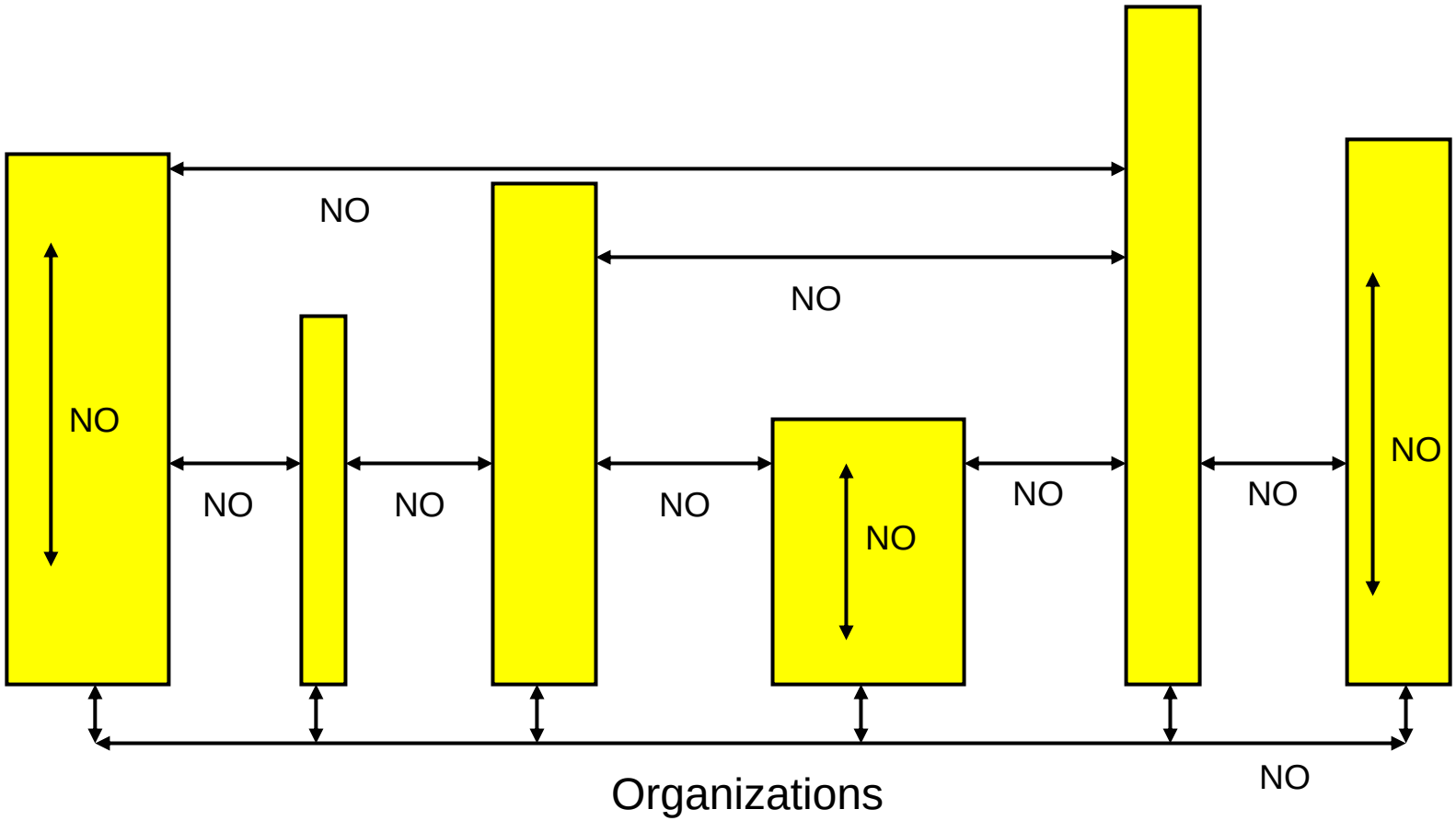
Characteristics of a dysfunctional Organization

What are the Characteristics of a Functional Organization?

Antithesis of a Dysfunctional Organization

Stove Piped Organizations

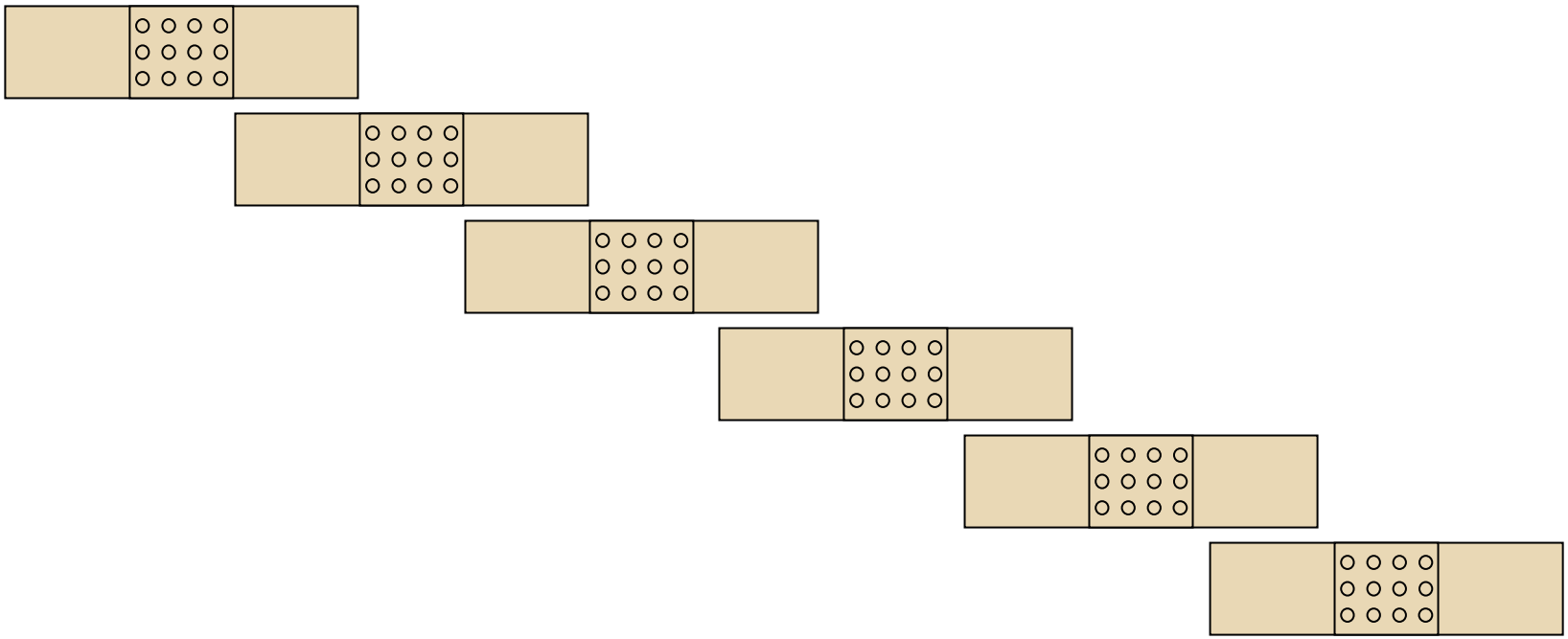
Cooperation/Communications/Information Sharing?



What we have here is a failure to communicate. *I can't believe I said that!*

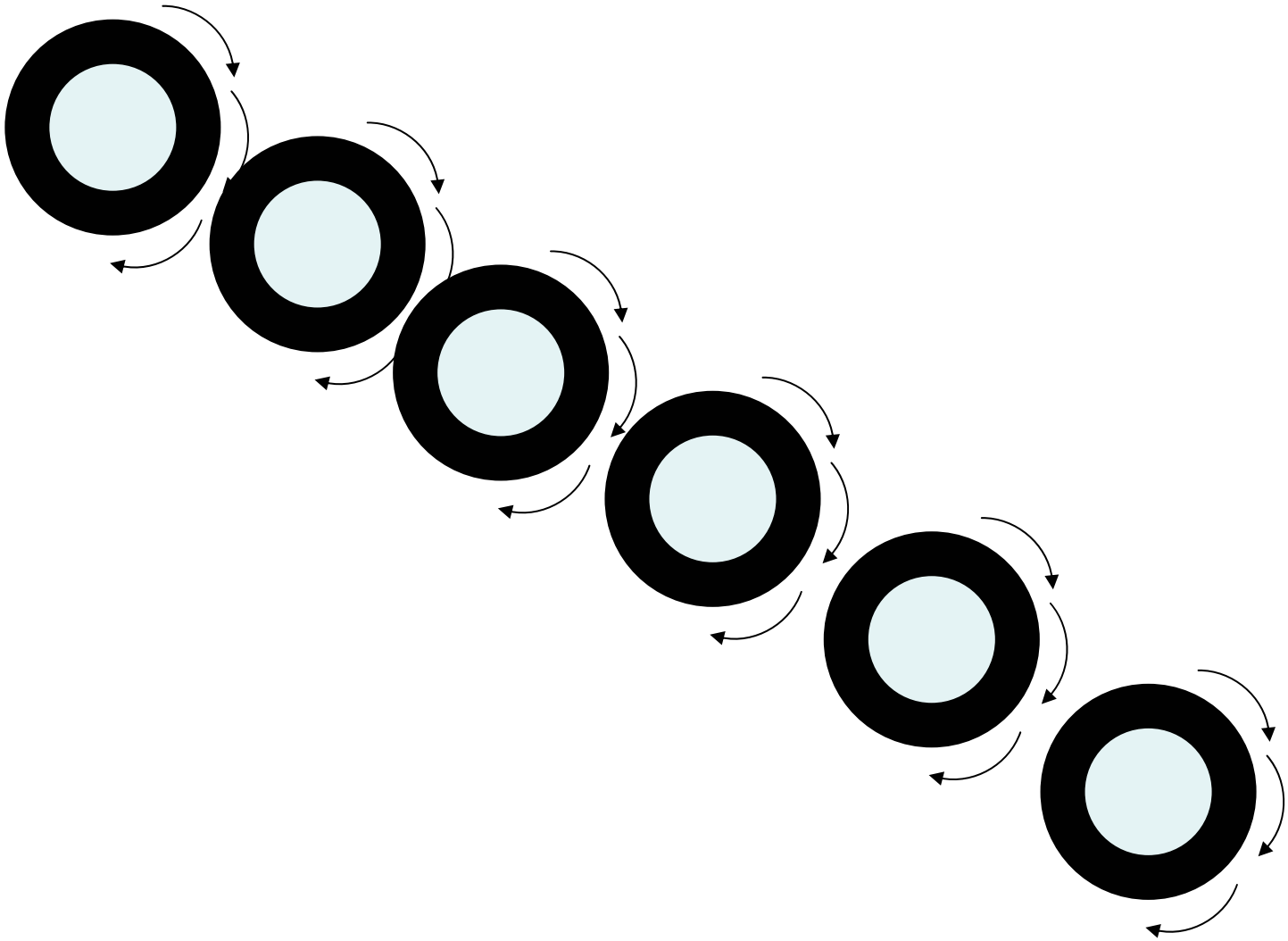
Attempting to do PI in a Stove-Piped Dysfunctional Organization

Results in: **Band-Aiding the problems**



Band-Aids Fall Off

And in Spinning Your Wheels



And failure!

And failure!

And failure!

And failure!

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A Solution

- Get to the root causes of the problem(s), fix the organization - Conduct an Organizational Analysis

What is Organizational Analysis?

- An organizational analysis is an assessment of an organization to determine the current “As-Is” state of the organization, to propose a “To-Be” state, and to develop a plan and schedule to achieve the desired state
- The intent is to uncover and correct root causes of problems and break down barriers which prevent organizations from functioning as cohesive and seamless units. This results in an organization where:
  - Information is shared
  - Communications are wide spread
  - Roles and responsibilities are assigned
  - Ownership is accepted
  - Accountability is exercised
  - Synergism is the rule
  - Re-work is minimized
  - Bureaucracies are non-threatening
  - Cost and schedules are adhered to
  - Disarray and chaos are non-existent
  - Fire-fighting is minimized

Where Are We?

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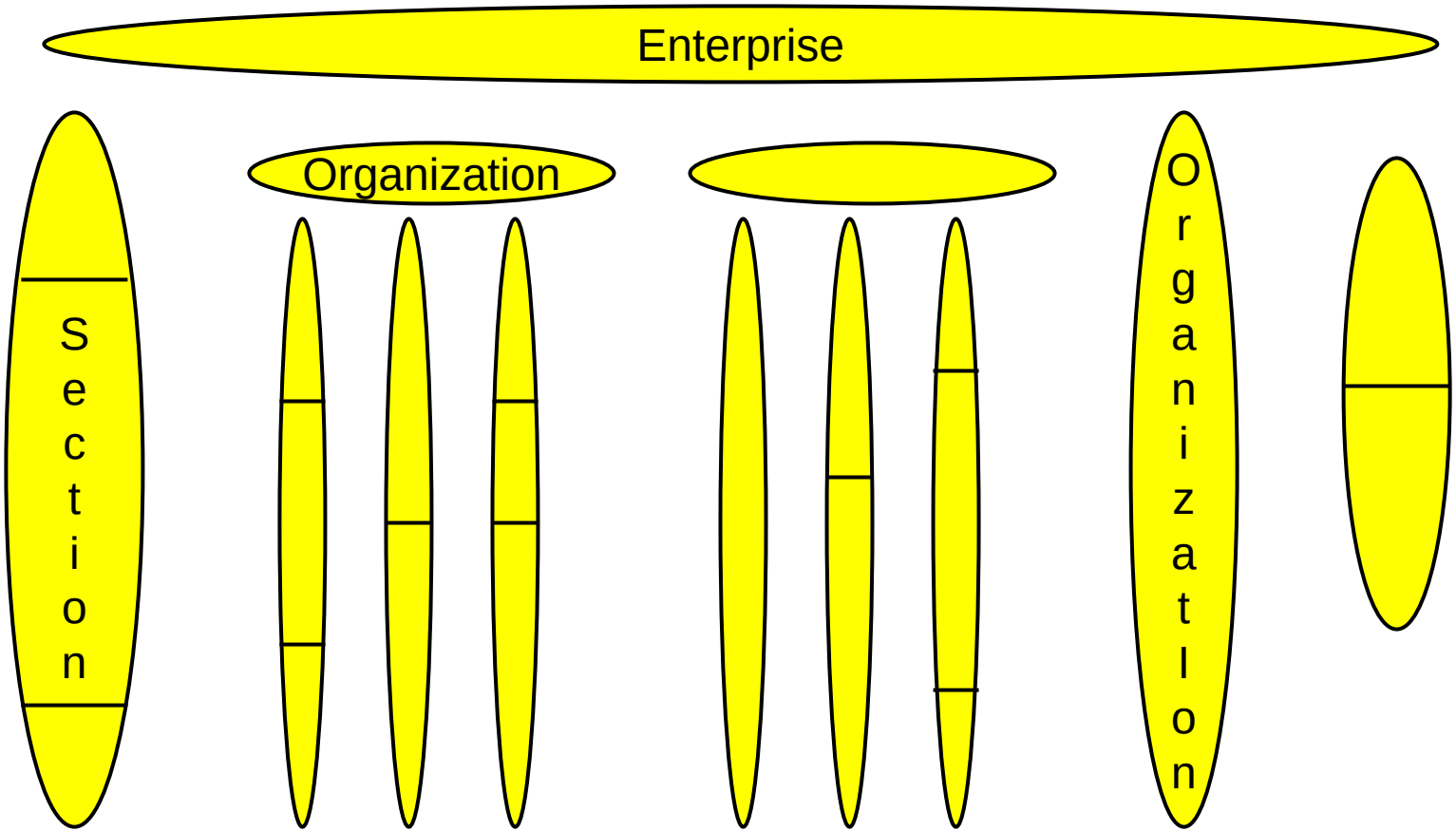
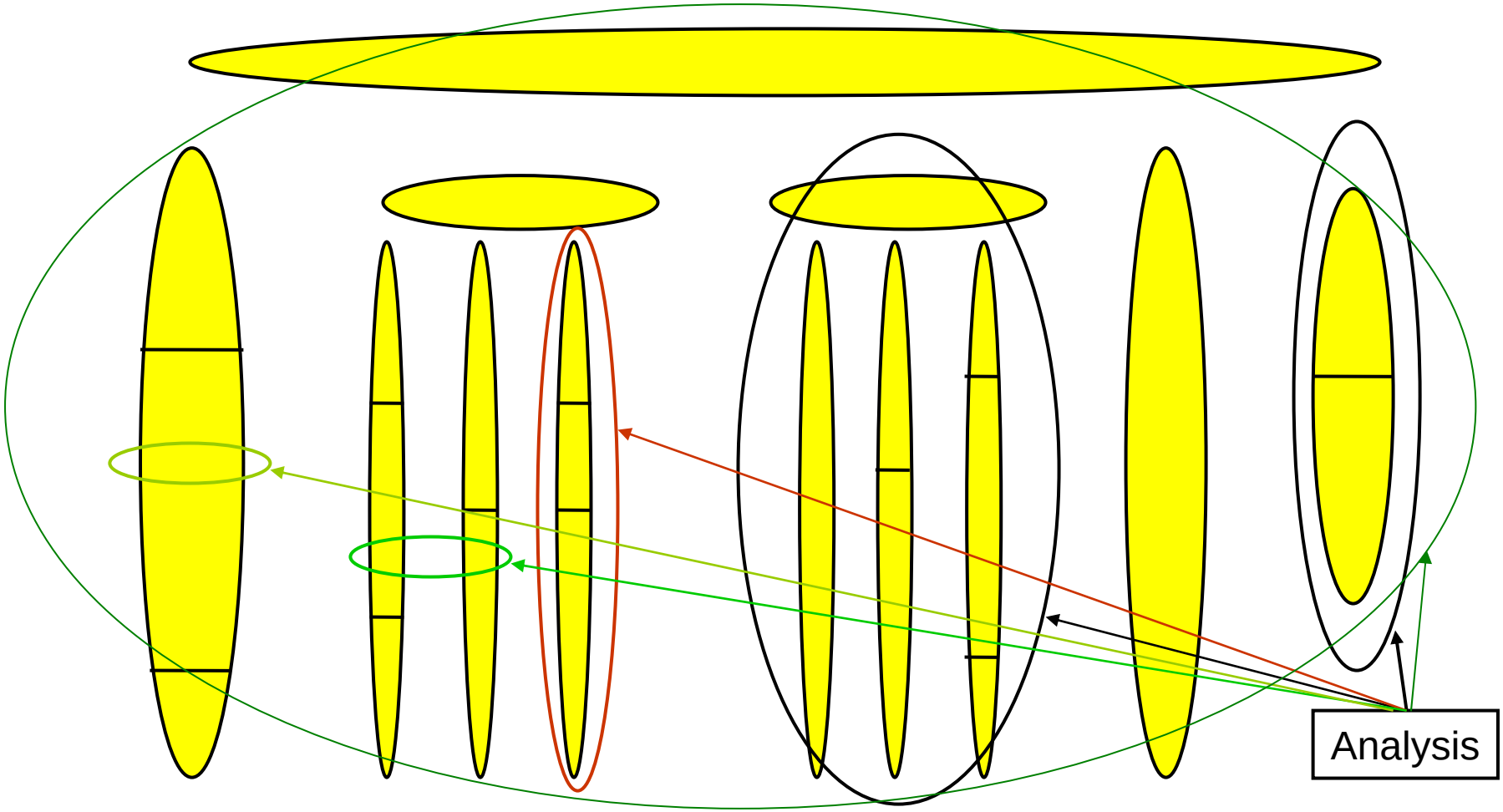
Configuration of Organizations

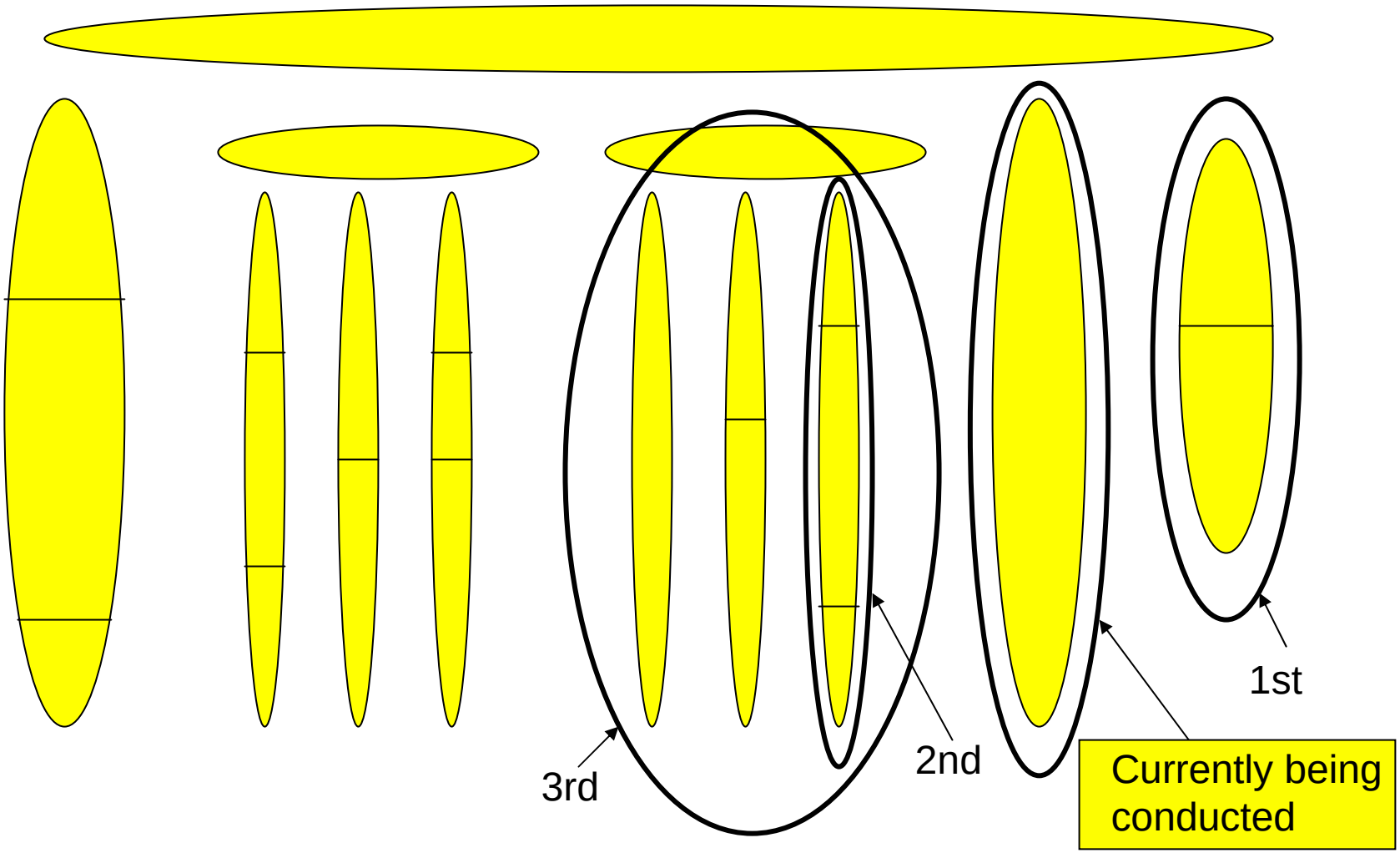


Levels of Organizational Analysis



Organizations analysis can be accomplished at various levels of the organization(s)

Organizational Analyses Conducted



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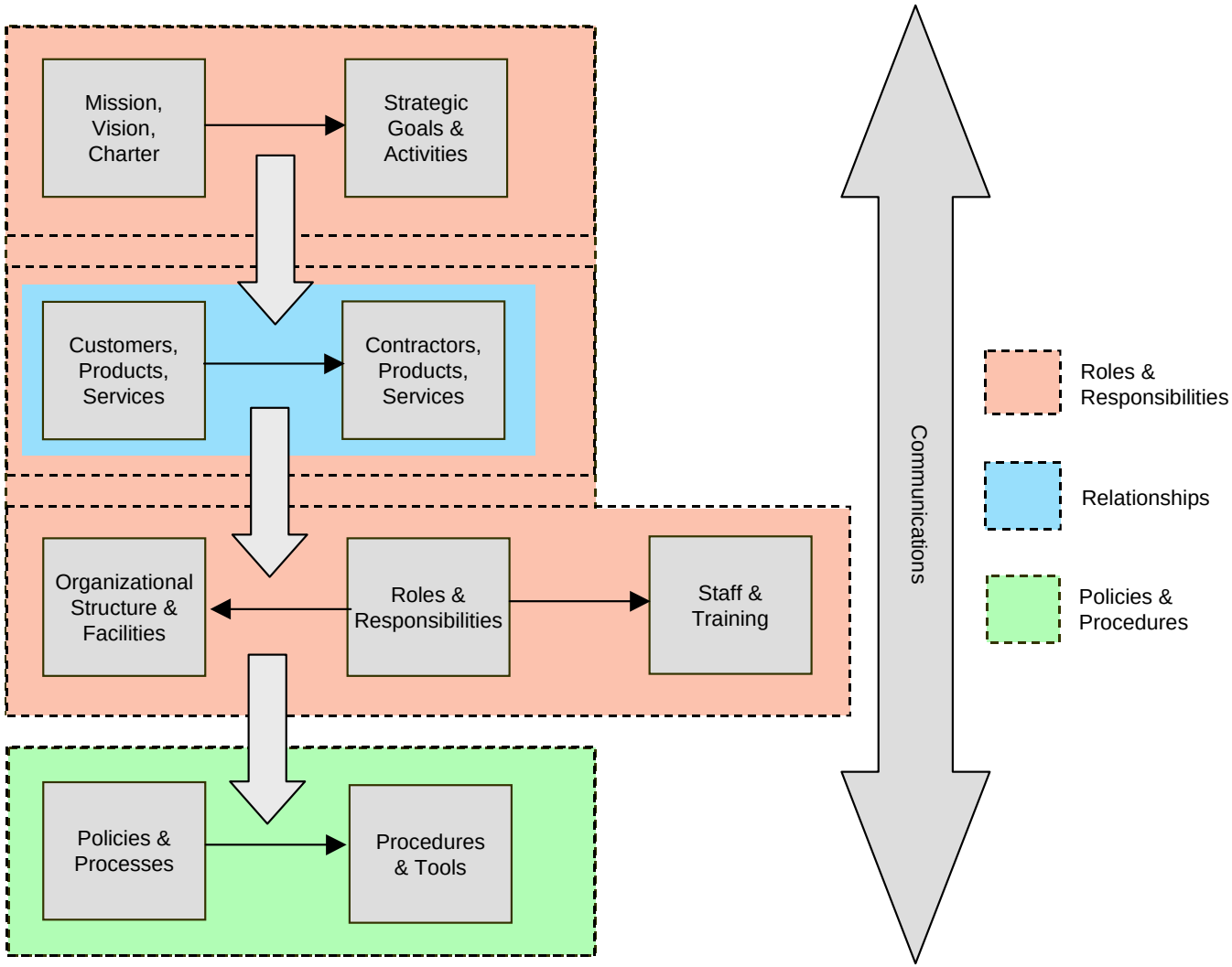
What Elements are investigated during an Organizational Analysis?

- Mission
- Vision
- Strategic Goals
- Charters
- Organizational Structures
- Contractors
- Suppliers
- Customers
- Stakeholders
- Products
- Services
- Roles
- Responsibilities
- Activities
- Accountability
- Ethics
- Communications
- Information Sharing
- Facilities
- Resources
- Tools
- Personnel
- Skills
- Training
- Policies
- Processes

NOTE: not all these need to be investigated in any one Organizational Analysis
These can be used as a “shopping list” to determine the scope of a specific Organizational Analysis

What Elements are investigated during an Organizational Analysis? (concl.)



Some Organizational Elements Defined

- **MISSION -** The mission of an organization relates top-level business objectives that an organization is chartered to accomplish and support. The mission is usually reflected in a succinct and precise statement that the organization constructs, endorses, and follows.
- **VISION** – The vision is where the organization desires to advance itself in the future in relation to expanding or changing its mission.
- **STRATEGIC GOALS** – Strategic goals are high-level goals that the organization has to achieve in order to meet its mission and vision.
- **CONTRACTORS** – Contractors provide products and/or services to the organization.
- **CUSTOMERS** – The organization's customers are those that receive products and/or services from the organization.

Some Organizational Elements Defined (cont.)

- **KEY STAKEHOLDERS** – Key individuals or groups that have a vested interest in the activities, products and services of your organization.
- **ACTIVITIES** – Actions that need to be executed and accomplished in support of developing, acquiring, and maintaining products and services.
- **ROLES** – The function and position of individuals and their expected behavior within the organization and with other stakeholders.
- **RESPONSIBILITIES** – Things for which individuals within the organization are responsible such as duty, obligation, and burden.
- **STAFF** – The individuals within the organization that need to have the appropriate skills and experience to satisfy their assigned roles and responsibilities.
- **TRAINING** – The training required to ensure that the staff obtains the required skills to satisfy their roles and responsibilities.

Some Organizational Elements Defined (cont.)

- **TECHNOLOGY INSERTION** – Keeping up with technology innovations and the insertion of advanced technologies into the work environment and products.
- **ETHICS** – The rules and standards that govern the conduct of members of an organization and the general nature of morals and of the specific moral choices made by individuals in relationship to others.
- **COMMUNICATIONS** – The ability of individuals within the organization to communicate with each other, with interfacing organizations, and with other stakeholders. Open and clear lines of communications are necessary for individuals to adequately perform their roles and responsibilities.
- **INFORMATION SHARING** – The ability of organizations to share valuable information within the organization, with stakeholders, and with interfacing organizations.

Some Organizational Elements Defined (cont.)

- **PROCESS** – The key activities that individuals conduct day-to-day to satisfy their roles and responsibilities and to produce or acquire products and services. Processes need to be documented, consistent and repeatable for both technical and management activities. Examples are processes for requirements management, configuration management, quality assurance, project planning, and risk management.
- **PROCEDURES** – Instructions that individuals follow in the execution of a specific process including the steps necessary to accomplish the activities within the process.
- **STANDARDS** – DoD or industry regulations that are required to be addressed when developing or acquiring products and services. Examples are documentation standards, safety standards, security standards, performance standards, and quality standards.

Some Organizational Elements Defined (concl.)

- **FACILITIES** – Physical building and rooms where the organization is housed including furniture and the proximity of individuals to each other.
- **RESOURCES** – Items required to ensure that staff can accomplish their roles and responsibilities, to develop and receive products and services, and to execute assigned activities. Examples of resources are budgets, funding, equipment, tools, and administrative support.

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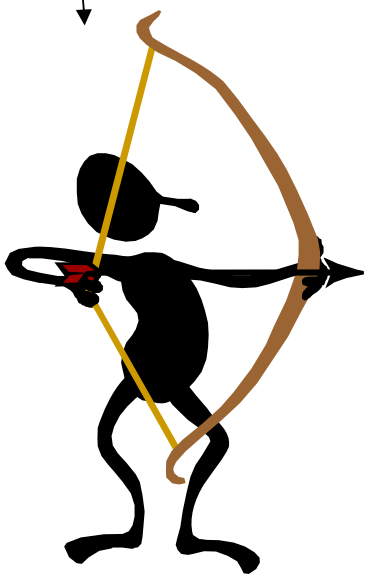
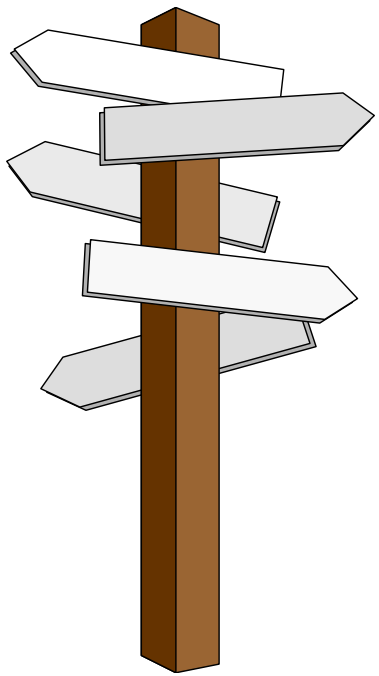
The Big Picture

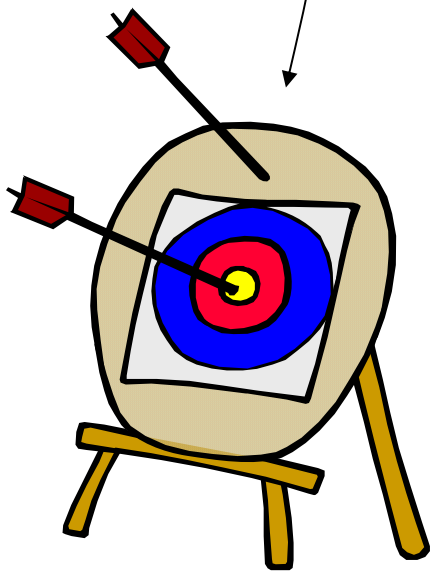
Where are you now?

Where do you want to get to?

What's the best way to get there?







How is an Organizational Analysis Conducted?

- Get agreement with the organizations to do an organizational analysis
- Develop a plan for the analysis to include:
  - Objective of analysis
  - Elements to review
  - Schedule for analysis
  - Identification of participants
- Request documentation/artifacts on elements for review
- Construct
  - Questionnaire and/or
  - Interview questions

  On organizational elements
- Interview and/or send out questionnaire to:
  - Executives
  - Managements and leads
  - Key staff members
  - Key stakeholders

Question may be different for executives, managers, staff and stakeholders

How is an Organizational Analysis Conducted? (concl.)

- Questions need to include:
  - What is the current state?
  - What do you think the future state should be?
    - What do you want to be when you grow up?

Results in an “As-Is” state and a proposed “To-Be” state of the organization

Organizational Analysis Questionnaire

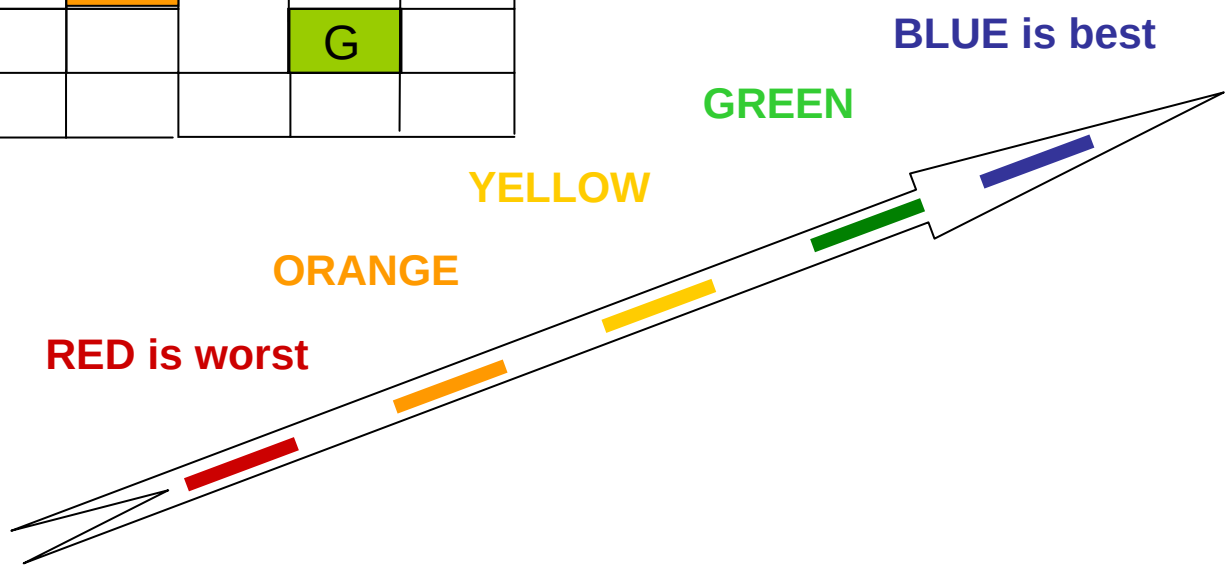
- An example of typical questions asked about Strategic Goals:
  - Does the organization have strategic goals?
  - Do you know what the strategic goals of the organization are?
  - Are the strategic goals well published?
  - Does staff receive exposure to the strategic goals?
  - If there are no strategic goals what do you think they should be?
  - Please provide additional comments
    - Will not be attributed to individuals

Important that it is understood that responses are not attributed to Individuals in order to obtain honest results

Results can be Depicted in an Executive Dashboard

Mission		O			
Vision			Y		
Strategic Goals					B
• • •					
Policies	R				
Processes		O			
Procedures				G	
• • •					

Analysis of the responses results in an “As-Is” State of the Organization



Next the organizations prioritizes the elements in order of importance (As-Is state analyses and prioritization shown later in example)

Next

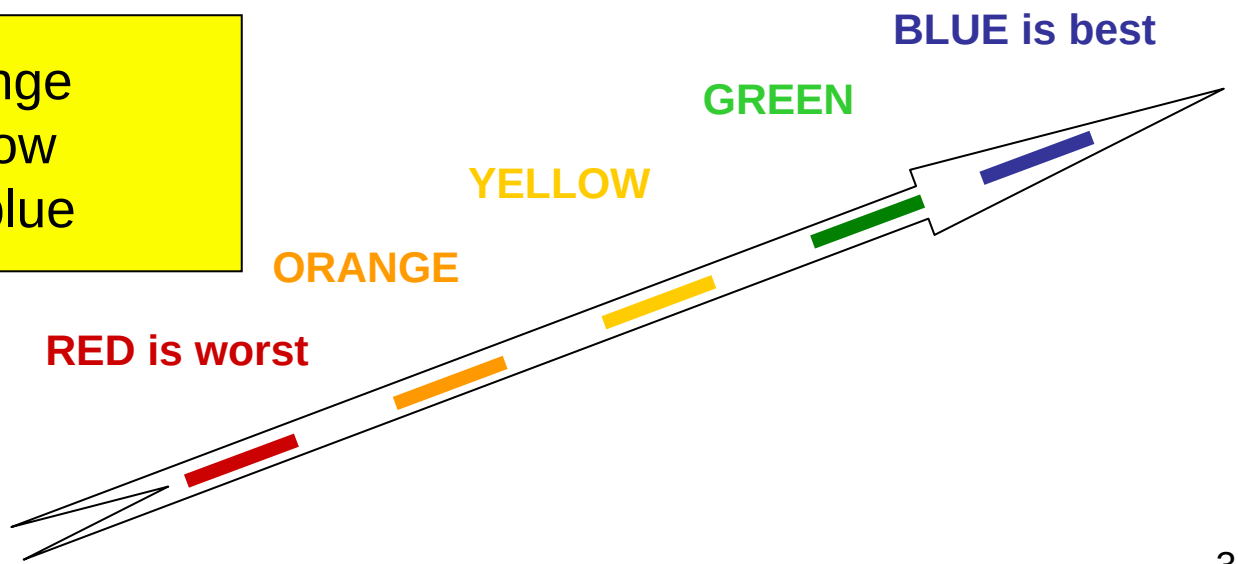
- Resolve misunderstandings/issues/conflicts in the results. May require:
  - Brain-storming sessions
  - Additional objective non-attribution investigations
    - Questionnaires
    - Interviews
- The respondents agree on the results
- Evaluate Priorities vs. Executive Dashboard results
- Develop a “To-Be” strategy and plan
  - Based on the evaluation of Priorities/Executive Dashboard/Comments Received
    - Near term plan
    - Mid term plan
    - Long term plan
- Execute plan

Misunderstandings, issues, and conflicts may be due to not understanding the questions, difference of opinions among respondents, further clarification of the current state, etc.

Use of Priorities vs. Executive Dashboard

- Where a high priority item rates low in the dashboard
  - May be selected for near term plan
- Where a mid priority item rates medium in the dashboard
  - May be selected for mid term plan
- Where a low priority item rates high in dashboard
  - May be selected for long term plan
  - May not be selected for plan

Low red, orange
Medium yellow
High green, blue



Comments Provided

- Can be used
  - To develop an understanding of organizational issues
  - As stepping stones for further discussions and ideas gathering
  - To harvest ideas for “To-Be” state
  - To support development of “To-Be” plan

The examples that follow will provided additional insight into the conduct of an Organizational Analysis

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Example 1

- At a working session with a new DoD client, while starting to implement CMMI using a FAS*Track*[3] approach it was mentioned that the Director was planning to reorganize the organization
- I mentioned that too often organizations reorganize for the wrong reasons especially when things are not going right
  - They think that reorganizing solves problems
  - What really happens is that they are masking the problems and not getting to their root causes
- I mentioned that I had conducted Organizational Analysis (OA) on organizations to uncover root causes of problems, fix them, and prevent them from recurring

FAS*Track* is a method to quickly implement change in an organization avoiding the many impediments that plague change

Example 1

- I briefly explained what an Organizational Analysis (OA) is
  - I mentioned that an OA may discover that a reorganization may not be necessary
  - But if reorganization is necessary, they now have a valid reason and a road map for this reorganization
- They got excited and suggested that I present my approach to the Director
- A meeting was arranged and I pitched my OA approach
- At first she hesitated
  - Was initially apprehensive about what she might learn
- Later she was willing to accept the consequence
  - Asked me to conduct the OA

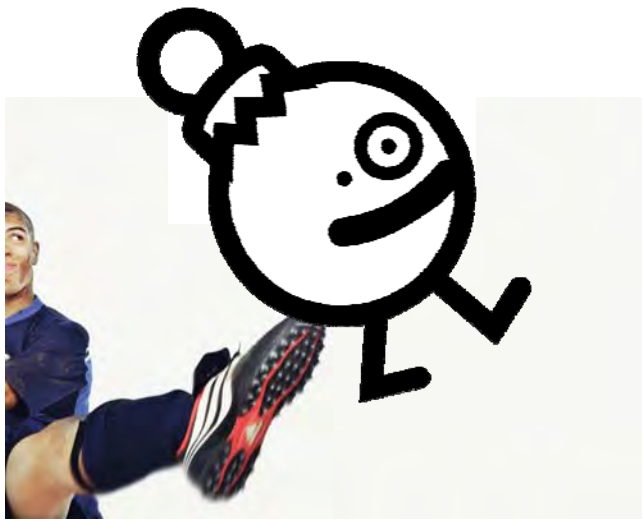
Example 1

Very Important

When explaining OA you need to state that you do not mean to Imply that:

- Their organization is stove piped and/or dysfunctional, ***BUT:***
  - Most suffer from some of the symptoms presented
  - Any one or any number of these may be impediments to change

This is very important unless you want to get *kicked out* of their office



Example 1

Questionnaire Developed

- Only questionnaire used
- No interviews conducted
- This method is faster and less intrusive than interviewing
  - But does not yield as much information
- The following 20 elements were in the questionnaire:
  - Mission
  - Vision
  - Strategic Goals
  - Contractors
  - Customers
  - Key Stakeholders
  - Activities
  - Roles
  - Responsibilities
  - Staff
  - Training
  - Technology Insertion
  - Ethics
  - Communications
  - Information Sharing
  - Process
  - Procedures
  - Standards
  - Facilities
  - Resources

Example 1

Questionnaire Sent Out

ORGANIZATIONAL ANALYSIS QUESTIONNAIRE

An organizational analysis is an assessment on an organization to determine the current "As-Is" state of the organization, to propose a "To-Be" state and to develop a plan and schedule to achieve the desired state. The intent is to uncover and correct root causes of problems that may exist which prevent an organization from functioning as a cohesive and seamless unit where:

- Information is shared
- Communications are wide spread
- Roles and responsibilities are assigned
- Ownership is accepted
- Accountability is exercised
- Synergism is the rule
- Re-work in minimized
- Bureaucracies are non-threatening
- Cost and schedules are adhered to
- Disarray and chaos are non-existent
- fire-fighting is minimizes

Enter "YES", "NO", "DNK" if you do not know, and "NA" if not applicable. If the answer is "No" go to the next logical question. You are encouraged to insert comments that further describe your knowledge of the area that the question refers to. These comments will support the establishment, enhancement and understanding of the specific area and will support the definition of the "To-Be" state. The final report will consolidate responses and will not attribute responses to individuals; feel free to express your true feelings. The only person that will see the raw information is independent of the organization.

Name of Individual:_____Date:_____

Example 1

Questionnaire Responses *(Sample as Returned)*

- Following are samples of returned questionnaires
- Each individual returned a complete set for all elements in the survey
  - All elements presented earlier were used
- The samples here are a few from only one individual

Example 1

Questionnaire Responses *(Sample as Returned) (cont.)*

QUESTIONS	YES NO DNK NA	COMMENTS
MISSION - The mission of an organization relates top-level business objectives that an organization is charted to accomplish and support. The Mission is usually reflected in a succinct and precise statement that the organization constructs, endorsed and follows.		
Do you know what the mission of the organization is?	YES	
Is the mission well published?	YES	
Does staff receive exposure to the mission?	YES	
VISION – The vision is where the organization desires to advance itself in the future in relation of expanding or changing its mission.		
Does the organization have a vision?	YES	
Is the vision well published?	YES	
Do you know what the vision of the organization is?	YES	
Does staff receive exposure to the vision?	NO	
If there is no vision what do you think it should be? →		The vision is readily available, but many employees are not aware of it.
STRATEGIC GOALS – Strategic goals are high-level goals that the organization has to achieve in order to meet its mission and vision.		
Does the organization have strategic goals?	NO	
Do you know what the strategic goals of the organization are?	NO	
Are the strategic goals well published?	NO	
Does staff receive exposure to the strategic goals?	NO	
If there are no strategic goals what do you think they should be? →		Strategic Goals: Establish open communication with the users (Test Teams, System Developers, etc.). Explore all areas of funding. Maximize testing and training where possible.

Example 1

Questionnaire Responses *(Sample as Returned) (cont.)*

QUESTIONS	YES NO DNK NA	COMMENTS
ROLES – The function and position and their characteristics of individuals and their expected behavior within the organization and with other stakeholders.		
Are there descriptions of the various roles within the organization?	N	There are job descriptions, but nothing on how to support or manage stakeholders. Nor have I seen anything on the functions of individuals or expected behavior to conduct within the organization.
Are these documented and can you briefly describe the ones t hat apply to you?	Y	
Does your manager or supervisor review them with you initially and as needed?	N	
Do you review them with your subordinate initially and as needed?	N	
RESPONSIBILITIES – Relates to things for which individuals within the organization are responsible for such as duty, obligation, and burden.		
Are there descriptions of the various responsibilities within the organization?	N	
Are these documented and can you briefly describe the ones t hat apply to you?	N	
Does your manager or supervisor review them with you initially and as needed?	N	
Do you review them with your subordinate initially and as needed?	N	

Example 1

Questionnaire Responses *(Sample as Returned) (concl.)*

QUESTIONS	YES NO DNK NA	COMMENTS
COMMUNICATIONS – The ability of individuals within the organization to communicate with each other, with interfacing organizations, and with other stakeholders. Open and clear lines of communication are necessary for individuals adequately perform their roles and responsibilities.		
Does the organization have open door policy with management?	DNK	
How useful is it?		
Does the organization identify key points-of-contact (POC) for communicating important information?	Y	
Are POCs published?	Y	
Are informational and status meetings held with the staff and how often?	Y	→ Weekly
Are informational status reports generated and how often?	N	
Are teambuilding sessions held and how often?	Y	
Do you find them useful?	N	
Can you please make any recommendations to ensure that individuals have open and clear lines of communications with management, each other and all stakeholders?		→ Walk around and inform, short weekly papers, or post notes.

Example 1

Questionnaire Results

- Nine responses were received *(including one from director)*
- The following compiled results reflect the “As-Is” state of the organization:
  - Executive Dashboard (Red, Orange, Yellow, Green, Blue)
  - Based on the responses to questions

Example 1

Questionnaire Compiled Results *(sample)*

RESPONSES	1	2	3	4	5	6	7	8	9	T
MISSION										
Do you know what the mission of the organization is?	1	1		1	1	1		1	1	7
Is the mission well published?	1	1	1	1		1		1	1	7
Does staff receive exposure to the mission?	1		1			1		1	1	5
Totals	3	2	2	2	1	3	0	3	3	**19**
VISION										
Does the organization have a vision?	1					1		1		3
Is the vision well published?	1					1		1		3
Do you know what the vision of the organization is?	1					1		1	1	4
Does staff receive exposure to the vision?	1					1			1	3
Totals	4	0	0	0	0	4	0	3	2	**13**
STRATEGIC GOALS										
Does the organization have strategic goals?	1					1				2
Do you know what the strategic goals of the organization are?	1					1				2
Are the strategic goals well published?	1					1				2
Does staff receive exposure to the strategic goals?	1					1				2
Totals	4	0	0	0	0	4	0	0	0	**8**

1s represent “Yes” answers to the questions

Example 1

Consolidated Results- Executive Dashboard

py	Individuals Responding →	1	2	3	4	5	6	7	8	9	TY	PY	%Y	
3	Mission	3	2	2	2	1	3	0	3	3	19	27	0.70	Y
4	Vision	4	0	0	0	0	4	0	3	2	13	36	0.36	R
4	Strategic Goals	4	0	0	0	0	4	0	0	0	8	36	0.22	R
2	Contractors	2	2	2	2	2	2	2	2	2	18	18	1.00	B
2	Customers	2	2	2	2	2	2	2	2	2	18	18	1.00	B
2	Key Stakeholders	2	2	0	0	2	2	2	2	2	14	18	0.78	Y
4	Activities	4	3	3	0	0	4	0	4	4	22	36	0.61	O
4	Roles	4	0	2	0	0	4	0	0	2	12	36	0.33	R
4	Responsibilities	4	0	2	0	0	4	0	0	4	14	36	0.39	R
2	Staff	2	1	2	0	1	1	0	1	2	10	18	0.56	O
3	Training	3	2	3	3	2	3	2	3	3	24	27	0.89	G
2	Technology Insertion	2	2	1	1	2	2	1	1	2	14	18	0.78	Y
4	Ethics	2	2	1	2	2	2	1	0	3	15	36	0.42	O
7	Communications	7	1	2	4	4	6	5	7	6	42	63	0.67	O
5	Information Sharing	5	1	2	1	1	1	3	1	3	18	45	0.40	O
3	Process	3	0	3	0	0	0	0	0	2	8	27	0.30	R
3	Procedures	3	0	0	0	0	2	0	0	2	7	27	0.26	R
3	Standards	4	3	0	2	2	2	0	3	2	18	27	0.67	O
3	Facilities	3	3	3	3	1	2	0	3	0	18	27	0.67	O
4	Resources	3	2	3	4	2	3	1	1	4	23	36	0.64	O

Key on following slide

Example 1

Key to Executive Dashboard

py - Possible yes's per item

TY - Total number of yes's for all responses

PY=py*9 - Possible yes's for all responses

%Y=TY/PY - Percent of yes's

Color=%Y

RED=<39%

ORANGE =40%-69%

YELLOW=70%-84%

GREEN=85%-94%

BLUE=>95%

Example 1

Comments Received

- The following are samples of comments received
- More that 250 comments were received

Example 1

Comments Received (cont.)

- Mission
  - The mission statement too broad.
  - The mission statement lacks focus and direction.
  - I feel that very few individuals internal and external understand the mission and several internal are not working to accomplish it.
  - Don't recall ever seeing a mission statement.
  - Mission is published in official document available on the Intranet and the mission is used in most briefings. On the other hand, I know from recent discussions that some don't know the mission clearly.

Example 1

Comments Received (cont.)

- Roles
  - Chief of Ops Division provides technology support to all the local test directorates and to the forward directorates as required.
  - Develop, modify and acquire technology to support the test requirements.
  - There are job descriptions, but nothing on how to support or manage stakeholders.
  - I have not seen anything on the functions of individuals or expected behavior to conduct within the organization.

Example 1

Comments Received (cont.)

- Responsibilities
  - Responsible for providing technology support for all operational tests of the local directorates and for developing technology to support those tests.
  - Funds management, personnel management, direct test support mission accomplishment, management of contractor response to tasks/requirements.
  - The only thing that comes close to listing responsibilities is the performance appraisal.

Example 1

Comments Received (cont.)

- Training
  - More technical courses needed, the limitation is funds available.
  - There is no certification process or training for M&S or Instrumentation Engineers.
  - We need also to stay current with DoD doctrine for unit behaviors and capabilities.
  - Training should consist of communication, contracting, briefing (presentations), and organizational.
  - Certain courses are mandatory for all civilians, such as Prevention of Sexual Harassment, Drug & Alcohol Awareness, etc. However, there is no structured training program specifically pertaining to engineering, M&S, or program management skill areas required for the job.

Example 1

Comments Received (concl.)

- Resources
  - Do not now have the required budget to properly accomplish our roles and responsibilities while executing our activities, but we think it is going to get better.
  - The admin folks make us do our own admin tasks now. We arrange our own travel, submit our own vouchers, and edit our own documents. I don't know what they do or why they are here any more.
  - Small office, inadequate storage space, little or no funding to purchase jump drives, etc. Most personnel probably purchase some equipment, such as jump drive storage devices out of personal funds.
  - This organization may need more in terms of security assurance, DITSCAP, threat, data management and program management.
  - Need better collaboration tools.

Example 1

Follow-up email

- Director sent out a follow-up email
- Requesting the 9 that responded to the survey to prioritize the elements in order of importance

Example 1

Follow-Up email (concl.)

BCC Addressees - A few weeks ago you completed an Organizational Survey. I appreciate the time you took to respond to the questions and provide additional information. I'm now asking that you assess the importance to you of 20 topics related to the survey areas. Just put a 1-to-5 assessment of Importance to You in front of each of the 20 areas. You can send your responses to me or to Al Florence.

1-low, 5-high What is the Importance to You of each of the following:

____ 1. Published mission statement
____ 2. Published vision statement
____ 3. Published strategic goals
____ 4. Identification of contractors responsible for products
____ 5. Identification of customers for organizational products
____ 6. Identification of key stakeholders for products.
____ 7. Documentation of key activities linked to each employee
____ 8. Documentation of key roles linked to each employee
____ 9. Documentation of your responsibilities
____10. Documentation of staff skills/experience required for each position
____11. Training to accomplish your mission
____12. Policy, procedures and actions for technology insertion
____13. Published DoD Ethics Standards of Conduct
____14. Communications and status meetings at division level
____15. Policy regarding information sharing
____16. Process to accomplish day-to-day activities
____17. Detailed Procedures to support the execution of the processes
____18. Documented standards for products and services.
____19. Facilities including collocation of team
____20. Resource to accomplish your mission and activities

Thanks, Jane Doe

Example 1

Priorities

Individual Responding → / Individual Priorities →	1	2	3	4	5	6	7	8	9	T	P
Published mission	3	5	4	5	3	1	3	3	3	30	3.33
Published vision	3	5	4	4	1	1	3	3	3	27	3
Published strategic goals	3	5	4	4	1	1	3	3	3	27	3
Identification of contractors responsible for products	3	5	3	3	2	1	4	5	5	31	3.44
Identification of customers for organizational products	4	3	4	2	2	4	5	2	3	29	3.22
Identification of key stakeholders for products	3	5	3	3	2	2	4	5	5	32	3.55
Documentation of Key Activities linked to each employee	4	3	4	2	2	4	5	2	3	29	3.2
Documentation of Key Roles linked to each employee	4	3	4	2	2	2	5	2	3	27	3
Documentation of your responsibilities	5	3	5	2	2	4	3	3	3	30	3.33
Documentation of staff skills/experience required for each position	4	3	4	2	3	1	4	2	3	26	2.89
Training to accomplish your mission	3	4	4	2	2	3	5	5	5	33	3.67
Policy, procedures and actions for technology insertion	4	3	5	3	4	3	3	3	4	32	3.56
Published DoD Ethics Standards of Conduct	2	5	3	5	4	1	2	1	2	25	2.78
Communications and status meetings at division level	2	3	3	4	2	3	3	5	4	29	3.22
Policy regarding information sharing	2	3	3	2	2	1	2	5	5	25	2.78
Process to accomplish day-to-day activities	2	3	2	2	4	1	2	3	4	23	2.56
Detailed Procedures to support the execution of the processes	3	4	3	4	4	3	3	2	3	29	3.22
Documented standards for products and services	3	4	3	3	3	1	4	3	4	28	3.11
Facilities including collocation of team	3	3	4	4	2	1	3	2	3	25	2.77
Resource to accomplish your mission and activities	4	5	4	3	2	5	5	5	5	38	4.22

T = sum of all priorities Average Priority (P) = T/9

Example 1

Priorities vs. Executive Dashboard

6	3.33	Y	Mission
10	3	R	Vision
10	3	R	Strategic Goals
5	3.44	B	Contractors
7	3.22	B	Customers
4	3.55	Y	Key Stakeholders
8	3.2	O	Activities
10	3	R	Roles
6	3.33	R	Responsibilities
11	2.89	O	Staff
2	3.67	G	Training
3	3.56	Y	Technology Insertion
12	2.78	O	Ethics
7	3.22	O	Communications
12	2.78	O	Information Sharing
14	2.56	R	Process
7	3.22	R	Procedures
9	3.11	O	Standards
13	2.77	O	Facilities
1	4.22	O	Resources

Example 1

First Cut at Near/Mid/Long Term Activities

- Near Term
  - Resources (tools, budget)
  - Training
- Mid Term
  - Key Stakeholders
  - Mission
  - Vision
  - Strategic Goals
  - Roles
  - Responsibilities/Activities
  - Staff (Skills/experience)
  - Process
  - Procedures
  - Standards
- Long Term
  - Communications/Information Sharing
  - Technology Insertion
  - Staff
- Ethics & Facilities received very low in priority

A report was complied and sent it to the director

Example 1

Received From Director

Al,

You can critique my near term plan. I sorted all items in priority sequence from high to low. Then I assessed the ratings for the high priority items. That led me to this conclusion:

Three areas for improvement plan - near term:

- **Tools to accomplish your mission** - highest priority item and low rating
  (I've asked the team leaders for input on resources needed by their team members. In about a month, I'll follow-up with information to individuals. Recent priority need in one area for ear protection headphones was met as urgent requirement. I'll use that as an example of how needs can be met.)

- **Documentation of your responsibilities** - high priority item and lowest rating
  (Since having a standard operating procedure for each Organizational position is low priority, I understand the need to me clearly stating responsibilities for each person, not detailing how to do the work).

Example 1

Received From Director (concl.)

- **Process and other policy documents** - high priority item and lowest rating
(Since having a standard operating procedure for each Organizational position is low priority, so our focus needs to be documenting Organizational-level processes, not focusing on how to do individual missions).

My intent was to brief this action plan during last week's 'all-hands' meeting. Had less than 50% attendance because of travel and ran out of time with other discussions. I'll now handle through a combination of Team Leaders' meetings and directorate email.

Your critique welcomed.

Jane

The organization is implementing this Near Term Plan starting with acquiring needed resources including tools.

Where Are We?

- Introduction
- Dysfunctional/Stove Piped Organizations - Associated Problems
- A Solution - Organizational Analysis
- Organizational Structures
- Organizational Analysis Elements
- The Big Picture - How an Organizational Analysis is Conducted
- Organizational Analysis Example 1
- Organizational Analysis Example 2
- Summary
- Reference
- Questions/Answers/Discussion/Comments
- Contact Information

Example 2

- Conducted on a civil agency
- Done by interviewing only, no questionnaire
  - This method takes longer than sending out questionnaire
  - Is intrusive on the organization
  - Interview questions need to be open ended
    - If “Yes/No” questions asked they need to be followed up with request for supporting data such as:
      - An artifact
      - A document
      - A memo
      - Meeting minutes
- Individuals interviewed
  - Executive management
  - Senior management
  - Supervisors
  - Key staff members
  - Key stakeholders

Example 2

Approach

- **Assess the current state of organization via research and interviews**
  - Identify mission and vision
  - Analyze capability to meet the mission
  - Identify improvement opportunities
  - Make improvement recommendations
- **Recommendations to help organization in defining:**
  - A single enterprise repository of policies, procedures, and standards
  - A common high-level process view
  - Required roles and responsibilities
  - Key activities for interactions with major stakeholders

Example 2

Organizational Elements

- **MITRE identified ten major organizational elements or areas in which to assess the state of the organization, the elements are:**
  - Mission, Vision, and Charter
  - Strategic Goals and Activities
  - Customers, Products, and Services
  - Contractors, Products, and Services
  - Organizational Structure and Facilities
  - Roles and Responsibilities
  - Staff and Training
  - Policies and Process
  - Procedures and Tools
  - Communication

Example 2

Questions Asked

- **Key to questions:**
  - E - questions for executives
  - M - questions for managers/supervisors
  - W - questions for worker bees
  - G - questions for anyone (some may not be appropriate for executives, you decide)
- When asking questions one may deviate from the canned questions as necessary
- The answers to questions may elicit additional questions to gather all required information

Example 2

Questions

- **Candidate questions for “Mission”**
  - Would you please explain the mission of the organization? E, G
  - What do you think the mission of the organization is? E, G
  - Is the mission of the organization documented? G
  - Can you please provided us a copy? M
- **Candidate questions for “Vision”**
  - Would you please explain the vision of your organization? G
  - What do you think vision should be? G
  - Is the vision of the organization documented? G
  - Can you please provided us a copy? M
- **Candidate questions for “Charter”**
  - Would you please explain the charter of your organization? G
  - What do you think the charter of the organization is? G
  - Is the charter of the organization documented? G
  - Can you please provided us a copy? M

Example 2

Questions (cont.)

- **Candidate questions for “Strategic Goals”**
  - Would you please explain the strategic goals of the organization? E, G
  - What do you think these goals of the organization should be? E, G
  - Are these goals documented? G
  - Can you please provided us a copy? M
- **Candidate questions for “Activities”**
  - Would you please explain the required activities to meet the strategic goals? G
  - What do you think these activities should be? G
  - Are these activities documented? G
  - Can you please provided us a copy? G

Example 2

Questions (cont.)

- **Candidate questions for "Customers"**
  - Would you please tell us who the customers of the organization are? G
  - Which are internal or external to the organization? G
  - Who are the end users of the organization's products? G
  - Who are your immediate customers? W
  - Are these customers described anywhere? G
  - Can we have a copy? M
- **Candidate questions for customer "Products and Services"**
  - Would you please tell us what products the organization produces and for whom? G
  - Would you please tell us what services the organization provides to its customers? G
  - What do you think these products and services should be? G
  - Are these products and services documented and/or described anywhere? G
  - Can we please have a copy? M

Example 2

Questions (cont.)

- **Candidate questions for “Contractors”**
  - Would you please tell us who the contractors of the organization are? G
  - Who are the end users of the contractors’ products? G
  - Are there statements-of-work (SOWs) for these contractors? G
  - Can we have a copy? M
- **Candidate questions for contractor “Products and Services”**
  - Would you please tell us what products the contractors produce and for whom? G
  - Would you please tell us what services the contractors provide to their customers? G
  - What do you think these products and services should be? G
  - Are these products and services documented and/or described anywhere? G
  - Can we please have a copy? M

Example 2

Questions (cont.)

- **Candidate questions for “Organization Structure”**
  - Do you have a diagram of the organization? G
  - Is there text to support the diagram? G
  - Are all stakeholders identified G
  - Are responsibilities of all branches documented? G
  - Are relationships to branches and other stakeholders documented? G
  - Can you please provide us a copy? M
- **Candidate questions for “Facilities”**
  - Can you please tell us where the Project Management organization physically resides? G
  - Are individuals in close proximity to each other? G
  - Is there diagram of the facility? G
  - What are the room arrangements, furniture, and other facilities for items as computers and printers? W

Example 2

Questions (cont.)

- **Candidate questions for “Roles”**
  - Where are position descriptions for the roles of the organization documented and can we please have a copy? M
  - Can you please explain your roll within the organization? G
  - What are the functions that you perform on a day-to-day basis? W
  - Are these documented? G
  - Can we have a copy? G
- **Candidate questions for “Responsibilities”**
  - Can you please explain your responsibilities within the organization? G
  - What duties do you perform on a day-to-day basis? W
  - What outputs or outcomes are you responsible for? W
  - Is this documented? G
  - Can we have a copy? G

Example 2

Questions (cont.)

- **Candidate questions for “Staff”**
  - Are the required skills and experience for the various roles of individuals documented? M
  - Can you please provide this to us? M
  - How do you ensure the staff members and project management have the required skills and experience for their roles? M
  - Could you please tell us what skills and experience you have to support your day-to-day duties? W

Example 2

Questions (cont.)

- **Candidate questions for “Training”**
  - Do you have a training program for individuals to augment the skills required for their roles and responsibilities? M
  - Do you have a training schedule? M
  - Where are the training requirements for individuals documented? M
  - Do you maintain training records? M
  - Can you please provide us copies of these? M
  - What training do you receive to augment the skills required for your roles and responsibilities? G
  - Where is this required training documented? W
  - Do you have records of the training you have received? W
  - Can we please have copies of these records? W

Example 2

Questions (cont.)

- **Candidate questions for “Policy”**
  - What high-level policies do you have for the activities and processes required to conduct the functions of Project Management ? M
  - Can you please provide them to us? M
  - What high-level polices do you follow to conduct your required activities? W
- **Candidate questions for “Process”**
  - What documented processes do you have for the execution of the day-to-day activities required to support your activities? G
  - Can you please provide them to us? M
  - How do you ensure that these processes are practiced as documented? G
  - Please explain how these processes are consistent and repeatable? G
  - Can you please tell us what processes exist to support your day-to-day activities? G

Example 2

Questions (cont.)

- **Candidate questions for “Procedures”**
  - Do you have step-by-step documented procedures for the execution of the processes required to support staff and project management activities? G
  - Can you please provide them to us? M
  - How do you ensure these procedures are practiced as documented? M
  - Please explain how these procedures are consistent and repeatable. G
- **Candidate questions for ”Tools”**
  - Do you have a list of the tools that are used to support the day-to-day activities of the staff and project management? M
  - Can we please have this list? M
  - What tools do you use to support you day-to-day activities? W
  - What training do you receive on these tools? G

Example 2

Questions (concl.)

- **Candidate questions for "Communications"**
  - How do you ensure that individuals or Project Management have open and clear lines of communications with you, each other and other stakeholders? E, M
  - How often are informational and status meeting held with the staff? G
  - How often are informational and status reports published? G
  - Can we please have some copies of these reports? M
  - Do you have an open door policy for your staff to communicate with you? M
  - Does your manager/supervisor have an open door policy for you to communicate with him/her? W
  - Do you use this open door policy? Was it useful? W
  - How often do you have teambuilding sessions? G
  - Can you please explain if these teambuilding session are useful? G
  - Do you have meeting minutes for status and teambuilding sessions? G
  - Can we please have copies of meeting minutes? M

Example 2

Interviews Conducted

- Two Executives
- Two Managers
- Four Supervisors
- Three Key Stakeholders
- General staff
  - Four sets
  - 2 to 5 in each set
- Resulted in much valuable information

Example 2

Organizational Analysis Report

Section 1: **Introduction** - Defines the purpose of the assessment and the organization of this report

Section 2: **Executive Summary** - Provides a high-level overview of the approach, findings, and recommendations.

Section 3: **Current State** - Presents the results of the analysis reflecting the current state

Section 4: **Desired State** - Presents recommendations to achieve the desired state

Section 5: **Implementation Plan** - Presents the priorities, the plan, and schedule to develop and implement the recommendations

Appendix A: **Category Definitions** - Presents detailed descriptions of the categories that were assessed

Appendix B: **Consolidated Comments** - Presents the interview comments against the categories compiled and consolidated

Appendix C: **Interview List** - Presents a list of the interviews that were conducted by organization the individual belong to, name of individual, and date

Appendix D: **Acronym List** - Provides an alphabetical list of the acronyms used in this document and their definitions

Appendix E: **List of References** - Presents a list of references to augment this report.

Appendix F: **List of Implemented Recommendations** - Presents a list of items that have been developed and implemented

Example 2

Will Look At

- Summary of Findings
- Current "As-Is" State *(Executive Dashboard)*
- Samples of Comments Received
- Samples of Summary Recommendations
- Samples of Detailed Recommendations
- Analysis Mapped to Recommendations
- Follow-up Working Meetings
- Sample "To-Be" Transition Strategy
- Sample of "To-Be" Transition Plan/Schedule

Example 2

Summary of Findings

- **Mission, Vision and Charter**
  - Mission and vision statements are not documented but some individuals have ideas as to what they should be
  - Charter not documented but some comments were received on what the charter might be
- **Strategic Goals and Activities**
  - Strategic goals are not documented although some individuals have ideas as to what they should be
- **Customers, Products and Services**
  - Customers, products and services are well known but documentation, delivery schedules and oversight are generally missing
- **Contractors, Products and Services**
  - Contractors, products and services are well known but documentation, delivery schedules and oversight are generally missing
- **Organizational Structure and Facilities**
  - A detailed organizational chart and organizational documentation does not exist
  - Staff is located on three different floors and most staff members have obsolete equipment

Example 2

Summary of Findings (concl.)

- **Roles and Responsibilities**
  - Roles and responsibilities are in some cases known and being accomplished but are not documented
  - Some roles and responsibilities are not assigned or assignments are not known so some individuals take on additional responsibilities
- **Staff and Training**
  - Staff members have been adequate up to this point, for basic support of the web site, with the appropriate skills for their roles and responsibilities
  - Training is generally lacking, especially as new products and services are introduced and for project and product management
- **Policies and Process**
  - Policies are generally missing. Some processes exist but are not documented
- **Procedures and Tools**
  - Some procedures exist but are not documented
  - Some tools are being used but training on tools is missing
- **Communications**
  - Communications are generally good throughout the entire organization

Example 2

Current “As-Is” State

Mission (Yellow)					
No mission statement written down					R
Many suggestions that need to be compiled into a mission statement		G			
Vision (Yellow)					
No vision statement written down					R
Many suggestions that need to be compiled into a vision statement		G			
Charter (Yellow)					
No charter written down					R
Many suggestions that need to be compiled into a charter		G			
Strategic Goals (Yellow)					
No strategic goals written down					R
Many suggestions that need to be compiled into strategic goals		G			
Activities (Yellow)					
Everyone understands the activities that are being conducted	B				
The activities are not documented in relation to the goals, roles and responsibilities they support					R

Example 2

Current "As-Is" State (cont.)

Customers (Orange)					
Everyone knows who their customers are		G			
Documentation on customers' information is minimal					R
Customers' Products and Services (Orange)					
Everyone knows what products and services are provided to their customers and are providing them		G			
Documented information on customers' products and services is minimal and processes are not established and followed for development and monitoring of delivery schedules					R
Contractors (Orange)					
Everyone knows who their contractors are		G			
Contractors' information is minimal and contractor monitoring is generally lacking					R
Contractors' Products and Services (Orange)					
Everyone knows what products and services their contractors provide		G			
Information on contractors' products and services is minimal and processes are not established and followed for development and monitoring of delivery schedules					R

Example 2

Current "As-Is" State (cont.)

Organizational Structure (Red)					
An organizational structure is not documented and an organization diagram does not exist					R
The relationships to interfacing organizations are not documented					R
Facilities (Orange)					
Staff is located on different floors			Y		
Some staff located in different building				O	
Roles (Red)					
Not everyone knows and understands their roles					R
In some cases roles have not been documented and some individuals are duplicating efforts					R
Responsibilities (Red)					
Not everyone knows and understands their responsibilities					R
In some cases responsibilities have not been assigned to individuals and some staff members are taking on responsibilities that they feel are not being accomplished				O	

Example 2

Current "As-Is" State (cont.)

Staff (Yellow)					
Staff seem to have the required skills to perform their roles		G			
Responsibilities are somewhat in flux at this time, as content creation and publishing are transitioning to content owners				O	
Training (Red)					
A formal training program or training plans do not exist					R
Very little training has been conducted; some feel they could use training on specific topics					R
Policies (Red)					
Policies generally do not exist					R
Policies for critical and essential activities, products and services do not exist					R
Process (Red)					
Processes are not documented but exist for some areas, such as content posting and investment decision, but missing in others, such as product, project, contract, and configuration management					R
Some processes are executed but not documented					R

Example 2

Current "As-Is" State (concl.)

Procedures (Orange)					
Some procedures exist but are not documented. Some are being developed for areas such as content posting and investment decision. Some are missing such as configuration management and quality assurance.				O	
A few procedures are loosely documented in guidelines				O	
Tools (Red)					
Some tools exist for some activities				O	
Training on tools is generally inadequate					R
Communications (Blue)					
Communications are generally good throughout the entire organization	B				
Some managers have an open door policy and they respond in a timely fashion to staff members	B				

Example 2

Samples of Comments Received

- **Lack of Clarity in Roles and Responsibilities**
  - Several people talked a lot about doing whatever it takes to get the job done, and they indicated that in the past they have gotten dinged at performance appraisal time because they were viewed as doing something that “wasn’t their responsibility”.
  - It sounds like sometimes it’s not clear whose job it is to do certain things, or those things just are not getting done, so people pick up those tasks to make sure they get done.
  - Fred’s group took over registration product from Sam, which was a huge help, but took away the clarity of roles.
  - The prime contractor should be integrator of all the pieces, but there were issues of ownership, and it hasn’t been clear who should make decisions.
    - Plus, different parts of projects are owned by different groups, which further complicate communication and decision-making.

Example 2

Samples of Comments Received (cont.)

- **Lack of Training**
  - The team members felt that it would be useful for them to attend technical forums to better understand requirements and what the users need to support development.
    - They indicated that they have not been allowed to attend many forums, or when they are allowed to go, they are designated as note takers.
    - They seemed to feel that even when they get to go, their need for being there is not recognized, while the other group seems to be very involved in the forums.
  - The participants indicated that when product ownership was given to them, training on project management and oversight was lacking.
    - They also had to work with contractors, and were often a daily contact for the contractors, but they weren't really trained in contractor oversight – it was not clear to the team members what they should be pushing the contractor to do, as opposed to what they should be asking acquirer to do.
    - As a result, the contractor ended up driving the project. Incomplete requirements are due to the contractor constantly trying to limit the number of requirements and delaying some to later implementation, which seldom occurred. The contractor also has had a lot of turnover resulting in lost work and increasing the learning curve.

Example 2

Samples of Comments Received (concl.)

- **Lack of Tools**
  - They do not have access to tools, like Rational Rose, except maybe in the lab, and some people do not have access to the lab, and do not have accounts to access needed software.
  - They feel like they are pushing the limits to try to get around all their obstacles, but feel they should not have to work so hard to get around these sorts of obstacles, and in some cases are bending the rules to try to get the job done, and fear repercussion.
  - After the requirements were baselined, they could not get access to view the latest requirements.
  - The team members felt that it would be useful for them to attend forums to better understand requirements and what the users need to support development.

Example 2

Samples of Summary Recommendations

- Mission and Vision statements need to be created and published.
- Strategic Goals and a Charter to meet the Mission and Vision need to be created and published.
- An Organizational Structure that supports the Strategic Goals and Charter needs to be created and published.
- Roles and Responsibilities that support the organization and the achievement of the strategic goals need to be reviewed and updated as the organization changes.
  - Clear roles and responsibilities need to be assigned to individuals and these assignments documented.
- Existing policies, processes and procedures need to be reviewed and updated.
  - New ones to support the roles and responsibilities and the achievement of the Mission, Vision and Strategic Goals need to be developed and followed.

Example 2

Samples of Summary Recommendations (cont.)

- Key relationships with other organizations need to be defined in a way that supports the achievement of the Mission, Vision and Strategic Goals.
- Electronic equipment and tools need to support the roles, responsibilities, policies, processes and procedures, and need to be upgraded or acquired.
- Individuals in the organization need to be located in closer proximity to each other
- A training program that supports all the above needs to be created and executed.
- Computing equipment is obsolete and is affecting both moral and productivity.
  - State-of-the-art equipment would resolve this problem.

Example 2

Samples of Summary Recommendations (cont.)

- Staff
  - Skills are needed in the following areas:
    - Technology, including XML, web services, and content management
    - Project and program management
    - Security
    - Telecommunications
- Training
  - Training needs to include tools, processes and procedures, web site functions and capabilities, and policies and regulations
  - Staff should be trained on the technologies being used for the web site, including Vignette, WebTrends, Akami
  - Staff should be trained in project, program, and contract management

Example 2

Samples of Summary Recommendations (concl.)

- Procedures and Tools
  - Detailed step-by-step procedures need to be developed to support the implementation and execution of the processes.
  - Staff members need to have state-of-the-art electronic equipment and other tools to support their day-to-day activities. Some require laptop computers and some read/write CD capabilities. Some require project management tools.
- Communications
  - Team building sessions need to be held and assignments need to be documented for each staff member.
  - Effective communications will help staff members in understanding their roles and responsibilities and working as a cohesive organization.

Example 2

Samples of Detailed Recommendations

Role Performed	Roles & Responsibilities
Programmatic Oversight	• Develop Requests for Proposals (RFPs) and Statements of Work (SOWs) for contractors' products and services, when necessary. • Develop and monitor schedules for contractor products and services. • Conduct technical and programmatic oversight of contractors' activities that produce products and services. • Review and approve contractor products and services • Coordinate with Procurement on contract issues
CCB Chair	• Serve as one of three co-chairs of the CCB • Suggest agenda items, and approve final agendas • Provide welcome and introduction at each meeting • Steer group according to charter (education, communication, *not* decisions)
Technical Oversight	• Contribute to and review all RFPs, SOWs, etc., for technical content • Participate in requirements definition for content management and portal • Participate in status meetings and design reviews for portal and applications • Coordinate with steering committee on technical issues for the site
Technical Investigations	• Conduct frequent reviews and investigations into technologies for the portal • Make recommendations for technology use or refreshment on the portal

Example 2

Samples of Detailed Recommendations (cont.)

Process Area	Description
Performance Management	Manage the performance of activities that support the roles and responsibilities in producing products and conducting services, both from the contractors and Program office perspective. Processes may include: • Product/Program/Project Management • Contractor Management and Oversight • Requests for Proposals • Statements of Work • Plans, Schedules & Budgets • Requirements Management • Reviews • Configuration Management • Quality Assurance • Metrics • Risk Management • Earned Value (cost/schedule monitoring) • Transition to Support
Investment Decision	Determine whether a new or additional feature should be added theweb site. This includes conducting impact analysis by all stakeholders against, but not limited to the following: function, cost and schedule. Processes may include: • Baselining • Impact Assessment (function, cost, schedule) • Change Control
Rapid Application Development	Provide the capability to develop smaller in-house web capabilities faster and cheaper without sacrificing functionality and quality

Example 2

Samples of Detailed Recommendations (concl.)

Process Area	Description
Application and Content Management	Manage the application and content of the web sites. This includes providing guidance and technical and programmatic support to users and content providers of the web site. Processes may include: • Content Analysis • Content Design • Content Implementation • Content Consulting
Web Usability Testing	Conduct tests on the web site to determine the ease of using the site. Processes may include: • Test Planning • Test Procedures • Test Conduct • Test Reporting
Web Statistics	Gather and report statistics on web site usage and issues. Procedures may include: • Gathering Statistics • Graphing Statistics • Analyzing Statistics • Reporting Statistics

Example 2

Analysis Mapped to Recommendations

- The Mission, Vision, and Charter must first be defined, and must tie back to the Missions, Visions, and Charters of the higher level organizations
- The Mission, Vision, and Charter help to define the Strategic Goals and activities that must exist and occur to meet the Mission, Vision, and Charter
- The Mission, Vision, and Charter and Strategic Goals and activities then help to define what products and services will be offered to what customers, and which contractors' products and services will be utilized to make those offerings
- Once the products and services are defined, then the organization can be defined to deliver those products and services. A set of roles and responsibilities can be defined that tie back to the products and the Mission. Those roles can then be crafted into an organizational structure with certain needs for specific staff and training
- The organization will need policies, processes, procedures and tools to help them accomplish their mission in a reliable, repeatable manner. The higher level policies and processes must first be defined, and these will then drive out more detailed procedures and tools

Example 2

Follow-up Working Meetings

- **Several follow-up brain storming meetings conducted involving:**
  - Executive
  - Managers
  - Supervisors
  - MITRE representatives
  - Meeting moderator
- **Examining**
  - Mission
  - Vision
  - Strategic Goals
  - Other Areas
  - Next steps

Resulted in an implementation strategy to achieve “To-Be” desired state

Example 2

Sample To-Be Transition Strategy

- This transition strategy will support the organization in establishing the desired “To-Be” state and in achieving the Strategic Goals:
  - Establish priorities
    - Prioritize the categories and the implementation activities based on the importance and value added to the Mission and Vision statements and Strategic Goals
    - Develop and prioritize a transition “To-Be” plan into short-term, mid-term and long-term implementation increments based on the importance and value added to the Mission and Vision statements and Strategic Goals
  - Establish an implementation schedule
    - For short-term implementation increments (less than 12 months)
    - For mid-term implementation increments (greater than 12 months, but less than 24 months)
    - For long-term implementation increments (greater than 18 months, but less than 36 months)

Example 2

Sample To-Be Transition Strategy (concl.)

- Obtain Funding and Resources for short-term implementation
  - Determine and obtain funding
  - Determine and obtain resources
  - Investigate best practices for short term implementation categories
    - Investigate organization's best practices
    - Investigate industry best practices

Example 2

Sample To-Be Transition Strategy (concl.)

- Implement best practices for short term implementation categories
  - Use best practices if available and usable
  - Tailor best practices, if necessary
  - Develop new practices, if required
  - Deploy practices
  - Deploy on trial basis
  - Fine tune practices
  - Deploy for general use
  - Use, maintain and improve practices
- Use Executive Dashboard to track improvements over time
- Repeat for mid-term implementation
- Repeat for long-term implementation

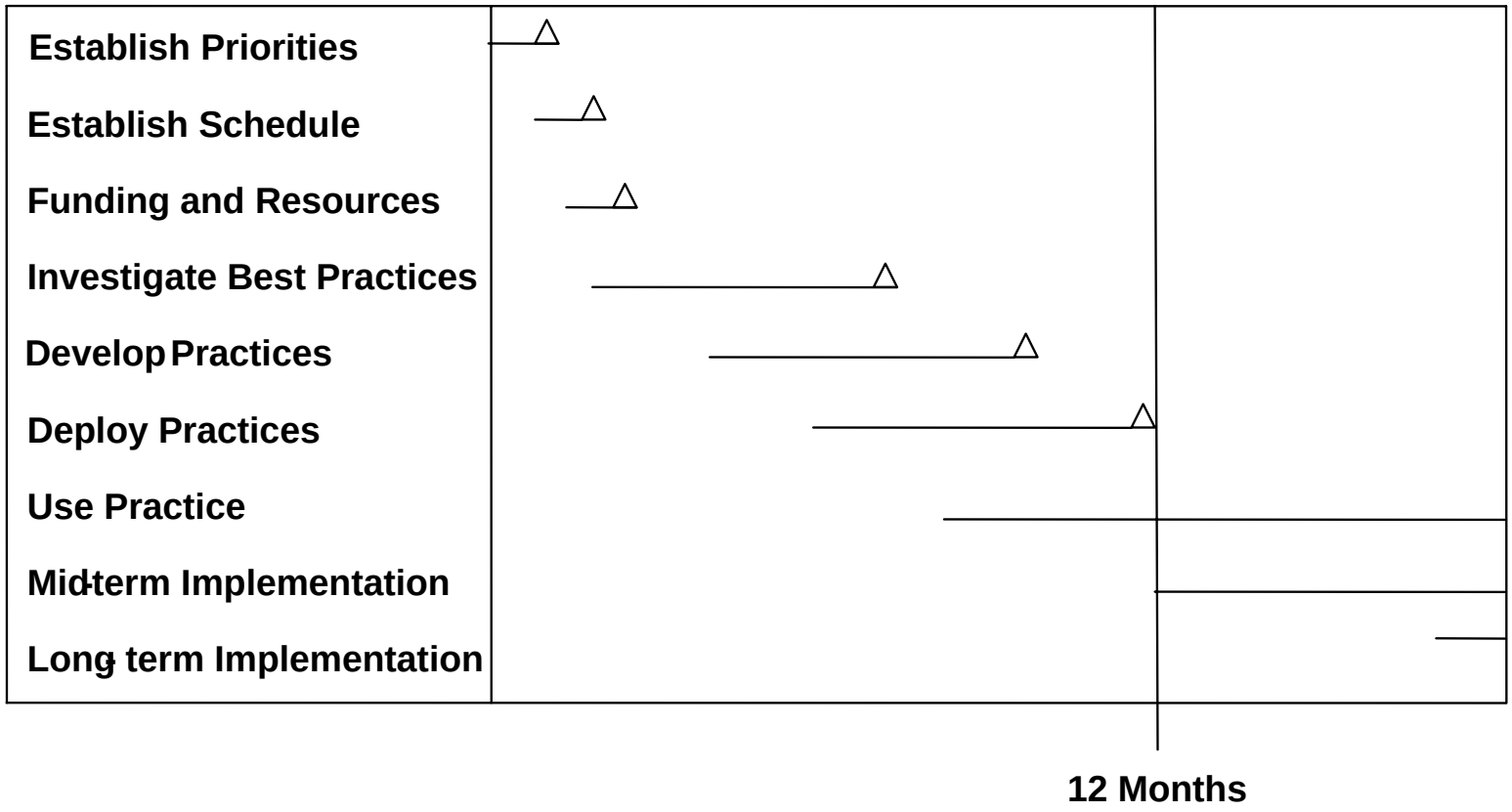
Example 2

Sample To-Be Transition Plan

Item to Implement	Priority	Near Term	Mid Term	Long Term
Mission and Vision Statements	1	X		
Strategic Goals and Charter	2	X		
Organizational Structure	3	X		
Roles and Responsibilities documented and assigned	4	X		
Relationships defined with other key organizations	5	X		
Staff and Skills Definition	6	X		
Acquisition of needed equipment and tools	7	X		
Critical policies, processes and procedures				
Performance Management	8	X		
Investment Decision	9	X		
Application and Content Management	10		X	
Usability Testing	11		X	
Statistics	12		X	
Communications	13			X
Training Program	14			X

Example 2

Sample To-Be Transition Schedule



Where Are We?

- Introduction
- Dysfunctional/Stove Piped Organizations - Associated Problems
- A Solution - Organizational Analysis
- Organizational Structures
- Organizational Analysis Elements
- The Big Picture - How an Organizational Analysis is Conducted
- Organizational Analysis Example 1
- Organizational Analysis Example 2
- Summary
- Reference
- Questions/Answers/Discussion/Comments
- Contact Information

Summary

- Before starting Process Improvement or other initiatives, it is best to determine if the organization is ready for change
  - If not ready, change becomes very difficult
- In many cases organizations are dysfunctional and stove piped
  - They reorganize thinking that this solves their problems
  - This only buries them further into the abyss
- An organizational analysis may be necessary to surface the root causes of the problem and break down barriers
- Fixing problems at their roots and breaking down barriers
  - Allows organizations to function as cohesive and seamless units
  - Provides for easier process improvement and other initiatives
  - Facilitates success

The problems tend to be SOCIAL rather than TECHNICAL

Where Are We?

- Introduction
- Dysfunctional/Stove Piped Organizations - Associated Problems
- A Solution - Organizational Analysis
- Organizational Structures
- Organizational Analysis Elements
- The Big Picture - How do we Conduct an Organizational Analysis
- Organizational Analysis Example 1
- Organizational Analysis Example 2
- Summary
- Reference
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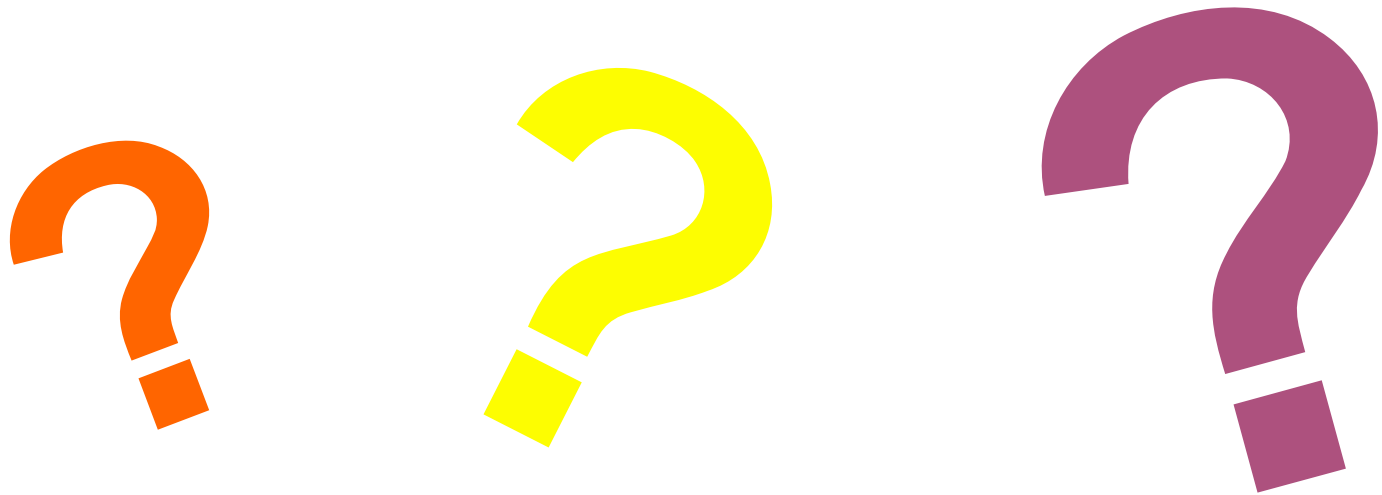
References

1. Noel, Dickover, Leonard Sadauskas; *Human Interface to Netcentricity*; Communibuild Technologies
2. John H, Maher, Jr.; *When SPI Isn't Enough: Redesigning the Organization*; Organization and Process Improvement, Inc.; SEPG Conference; March 2005, Seattle, Washington
3. Al Florence; *FASTrack to CMMI®,* CMMI® Technology Conference & Users Group; November, 2006 ; Denver, Colorado

Questions/Answers/Discussion/Comments



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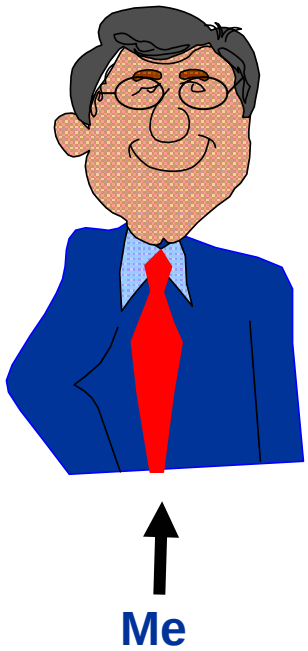

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Calculating CMMI-Based ROI Why, When, What, and How?

Rolf W. Reitzig – cognence, inc.
Dennis R. Goldenson - SEI
Diane Gibson – SEI
Mark R. Cavanaugh - IBM

6th Annual CMMI Technology Conference & User Group
November 13, 2006
Denver, CO

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Agenda

1. **Introductions and Logistics**
2. **Why?**
   Why should an organization attempt to calculate the ROI of CMMI-based efforts? Is ROI the right way to show financial value?
3. **When?**
   When should these ROI calculations be performed? When can you compare ROI results across organizations?
4. **What?**
   What information is needed in order to calculate ROI? What information is inappropriate?
5. **How?**
   How do organizations calculate ROI? How can they do it better?
6. **Wrap-Up**

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1 - Introductions and Logistics

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How often have you heard this....?

What is the value of process improvement to our organization?

Why CMMI?

What should we focus on?

How much is this going to cost?

What's in it for me?

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Overview

This tutorial is intended to be a basic introduction to calculating the costs and benefits of CMMI-based process improvement

We'll discuss estimating, tracking, and validating ROI over the course of a CMMI improvement effort

You'll be introduced to several ways to calculate ROI, and the pros and cons of each

Implementation approaches, hints and tricks will be introduced to help you really make this work!

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Logistics

Workshop Time/Duration

Rest Rooms

Breaks

Smoking Rules

Phones

Messages

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ROI can be calculated many ways

There is no single, official "definition" of ROI – it can be calculated in many ways.

Some of these include:

- Benefit/Cost ratio (typically considered ROI)
- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Payback Period (PP)/Break Even Point (BEP)

A complete ROI analysis includes all of the above.

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The Value of CMMI Improvement

Average software organizations spend 65% or more of their engineering dollars addressing quality problems!

This means that only 1/3 of the organization is actually creating something.

Leading software organizations can reduce this Cost of Quality to 40% or less, resulting in 50% or more gains in productivity.

Numerous CMM case studies conclusively demonstrate the value that can be achieved.

A rapidly growing number of CMMI case studies are duplicating & exceeding these results.

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Examples

Reduced cost of poor quality from over 45% to under 30%
- 2:1 ROI over 3 years (Siemens Information Systems Ltd, India)

$2.1 Million in savings in hardware engineering processes
(Reported under non disclosure)

Reduced software defects per million delivered SLOC by over 50% compared to defects prior to CMMI
(Lockheed Martin Systems Integration)

Reduced defect rate at CMMI ML5 approximately one third compared to performance at SW-CMM ML5
(Lockheed Martin Maritime Systems & Sensors – Undersea Systems)

Avoided $3.72M in costs due to better cost performance
- As the organization improved from SW-CMM level 4 to CMMI level 5 (Raytheon North Texas Software Engineering)

2.5:1 ROI over 1st year, with benefits amortized over less than 6 months (reported under non disclosure)

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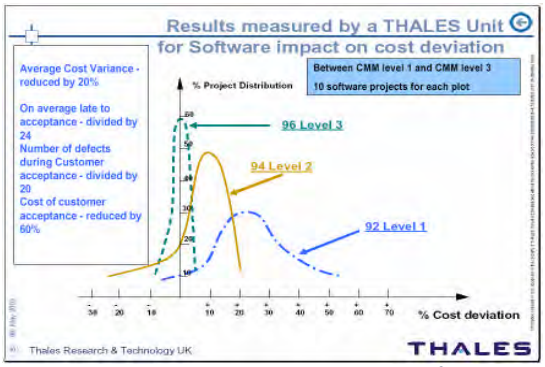
Thales Research & Technology

CMM data from another Thales Unit used by Thales Research & Technology as part of rationale to begin PI with CMMI.



Improvements in:

- Product cost
- Schedule / cycle time
- Quality
- Customer satisfaction

Getting Started with Process Improvement Using the CMMI®. Carol Marsh, Patrick Vigier. ESEPG 2003.

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Northrop Grumman IT

Appraised at CMMI ML 5 in December 2002

Results

- met 25+ milestones in a row
- earned a rating of "Exceptional" in every applicable category on a formal Contractor Performance Evaluation Survey

- Hours Invested: 124 in Defect Prevention (CAR)
- Hours saved: 1650 hours (15 hours per defect)
- **ROI:** 13:1

Improvements in:

- Schedule / cycle time
- Customer satisfaction
- Quality
- Cost of quality / ROI

Integrating PSP[sm] and CMMI® Level 5. Gabriel Hoffman, Northrop Grumman IT . May 1, 2003

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Accenture

Transition SW-CMM to CMMI ML 3

- May 2001 to May 2002
- Transition Time: 1149 person hours

Key Content

Measurement and Analysis
DAR ➡ TS, RM, Change Control
IPPD ➡ visions, OEI
Generic Goals

Results

- **ROI**: 5:1 (for quality activities)

Costs:

- Investment in Improvement

Improvements in:

- Cost of quality / ROI

Innovation Delivered. CMMI® Level 3 in a Large Multi-Disciplinary Services Organization. Bengzon, SEPG 2003

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Some Caveats!

No financial or accounting knowledge is assumed

The tutorial is not intended to be comprehensive, some topics are presented at a high-level only

In some cases, nuances of financial accounting and ROI determination are not addressed

We'll do our best to get you started without burying you in details!

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Audience

Executive/leaders of organizations seeking to understand the costs/benefits of CMMI-based process improvement and how to quantify them

Process improvement/EPG personnel seeking ways to communicate more effectively to senior management about the costs/benefits of CMMI-based process improvement

Personnel in organizations starting down a CMMI-based process improvement path

Project managers and engineers who need information to make better decisions about their project work.

Personnel in higher-maturity organizations seeking to transition to the CMMI, or implement higher-maturity process areas

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Introductions

Tutorial leader introductions

Participant introductions

- Name
- Company
- Position
- Expectations
  - What do you want to get out of the tutorial?
  - Do your expectations match the tutorial agenda?
  - How can we best address your concerns?

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Tutorial Approach

Interactive Presentation

Examples

Exercises

Questions and Answers

Participate!!!

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2 – Why?

i. To develop the business case for process improvement
ii. Need to communicate to decision makers who understand the language of money, not CMMI
iii. ROI is the only way to show financial value

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Business Context

The first question to answer is "what is the business context in which we're undertaking a CMMI effort?" Is it because we want to:

- Do things better, faster, cheaper?
- Increase contract award fees?
- Secure more contracts?
- Improve product quality?

We're going to focus on the quality, project management, and productivity implications of CMMI process improvement

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System Development Costs

Costs incurred to develop the product

Examples:

- Requirements development
- Design
- Product development + unit test
- Project management
- Engineering infrastructure
- Purchased components

What isn't on this list?

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Cost of Quality (CoQ) Concept

Developed by J.M. Juran and applied successfully by companies like Toyota Motor Corporation to achieve competitive advantages through the development of better quality products

CoQ represents *all costs associated with poor quality*

Source: Juran's Quality Handbook

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Cost of Quality Appraisal Objectives

- Quantify quality costs in the language management understands – money
- Identify major opportunities for quality cost reduction
- Identify opportunities for reducing customer dissatisfaction and threats to product saleability
- Expand budgetary and cost controls
- Stimulate improvement through publication
- Improve ability to deliver more to the business/market
- Reduce the functionality gap versus the competition
- Provide executives with reasons to invest in engineering improvement
- **CoQ appraisals are an easy way to understand where money is spent and to gauge the effectiveness of an organization**

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Internal Failure Costs

Costs associated with defects that are found prior to transfer of the product to the customer

Examples:

- Design corrective action
- Design re-reviews
- Purchased component corrective action
- Purchased component re-test
- Defect reporting/tracking
- Defect fixing
- 2nd and subsequent integration testing iterations
- 2nd and subsequent system testing iterations

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External Failure Costs

Costs associated with defects that are found after the product is shipped to the customer

Examples:

- Next release defect rework (maintenance)
- "Re-engineering"
- Technical support personnel
- Product returns
- Lawsuits
- Contract penalties
- Lost customers
- Lower marketplace perception
- Loss of pricing power
- Lost sales

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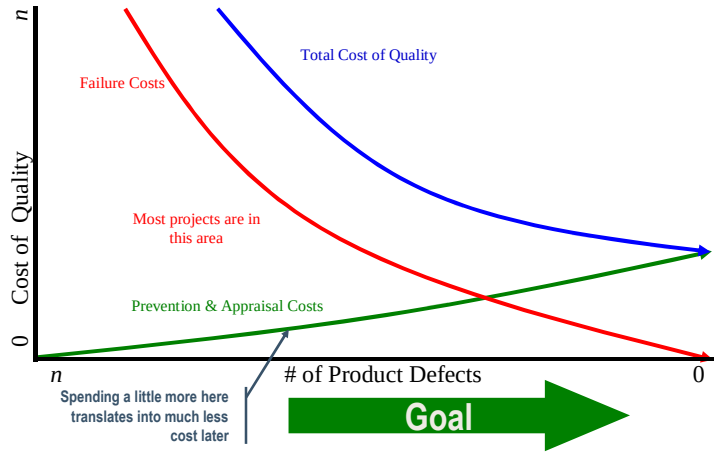
Graphical Representation of CoQ



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Prevention Costs

Costs incurred to keep failure and (product) appraisal costs to a minimum

Examples:

- Quality planning
- Quality assurance
- Configuration management
- Supplier capability assessments
- Quality training
- Component/software reuse
- Requirements reviews
- Design reviews
- Code reviews
- CM tools
- External process appraisals/audits (CMMI, ISO, SPICE, etc)
- Process improvement efforts

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(Product) Appraisal Costs

Costs incurred to determine the degree of conformance to quality requirements

Examples:

- Purchased component testing
- Defect reporting/tracking
- Test automation systems/software
- First iteration integration testing
- First iteration system testing
- User acceptance testing

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Relating CoQ to Productivity

Decreasing an engineering organization's Cost of Quality directly impacts productivity:

- Fewer defects mean less time testing and reworking the product
- Less time testing means a shorter cycle time
- Shorter cycle time means more products can be developed in similar time frames
- Fewer defects also mean a smaller customer support staff – these resources can be applied to new product development

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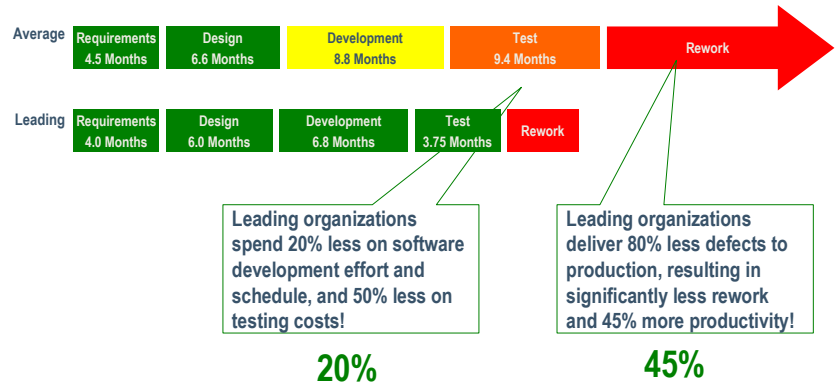
SW Example: 65% More Productivity



Average organizations spend 30% of project resources on testing, leading organizations spend 15%

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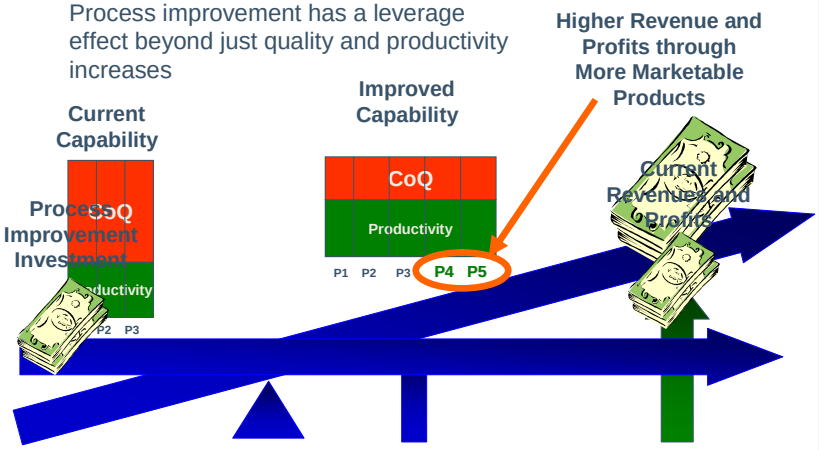
Leverage

Process improvement has a leverage effect beyond just quality and productivity increases



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Communication

Executives, senior management, and other decision makers don't use CMMI language

- $ **Their language is money**
- $ Decision making is done in the context of money

  so.....
- $ Communicating the importance and effectiveness of CMM-based process improvement
- $ Champions must communicate in the language of executives – money

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Business Case

- Resources are scarce (especially $money$)
- It is impossible to execute on all opportunities available to the organization
- Executives want an “apples-to-apples” comparison of the various investment options available

Incorporating ROI analysis into a proposed or existing CMMI effort allows for comparison of efforts across seemingly disparate projects

And, the ROI of CMMI can be quite high

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Provide Focus and Tracking Capability

Performing an ROI analysis up-front (estimation) can

- focus the organization on concrete business objectives for CMMI process improvement,
- clarify how improvement efforts map to corporate objectives,
- establish expectations about results
- establish a baseline to track performance

Multi-year process improvement efforts need to maintain the business focus by continuously tracking

- $ the associated actual costs
- $ the related benefits

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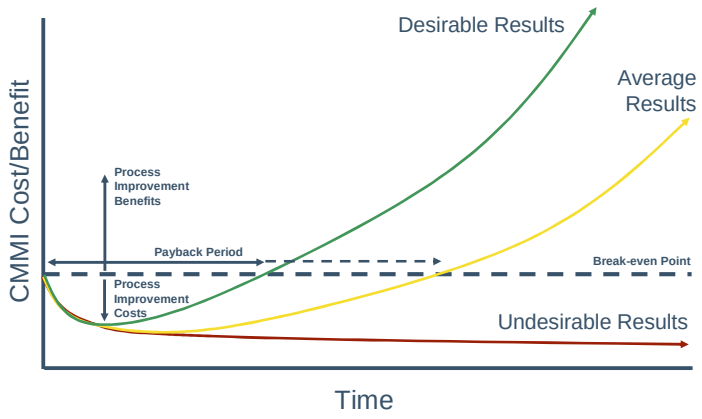
Drive Better Results



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Difficulties in Using ROI

Differing perceptions of ROI

Buy-In

Access to Data

Calculating benefits is tough

Consistently measuring ROI over time is tough

Organizations are resistant to measurement

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Discussion

What other difficulties have you experienced in determining CMMI ROI? How did you overcome them?

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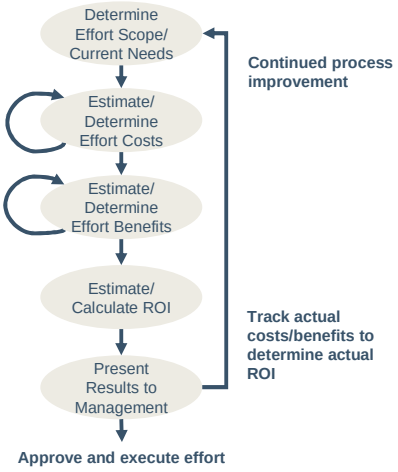
A Process for Determining ROI



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3 – When?

i. Before
ii. During
iii. After

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Before

Initially, it is VERY important to understand the potential value of a CMMI-based improvement effort to:

- Clearly understand the estimated costs associated with the effort
- Demonstrate the potential business value
- Provide a comparison against competing projects
- Establish a baseline for ongoing tracking and oversight
- Establish the expectations that benefits require time to develop, particularly for senior management
- Communicate with decision makers

At this time, other organizational indicators such as quality measurements, schedule adherence, customer satisfaction, etc. should be baselined.

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During

In order to track and maintain visibility, ROI should be tracked on an ongoing basis (perhaps every 6-12 months)

At the same time, intermediate indicators such as quality measurements, customer satisfactions surveys, etc. are tracked to determine the impact of improvement activities

Doing so demonstrates that the effort is on track from a cost perspective, and continues to keep the focus on the effort.

Additionally, early wins are communicated unambiguously in financial terms – something executives like to see.

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After

After a particular effort is completed, the ROI should be calculated to fully understand the true value of the effort.

This is needed to evaluate the financial effectiveness of the effort, create lessons learned, and set the stage for driving continuous improvement and institutionalization.

This forms the basis for the implementation of higher maturity process areas that support fact-based decision making.

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In other words....

continuously,
throughout the entire effort!

Implementation of the Measurement and Analysis process area early in your adoption effort will facilitate this. It will also support your organization's comparison to applicable benchmarks as well as modeling and simulation.

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4 – What?

i. All applicable direct costs should be identified
ii. As well, all direct benefits should be accounted for
iii. Indirect costs and benefits shouldn't be part of the analysis as they are difficult to attribute solely to the effort

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What information is needed.....

In its most basic definition ROI = A comparison of the costs and benefits of a process improvement effort across a specific organizational scope and time span.

You need to understand:

- Scope of the analysis
- Appropriate time horizon for analysis
- Relevant costs
- Financially quantifiable benefits

Remember, for a proper ROI analysis, all cost and benefit information needs to be calculated in terms of dollars and cents.

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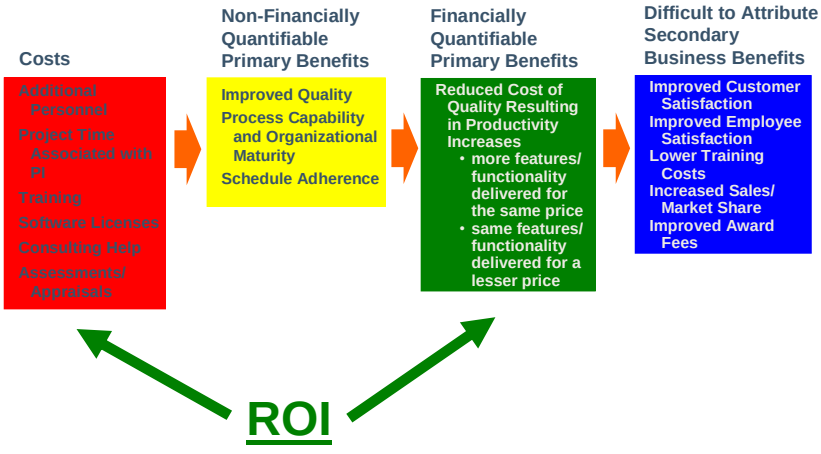
Process Improvement ROI Model



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Scope of Analysis

There are many ways to scope an ROI analysis.

- At the:
  - Organizational level
  - Project level
  - Process level
- Examples include:
  - Moving from CMM to CMMI
  - Introducing all practices associated with a particular PA
  - Implementing specific practices
  - Achieving a specific maturity or capability level
- **ROI calculations/equations won't change due to scope.**

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Time Horizon

Over how much time should an ROI analysis be performed?

Organizational - Generally, organizational efforts must show net value over a 2-3 year time period and unambiguous incremental value in shorter time frames.

Project/process - must show value in a shorter period of time.

It is probably unrealistic in most circumstances to demonstrate meaningful and measurable benefit in less than 3 months time due to:

- Need to develop/implement processes
- Train organizational units
- Institutionalize the improved processes

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Scope: Exercise

At this point, we'll begin working though our fictitious example of:

- Organizational CMMI improvement effort
- 150 person engineering organization at maturity level 1
- Looking to reach maturity level 2 in 18 months
- No EPG or QA in place
- Experiencing a Cost of Quality of 65%

In the exercise, we'll utilize an ROI calculation worksheet that guides the type of information we need to consider.

First off, we need to define the scope of the effort

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What Costs and Benefits?

What **costs** do you need to track?

What **benefits** are you expecting to realize?

When will costs and benefits be incurred?

How will these come together to generate **ROI**?

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Key Factors

Generating Cost & Benefit Data, you need to be aware of:

- Consistency
  - in gathering over time
  - in matching costs and benefits
- Clear & detailed operational definitions
- Clearly understanding **incremental** costs and benefits
- Costs and benefits defined in financial terms

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Direct People Costs of CMMI Improvement

Costs of Process Definition / Improvement	
Process definition & documentation	Interviews, meetings
MSG, EPG, TWGs	Attendance in training
Management of the effort	Process implementation
Consulting	Process institutionalization
Additional personnel	Process adherence
Project team diversion	Assessments/appraisals
Communication	Rewards and recognition

Generally counted as salary & benefit costs associated with people's time

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Direct Non-People Costs of CMMI Improvement

Costs of Process Definition / Improvement	
Tools	PAL, Measurement Repository
Training	

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Indirect Costs of CMMI Improvement

Costs of Process Definition / Improvement	
Loss of organizational/project team productivity	

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Other Costs to Think About

Rework due to poor quality • Prior to shipping • After shipping
Poor project cycle time
Lack of schedule predictability

Rather than consider these expenses on the "cost" side of the ROI analysis, we'll consider improving them to be part of the "benefits" side.

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Costs: Exercise

- Organizational CMMI improvement effort
- 150 person engineering organization
- Looking to reach maturity level 2 in 18 months
- No EPG or QA in place
- Experiencing a Cost of Quality of 65%

Which costs should we plan and account for?

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Direct Benefits

Reductions in:	Improvements in:
Defects	Process adherence
Rework	Quality
Effort/overtime	Product features
Schedule cycle time	
Product costs	
Production costs	
Support costs	

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Indirect Benefits

Reductions in:	Improvements in:
Training costs	Employee satisfaction/retention
	Customer satisfaction/retention
	Revenue
	Award fees
	Market share

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Discussion

Most direct process improvement benefits can be financially quantified in terms of productivity increases

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So, How Do We Measure Productivity?

The definition of Productivity is the number of outputs delivered for a certain number of inputs.

For systems engineering, the inputs are typically people-related.

The outputs however, can vary significantly, and are difficult to compare against each other:

- Missile system
- Copy machine
- Cell phone
- Function points or SLOC (for software)

The easiest way to help understand the notion of productivity in an engineering organization is Juran's Cost of Quality concept.

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Measuring Non-Financial Benefits

As discussed, there are many non-financial benefits with different ways to measure them.

It is important to measure non-financial benefits on an ongoing basis as part of the effort in order to keep focus on other indicators of progress or value.

Keep in mind that measuring these in non-financial terms doesn't directly impact the ROI calculation.

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Using Benchmarks to Estimate

To aid in determining what costs and benefits may be expected, consider the use of industry benchmarks. For example:

- Gartner research shows software organizations spend 3% - 5% on CMMI process improvement efforts
- CMM maturity level 1 organizations typically experience a Cost of Quality of 65%
- CMM maturity level 3 organizations typically experience a Cost of Quality of 40%

Baselining the organization and using benchmarks to compare against helps in building a credible ROI calculation.

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Using Simulation to Estimate

Engineering process simulation models focus on the dynamics of engineering development and maintenance.

Modeling and simulation of the significant features of engineering processes facilitates experimentation, answer "what-if" questions, and perform sensitivity analysis.

By modeling an organization's current engineering processes and simulating improvements to them, costs and benefits can be better estimated and determined.

Example: would the cost of source code inspections add value if the input source code had an abnormally high degree of errors?

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Benefits: Exercise

- Organizational CMMI improvement effort
- 150 person engineering organization
- Looking to reach maturity level 2 in 18 months
- No EPG or QA in place
- Experiencing a Cost of Quality of 65%

Benchmarks indicate that an organization operating at maturity level 2 can reduce its Cost of Quality to 50%

How can we quantify these benefits?

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Levels of Data Fidelity

The level of detail you go to in an ROI analysis will depend on the size of the effort

Multi-million dollar CMMI efforts in larger organizations will most likely require a greater degree of data fidelity than a smaller, more tactical solution on just one project.

Understand the level of fidelity needed to make a **credible** ROI analysis. Don't blow your chance with a shallow case if decision makers are expecting more details.

"Test run" your assumptions and analysis with peers and other managers before presenting the final results.

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5 – How?

i. There are several ways to calculate ROI
ii. Using multiple methods provides for a multi-faceted view and allows for better decision making

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ROI can be calculated many ways

There is no single, official "definition" of ROI – it can be calculated in many ways.

Some of these include:

- Benefit/Cost ratio (typically considered ROI)
- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Payback Period (PP)/Break Even Point (BEP)

A complete ROI analysis includes all of the above

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Match Cash Flows and Don't Double Count

Costs must align appropriately with benefits

- Don't include costs or benefits that don't relate to each other
- Beware of "one-time" costs that should really be incurred over the entire ROI analysis time period
- Don't scope the effort's costs to a specific project but count benefits organizationally

No double counting

- For example, you can't count the value of an avoided defect *and* the productivity that's improved as a result

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Benefit/Cost Ratio

Benefit/Cost Ratio (typically considered to be ROI) is simply the ratio of benefits enjoyed by a certain effort divided by the costs incurred. i.e. 150%

Pros
- Fairly easy to compute
- Provides a "one number" method of comparing projects

Cons
- Doesn't incorporate the Time Value of Money (TVM)
- No way to know the dollar magnitude of the return
- Don't know how long the return took to achieve

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Benefit/Cost Ratio

	Year 0	Year 1	Year 2	Total
Costs	$300	$100	$100	**$500**
Benefits	$0	$500	$500	**$1000**
Return	-$300	$400	$400	$500

Benefit/Cost Ratio in this example would be 2:1 or 200%

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Time Value of Money (TVM)

Benefit/Cost ratio, while valuable, doesn't take into account the concept of the Time Value of Money (TVM).

Simply stated, the value of a dollar is less in the future than it is now.

Question: If risk-free interest rates are 10%, how much would you pay me now for $100 in 3 years?

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Time Value of Money (TVM)

Answer: $75.13

	Year 0	Year 1	Year 2
Principal	**$75.13**	$82.64	$90.91
Interest	$7.51	$8.26	$9.09
Total	$82.64	$90.91	$100

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Discounted Cash Flow (DCF)

To aid in corporate decision-making, the TVM is captured in Discounted Cash Flow (DCF) analysis.

In DCF analysis, future cash flows are discounted using either:

- The company's weighted average cost of capital (WACC)
- A "hurdle rate" consisting of the company's cost of capital adjusted by a risk premium appropriate for the type of project being analyzed

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Discounted Cash Flow (DCF)

This risk premium can be significant (30%+) in some cases!

	Year 0	Year 1	Year 2
Principal	**$45.52**	$59.17	$76.92
Interest	$13.65	$17.75	$23.08
Total	$59.17	$76.92	$100

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Net Present Value (NPV)

Net Present Value (NPV) takes both cost and benefit cash flows and discounts them appropriately using the company's cost of capital or hurdle rate.

NPV is described as a dollar value, allowing for seemingly dissimilar projects to be compared against each other.

Pros
- Articulates the dollar magnitude of the return
- Provides a "one number" method of comparing projects
- Incorporates TVM

Cons
- Not as easy to compute
- Don't know how long the return took to achieve

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Net Present Value (NPV)

With a 10% hurdle rate, our example looks like:

	Year 0	Year 1	Year 2	Total
Costs	$300	$100	$100	$500
Benefits	$0	$500	$500	$1000
Return	-$300	$400	$400	$500
Disc Return (NPV)	-$300	$363.63	$330.58	**$393.94**

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Internal Rate of Return (IRR)

IRR determines the intrinsic interest rate that summarizes the value of a series of cash flows. 0% indicates "break-even", positive percentage indicates a positive return while a negative percentage indicates a negative return.

Essentially determines the discount rate that results in NPV=0

Pros
- Provides a "one number" method of comparing projects that is independent of the company's WACC or hurdle rate

Cons
- No way to know the dollar magnitude of the return
- Don't know how long the return took to achieve
- In unusual cases, may provide multiple answers
- Not as easy to compute

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Internal Rate of Return (IRR)

In our example, the **IRR is 100%**

	Year 0	Year 1	Year 2	Total
Costs	$300	$100	$100	$500
Benefits	$0	$500	$500	$1000
Return	-$300	$400	$400	$500
Disc Return	**-$300**	**$200**	**$100**	**$0**

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Payback Period/Break Even Point

Determines the amount of time it takes for cash inflows to equal cash outflows, resulting in the *break even point*

Pros
- Indicates how quickly a project turns profitable

Cons
- No way to know the dollar magnitude of the return
- In unusual cases, may provide multiple answers

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Payback Period/Break Even Point

In our example, the PP/BEP is Year 1

	Year 0	Year 1	Year 2	Total
Costs	$300	$100	$100	$500
Benefits	$0	$500	$500	$1000
Return	-$300	$400	$400	$500
Net Return	-$300	**$100**	$500	$500

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Exercise

- Organizational CMMI improvement effort
- 150 person engineering organization at maturity level 1
- Looking to reach maturity level 2 in 18 months
- No EPG or QA in place
- Experiencing a Cost of Quality of 65%

How do the various ROI calculations turn out for our exercise?

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6 – Wrap-up

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Implementation Issues

ROI analysis won't necessarily improve a CMMI effort's results – you still have to execute!

In any process improvement effort, you should find ways to leverage organizational change best practices to overcome resistance to change.

Determining and tracking ROI as well as other measurements keeps the focus of the effort on the **business benefits**

Use the Measurement and Analysis process area early to put the focus on the business benefits from the start

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Discussion

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What Did You Learn?

1. **Why?**
   i. To develop the business case for process improvement
   ii. Need to communicate to decision makers who understand the language of money, not CMMI
   iii. ROI is the only way to show financial value
2. **When?**
   i. Before, During, and After
3. **What?**
   i. All applicable direct costs should be identified
   ii. As well, all direct benefits should be accounted for
   iii. Indirect costs and benefits shouldn't be part of the analysis as they are difficult to attribute solely to the effort
4. **How?**
   i. There are several ways to calculate ROI
   ii. Using multiple methods provides for a multi-faceted view and allows for better decision making
5. **Case Study**
   We went through a case-study where we estimated CMMI-based process improvement costs and returns over a 3 year time period, and explored the various ways of calculating the value of the effort over the 3 years.

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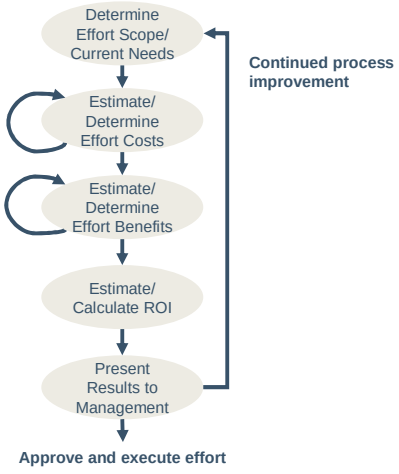
A Process for Determining ROI



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Parting thoughts: What's Next for You?!

Determining the monetary value of CMMI-based process improvement may appear to be difficult.

But it's not that hard.
- It does take disciplined effort
- You may have to build or buy the necessary organizational capabilities & resource capacities

And it's extremely important.
- Making informed decisions about how to invest scarce resources
- Sustaining commitment for disciplined process improvement

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Bibliography

1. Juran's Quality Control Handbook, Joseph Juran
2. Winning with Software – An Executive Strategy, Watts S. Humphrey, Pearson Education, 2002
3. The ROI from Software Quality, Khaled El Emam, 2003
4. Software Assessments, Benchmarks, and Best Practices, Capers Jones, Addison Wesley, 2000
5. Why Make The Switch? Evidence About the Benefits of CMMI, Dennis Goldenson, Diane Gibson, Robert Ferguson, SEI/CMU, 2004
6. Demonstrating the Impacts and Benefits from CMMI, Dennis Goldenson & Diane Gibson, SEI/CMU, 2003

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96th COMMUNICATIONS GROUP

Into the Future Part 1: Process Definition on Steroids

Kathy Reid
96th Communications Group/TYBRIN Corporation
Eglin Air Force Base, Florida
13 November 2006

U.S. AIR FORCE

OUTLINE

- Process Goals
- Proven Approach
- Process Improvement Infrastructure
- Process Execution
- Applying Techniques
- Questions

Process Goals

- **Build a process that is**
  - ***Adaptable*** **to changing user needs**
  - ***Maintainable*** **to implement changes rapidly**
  - ***Flexible*** **to support a solid architectural framework**
    - **Modularized components**
    - **Reusable components**

Process Goals Continued

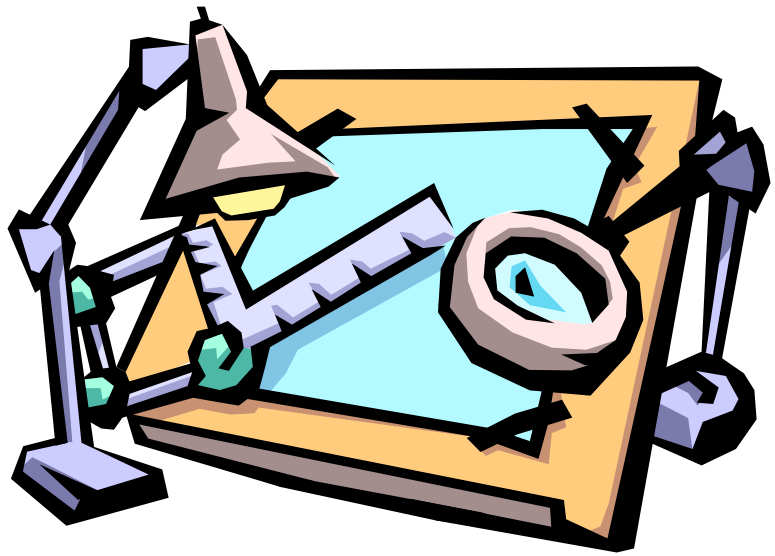
- **Build a process that is NOT**
  - **Cumbersome to understand (shelfware, big honkin' binder)**
  - **Circumvented when schedule and cost pressures affect a program**
  - **Difficult to maintain**
    - **Changes require redesign**
    - **Fixing one error propagates more errors**
    - **No programmer wants to be assigned to the team**

Process Goals Continued

- **Build a process that supports**
  - **Daily needs of the engineers and managers**
  - **Various levels of expertise**
  - **Multiple disciplines with a unified process**
  - **Ownership by the engineers**

Proven Approach – Overview

- **Define the Level of Detail**
  - Establish an approach that meets user experience levels
- **Define the Design Components**
  - Cartography, Step Action Table (SATs) and Decision Tables (DTs)
  - Artifacts
- **Define the Environment**
  - Processes
  - Tools
  - Analysis Methods

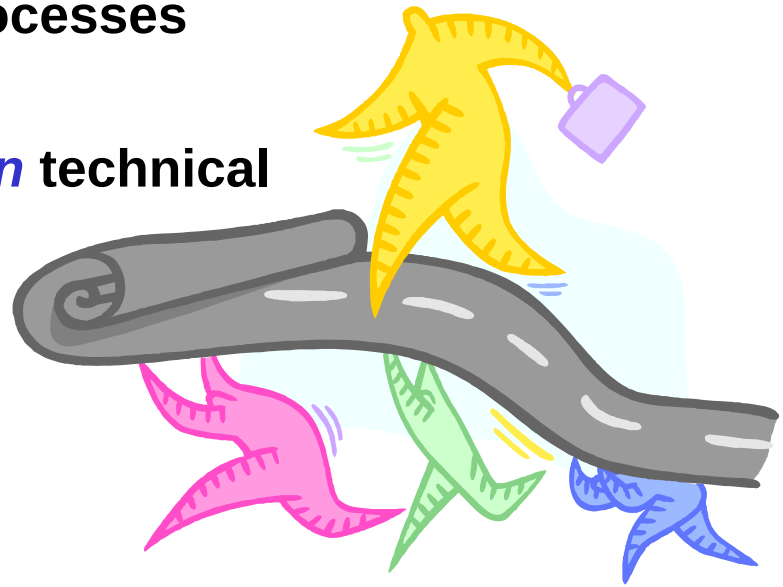


Proven Approach – Level of Detail Expert

- **Cartography is a graphical representation designed for highly experienced engineers that**
  - ***Improves*** **the business objectives**
  - ***Teaches*** **others how to apply the organization's processes**
  - **Designs and implements *innovative* technical solutions**

Proven Approach – Level of Detail Intermediate

- **Step Action Table (SAT) is a textual representation designed for moderately experienced engineers that**
  - ***Applies*** **the business objectives**
  - ***Executes*** **the organization's processes**
  - **Designs and implements *proven* technical solutions**



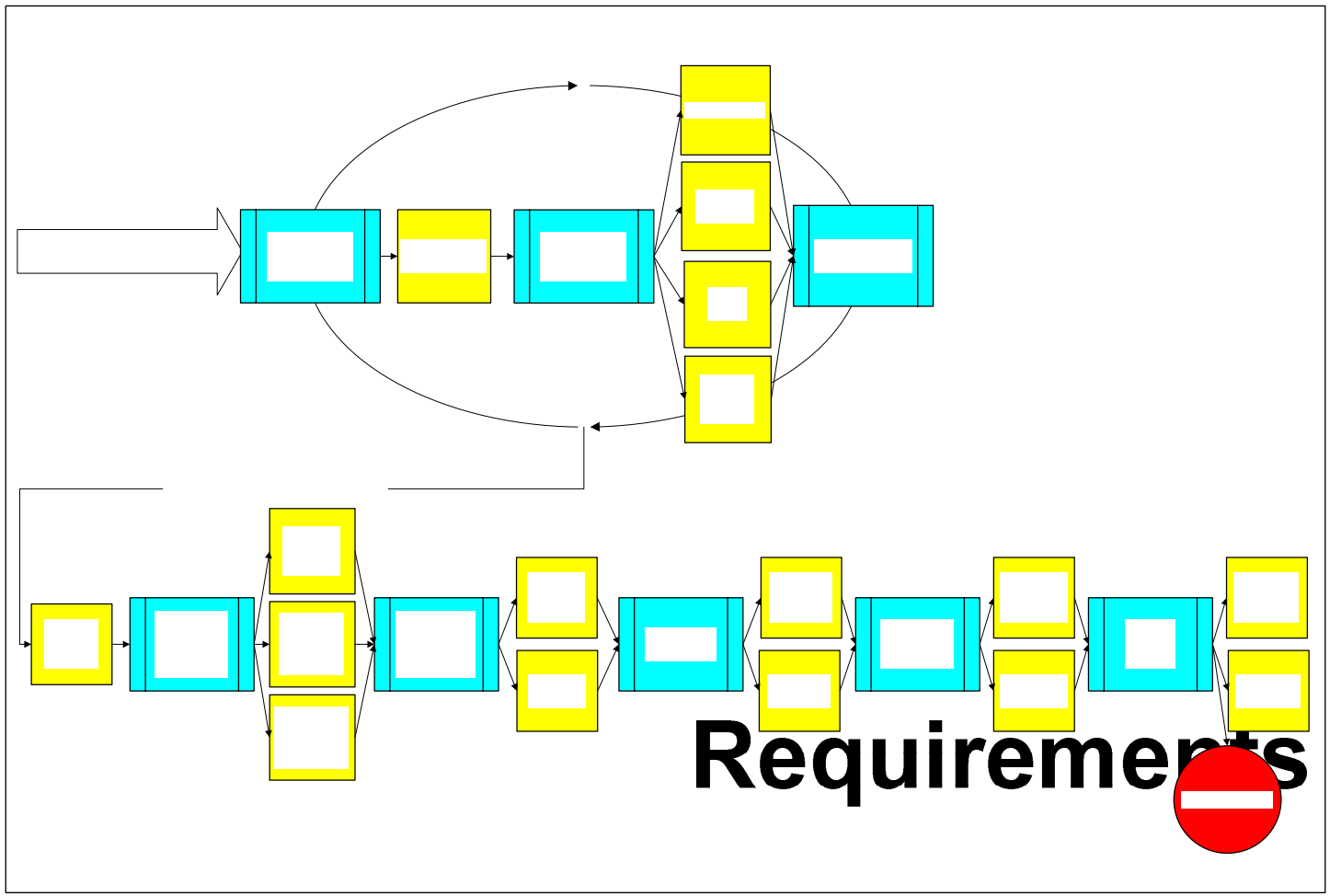
Proven Approach – Level of Detail Beginner

- **Decision Table (DT) is a tabular representation with tailoring options to include templates and checklists designed for inexperienced engineers that are**
  - ***Understanding*** **the business objectives**
  - ***Learning*** **the organization's processes**
  - ***Assisting*** **with the design and implementation of technical solutions**

Approach – Design Components Cartography

- Represents high-level overview of process activities to include a link to process-related information such as policy, training, frequently asked questions, Quality Assurance (QA) tips and Best Practices
- Supports point and click process navigation using web pages
- Requires Microsoft Visio to implement t
  to create the graphical symbols

Approach – Design
Sample Cartography Component



Approach – Design Components Step Action Table (SAT)

- **Defines step-by-step details of the process activities**

- **Supports point and click process navigation using web pages**
- **Requires HTML and Java languages to implement web pages and the automatic numbering for process steps**

Approach – Design
Sample SAT Component

Requirements Management Step Action Table

(as of April 2006)

Step	Action	Responsible
	Verify Entry Criteria	
1	Verify that Project initiation has been completed or system requirements allocated to software have been modified	Project Leader(PL)
2	Record/review the project purpose and for Standard Software Process (SSP) projects, Scope, Goals, and Objectives in the ***Project Tracking Form (PTF)*** Description section, as needed	PL
3	Acquire the Software Requirements Specification (SRS) Package **?** and record initial data and remaining data as tasks below are completed using the *Requirements Checklist* or an approved group-specific Requirements Checklist, and referencing the *Requirements Compliance Checklist*	PL
4	Record/review the following data in the ***PTF*** Schedule Breakdown section for the Requirements Management and Project Planning phases: • Requirements as a critical milestone or not • Actual start date • Adjusted effort and date estimates (may use calculate button in PDB to acquire adjusted estimate date based on the actual start date) • Development Team Members	PL

•
•
•

	Measurements	
30	Referencing the SRS Package, record the total number of initial requirements in the Requirement Volatility Metric in the Project Metrics sheet of the ***Automated Metric Analysis Tool (AMAT)***	PL
31	Verify/record actual hours in ***SERTS*** under the Requirements lifecycle activity, tailoring decisions in the ***PTF*** and requirements completion date in the Schedule Breakdown section of the PTF	PL

Approach – Design Components
Decision Table (DT)

- **Defines criteria and action for each critical process decision (i.e., *when* y exists *then* perform x) to identify tailoring options that meet the unique needs of each process user**

- **Supports point and click process navigation using web pages**
- **Requires HTML to implement web pages**

Software Requirements Specification Package Decision Table

(as of April 2006)

When	Then
Software Requirements Specification (SRS) Package exists	Acquire and modify SRS Package, as applicable
SRS Package does not exist, and Customer or First Level Supervisor (FLS) / Group Leader (GL) does not require a formal requirements document	Acquire one of the following to complete the SRS Package: • The ***Software Requirements Specification Form (SRSF)***, or • An approved SRS Database that captures all data items listed in the SRSF
SRS Package does not exist, and Customer or FLS/GL requires a formal requirements document	Acquire the ***Requirements Traceability Matrix (RTM) Template*** and one of the following to complete the SRS Package: • The ***Condensed SRS (CSRS) Template***, or • The ***SRS Template***

Approach – Design Artifacts Definitions/Checklists

- **Definitions**
  - Clarify terminology based on the organization's processes
- **Checklists**
  - Derived from a template
  - Identify detailed questions to enhance the effectiveness of the process
  - Focus on product and process quality

Approach – Design Artifacts Forms

- **Forms**
  - **Provides a unified method to collect data consistently**
  - **Identifies minimum data requirements**
  - **Focuses on capturing the right data to measure progress and quality**

Approach – Design Artifacts Plans

- **Plans are**
  - **Derived from a specific template (Requirements Specification, Test Plan)**

- **Utilized to Identify formal information required by the customer**

- **Focus on product quality**

Process Overview

Process	Policy	Training	FAQ	QA Tips	Best Practices
General	-	-	FAQ	QA Tips	None
Acceptance Test	Policy	Training	FAQ	QA Tips	None
Integration Test	Policy	Training	FAQ	QA Tips	None
Peer Review	Policy	Training	FAQ	QA Tips	None
Process Development	Policy	Training	None	None	None
Project Tracking and Oversight	Policy	Training	FAQ	QA Tips	None
Rapid Implementation Process	Policy	Training	None	QA Tips	None
Requirements Management	Policy	Training	FAQ	QA Tips	Best Practices
System Test	Policy	Training	FAQ	QA Tips	Best Practices
Technology Change Management	Policy	Training	FAQ	None	None

Requirements Management Process Best Practices

1. OSP v5.0

Artifact Type: Software Requirements Specification Form

Description:

This artifact is a good example of a completed SRSF with clearly defined requirements.

Link: Artifact

Requirements Management Process FAQ

1. OSP v5.0 4/24/2005

As a new project leader in the requirements phase of the project, I wasn't sure if I had to do this step or not. Is it only if you are in the Project Planning phase or later?

The PMF is required during Requirements to capture your initial requirements, your estimated/actual effort, and peer review defects.

2. OSP v5.0+ 9/18/2006

In the Training Requirements section of the PTF, can the PL modify or remove a skill from the team skill set?

Yes you can modify or remove a skill from the team skill set. To delete a skill select the skill you wish to modify, this should highlight that skill, and click the delete button to remove.

Approach – Environment Processes

- **Web-based Processes**
  - **HTML Processes**
    - **Allows for centralized access and easy navigation**
  - **XML Configuration Files**
    - **Allows for easy modifications of changing data and implementation of business rules**

Approach – Environment Tools

- **Development of In-House Tools**
  - **Standard Engineering Request Tracking System (SERTS) – tracks change requests as well as estimated and actual hours expended**
  - **Process Database Tool (PDB)– centralizes data, captures information to track progress and provides real-time insight into status**
  - **Automated Metric Analysis (AMAT) – extracts data from PDB and SERTS to provide a means to track project goals against organizational goals and perform quantitative analysis on performance**
  - **Shared Knowledge Provider (SKP) – provides access to process improvement tools and project data via a centralized web page**

Approach – Environment
Statistical Analysis Methods

- **Statistical Analysis Methods**

  - **Statistical Process Control with moving range to allow for analysis to determine if the processes are stable and under control**
  - **Mini tab tool provides numerous charts and graphs to aide in data analysis**

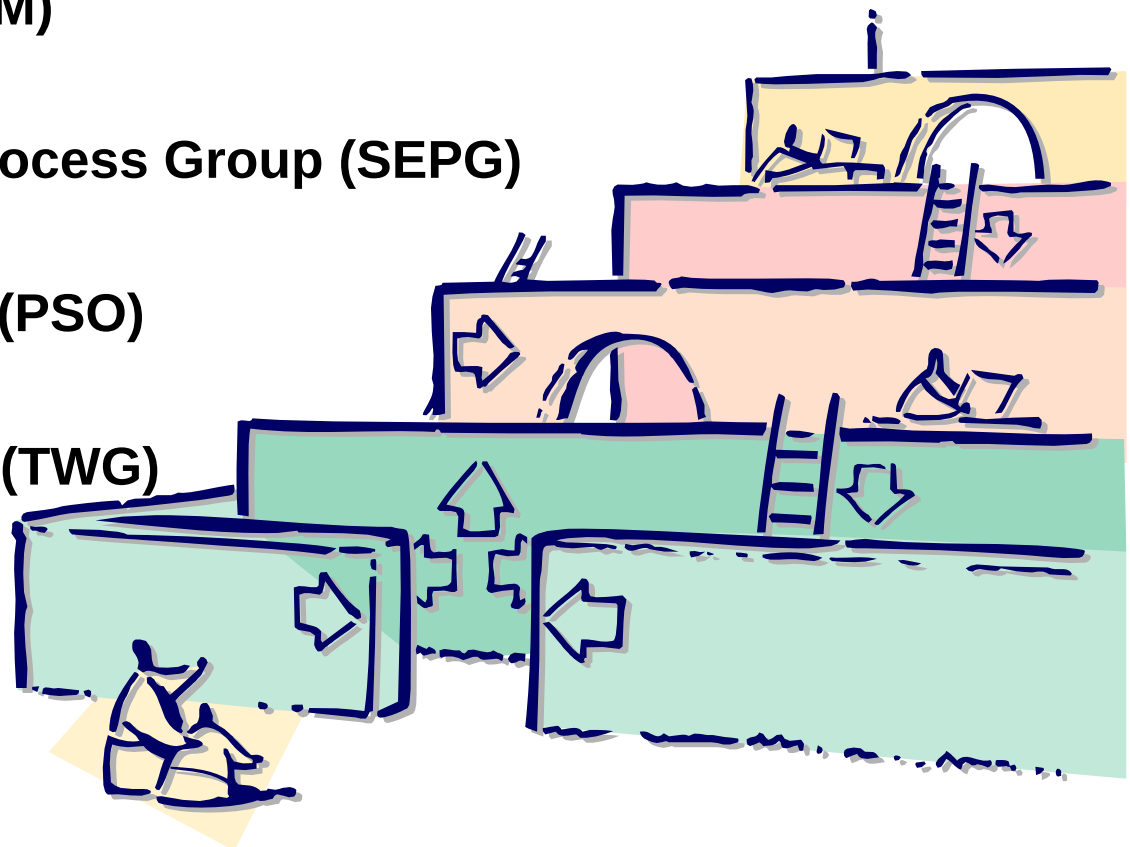
Approach – Environment People

- **Produce Process Champions**

  - **Believe their individual words and actions ultimately improve the project performance and build a more positive work environment**
  - **Display a constant willingness to help others understand, utilize and improve the processes by effectively communicating the direct benefits to the project**
  - **Transform the engineer's frustrations into positive energy and focus towards building a better organization**
  - **Seek to continually add value by improving disciplined processes**

Process Management Infrastructure - Overview

- Executive Steering Committee (ESC)
- Senior Management (SM)
- Standard Enterprise Process Group (SEPG)
- Project Support Office (PSO)
- Technical Work Group (TWG)
- User Group (UG)
- Target Group (TG)



Process Management Infrastructure - ESC

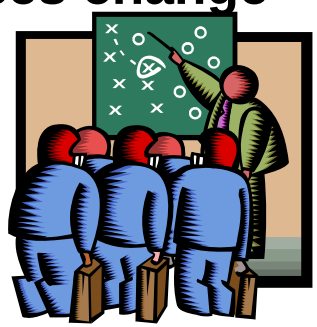
- **Executive Steering Committee (ESC)**
  - **Membership includes 3 Senior Executives and 5 Senior Managers**
  - **Identifies process improvement approach and allocates funding and resources**
  - **Provides oversight to the Organization Standard Process (OSP), policies, charters, Process Improvement Plan (PIP), and budget**
  - **Supports ESC Meetings bimonthly to review progress of planned versus actual tasks**

Process Management Infrastructure - SM

- **Senior Management (SM)**
  - Membership includes 5 Senior Managers
  - Guides and directs activities to achieve the strategic goals
  - Supports SM Meetings bimonthly review SEPG status
  - Addresses resource, budget, and training issues

Process Management Infrastructure - SEPG

- **Standard Enterprise Process Group (SEPG)**
  - **Membership includes 7 to 10 Group Leaders and the Organization Quality Assurance (QA) Manager**
  - **Facilitates the definition, execution, and improvement of policies and processes**
  - **Represents each target group's interests, processes change requests and addresses action plans**



Process Management Infrastructure – SEPG continued

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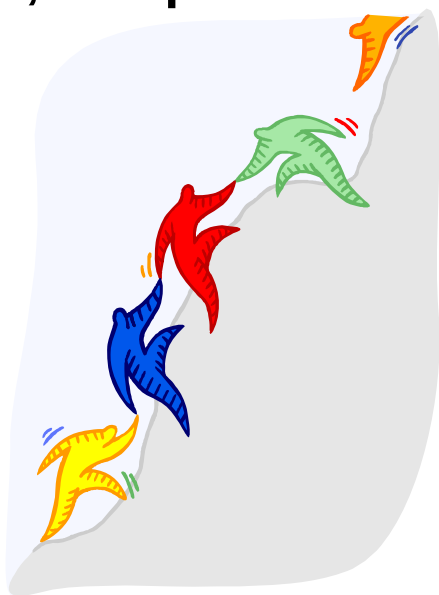
- **Standard Enterprise Process Group (SEPG)**
  - **Oversees Technical Work Group, Project Support Office, User Group and Training activities**
  - **Performs Causal Analysis and Resolution, Organizational Process Performance, Quantitative Project Management, and Organization Innovation and Deployment activities**
  - **Provides training courses to engineers and all levels of management**
  - **Reports status to ESC and SM**

Process Management Infrastructure - PSO

- **Project Support Office (PSO)**
  - **Composed of 6 permanent and 1 rotating position**
  - **Performs QA activities, training management, and process maintenance**
  - **Maintains and creates applications supporting process improvement**
  - **Provides support to the SEPG**



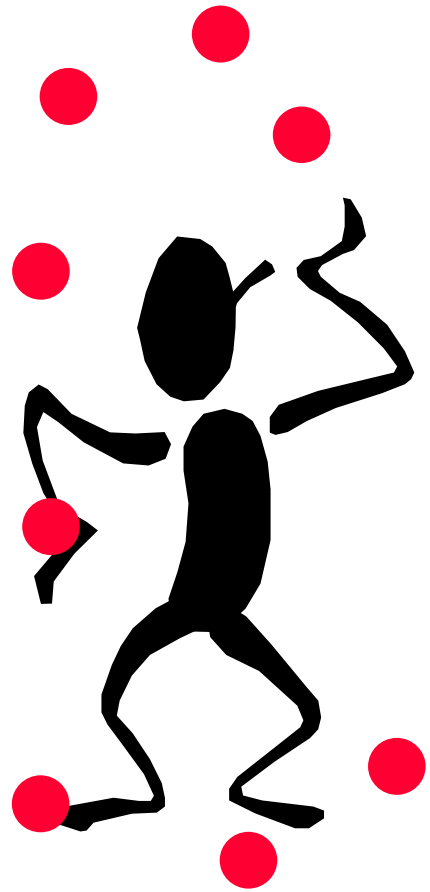
Process Management Infrastructure – TWG/UG

- **Technical Work Groups (TWG)**
  - Composed of engineers representing each target group
  - Develops processes and accompanying artifacts as defined by a charter

- **User Group (UG)**
  - Composed of representatives from all groups
  - Resolves process issues at the engineering level

Process Management Infrastructure - TG

- **Target Group (TG)**
  - Adheres to Organization Standard Process
  - Addresses Compliance Issues
  - Submits Change Requests
  - Reports Project Status
  - Attends User Group Meetings
  - Supports Technical Work Groups



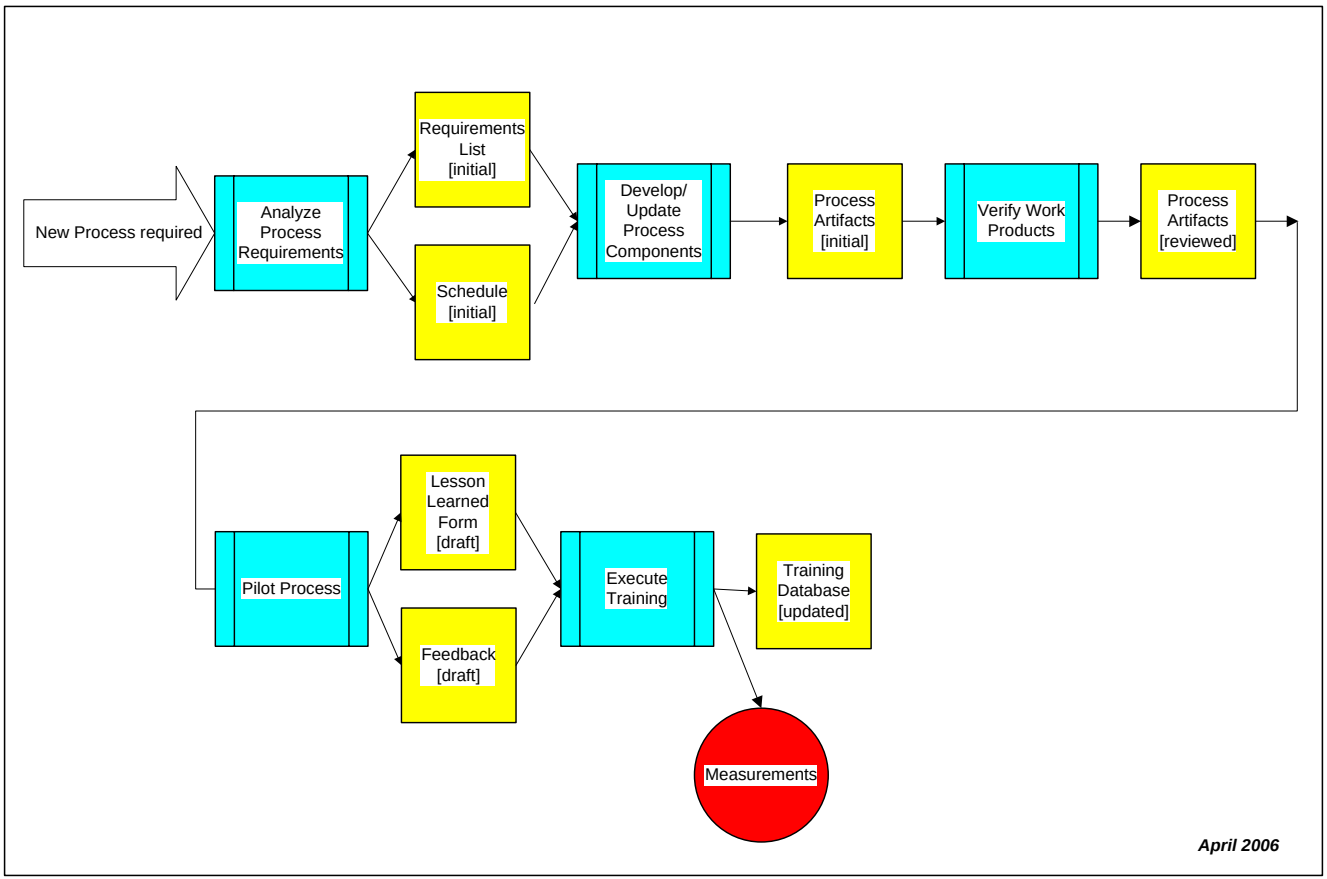
Process Execution – Overview

- **Process Development Process**
  - Cartography
  - Step Action Table
  - Artifacts
  - Supporting Processes
  - Evaluating Processes

Process Execution – Cartography

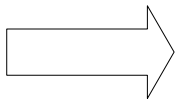
Process Development

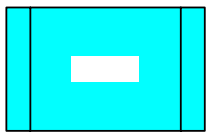
Process Overview

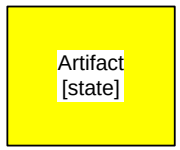


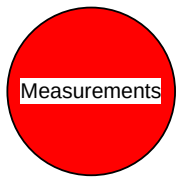
Process Execution – Cartography Symbols

Cartography symbols









- Entry Criteria defines conditions that must be met to initiate the process
- Activity Box defines action that results in the creation/modification of an artifact to the next higher state
- Artifact is the direct result of an activity taking place and displays an associated state as the artifact progresses within the development cycle
- Process measurements are collection points for process data
- Dashed lines indicate the component is optional. Activity boxes, artifact boxes and measurement components can be optional

Process Execution – Cartography Guidelines

- Use predefined cartography symbols
- Include entry criteria, activity box, artifact box and measurement at a minimum
- Include no more than 7 activity boxes per process
- Start Activity Boxes with a verb in the description
- Display optional components with dashed lines
- Link to process-related information (policy, training, best practices, frequently asked questions and QA tips)
- Must have a last updated date

Process Execution – Step Action Table

- **Process Development Process Steps**
  - **Verify Entry Criteria**
  - **Analyze Process Requirements**
  - **Develop/Update Process Components**
  - **Verify Work Products**
  - **Pilot Process**
  - **Execute Training**
  - **Measurements**

Process Execution – Step Action Table Continued

- **Verify Entry Criteria**
  - **Project Leader (PL) verifies a Standard Engineering Request Form (SERF) is received stating a new process must be developed**

- **Analyze Process Requirements**
  - **PL reviews existing process artifacts based upon current requirements**
  - **PL reviews the Lessons Learned Forms (LLFs) to gain insight on process and management lessons learned for process development**
  - **PL identifies resources required (i.e., tools, person hours, hardware, etc.) and provides estimated hours for updating/developing the process to the applicable Configuration Control Board (CCB) and the First Level Supervisor (FLS)/Group Leader (GL)**

Process Execution – Step Action Table Continued

- **Develop/Update Process Components**
  - **PL develops/updates the following process artifacts according to the Process Development section of the Standards and Style Guide:**
    - **Cartography**
    - **Step Action Table (SATs)**
    - **Forms**
    - **Checklists, as required**
    - **Decision Tables (DTs), as required**
    - **Templates, as required**
  - **PL updates the Standard Definitions, as required**

Process Execution – Step Action Table Continued

- **Verify Work Products**
  - **PL verifies the process artifacts are complete and correct**
  - **PL provides the process artifacts to the CCB and FLS/GL for review**
  - **PL updates the process artifacts based on the CCB and FLS/GL feedback**
  - **PL submits the process artifacts to CCB for piloting**

Process Execution – Step Action Table Continued

- **Pilot Process**
  - **Configuration Control Board (CCB) selects project/group to pilot the process artifacts**
  - **CCB defines the piloting period start date and completion date**
  - **CCB trains the Project Leaders (PLs) and Development Team Members (DTMs) on the process being piloted**
  - **CCB solicits feedback from piloting project/group after the piloting period has ended and provides to the PL**

Process Execution – Step Action Table Continued

- **Pilot Process**
  - **PL updates the process artifacts based on the piloting feedback and generates lessons learned**
  - **PL submits the final process artifacts and the lessons learned to CCB for baseline approval**
  - **CCB submits finalized process artifacts and lessons learned to the SEPG and the QA Managers, if the process needs to be incorporated into the OSP**

Process Execution – Step Action Table Continued

- **Execute Training**
  - **CCB executes the Training Process with affected individuals**

- **Measurements**
  - **PL, CCB verifies/records actual hours in Standard Engineering Request Tracking System (SERTS) under the Implementation lifecycle activity to develop, review, update and train the process**

Process Execution – Artifacts

- Requirements List
- Schedule
- Process Artifacts
- Feedback
- Lessons Learned Form
- Updated Training Database

Process Execution – Supporting Processes

- **Training Process**
  - **Executed by the Organization Training Manager to**
    - **Identify training needs**
    - **Schedule classes**
    - **Track attendance**
    - **Acquire feedback on training effectiveness**

Process Execution – Evaluating Processes

- Capture the estimated and actual effort expended to define, implement, review and test the new process

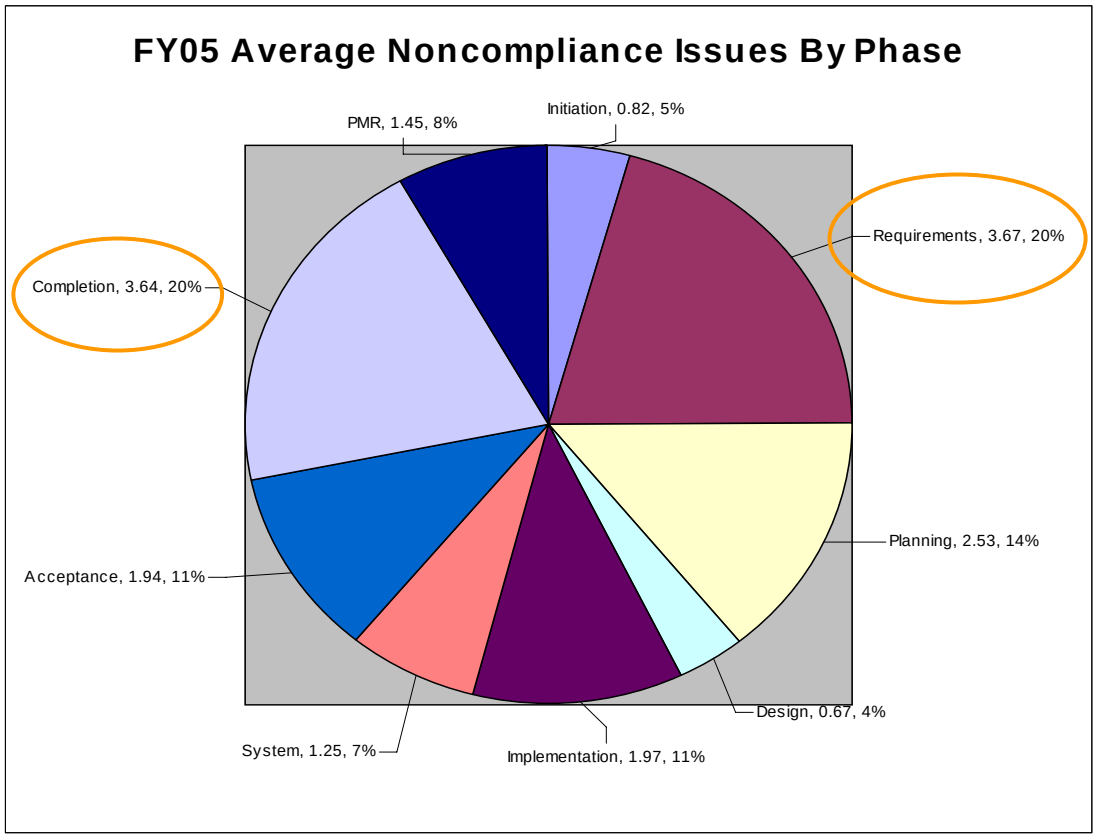
- Capture the estimated and actual start and completion dates for the new process

- Capture the resources (number of people, tools, training, etc.) utilized on the new process

- Capture number of post release defects associated with the new process

Process Execution – Evaluating Processes Continued

- **Capture the number of compliance issues encountered while executing the Process Development Process**



Applying Techniques

Applying Techniques

- **Demonstrate Shared Knowledge Provider (SKP) Functionality**
  - **Show links to applications**
  - **Show structure of the menu bar**
  - **Show process assets**
  - **Show point and click navigation of the processes**

Applying Techniques

- **Execute Process Definition Exercise**
  - **Apply process and techniques learned to create a process as a group**
  - **Expand process to address the enterprise level**

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Questions

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Acronyms

- AMAT – Automated Metric Analysis Tool
- CCB – Configuration Control Board
- CG – Communications Group
- CM – Configuration Management
- DT – Decision Table
- DTM – Development Team Member
- ESC – Executive Steering Committee
- FLS – First Level Supervisor
- GL – Group Leader
- LLF – Lessons Learned Form
- OSP – Organization Standard Process
- PDB – Process Database

Acronyms

- PIP – Process Improvement Plan
- PL – Project Leader
- PSO – Project Support Office
- QA – Quality Assurance
- SAT – Step Action Table
- SEPG – Standard Enterprise Process Group
- SERTS – Standard Engineering Request Tracking System
- SKP – Shared Knowledge Provider
- SM – Senior Management
- TG – Target Group
- TWG – Technical Work Group
- UG – User Group

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References

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- Gamberini, Rudy, Reuters Inc., “Process Cartography: A Graphical Approach to Process Definition”, SEPG 2000.
- Olson, Timothy G., Quality Improvement Consultants (QIC), Inc., “How to Define Processes in Expert Mode”, SEPG 2000

Carnegie Mellon
Software Engineering Institute
Pittsburgh, PA 15213-3890

Basics of PSP and TSP for Systems Engineering

James McHale
Software Engineering Institute
November 2006

Sponsored by the U.S. Department of Defense
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Agenda

- Why PSP and TSP for Systems Engineering?
- Things That Change, Things That Don't
- Time Logging Exercise
- The TSP Launch
- The TSP Management Framework
- TSP Quality Management

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Team Software Process

The Team Software Process (TSP) is a engineering development process originally developed for software teams.

TSP addresses common engineering and management issues (the same ones addressed by CMMI).

- cost and schedule predictability
- productivity and product quality
- process improvement

TSP

- truly empowers teams and team members
- is a complete, mature, “operational” process
- provides immediate and measurable results

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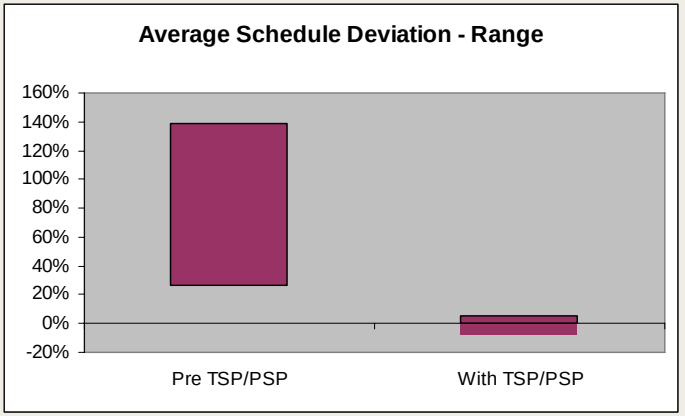
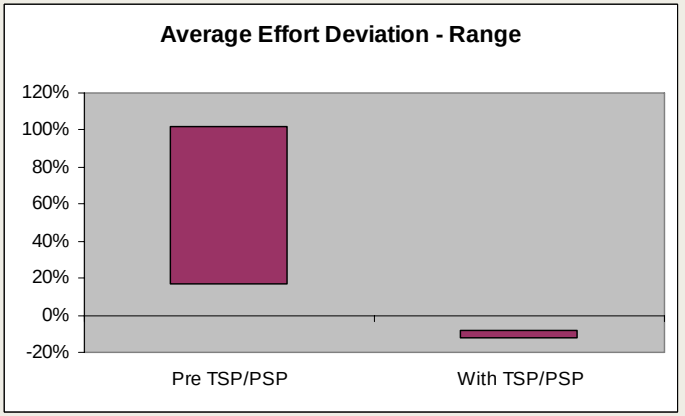
Improved Predictability

Effort and schedule deviation are dramatically improved.

Schedule Performance	
Typical Industry	100%+
Study baseline	27% to 112%
TSP	< 10%

Effort/Cost Performance	
Typical Industry	100%+
Study baseline	17% to 85%
TSP	< 5%





Source: CMU/SEI-2000-TR-015

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Improved Productivity

A nine person TSP team from the telecommunications industry developed 89,995 new LOC in 71 weeks, a 41% improvement in productivity.

A TSP team from the commercial software industry, developing an annual update to a large “shrink-wrapped” software product, delivered 40% more functionality than initially planned.

A TSP team within the DoD, developing a new mission planning system, delivered 25% more functionality than initially planned.

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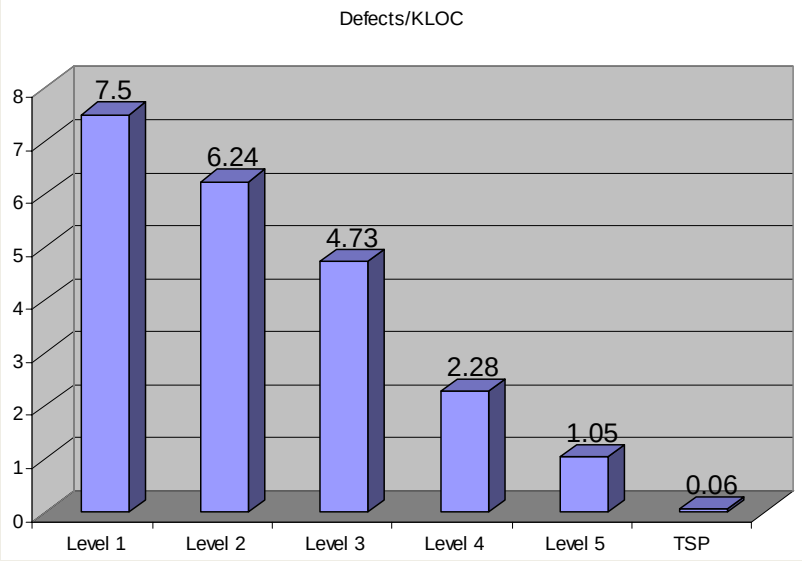
Improved Quality

An analysis of 20 projects in 13 organizations showed TSP teams averaged 0.06 defects per thousand lines of new or modified code.

Approximately 1/3 of these projects were defect-free.



Source: CMU/SEI-2003-TR-014

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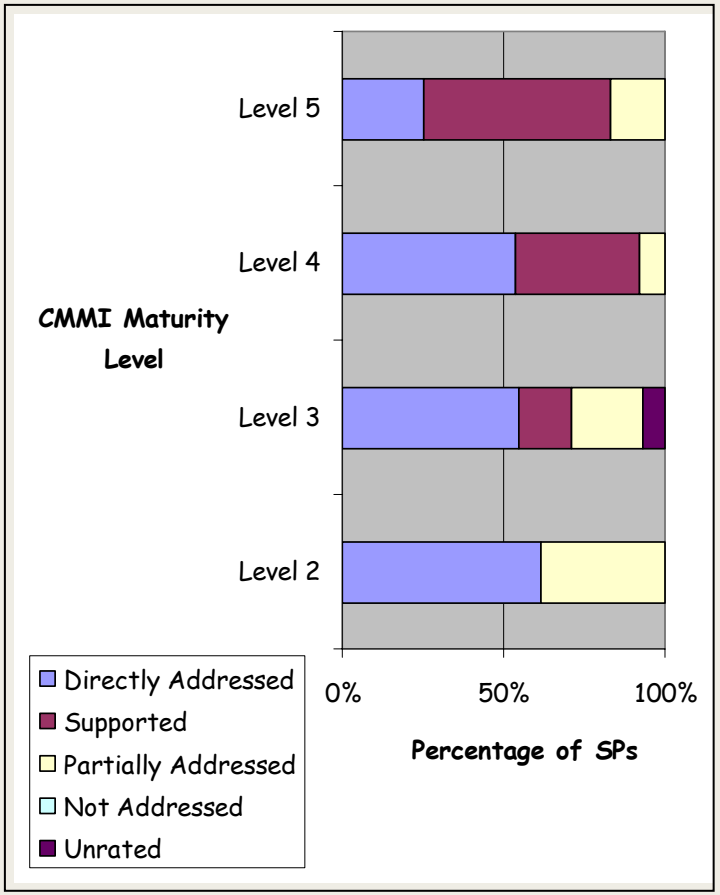
Accelerated Process Improvement

TSP addresses or supports most of the capabilities expected of a project team through CMMI Level 5.

It provides either a “starting point” or a “next step”.

Using TSP as a starting point, three organizations have advanced from ML1 to ML4 in less than 3 years.



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TSP Results: NAVAIR AV-8B

Mar. 2000	Began current CMM-based improvement effort (now a CMMI-based effort)
Oct. 2000	Began PSP/TSP introduction sequence
Jan. 2001	First TSP team launched
May 2001	CBA-IPI: CMM level 2; 3 KPAs satisfied at level 3; level 4/5 observations on TSP
June 2001	Received draft of CMM-TSP gap analysis (levels 2 and 3 only, minus SSM and TP) to help guide improvement efforts
Feb. 2002	Received late-model gap analysis (including TP at level 3 and levels 4 and 5)
June 2002	Launched second TSP team
Sep. 2002	CBA-IPI: CMM level 4 (16 months from L2!)

See Crosstalk, Sep. 2002, "AV-8B's Experiences Using the TSP to Accelerate SW-CMM Adoption," Dr. Bill Hefley, Jeff Schwalb, and Lisa Pracchia, and Crosstalk, Jan. 2004, "The AV-8B Team Learns Synergy of EVM and TSP and Accelerates Software Process Improvement"

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AV-8B CMMI "Quick Look" Profile

PA ->	RM	RD	TS	PI	VE	VAL	CM	PPQA	MA	CAR	DAR	OEI	OPD	OPF	OID	OT	OPP	PP	PMC	IPM	QPM	SAM	RSKM	IT
Specific Goal 1	U	FI	NR	S	S	S	S	S	U	U	NR	S	S	S	U	S	U	S	S	U	U	U	U	S
SP1.1	FI	FI	NR	FI	FI	FI	FI	FI	PI	PI	NR	FI	FI	FI	LI	FI	PI	FI	FI	FI	FI	FI	FI	FI
SP1.2	FI	FI	NR	FI	FI	FI	FI	FI	PI	PI	NR	FI	FI	FI	LI	FI	PI	FI	FI	FI	PI	FI	LI	FI
SP1.3	FI		FI	FI	FI	FI	FI		LI		NR	FI	FI	FI	FI	FI	FI	FI	FI	FI	PI	LI	FI	FI
SP1.4	PI								PI		NR		FI		FI	FI	LI	FI	FI	FI	FI			
SP1.5	FI										NR		FI				PI		FI	PI				
SP1.6											NR								FI					
SP1.7																			FI					
Specific Goal 2		S	NR	S	S	S	S	U	U	U		NR		U	U	U		S	S	NR	U	U	S	S
SP2.1		FI	FI	FI	FI	FI	FI	LI	LI	PI		PI		FI	FI	LI		FI	FI	NR	PI	NR	FI	FI
SP2.2		FI	FI	FI	FI	FI	FI	FI	LI	PI		NR		FI	FI	FI		FI	FI	FI	PI	LI	FI	FI
SP2.3		FI	FI		FI				PI	NR		PI		FI	LI	FI		FI	FI	FI	LI	FI		FI
SP2.4			NR						LI					LI				FI			LI	FI		FI
SP2.5																		FI						FI
SP2.6																		FI						
SP2.7																		FI						
SP2.8																								
Specific Goal 3		NR	S	S	S		S											S		S			S	
SP3.1		NR	FI	FI	FI		FI											FI		FI			FI	
SP3.2		FI	FI	FI	FI		FI											FI		FI			FI	
SP3.3		LI		FI														FI						
SP3.4		NR		FI																				
SP3.5		NR																						
Specific Goal 4																				S				
SP4.1																				FI				
SP4.2																				FI				
SP4.3																				FI				

PA ->	RM	RD	TS	PI	VE	VAL	CM	PPQA	MA	CAR	DAR	OEI	OPD	OPF	OID	OT	OPP	PP	PMC	IPM	QPM	SAM	RSKM	IT
Generic Goal 2	S						S	S	U									S	S			S		
Generic Goal 3	S	U	U	S	S	S	S	S	U	U	NR	NR	S	S	NR	S	U	S	S	S	S	S	S	S

LEGENDS

Practices

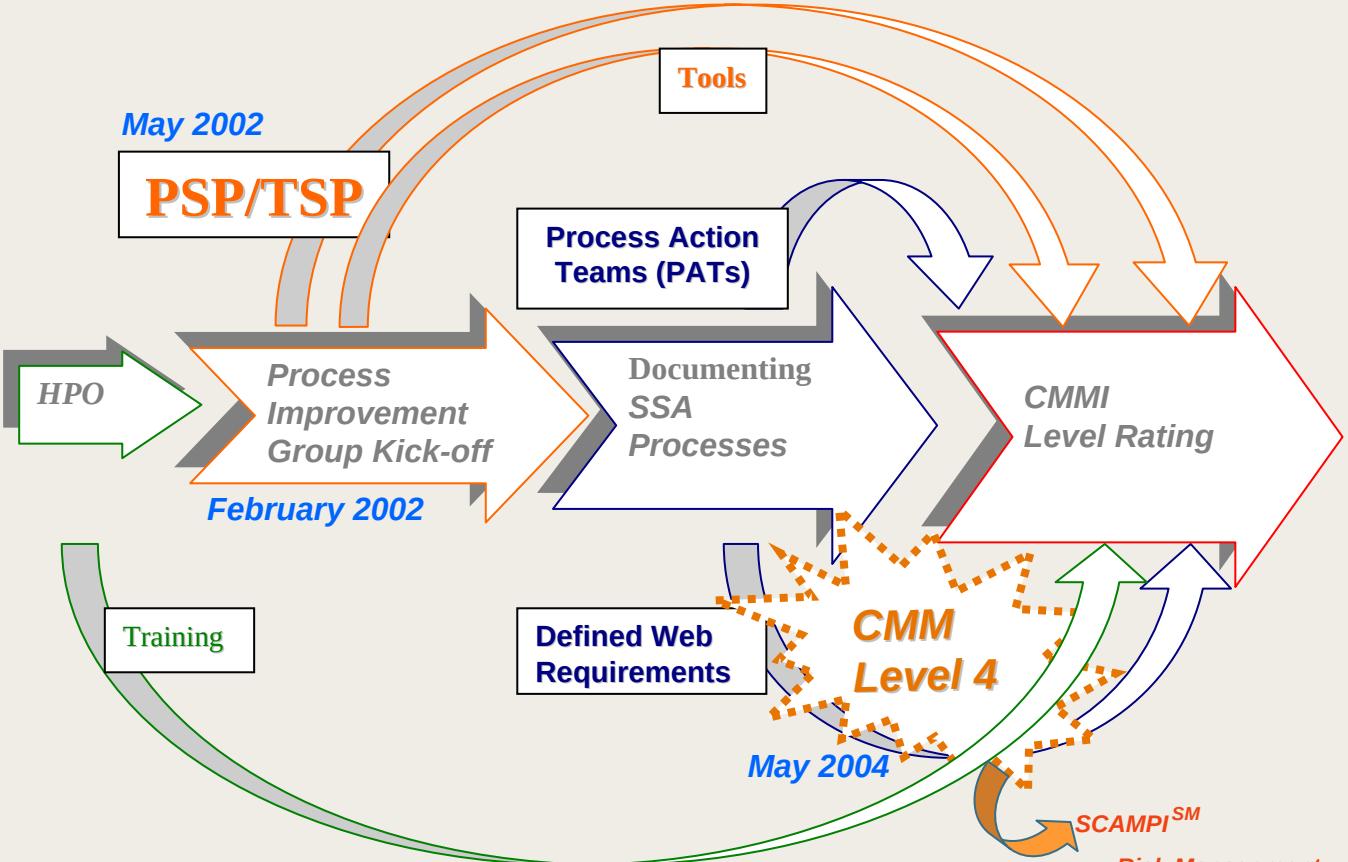
FI	Fully Implemented or Satisfied
LI	Largely Implemented
PI	Partially Implemented
NI	Not Implemented
NR	Not Rated

Goals

S	Satisfied
U	Unsatisfied (Goals)
NR	Not Rated

Source: NAVAIR

NAVAIR P3-C Journey



Source: NAVAIR

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Improved Quality of Work Life

"A more disciplined process allowed me to do a better job, and allowed me to balance my job with other aspects of my life."

"This project ended up a lot less stressful than other projects."

"Promotes a less stressful environment. Can track that the project is on schedule. Fewer defects are seen positively in the organization."

"It is nice to be associated with a project that had few defects."

"I liked the level of detail that went into initial plan, and the constant awareness of the schedule. Allowed us to make adjustments as the project went on, instead of waiting for a major milestone."

"It was nice that management finally allowed the team to create the schedule."

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Adoption

Organizations that are using, piloting, or preparing to pilot the TSP.

ABB
ABC Informatica
Activision
Advanced Information Services
Advanced Maturity Services, Inc.
Alan S. Koch Consultants
Ambient Consulting
AMRDEC
Boeing
Centre De Investigacion En Matamaticas
Census Bureau
CQG, Inc.
CRSIP / STSC / DRAPER
Davis Systems
DOE / Los Alamos
DOE / Naval Reactors
DPC Cirrus
Dynamics Research Corp.
EDS
Halex Associates
Heath Solutions, Inc.
Helsana
Honeywell
IBM
Intuit*
Iomega
I.Q. Inc.
KPMG
L. G. Electronics
Lockheed Martin / KAPL*
LogiCare
Los Alamos National Laboratory
M/A-Com Private Radio Systems, Inc
Magellan Navigation*
Microsoft*
Motiva
NASA Langley
NCR/Teradata
NCS Pearson
Northern Horizons
Northrop Grumman
Oracle*
Prodigia S.A. de C.V.
PS&J Consulting / Software Six Sigma
QuarkSoft
Respironics
Rockwell Collins
SAIC
Samsung SDS
Siberlink
STPP, Inc.
STSC
Trilogy
TYBRIN Corporation - Air Logistics
University of Alabama / Huntsville
University of Queensland
US Army / AMRDEC
US Navy / NAVAIR*
US Navy / NAVOCEANO*
US Navy / NAVSEA*
Xerox

***Organizations we are currently working with**

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TSP for Systems Engineering

NAVAIR and other organizations have discussed the possibilities of adapting TSP for systems engineering use for several years.

Late in 2005, an effort was launched to extend TSP practice to systems engineers working in NAVAIR organizations, beginning with those that have had success using TSP for software development.

Several organizations, including at least one within NAVAIR, are forging ahead with their own TSP adaptations.

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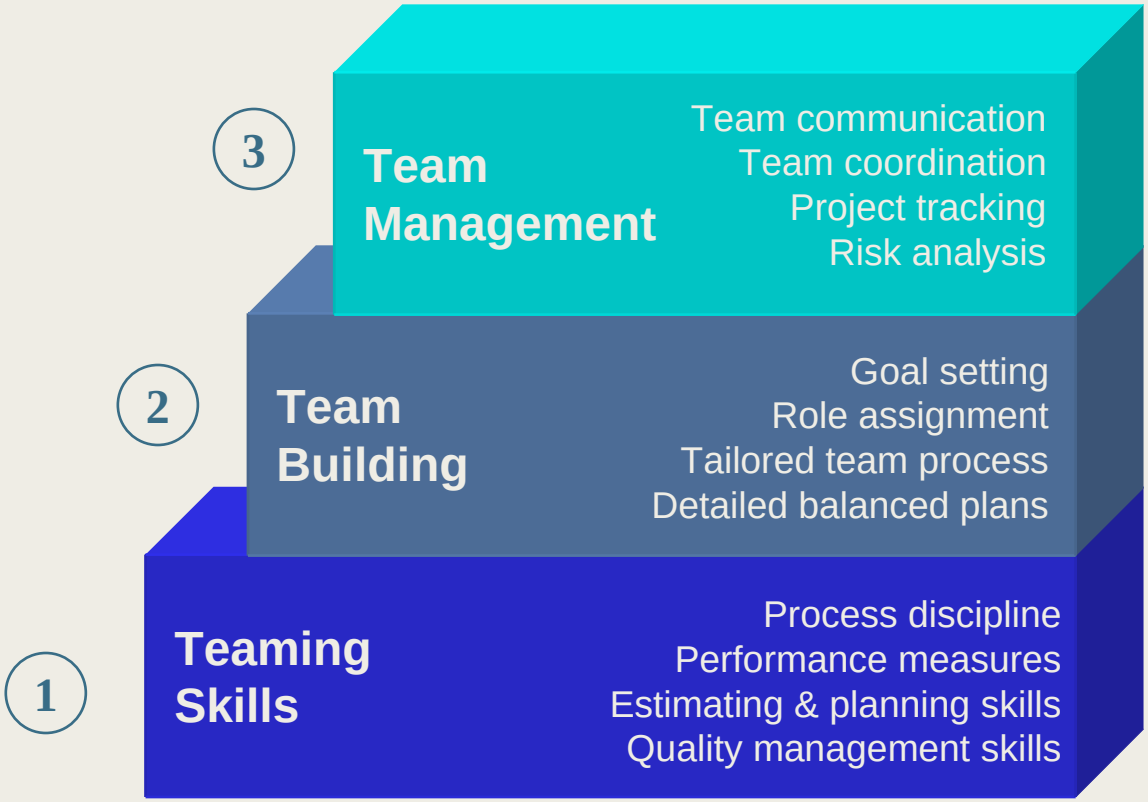
Building High-Performance Teams

TSP builds high-performance teams from the bottom-up.



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Personal *Software* Process?

The PSP is a process designed for individual use that applies to structured personal tasks.

PSP builds the teaming skills required for the TSP.

With PSP, developers learn how to use a defined process and how to measure, estimate, plan, and track their work.

This leads to

- better estimating, planning, and tracking
- protection against over-commitment
- a personal commitment to quality
- personal involvement in process improvement

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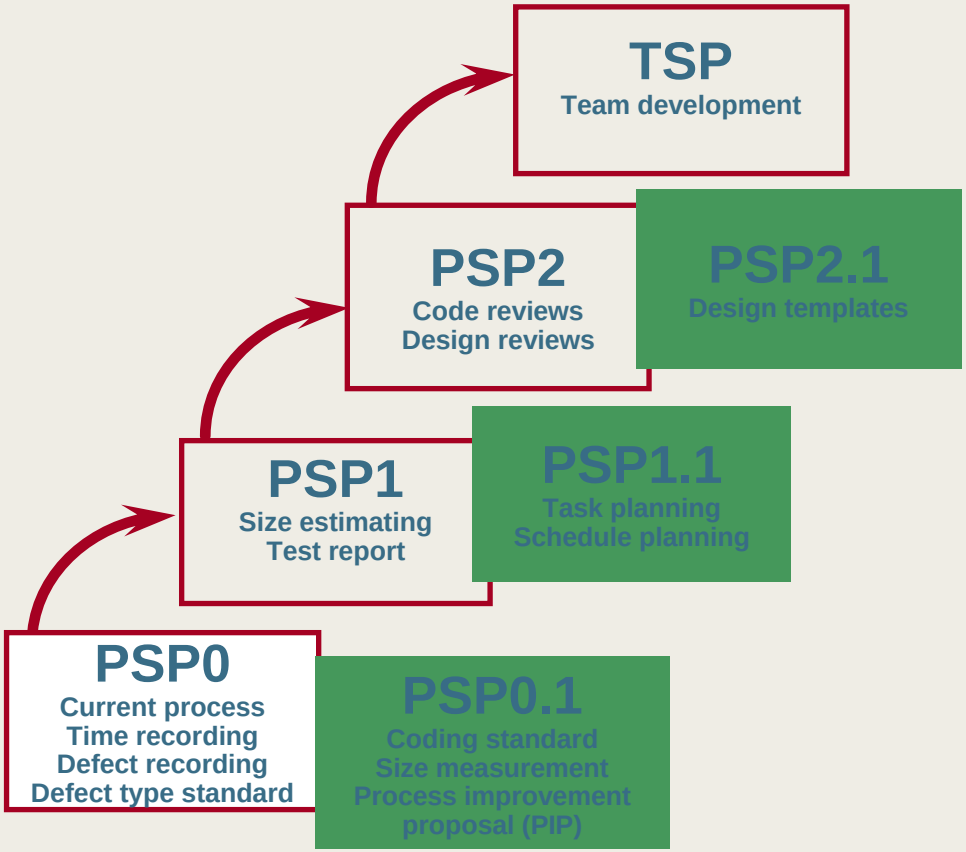
PSP-TSP Process Evolution



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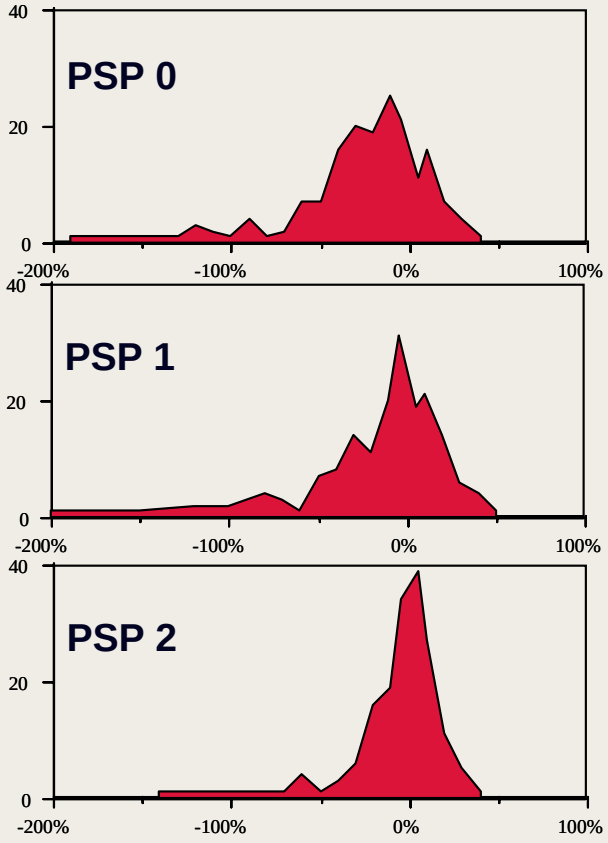
PSP Improves Performance

Estimation accuracy

- fewer underestimates
- more accurate estimates
- estimates balanced around zero

Quality

- yield improves by 2X to 3X
- fewer defects in unit test, integration test, system test
- COQ is flat or reduced



Effort Estimation Accuracy

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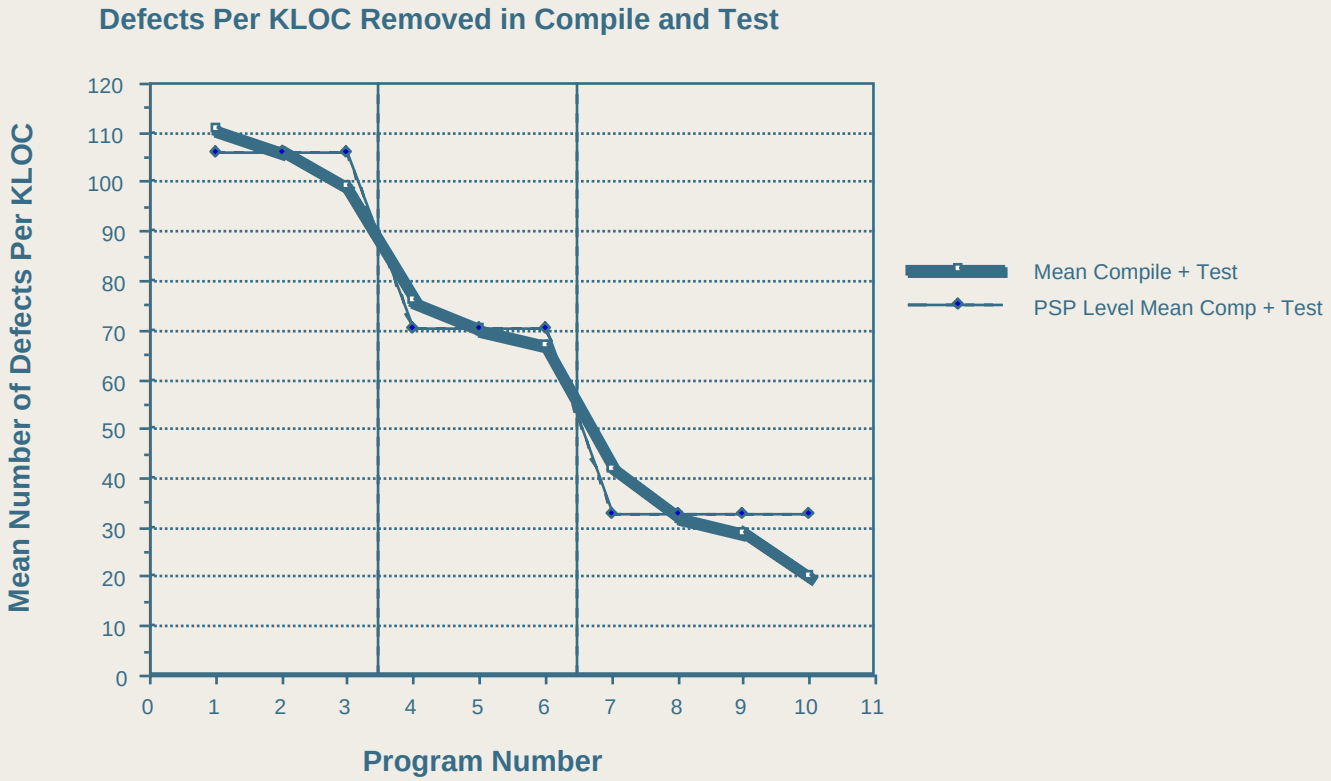
PSP Quality Results



Agenda

Why PSP and TSP for Systems Engineering?
Things That Change, Things That Don't
Time Logging Exercise
The TSP Launch
The TSP Management Framework
TSP Quality Management

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Non-Software Disciplines

Many software-intensive projects have significant non-software components in terms of

- requirements and test
- support activities
- customer deliverables

The ways that these “other” activities are planned, staffed, and managed are reflected in organizational structure.

- separate departments for systems engineering, test, documentation, etc.
- often depends on the size of the organization and the size of the typical project
- multi-disciplinary teams
- matrixed project teams

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Introduction to Personal Process

SEI teaches a two-day class, *Introduction to Personal Process*, which begins the individual quality journey by raising the issues of size measures and process and defect definitions for intellectual work other than software development.

It makes both economic and technical sense to extend the formal definitions of such work so that it may be planned and tracked with TSP methods.

NAVAIR has been a leader in adapting PSP and TSP to non-software work, and is actively engaged with SEI to formalize this work.

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Process Improvement for “Others”

Applying TSP practices to other disciplines besides software engineering can be relatively straightforward.

- many teams are already doing it successfully
- based on CMM originally, which was based roughly on Crosby’s five-level model of the manufacturing quality journey
- planning and tracking mechanisms are not software-specific
- *size and defect definitions (by default) are rooted in the software-specific examples from PSP training!*

In order to adapt PSP for use by other disciplines, size measures and defect definitions must be addressed.

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Size Measures

For a size measure to be useful, it must be

- useful for planning
- precisely defined
- directly countable in an intermediate or final product

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Defect Definitions

A defect is anything in an interim or finished product that must be changed for the product to be used as intended.

Defects in test procedures, requirements analyses, specifications, or user documentation can all adversely affect a customer's use of the delivered product.

Defect definitions must make sense to the people who must correct them.

Defect correction is sometimes called rework.

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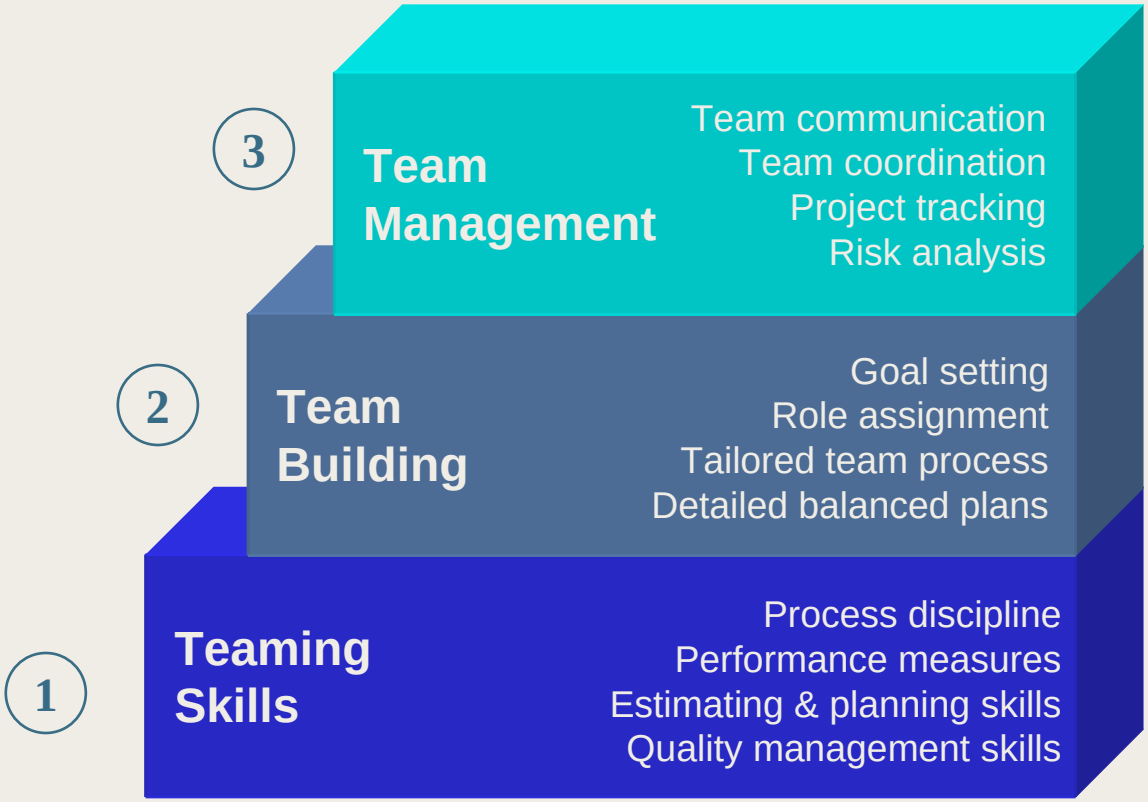
Building High-Performance Teams

TSP builds high-performance teams from the bottom-up.



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Team Management Framework

The TSP team management framework helps the team meet their planned commitments by providing support for

- team communication and coordination
- project tracking and status reporting
- requirements management
- change management
- risk management

Team members gather data and manage their personal plans.

These data are consolidated at the team level and used by the team to manage the team's plan.

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TSP Base Measures

Size

Effort

Quality

Schedule

Source: CMU/SEI-92-TR-019

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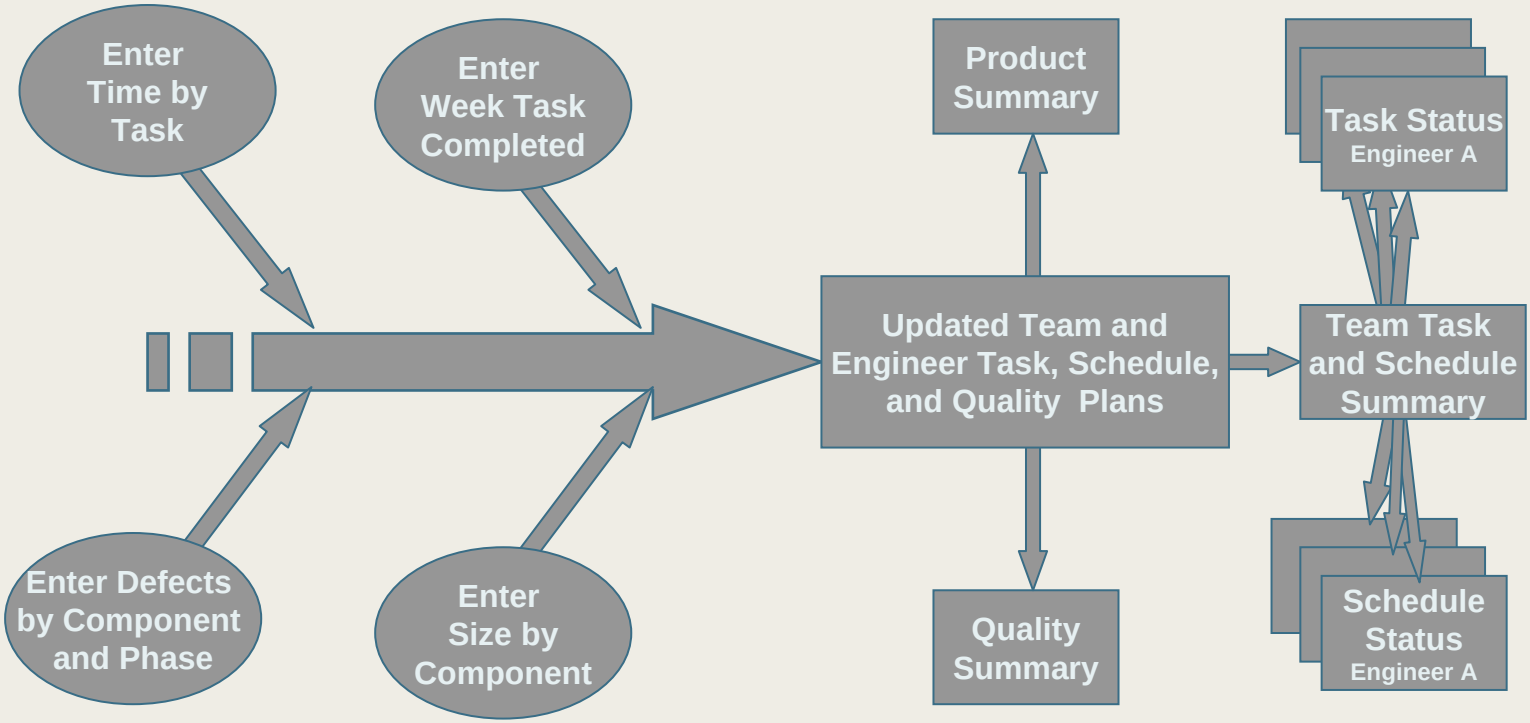
TSP Project Tracking



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Tracking with TSP Measures

The TSP base measures can be combined to provide a number of derived measures for managing projects.

TSP Derived Measures

Estimation accuracy (size/time)	Defect density
Prediction intervals (size/time)	Defect density by phase
Time in phase distribution	Defect removal rate by phase
Defect injection phase distribution	Defect removal leverage
	Review rates
Defect removal phase distribution	Process yield
	Phase yield
Productivity	Failure cost of quality
%Reuse	Appraisal cost of quality
%New Reusable	Appraisal/Failure COQ ratio
Cost performance index	Percent defect free
Planned value	Defect removal profiles
Earned value	Quality profile
Predicted earned value	Quality profile index

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TSP Weekly Tracking

TSP teams track their status weekly using a defined process and the weekly status summary in the TSP support tool.

TSP Week Summary - Form WEEK

Name	Carol	Date	4/7/2003
Team	PSP Ghost		
Status for Week	15	Cycle	
Week Date	3/10/2003		

Weekly Data	Plan	Actual	Plan/ Actual
Schedule hours for this week	151.0	86.0	1.76
Schedule hours this cycle to date	1526.0	1594.8	0.96
Earned value for this week	6.9	4.2	1.64
Earned value this cycle to date	79.5	84.3	0.94
To-date hours for tasks completed	1580.7	1568.1	1.01
To-date average hours per week	101.7	106.3	0.96

Assembly	Phase	Tasks Completed or Due	Resource	Task Plan Hrs.	Task Actual Hrs.	Earned or Plan Value	Planned Week	Plan vs. Actual Hrs.
Main Form	CODEINSP	Main Form Code Inspection	SA	1.5	2.4	0.1	10	0.63
OEMMOO Delivery.aspx	UT	OEMMOO Delivery.aspx (FE-Server) U	NK	8.9	3.0	0.5	13	2.91
OEMMOO Delivery.aspx	DLDINSP	OEMMOO Delivery.aspx (FE-Client) DI	NK	0.0	0.0	0.0	13	
OEMMOO Delivery.aspx	CODE	OEMMOO Delivery.aspx (FE-Client) C	NK	7.5	5.7	0.4	14	1.32
OEMMOO Delivery.aspx	CR	OEMMOO Delivery.aspx (FE-Client) C	NK	3.8	1.7	0.2	14	2.26
OEMMOO Delivery.aspx	COMPILE	OEMMOO Delivery.aspx (FE-Client) C	NK	1.3	0.9	0.1	14	1.44
OEMMOO Delivery.aspx	CODEINSP	OEMMOO Delivery.aspx (FE-Client) C	NK	0.0	0.0	0.0	14	
OEMMOO Delivery.aspx	UT	OEMMOO Delivery.aspx (FE-Client) U	NK	5.9	6.8	0.3	14	0.87
Query Object	TD	Query Object Test Development	MB	0.0	0.0	0.0	14	
Query Object	CODEINSP	Query Object Code Inspection	MB	0.0	1.2	0.0	14	0.00
Query Object	UT	Query Object Unit Test Dialogs	MB	1.1	1.7	0.1	14	0.66

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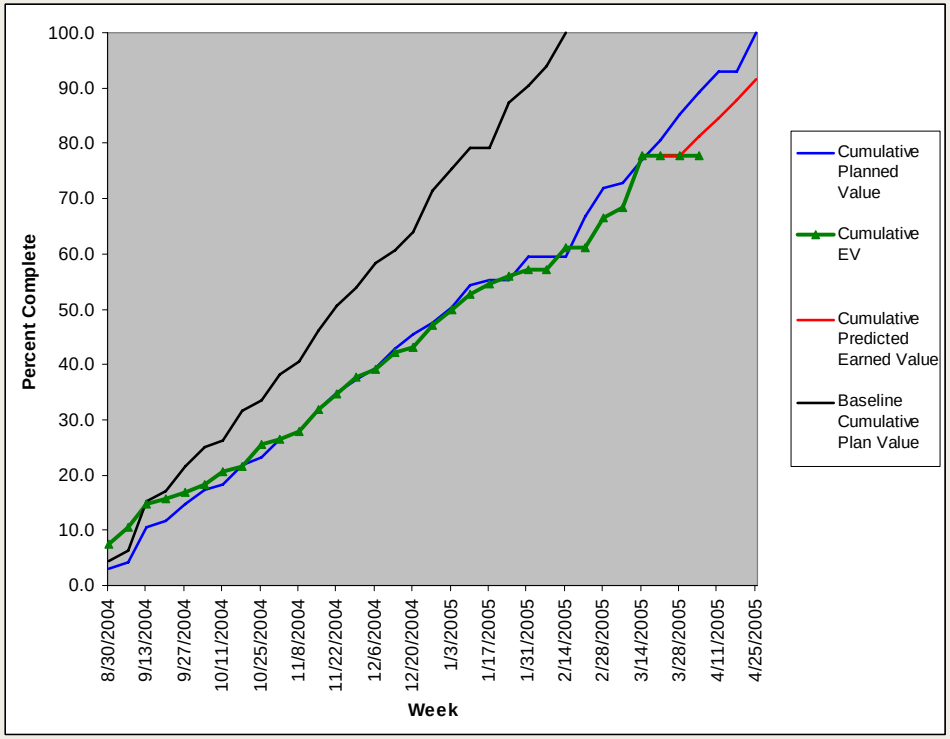
Earned Value Management

TSP teams review progress at the weekly meeting using earned value tracking provided by the TSP support tool.



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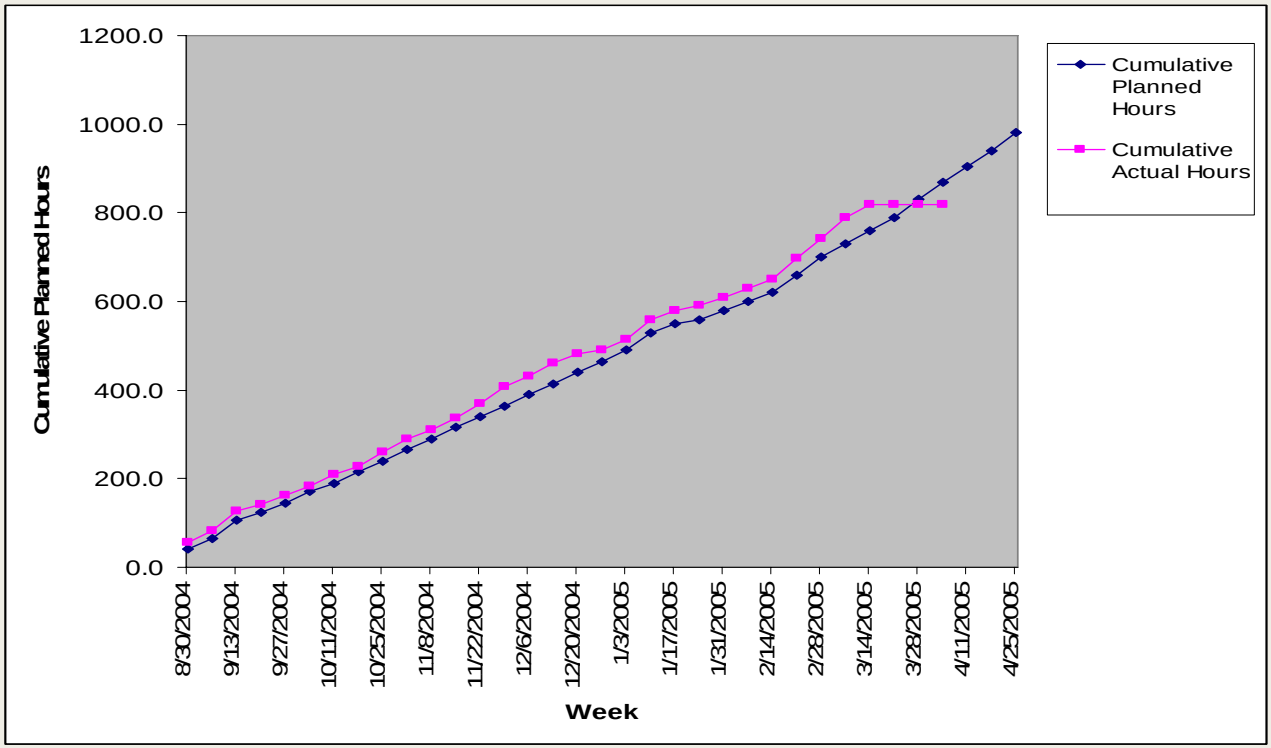
Resource Management

TSP teams review resource utilization at the weekly meeting using analyses provided by the TSP support tool.

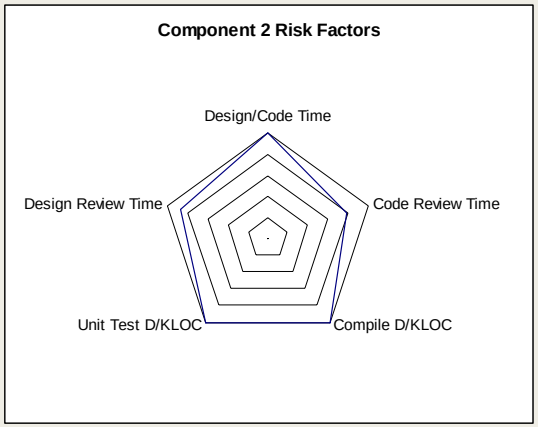


Quality Management

TSP teams use the Quality Profile as an early warning indicator of post-development defects.

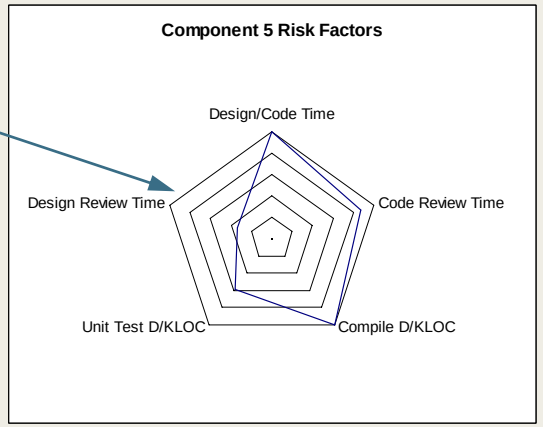
The quality profile uses five software quality benchmarks.

Satisfied criteria are plotted at the outside edge of the chart.



High quality component

Inadequate design review time results in design defects escaping to test and production.



Poor quality component

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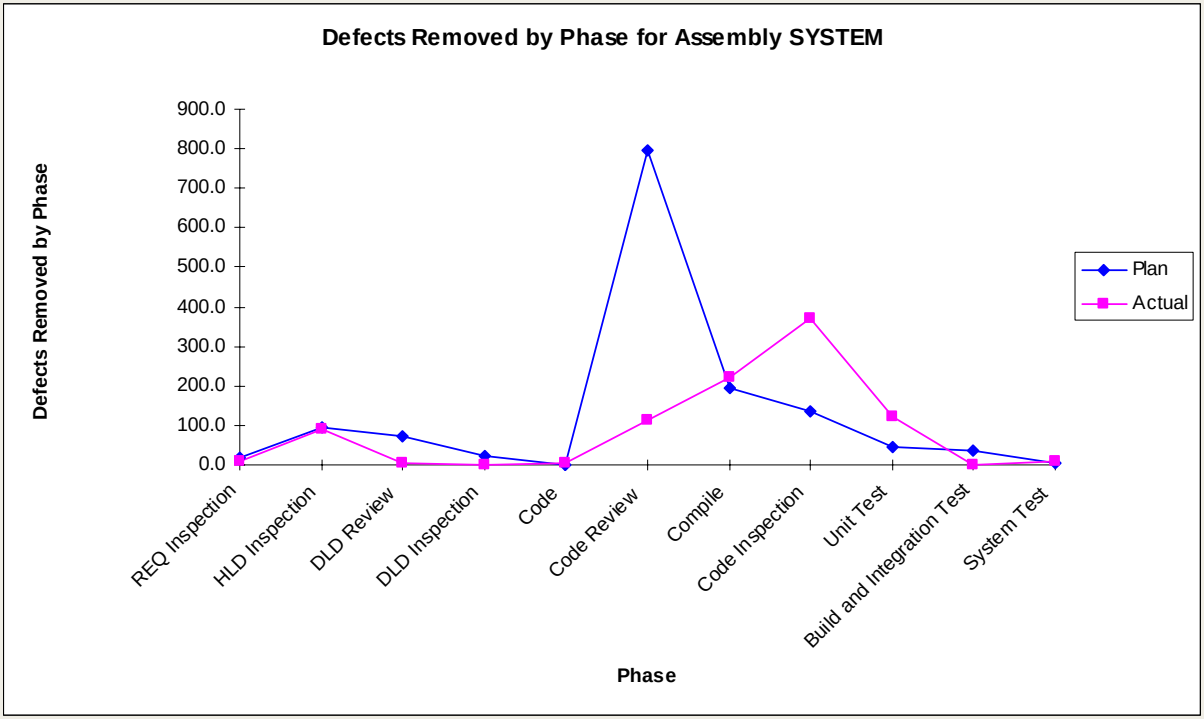
Defect Removal Profile

TSP teams use the Defect Removal Profile to track

- plan and actual defects removed by phase
- early vs. late defect removal plan



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Agenda

Why PSP and TSP for Systems Engineering?
Things That Change, Things That Don't
Time Logging Exercise
The TSP Launch
The TSP Management Framework
TSP Quality Management

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Exercise Objectives

The PSP is the foundation for the TSP.

This exercise provides

- an understanding of the baseline process, PSP0
- familiarity with the basic measurement forms used in the PSP

Similar measures and forms are used in the TSP.

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Basic Process Elements

A process script and basic measures

A project plan summary form

A time recording log

A defect reporting log

A defect type standard

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Basic Process Measures -1

The reason to measure a process is to understand it.

- how much time is spent in various activities
- what is produced at various times
- how many defects are injected and removed, and when

With these data, engineers can better

- plan and estimate the work to be done
- evaluate the results
- improve the process for the next project

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Basic Process Measures -2

To measure the process, the work is divided into defined activities called *phases*.

Each phase consists of

- the task to be done during the phase
- the entry criteria, or the items required before the work can start
- the exit criteria, or the items that must be produced by the end of the phase
- verification steps to ensure that the work is properly done

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Basic Process Measures -3

The measures for each phase are

- time spent (in minutes) in that phase
- defects injected in that phase
- defects removed in that phase

The program size is also measured, but only during the postmortem phase at the end of the project.

These measures provide the foundation for all PSP measurements, analyses, and planning.

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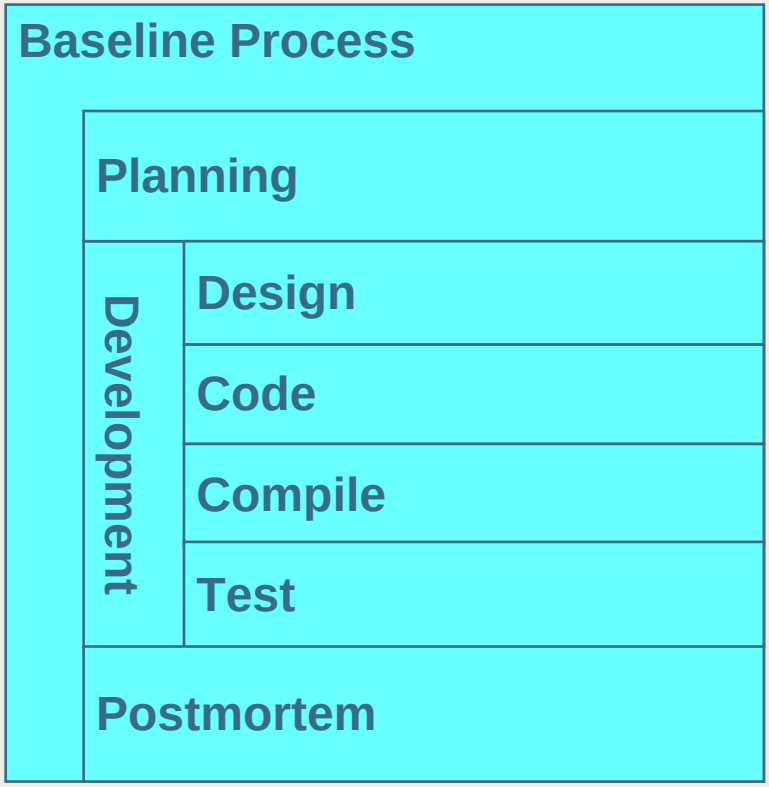
Baseline Process Phases



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A Process Script

PSP0 Process Script

Phase Number	Purpose	To guide you in developing module-level programs
	Entry Criteria	• Problem description • PSP0 Project Plan Summary form • Time and Defect Recording Logs • Defect Type Standard • Stop watch (optional)
1	Planning	• Produce or obtain a requirements statement. • Estimate the required development time. • Enter the plan data in the Project Plan Summary form. • Complete the Time Recording Log.
2	Development	• Design the program. • Implement the design. • Compile the program and fix and log all defects found. • Test the program and fix and log all defects found. • Complete the Time Recording Log.
3	Postmortem	Complete the Project Plan Summary form with actual time, defect, and size data.
	Exit Criteria	• A thoroughly tested program • Completed Project Plan Summary form with estimated and actual data • Completed Defect and Time Recording Logs

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PSP0 Project Plan Summary

The project plan summary holds project data in summary form.

- planned and actual data
- to date history
- time in phase
- defects injected
- defects removed

PSP0 Project Plan Summary

Student _____ Date _____
Program _____ Program # _____
Instructor _____ Language _____

Time in Phase (min.)	Plan	Actual	To Date	To Date %
Planning				
Design				
Code				
Compile				
Test				
Postmortem				
Total				

Defects Injected	Actual	To Date	To Date %
Planning			
Design			
Code			
Compile			
Test			
Total Development			

Defects Removed	Actual	To Date	To Date %
Planning			
Design			
Code			
Compile			
Test			
Total Development			
After Development			

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Time Recording Log

Engineers use the time recording log to record

- the time when they start on a project phase
- the time when they stop work on a phase
- the interruption time
- the elapsed time less interruption time
- comments

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Defect Recording Log

Engineers use the defect recording log to record information about all defects found in reviews, compiling, and test.

- the defect number
- the defect type
- the phase in which it was injected
- the phase in which it was removed
- the time to find and fix the defect
- a brief description of the defect

If the defect was injected while fixing a defect, that defect's number is recorded.

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Exercise Instructions -1

Read through the PSP0 process scripts (in the workbook) so that you understand the entry and exit criteria for each phase.

Read JD's scenario for program 1A and fill out the time log. The defect log and project plan summary are already filled out for you.

Refer to the instructions for each form to determine what information goes in each field.

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Exercise Instructions -2

When did JD start?

When did he finish?

Was he interrupted?

What process phase is this?

Where should this information be recorded?

JD begins work on assignment 1A [8:00] **by reviewing the requirements in the assignment package, including the test requirements, to be sure he understands them. He copies the requirements to his note pad. Then, based on the data presented on past student performance and JD's feeling about his own performance, he estimates this assignment will take 3 hours and writes this on his note pad** [8:06]**.**

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Results

How long did the project take? _____

How many defects were removed? _____

In what phase did JD spend the most time? _____

What percent of JD's time was spent in compile + test? _____

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Exercise Summary

The baseline personal process is simple and easy to use.

The PSP forms simplify data collection and provide a convenient reference for planning future projects.

The basic PSP time, size, and defect measures provide the data for the TSP.

HOMEWORK: For systems engineering in your organization, how would the Plan Summary change? What phases of development would you define?

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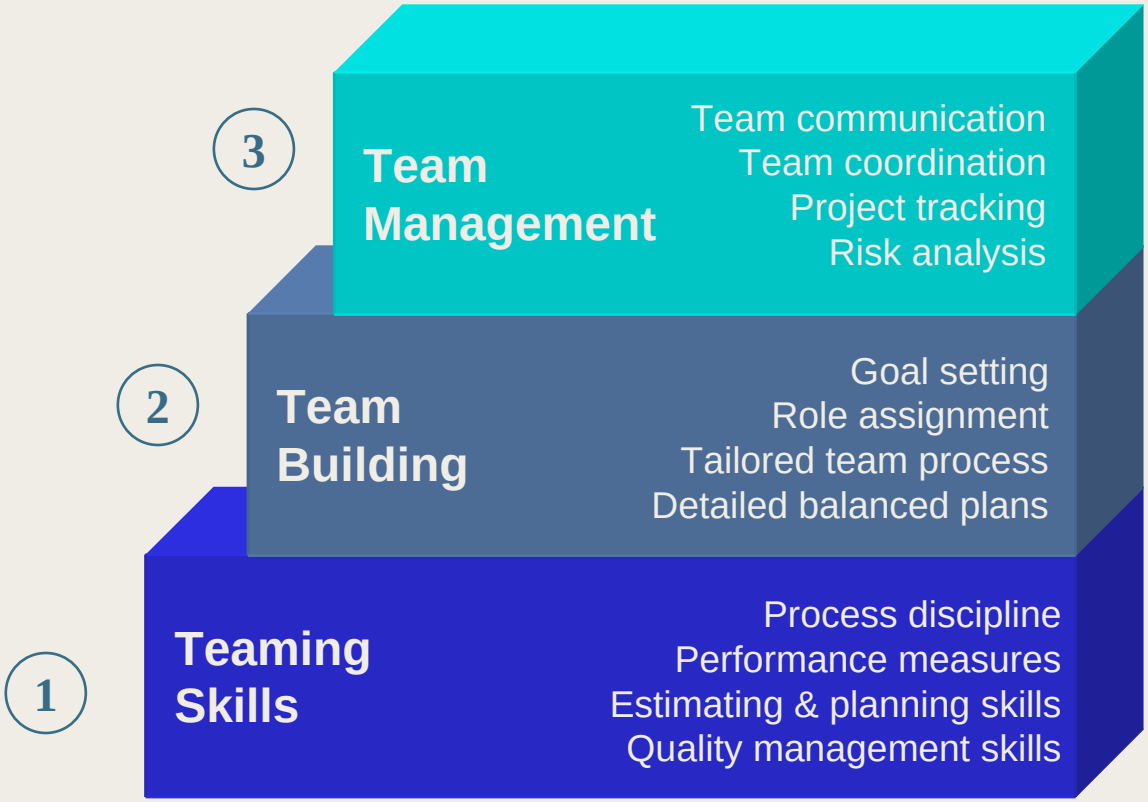
Building High-Performance Teams

TSP builds high-performance teams from the bottom-up.



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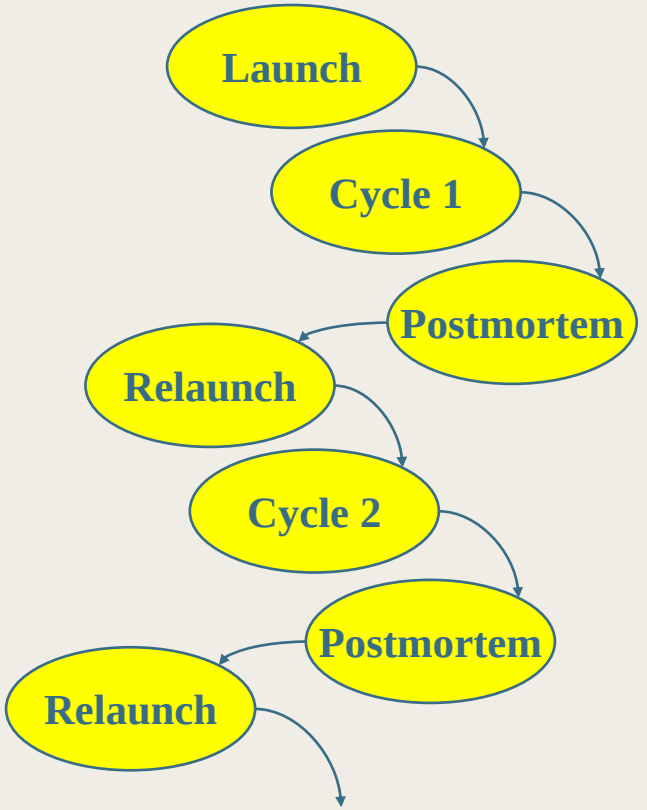
TSP Structure and Flow -1

In the TSP, each major project cycle or phase begins with a Launch.

The Launch is a defined team planning process that also facilitates team-building.

The team reaches a common understanding of the work and the approach.

They produce a detailed plan to guide the next development phase or cycle.



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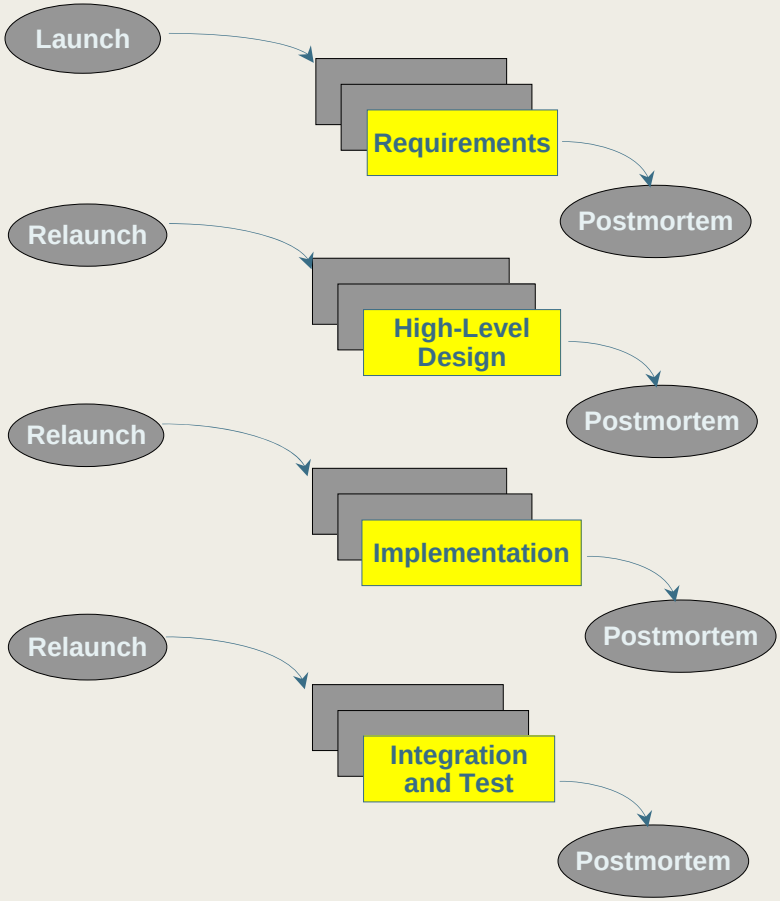
TSP Structure and Flow -2

TSP has four principal development phases.

- Requirements, High-Level Design, Implementation, Test (TSP default)
- *or a project-defined lifecycle*

TSP projects can start or end on any phase.

- from requirements through system test
- requirements only
- high-level design only
- *as needed to do the work*



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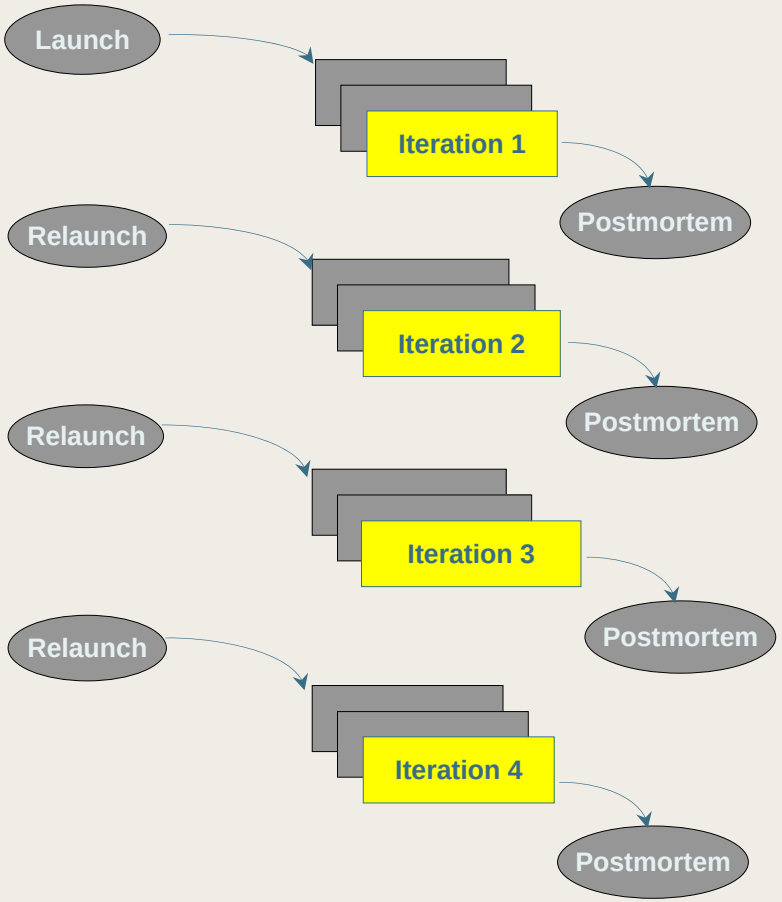
TSP Structure and Flow -3

The TSP phases can and should overlap.

The TSP development strategy encourages

- incremental development
- iterative development
- multiple builds or cycles
- work-ahead

TSP permits whatever process structure makes the most business and technical sense to the team.



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TSP Process Elements

Checklists, specifications, standards, and other process assets (22), including

- TSP introduction sequence
- Launch planning guidance
- Executive tools such as checklists for planning assessment and quarterly reviews

Forms (22), including

- Time Recording Log
- Defect Recording Log
- Inspection Report
- Process Inventory
- Quality Summary

TSP role specifications (12), including

- Meeting roles and responsibilities
- Inspection roles and responsibilities
- Customer interface manager role and responsibilities
- Process manager role and responsibilities

Process Scripts (30), including

- Overall development and enhancement process
- Overall maintenance and enhancement process
- Launch process
- Test defect handling

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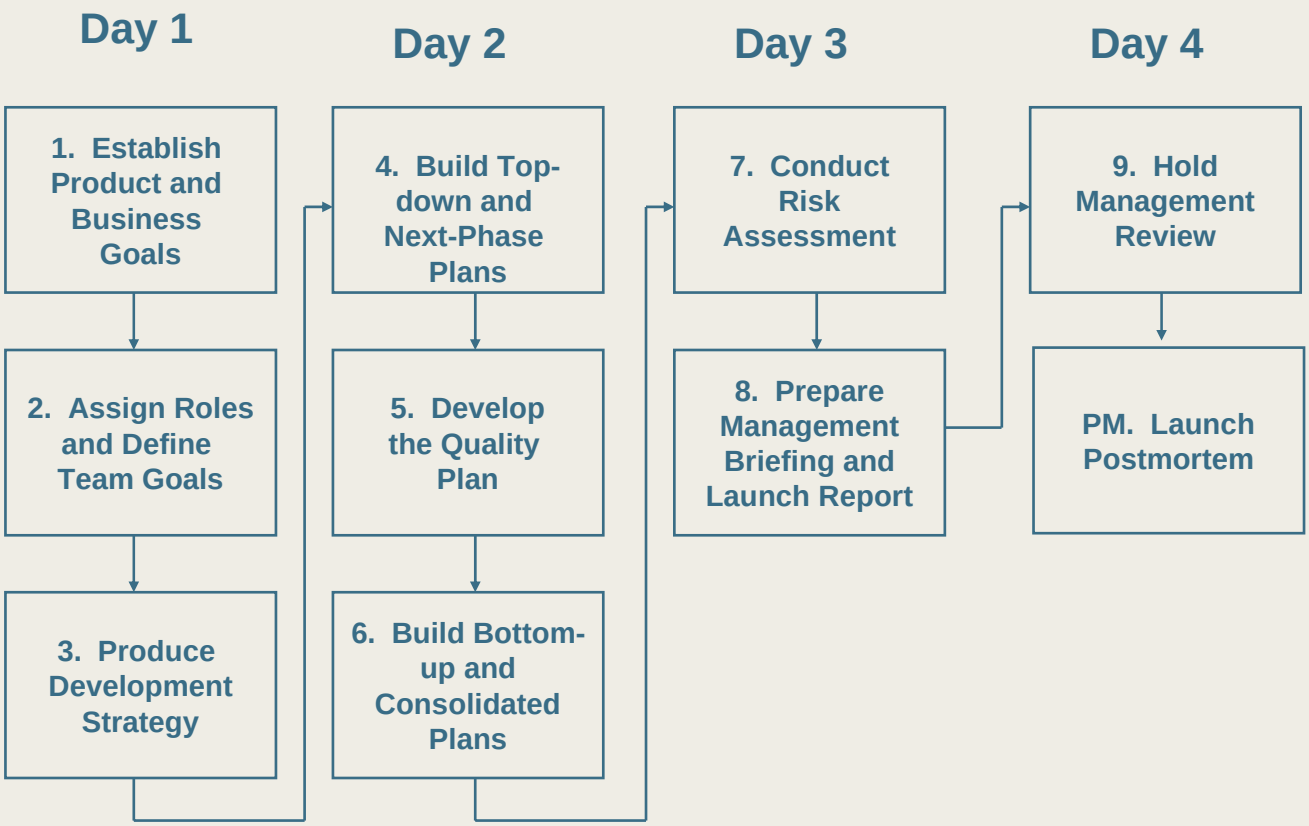
The Launch Process Meetings



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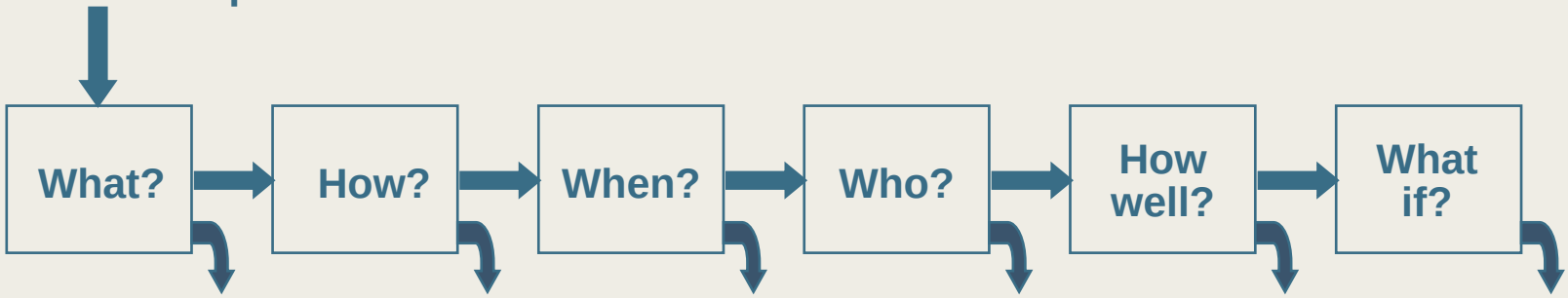
The TSP Launch Artifacts

Business needs
Management goals
Product requirements



What?	How?	When?	Who?	How well?	What if?
Team goals Conceptual design Planned products Size estimates	Team strategy Team process	Task hour plan Schedule plan Earned-value plan	Team roles Task plans Detailed plans	Quality plan	Risk evaluation Alternative plans

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TSP Project Tracking -1

Project tracking in the TSP is based on the principles and measures used in the PSP.

The detailed team and individual plans facilitate precise project tracking.

Each team member is responsible for

- gathering data on their work
- tracking status against their personal plan
- keeping the team informed
- the quality of the work they produce

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TSP Weekly Meeting

Manager's report (team leader)
- new issues and developments

Role reports (8, more or less)
- customer/requirements, design, implementation, test, planning, process, quality, support

Risk report
- status and changes in assigned risks
- impending flag dates and required actions

Project status
- individual and team (planning manager)

Next week's plans
- individual tasks
- dependencies (e.g. reviews needed)
- task, hour, EV goals

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TSP Project Tracking -2

Project tracking in TSP is based on

- the team's plan
- task hour and task completion data
- plan and earned value

Individual plans facilitate precise project tracking.

Team members are each responsible for

- gathering data on their work
- tracking status against their personal plans
- the quality of the work that they produce
- keeping the team informed of their progress

Individual team member data are consolidated each week so that the team can assess progress against goals.

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The WEEK Summary

The weekly team meeting is the forum that the team uses to

- track progress against the plan
- track the status on the project's issues and risks
- communicate with each other

TSP Week Summary - Form WEEK

Name	Consolidated Team Plan	**Date**	2/7/2000
Team	Security System Upgrade		
Status for Week	5	**Cycle**	
Week Date	1/31/2000		

Weekly Data	**Plan**	**Actual**	**Plan/ Actual**
Project hours for this week	80.0	69.0	1.16
Project hours this cycle to date	400.0	344.8	1.16
Earned value for this week	10.3	3.1	3.37
Earned value this cycle to date	40.2	30.0	1.34
To-date hours for tasks completed	293.0	303.8	0.96

Assembly	**Phase**	**Tasks Completed**	**Resource**	**Plan Hours**	**Actual Hours**	**Earned Value**	**Planned Week**	**Plan Hrs./ Actual Hrs.**
SYSTEM	REQ	Write SRS general sections	tmc	14.0	12.0	1.4	4	1.17
SYSTEM	REQ	Weekly requirements analysis meeting 5	tma	4.0	4.0	0.4	5	1.00
SYSTEM	REQ	Weekly requirements analysis meeting 5	tmb	4.0	4.0	0.4	5	1.00
SYSTEM	REQ	Weekly requirements analysis meeting 5	tmc	4.0	4.0	0.4	5	1.00
SYSTEM	REQ	Weekly requirements analysis meeting 5	tmd	4.0	4.0	0.4	5	1.00
		TASKS DUE THROUGH WEEK 7						
SYSTEM	REQ	Review SRS general sections	tmc	5.0		0.0	4	
SYSTEM	STP	Complete Validation Test Plan	tmd	8.0	8.5	0.0	4	0.94

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Maintaining the Team's Schedule

The team manages its commitments by using the data it collects.

The team determines how it is doing against its plan.

If the team is falling behind, it determines

- what is the likely cause
- what the team can do to maintain its commitment

The team informs management if the commitment cannot be maintained or if management help is needed.

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Determining Status Against Plan -1

Two things are important here.

- the team's current project status
- the team's projected completion date

Current status is determined using data on the WEEK form.

TSP Week Summary - Form WEEK

Name	Consolidated Team Plan	Date	2/7/2000
Team	Security System Upgrade		
Status for Week	5	Cycle	
Week Date	1/31/2000		

Weekly Data	Plan	Actual	Plan/ Actual
Project hours for this week	80.0	69.0	1.16
Project hours this cycle to date	400.0	344.8	1.16
Earned value for this week	10.3	3.1	3.37
Earned value this cycle to date	40.2	30.0	1.34
To-date hours for tasks completed	293.0	303.8	0.96

$$weeks\,behind = \frac{(plan\,EV\,todate - actual\,EV\,todate)}{(actual\,EV\,todate / current\,week)}$$

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Determining Status Against Plan -2

Projected completion date can be determined using data on the WEEK form and the original planned weeks.

TSP Week Summary - Form WEEK

Name	Consolidated Team Plan
Team	Millenium Upgrade
Status for Week	5
Week Date	1/31/2000

Date 2/7/2000
Cycle

Weekly Data	Plan	Actual	Plan/ Actual
Project hours for this week	80.0	69.0	1.16
Project hours this cycle to date	400.0	344.8	1.16
Earned value for this week	10.3	3.1	3.37
Earned value this cycle to date	40.2	30.0	1.34
To-date hours for tasks completed	293.0	303.8	0.96

$$weeks\,to\,go = \frac{(100 - actual\,EV\,to\,date)}{(actual\,EV\,to\,date)/(current\,week)}$$

$$\begin{Bmatrix} weeks\,behind \\ at\,completion \end{Bmatrix} = (weeks\,to\,go + current\,week) - \begin{Bmatrix} original \\ planned\,weeks \end{Bmatrix}$$

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Identifying Estimating Problems

The cost performance index (CPI) shows how the team is performing with respect to the effort estimates in the plan.

$$CPI = \frac{plan\ hours\ for\ completed\ tasks}{actual\ hours\ for\ completed\ tasks}$$

The CPI is available on the WEEK form.

TSP Week Summary - Form WEEK

Name	Consolidated Team Plan
Team	Security System Upgrade
Status for Week	5
Week Date	1/31/2000

Date	2/7/2000
Cycle	

Weekly Data	**Plan**	**Actual**	**Plan/ Actual**
Project hours for this week	80.0	69.0	1.16
Project hours this cycle to date	400.0	344.8	1.16
Earned value for this week	10.3	3.1	3.37
Earned value this cycle to date	40.2	30.0	1.34
To-date hours for tasks completed	293.0	303.8	0.96

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Interpreting the CPI

A CPI of 1 means

sum of the effort estimates for the completed tasks = ***sum of the actual effort for the completed tasks***

What does this imply about the accuracy of the individual estimates?

Assuming the team is achieving the planned task hours, what does this imply about schedule performance?

What does a CPI of 0.5 imply about

- effort estimates?
- schedule performance (assuming the team is achieving the planned task hours)?

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Interpreting the CPI (continued)

What does a CPI of 2 imply about

- effort estimates?
- schedule performance (assuming that the team is achieving the planned task hours)?

What general characterization can be made about schedule performance based on the CPI?

Schedule growth (due to effort estimates) = 1/CPI

Projected schedule = Original plan weeks/CPI

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Interpreting Task Hour Data

The task hour data is in the form WEEK and can be interpreted similar to the effort for completed tasks data.

•TSP Week Summary - Form WEEK

•Name	Consolidated Team Plan		•Date	2/7/2000
•Team	Security System Upgrade			
•Status for Week	5		•Cycle	
•Week Date	1/31/2000			

•Weekly Data	•Plan	•Actual	•Plan/ •Actual
•Project hours for this week	~~138.9~~	~~69.0~~	~~2.00~~
•Project hours this cycle to date	689.6	344.8	2.00
•Earned value for this week	~~16.3~~	~~3.1~~	~~3.37~~
•Earned value this cycle to date	80.4	30.0	2.68
•To-date hours for tasks completed	293.0	303.8	0.96

If (Plan hours to date)/(Actual hours to date) = 2

- What does it mean?
- What is the effect on schedule performance?

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Interpreting Task Hour Data (continued)

If (Plan hours to date)/(Actual hours to date) = 0.5

- What does it mean?
- What is the effect on schedule performance?

What general characterization can be made about schedule performance based on the plan/actual task hours?

Schedule growth (due to task hours) = plan/actual

Projected schedule = Original plan weeks * (plan/actual)

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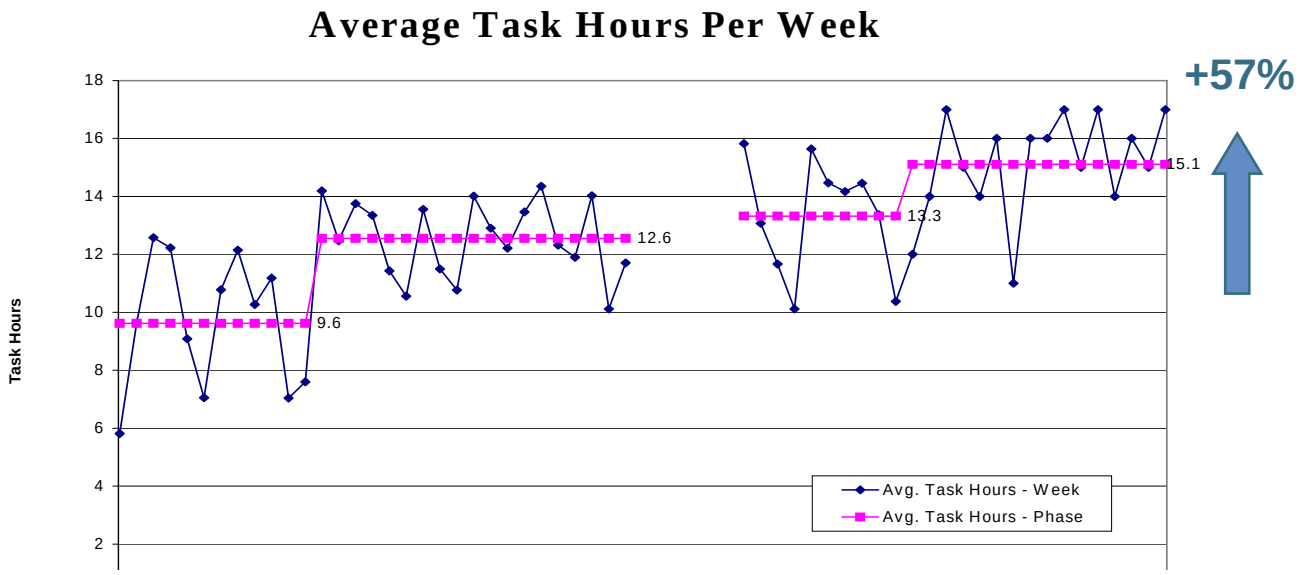
Improving Task Hours

Average task hours per developer per week were improved from 9.6 hours to 15.1 hours through quiet time, process documentation, more efficient meetings, etc.



Source: Allied Signal

Agenda

Why PSP and TSP for Systems Engineering?
Things That Change, Things That Don't
Time Logging Exercise
The TSP Launch
The TSP Management Framework
TSP Quality Management

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What is Quality?

Basic definition: Meeting the user's needs

There are three categories of product quality.

- functionality
- properties (e.g., safety, security, privacy, usability)
- defects

A software-intensive product can't be safe or secure until it is nearly defect-free.

Most current software-intensive processes are preoccupied with removing defects.

Little or no time is left for the other aspects of quality.

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The System Quality Problem

Software quality problems are largely caused by defects.

- Defects are injected by the product's developers.
- Even experienced and capable developers inject many defects.
- Each defect is a potential system failure.
- A significant fraction of software defects can be avoided or mitigated by effective systems engineering.

Current practices often rely on testing to remove these defects.

Testing is necessary but, for finding and fixing defects, it is

- time-consuming
- expensive
- ineffective

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The Defect Problem

Programs are complex products.

- Small programs have thousands of instructions.
- Large programs have millions of instructions.
- These instructions are individually produced.
- Each instruction must be precisely correct, beginning with the problem statement.

Software effort has a multiplying effort on systems engineering defects.

On average, even experienced programmers inject a defect about every 10-to-12 instructions.

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Testing

A single test

- exercises the product under one set of conditions
- produces correct or incorrect results

If there is a problem, developers must find the defect, fix it, and then test the fix.

For products with many possible operating conditions, many tests are required. *How many of these tests are defective?*

Projects that rely on testing for quality spend a lot of time and money on testing.

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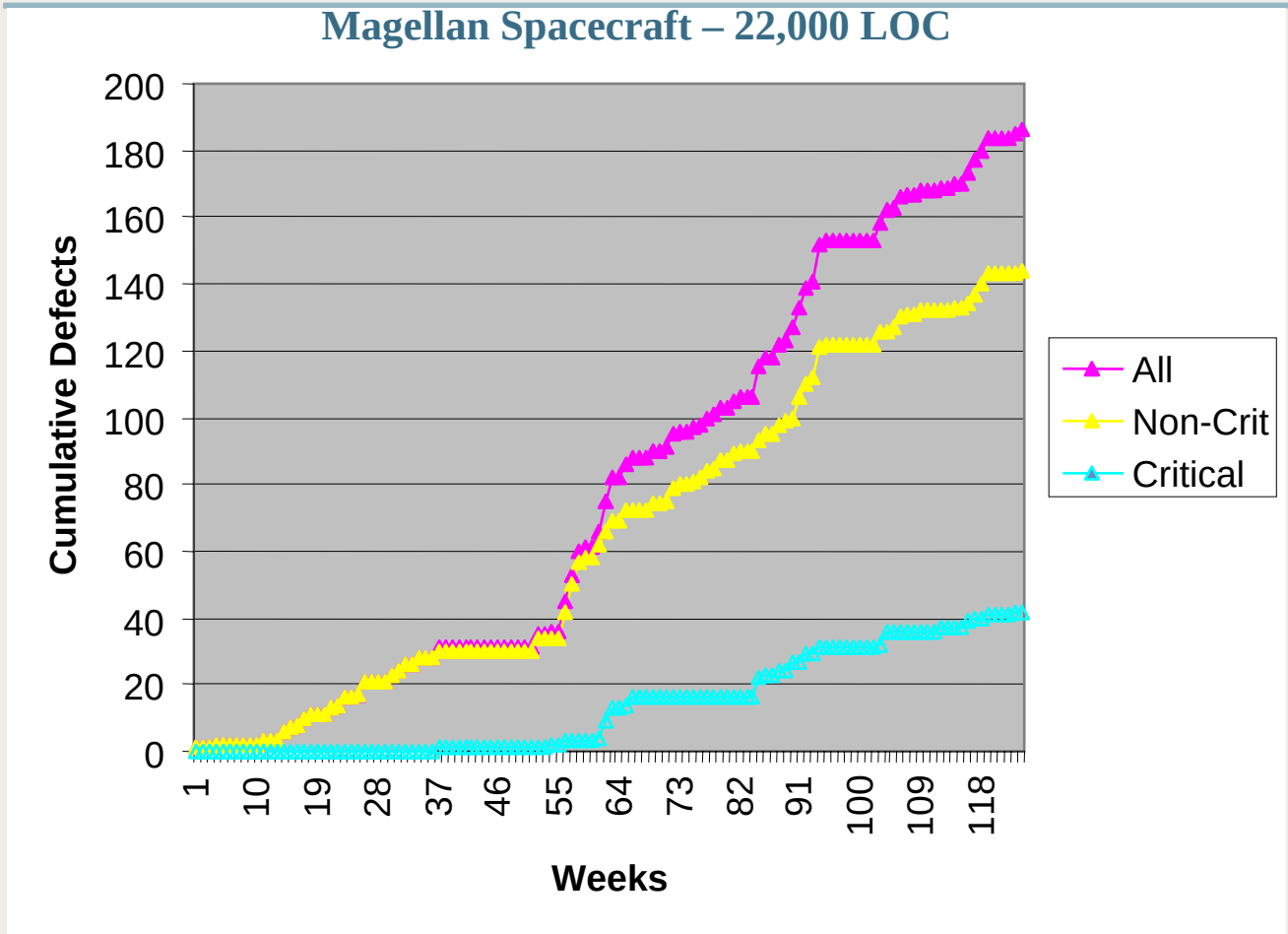
Testing Takes a Long Time



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Testing Effectiveness

Large complex systems *cannot* be exhaustively tested.

- It is impossible to test every operating condition.
- Testing must focus on only the most frequent conditions.
- Extensive user testing finds even more defects.

Testing finds a percentage of the defects in a product, usually less than 50%.

To get a quality product out of test, you must put a quality product into test.

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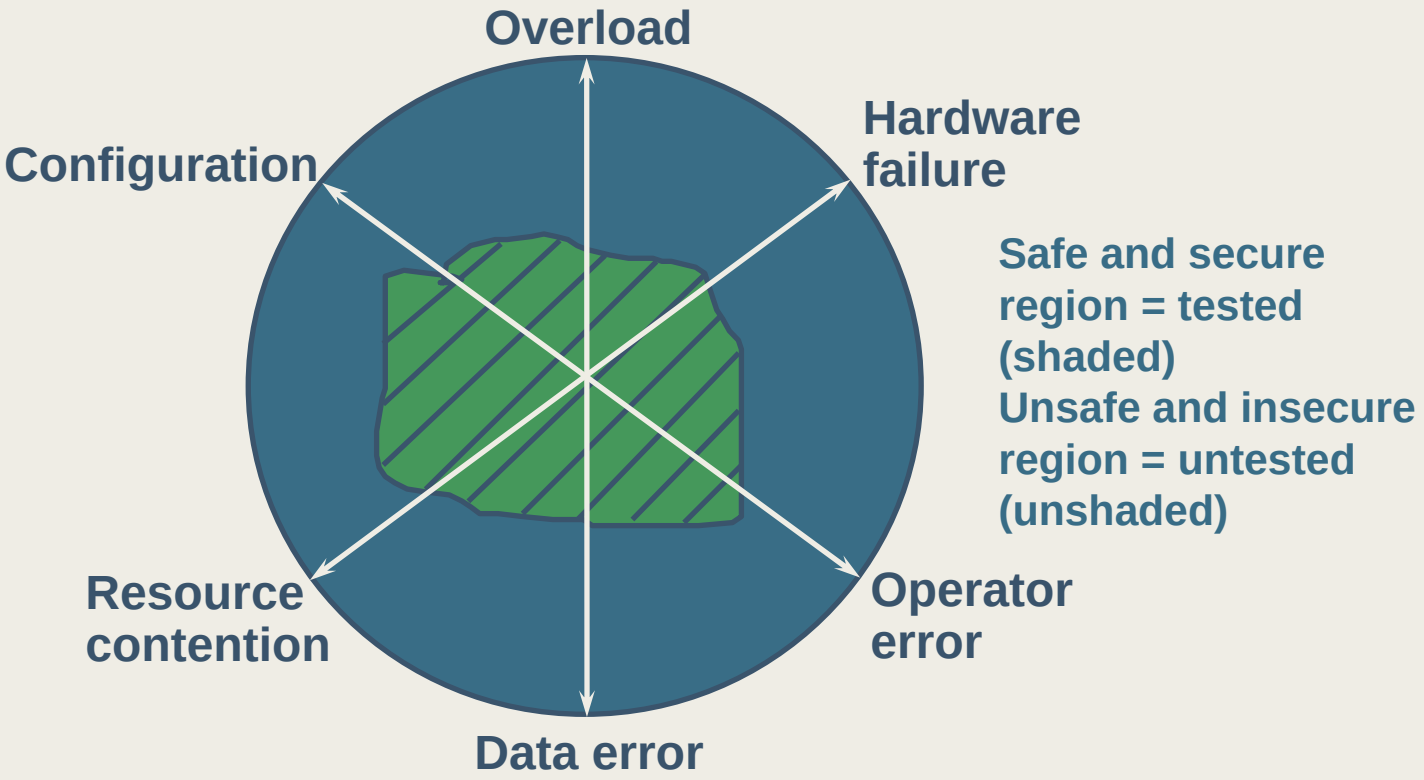
Testing is Ineffective



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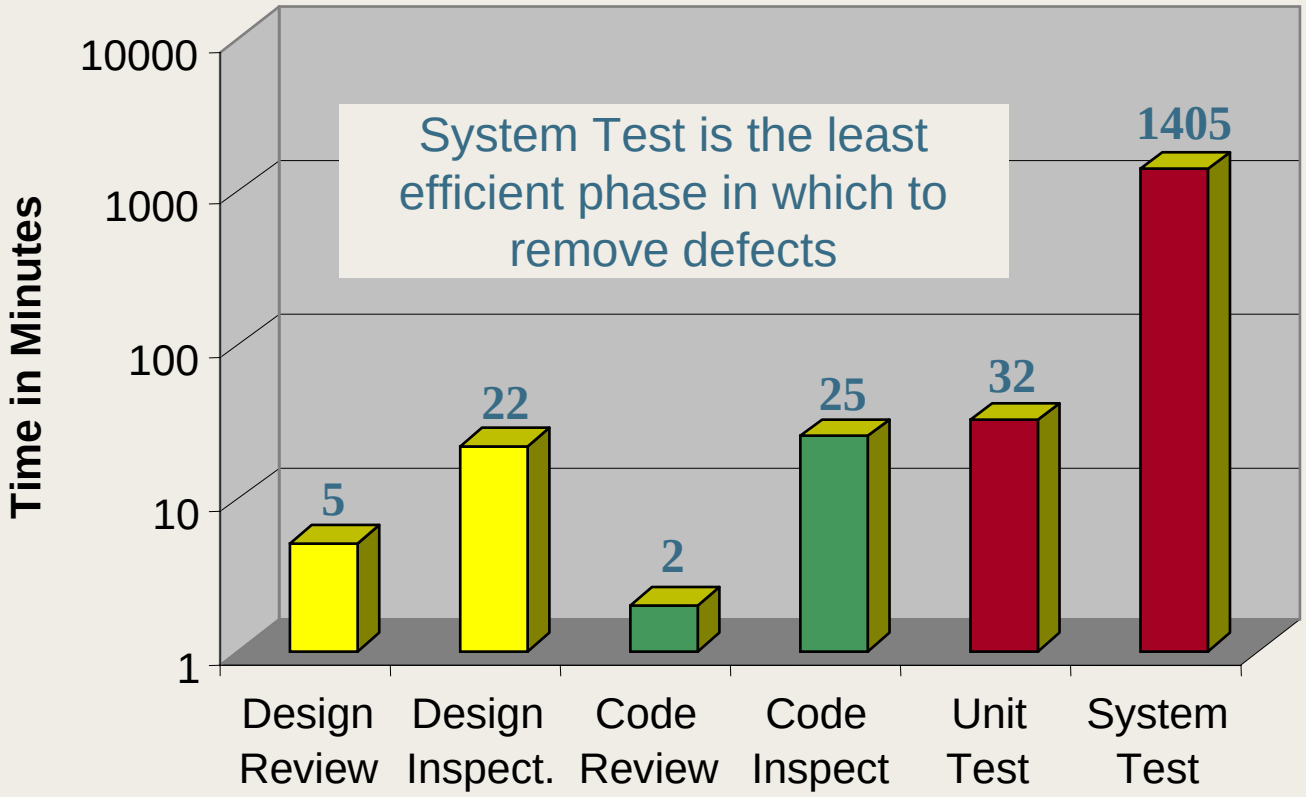
Reviews and Inspections Save Time



Source: Xerox

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Why TSP is Faster and Better

With TSP

- most defects are removed by reviews and inspections
- few defects are left for testing
- testing takes relatively little time

By using TSP, organizations can

- cut testing times by 80% or more
- shorten schedules
- reduce costs
- produce better products

Testing should verify that the development process worked well, rather than fix its exported problems.

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Measuring Quality

To produce quality systems, the quality of all its parts must be measured and managed.

These measures must be made at every step in the process.

With TSP and the underlying PSP principles, developers use quality measures to manage the quality of their work. The developers

- inject fewer defects
- remove most defects soon after injecting them

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TSP Quality Measures

There are many potential quality measures.

With the TSP, every product element and every process step can be measured.

Quality Measure		Description
Product Quality	Total defect density	The number of defects found in development, per unit of size
	Compile defect density	The number of defects found in compile, per unit of size
	Test defect density	The number of defects found in test, per unit of size
	Percent defect free	The percent of system modules or components that had no defects in a defect removal phase
Process Quality	Phase yield	The percent of defects in a product that are found during the phase
	Review rate	The volume of code or design that is reviewed per hour
	Defect removal rate - defects/hour	The hourly rate at which defects are removed in reviews or inspections
	Quality profile	Composite picture of a module's process quality
	Process quality index (PQI)	A composite value representing the five quality profile dimensions

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Quality Implications

With proper training, guidance, and motivation, most developers can produce near-defect-free programs.

Does the same hold true for systems engineers?

With essentially defect-free products
- testing times are sharply reduced
- delivered products work
- maintenance costs are reduced

The key is the engineer's ability to produce defect-free products.
- measure quality
- manage quality
- personal quality commitment

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Quality Goals and Plans

With data, TSP teams can

- set measurable quality goals
- make quality plans to meet these goals
- estimate the defects injected and removed in each phase
- track the work to see if they are meeting their quality plans

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The TSP Defect Model

At each step of development, defects are injected, removed, or possibly both.

For each step:

Defects Out = Defects In + Defects Injected – Defects Removed

Defects In = Defects Out from the previous step

Defects Injected = function of time in production activities

Defects Removed = percentage (usually much less than 100%) of Defects In + Defects Injected

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Example: Planning for Quality -1

A TSP team plans to develop 20 KLOC.

The goal is a design review yield of at least 70%.

- The plan shows 442 hours in detailed design.
- Data show that developers inject 1.3 defects per hour in detailed design.
- Data show that they remove 3 defects per hour in detailed design reviews.

What is the minimum design review time required to remove these defects?

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Example: Planning for Quality -2

Defects injected

- 442 hours of design
- 1.3 defects injected per hour
- 1.3*442 = 574.6 defects injected

Defect removal

- 574.6 defects total
- 3 defects removed per hour
- 574.6/3 = 191.5 hours of design review time

The team should plan on 191.5 hours of review time.

To achieve a 70% yield, they must spend at least 0.7*191.5 = 134.1 hours in design reviews.

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Example: Planning for Quality -3

Assume that

- no design reviews are done
- ½ of the design defects (.5 * 574 = 287) can be found by integration testing at 5 hours/defect
- ½ of the remaining defects (i.e. ½ of ½ or .5 * 287 = 144) can be found in system testing at 10 hours/defect

How much time will integration and system testing take?

How much time will be saved by doing design reviews?

How many design defects will likely remain for your customers to find?

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Maintain Process Discipline

To produce quality systems, every part must be of high quality.

This is possible only if every developer consistently follows a quality process.

To consistently follow a quality process, each member of the development team must

- be properly trained (with the PSP or equivalent)
- work on a disciplined team (with the TSP or equivalent)
- have coaching support and management guidance

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Management Support

People do not naturally do disciplined work.

To ensure disciplined work, management must

- train and support the developers
- ensure that the developers' work is guided and monitored
- provide coaching assistance

Management must also

- build and maintain effective teams
- ensure that all team members are trained and willing to follow the process
- recognize and reward quality work

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TSP Quality Messages

High-quality processes produce high-quality products.

Quality work is not done by accident; it requires discipline, commitment, management, and measurement.

Quality work saves time and money.

The cornerstone of a high-quality software process is early defect removal.

TSP shows teams how to efficiently remove defects at the earliest possible point in the process.

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Your Organization is Unique…

…but most organizations share common problems.

An organization can change under duress, or it can change in response to leadership.

Duress can lead to undesirable consequences since, by definition, it is trying to get away from whatever is causing the duress.

Only leadership can take an organization reliably in a desired direction.

Where will you lead your organization?

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Thank you!

Contact information: jdm@sei.cmu.edu

Contact a PSP or TSP transition partner:
http://www.sei.cmu.edu/collaborating/partners/trans.part.psp.html

Contact SEI customer relations:

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213-3890
Phone, voice mail, and on-demand FAX: 412/268-5800
E-mail: customer-relations@sei.cmu.edu

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Raytheon

“Who needs that process stuff anyway?”

A practical example of process discipline to improve deployment

Raytheon Missile Systems
William Borkowski, Jr.
November 14, 2006

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Organization and Accomplishments

Raytheon Missile Systems, Headquarters Tucson, AZ

- **Employees: 11,000**
- **2005 Sales: $4.1 B**
- **World Largest Appraised SEI CMMI Level 3 Organization December 2004**
- **SW-CMM® Level 5 in November 2001**
- **SE / SW CMMI® V1.1 Staged Representation Level 3 in December 2004**

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The Situation

- **"The Conflict"**
  - **No insight into progress toward CMMI level 3 goal**
    - What Specific & Generic Practices by PA assessment ready across Front Runners

- **"The Questions"**
  - **How much evidence do we need?**
  - **How do we know where we are?**
  - **How many process areas are deployed?**
  - **What evidence are we going to collect?**
  - **Where are we with evidence collection?**
  - **How much do we collected?**
  - **Where is it?**
  - **Etc, Etc, Etc**

- **"What to do"?**
  - **R6S Project –**
    - **Show 6 stages – Visualize, Commit, Prioritization, Characterization, Improve, Achieve**
      - Tools - Brainstorming, affinitizing, prioritizing, root cause analysis, & consensus building

Observation – Undesirable Effects

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Key elements of our approach

GOAL:

•Use a proven approach to rapidly fix a major problem

•Provide quick, accurate, detailed graphic results to improved visibility into SCAMPI readiness

•Quick response < 6 weeks

- **Vision**
  - **Create a vehicle that can be used to track progress of the RMS CMMI Project toward attaining level 3**
- **Requirements**
  - **Involve key stakeholders**
    - **Leadership**
    - **Deployment teams**
    - **Process Area Experts**
  - **Collecting & reporting status to the stakeholders in a consistent, deterministic, and timely manner**
  - **Graphic reports of key metrics**

Use a proven approach to improve the situation

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Visualize

- **Problem Statement**
- **The CMMI Deployment Tracking Spreadsheet & Reporting Tools where difficult to use, inaccurately populated, and consequently not readily usable by the CMMI Leadership Team to monitor project status**

- **Vision**
- **Implement a deployment tracking process to monitor progress towards attaining CMMI Level 3 at RMS**
  - **Reports tracking progress are required**

- **Scope**
- **Deployment Tracking Spreadsheet updates shall be ready in less than 6 weeks**

Clearly define the desired state

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R6σ Process Model

Our *Knowledge Based Process* for *Transforming Our Culture* to *Maximize Customer Value* and *Grow Our Business*

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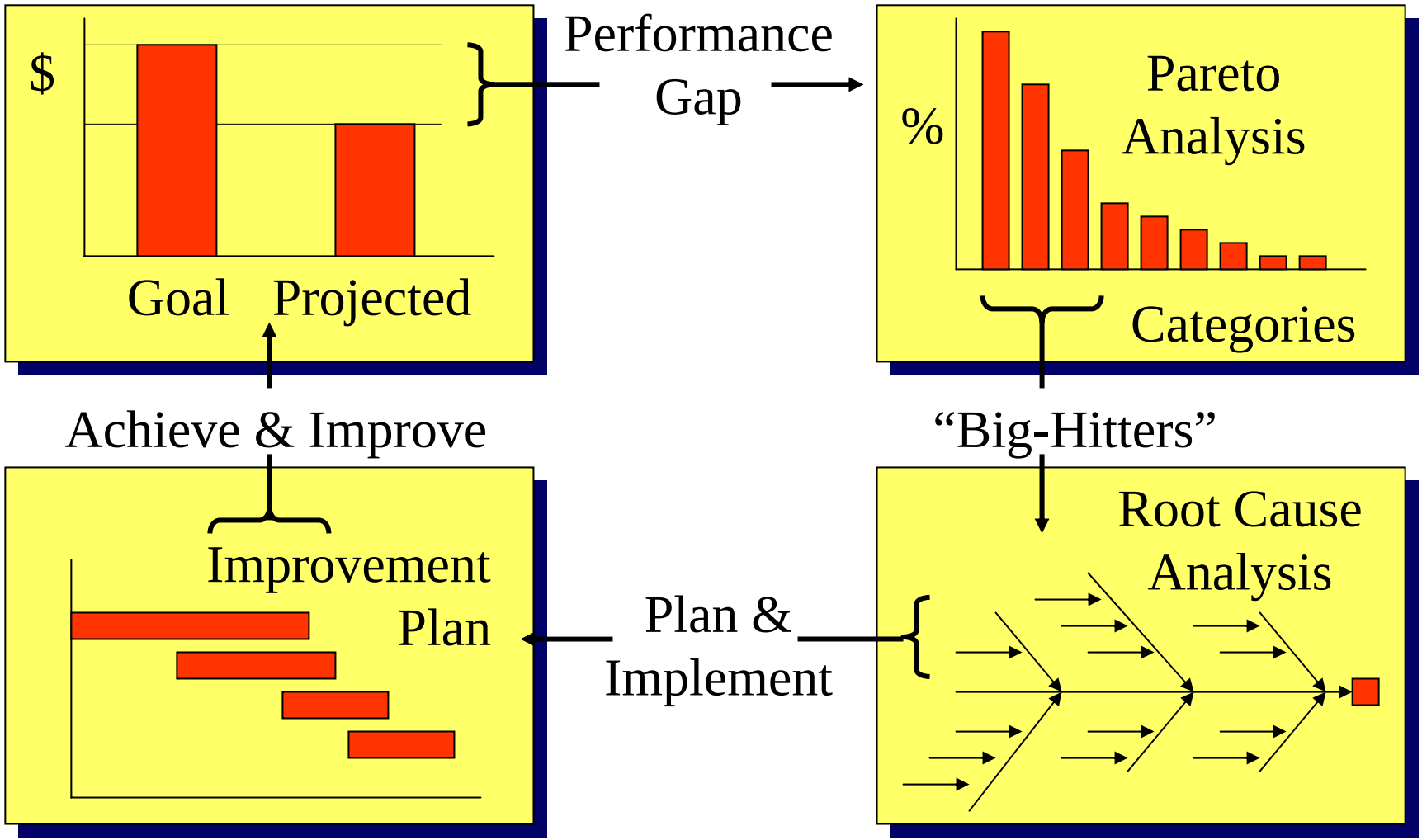
Applying $R6\sigma$ to What We Do



How it works

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Commit

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- **Met with Sponsors**
  - **Outlines approach & Project requirements**
- **Obtained commitment to proceed:**
  - Vision, Commitment (do whatever it takes), Scheduled this as an agenda item for Project all hands meeting (5/18/04) to discuss & gather survey comments
  - Meeting agenda with stakeholders
    - » Project Vision & Deliverables
    - » Project Assumptions
    - » Data Gathering approach
    - » Determination of current Process Flow
    - » Deliverable
    - » Assumptions
    - » Stakeholder Tasks – how they could make this successful

Obtained Leadership commitment to the Plan

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Deliverables

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- Updated Deployment Tracking Spreadsheet
- Updated Run Rules & Process Flow & training
- Reporting Charts
  - Deployment & Evidence Rate Charts (1 per Program & Roll up)
  - Program Plans / TDs by PA and Practice (1 per Program)
  - Program Opportunities by Program & PA
  - Evidence Status by Program & PA
  - Program Evidence by PA & SP (1 per Program)
  - Program Evidence by PA & GP (1 per Program)
  - Rollup of all evidence across all Front runners required for SCAMPI
- Demonstrated accurate information usable by the CMMI Project Team

Clearly define a finite set of deliverables

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Prioritization

Raytheon

- **Devised plan to survey PAEs, MOR's, POR's, & Deployment Leads**
  - **Got stakeholders opinion**
- **Fashion a solution that met Sponsor's vision**
  - **Usable by different class of users**
    - **Deployment teams**
    - **Process area Representatives**
    - **Leadership team for status**
    - **Appraisal team for SCAMPI**
  - **Reporting requirement**

Clearly determined where we were & where headed

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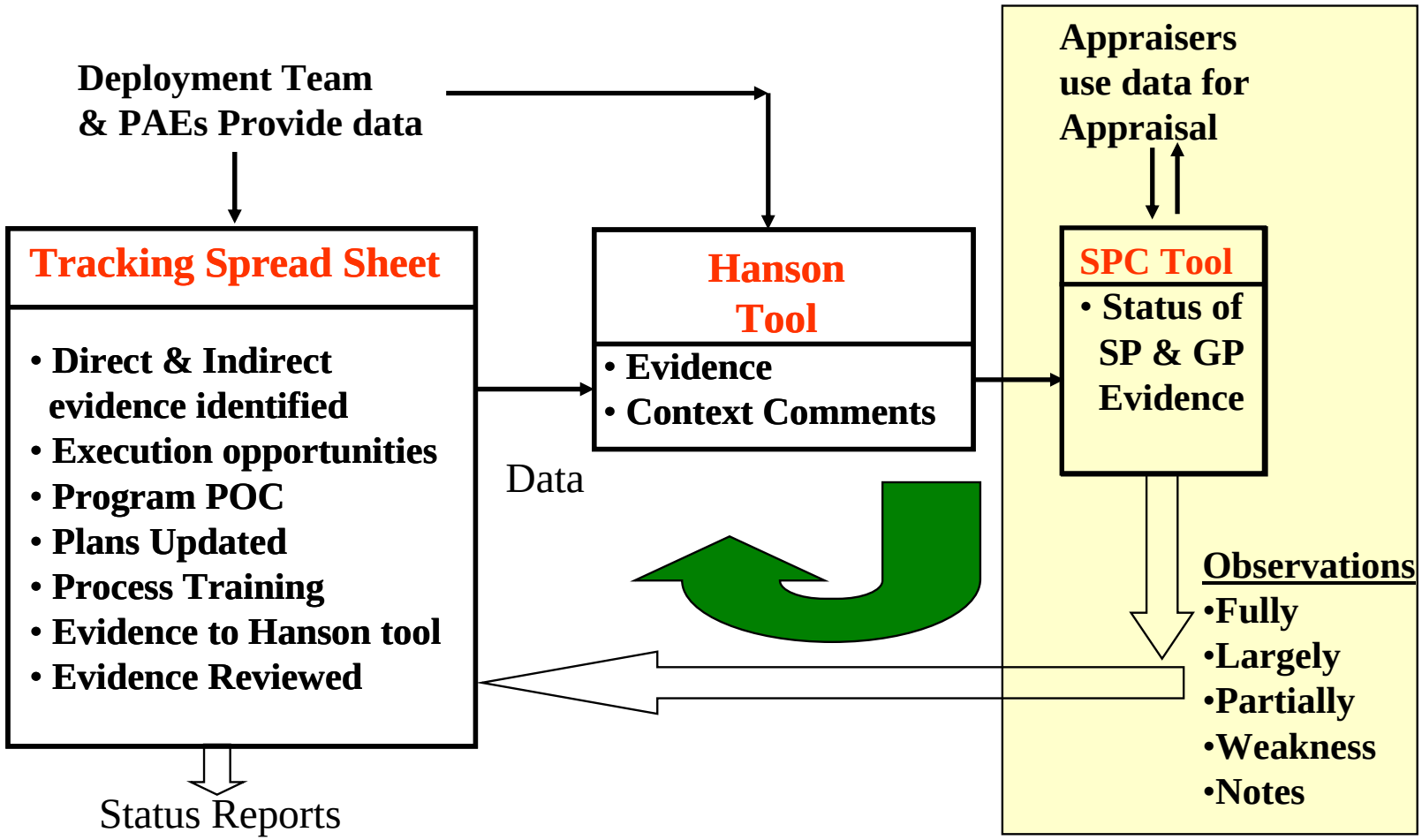
Requirements Context Diagram



Appraisal team required a tool

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Shared Activities (OLD) Process Flow

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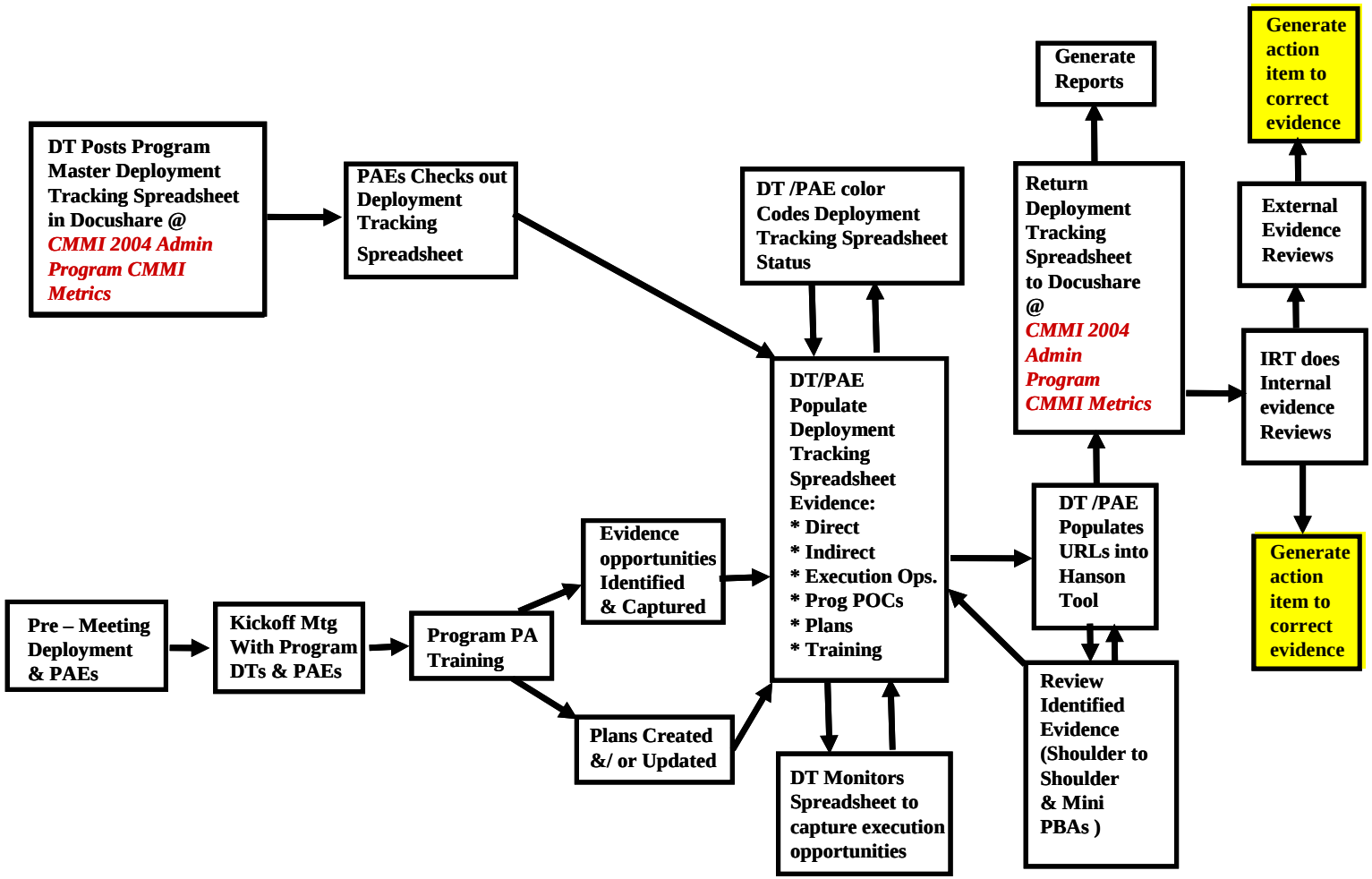

Determined current state process flow

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Characterization – 1 of 2

Raytheon

- **Survey Questions**
  - **Describe your Current State**
  - **What are your top 3 Desirables about the Current State?**
  - **What are your top 3 Undesirables about the Current State?**
  - **What specific Run Rules have you developed for your team?**
  - **What is your Ideal Future State? (3 key descriptions)**
  - **What are your change recommendations? Be Specific**
  - **What data do you find useful to you?**
  - **What data is not useful to you?**

- **Received 182 inputs from 5/18/04 data gathering session**
  - 72% (122) are covered by proposed solution
  - 28% (47) are not covered
  - (13) Use one tool
    - » The Spreadsheet and the Hanson tool both have unique capabilities
  - (9) Opinions about what is useful data
    - » Varies greatly from nothing is useful to everything is useful
  - (6) Spreadsheet control
    - » Decision is to not lock spreadsheets and to allow docushare checkout
  - (4) Consistency between Spreadsheet and Hanson tool
    - » Required to ensure accuracy of content and eliminate confusion on what is loaded versus what is required
  - 13 inputs are non-actionable

Use a proven approach to improve the situation

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Characterization – 2 of 2

- **Deliverables – See Tasks Below**
- **Improvement Plan Schedule**

Task	Owner	Start Date	End Date	When	Total L OE
Develop proposed task list	Mike	5/14/2004	5/16/2004	Sunday	2.0
Create proposed Problem Statement	Bill	5/14/2004	5/17/2004	AM	0.4
Create proposed Vision	Bill	5/15/2004	5/17/2004	AM	0.4
Create proposed expectations	Bill	5/16/2004	5/17/2004	AM	0.6
Create proposed deliverables	Bill	5/17/2004	5/17/2004	AM	0.6
Get Peckney to start looking at current matix & data guidelines	Mike / Bill	5/17/2004	5/17/2004	AM	0.5
Gather/Understand all Reporting Charts	Mike	5/17/2004	5/17/2004	AM	2.0
Obtain Sponsor agreement on Tasks 1-5	Mike / Bill	5/17/2004	5/17/2004	Lunchtime	2.0
Identify & Invite Stakeholders to 5/18 PAE/DT Meeting	Mike	5/17/2004	5/17/2004	PM	1.5
Develop questions to ask Stakeholders at 5/18 PAE/DT Meeting	Bill	5/16/2004	5/17/2004	PM	1.0
Prepare agenda & Presentation for 5/18 PAE/DT Meeting	Mike / Bill	5/16/2004	5/17/2004	PM	2.0
Gather data from all Stakeholders (may have to call some directly)	Mike / Bill	5/18/2004	5/18/2004	AM	12.0
Develop Current State Descriptors	Bill	5/18/2004	5/18/2004	PM	3.0
Develop a Current State Process Flow	Bill	5/18/2004	5/18/2004	PM	3.0
Create Future State Descriptors from Stakeholder inputs	Mike	5/18/2004	5/18/2004	PM	3.0
Determine Root Causes for Undesirables	Mike / Bill	5/19/2004	5/19/2004	AM	3.0
Identify the Gaps between Current & Future States	Mike / Bill	5/19/2004	5/19/2004	AM	3.0
Merge Root Causes & Gaps & Affinitize the list	Mike	5/19/2004	5/19/2004	Lunchtime	3.0
Brainstorm Solutions to the Affinitized List	Mike / Bill	5/19/2004	5/19/2004	PM	5.0
Prioritize Brainstormed Solutions	Mike / Bill	5/19/2004	5/19/2004	PM	2.0
Create a Business Case (Desccription, Benefit Implementation Process & Cost, etc) for Key Brainstormed Solutions	Mike / Bill	5/19/2004	5/20/2004	PM - AM	6.0
Measure proposed Solutions against Future State Descriptors	Mike	5/20/2004	5/20/2004	AM	2.0
Weekly Progress Report Due	Bill	5/20/2004	5/20/2004	PM	1.0
Obtain Sponsor Approval to Proceed	Mike / Bill	5/20/2004	5/20/2004	PM	4.0
Update Documentation Instructions	Mike / Bill	5/21/2004	5/24/2004	Daily	16.0
Train Stakeholders	Mike / Bill	5/25/2004	5/25/2004	AM	6.0
Weekly Progress Report Due	Bill	5/27/2004	5/27/2004	PM	1.0
Stakeholders Update Spreadsheets	Stakeholders	5/25/2004	6/1/2004	PM	???
Correct Spreadsheet Errors	Mike / Bill	6/1/2004	6/4/2004	Daily - AM	48.0
Measure Success to Deliverables	Mike / Bill	6/4/2004	6/4/2004	AM	2.0
Complete Project Submittal	Mike / Bill	6/4/2004	6/4/2004	PM	2.0
Celebrate	Mike / Bill	6/4/2004	6/4/2004	PM	Infinity

Developed a detailed plan

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Improve

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- **Executed plan**
- **Suggested improvements to meet requirement as project progressed**
- **Got expert & necessary help to transition current state matrix to improved form**
- **Trained stakeholders**
- **Using the matrix to track progress**
- **Using output reports to show status & to focus team efforts**

Execution included deployment & use of Work products

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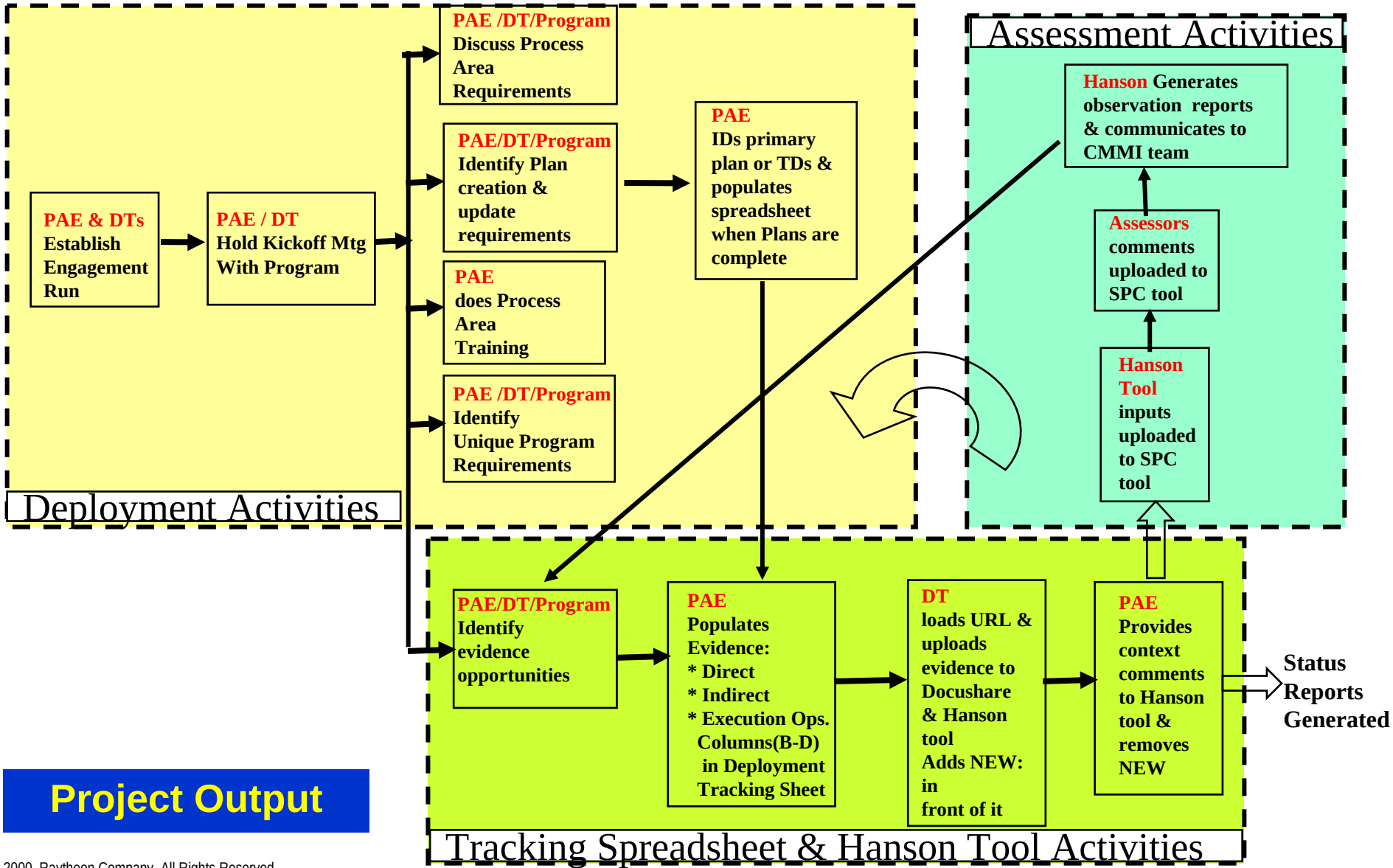
New Process Flow



Project Output

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Tracking Run Rules

A	B
#	Run Rule
1	Each Practice will have a minimum of 1 direct evidence item and 1 indirect evidence item / affirmation
2	1 Evidence item per row
3	Deployment Tracking Spreadsheet column owners are ultimately responsible for the completion of their columns
4	Deployment Tracking Spreadsheets are available to all CMMI team members folr docushare checkout
5	When you update a Deployment Tracking Spreadsheet, notify applicable DTs & PAEs. DTs will verify links are ok and PAEs will verify content is ok
6	When adding or modifying evidence in the Hanson tool, add "New" in front of the document name
7	When reviewing and/or adding context comments for evidence that has been placed in the Hanson tool, remove the "NEW" from the front of the document name
8	Each Program DT will maintain a golden Deployment Tracking Spreadsheet in a separate location as insurance in the event of a docushare data crash
9	Consistency between the Deployment Tracking Spreadsheet and the Hanson tool will be maintained
10	Scoring for a column is not "Complete" until all activity on the Evidence rows is finished
11	If no evidence is available type in"No Opportunity" in the "Load Latest Review Results" column
12	If "No Opportunity" is used, reduce the "Total # of Opportunities" count at the bottom of the Deployment Tracking Spreadsheet
13	Maintain each program's Deployment Tracking Spreadsheet in the docushare admin area for each program
14	The Practices row order on the Deployment Tracking Spreadsheets will not be modified
15	The Practices row is for "scoring" only.
16	Evidence rows are used to gather evidence information
17	"Total # of Opportunities" is defined as the # of SPs and GPs, minus any identified as "No Opportunity"
18	For the Plan column to be considered "Complete", the Plan must be identified, created / updated, and be ready for program use
19	If no Plan is applicable for a Practice, load the applicable IPDS@RMS Task Descriptor
20	The Plan is loaded at the Practice level
21	If additional Plans need to be referenced, place them in the "Comments" column
22	For the "Identify & Complete Execution Opportunity" column, follow the date (2004/04/18) - opportunity (Team of Three) - Program POC (name) convention. If you don't know the specific day, use the last day of the month.
23	The "Identify Execution Opportunity" column is considered "Complete" when the opportunity information for each evidence row is captured on the Deployment Tracking Spreadsheet.
24	To be able to "Load Evidence", the Execution Opportunity must have have occurred and the information captured
25	When Review results are anything but "Fully", the Practice is considered red and the "Complete" for all columns is removed.
26	Select "Loaded in Hanson Tool" to indicate Context Comments have been loaded into the Hanson Tool. Select "None" if no Context Comments are required. Select "Blank" if Context Comments have not yet been loaded into the Hanson Tool.
27	If a Practice has no indirect evidence available, type "Affirmation Required" in the "Comments" column on the Practice row
28	When a review results in a "Largely", "Partially", or "Not", a "Red" color code is reported. DT removes the "Complete" from columns C,F,G, and H. Once a "Complete" is reloaded (which means that an update has occurred) into one of the columns C,F,G, or H, the DT changes the review results column H to "Blank". This resets the colors to restart progressing through yellow and green.
29	When uploading URLs, do not paste the document name, because if the document is changed, the link will be broken. Example to use: http://ds.rms.ray.com/dscgi/ds.py/Get/File-209214 . Avoid: http://ds.rms.ray.com/dscgi/ds.py/Get/File-209214/TTL_Master_Status_Template.xls . Browse to the file using the DocuShare client then right-click on the file, edit, copy URL.
30	If column E (Identify Execution Opportunity) has not been completed on an evidence row, and the opportunity has already occurred and been loaded into the Hanson Tool, then an alternative to loading "Date - Opportunity - POC" is to load "OBE - POC". Leaving the cell "blank" or using "na" is not a suitable alternative.
31	Order evidence supporting each practice by importance in the Hanson Tool.
32	To assist the Assessors review, Context Comments should contain the following 4 parts, as appropriate: 1. Applicable page # or location in the evidence document; 2. What part of the practice or sub-practice the evidence answers; 3. Which thread the evidence ties to; and 4. Historical background/perspective of the document

Project Output

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Deployment Tracking Spreadsheet Definitions

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Rows	Description	Clarification / Example
Practices Rows	Columns on this row are for "scoring" only. Words placed in the cell relate to color codes. For Column B, type in the applicable Plan or IPDS@RMS Task Descriptor For Columns C, E, F & G on the SP row, typing "Complete" into the cell indicates task completion For Column H, type in the scoring result received from the latest review	In SP 1.1 Column C (Identify Evidence), when all applicable evidence is loaded into the deployment tracking spreadsheet, type "Complete" in the SP row Column C cell
Evidence Rows	Evidence and all actions associated with Columns C – G are captured in the applicable column	In SP 1.1 Column C (Identify Evidence), type in evidence "xyz"
Opportunity Scoring	At the bottom of each worksheet Total # of Opportunities = the total # of SPs & GPs. This should be a fixed # (Exception) If "No Opportunity" is identified for a specific practice, then remove that SP from the count Total # Complete=the # of Practices Rows that 1. Have a Plan or TD loaded 2. Have "Complete" loaded 3. Have a Latest Review Result loaded	Column C (Identify Evidence) has Total # of Opportunities = 20 because there are 21 SPs & GPs on the worksheet minus 1 no opportunity Total # Complete = 6 because "Complete" was loaded on the SP Row cell 6 times
Shaded areas	No input is needed in the cell	Leave blank

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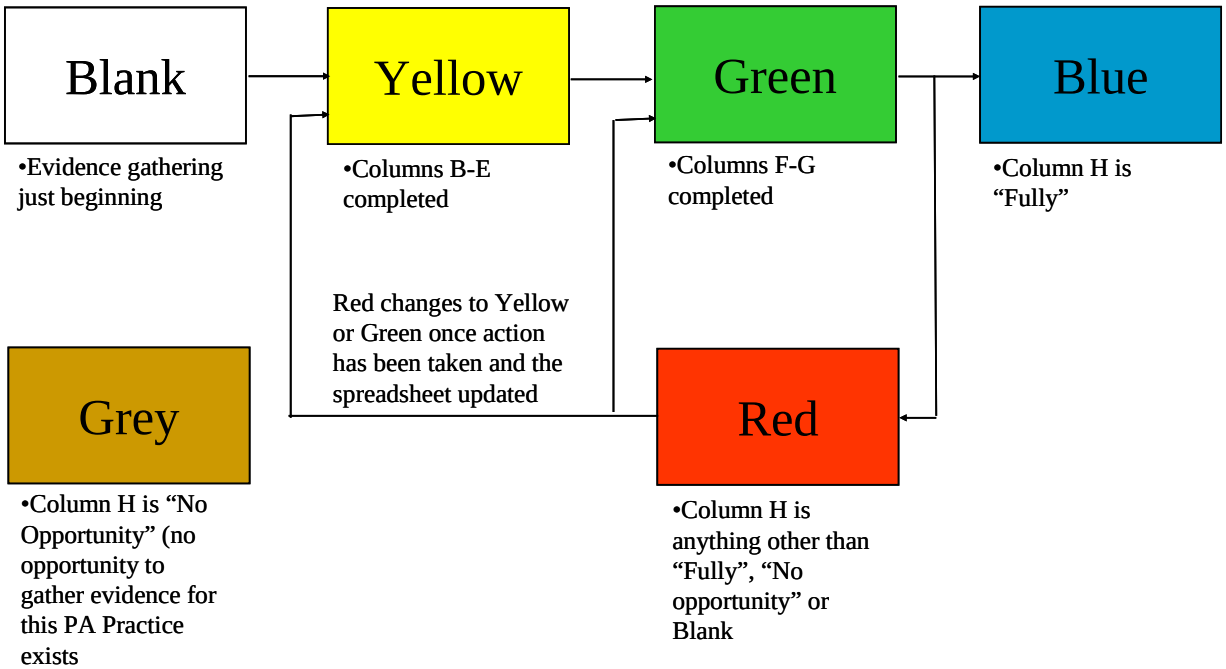
Data Gathering Analysis

Reporting Color Coding Process Flow



	A	B	C	D	E	F	G	H	I
1	Program: NFIRE			Process Area: MA		PAE: SANTILLAN / MARSH		DT:BORKOWSKI / ARD	
2									
3		Identify & Gather Evidence				Load Evidence			
4	**Practice**	**Identify Primary Plan** (that is ready for program use) **or Task Descriptor** (is identified) **(PAE)**	**Identify Evidence (PAE)**	Identify as Direct or Indirect (PAE)	**Identify & Complete Execution Opportunity** (Date - Opportunity - POC) **(PAE)**	**Load Evidence** (into Docushare & Hanson Tool) **[List url] (DT)**	**Load Context Comments** (into Hanson Tool) **[List comments] (PAE)**	**Load Latest Review Results (DT)**	**Comments**
5	SP 1.1 Establish and maintain measurement objectives that are derived from identified information needs and objectives.	M&A Plan	Complete		Complete	Complete	Complete	Fully	
						http://ds.rms.ray	Complete		

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Updated Deployment Tracking Spreadsheet

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Example

Program: NFIRE			Process Area: TS		PAE: Hector Esparza		DT: Bill Borkowski / Mike Ard	
	Identify & Gather Evidence				Load Evidence			
Practice	**Identify Primary Plan (that is ready for program use) or Task Descriptor (is identified) (PAE)**	**Identify Evidence (PAE)**	**Identify as Direct or Indirect (PAE)**	**Identify Execution Opportunity {Date [yyyy/mm/dd] - Opportunity - POC} (PAE)**	**Load Evidence {into Docushare & Hanson Tool} [List url] (DT)**	**Load Context Comments {into Hanson Tool} [List comments] (PAE)**	**Load Latest Review Results (DT)**	**Comments**
SP 1.1 Develop detailed alternative solutions and selection criteria	M&A Plan	Complete		Complete	Complete	Complete	Fully	
		xyz	D	2004/04/18 - Team of Three - Bhalala	xyz@raytheon.com	None		
		rst	I	2004/04/11 - Worksheet Markups - Bhalala	rst@raytheon.com	page 3		
SP 1.2 Evolve the operational concept, scenarios, and environments to describe the conditions, operating modes, and operating states specific to each product component.	M&A Plan	Complete		Complete	Complete	Complete	Largely	
SP 2.1 Develop a design for the product or product component.	M&A Plan	Complete		Complete	Complete	Complete		
		ghi	D	2004/04/18 - Team of Three - Bhalala	xyz@raytheon.com	None		
		jkl	I	2004/04/11 - Worksheet Markups - Bhalala	rst@raytheon.com	Table 2		
SP 2.2 Establish and maintain a technical data package.	M&A Plan	Complete		Complete				
		ghi	D	2004/04/18 - Team of Three - Bhalala				
		jkl	I	2004/04/11 - Worksheet Markups - Bhalala				
SP 2.3 Design comprehensive product-component interfaces in terms of established and maintained criteria.		Complete						Affirmation Required
		ghi	D					
		jkl	D					
SP 2.4 Evaluate whether the product components should be developed, purchased, or reused based on established criteria.							No Opportunity	
Total # of Opportunities	20	20		20	20	20	20	
Total # Complete	5	6		5	4	4	2	

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Tracking Matrix Output # 1 Evidence by PA

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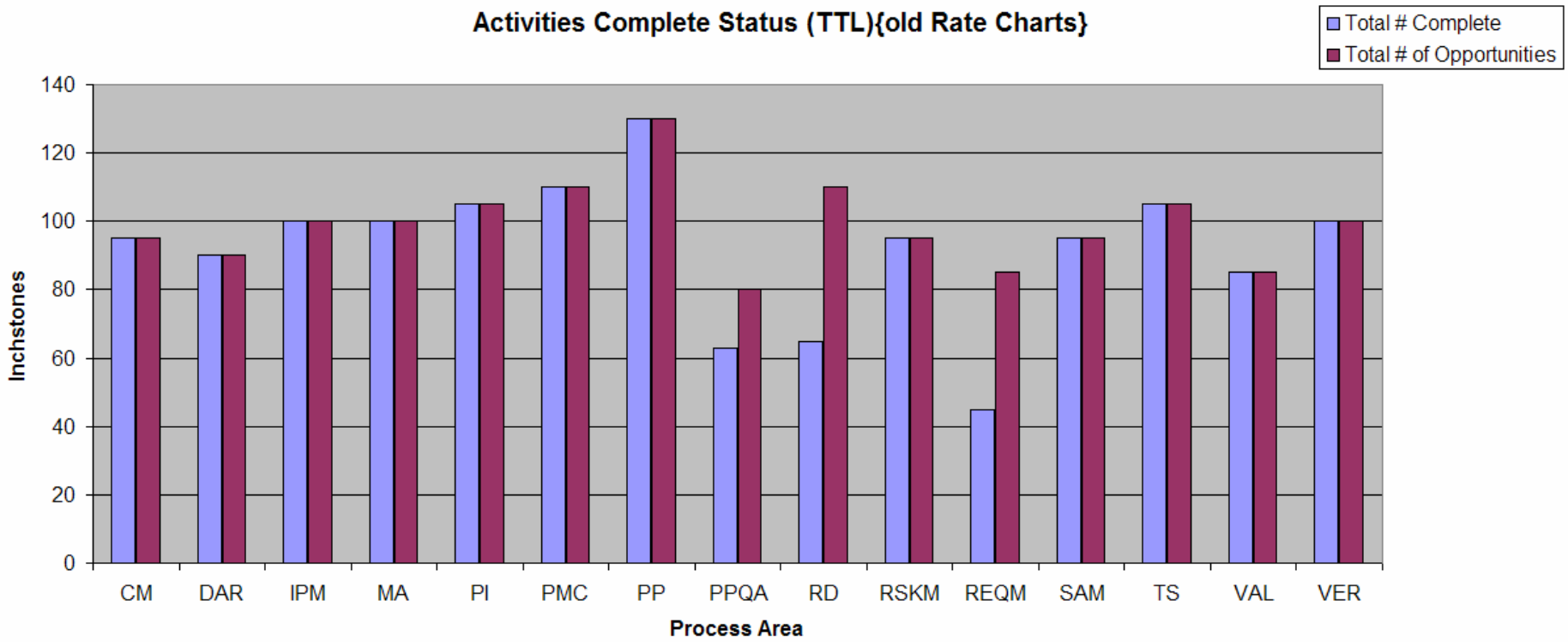

Project Output

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Tracking Matrix Output # 2 Overdue Report

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CMMI Evidence Overdue Report by Program

#	Program	Process Area	Practice	Execution Opportunity	Evidence
1	Prog A	CM	SP 1.1	2005/06/24 Mary Process	ENB Table of Contents
2	Prog A	CM	SP 1.1	2005/06/30 John Practice	Specification Tree
3	Prog A	CM	SP 1.1	2005/06/30 John Practice	Boost Flight DVT Drawing Tree
4	Prog A	CM	SP 1.1	2005/06/21 John Practice	Drawing Number List
5	Prog A	CM	SP 1.2	2005/06/22 Mary Process	Date Accession List (DAL)
6	Prog A	CM	SP 1.2	2005/06/21 John Practice	PDM control procedure for work authorization for CMOP
7	Prog A	CM	SP 1.2	2005/06/22 Mary Process	E-mail for ENB Structure
8	Prog A	CM	SP 1.3	2005/06/30 John Practice	Functional Baseline Report (BFDVT)
9	Prog A	CM	SP 1.3	2005/06/30 John Practice	SOW Describing Functional Baseline.
10	Prog A	CM	SP 1.3	2005/06/24 Joe Procedure	Software Baseline
11	Prog A	CM	SP 1.3	2005/06/30 John Practice	Allocated Baseline
12	Prog A	CM	SP 1.3	2005/06/24 Joe Procedure	Software Synergy/PDM Baseline View
13	Prog A	CM	SP 1.3	2005/06/24 Joe Procedure	Software CCB Minutes
14	Prog A	CM	SP 1.3	2005/06/24 Joe Procedure	E-Mail Scheduling Software CCB Agenda
15	Prog A	CM	SP 1.3	2005/06/24 Jane Audit	Hardware CCB agenda and minutes: Dated TBD
16	Prog A	CM	SP 2.1	2005/09/01 John Practice	Change Notification (TBD)
17	Prog A	CM	SP 2.1	2005/06/24 Jane Audit	Initial Release Memo (IRM)
18	Prog A	CM	SP 2.1	2005/06/16 John Practice	Signed CN number xxxxxx for Revision A Specifications.
19	Prog A	CM	SP 2.1	2005/09/01 John Practice	CCB to analyze the Revision A CN.
20	Prog A	CM	SP 2.1	2005/09/01 John Practice	File Version History View (PDM)
21	Prog A	CM	SP 2.1	2005/06/24 Joe Procedure	E-Mail Scheduling Software CCB Agenda
22	Prog A	CM	SP 2.1	2005/06/24 Joe Procedure	Software CCB Minutes: Dated TBD
23	Prog A	CM	SP 2.1	2005/06/24 Joe Procedure	Software CI's from SDP
24	Prog A	CM	SP 2.1	2005/06/24 Joe Procedure	Software CR's
25	Prog A	CM	SP 2.2	2005/09/01 John Practice	Change incorporation history (screen shot of PDM from Revision - to Revision A)

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Tracking Matrix Output # 3
Plans Completed

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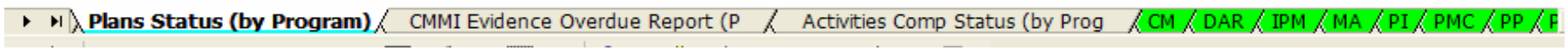
Practice	CM	DAR	IPM	MA	PI
SP 1.1	Configuration Management Plan	Program Management Plan (PMP)	Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)
SP 1.2	Configuration Management Plan	Program Management Plan (PMP)	Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)
SP 1.3	Configuration Management Plan	Program Management Plan (PMP)	Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)
SP 1.4		Program Management Plan (PMP)	Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	
SP 1.5		Program Management Plan (PMP)	Program Management Plan (PMP)		
SP 1.6		Program Management Plan (PMP)			
SP 1.7					
SP 2.1	Configuration Management Plan		Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)
SP 2.2	Configuration Management Plan		Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)
SP 2.3			Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	
SP 2.4				Measurement and Analysis Plan (PMP)	
SP 2.5					
SP 2.6					
SP 2.7					
SP 3.1	Configuration Management Plan				Program Management Plan (PMP)
SP 3.2	Configuration Management Plan				Program Management Plan (PMP)
SP 3.3					Program Management Plan (PMP)
SP 3.4					Program Management Plan (PMP)
SP 3.5					
GP 2.1	RMS Practice 07-04-525	RMS Practice 07-04-525	RMS Practice 07-04-525	RMS Practice 07-04-525	RMS Practice 07-04-525
GP 3.1	Configuration Management Plan	Program Management Plan (PMP)	Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)
GP 2.2	Configuration Management Plan	Program Management Plan (PMP)	Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)
GP 2.3	Staffing Plan	Staffing Plan	Staffing Plan	Staffing Plan	Staffing Plan
GP 2.4	Configuration Management Plan	Program Management Plan (PMP)	Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)
GP 2.5	Training Plan	Training Plan	Training Plan	Training Plan	Training Plan
GP 2.6	Configuration Management Plan	Data Management Plan	Data Management Plan	Data Management Plan	Data Management Plan
GP 2.7	Stakeholder Involvement Plan (PMP)	Stakeholder Involvement Plan (PMP)	Program Management Plan (PMP)	Stakeholder Involvement Plan (PMP)	Stakeholder Involvement Plan (PMP)
GP 2.8	Measurement and Analysis Plan (PMP)	Measurement and Analysis Plan (PMP)	Measurement and Analysis Plan (PMP)	Measurement and Analysis Plan (PMP)	Measurement and Analysis Plan (PMP)
GP 2.9	Interceptor Objective Evaluation Plan (OE)	Interceptor Objective Evaluation Plan (OE)	Interceptor Objective Evaluation Plan (OE)	Interceptor Objective Evaluation Plan (OE)	Interceptor Objective Evaluation Plan (OE)
GP 2.10	Configuration Management Plan	Program Management Plan (PMP)	Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)
GP 3.2	Configuration Management Plan	Program Management Plan (PMP)	Program Management Plan (PMP)	Measurement and Analysis Plan (PMP)	Program Management Plan (PMP)



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Tracking Matrix Output # 4
Assessment Coverage

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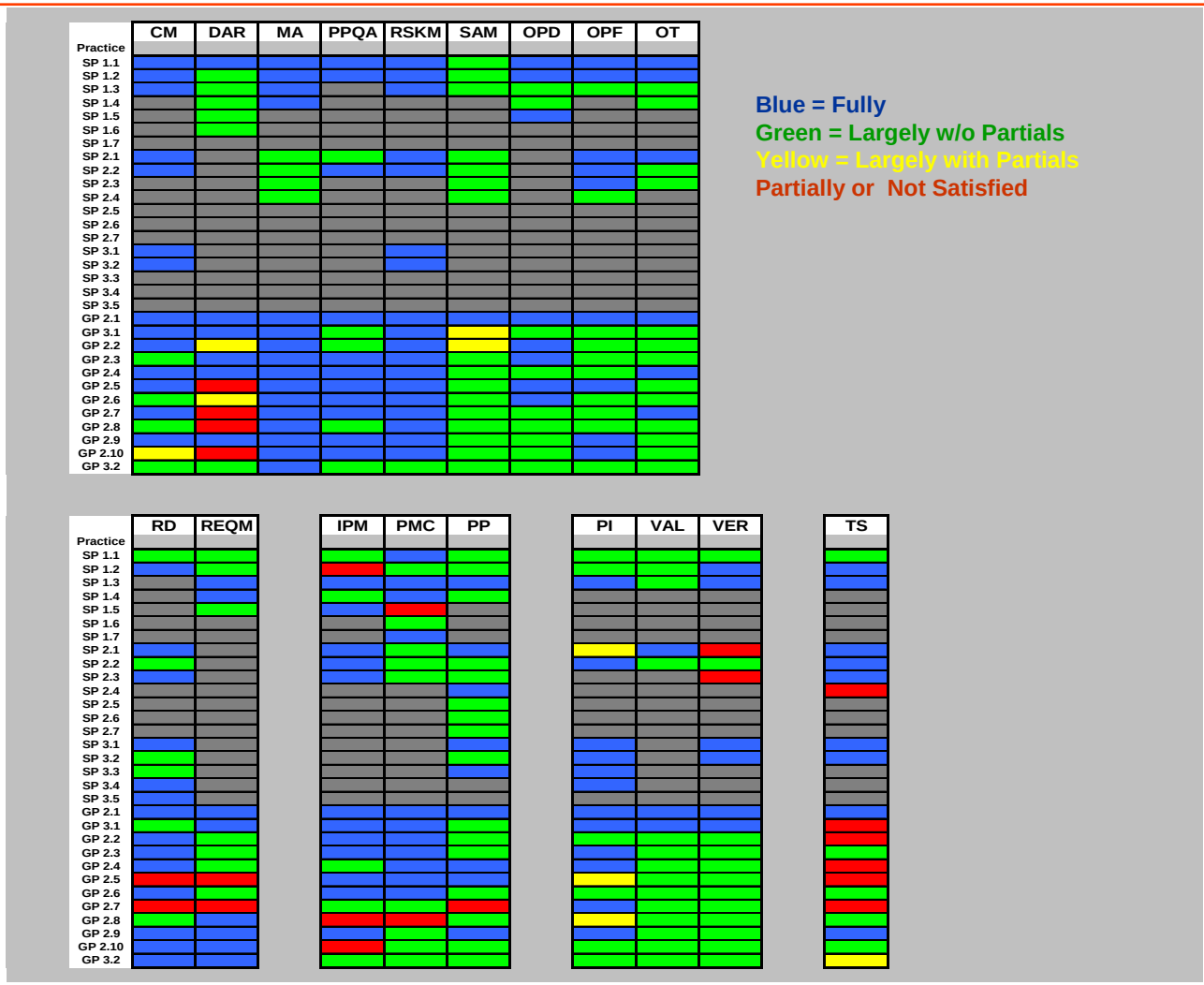

Appraisal team knew precisely where they where with respect to required evidence using the products from the project

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Achieve

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- **Documented project using Specialists Template & STS**
- **Rewarded stakeholders with gift certificates**
- **Showed results of tracking matrix to outside assessors who say it is Best in Class for tracking progress**
- **Intend to present this approach at R6 Sigma Forum as an example of a “Go Fast” project that had results**
- **<u>Deliverables</u>**
  - **Updated Deployment Tracking Spreadsheet**
  - **Updated Run Rules & Process Flow**
  - **Reporting Charts**
    - **Deployment & Evidence Rate Charts (1 per Program & Roll up)**
    - **Program Plans / TDs by PA and Practice (1 per Program)**
    - **Program Opportunities by Program & PA**
    - **Evidence Status by Program & PA**
    - **Program Evidence by PA & SP (1 per Program)**
    - **Program Evidence by PA & GP (1 per Program)**
  - **Demonstrated accurate information usable by the CMMI Project Team**
  - **All deliverables were generated on time with minimal changes**

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Lessons Learned

- **Imposing strict run rules and enforcing them worked in the solution**
- **Inputs from stakeholders & using them in the solution created a win / win for most parties**
- **If you measure it, you should act on it**
  - **Less panic in the end game because we knew exactly where we were with the evidence**
- **All SCAMPI A goals appraised as satisfactory**

	Maturity Level																								
	Level 2							Level 3														Level 4		Level 5	
Goals	REQM	PP	PMC	SAM	MA	PPQA	CM	RD	TS	PI	VER	VAL	OPF	OPD	OT	IPM	RSKM	IT	ISM	DAR	OEI	OPP	QPM	OID	CAR
GG 3	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S			S					
GG 2	S	S	S	S	S	S	S																		
SG 4																									
SG 3		S					S	S	S	S	S						S								
SG 2		S	S	S	S	S	S	S	S	S	S	S	S		S	S	S								
SG 1	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S			S					
Rating	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S			S					

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Goal Attained

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CMMI®

A CMMI® based Appraisal was completed on December 16, 2004 in accordance with the Software Engineering Institute's SCAMPI℠, V1.1: Method Definition Document and it was determined that

Raytheon Missile Systems

SEI Level 3 Process Maturity

as defined by the SEI CMMI® Version 1.1 SE/SW Staged Representation.

(signed)

Albert J. Truesdale
SEI Authorized Lead Appraiser
Center for Systems Management

CSM CENTER FOR SYSTEMS MANAGEMENT

(signed)

James Armstrong
Appraisal Team Member
Software Productivity Consortium

SOFTWARE PRODUCTIVITY CONSORTIUM

Largest world wide facility to obtain CMMI Level 3 Certification

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The Continuous Representation:

Cultivating Process Improvement from Grassroots Efforts

November 14, 2006

Jennifer Turgeon
Sandia National Laboratories

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Agenda

- My Background
- Overcoming Objections to CMMI
- Know the Problems
- Staged vs. Continuous for Small Organizations and Project Teams
- Small Project Teams
- The Plan
- Questions?

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My CMMI Background

- Member of SCAMPI B & C Development Team
- Member of Honeywell Aerospace and Corporate IT Appraisal Teams
- Authorized SCAMPI B & C Lead Appraiser
- Candidate Authorized SCAMPI A Lead Appraiser

- Led teams of varying sizes toward some form of CMMI compliance at Honeywell, FM&T; Lockheed Martin, ATARS; and Sandia National Laboratories

CMMI Objections

- CMMI creates endless documentation and useless artifacts
- CMMI is only for large organizations and projects
- CMMI interferes with creativity
- CMMI costs too much
- CMMI is too large and complex

- Used inappropriately, ANY process improvement initiative can cause these problems.
- The key is to focus on what benefits the team or organization the most.

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Overcoming CMMI Objections

- Listen to and document objections
  - Understand what the apprehension is
  - Address the issues directly
  - Communicate with and involve management in these discussions
- Consider process improvement over a “Level”
  - Discuss the pros and cons with management
  - Realize that the “Level” can always come later

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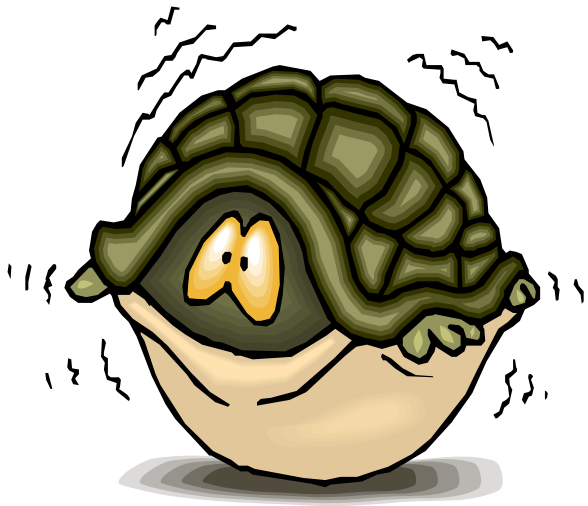
Know the Problems

Change Resistance

- What I'm doing works fine, **why change**?
- I don't have time to learn something new, **what's in it for me**?
- I don't trust **management's** motivation for change!

Emotional Responses

- If I change, that means what I've been doing in the past was wrong…
- I don't want to move out of my comfort zone…
- I have no control over what is changing…



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Staged vs. Continuous

For small organizations and project teams…

Staged

- Can be costly, especially when Maturity Levels are selected arbitrarily
- Overwhelming for people new to process improvement
- Can lead to process improvement gone

BAD

Continuous

- Cost effective; organizations can prioritize and where they need to improve systematically
- Reduces anxiety by focusing on limited areas
- Supports the need for institutionalization

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Presentation Scope

Small organizations and teams

- Team size of 1-5 people
- New to defined or consistent use of process
- Have a general desire to improve the work that they do
- Have some undefined processes in place that are unique to each team member
- Averse to CMMI

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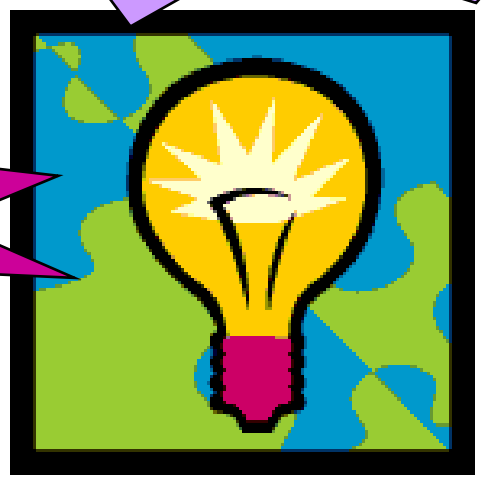
The Plan

Let the team build the processes

What will benefit the team?



Take small steps

Bottom up approach

What will benefit the customer?

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Bottom Up/Grassroots Approach

- **Find process improvement grassroots advocates**
  - **These people believe that their work can be improved and are willing to do something to change**
  - **They generally do not like “initiatives” because they have seen these come and go**
  - **They are leaders in their work community**
- **Let the advocates drive the change**
  - **Other practitioners trust these advocates**
  - **They understand how to express the need for change to their peers**

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Give the Implementation Team Control

- **Discuss and identify benefits that can be achieved from change**
  - **Identify benefits to the team members**
  - **Identify benefits to the customers**
  - **Identify benefits to the organization**
- **Identify areas for improvement**
  - **Teams identify areas for improvement**
  - **Teams prioritize the identified areas**
  - **Teams then schedule the improvement efforts**

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Small Steps

- **Develop a schedule that works for the implementers**
  - **Keep management informed**
  - **Allow for small increments of change**
    - **Small steps that elicit great success will allow for bigger steps the next time around**
  - **Hold people accountable for their work**
  - **Communicate frequently**

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Start with Existing Processes

- **Identify existing processes**
  - **Provide time for teams to share what they do**
  - **Include both documented and undocumented processes**
  - **Take the time to understand the underlying process culture**
- **Discuss how existing processes can be improved**
  - **Attempt to maintain the culture as processes are improved**

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Simple Steps to Process Improvement

- **Define what you do** (may be the draft of a process)
- **Identify areas for improvement**
- **Establish goals**
- **Develop a process** (or refine what you already have)
- **Use the process**
- **Reassess how you are doing** after using the new process
- **Continuously improve**, as needed

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Using the Continuous Representation

- **Use the continuous representation as a process improvement guide**
  - **Provides a mechanism for measuring improvement toward goals**
  - **Allows management to identify readiness for a formalized appraisal**
- **Avoid “reinventing the wheel”**

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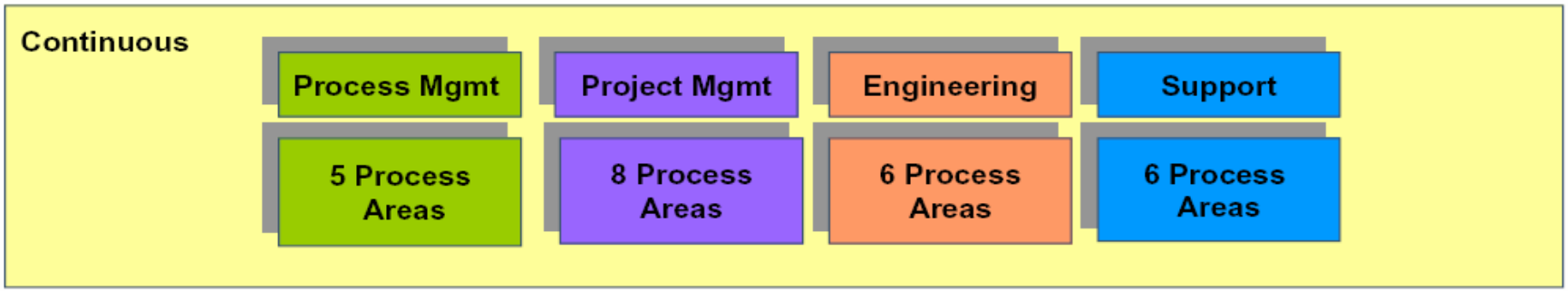
Continuous Representation



- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management
- Risk Management
- Integrated Teaming
- Integrated Supplier Management
- Quantitative Project Management

- Configuration Management
- Process and Product Quality Assurance
- Measurement and Analysis
- Decision Analysis and Resolution
- Organizational Environment for Integration
- Causal Analysis and Resolution

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Continuous Generic Goals

Generic Goals	Generic Practices
GG1: Achieve Specific Goals	GP 1.1: Perform Base Practices
GG2: Institutionalize a Managed Process	GP 2.1: Establish an Organizational Policy GP 2.2: Plan the Process GP 2.3: Provide Resources GP 2.4: Assign Responsibility GP 2.5: Train People GP 2.6: Manage Configurations GP 2.7: Identify and Involve Relevant Stakeholders GP 2.8: Monitor and Control the Process GP 2.9: Objectively Evaluate Adherence GP 2.10: Review Status with Higher Level Management
GG3: Institutionalize a Defined Process	GP 3.1: Establish a Defined Process GP 3.2: Collect Improvement Information
GG4: Institutionalize a Quantitatively Managed Process	GP 4.1: Establish Quantitative Objectives for the Process GP 4.2: Stabilize Subprocess Performance
GG5: Institutionalize an Optimizing Process	GP 5.1: Ensure Continuous Process Improvement GP 5.2: Correct Root Causes of Problems

Simple Steps to Process Improvement

- **Define what you do** (may be the draft of a process)
- **Identify areas for improvement**
- **Establish goals**
- **Develop a process** (or refine what you already have)
- **Use the process**
- **Reassess how you are doing** after using the new process
- **Continuously improve**, as needed

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Define What you Do

Process Management

- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

Engineering

- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

Product Management

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management
- Risk Management
- Integrated Teaming
- Integrated Supplier Management
- Quantitative Project Management

Support

- Configuration Management
- Process and Product Quality Assurance
- Measurement and Analysis
- Decision Analysis and Resolution
- Organizational Environment for Integration
- Causal Analysis and Resolution

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Simple Steps to Process Improvement

- **Define what you do** (may be the draft of a process)
- **Identify areas for improvement**
- **Establish goals**
- **Develop a process** (or refine what you already have)
- **Use the process**
- **Reassess how you are doing** after using the new process
- **Continuously improve**, as needed

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Identify Areas for Improvement

Process Management

- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

Engineering

- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

Product Management

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management
- Risk Management
- Integrated Teaming
- Integrated Supplier Management
- Quantitative Project Management

Support

- Configuration Management
- Process and Product Quality Assurance
- Measurement and Analysis
- Decision Analysis and Resolution
- Organizational Environment for Integration
- Causal Analysis and Resolution

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Prioritize Improvement Areas

Process Management

- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

Engineering

- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

1

Product Management

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management
- Risk Management
- Integrated Teaming
- Integrated Supplier Management
- Quantitative Project Management

2

Support

- Configuration Management
- Process and Product Quality Assurance
- Measurement and Analysis
- Decision Analysis and Resolution
- Organizational Environment for Integration
- Causal Analysis and Resolution

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Simple Steps to Process Improvement

- **Define what you do** (may be the draft of a process)
- **Identify areas for improvement**
- **Establish goals**
- **Develop a process** (or refine what you already have)
- **Use the process**
- **Reassess how you are doing** after using the new process
- **Continuously improve**, as needed

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Establish Goals - 1

Process and Product Quality Assurance Process Area

- **SG 1 Objectively Evaluate Processes and Work Products**
  - **SP 1.1-1 Objectively Evaluate Processes**
  - **SP 1.2-1 Objectively Evaluate Work Products and Services**

- **SG 2 Provide Objective Insight**
  - **SP 2.1-1 Communicate and Ensure Resolution of Noncompliance Issues**
  - **SP 2.2-1 Establish Records**

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Establish Goals - 2

- Goals may be all or some of the specific practices
- Be careful with the jargon
  - "We are working toward improving our functional testing" versus
  - "We are implementing SPs 1.1 – 1.3 in order to improve the way that we prepare for functional testing
- It is important to pace achievement towards goals to ensure success

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Establish Goals - 3

Generic Goals	Generic Practices
GG1: Achieve Specific Goals	GP 1.1: Perform Base Practices
GG2: Institutionalize a Managed Process	GP 2.1: Establish an Organizational Policy GP 2.2: Plan the Process GP 2.3: Provide Resources GP 2.4: Assign Responsibility GP 2.5: Train People GP 2.6: Manage Configurations GP 2.7: Identify and Involve Relevant Stakeholders GP 2.8: Monitor and Control the Process GP 2.9: Objectively Evaluate Adherence GP 2.10: Review Status with Higher Level Management
GG3: Institutionalize a Defined Process	GP 3.1: Establish a Defined Process GP 3.2: Collect Improvement Information
GG4: Institutionalize a Quantitatively Managed Process	GP 4.1: Establish Quantitative Objectives for the Process GP 4.2: Stabilize Subprocess Performance
GG5: Institutionalize an Optimizing Process	GP 5.1: Ensure Continuous Process Improvement GP 5.2: Correct Root Causes of Problems

Establish Goals - 4

- **Generic practices start to take care of themselves as processes improve**
  - **Monitoring generic practices should be a project management activity reported to management**
- **Don't talk CMMI until practitioners are ready**
  - **Gradually introduce the fact that the process improvement efforts align well with CMMI implementation**

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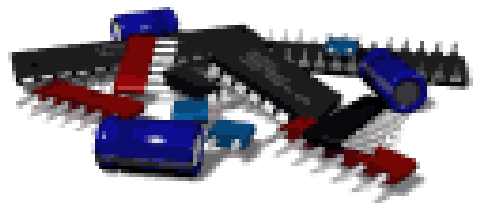
Simple Steps to Process Improvement

- **Define what you do** (may be the draft of a process)
- **Identify areas for improvement**
- **Establish goals**
- **Develop a process** (or refine what you already have)
- **Use the process**
- **Reassess how you are doing** after using the new process
- **Continuously improve**, as needed

Sandia National Laboratories

Develop a Process

- Relevant practitioners need to write, or at least edit, the process
- Keep the process simple, even if it is not complete
- Don’t shoot for a perfect process the first time
- Get team consensus



Sandia National Laboratories

Simple Steps to Process Improvement

- **Define what you do** (may be the draft of a process)
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- **Develop a process** (or refine what you already have)
- **Use the process**
- **Reassess how you are doing** after using the new process
- **Continuously improve**, as needed

Sandia National Laboratories

Use the Process

- Use the process for an extended period of time
- Collect issues related to the process as they arise
- Reassess how you are doing after using the new process
- Continuously improve, as needed

Sandia National Laboratories

Contact Information

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Sandia National Laboratories

Questions?

Sandia National Laboratories

LOCKHEED MARTIN

CMMI®-Based Improvement: The View from the Project

Beth Clark

Trish Cavenee

Lockheed Martin Integrated Systems and Solutions

The Project

- Large-scale Ground System that fits into larger, Space-based program providing sensor data to military users
  - Software-intensive, net-centric environment
  - Part of larger, system of systems

The Organization

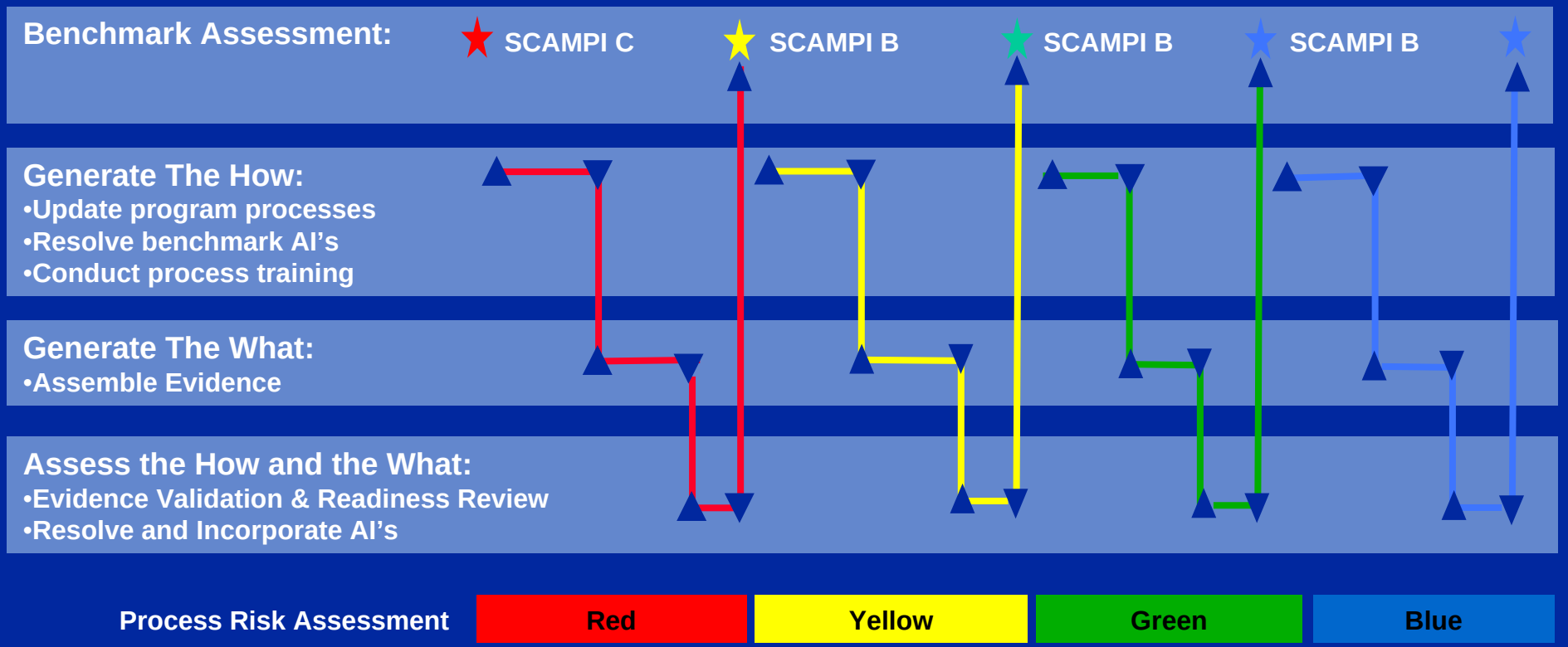
- Lockheed Martin Integrated Systems & Solutions, which achieved CMMI® Version 1.1, SE/SW/IPPD/SS Maturity Level 5, October 2005
- IS&S has rigorous CMMI® maintenance methodology
  - All programs visited
    - 6 – 9 months after ATP with SCAMPI℠ C
    - One year after initial benchmark, SCAMPI℠ B or C depending on value and/or risk
  - Depending on process risks identified in previous benchmarks, revisited at least every two years

The Project Process History

- Awarded in late 1990's
- Troubled with cost and schedule problems
- In 2001, initial SCAMPI℠ C held to assess process risk – declared "red"
- Process Action Team formed and improvement strategy defined
  - Process initiatives managed like a project
  - Benchmark at least annually, until "blue" risk rating achieved

Project Improvement Strategy

- Generate How's and What's, Then Assess
- Repeat until Blue
- Maintain



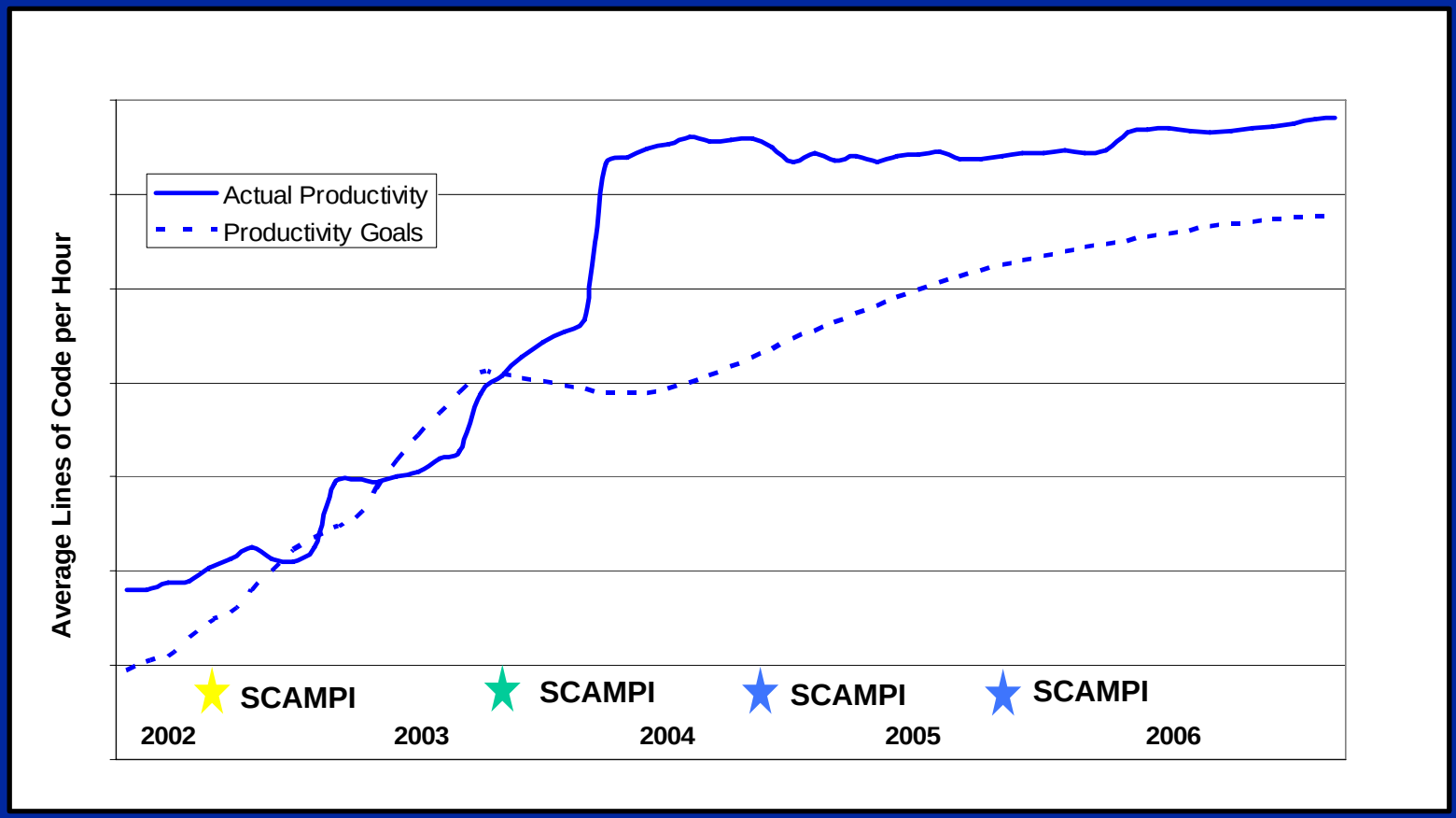
What Did We Do?

- Aligned project processes with organization's standard processes
- Provided adequate resources (training, tools, labs)
- Instituted quantitative management and causal analysis
- Benchmarked program process maturity annually, beginning in 2002, following IS&S CMMI® maintenance methodology
- In 2006, participated in IS&S SCAMPI℠ A

Process Improvement Results

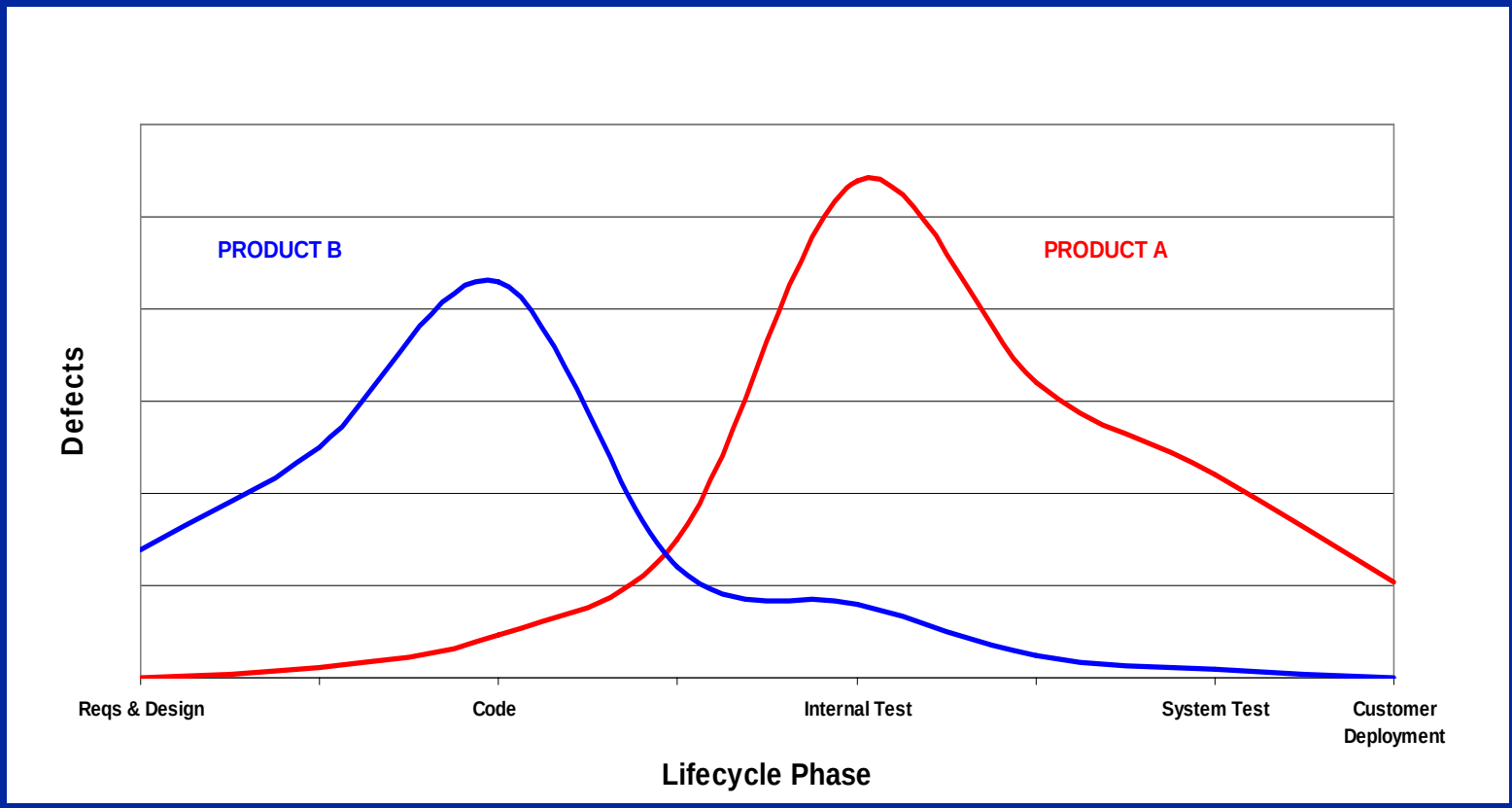
- **Better and better benchmarks**
- **Measurable improvement in project execution**

Productivity



- Substantial improvement in software productivity as a result of process improvement efforts
- Cost savings realized by project

Defect Discovery



- Product A delivered around time of initial SCAMPI-C
- Product B delivered very recently
- By fixing problems earlier in the product lifecycle, defect resolution costs have been reduced by 60- 70%

What We're Doing Now

- Continuing to understand and improve process performance capabilities
- Generating innovation for organizational deployment

Questions?

Panel: The Business Value Of CMMI ML 5

Lynn Penn	Lockheed Martin
Rushby Craig	Hill AFB
Rick Heffner	Northrop Grumman
Gene Miluk	SEI

Sponsored by the U.S. Department of Defense
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CMMI Maturity Level 5

- Describe CMMI ML 5 beyond OPP, QPM, OID and CAR
- How do you operationalize ML5
- What do you measure? What do you watch?
- What business value results:
  - For your customers
  - For your organization

LOCKHEED MARTIN

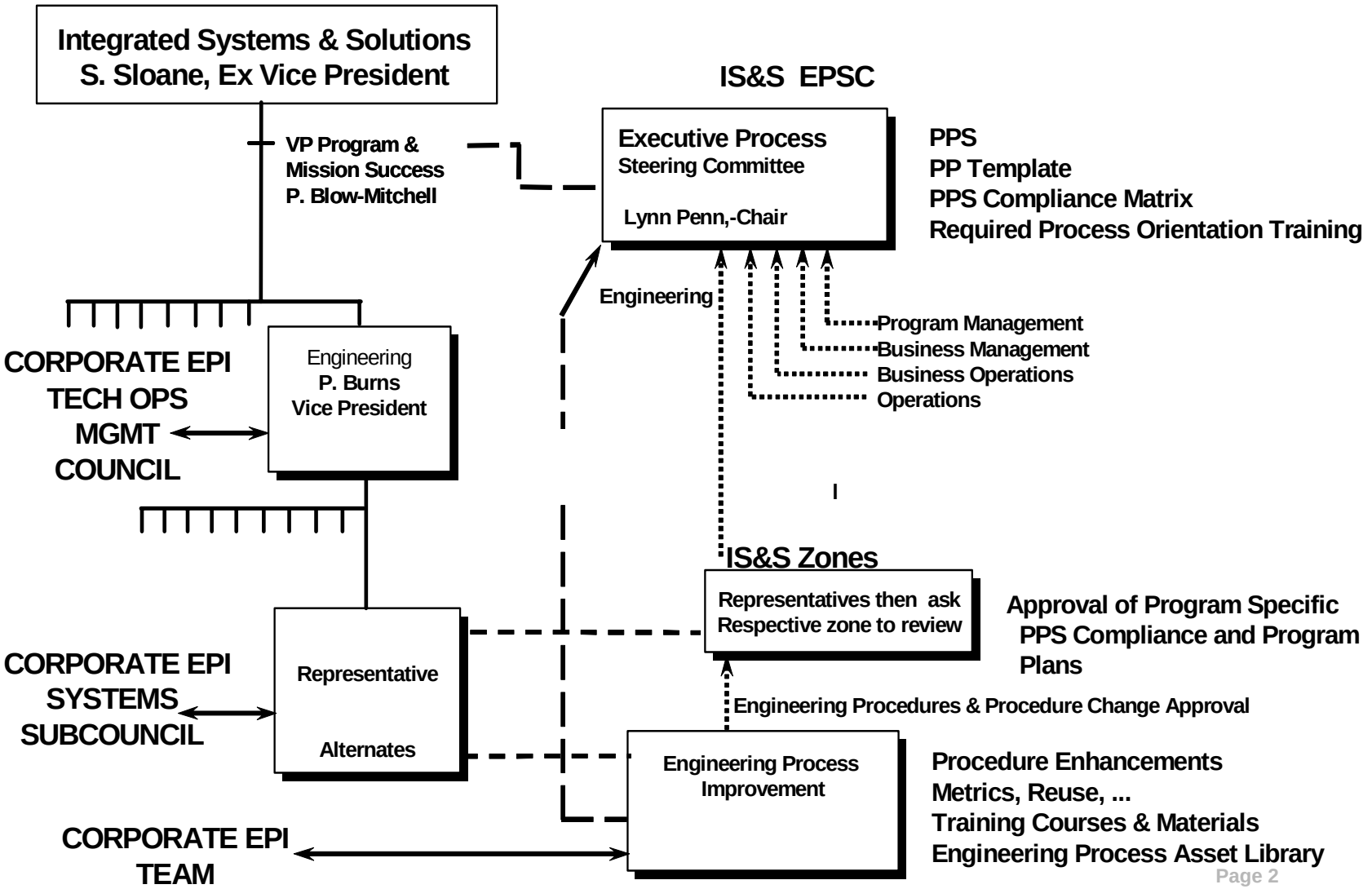
Lockheed Martin
Integrated Systems & Solutions

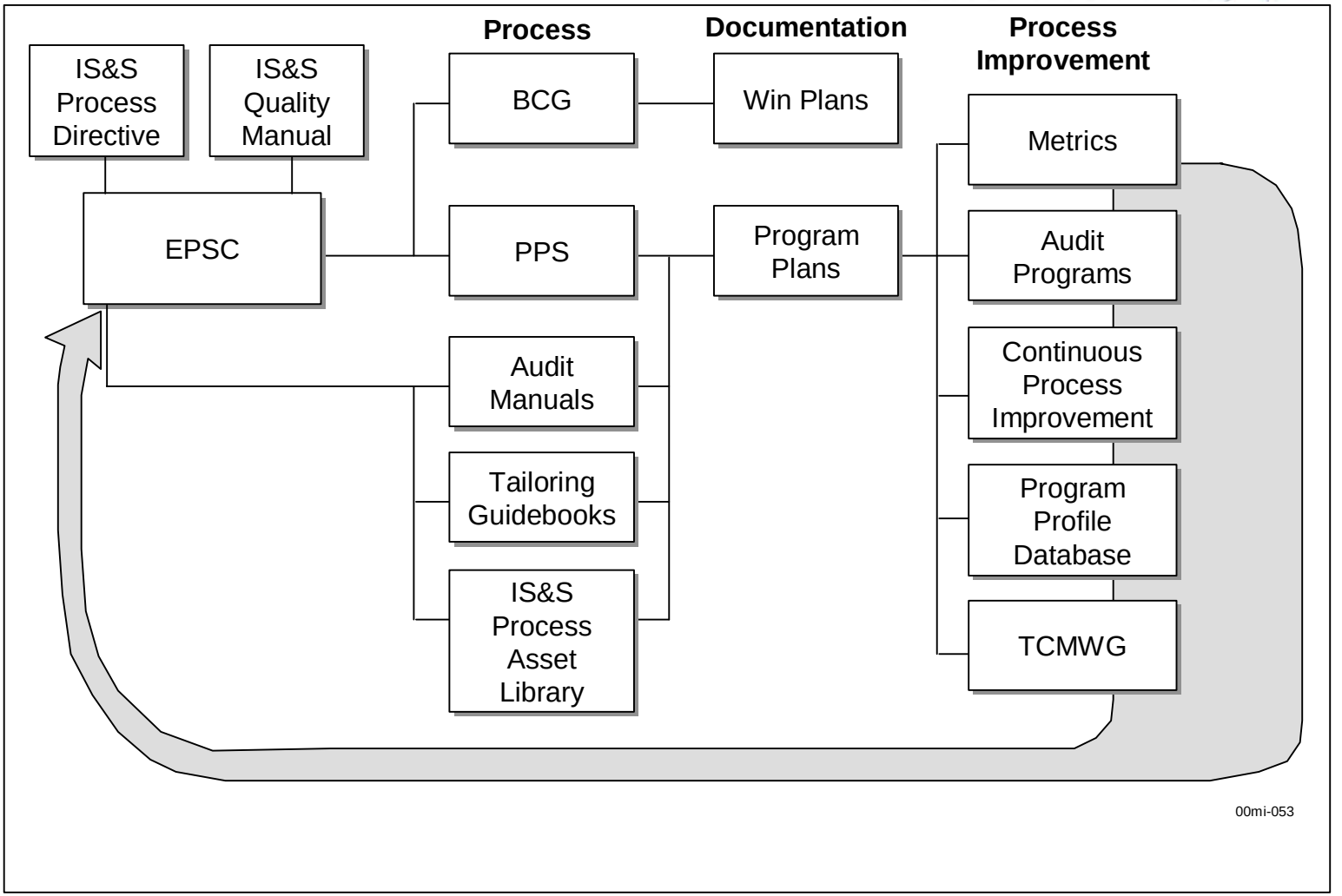
CMMI Maturity Level 5 Foundation

M. Lynn Penn
Director Quality Systems & Process Management

Integrated Systems & Solutions Process Improvement Structure

LOCKHEED MARTIN





Communication…Training…Communication…Training

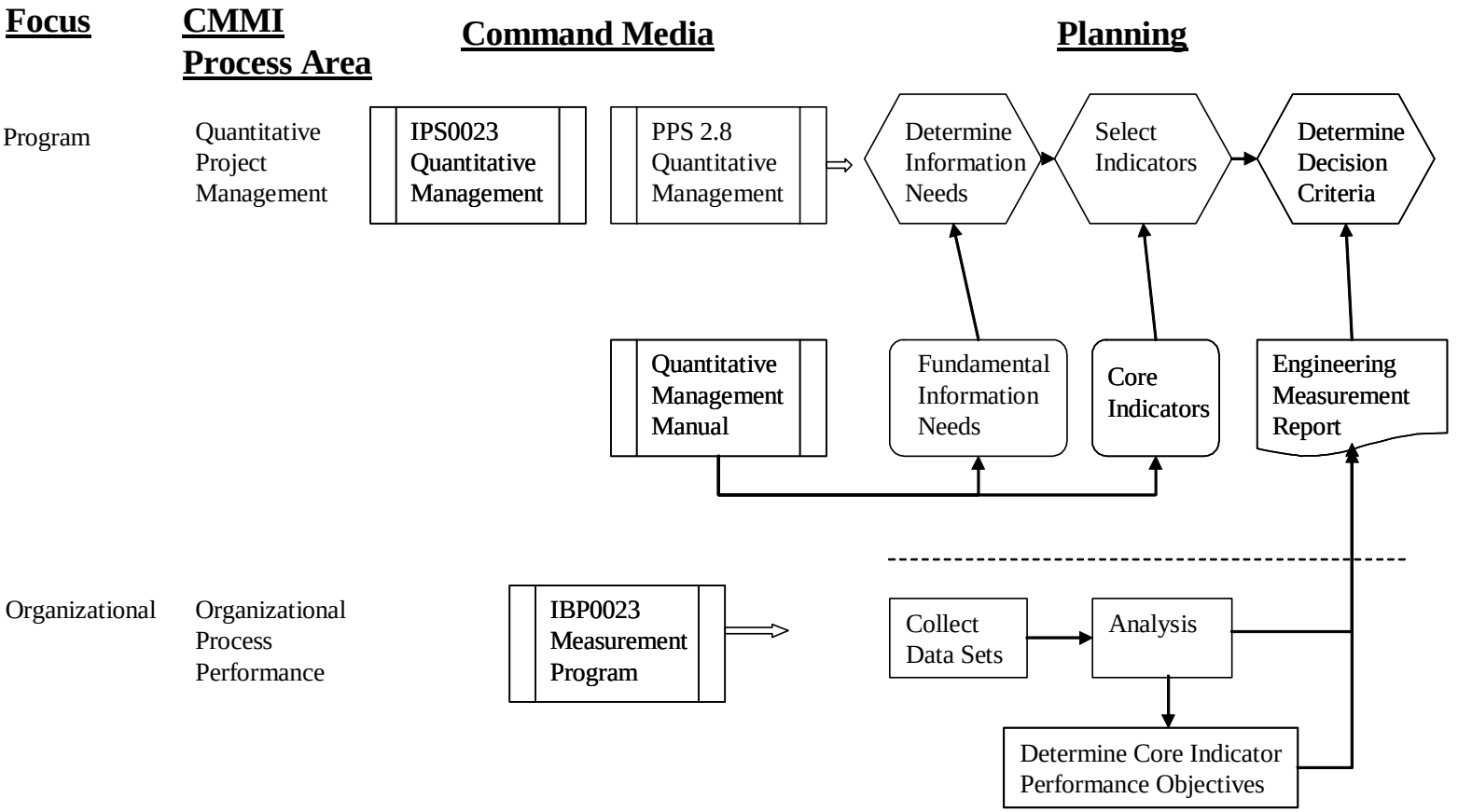
IS&S Measurement Program

Objective: The IS&S Measurement Program provides the infrastructure, data, and analysis that

- facilitates program level quantitative management,
- establishes the organization's process performance baselines,
- facilitates the alignment of organizational process performance with business objectives,
- identifies opportunities to improve program and/or organizational processes,
- models program performance to establish deployment initiatives, and
- facilitates cost, schedule, and quality estimation.

Led by: IS&S Measurement Coordinator
Reports to: Director, Quality Systems & Process Management, Mission Success
Oversight: Measurement Program Steering Committee

IS&S Approach to CMMI Measurement Requirements



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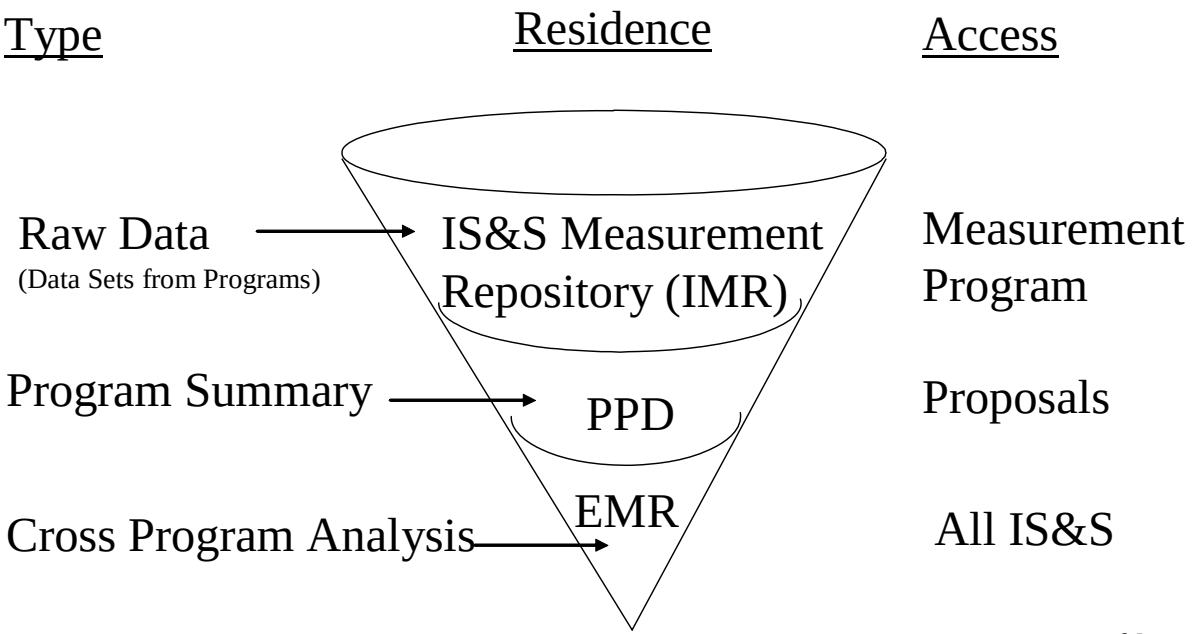
Quantitative Project Management

The process to the right is quantiatively managed using the indicator below	System Requirements Analysis	Architecture Design	Software Requirements Analysis	Software Design	Code and Unit Test	Product Integration and Verification	System Integration and Verification	Deployment
Earned Value, Schedule								
Earned Value, Cost								
Product Progress								
Requirements Traceability								
Requirements Stability								
TBDs and TBRs								
Design Stability								
Breadth of Testing								
Monthly Fault Profiles								
Cumulative Fault Profiles								
Defect Density								
Staffing								
Product Growth and Progress								
In-process Productivity								
Defect Detection Profile								
Effort Profile								
Technical Performance Measurements								
The critical subprocess to the right is statistically managed using the indicators below	Inspections	Inspections	Inspections	Inspections	Inspections			
Preparation Rate Control Chart								
Pace Rate Control Chart								
Defect Density Control Chart								

Organizational Measurement Analysis



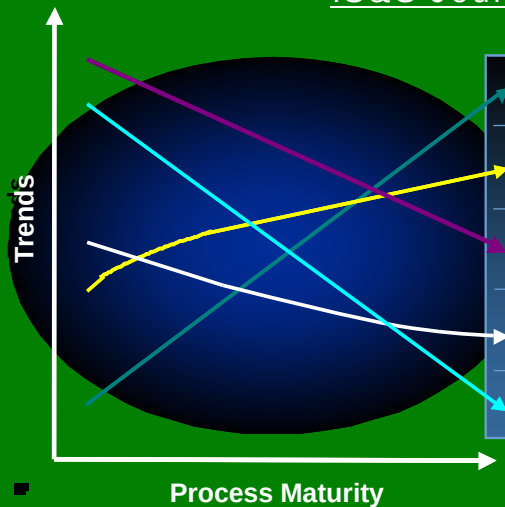
EMR: Engineering Measurement Report

PPD: Program Profile Database

World Class Processes...

LOCKHEED MARTIN

IS&S Journey to CMMI L5

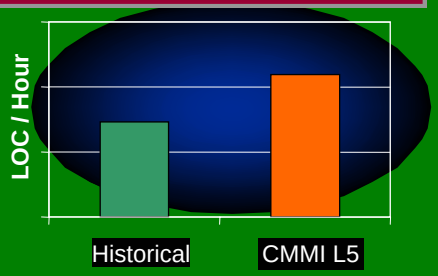


Software Productivity	Up 52%
Potential Additional Award Fee Achieved	52.5%
SW Development Cost	Down 23%
Wrap Rate	Down 5.5%
Defect Find / Fix Cost	Down 21 %

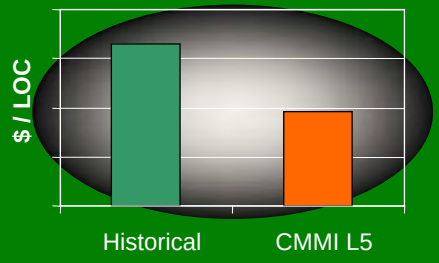
Program Performance

- 95.5% of programs > $50M have no serious problems.
- Improved Award Fee performance continues

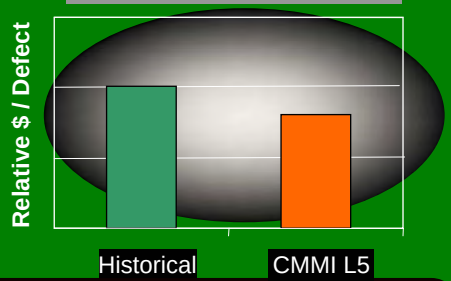
S/W productivity increased 52% over baseline average capability



S/W cost decreased 23% in Constant 2004 dollars



Defect Find / Fix cost down by 21%



Drive World Class Performance / Competitiveness

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IS&S Benchmarking Maintenance

Initial Benchmark
- SCAMPI C 6-9 months after ATP

One year after Initial Benchmark:

SCAMPI B
- All programs over $X contract value
- Some programs between $X and $X
  - FFP, numerous subs, not co-located team, high risk, corporate or IS&S visibility

SCAMPI C
- Non-SCAMPI B programs between $X and $X
- All programs (>$X) that are following the “primes” or “customers” processes
  - A PPS mapping is required and this is done for process risk determination

REVISITS depend on “Process Risks” identified in previous benchmark – ALL PROGRAMS VISITED EVERY TWO YEARS

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The Challenge

COAST-TO-COAST LOCATIONS

200+ PROGRAMS

4 BUSINESS UNITS

15,000 TECHNICAL EMPLOYEES

PROCESS COMPLIANCE

PROCESS PERFORMANCE

LOCKHEED MARTIN

Questions ?

NORTHROP GRUMMAN

DEFINING THE FUTURE

Business Value of CMMI Level 5

CMMI Technology Conference & User Group
13-16 November 2006

Rick Hefner, Ph.D.
Director, Process Management
Northrop Grumman Corporation

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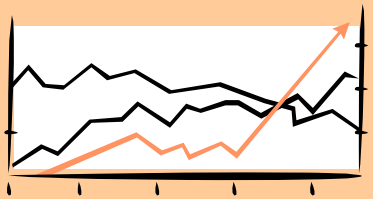
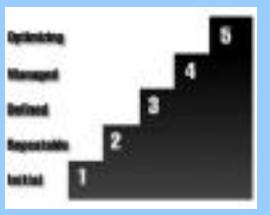
Two Complimentary Approaches to Process Improvement

Data-Driven (e.g., Lean Six Sigma)



- **Clarify what your customer wants (Voice of Customer)**
  - Critical to Quality (CTQs)
- **Determine what your processes can do (Voice of Process)**
  - Statistical Process Control
- **Identify and prioritize improvement opportunities**
  - Causal analysis of data
- **Determine where your customers/competitors are going (Voice of Business)**
  - Design for Six Sigma

Model-Driven (e.g., CMM, CMMI)



- **Determine the industry best practice**
  - Benchmarking, models
- **Compare your current practices to the model**
  - Appraisal, education
- **Identify and prioritize improvement opportunities**
  - Implementation
  - Institutionalization
- **Look for ways to optimize the processes**

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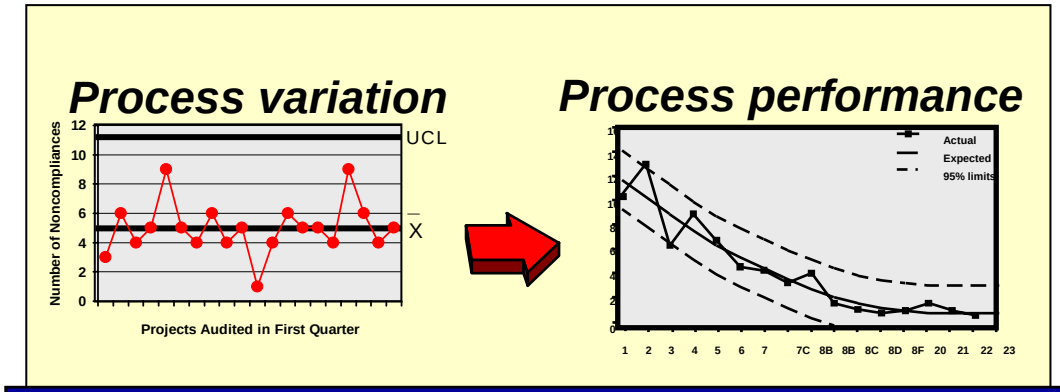
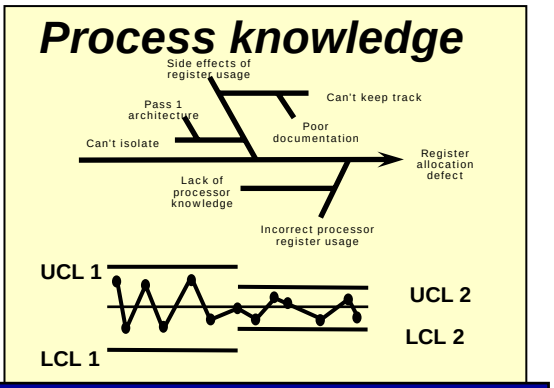
Lean Six Sigma Provides the Needed Tools to Implement CMMI High Maturity





Stabilize **Predict** **Improve & Control**

Level 4

- Understand project's process capabilities based on process performance baselines
- Control process variation (remove "assignable causes")
- Predict results using process performance models
- Manage to achieve goals

Level 5

- Base improvement goals on future business needs
- Eliminate problem and defect causes ("common causes")
- Select, predict, and measure improvements to change the process performance baselines - shift the mean; tighten the variance
- Manage change

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Barriers and Challenges

- **Engineering process measurements are often difficult to analyze**
  - Inherent process variations when human creativity is involved
  - Dirty (or no) data
  - Vague measurement definitions, human recording errors
  - Infrequent measurements
  - Non-normal data
  - Need for stratification/aggregation
- **Must demonstrate the value of quantitative data to managers**
  - Management style - reactive vs. proactive vs. quantitative
  - Less value in a chaotic environment
  - Must involve customers

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Launch Workshop Strategy

Prerequisite
2 week Six Sigma Green Belt training

Launch 0
Executive Overview

Launch 1
Intro to Quantitative Management

- Finalize project goals
- Obtain measurement data for the subprocesses the project will put under SPC analysis
- Become familiar with Northrop Grumman Mission Systems QPM process
- Definition of related six sigma project(s)
- Incorporate and measure progress against the Level 4/5 plan tasks

Launch 2
Statistical Process Control

- Collect relevant project historical data, review it and perform initial "clean up"
- Collect data from project subprocesses and put on SPC charts
- Complete project profile
- Review business issues for clarity
- Identify Quantitative Measurement Plan data
- Measure progress against the Level 4/5 plan tasks

Launch 3
Quantitative Monitoring & Management

- Finish building models
- Begin tracking to models
- Draft Quantitative Measurement Plan
- Draft QPM evidence
- Measure progress against the Level 4/5 plan tasks

Launch 4
CMMI Level 5 (OID &CAR)

- Develop project CAR plan
- Start project CAR activities
- Submit improvements to support OID (when applicable)
- Measure progress against the Level 4/5 plan tasks

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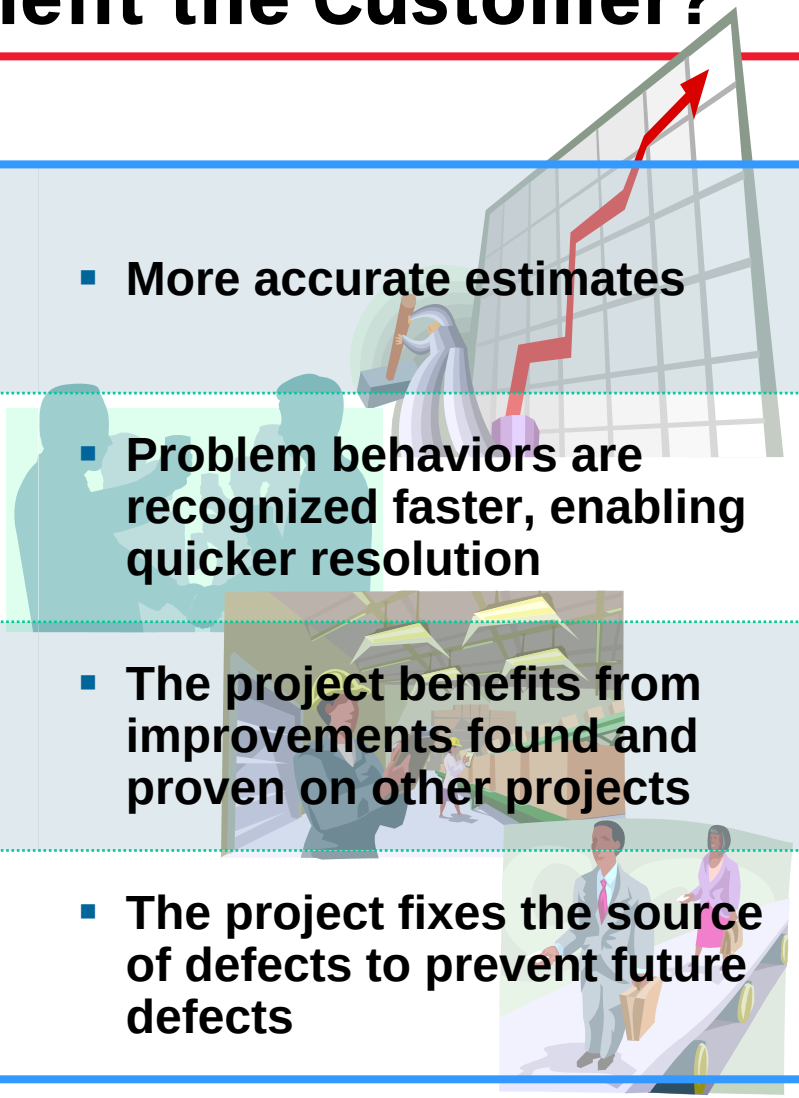
How Does Level 4 & 5 Benefit the Customer?

▪ Organizational process performance	▪ More accurate estimates
▪ Quantitative project management	▪ Problem behaviors are recognized faster, enabling quicker resolution
▪ Organizational innovation and deployment	▪ The project benefits from improvements found and proven on other projects
▪ Causal analysis	▪ The project fixes the source of defects to prevent future defects



Level 5 reduces costs and improves quality (so we implement it on <u>all</u> projects)

Reference: ***How Does High Maturity Benefit the Customer?, R. Hefner, Systems & Software Technology Conference, 2005***

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Lessons Learned

Based on over 20 Northrop Grumman CMMI Level 5 organizations

- **Having multiple improvement initiatives helps encourage a change in behavior as opposed to "achieving a level"**
  - Reinforces that change (improvement) is a way of life
- **CMMI and Six Sigma compliment each other**
  - CMMI can yield behaviors without benefit
  - Six Sigma improvements based solely on data may miss innovative improvements (assumes a local optimum)
- **The real ROI comes in institutionalizing local improvements across the wider organization**
  - CMMI establishes the needed mechanisms
- **Training the staff as Six Sigma Green Belts has resulted in a change of language and culture**
  - Voice of Customer, data-driven decisions, causal analysis, etc.
  - Better to use the tools in everyday work than to adopt the "religion"

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Ogden Air Logistics Center

U.S. AIR FORCE

309 SMXG

Business Value of High Maturity

CMMI Technology Conference

Denver, CO

November 2006

Who We Are

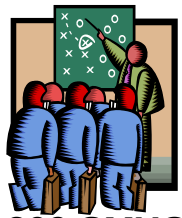
- 309th Software Maintenance Group, Hill AFB, Utah
- Approximately 700 engineering personnel
- Develop and maintain software for Air Force and other DoD customers
  - F-16 Block 30 OFPs
  - Mission Planning software
  - Aircraft and Missile Automatic Test Systems
  - Command and Control Software
  - IT software
- Majority of work is software maintenance
- 3 product lines--containing 40+ projects total

Our High Maturity Strategy

Customers

Needs

Needs



309 SMXG
Strategic Plan

Provides focus for what we want to measure

Metrics Implementation Guide

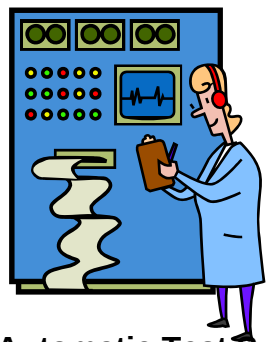
Input

Goals

Measures

Product Lines

- Standard Processes
- Quantitative Goals
- Models
- Baselines



Automatic Test Systems

Weapon Systems Software

Operational Flight Software

Product Lines

- In addition to an organization-level SEPG we have Extended SEPGs (ESEPGs) in each product line
- ESEPG leads are:
  - Accomplished Project Managers
  - Responsible for mentoring new and less experienced PMs
  - Responsible for leading process improvement in the product-line
    - Establishment of process baselines, and models and ensuring their use
    - Collection of measures
    - Leading CAR teams
- ESEPG members typically made up of PMs and project leads from within the product line

Benefits 1

- Improved Customer Relationships
  - Some customers were not initially supportive of our process improvement efforts
  - Now many customers can quantify their expectations to us
  - They are comfortable with reviewing project data and even understand it
  - They have more realistic expectations
  - They can see that they are getting more product for their dollar than in the past

Benefits 2

Three fold reduction in defect density while increasing Productivity by 60% (OFP)

417% increase in productivity (GTACS)

Cycle time reduced from 120 days to less than 60 days in past 2 years. (ATE)

Contact Information

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309th Software Maintenance Group
Hill AFB, Utah

NORTHROP GRUMMAN

DEFINING THE FUTURE

SCAMPI A Appraisals - Preparation in 100 Hours; Execution in a Week

CMMI Technology Conference & User Group
13-17 November 2006

Ron Ulrich
Manager, Appraisal Program
Mission Systems Sector
Northrop Grumman Corporation

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What's ahead

- **You can save $$ and still be effective**
- **Prepare for the appraisal**
  - Artifacts
    - Optimize to save
  - Training
    - Consistency
  - Presentations
  - Lead Appraiser Selection
  - Appraisal Plan/Input
  - Schedule
    - Optimize to save
  - Measure & analyze
  - Deliver the results to the sponsor

NORTHROP GRUMMAN

CMMI Background Message – 1/2

- **Northrop Grumman Corporation**
  - 7 Sectors (including Mission Systems)
  - 79 SCAMPI A's - 52 externally led
    - 28 Level 5 SCAMPI A Appraisals
  - 15 Authorized SCAMPI A Lead Appraisers
- **Northrop Grumman Mission Systems**
  - Started June 2002 - first SCAMPI A Appraisal
  - Common, tailored Policies & Plans for all of Mission Systems
  - Performed over 57 SCAMPI A Appraisals (37 externally led)
    - 20 Level 5 SCAMPI A Appraisals
  - Appraised over 164 Projects (92 unique projects – annual re-appraisal)
  - 12 Authorized SCAMPI A Lead Appraisers
  - 4 Authorized "Introduction to CMMI" instructors
- **Measurements were taken on all appraisals & analysis done using Six Sigma**
  - Time to review artifacts (average 2.0 hours per PA per Project)
  - Time to perform interviews (average 1.5-3.0 minutes per SP/GP with 3 projects or less)

- **Nice to work in an organization that supports CMMI, 6 Sigma and process improvement (as most of you can imagine)**
- **I have been on over 40 SCAMPI A Appraisals**

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CMMI Background Message - 2/2

Northrop Grumman
CMMI Level 5 Appraisals Performed

(NOTE: Includes internally* led and "organizational repeats")

(* Internally led appraisals are led by SEI Authorized SCAMPI Lead Appraisers who work for NG)

Number	Organization	Level/Discipline	Date
28	IS - AGS & BMS	L5 SW/SE/IPPD/SS	2-Nov-05
27	MS - DMS	L5 SE/SW	14-Nov-05
26	MS - MDD/AFSPC-CLE	L5 SE/SW	2-Nov-05
25	MS - SRD/SDO	L5 SE/SW	2-Nov-05
24	MS - MDD/GFCC	L5 SE/SW	31-Oct-05
23	MS - IPIC	L5 SE/SW	12-Oct-05
22	MS - SRD/DSO	L5 SW L3 SE	9-Jun-05
21	MS - IPIC (internally led)	L5 SW	18-May-05
20	IS - AGS & BMS	L5 SW/SE	04 - 08 Apr 05
19	IT - DES (now Defense Group)	L5 SW/SE	14 - 24 Mar 05
18	MS - NSO/PDAS	L5 SW L3 SE	21-Feb-05
17	MS - MDD/CO	L5 SW L3 SE	10-Dec-04
16	MS - ITSD	L5 SW	10-Dec-04
15	MS - MDD/NM	L5 Serv	3-Dec-04
14	MS - C2ID/ISO	L5 SW/SE	12-Nov-04
13	MS - TSD	L5 SW/SE	11-Nov-04
12	MS - C2ID/ESL	L5 SW/SE	8-Oct-04
11	ST	L5 SW/SE	23 - 27 Feb 04
10	MS - GITD (now Civilian Agencies)	L5 SW	11-Dec-03
9	IT - TASC (now Intelligence Group)	L5 SW/SE	01 - 05 Dec 03
8	IT - DMS (now Mission Systems)	L5 SW/SE	09 - 13 Nov 03
7	MS - TSD/BC2	L5 SW	7-Nov-03
6	MS - C2ID/SDO	L5 SW	22-Oct-03
5	MS - MDD/HSVO	L5 SW/SE	29-Sep-03
4	ES/ASD	L5 SW	6-Jun-03
3	MS - C2ID/DSO	L5 SW/SE	24-Apr-03
2	MS - TSD/BD	L5 SW	14-Apr-03
1	IT - DES (now Defense Group)	L5 SW/SE	02 - 13 Dec 02

←**Time line for Level 5 SCAMPI A's**
1, 9, 7, 11, 6 (2002-2006)

- Each Organization MUST perform a SCAMPI appraisal ANNUALLY
  - Every other one MUST have an External Lead
  - All are tracked

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Are you ready to be appraised?

- **What do you need?**
  - Process Improvement?
  - Level 2 – or higher?
  - If Level 3/4/5 does your organization have policies/processes in place?
    - You need to create them (or get them somehow)
    - Takes time if you need to do it from scratch
- **Do you know the details of all your projects?**
  - You should have a memo or directive that specifies what projects apply to you business objectives (e.g., all projects over $500K, all projects with 10 or more personnel involved in CMMI processes)
  - You will need this to help your SCAMPI Appraisal Leader in selecting the appropriate projects for your organizational appraisal

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Move out to get it done right

- **Details for the Scope of the Appraisal**
  - How many Projects?
  - How many Appraisal Team Members?
    - Is everyone trained?
    - You should have at least 1 member (but no more than half) from your site
- **Need to do a "readiness review"**
  - Why?
    - SCAMPI requires it … and it makes you more likely to "pass" your goals
    - Alternate approach (details later)
- **Perform the Appraisal**
  - Select Lead Appraiser
  - Plan
  - Schedule
- **Follow on activities**
  - Correct deficiencies
  - Do it again (keep projects involved)

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Appraisal Process Flow
(Pre Onsite SEPG Lead/Site Coordinator& Lead Appraiser**)

Decision to assess organization
Decide on Assessment Date & Select LA
Select Project(s) & fill out PIID(s)

$1 Begin Evidence Collection

$2 Get Org Evidence Artifacts

$3 Evaluate Evidence for assessment readiness

Select Appraisal Interviewees
Prepare Interviewees (brief & mock interviews)

$4 Generate Appraisal Plan and Appraisal Input & Schedule

Meet with Sponsor to review Appraisal Plan and Input
Get Sponsor's signature on Appraisal Plan and Input
Develop Onsite Organization and Project Briefing
Select Site Coordinator
Select On Site Rooms (Main & 3 Interview Rooms)
Setup for Onsite Internet Connections
Provide Interviewee list to Lead Appraiser
Get charge numbers for ATMs
Get PIID Interview Questions with PIID responses
Generate ATM Interview Notebooks
Generate ATM Interview Notebooks
Reproduce copies of Evidence Request Forms
Set up interview rooms with mini-team notebooks
Prepare Schedule and Submit to Site Coordinator (SC)
Select Appraisal Team Members (ATMs)
Prepare Team Briefing & Training
Set up SEI TPWEB site for Assessment

$5 Establish Mini-team Assignments

Send PAIS & other materials to SC for completion
Consider NetMeeting for Findings Presentations
Send out details of appraisal to ATMs
Get any missing experience data from ATMs
Modify any information in Schedule Templates and send to ATMs
Perform Onsite ATM Training

$6 Distribute Metrics Forms (collection times in worksheet)

$7 Perform Interviews

Lead consolidation activities
Prepare Draft Findings
Perform OU consolidation

$8 Deliver Draft Findings Presentation

Review Evidence as a result of Draft
Perform Ratings to Goal, PA, Maturity Level
Prepare Final Findings
Deliver Executive Briefing
Deliver Final Findings Briefing
ATM Lessons Learned
Gather metrics from team members
Clean Up and Leave site
Collect and destroy or maintain material
Collect and maintain Action Items
Prepare Process Improvement Plan
Act on Process Improvement Plan
Coordinate Actions of Process Improvement Plan

$9 LA Analyze Measurements & Send Appraisal results to SEI Steward

Get ready for Next Appraisal

$ Talking points (later)

**** Order of Pre Onsite activities may performed in parallel**

Two Approaches for Artifact Collection

(get ready & cut costs - **$1, $2, $3**)

Standard approach

1. Have projects and org gather artifacts
2. Place into folders with annotation describing why the artifact was selected (NOTE: annotation usually provides little insight)
3. Have qualified team review artifacts and specify which ones were wrong
4. Have projects and org gather replacement artifacts

About 400 hours per project

NGMS Approach

1. Specify Project "Book Bosses" for each Process Area (PA) (same person could do more than 1)
2. Hire a consultant (Authorized Lead Appraiser or qualified as such)
3. Spend an hour training "book bosses" on what to gather for the Generic Practices
4. Have consultant and each PA "book boss" meet for 2 hours to "gather, annotate, and capture" each artifact into folders

About 100 hours per project

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Some more savings 1/2

- **Lay out your schedule* based upon metrics** (take them too - **$4, $6**)
  - Don't forget
    - Team meetings
    - Training**
    - Appraisal team briefing
    - Site/org/project briefings
  - Plan for breaks (and don't work late)
- **Assign mini-teams to review artifacts by PA category**
  (e.g., engineering, support, process management, project management, L4/5 – **$5**)
  - Almost everyone follows this approach (e.g. PPQA+CM, RM+RD)
  - Only trained qualified personnel on L4/5 team
  - Plan for 2 hours per process area per project (on average)
  - Mini-team alternative approaches
    - Review Projects PA's as team (e.g. step thru each SP/GP)
    - GP's assigned across all Projects (e.g. GP 2.1+2.9+3.1)

* See Appendix A (typical schedule chart)

** See Hefner/Draper presentation - Applying CMMI Generic Practices with Good Judgment, http://www.dtic.mil/ndia/2004cmmi/CMMIT2Tue/1116RickHefner.pdf (2 sample charts shown at end of this material)

Some more savings 2/2

- **Form interview sessions in parallel** (i.e. mini-teams perform interviews concurrently - **$5,$7**)
  - Questions for each mini-team to use
  - Annotate/update questions based upon review of the artifacts
  - Most interview sessions can be performed in about 90 minutes BUT more projects (e.g. over 3) take more time
  - **Save about 1 day** (analyze the measurements – **$9**)
  - Optimize the interview sessions (based upon number of projects)
    - Specific Practices for ALL PA's then GPs - **$7** (30-45 mins/combo)

- **Draft Finding Presentation**
  - During the team consolidation process you may find (if the org and project(s) are performing at the Level being appraised) that:
    - All artifacts have been returned **(at least once)**
    - No significant weaknesses have been found
    - That the OU consolidation are all Fully or Largely Implemented
  - **Save another day - $8**

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The Results

- **You can save $$ and still be effective**
- **Prepare for the appraisal**
  - Artifacts
    - Optimize to save
  - Training
    - Consistency
  - Presentations
  - Lead Appraiser Selection
  - Appraisal Plan/Input
  - Schedule
    - Optimize to save
  - Measure & analyze (**$6, $9**)
  - Deliver the results to the sponsor

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APPENDIX A

Typical Appraisal Raw Data Collected During the Northrop Grumman Appraisal Process

Using the following data as collected from the pilots, estimates for interview times and for evidence evaluation times were calculated. Other factors (e.g. new person, Process Area, experience in PA, method of presentation) seem to influence the times. All are being investigated to further refine the NG SCAMPI Appraisal Process.

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Interview Times

Project Mgmt MiniTeam	Minutes
I&T FAR	53
PI	28
VE G1/G2	25
GPs	38
Two Questions	5
Impl FAR	58
TS	28
VE G1/G3	30
GP	33
Two Questions	5
PL Proj 1	120
RskM	22
PP	23
PMC	19
IPM	11
SAM	5
GPs	25
Two Questions	15

Engineering MiniTeam	Minutes
RD+RM FAR	112
RD	56
RM	20
GPs	30
Two Questions	6
Val FAR	18
VA	18
GPs	34
Two Questions	4
Impl FAR	58
TS	28
VE G1/G3	30
GP	33
Two Questions	5

Process Mgmt & Support MiniTeam	Minutes
SEPG & OT FAR	63
OPF	11
OFD	9
OT	13
GPs	20
Two Questions	10
CM & PPQA FAR	33
CM	20
PPQA	13
GPs	46
Two Questions	8
M&A + DAR FAR	32
M&A	16
DAR	16
GPs	24
Two Questions	4

Data shown above is typical of collected data to support interview time spent during appraisals.

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Evidence Review Times

Evidence Checks (Bads=Number of evidence requests)			
Project	PA	Elapsed/min	Bads
A	CM	135	10
B	CM	120	14
C	CM	60	10
A/B/C	DAR	120	0
A/B/C	DAR	60	13
A/B/C	DAR	150	2
A	IPM	40	9
B	IPM	100	6
C	IPM	40	2
A	MA	80	2
B	MA	105	6
C	MA	143	3
D	OPD	71	2
D	OPF	185	7
D	OPF	15	
D	OPF/OPD	30	
D	OT	60	1
D	OT	135	5
A	PI	40	1
C	PI	150	14
A	PMC	70	8
B	PMC	90	11
A	PP	80	0
A	PP	105	11
B/C	PP	165	18
A/B/C	PPQA	70	
A/B/C	PPQA	30	6
A	RD	60	8
B/C	RD	160	18
A	RiskM	145	3
B/C	RiskM	185	8
A	RiskM	40	3
A	RM	120	5
B	RM	90	4
C	RM	90	4
A	SAM	145	9
A	TS	90	5
B	TS	60	5
C	TS	50	11
A/B/C	VE	155	29
	Average Time	95.975	

Data shown here is typical of collected data to support evidence review time spent during appraisals.

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A Typical Schedule

(SCAMPI A Level 5 with 3 Projects or less)

Time (CT)	Monday	Tuesday			Wednesday			Thursday	Friday	Time (CT)
	11/13/2006	11/14/2006			15-Nov-06			16-Nov-06	17-Nov-06	
0800	**Team Assembles** RM ####	**Team Meeting** RM ####			**Team Meeting** RM ####			**Team Meeting** RM ####	**Team Meeting** RM ####	0800
0815										0815
0830	**On-Site Training** RM ####	**Evidence Review** *Appraisal team only*	**Evidence Review** *Appraisal team only*	**L4/5 Mini-Team** *QPM, CAR* RM #### xxx-xxx-xxxx Code: ####	**ProjMgt Mini-Team** *SAM, IPM, Risk* RM #### xxx-xxx-xxxx Code: ####	**Engr Mini-Team** *RD, RM* RM #### xxx-xxx-xxxx Code: ####	**Support Mini-Team** *M&A, DAR* RM #### xxx-xxx-xxxx Code: ####	**Review Prelim Findings as a Team**	**Collect/Review Evidence**	0830
0845										0845
0900									**Draft Final Findings in Mini-Teams** (all evidence due	0900
0915										0915
0930	**Opening Briefing** *Interviewees/sponsor* Main CR 310-764-6338 Code: 5501#									0930
0945										0945
1000									**Review Final as a Team**	1000
1015										1015
1030	**Evidence Review** *Appraisal team*			**Consolidation** *Appraisal team only*	**Consolidation** *Appraisal team only*	**Consolidation** *Appraisal team only*	**Consolidation** *Appraisal team only*			1030
1045										1045
1100										1100
1115										1115
1130									**Working Lunch** *Appraisal Wrap-Up*	1130
1145										1145
1200	**Working Lunch** *only* RM ####	**Working Lunch** *Appraisal team only* RM ####			**Working Lunch** *Appraisal team only* RM ####			**Working Lunch** *only* RM ####	**Exec Review** Main CR	1200
1215										1215
1230									**Final Findings** *All* Main CR xxx-xxx-xxxx Code: ####	1230
1245										1245
1300	**Evidence Review** *Appraisal team*	**ProjMgt Mini-Team** *PP, PMC* RM #### xxx-xxx-xxxx Code: ####	**Engr Mini-Team** *PI, Val, Ver (testing)* RM #### xxx-xxx-xxxx Code: ####	**L4/5 Mini-Team** *OPP, OID* RM #### xxx-xxx-xxxx Code: ####	**Consolidation** *Appraisal team only*	**Engr Mini-Team** *TS, Ver (Peer Reviews)* RM #### xxx-xxx-xxxx Code: ####	**Support Mini-Team** *PPQA, CM* RM #### xxx-xxx-xxxx Code: ####	**Review Prelim Findings as a Team**		1300
1315										1315
1330									**Appraisal Team Wrap-Up**	1330
1345										1345
1400								**Draft Findings Presentation** *All* Main CR xxx-xxx-xxxx Code: ####		1400
1415										1415
1430	**Whole Team** *OPF* Rm #### xxx-xxx-xxxx Code: ####									1430
1445										1445
1500		**Consolidation** *Appraisal team*	**Consolidation** *Appraisal team only*	**Consolidation** *Appraisal team only*	**Consolidation** *Appraisal team only*	**Consolidation** *Appraisal team only*	**Consolidation** *Appraisal team only*			1500
1515										1515
1530	**Support Mini-Team** *OPD, OT* RM #### xxx-xxx-xxxx Code: ####									1530
1545										1545
1600								**Collect/Review Evidence**		1600
1615										1615
1630		**Evidence Review** *Appraisal team only* (as needed)	**Evidence Review** *Appraisal team only* (as needed)	**Evidence Review** *Appraisal team* (as needed)	**Consolidate Findings** **Draft Prelimin Findings in Mini-Teams** Appraisal team only			**Draft Final in Mini-Teams**		1630
1645										1645
1700	**Consolidation** *Appraisal team*									1700
1715										1715
1730										1730
1745										1745

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Samples from Hefner/Draper Charts 1/2

GP 2.6 – Manage Configurations

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Place designated work products of the process under appropriate levels of configuration management.

Implementation Guidance

- Must identify which work products are to be controlled and how they will be controlled (level of formality)
  - It is NOT necessary to designate and control every work product; omission implies "not controlled"

Appraisal Guidance

- A list of what is being controlled (e.g., a DM master document list) is not sufficient
  - Must understand what is planned to be controlled

Samples from Hefner/Draper Charts 2/2

GP 2.8 – Monitor and Control the Process

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Monitor and control the process against the plan for performing the process and take appropriate corrective action.

Implementation Guidance

- Activities must be reviewed against plan, budget, and schedule
  - Typically performed in staff meetings, cost/schedule reviews, variance reports
  - Detailed review of the process performed against the process description is performed in the QA audits

Appraisal Guidance

- Must establish appraiser consensus
  - Frequency, formality of review
  - Budgets need not be tracked to individual process areas, but each process area must be covered in some budget
- Often difficult to find direct evidence that something is tracked
  - E.g., tracking of Project Management PAs

Questions ? & Answers !

?’s

NORTHROP GRUMMAN

LOCKHEED MARTIN

Maximizing Value for SCAMPI[SM] Preparation

NDIA 6th Annual CMMI® Technology Conference and User Group

November 14, 2006

Roland G. Weiss
Joan Weszka
Perla Unpingco
Lockheed Martin
Corporate Engineering & Technology
Systems & Software Resource Center

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Agenda

- Introduction
- Approach
- Applying the Lockheed Martin 21st Century (LM21) Approach
- Improvements to SCAMPI Preparation and Conduct
- Summary and Next steps

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Introduction

- Lockheed Martin typically conducts SCAMPI As at the enterprise level (3 Business Areas and 9 Business Units):
  - Corporate policy requires use of CMMI-SE/SW/IPPD/SS (will be CMMI-DEV+IPPD V1.2)
  - Promotes a consistent process context across the Business Unit
  - Ensures a unified approach to process improvement across the Business Unit
  - Facilitates integration for new acquisitions and business unit consolidations
  - Eliminates the overlap/waste resulting from conducting multiple SCAMPI A's on the same set of organizational processes
- Lockheed Martin Business Areas and Units are large organizations, managing geographically distributed, complex programs
- Efficient SCAMPI preparation and conduct of SCAMPIs are required to ensure that they provide the best value for the business and the customer

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Applying the LM21 Approach

- Considerable resources are spent by LM Business Units to plan, prepare for, and conduct SCAMPIs
- Lockheed Martin has employed its "Lockheed Martin 21st Century (LM21)" approach to improve the process of appraisal preparation and conduct
  - Enterprise process improvement method
- Benefits to customer and business
  - Reduced Business Unit cost to be appraised
  - Reduced impact to programs participating in appraisals

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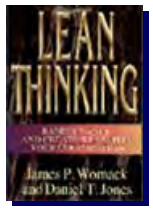
The LM21 - Lean Processes that Operate at Six Sigma Capability

LM21 is the how-to guide for cutting cost and improving quality and customer satisfaction.

It builds on the five principles of Lean as a set of leadership and decision-making mandates that define excellence:



Principles:

- ***Value from the Customers perspective***
- ***Value Stream - measured***
- ***Flow***
- ***Pull***
- ***Perfection***
  - ***Rapid feedback***
  - ***Mistake-proofing***

1. Customer Value – define it from the customer's perspective.
2. Value Stream – identify all activities used to make a product or provide a service.
3. Flow – create a system where value is continuously added. Clear away obstacles that don't add value or clog the value stream.
4. Pull – initiate work only at the demand and to the specific specifications of the customer.
5. Perfection – continuously refine the process to improve efficiency, cycle time, costs and quality.

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The LM21 Approach

- This tool gives leadership a strategic look at its value streams and the ability to see waste at a macro level
- Leaders identify and prioritize the improvement events necessary to
  - Eliminate the waste
    - **Kaizen events (an activity where a team is chartered for a period of 3–5 days)**
  - Identify waste for a given process and
  - Implement immediate, sustainable solutions for waste elimination/reduction
    - **Other VSMs, projects - activities that require extensive work and change**
    - **Just Do Its - short term projects**

The result: a plan is in place to strategically identify and eliminate the waste that most interferes with the ability to deliver value to the customer.

Consistently Deliver Value Growth Thru Operating Excellence

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Applied VSM to the Appraisal Process

- Formed a SCAMPI Tiger Team of process improvement leaders from across Lockheed Martin Business Units
- Performed a Value Stream Mapping
- Identified and evaluated candidate efficiencies
- Further defined the leading candidate efficiencies

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Formed a SCAMPI Tiger Team

- Membership
  - Lockheed Martin Business Units with SCAMPI experience
    - Business Units had experience with a number of Lead Appraisers and Lead Appraiser organizations
  - Inputs represent a number of different approaches toward making SCAMPIs more efficient
- Objective
  - Define the as-is processes, analyze them for inefficiencies, and identify opportunities for improvements that reduce
    - Business Unit CMMI appraisal preparation labor by at least 50%
    - BU appraisal conduct costs by 25%

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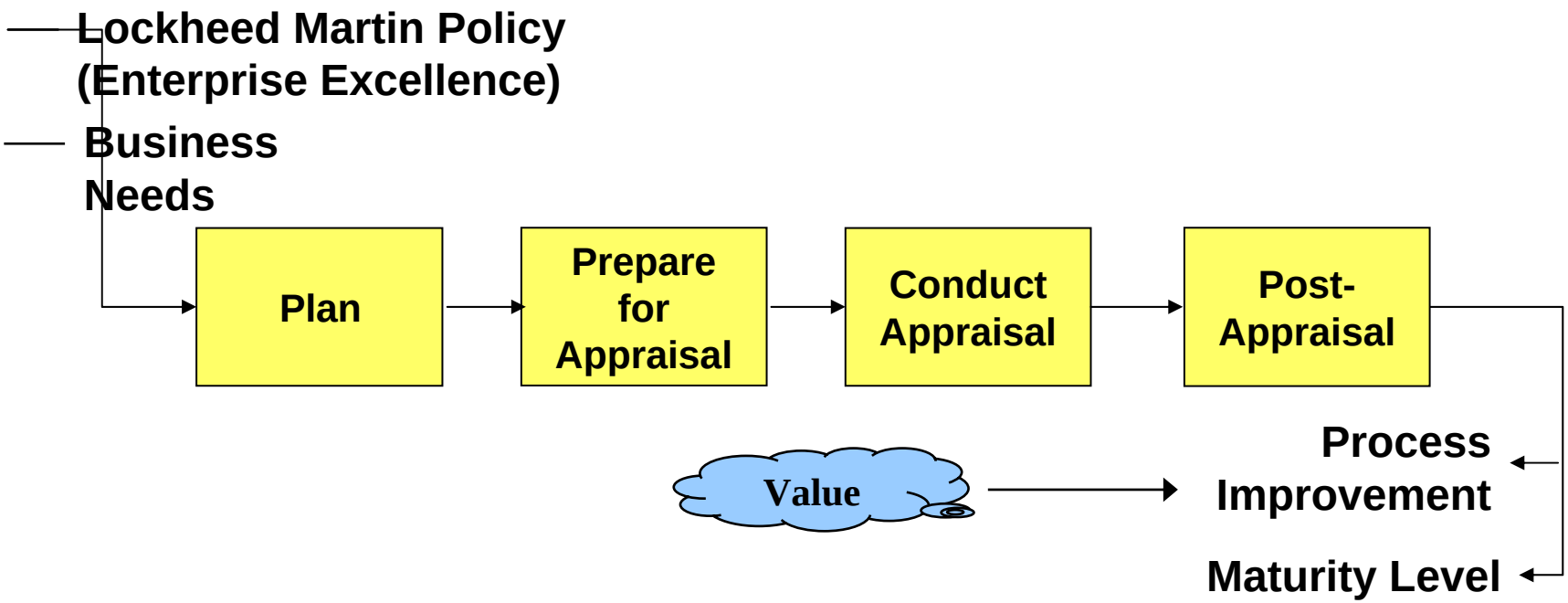
Performed a Value Stream Mapping (VSM)

- Appraisal cost is dominated by preparation costs
  - Implementation artifacts from the organization and programs must be identified, verified, and characterized in the PIIDs
  - Not all artifacts are needed by the business
- Efficient preparation is essential to maximize value



VSM is a Powerful Tool For Development of Strategic Performance Improvement Plans

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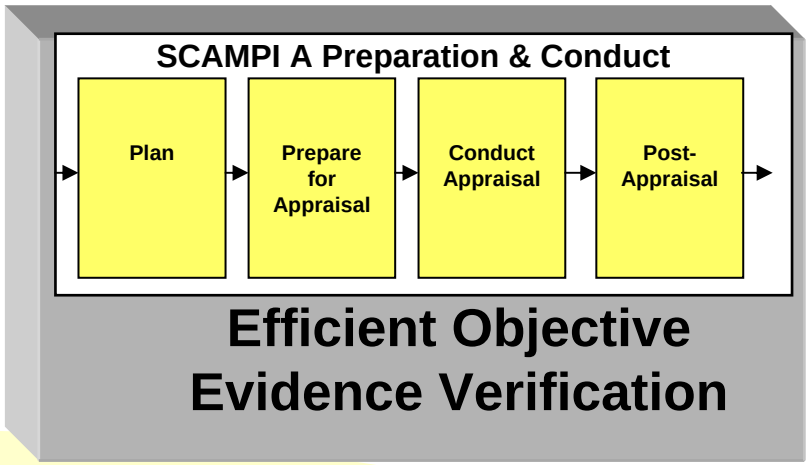
Improvements to SCAMPI Preparation & Conduct

Legend: - Prepare/Conduct Specific SCAMPI

- Proposed Efficiencies

Establish & Maintain Support Infrastructure



Establish & Maintain Process & Objective Evidence Mappings

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Improvements to SCAMPI Preparation & Conduct

Establish & Maintain Support Infrastructure

Expected benefits:

- Enable efficient, ongoing collection of data
- Eliminate generating/collecting objective evidence of no value to the business
- Support jump-starting new projects with templates for process artifacts

Improvements:

- **Establish data structure & tools**
- **Plan optimal evidence collection and mapping**

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Data Structure and Tools - 1

- Maintain a CMMI compliance data structure and supporting tools to identify and manage all of the data necessary to prepare for and conduct a SCAMPI
  - Compliance data includes: CMMI, OSP, PDP, objective evidence, links
- Ideally, implement in a single database which is incrementally populated and verified
  - Distributes appraisal preparation effort as smoothly as possible across the interval between appraisals
  - Supports appraisal readiness by minimizing verification and update required in the immediate pre-appraisal period
- Implementation could vary: database report, web site, spreadsheets, etc.

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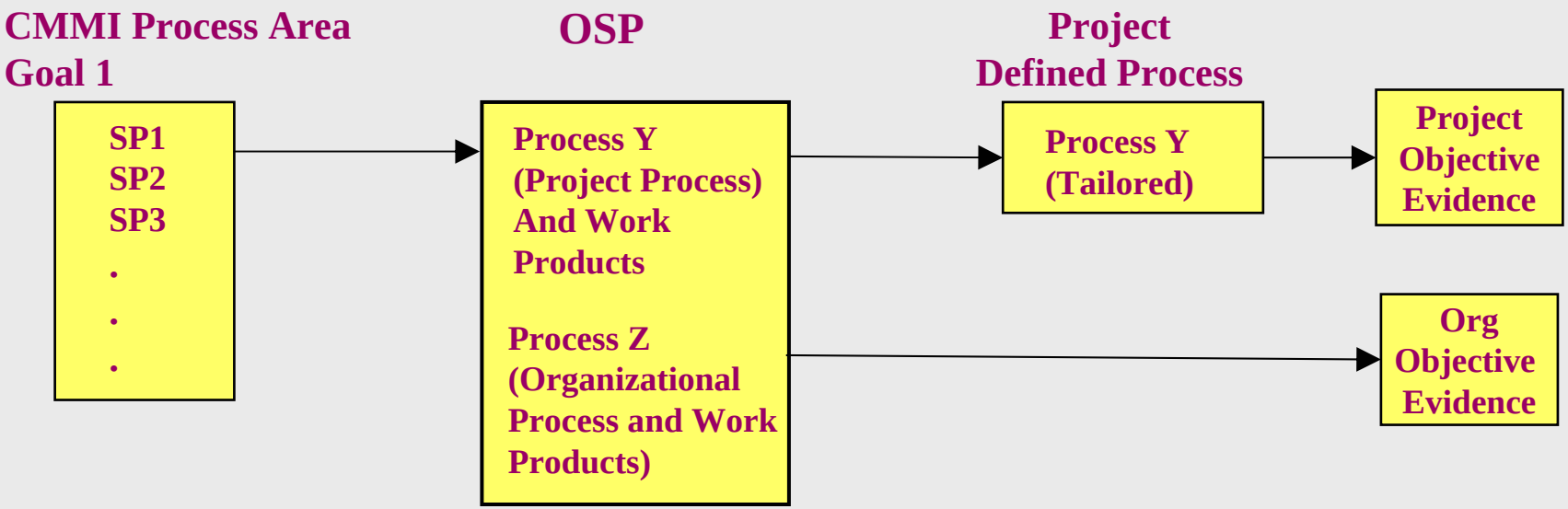
Data Structure and Tool - 2

- Compliance data structure includes fields describing:
  - CMMI Model (PA, Goal, Practice)
  - Organizational Standard Process (OSP) and mappings to the CMMI
  - Direct and indirect evidence mapped to CMMI

Compliance Data Mapping Concept



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Data Structure and Tools - 3

- Use the compliance data structure/tools to create pre-populated PIID templates for programs
  - Jump start the programs by providing them with PIID templates
  - Identify the objective evidence that would result if the Organizational Standard Process is performed exactly as documented
- Make it easy for programs to document their specific work product information on an ongoing basis, e.g.,
  - Program specific work product names
  - Location of the work products

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Plan Optimal Evidence Collection & Mapping

- Eliminate generating or collecting objective evidence not required by the business
- Eliminate redundant collection of objective evidence for Generic Practices
  - Generic Practices tend to be supported by Specific Practices, and in some cases, by other Generic Practices
  - Understand these relationships and identify where direct and indirect evidence that addresses the generic practices might already be produced
- Efficiently use indirect artifacts
  - Determine what indirect artifacts are naturally produced by organization's processes and map to the CMMI practices
  - Objective is to identify the minimal set of available indirect artifacts with a maximum correlation to corroborating the implementation of CMMI practices

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Improvements to SCAMPI Preparation & Conduct

Improvement:

- **Ongoing currency of mappings and evidence location**

Expected benefits:

- Collecting information incrementally throughout the project life cycle
  - Is more efficient
  - Reduces program disruption
  - Supports sampling of programs across the enterprise

Establish & Maintain Process & Objective Evidence Mappings

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Establish & Maintain Process & Objective Evidence Mappings

- Maintain mapping of Organizational Standard Process (OSP) to CMMI practices (specific and generic)
  - Use/populate compliance data structure and tools
- Maintain mapping of Project Defined Process to CMMI practices (specific and generic)
  - Ensure that CMMI requirements are met at project startup and as changes are made to the OSP
- Collect basic information on the project's objective evidence on an ongoing basis:
  - As projects create their specific work products, they populate the compliance data structure and tools, e.g.,
    - Program specific work product names
    - Location of the work products.

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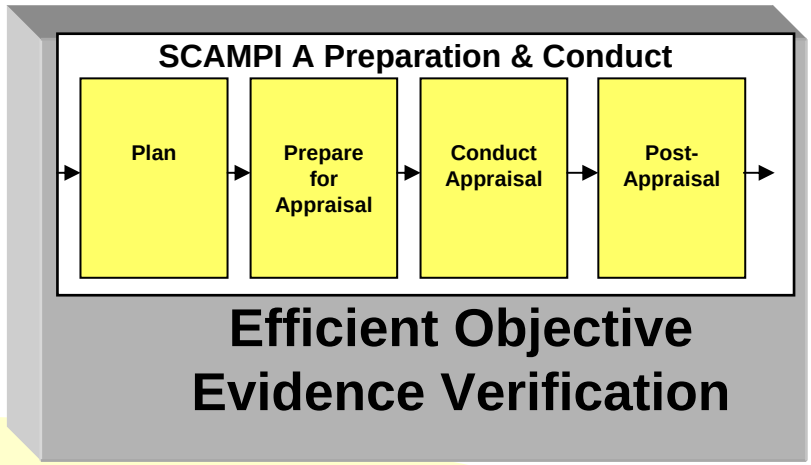
Improvements to SCAMPI Preparation & Conduct

Expected benefits:
- Provides efficient verification methods and tools
- Improves consistent interpretation of requirements



Improvements:
- **Verify evidence efficiently**
- **Use incremental preparation approach**

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Efficient Objective Evidence Verification - 1

- Verify objective evidence efficiently
  - PIIDs must be carefully verified before an appraisal, including the links
  - Use a small team (e.g. 3-5 people)
  - Use a checklist which documents standard criteria to improve consistency
- Track progress and status of evidence collection
  - Collecting and verifying the objective evidence is time consuming and costly
  - Use compliance data structure and other tools to track the progress and status of evidence collection and evaluation

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Efficient Objective Evidence Verification - 2

- Perform independent verification of objective evidence with appropriate appraisal methods
  - Independently verify objective evidence before a SCAMPI A
  - Lockheed Martin recommends the Lockheed Martin Continuous Appraisal Method (LM CAM)
    - CAM is an ARC Class B appraisal method
    - CAM enables incremental appraisal and improvement
  - Maintain continuity of the appraisal team members between appraisal events

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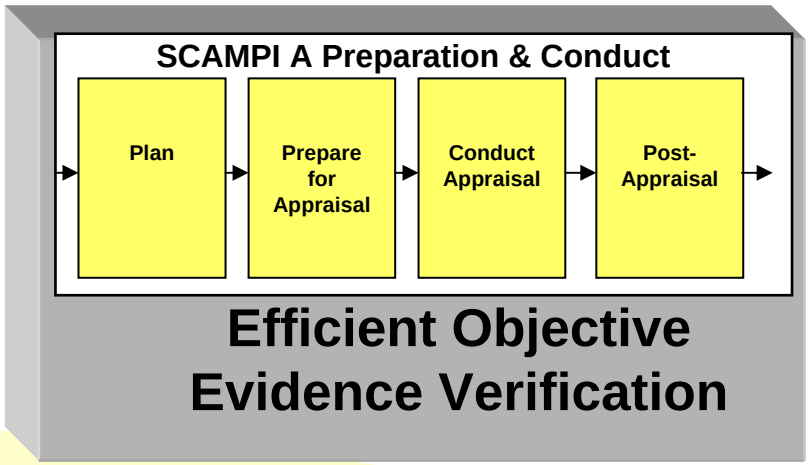
Summary of Improvements

Legend: - Prepare/Conduct Specific SCAMPI

- Proposed Efficiencies

Establish & Maintain Support Infrastructure



Establish & Maintain Process & Objective Evidence Mappings

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Summary and Next Steps

- **Summary**
  - Efficient SCAMPI preparation and conduct is a business imperative
  - Improvements are expected to
    - Eliminate objective evidence not required by the business
    - Increase efficiency of data collection
    - Reduce program disruption
    - Support sampling of programs across the enterprise
    - Verify objective evidence efficiently (consistently, independently and incrementally)
  - Enterprise process improvement methods are being applied to the appraisal process improvement
- **Next Steps**
  - Complete the estimated savings by implementation of improvements
  - Create a description of the “To Be” approach for SCAMPI preparation and conduct
  - Conduct pilots (underway)

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CMMI-Based Process Improvement: How and When Does Success Happen?

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Motorola Software Group, China Center

CMMI Technology Conference
14 November 2006

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The presentation is greatly enhanced by the help graciously provided under difficult circumstances by my co-authors Angel Liu (Liu Qi) & Qi Jianping from the Motorola Software Group China Center.

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Today's Talk

Setting the stage

Our approach

Current & Proposed Studies

Enterprise wide performance benchmarking

Example results

How can you help?

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Setting the Stage

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Purpose: Describe Ongoing Research Meant To...

1. Provide objective evidence to substantiate value added by CMMI-based process capabilities
   - To what extent are there better performance outcomes when organizations & their projects follow processes that satisfy the goals of CMMI?
2. Improve processes & resultant performance outcomes for organizations that participate in this research
   - As well as for others that modify their own measurement activities similarly to support performance driven improvement
3. Explain less than stellar product delivery by high maturity organizations as well as low
   - As well as process enactment at the program/project level that does not always match appraised maturity
   - Document the extent of such occurrences

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Why is this Work Important?

Substantial proof of concept exists

- CMMI-based process improvement can & has led to concomitant improvement in performance outcomes
- Predictably faster, better, cheaper product development and maintenance

But skepticism remains about the value of disciplined adherence to well defined processes

- As opposed to solutions *de jour*
- That are ***not*** necessarily at odds with processes that satisfy the goals of CMMI best practices – e.g., Agile or Six Sigma methods

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Some Existing Evidence

Performance Results of CMMI-Based Process Improvement, Technical Report, CMU/SEI-2006-TR-004, August 2006

Benchmarking CMMI Cost and Impact: Interim Report, December 2004 (Distribution of full document limited to benchmark contributors)

Demonstrating the Impact and Benefits of CMMI: An Update and Preliminary Results, Special Report, CMU/SEI-2003-SR-009, October 2003

CMMI Performance Results Web site

- http://www.sei.cmu.edu/cmmi/results.html

Numerous presentations

- At this & previous conferences

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What's Missing?

Most existing work is based on case studies

- Which are based on credible quantitative evidence
- But circumstances differ
  - Case based results ***can*** be very instructive
  - But, they may ***not*** be applicable elsewhere
  - & they can be accused of "cherry picking" ... fairly or not

More generalizable comparative analyses are needed ... ***Process models!***

- Of the effects on performance outcomes of ***differences*** in process enactment
- Under ***varying*** organizational circumstances & product characteristics
  - ***That may affect variation in both successful process enactment & performance outcomes***

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What Else is Needed?

A viable benchmarking infrastructure & community of practice

- In a field where people aren't comfortable sharing information
- Without which we're just guessing about "industry standards" ...

Empirical analyses that focus on barriers & facilitators of adoption & improvement initiatives

- Process capability doesn't always guarantee successful program performance & product quality
- Not all improvement initiatives are implemented successfully

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Our Approach

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Current State

Case studies

- With quantitative evidence of process improvement & concomitant performance gains
- Typically showing total results over time ... often rolled up over multiple projects

Often accompanied by qualitative affirmations

- Based on experience of those doing the work
- That process improvement is the major source of change

But little explicit discussion of competing explanations

- Whether or how they were considered
- Leading to accusations of spurious correlation

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Understanding Variation & Causal Thinking

There almost ***always*** is variation

- In product quality, project & organizational performance
- How processes are enacted
  - The existence of defined processes
  - Adherence/compliance with them
  - & how well the processes are enacted ... the "goodness" issue
- & the other factors that may effect both process & performance outcomes

Looking only at total results

- May mask important differences at the project level ... where most of the development work actually takes place
- {Per an important statistical literature about possible misinterpretations from looking only at the marginal totals as opposed to individual data points}

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Bases for Comparison

Organizations vary widely in the measures that they use

- & their use of measurement altogether

No industry standard measurement criteria yet exist

- Even if they did exist ... organizations in our field are cautious to say the least about sharing proprietary information about their business assets

Organizations differ widely in ***how*** they establish processes that satisfy the goals of CMMI

Other factors must be considered in addition to process & performance

- Staff capabilities (skills & expertise), tools & technologies used, product domains, precedentedness, interactions with acquirers & so on
- All of which can & should be the subject of defined processes

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Our Evolving Research Agenda

A two-fold approach

1. Examine performance effects of variation in maturity level & capability level
   - For that we need wider variation in process enactment
   - Results most pertinent for organization less far along in their improvement journeys
2. Higher maturity organizations (by definition) have (or should have) less variation in ***what*** processes they follow
   - But there can be, & sometimes is, variation in ***how*** they do it
   - & some variation ***does*** remain in their performance outcomes

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Systems Engineering Effectiveness

Survey of DoD Program contractors

- In collaboration with NDIA Systems Engineering Division
- Under strict conditions of non disclosure

Measures of:

- Earned value, other performance criteria, project & product context
- Process capability questions about existence, use & quality of interim process work products
- Consistency with appraised maturity levels

Results currently expected in 1st quarter of CY2007

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Performance Measurement Associated with DoD Program Monitoring

Independent judgments about programs' adherence to processes consistent with appraised maturity of parent organizations

- Program monitoring by DCMA ... along with surveys of performance outcomes
- Currently considering similar analyses with ~20-30 programs for which monitoring appraisals have been done by SEI ... & possibly others of comparable quality

Possibly in concert with a "SCAMPI+" performance module

- Appraising project/program performance
- Linked directly with process appraisal results

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The Performance Benchmarking Consortium (PBC)

Members with existing quantitative measures & experience using them

- Working together to create (& then enhance) a common product suite

Measures & a repository infrastructure to

- Facilitate benchmarking comparisons
- Provide CMMI-based measurement guidance
- Supported by appropriate trailing activities

Come to Mark Kasunic's presentation for much more detail

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Enterprise Wide Performance Benchmarking

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Overview$_1$

Work with larger enterprises

- Comprised of multiple projects, contractual programs, & other constituent organizational units
- That already have &/or are evolving common measures of performance
- Along with complimentary measures of process enactment, organizational & product attributes

An important way to provide:

- More generalizable, comparative analyses explaining variation
- In both successful process enactment & the performance outcomes that the processes are meant to achieve

Especially important *in lieu* of shared measures that enable wider state of the practice & benchmarking analyses

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Overview$_2$

Participating organizations bring:

- Validated data that are actually used to inform management & technical decisions
- Personnel and financial resources to support the analyses

Work now in progress with three selected organizations

- All want to focus on factors that affect that performance
- Also prefer to address their own more concrete “how to” questions
- Augmented with survey or other mining of “tribal knowledge” about current variations in process enactment that may account for exemplary outliers
- Initial focus on high maturity organizations within their larger enterprises
- All three do have somewhat wider capability variation though
  - & BAE has wider maturity level variation

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Overview$_3$

Current Participants

- Motorola Software Group
- Lockheed Martin Integrated Systems & Solutions
- BAE

Work also provides useful how-to guidance for others elsewhere

- With enough detail to give others a good sense of the participating organizations' processes without divulging anything proprietary

Work in progress

- Only a few example results shown here
- More to follow next year's conference & in the interim

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Similar Work$_1$

Similar studies exist ... Mostly based on the SW-CMMI

- Clark, B. *The Effects of Software Process Maturity on Software Development Effort*. PhD Thesis, University of Southern California, April 1997.
- Deephouse, C.; Goldenson, D.; Kellner, M.; & Mukhopadhyay, T. "The Effects of Software Processes on Meeting Targets and Quality," 710-719. *Proceedings of the Hawaiian International Conference on Systems Sciences*. Wailea, HI, Jan. 3-6, 1995. Los Alamitos, CA: IEEE Computer Society Press, 1995.
- K. El Emam, A. Birk (2000). 'Validating the ISO/IEC measure of software development process capability'. *Journal of Systems and Software* 4(2), 113-133.
- El Emam, K. & Goldenson, D. "An Empirical Review of Software Process Assessments." *Advances in Computers* 53 (2000): 319-423.
- Goldenson, D. & Herbsleb, J. *After the Appraisal: A Systematic Survey of Process Improvement, Its Benefits, and Factors that Influence Success* (CMU/SEI-95-TR-009, ADA 302225).

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Similar Work$_2$

- Goldenson, D.; El Emam, K.; Herbsleb, J.; & Deephouse, C. “Empirical Studies of Software Process Assessment Methods.” in K. El Emam and N. H. Madhavji (eds.): *Elements of Software Process Assessment and Improvement*. Los Alamitos, CA: IEEE Computer Society Press, 1999.
- Harter, D. E.; Krishnan, M. S.; & Slaughter, S. A. “Effects of Process Maturity on Quality, Cycle Time, and Effort in Software Product Development.” *Management Science* 46, 4 (April 2000): 451-466.
- Jung, H. & Goldenson, D. *CMM-Based Process Improvement and Schedule Deviation in Software Maintenance* (CMU/SEI-2003-TN-015, ADA 416418).
- Krishnan, M.S. & Kellner, M. I. “Measuring Process Consistency: Implications for Reducing Software Defects.” *IEEE Transactions on Software Engineering* 25, 6 (November/December 1999): 800-815.
- Lawlis, P.; Flowe, R.; & Thordahl, J. “A Correlational Study of the CMM and Software Development Performance.” *CrossTalk* 8, 9 (September 1995): 21-25.
- Paulk, M.C. *An Empirical Study of Process Discipline and Software Quality*. Ph.D. Dissertation, University of Pittsburgh, 2005. <http://etd.library.pitt.edu/ETD/available/etd-070 82004-155917>

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Higher Maturity Comparisons$_1$

Focus on finer grained how-to measures

- Either already existing or collected as needed ... perhaps with custom survey data
- As part of QPM, OPP, CAR & OID activities

CAR typically ...

- Looks for plausible explanations of special causes of variation
  - What's different about the exemplary & least successful projects
  - Both process & other factors
  - Where success is measured by performance outcomes
- Then defines or redefines processes, trains & implements them & monitors the performance effects of the changes in process

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Higher Maturity Comparisons$_2$

Proactive, statistically based CAR

- Uses data from existing & enhanced measurement repositories
  - To examine as-is statistical relationships

Since there is less process variation in higher maturity organizations

- Probably makes more sense to look first for repeatable patterns between performance & ***other*** contextual factors
- Then identify, define, refine & evaluate the effects of new or changed processes

Where appropriate, use quasi experimental OID processes to:

- Pilot, incrementally deploy & modify the new processes as necessary based on measured performance results

Exactly what MSG China did

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More “High Maturity” Measurement Guidance: OID

It is reasonable to pilot first with accommodating projects

- To refine new processes before wider deployment
- But need some degree of experimental control, e.g.,
  - Matching or paired comparisons
  - To attribute change to the process intervention as opposed to spurious correlation due to other factors
  - Then track & revise as necessary

Incremental deployment yields more confidence in cause & effect

- As opposed to “training pants” learning effects
- But need baselines of as-is state prior to process intervention

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More "High Maturity" Measurement Guidance: CAR_1

"Cross sectional" statistical studies are less vulnerable to accusations of learning effects due simply to staff maturation over time

- But we do need process variation to separate process effects from competing explanations of differences in performance

Historical data in measurement repositories & other existing measurement infrastructure

- Make it easier for higher maturity organizations to make comparisons of otherwise comparable circumstances

The R in CAR still needs to be compared with an otherwise like baseline

- But that's possible when incremental changes are made with the same people, same product & project characteristics
- Especially after similar new projects apply the same new processes

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More "High Maturity" Measurement Guidance: CAR_2

One can pool cases over time to increase variation in process enactment

- It's still necessary to control for staff experience & learning effects
  - Even though experience *per se* doesn't always explain all that much {as per the early research on programmer productivity}
  - Still, we need better measures of staff skill, e.g., design, code, domain knowledge
- With enough cases, the mix of contextual variables hopefully can be controlled statistically ... not just experimentally

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Example Results

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Cost of Quality at Motorola Software Group (MSG)

Cost of Quality (COQ) at MSG includes effort spent on...

- Review / Inspection
- Test development & execution
- Quality auditing, training, other process Improvement & problem prevention

Cost of Poor Quality (COPQ) includes...

- Rework & related failure correction throughout the life cycle

Both expressed as percentages of overall effort spent for product development

Results presented here examine ***test development & execution***

- Initial results from 2002 drill-downs ... N = 46 projects

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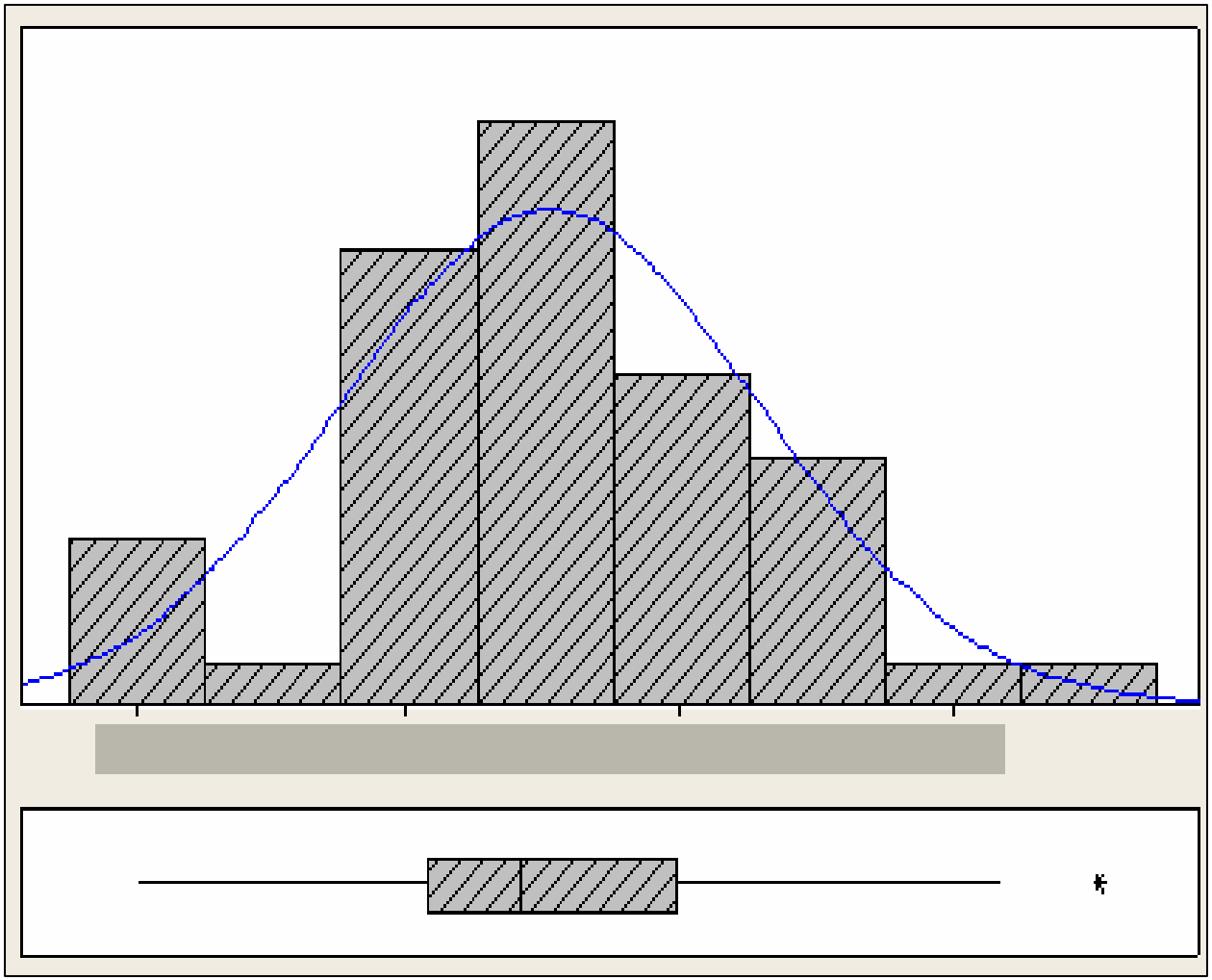
Variation in Cost of Quality for Test Appraisal

Results from MSG China Center

- N = 46
- Actual values of data distribution (not shown here) are quite good by our sense of "industry standards"
- Still, there are variations that MSG wishes to reduce further



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Differences by Domain

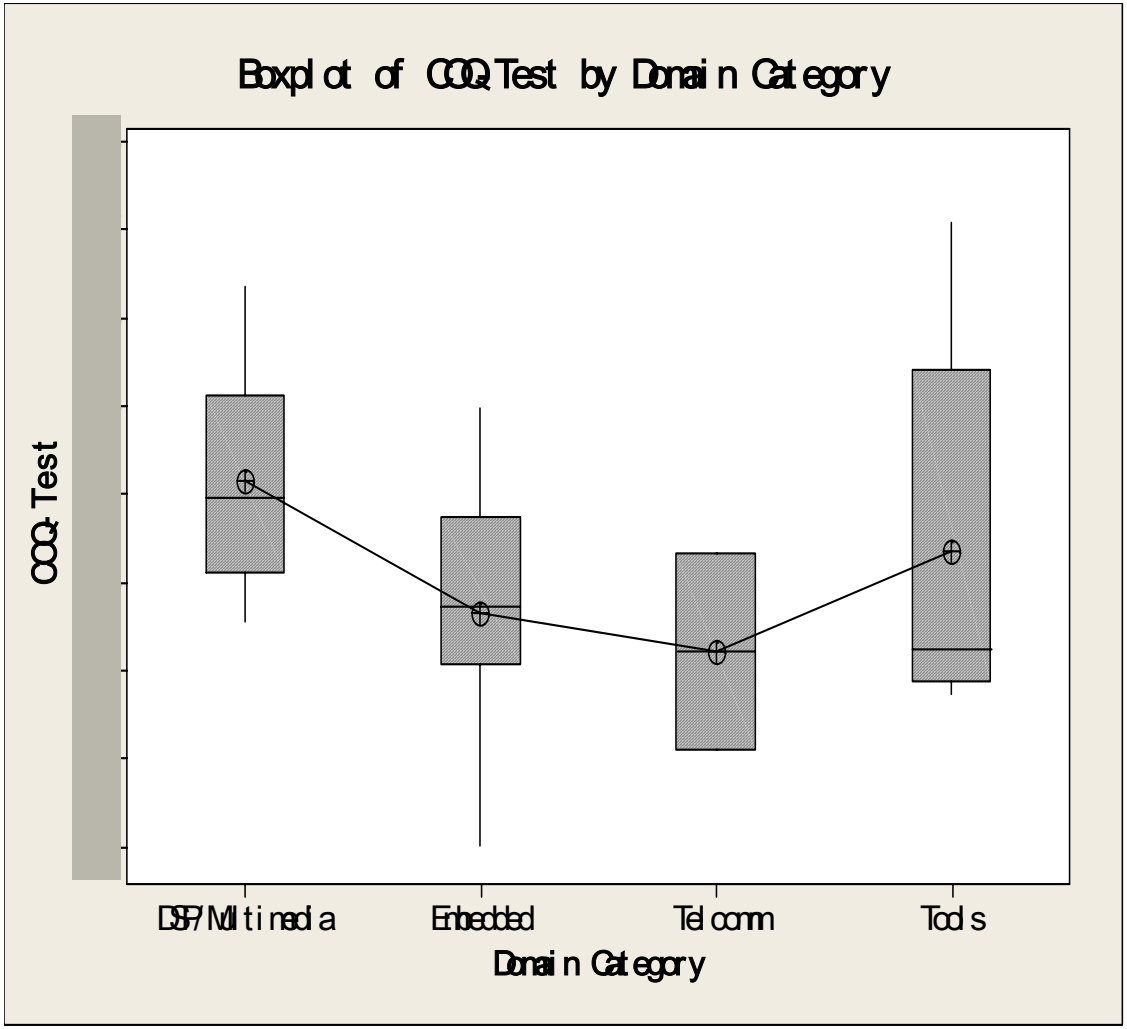
DSP/Multimedia projects have higher COQ-test

- Most Assembly projects fall here
- Some porting & optimization-oriented development projects, with high performance requirements
- & some product-oriented projects

Embedded vary more

Ns:

- 10 DSP Multimedia
- 29 Embedded
- 2 Telecom; 5 Tools



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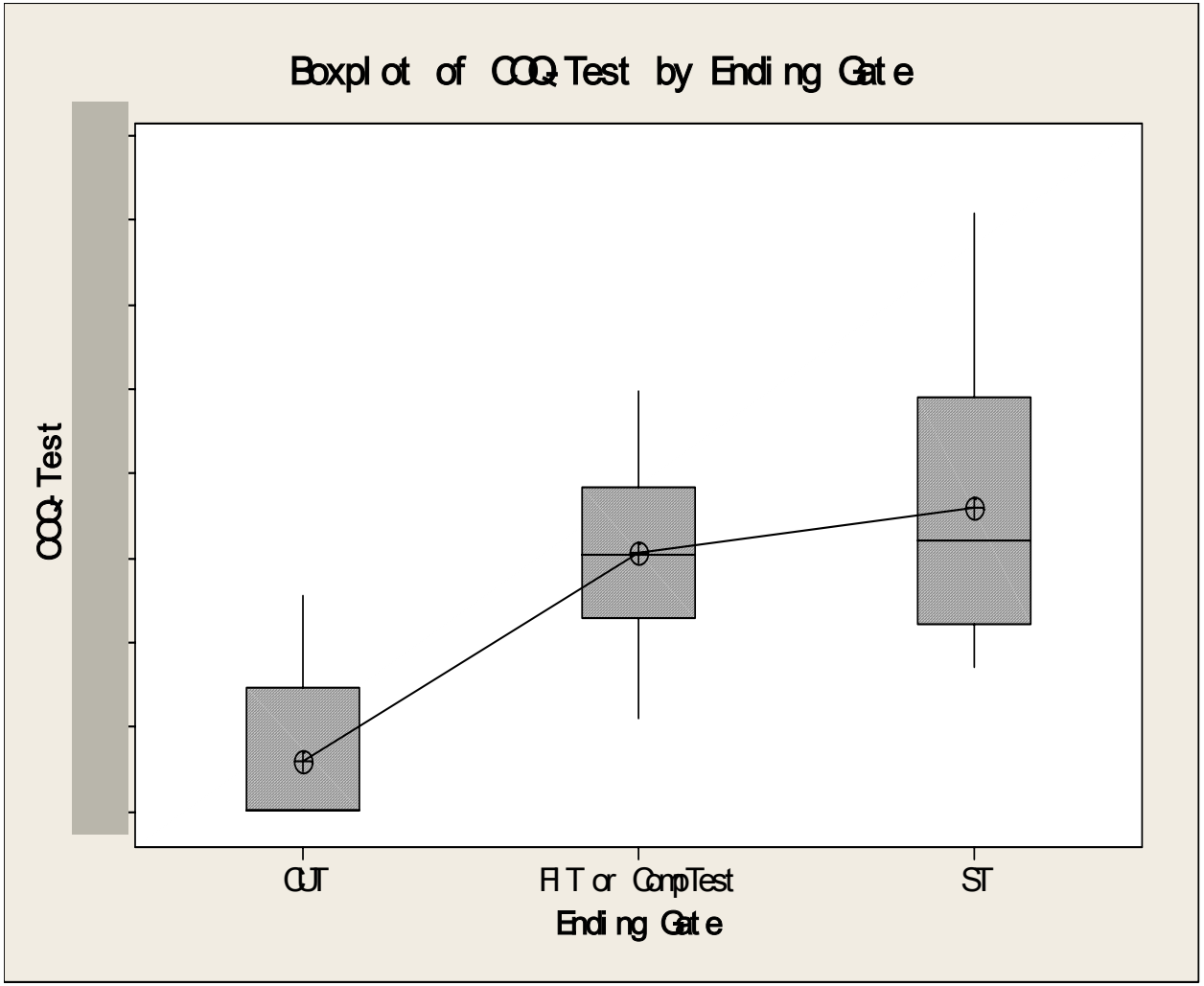
Differences by Motorola “End Gates”

Projects ending at System Test often have much higher COQ-Test

Ns:

- 5 Code & Unit Test (CUT)
- 20 Component Test & Feature Integration Test (FIT)
- 21 System Test (FT)



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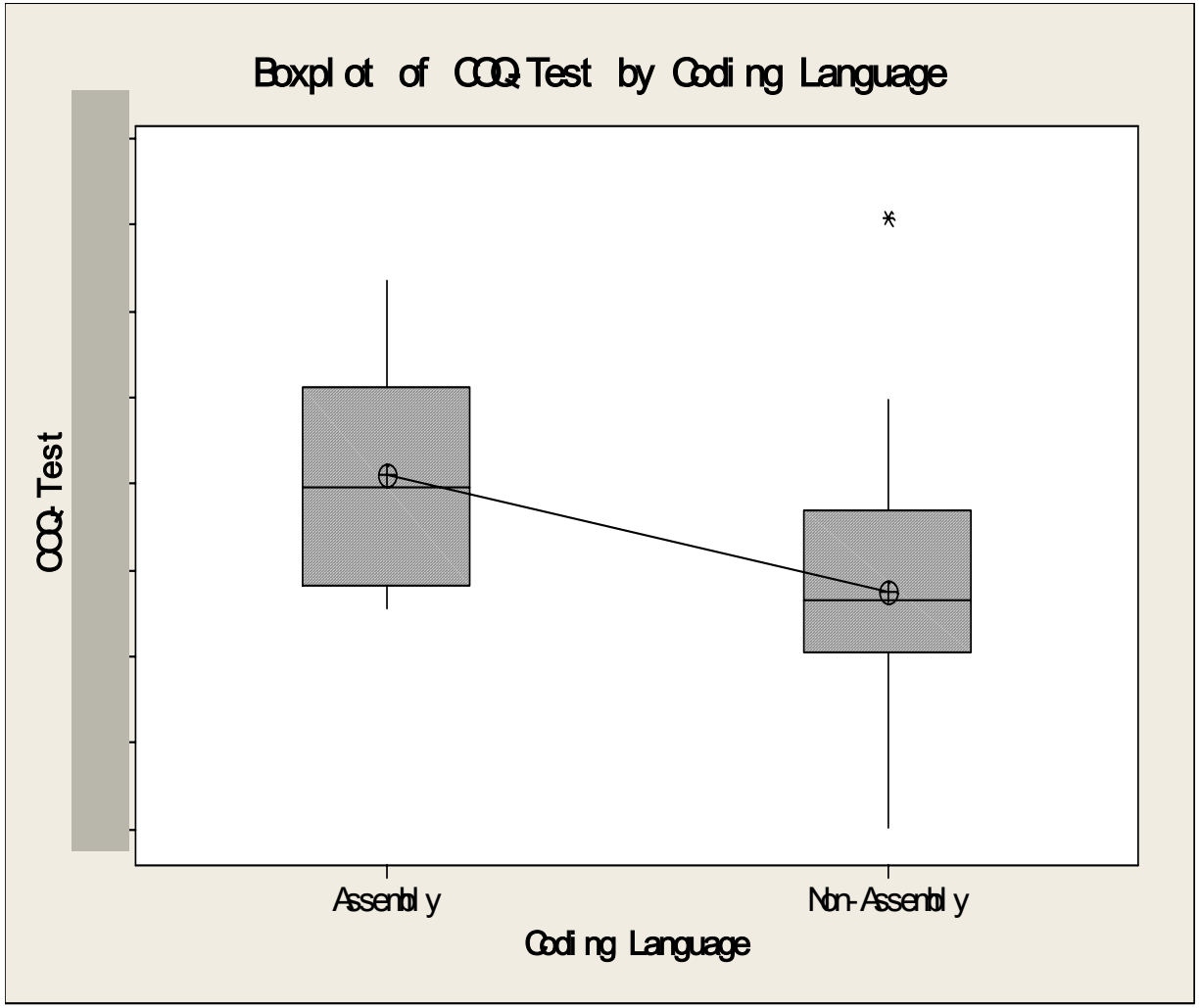
Differences by Coding Language

Major effects on test effort & COQ-Test

- Projects coded in assembly significantly more costly to test

Ns:

- 10 Assembly
- 26 Non assembly



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Explaining the Variation

Factors that vary jointly with COQ-test – MANOVA Adjusted R^2 = .67

- Motorola end gates (Code & unit test; feature & component test; or system test)
- Delta Code Size in KLOC
- Domain (Multimedia, embedded, tools & telecom)
- Coding language (assembly versus non-assembly)
- Base Code size in thousand assembly-equivalent lines of code (KAELOC)

Other factors examined – weak relationships, not significant

- Project Lifecycle (full or partial)
- In Process Faults (IPF) ... Post Release Defects (PRD)
- COQ for review/inspection ... Total Document Size (pages)

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Some Actions Taken

1. Encourage test automation
   - Especially for product-oriented projects
2. Develop organizational integration & system test guidelines
   - To reduce test development effort
3. Encourage project test case reuse & automation
   - Especially for long term projects
4. Enhance analysis of escaped defects
   - Develop causal analysis guidelines
   - Introduce causal analysis methods such as ODC
5. Optimize regression test strategy
   - Introduce fault prediction tool
6. Better sharing of practices & lessons learned among projects.

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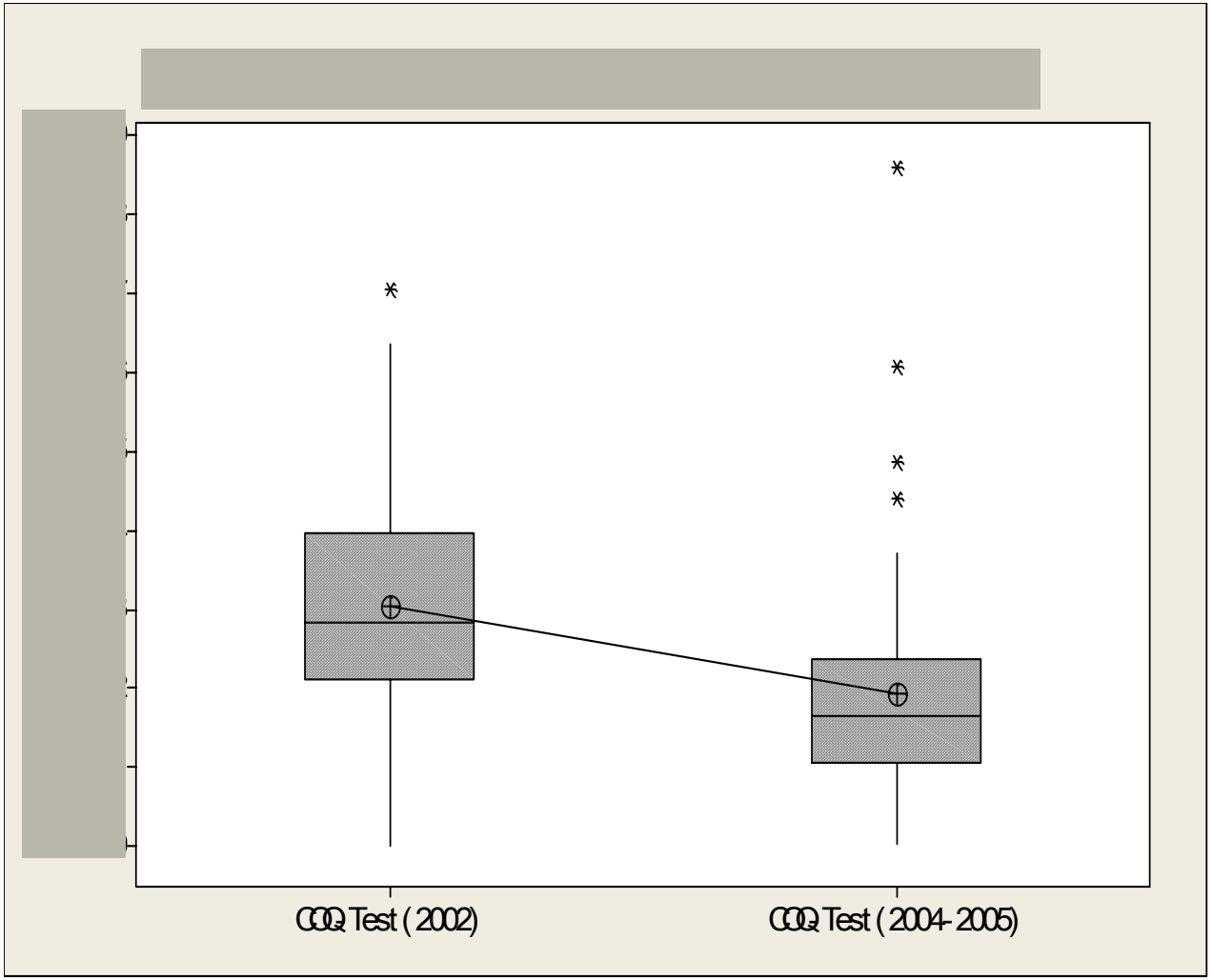
Effects of Process Change

Improvement actions reduced COQ-test cost

Ns:

- 56 in 2002
- 75 in 2004-2005



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Phase Containment Effectiveness & In Process Faults at Motorola Software Group (MSG)

Phase Containment Effectiveness

- The proportion of faults that are found at the first check point after they were introduced
  - Classified by root cause analysis as errors ... as opposed to defects that escape detection until later
  - ***Examples shown here are for coding only***
- Updated incrementally by phase to monitor & control pertinent processes

In-Process Faults

- Number of faults found before completion of the project's final phase prior to release Customer Satisfaction

Related MSG performance measures (not shown here) include ...

- First Estimation Accuracy, Cycle Time Reduction Rate, Post-Release Defect Rate & Customer Satisfaction

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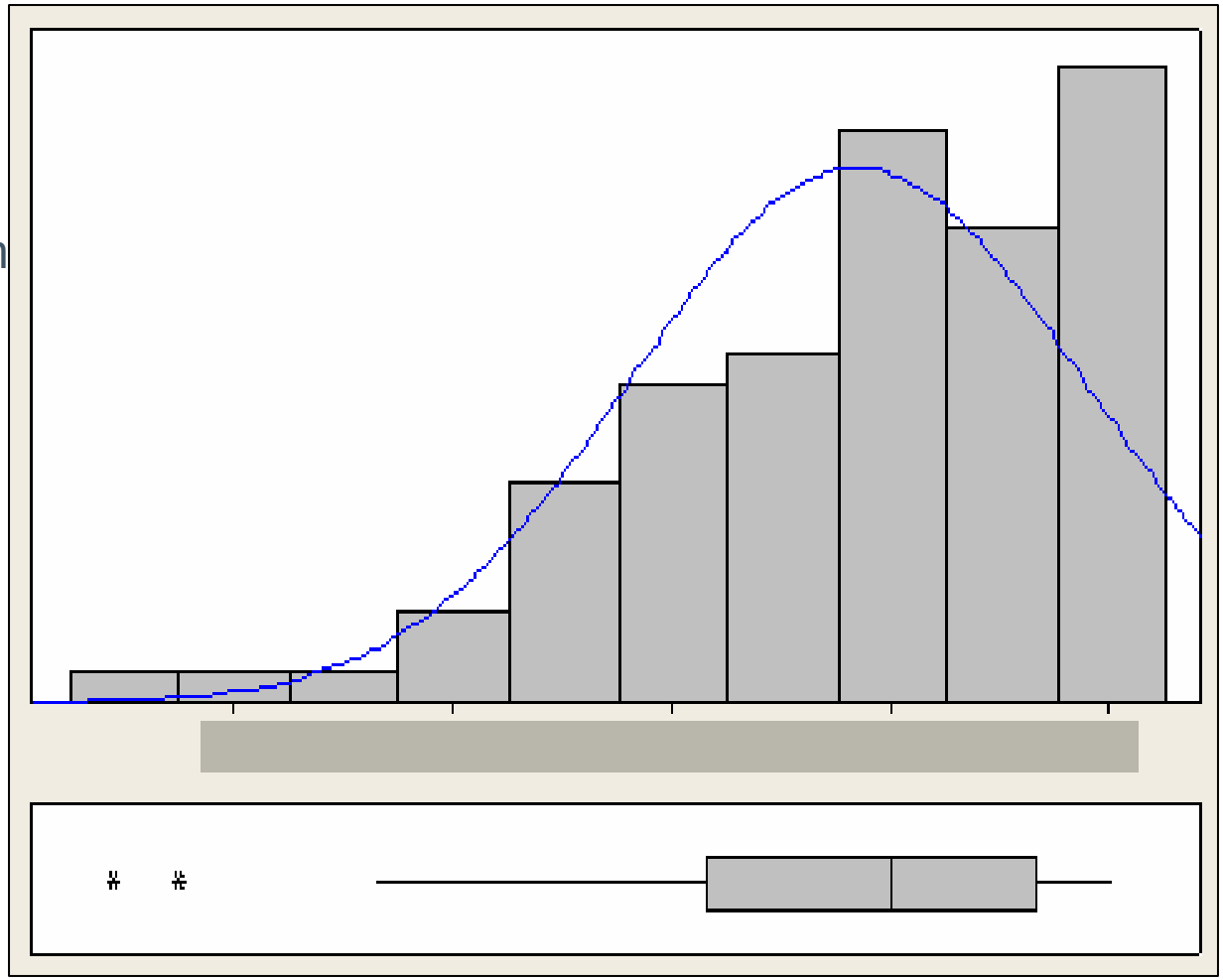
Variation in Phase Containment Effectiveness

Results from MSG China Center

- N = 87; pooled from 2004 through 2006
- Actual values of data distribution (not shown here) are quite good by our sense of "industry standards"
- Still, there are variations that MSG wishes to reduce further



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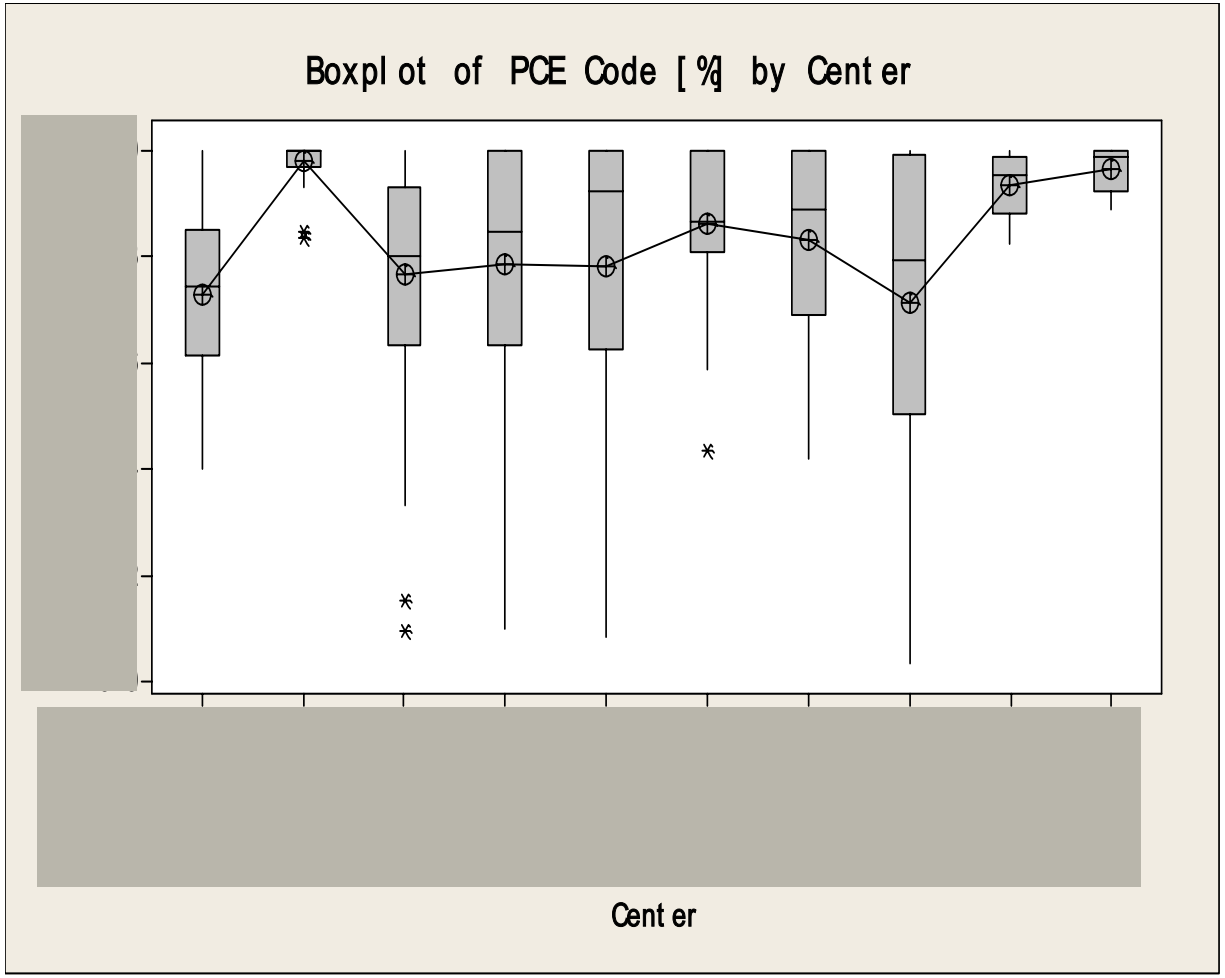
Phase Containment Effectiveness by MSG Center

Results from 10 MSG Centers

- N = 487
- All Centers do well by our sense of “industry standards”
- Again, there are variations that MSG wishes to reduce further



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Phase Containment Effectiveness by Domain

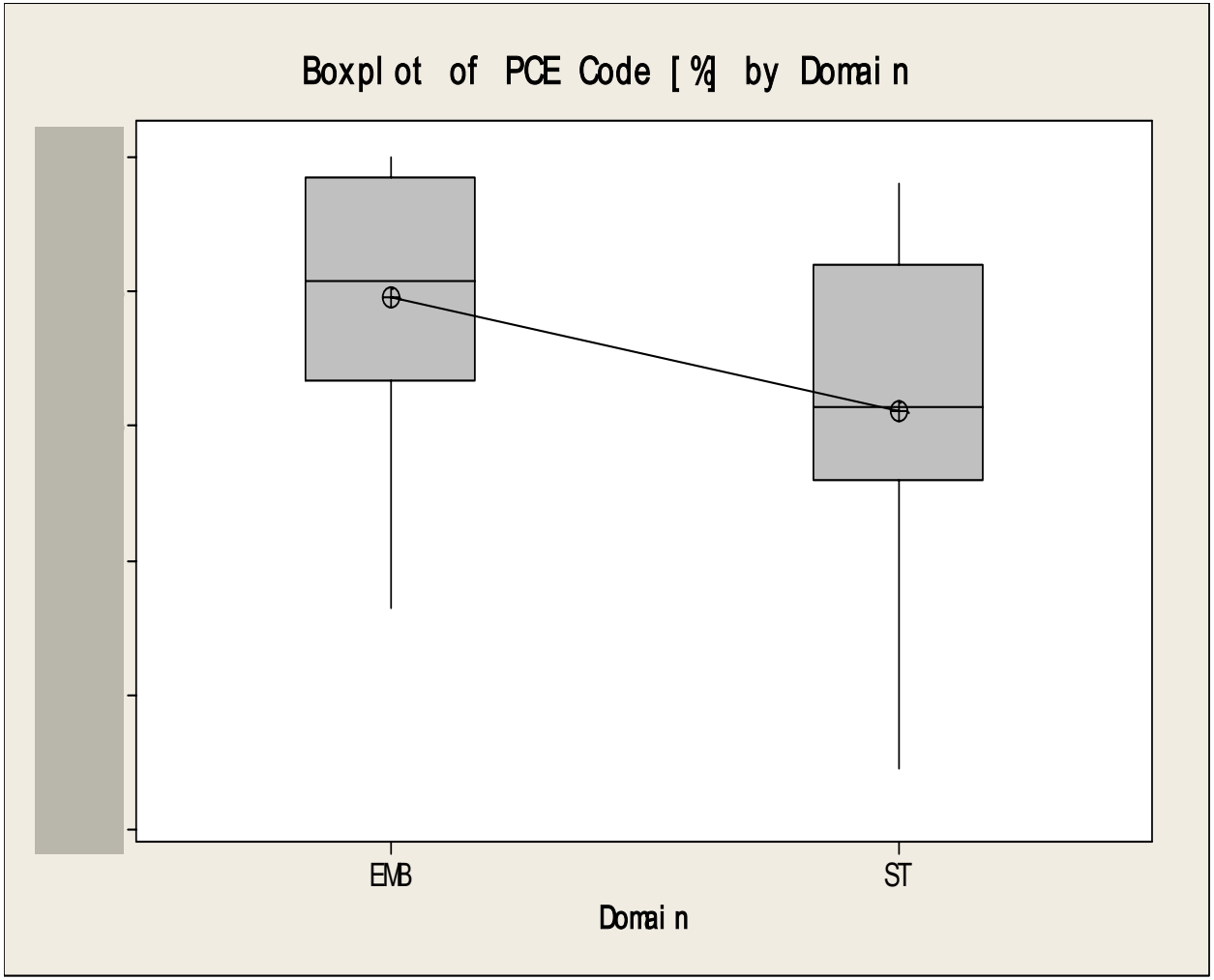
Better phase containment for Embedded projects

- Where China Center has more experience

Projects to develop Software Tools are newer work for the Center

Ns:

- 66 Embedded
- 15 Software Tools



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Do Other Factors Affect Code Phase Containment Effectiveness?

Substantial differences among product lines

- Center does particularly well with multimedia projects – where they are very experienced

Yet, team experience has no independent overall effect

- Possibly implying adequate process definition & training

No significant differences by project category

- Customer completes some of the lifecycle
- Normal Development
- DMS
- Porting

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Variation in In-Process Faults

Results from MSG China Center

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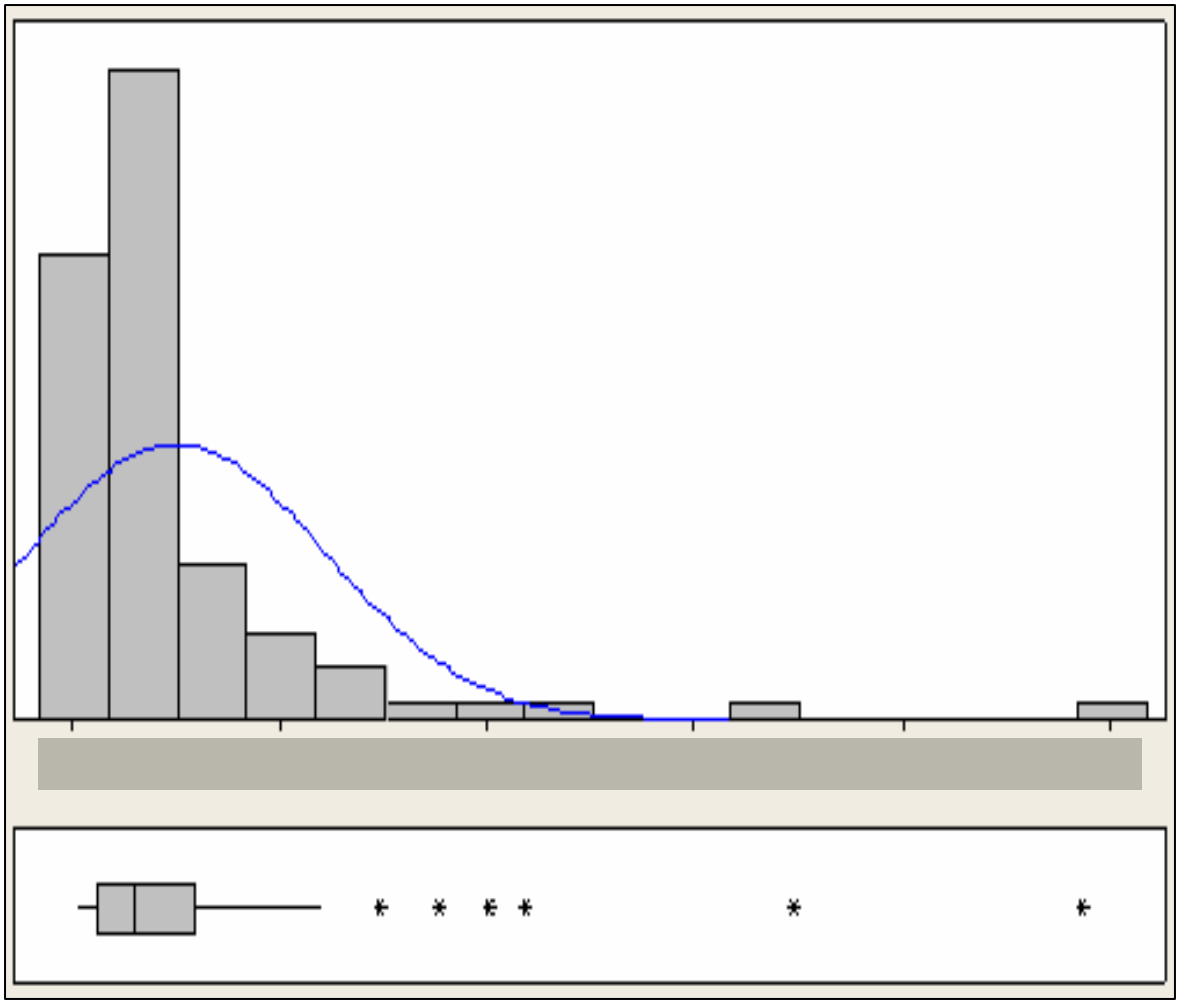

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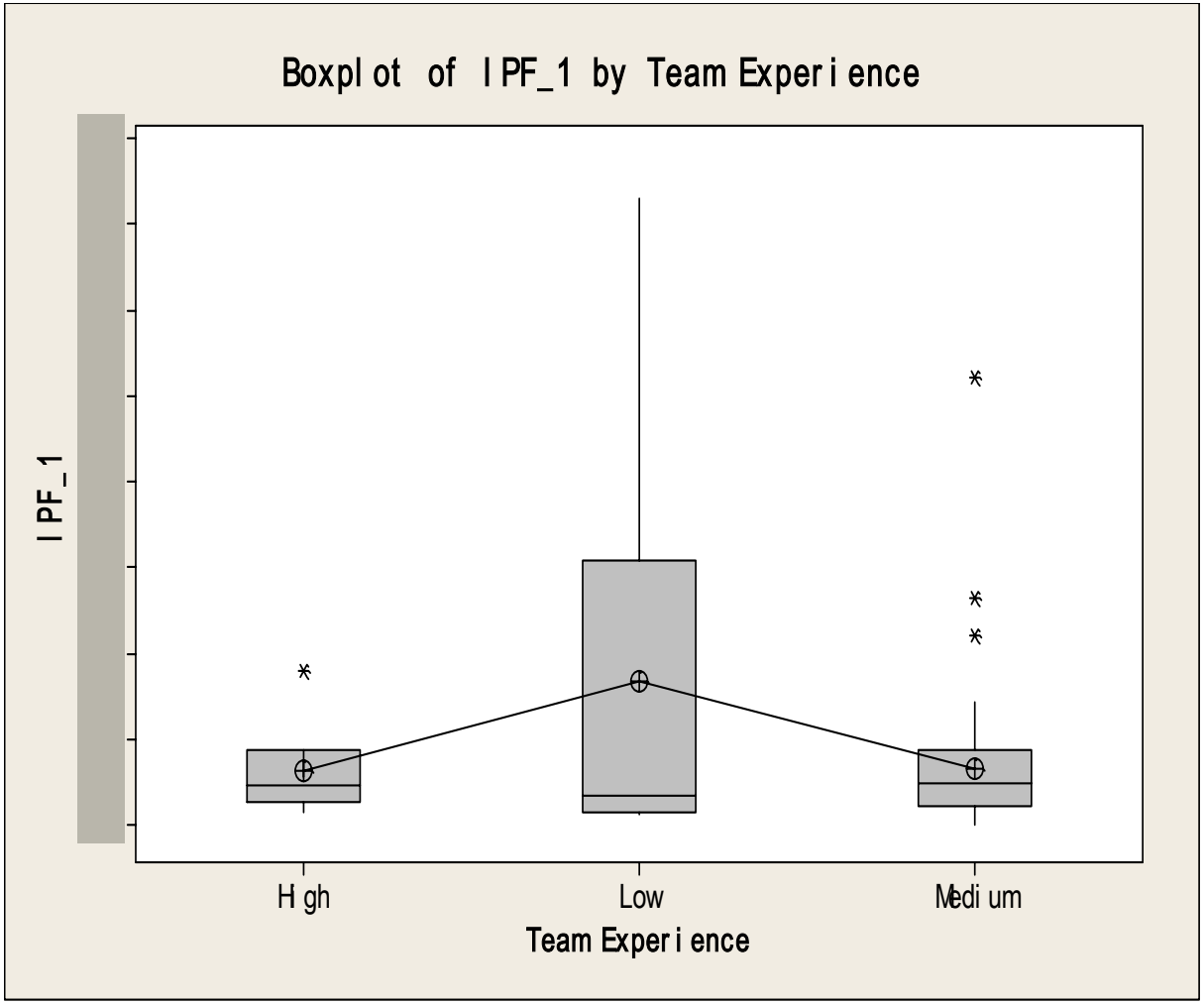
In-Process Faults by Team Experience

Team experience does affect insertion of faults

- Implying need for improved staffing, training, coding standards or other improved processes

Ns:

- 6 High
- 67 Medium
- 10 Low



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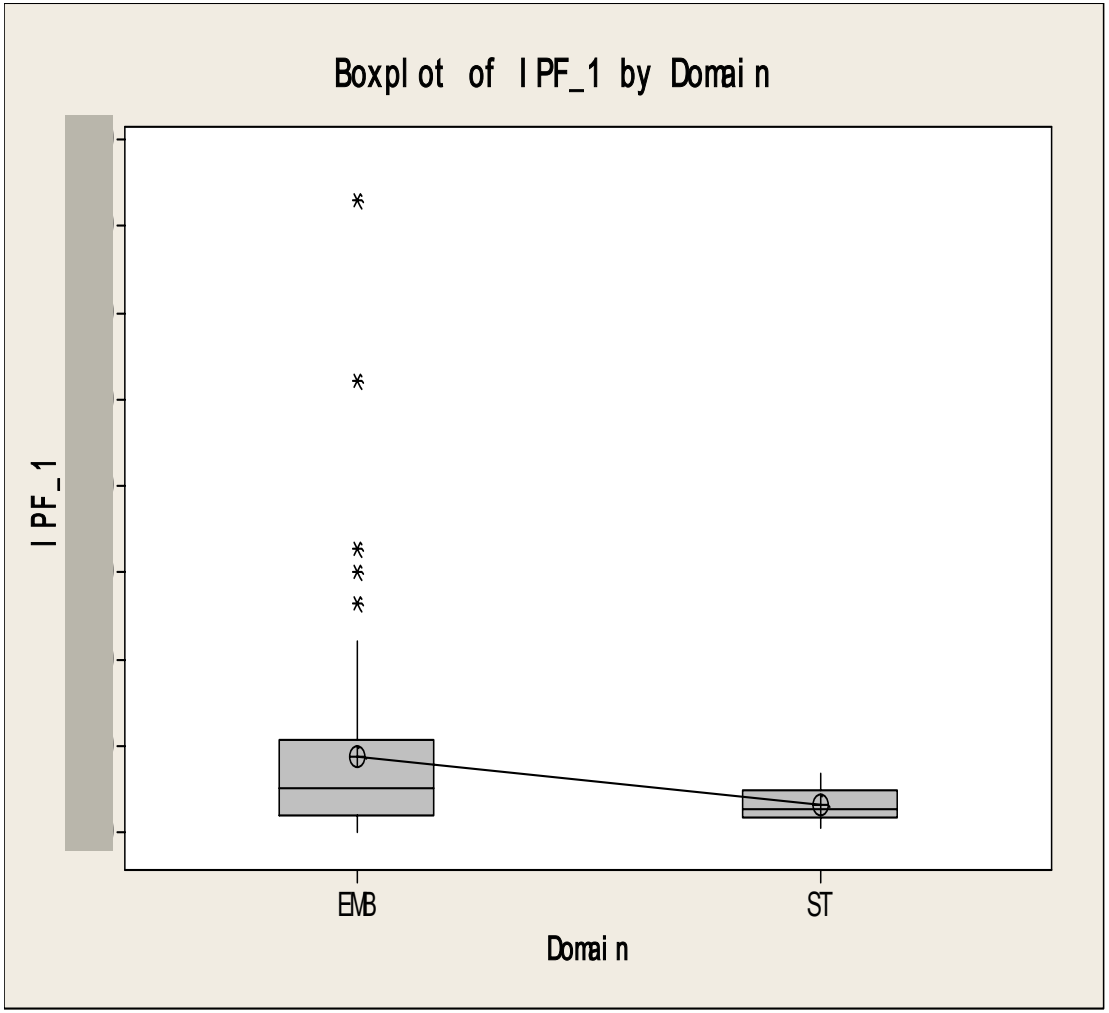
In-Process Faults by Domain

Marginally more faults in Embedded than Software Tools development projects

- Could be a function of greater complexity, imply need for improvement on engineering processes, or simply be statistical noise

Ns:

- 66 Embedded
- 15 Software Tools



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Synopsis: Lockheed Martin Integrated Systems & Solutions

Performance Measures

- Unit Software Costs
- Find & fix costs
- Overhead rate
- Productivity (for equivalent lines of new code)
- Award fees

Processes instituted include

- Architecture based design
- Scenario based testing
- Design adequacy assessments
- Quality awareness throughout the lifecycle
- Early defect detection through inspections & defect causal analysis

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Amassing the Necessary Evidence:
Some Related Examples

1. Independent measures of process compliance/adherence
2. CAR at Northrop Grumman IT
3. Project performance at Warner Robins Air Logistics Center

If short on time then punt

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Measuring Process Compliance & Adherence

To do broadly-based comparisons

- Must already have (or begin to collect) independent measures of process capability

Available from

- CMMI class C appraisals
- Monitor & control activities
- QA tracking of existence, timeliness & quality of interim process work products:
- Questionnaires, e.g., in existing SW-CMM based studies

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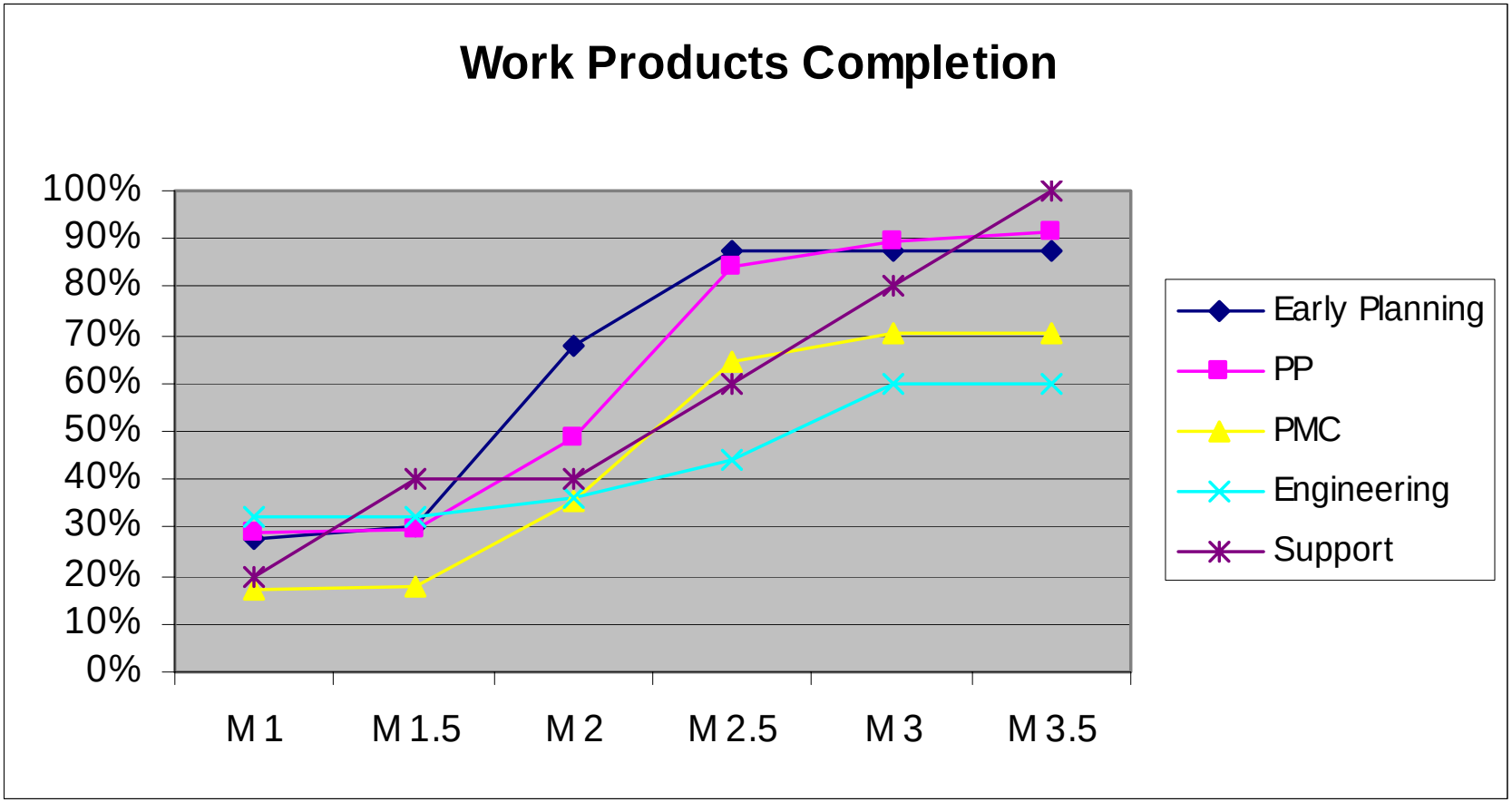
Measuring & Tracking Process Adherence



CMS Information Services, Inc.

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CAR at Northrop Grumman IT

An example of careful CAR

- Albeit with one large project

Quasi-experimental control of change over time,

- Similar difficulty development tasks
- No other known differences over time
- A step jump after process intervention
  - Unlikely had the process change not taken place

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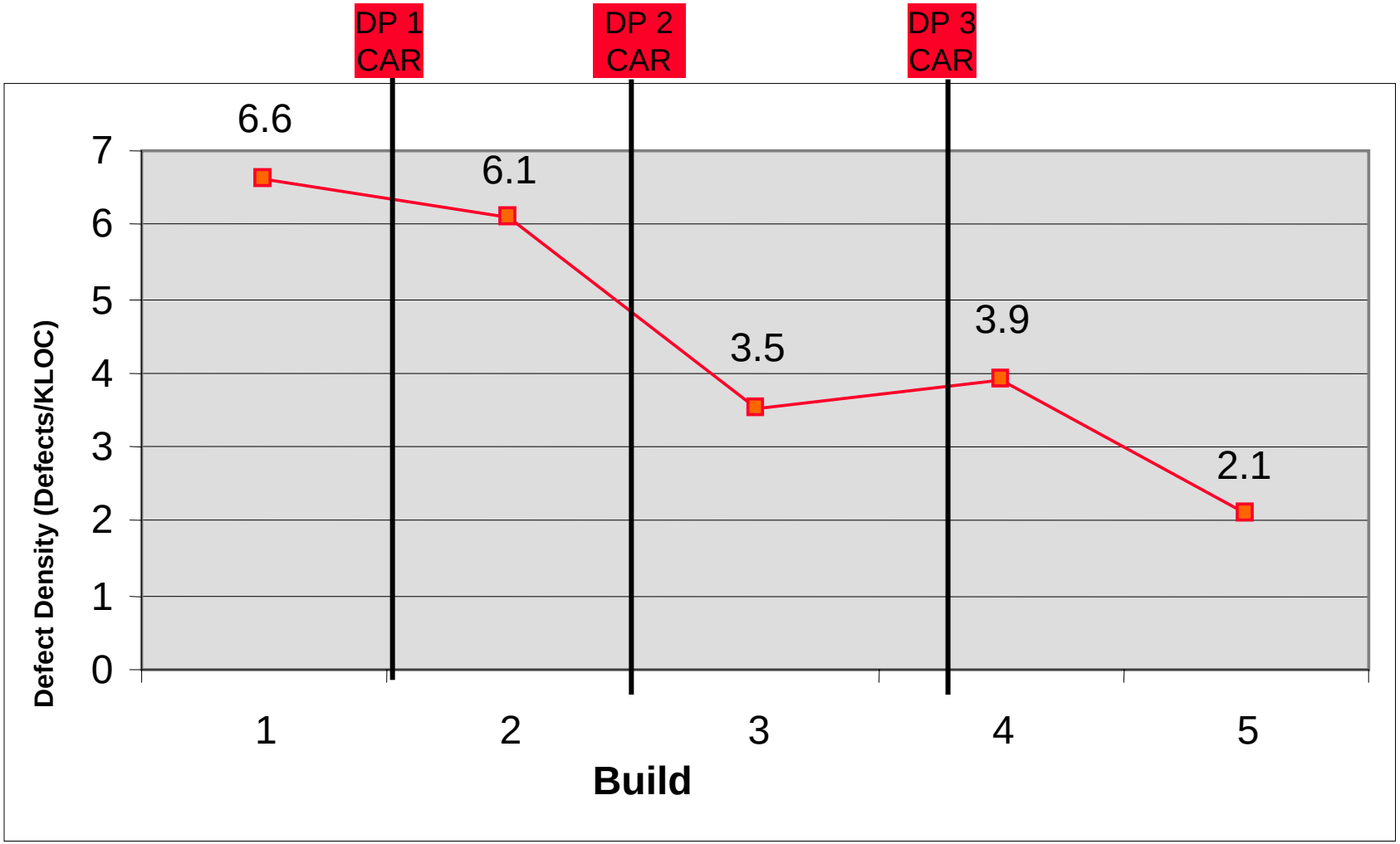
CAR at Maturity Level 5: Northrop Grumman IT_1



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CAR at Maturity Level 5: Northrop Grumman IT_2

Similar results for cost & schedule variance

ROI: ~13:1

- Hours saved fixing had defects not been avoided
- Hours invested on team training & conducting CAR Cycles

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Project performance at Warner Robins Air Logistics Center

Comparisons of variation in performance over time

No explicit measurement of variation in process adherence by project

- But the process intervention clearly was the only thing that changed other than marginally

Small, short term maintenance projects

- Almost entirely adding new capabilities / functionality

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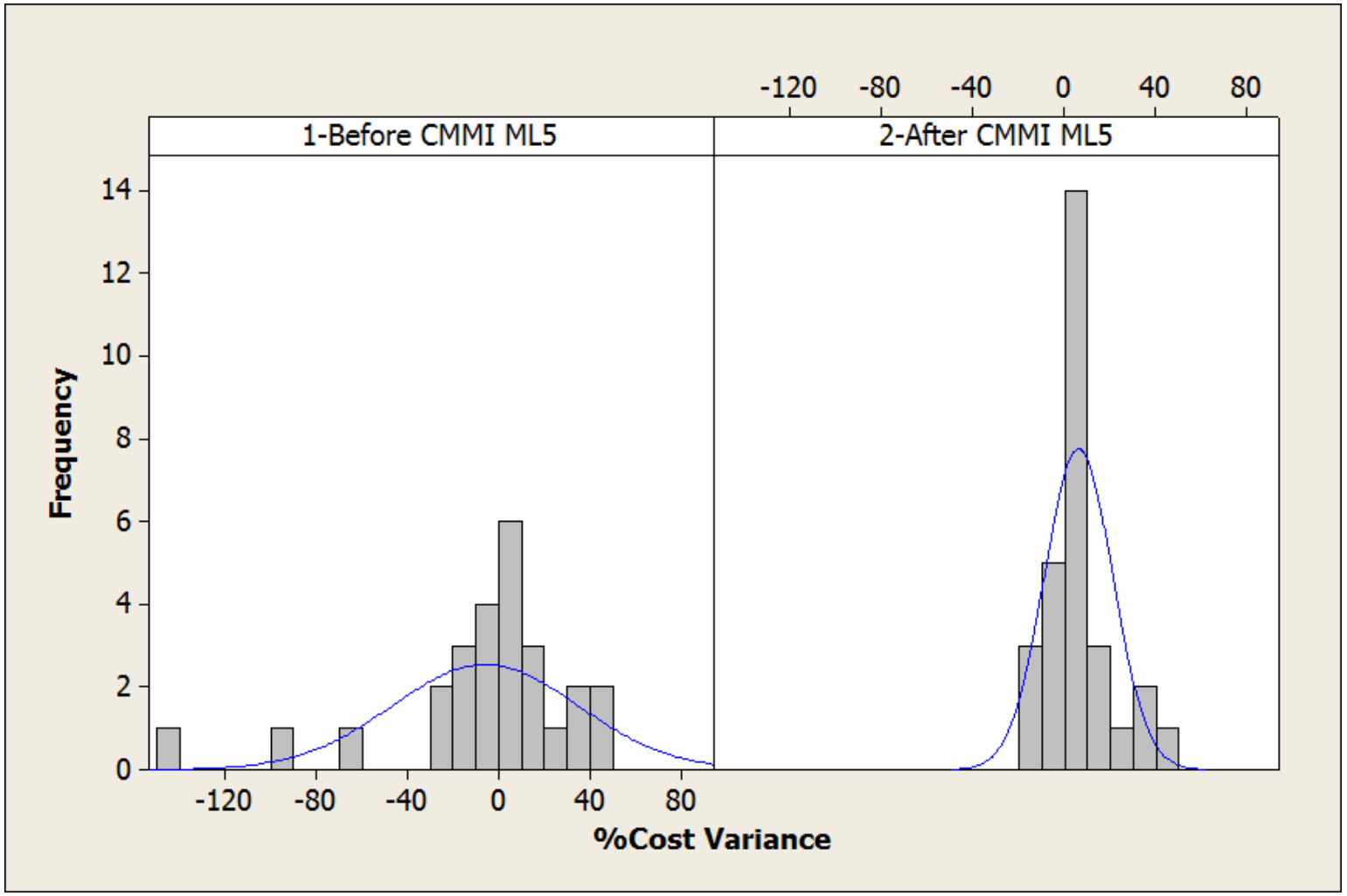
Change in Percent Cost Variance



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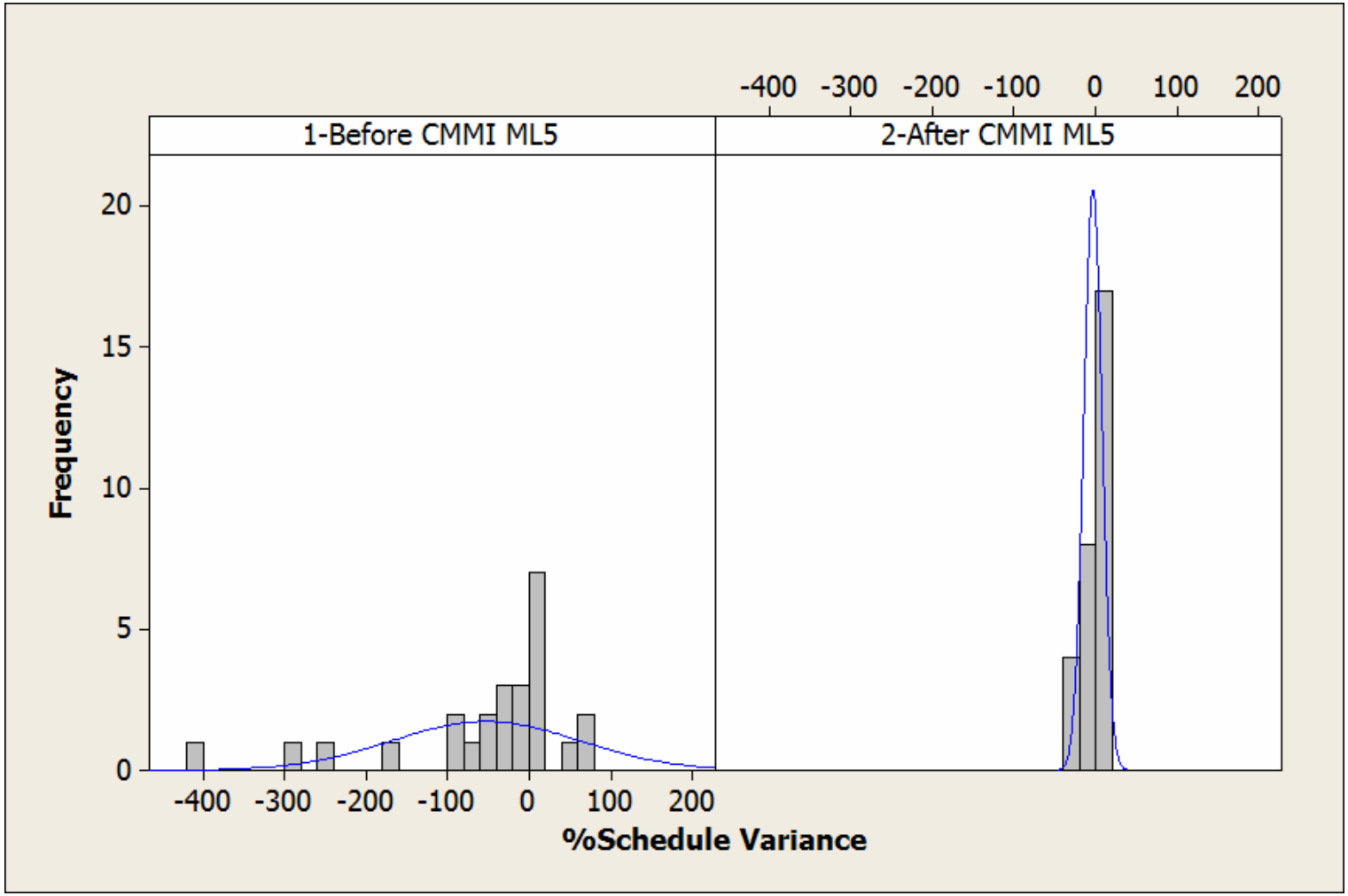
Change in Percent Schedule Variance



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How can you help? ←

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How Can You Help?

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Participate in Our Work & Contribute Your Own

We are always on the lookout for serious collaborators for:

- Enterprise Wide Performance Benchmarking studies
- The other work described today
- Any other ideas you may wish to pursue

Share your experiences with us & the wider systems& software community

- Submit a brief article for *DoD Software Tech News*, March 2007 Issue
  - Special issue on performance results of CMMI ... 31 January deadline
  - Quantitative case studies welcome ... comparisons of variations among projects/programs preferred

Also editing an issue (perhaps issues) of *Software Process Improvement and Practice* later in the year

Please see me here in Denver about these & other opportunities

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Thank You for Your Attention!

Dennis R. Goldenson
dg@sei.cmu.edu

Software Engineering Institute
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CMMI for Acquisition: Introducing the Acquisition Constellation

CMMI Technology Conference
November 2006

Ms. Kristen Baldwin
OUSD(AT&L)/Systems and Software Engineering

Interest in Acquisition Process Improvement

- Congress directed the Department to establish software acquisition process improvement
- OSD led the development of the CMMI-Acquisition Module (CMMI-AM)
- Services and Agencies tailoring CMMI and CMMI-AM for use in acquisition activities
- General Motors and the SEI publish *Adapting CMMI for Acquisition Organizations: A Preliminary Report*
- CMMI Steering Group with DoD Sponsorship, established the CMMI-Acquisition project

"How do I measure PEO capability; credentials?"

LTG Yakovac, 14 Nov 05, CMMI Technology Conference Keynote

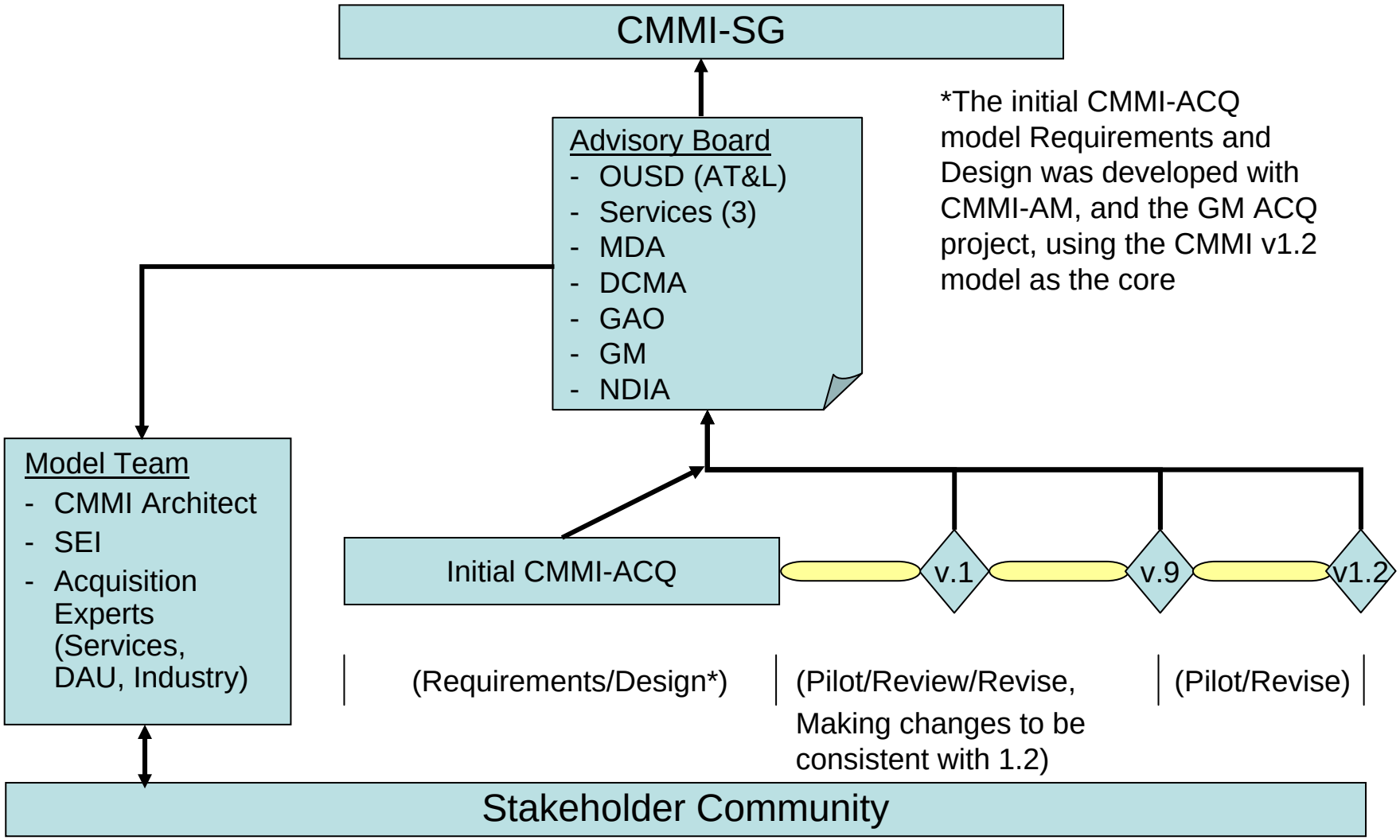
New CMMI Architecture
Concept of Constellations

- Constellation: "A collection of components that are used to construct models, training materials and appraisal materials in an area of interest"
  - Development Constellation
  - Acquisition Constellation
  - Services Constellation
- Each constellation adds "additions" to the CMMI Foundation Model, which includes core components
- The model for the Acquisition Constellation will be called CMMI for Acquisition, CMMI-ACQ

CMMI-ACQ Development Strategy

- General Motors and the SEI developed the initial CMMI-ACQ model
  - Considered CMMI Acquisition Module (CMMI-AM) in its development
  - Involved industry and government agencies in developing and reviewing the initial draft model
  - Special report at http://www.sei.cmu.edu/cmmi/models/initial-cmmi-acq-release.html
- Additional requirements solicited by piloting
  - Assures Service/Agency/Industry acquirer needs are addressed
  - Enhances acquiring organization understanding of process improvement
- CMMI-ACQ Model Team will propose improvements to the initial model based upon findings from the pilots
- CMMI-ACQ Advisory Board will vet changes
  - Key reviewers identified for stakeholder review
- Steering Group will endorse final update

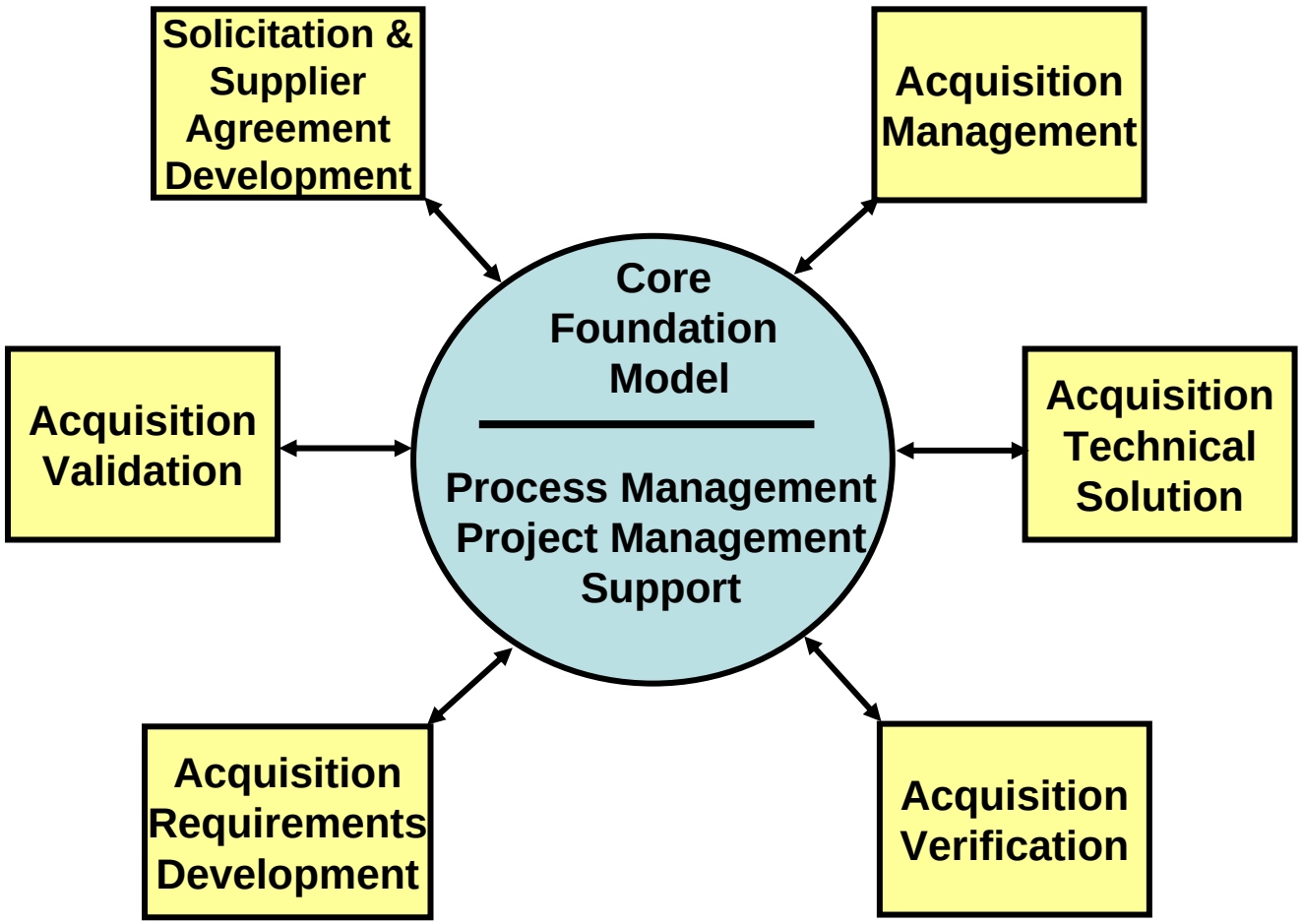
CMMI-ACQ Operational Concept



Initial CMMI-ACQ

- GM/SEI Joint Project Goal: Develop an Acquisition Model that conforms with the CMMI architecture
  - Based on the CMMI Model Foundation
    - 16 process areas that cover project management, organizational and support process areas; the generic goals and practices; and glossary
  - Source models included
    - CMMI Acquisition Module (CMMI-AM)
    - Software Acquisition Capability Maturity Model (SA-CMM).
  - Incorporates attempts by several acquisition organizations to adapt the CMMI for Development (CMMI-DEV) for an acquisition organization
- Best practices contained in the initial draft CMMI-ACQ went through an extensive review process
  - More than 1,000 comments and change requests from acquisition organizations as well as suppliers
  - Over 60 reviewers from 24 industry and government organizations

Initial CMMI-ACQ Acquisition Process Area Additions



Specific Goals in CMMI-ACQ PA Additions

- Acquisition Requirements Development
  - Develop Customer Requirements
  - Develop Contractual Requirements
  - Analyze and Validate Requirements
- Acquisition Verification
  - Prepare for Verification
  - Verify Selected Work Products
- Solicitation and Supplier Agreement Development
  - Prepare for Solicitation and Supplier Agreement Development
  - Select Suppliers
  - Establish Supplier Agreement

Acquisition PAs cover the activities related to the acquisition of products and services from suppliers

Specific Goals in CMMI-ACQ PA Additions, continued

- Acquisition Management
  - Manage Supplier Agreements
  - Satisfy Supplier Agreements
- Acquisition Technical Solution
  - Develop Technical Constraints
  - Analyze and Verify Technical Solution
- Acquisition Validation
  - Prepare for Validation
  - Validate Products or Services

Acquisition PAs cover the activities related to the acquisition of products and services from suppliers

CMMI-ACQ Pilots

- CMMI planned/proposed pilot efforts for FY07
  - Australian DMO (complete)
  - General Motors and Hewlett Packard (in progress)
  - Army – Picatinny Arsenal (complete)
  - USAF – Space & Missile Center; Electronic Systems Command
  - DHS – “US Visit” Program
  - NAVAIR – (tbd)
  - Missile Defense Agency (tbd)
  - HUD – (tbd)
- UK MoD interest being explored
- GAO and others are piloting as opportunities arise

Pilot Details

- GAO Review/Agency input
  - 38 CRs already submitted
- SCAMPI-B with GM and Hewlett Packard
  - Conducted at GM site, 2-6 October, to identify strengths, weaknesses, and needed improvements
  - Generated 19 CRs, some overall issues and some specific technical issues with the special report
  - SCAMPI-C conducted at HP site, 6-10 November
- Australia Defense Material Organization
  - Proposed reorganization for the model
- Army, Picatinny
  - Review conducted with engineering group that provides acquisition support to Program Offices
  - Generated several CRs

CMMI-ACQ Governance: Advisory Board

- Includes representatives from major acquisition community stakeholders
  - DoD (OUSD (AT&L) and Services)
  - Other Government Agencies (GAO, DCMA)
  - Commercial and Defense Industry
- Ensures CMMI-ACQ considers stakeholder needs
- Coordinates with CMMI Steering Group to ensure consistency among constellations
- Reviews pilot results and categories of change requests to set the criteria for changes to the initial draft CMMI-ACQ
- Reviews and comments on products from the CMMI-ACQ model team

CMMI-ACQ Development: Model and Training Teams

- Model Team
  - Makes changes to the GM/SEI initial draft CMMI-ACQ baseline according to criteria defined by the Advisory Board
  - Dispositions CRs generated from the pilots against the baseline and approved by the Advisory Board
  - Raises overarching issues to the Advisory Board
  - Submits model to the Advisory Board for review
- Training Team
  - Develops CMMI-ACQ-specific training material from model
  - Submits training material to the Advisory Board for review

Schedule

Sep - Nov 2006	Conduct pilots with initial draft CMMI-ACQ baseline
Dec 2006 - Feb 2007	Update baseline based upon pilot findings and submitted change requests
	Develop training
March 2007	CMMI-ACQ available for stakeholder review
April 2007	CMMI-ACQ available for QA
April 30, 2007	Release CMMI-ACQ *Product Suite (Model, Method, Training)*

Summary

- An integrated approach to developing acquisition process improvement
  - Industry involvement
  - Government-wide needs
  - Builds on existing process improvement efforts
- Advisory Board and pilots will shape the final outcome
- This is an opportunity to transform acquirer and supplier relationships and shape the future of process improvement
- For more information contact Karen Richter, IDA, krichter@ida.org, or Mike Phillips, dmp@sei.cmu.edu
- For a copy of the *GM/SEI Special Report go to* *http://www.sei.cmu.edu/publications/documents/06.reports/06sr005.html*

Carnegie Mellon
Software Engineering Institute

NAVAIR

Extending the Team Software Process for Systems Engineering

Tim Chick (a.k.a. Jeff Schwalb)

Naval Air Systems Command

James McHale

Software Engineering Institute

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Topics

Need

NAVAIR/SEI Collaboration

Approach

Team

Research Challenges

Conduct of Pilot Project

What's Next?

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Need

TSP is being used with great results on software teams.

See *CMU/SEI-2005-SR-012, CMU/SEI-2003-TR-014,* and *CMU/SEI-2000-TR-015.*

There is growing interest in applying TSP to other domains.

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NAVAIR/SEI Collaboration

NAVAIR already has a great track record with TSP:

- ROI demonstrated on software projects
- other teams (SE) requested training and launch support

SEI is also receiving additional requests to apply TSP to non-software settings.

Solving software problems becomes increasingly difficult without addressing systems engineering and acquisition issues.

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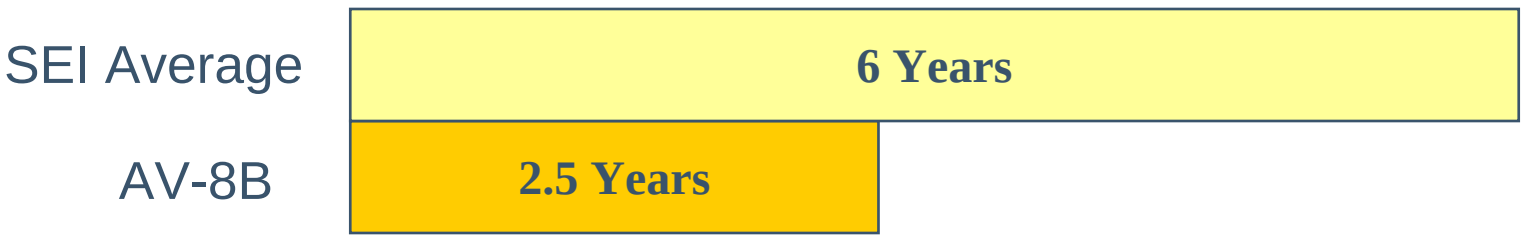
AV-8B TSP/CMMI Experience

AV-8B is a NAVAIR System Support Activity (SSA).

They integrate new features into the Marine Harrier aircraft.

They used TSP to reduce the time to go from CMMI Level 1 to CMMI Level 4.



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TSP Results at NAVAIR

Program	Size of Program	Defect Density (Defects/KSLOC))	Cost Savings from Reduced Defects
AV JMPS	443 KSLOC	0.59	$2,177,169
P-3C	383 KSLOC	0.6	$1,478,243

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Approach

Conduct a series of pilot projects to determine if extending TSP practices to Systems Engineering and Acquisition Management results in measurable improvement

Use the results of this work to establish a common process for both systems and software engineering across the NAVAIR Mission Area Teams (MATS).

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What is TPi?

Team Process Integrated

- a multi-year experiment
- adapt and extend the training, methods, and tools associated with TSP
- targets selected systems engineering and acquisition teams within NAVAIR (i.e. already using TSP successfully for software development)

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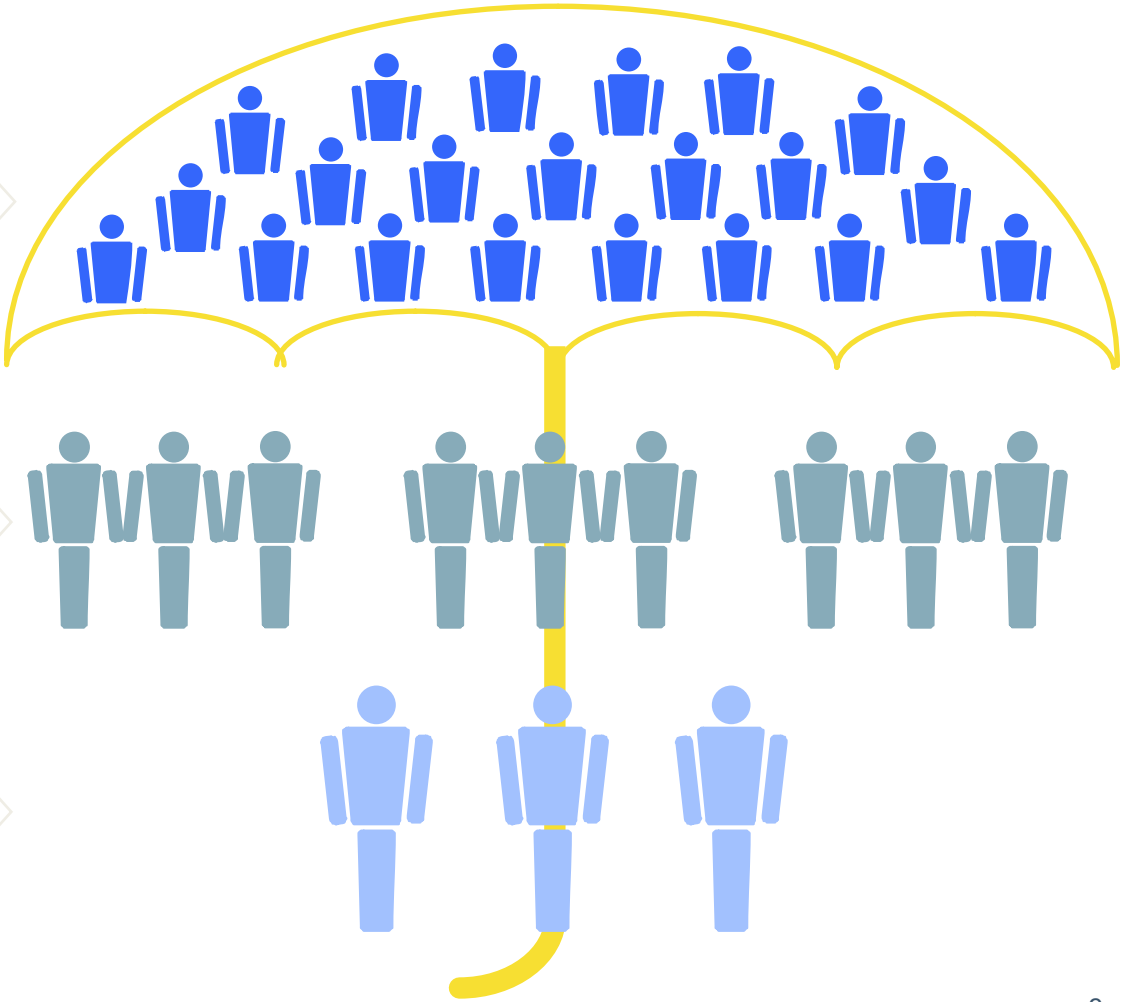
CMMI, TSP & PSP Relationship

CMMI - *Builds organizational capability*

TSP - *Builds quality products on cost and schedule*

PSP - *Builds individual skill and discipline*



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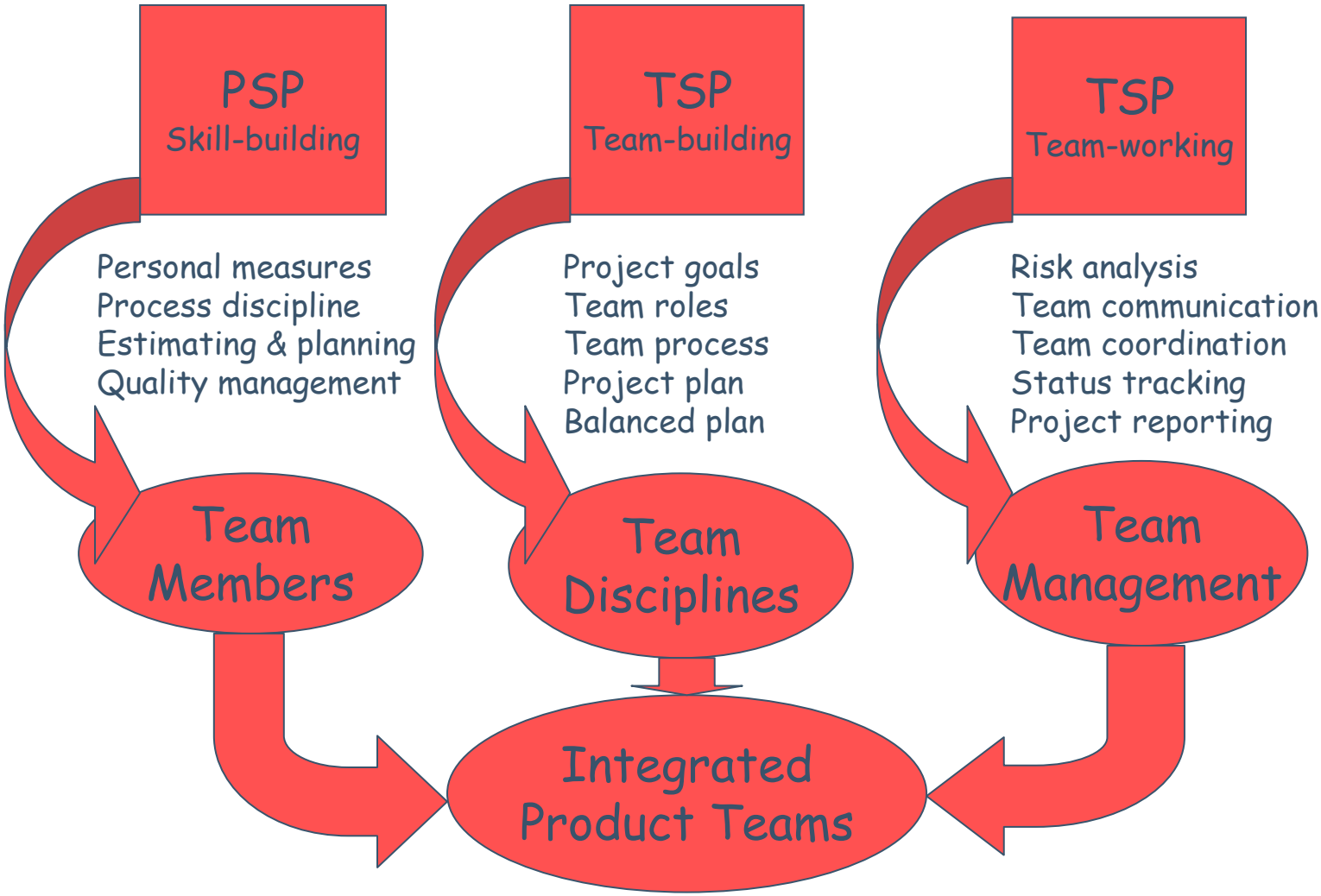
TSP Builds Effective Project Teams



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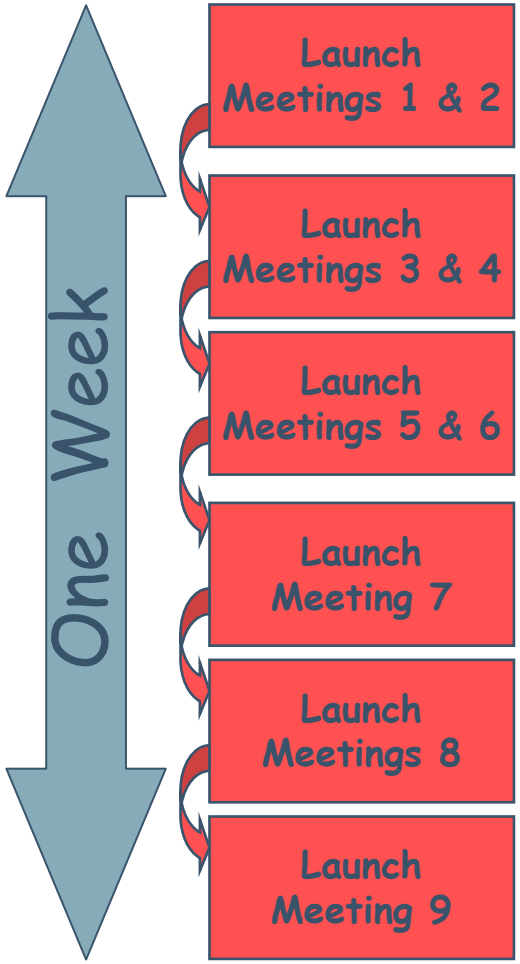
The TSP Launch Process



Management: Defines project goals
Answers team questions

Team: Establishes team roles
Defines team goals

Team: Defines the project strategy and process
Produces process and support plans
Makes an overall development plan

Team: Produces quality plan
Allocates next phase work to individuals
Engineers produce detailed personal plans
Consolidates individual plans into a team plan

Team: Conducts a project risk assessment
Assigns risks to engineers to track

Team: Reviews launch work completed
Prepares management presentation
Conducts a launch postmortem

Team: Presents the plan to management
Defends the plan to management

Management: Reacts to the team's plan
Resolves plan issues with the team

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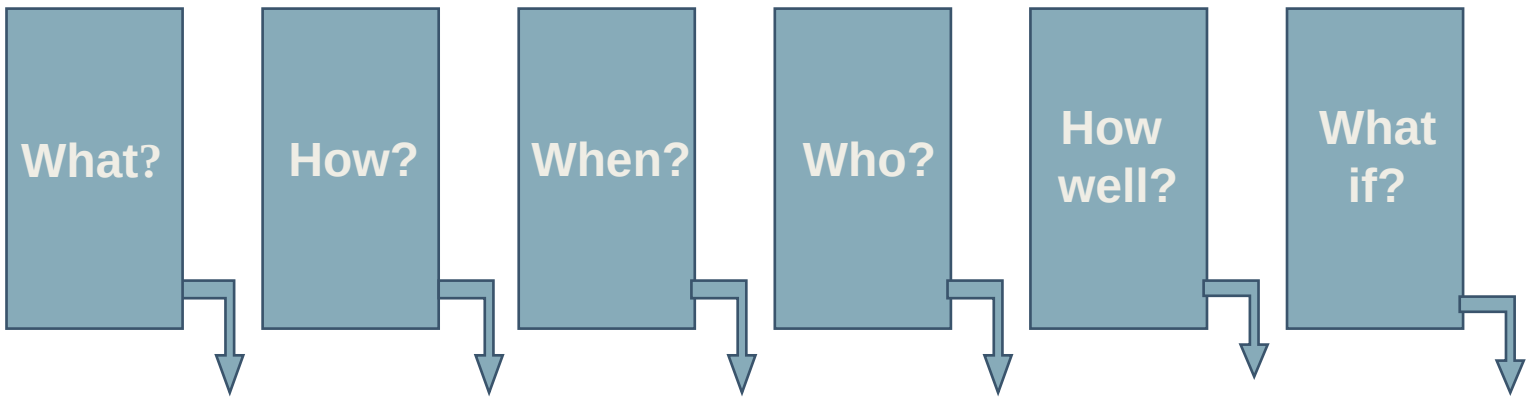
The TSP Launch Products

Business needs
Management goals
Product requirements



- Team goals
- Conceptual design
- Planned products
- Size estimates

- Team strategy
- Team defined process

- Task plan
- Schedule Plan
- Earned-value Plan

- Team roles
- Task plans
- Earned-value Plan

- Quality plan

- Risk evaluation
- Alternate plans

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NAVAIR/SEI Team

NAVAIR
- Tim Chick
- Dennis Linck
- Linda Roush
- Jeff Schwalb
- Paula Strawser

SEI
- Anita Carleton
- Noopur Davis
- Watts Humphrey
- Jim Over

NAVAIR Systems Engineering Pilots
- AV-8B Harrier Aircraft
- E2-C Hawkeye

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Research Challenges

As we kicked-off this effort, we realized that there were five areas of TSP that specifically had to be addressed for SE:

- Processes
- Measurement
- Role Definition
- Training
- Tool Support

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Research Challenges - Processes

Develop prototype processes/scripts for SE

Develop prototype processes/scripts for ACQ based on:

- the DoD 5000 series regulations
- CMMI Acquisition Module

Used “traditional” TSP launch process

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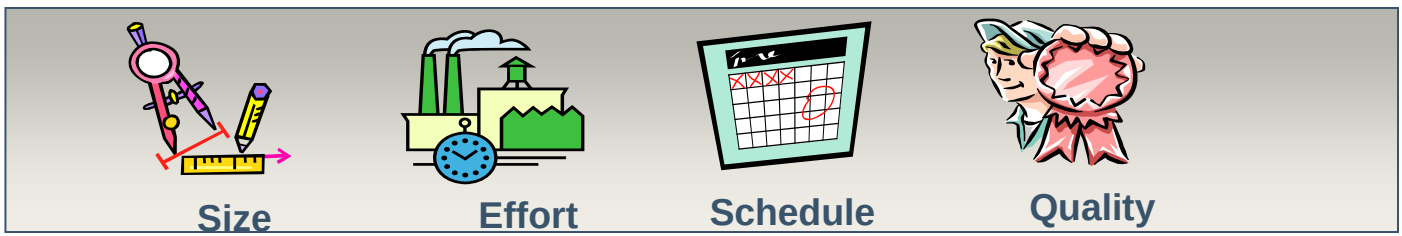
Research Challenges – Measurement - 1

Schedule and effort measures are essentially unchanged.

Lines of Code/Function Points would not serve as relevant size measures for SE/ACQ.
Formulate size measures for SE and ACQ.
Examples:

- DOORS objects
- Requirements
- Verifies



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Research Challenges – Measurement - 2

Quality measures in SE

- Define what “quality” means in SE
- Where in the process do you collect data?
- What are the derived quality measures (e.g., defects/DOORS object?)
- Establish an initial quality baseline during Build 1

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Research Challenges – Measurement - 3

What are the quality goals? Examples:

- Goal: Accuracy in the work
  Measure: # of problem reports against requirements and test documents

- Goal: Conformance to standards
  Measure: # of defects in peer reviews; # of defects in requirements and test documents, etc…

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Research Challenges – Role Definition

Apply four primary roles—planning, process, quality, support

Assess applicability of remaining roles and define additional roles needed for SE and ACQ.

- Added Requirements Manager
- Design and Implementation roles were combined into one role
- Test Manager role expanded to Flight Test Manager and Lab Test Manager

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Research Challenges – Training - 1

Currently, our training is geared to software teams.

Our challenges:

- building conviction and discipline in teams that don't write software programs
- providing just the right amount of training to get a team started
- supplementing with additional training modules as needed

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Research Challenges – Training - 2

Develop “JIT” training to support SE teams

Develop Leadership Seminar and Team Member Training to focus on:

- providing the fundamentals of TSP
- launching a team
- maintaining a plan

Follow-up with additional, “JIT” training, e.g.,

- Inspections
- Measurement, data analysis, and reporting
- Checkpoints and Postmortem Analysis
- Tool

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Research Challenges – Support Tool

Develop an extensible tool that allows for:

- Defining any process
- Collecting data unobtrusively
- Defining a measurement framework

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Progress

SE Pilot Projects Selected (AV-8B and E-2C)

SE/ACQ Prototype Processes/Scripts Developed

Training Developed

Prototype Support Tool Developed

AV-8B Team Trained and Launched

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Some Early Data

Launch Sept. 2006 … Ran like a “normal” launch

- Two year overall plan
- Near-term plan is 4 months
- 475 tasks
- 12 team members
- 22,000 task hours
- Gantt Chart didn’t provide visibility into all of the tasks that had to be completed
- Team members engaged in discussions of what the work would entail, dependencies, and what “task complete” meant

Issues:

- Level of granularity of the plan
- Defining appropriate roles for SE Projects
- Defining the SE process
- Developing a quality plan

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What's Next?

Complete NAVAIR pilots

Expand NAVAIR use as warranted

Incorporate lessons learned in TSP Program Plans

Evaluate prototype tools and courses for broader use

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NDIA
6th Annual CMMI Technology Conference
Denver, Colorado
November 13-16, 2006

Developing Systems Engineering Processes from Existing Software Processes

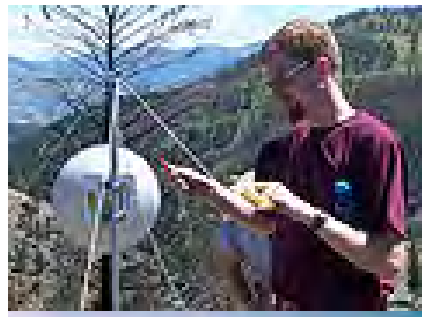
Lee Sheiner
Jeanne Balsam
Mark Pellegrini

Electronic Systems Laboratory
Georgia Tech Research Institute
Georgia Institute of Technology

Georgia Tech Research Institute

Georgia Tech Research Institute (GTRI) Overview

- Unit of the Georgia Institute of Technology
- 1200+ employees
- 70% of research employees hold advanced degrees
- Wide variety of products
- Customers include federal and state government; and industry
- Competitively bid projects range greatly in size and duration
- More Info: http://www.gtri.gatech.edu/



Overview

Transitioning to Systems Engineering

Configuration Management

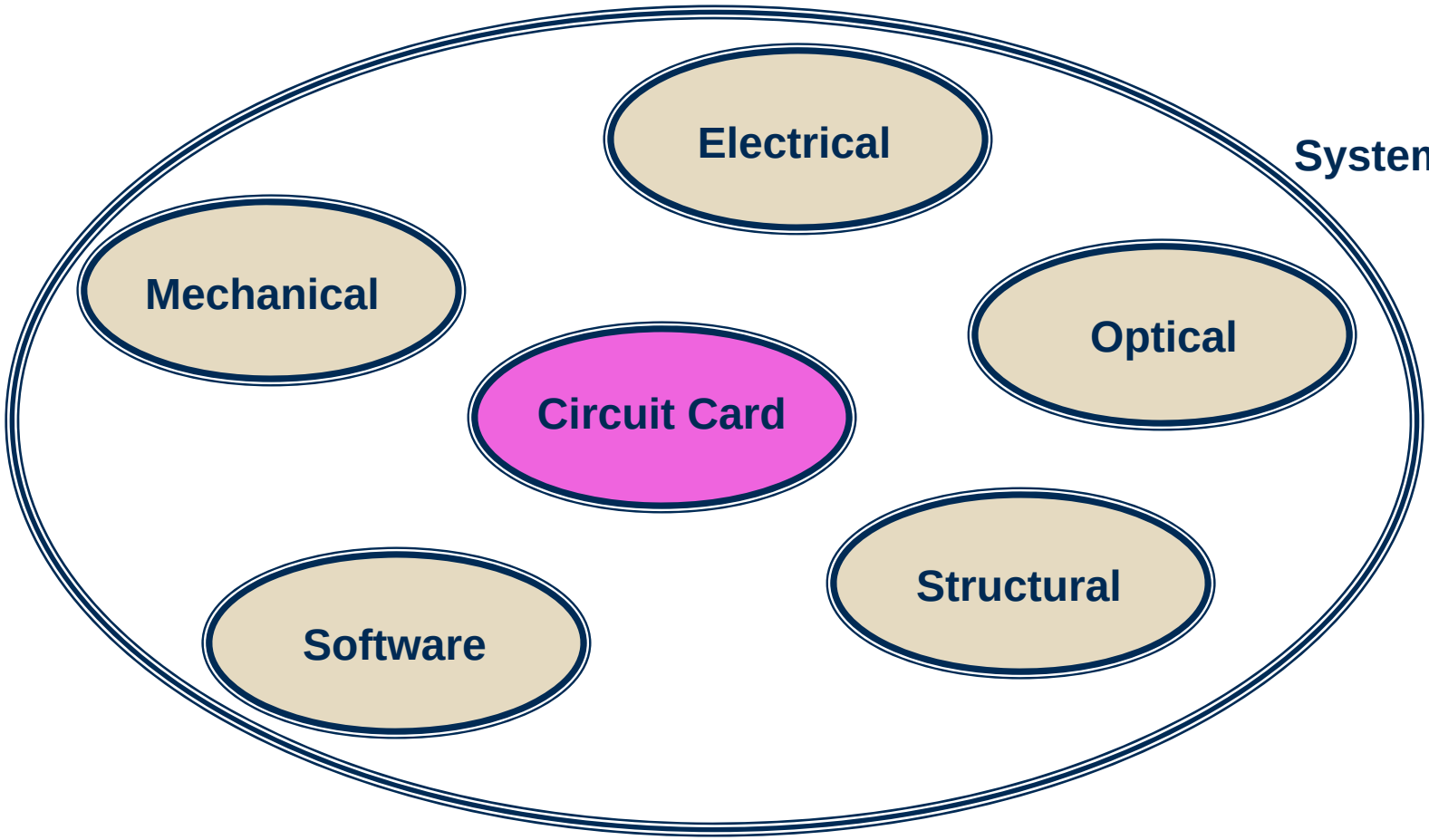
Project Planning

Peer Reviews

Summary

Questions

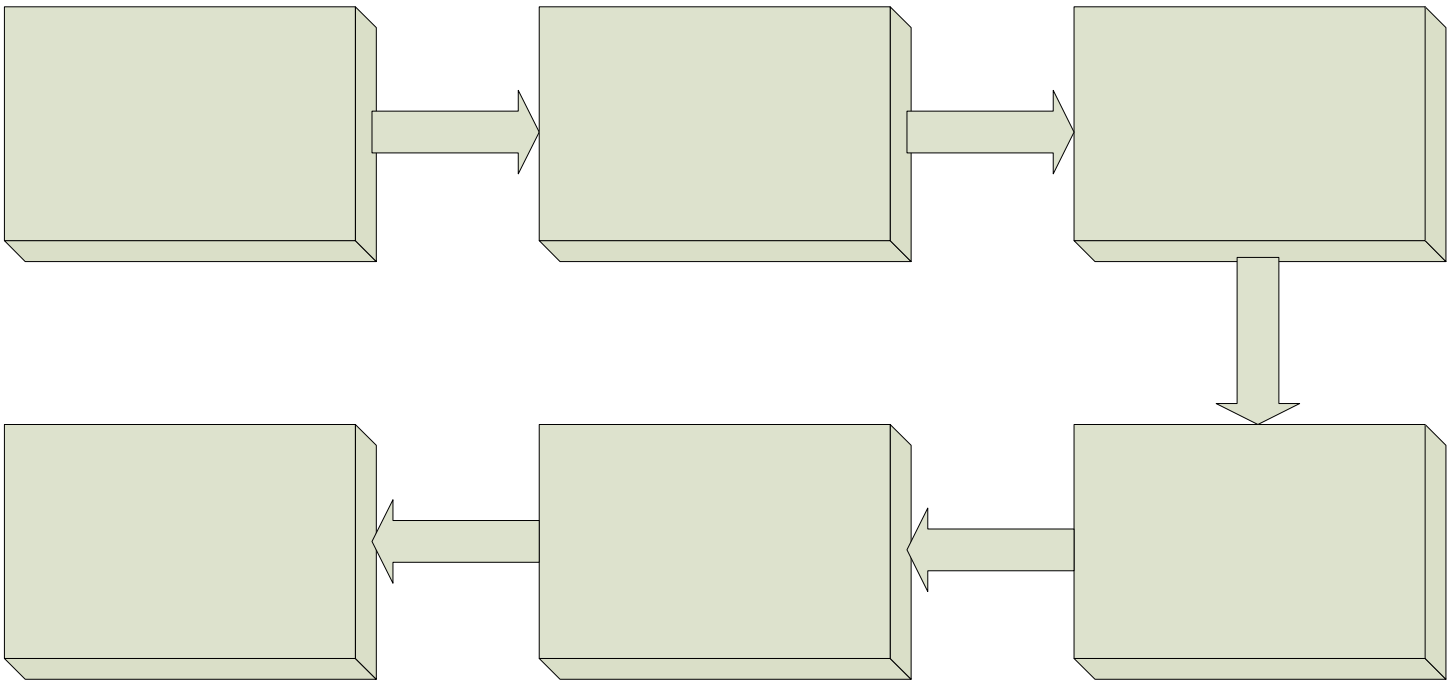
Systems Engineering



Starting Point

- Software developers were using CMM level 3 development processes
- An increasing number of programs included hardware components
- Developers with SW and HW expertise were informally carrying some processes to HW development
- Hired additional QA/Process Engineer with hardware development experience

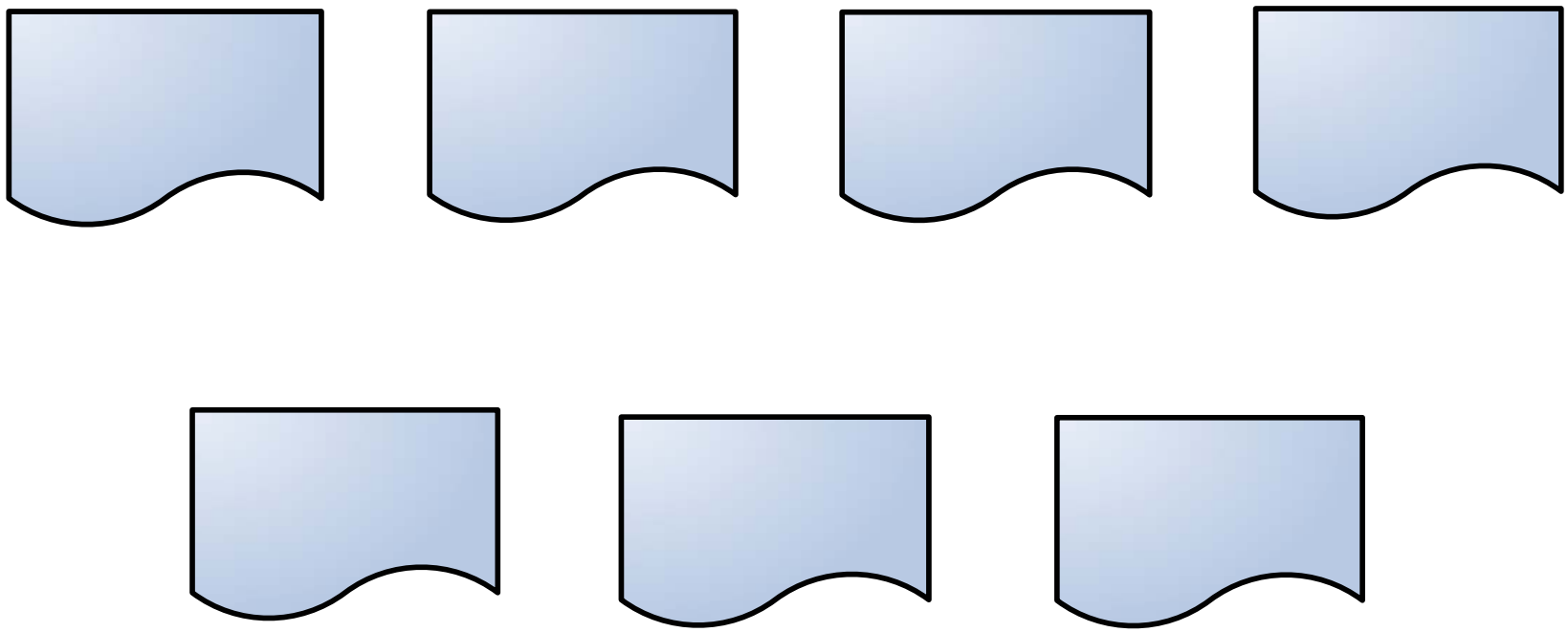
HW Development Process Overview



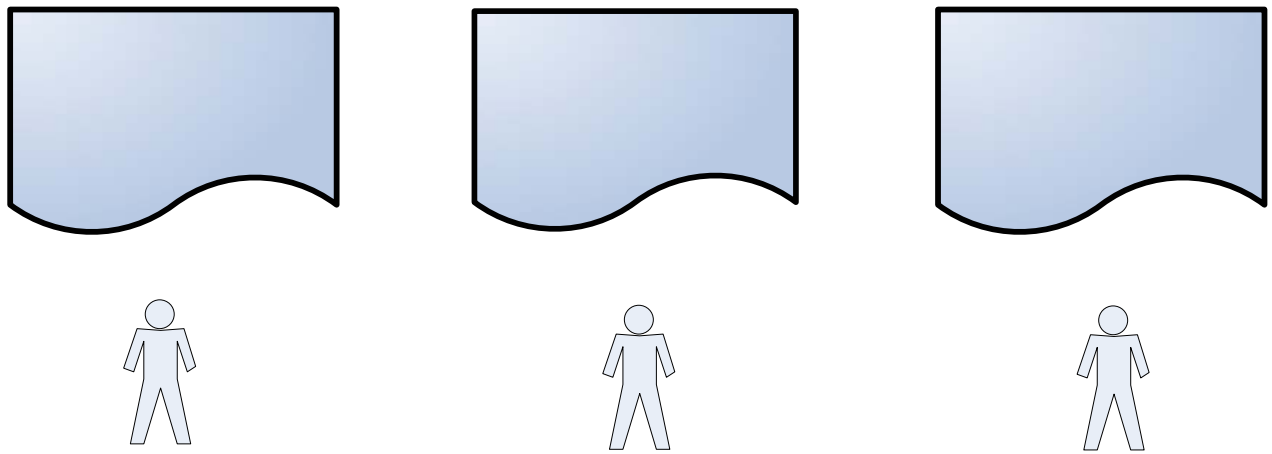
Beginning the Transition

- Removed “software” from our documented processes and procedures where appropriate
- Discovered that many existing procedures mapped reasonably well to Systems Engineering
- Identified additional items for project planning and peer reviews
- Configuration management did not map well at the lower-level details

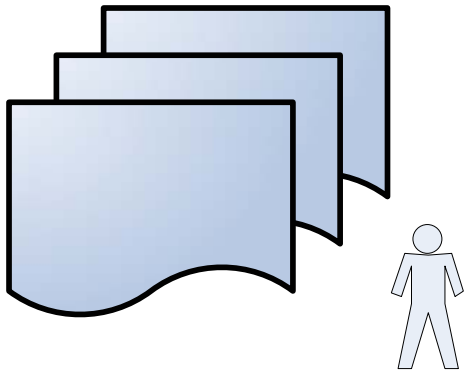
Work Products by Phase - Planning

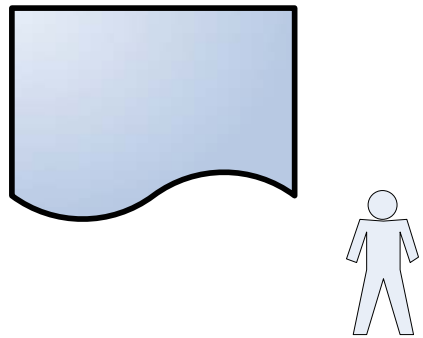


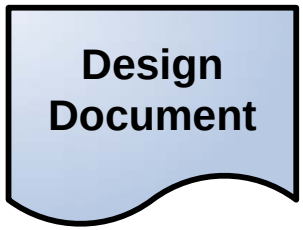
Work Products by Phase - Requirements

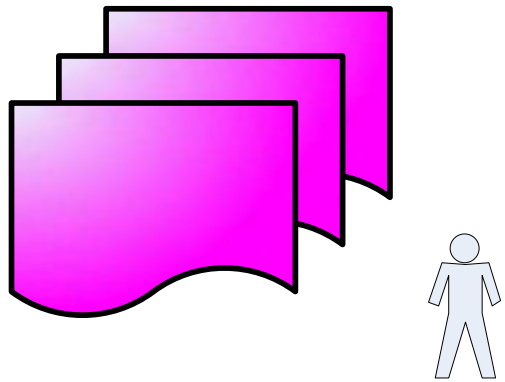


Work Products by Phase - Design

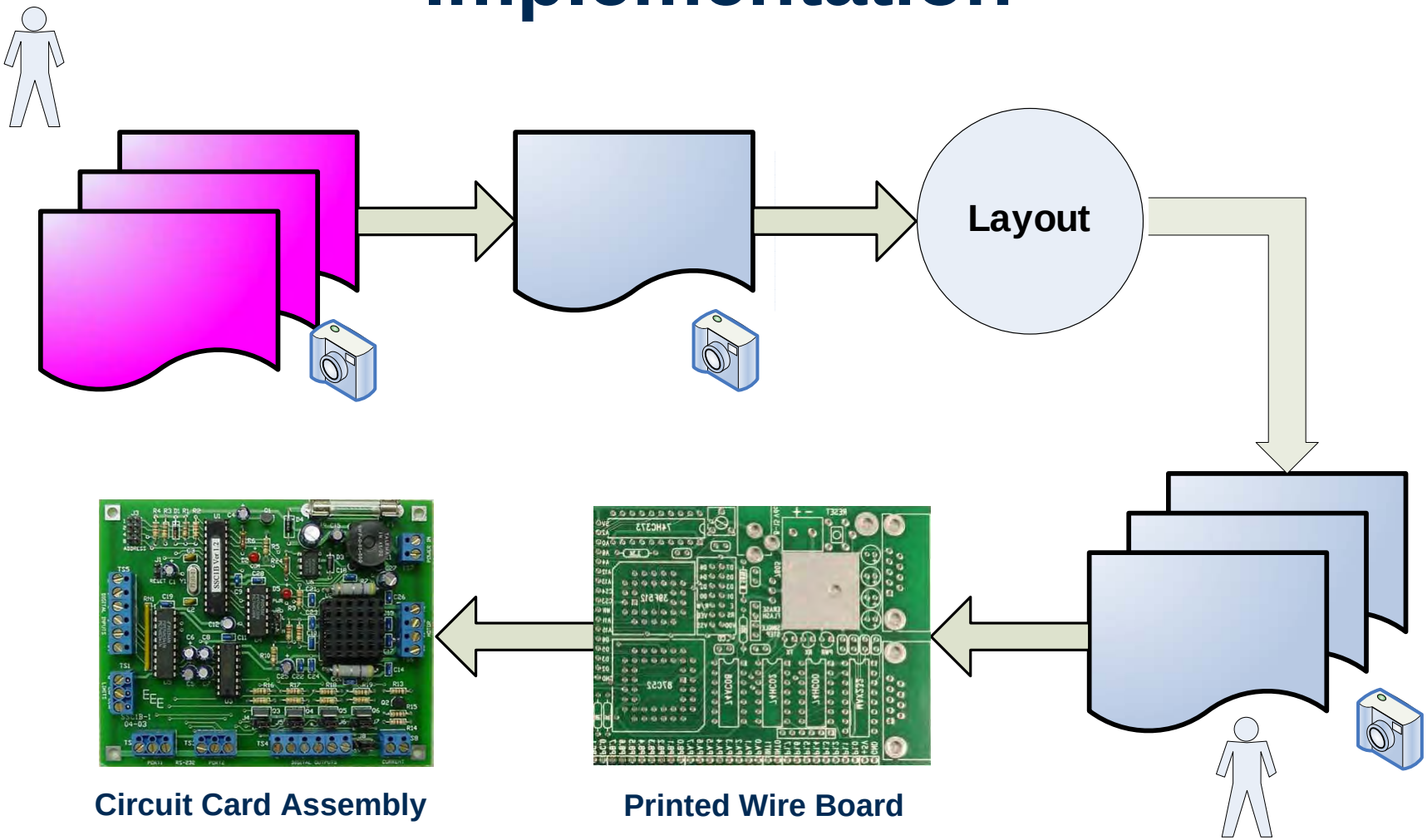




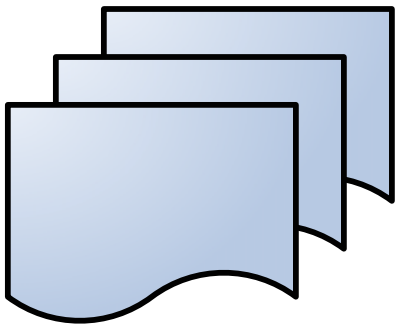


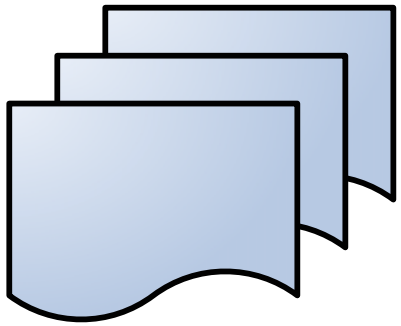


Work Products by Phase - Implementation



Work Products by Phase – Integration and Test





CM Issues: What to Control?

- **Many new types of configuration items are introduced with hardware**
- **Developers need guidance in what to control – important interim CIs are often overlooked**

CM Issues: New CIs to Control

- Gerbers
- VHDL
- Netlists
- Schematics
- Cable Drawings
- BOM / Parts List
- Data Sheets
- Symbol Libraries
- Technical Data Packages
- Assembly Drawings
- Text Fixtures / Test Code
- Master Pattern Drawings

CM Issues: Don’t lose Control

- Remember to control all files associated with HW development
- Items being fabricated (internally or externally) must be put under configuration control in advance
- Maintain control of physical HW items – which version of the card, firmware, embedded SW, and wire-mods are on the card
- Work products documented using multiple configuration items must be baselined
- Beware of “back-of-the-envelope” and red-line issues in fabrication

Example Directory Structure

- System
  - CCA-1
    - SW
    - HW
      - Assembly
      - Datasheets
      - Development Folder
      - Documents
      - Gerbers
      - Plans
      - PLDs
      - Schematics
  - CCA-2
  - CCA-N

File Types

Schematics

Sheet 1
:
Sheet N
Netlist
Symbol Library

Assembly

Mechanical Outline
Assembly Drawing
Master Pattern Drawing
BOM / Parts List

Gerbers

Layer 1
:
Layer N
.ipc Test File

PLDs

FPGA
VHDL
CPLD
VHDL

File Types – Continued

Documents

- *Requirements*
- *Design Description*
- *Interface Control Document*
- *Baseline Documents*
- *Test Descriptions*
- *Product Version Description*

Development Folder

- *Test scripts*

Plans

- *CM Plan*
- *Project Plan*
- *HW Development Plan*
- *Test Plan*

Data Sheets

- *Parts vendor info*

Project Planning Issues

- **Long lead times / critical path**
- **Facilities and equipment management**
- **Developmental baselines needed for fabrication**
- **“Hidden” software items**

Peer Review Issues

- **Consider schedule impact as well as cost-effectiveness**
- **Proper baselining of reviewed materials with multiple configuration items**
- **VHDL (Very High-speed Integrated Circuit Hardware Description Language) is software!**

Peer Review Issues

- Review hardware configuration items such as Gerber files, drawing packages (schematics, wiring diagrams, assembly drawings, parts lists, mechanical part designs, etc.)
- Select reviewers with HW and SW knowledge – be aware of software denial
- Review test software needed to exercise hardware

Beware

- Software “hiding” inside hardware items
- Tracing hardware requirements to hardware design
- Fabrication from uncontrolled designs
- “Quick fixes” that don’t get documented
- Changing HW configurations
- Software needed for HW testing

Acronyms

- BOM – Bill of Materials
- CCA – Circuit Card Assembly
- CI – Configuration Items
- CMM – Capability Maturity Model
- CMMI – Capability Maturity Model Integration
- GTRI – Georgia Tech Research Institute
- HW – Hardware
- PLD – Programmable Logic Device
- SW – Software
- VHDL – Very High-speed Integrated Circuit Hardware Description Language

Contact Information

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- **More Info about GTRI:**
  http://www.gtri.gatech.edu/

Rapidly Defining a Lean CMMI Maturity Level 3 Process

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Presentation Objectives

Describe CMMI compliant online HP process
- Outline Components for a cost effective, lean process

Describe HP's improvement objectives.
- Identify problems addressed by the streamlined CMMI L3 HP process

Describe the approach that was used to achieve CMMI Maturity Level 3.
- Unique techniques for defining & implementing an effective, lean CMMI L3 process in 8 months

Present some challenges and lessons learned.

Answer any questions.

Outline

HP Overview

HP Improvement Objectives

HP Approach

Challenges and Lessons Learne

Questions and Answers

FY05 C&I EAS/Federal Initiatives

EAS & Public Sector Initiative	*CMMI Relation*
• CMMI L3 Achievement	• Development of EAS HPGM-AS methodology, rollout and assessment.
• Expand Application Services	• L3 methodology is unifying force for consistent standards and practices.
• Increase Pursuit Capabilities	• CMMI allows us to pursue opportunities we would not get otherwise • Better estimation and marketing of services
• Delivery Excellence	• Standardization and enforcement of best practices.
• Profit Improvement	• Disciplining delivery execution and preventing margin leakage by fostering reuse and minimizing risk

Existing Methods Revised to Meet CMMI Level 3

2004

A $1.5 Million dollar, 8 month project started to revise Success Program to meet CMMI level 3 and improve project controls. Some current and new FY05 Federal Contracts at risk without a CMMI level 3 compliant process.

- Sept — CMMI Level 3 Gap Analysis on Current Methodology
- Oct -Nov — HPGM-AS Methodology Customizations - define per Sharepoint portals
- Dec — Pilots Start :
  - •PM Orientations/Planning Sessions per project
  - •CMMI & Methodology Classroom Training

Pilots Underway

2005

Success Program Office (SEPG team) and Pilot Projects start leveraging Success Program revised with the new CMMI level 3 compliant process

- Jan — Envisioning & Maintenance Phase Pilots start
- Feb — Design & Maintenance Phase Pilots
- Mar — Build & Maintenance Phase Pilots
- April — Pilots Continue & CMMI Assessment begins
  - April 29 EAS and Public Sector Achieve CMMI level 3 maturity

Components of the HP CMMI L3 Process

Technology

- Sharepoint based portals:
  - Success Program Office
  - Success Manager
  - Success Reviews
  - HPGM-AS Roadmap
  - RADM Virtualization

Process

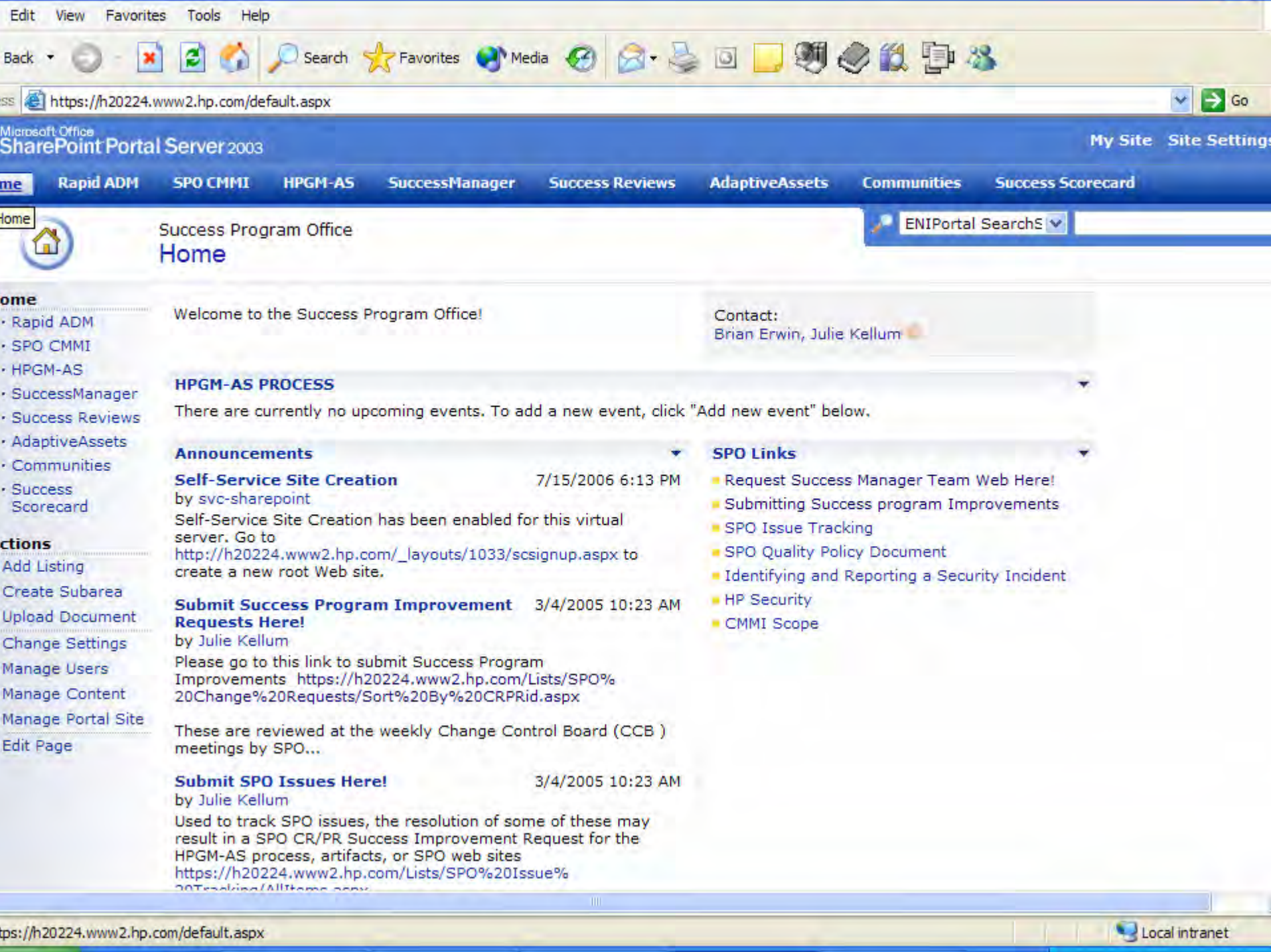
- SEI CMMI L3 framework
- HP Global Method Application Services (HPGM-AS - methodology)
- Success Reviews (PPQA audit process)
- Success Manager (Team Collaboration process)
- Adaptive Assets (Knowledge Capture & Reuse process)

People

- Success Program Office (SEPG function)
- SQA Coaches (per team)
- Program Management
- Organization & Culture

Success Program Office

EAS HP Global method Application services (HPGM-AS)	• Delivery Workflow portal/process • CMMI level 3 compliant • Phase deliverables & Signoffs
Success Manager	• Team Collaboration web/process • Pre-Loaded HPGM-AS • Customer accessible
Success Reviews	• Process Review (PPQA) portal/process • Mentoring Support By Field PMs
Adaptive Assets Knowledgebase	• Process and Tech Asset KB portal/process • Reuse tool
Rapid ADM	• Supports HPGM-AS Configuration Mgt • Virtualization and Software Configuration • Management (SCM) services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· Communities
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Create Subarea
Upload Document
Change Settings
Manage Users
Manage Content
Manage Portal Site
Edit Page
Welcome to the Success Program Office!
Contact:
Brian Erwin, Julie Kellum
HPGM-AS PROCESS
There are currently no upcoming events. To add a new event, click "Add new event" below.
Announcements
Self-Service Site Creation 7/15/2006 6:13 PM
by svc-sharepoint
Self-Service Site Creation has been enabled for this virtual server. Go to http://h20224.www2.hp.com/_layouts/1033/scsignup.aspx to create a new root Web site.
Submit Success Program Improvement Requests Here! 3/4/2005 10:23 AM
by Julie Kellum
Please go to this link to submit Success Program Improvements https://h20224.www2.hp.com/Lists/SPO%20Change%20Requests/Sort%20By%20CRPRid.aspx
These are reviewed at the weekly Change Control Board (CCB) meetings by SPO...
Submit SPO Issues Here! 3/4/2005 10:23 AM
by Julie Kellum
Used to track SPO issues, the resolution of some of these may result in a SPO CR/PR Success Improvement Request for the HPGM-AS process, artifacts, or SPO web sites https://h20224.www2.hp.com/Lists/SPO%20Issue%
SPO Links
Request Success Manager Team Web Here!
Submitting Success program Improvements
SPO Issue Tracking
SPO Quality Policy Document
Identifying and Reporting a Security Incident
HP Security
CMMI Scope
tps://h20224.www2.hp.com/default.aspx
Local intranet

Home - HPGM-AS Roadmap R2.6 - Microsoft Internet Explorer provided by Hewlett-Packard

File Edit View Favorites Tools Help

Back Search Favorites Media

Address https://h20224.www2.hp.com/sites/ProjectsCMMi/SuccessPath_HPGM-AS_Roadmaps/Roadmap_v6/default.aspx Go Links

Home Documents and Lists Create Site Settings Help Up to Success Manager HPGM-AS Roadmaps

HPGM-AS Roadmap R2.6

Home

This Site

Modify Shared Page

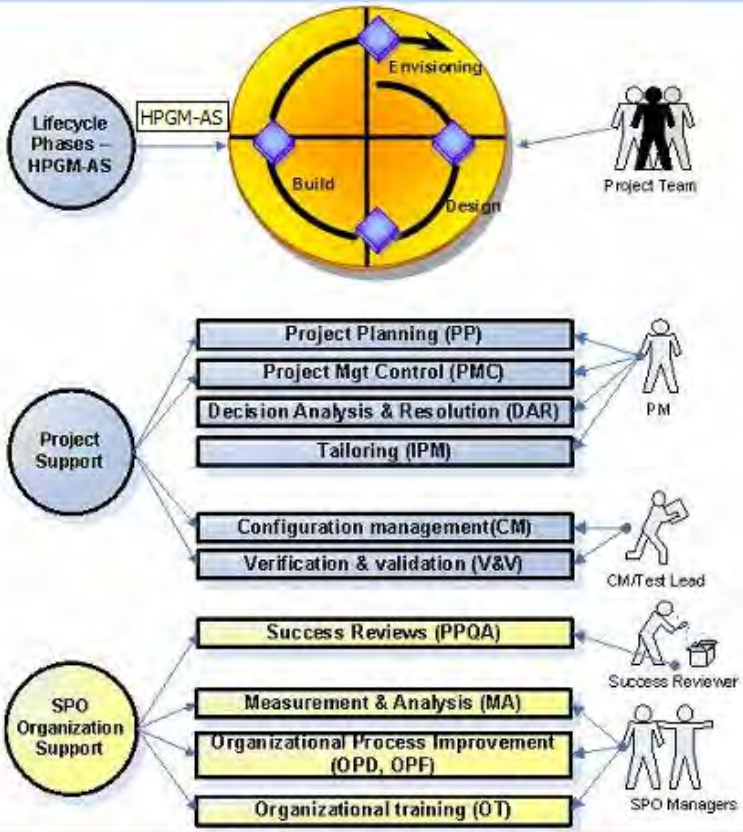
Documents
- HPGM-AS ZIPed Templates

Pictures

Lists
- New Projects START HERE
- Lifecycles
- ENVISIONING PHASE
- DESIGN PHASE
- BUILD PHASE
- ARTIFACTS
- Project Planning (PP)
- Project Management (PMC)
- Configuration Management (CM)
- Verification and Validation (V&V)
- Peer Review (V&V)
- Decision Analysis Resolution (DAR)
- Tailoring (IPM)
- SPO Success Reviews (PPQA)

Second Release of HP Global Method for Application Services which is a level 3 CMMI application development methodology supporting iterative, waterfall and maintenance lifecycles in HP's Consulting and Intergration (C&I) area

HPGM-AS



CMMI Links
- SUBMIT Success Program Improvements Here!
- Adaptive Assets
- Success Reviews
- CMMI project webs (currently USPS only - special clearance required)
- HPGM-AS Lifecycles Overview
- SPO Portal
- SPO Lessons Learned Analysis
- HPGM-AS Impact Analysis Tool
- SPO Configuration Management Plan
- SPO Training Plan
- SPO Improvement Plan (SIP)
- SPO Quality Policy
- SPO Quality Assurance (QAP) Plan
- CMMI Scope & Design Decisions

Add new link

Contacts

Last Name	First Name	Role
Galvan	Carlos	April 18-29 Lead CMMI Assessor
Erwin	Brian	Centers of Excellance Manager

Done Local intranet

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Success Program Office

Success Reviews

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Success Review Home Page

Welcome to the Success Review Home Page!
This site defines the PPQA Success Review schedule and lists the results of the PPQA based CMMI audits. In addition, the templates used in Success Reviews are shown in LINKS section.

Contact:
Debra Henrichs

Announcements

Success Review Schedule 5/8/2006 4:11 AM
by Julie Kellum
Latest schedule for all CMMI project and SPO PPQA audits: https://h20224.www2.hp.com/C15/Success%20Review%20Scorecard/Lists/Success%20Review%20Summary/AllItems.aspx

Auditors Place Results here 8/12/2005 9:42 AM
by Julie Kellum
https://h20224.www2.hp.com/C2/SuccessReviews/Document%20Library/Forms/AllItems.aspx

Success Review R2v6 Process 6/15/2005 6:38 AM
by Julie Kellum
PPQA-based process that outlines how audits will be performed to monitor and control HPGM-AS process compliance by project's that fall within the CMMI scope area

https://h20224.www2.hp.com/sites/ProjectsCMMi/SuccessPath_HPGM-AS_Roadmaps/Roadmap_v6/Lists/Process%20and%20Product%20Quality%20PPQA%20%20INSHORE/ByActivityId.aspx

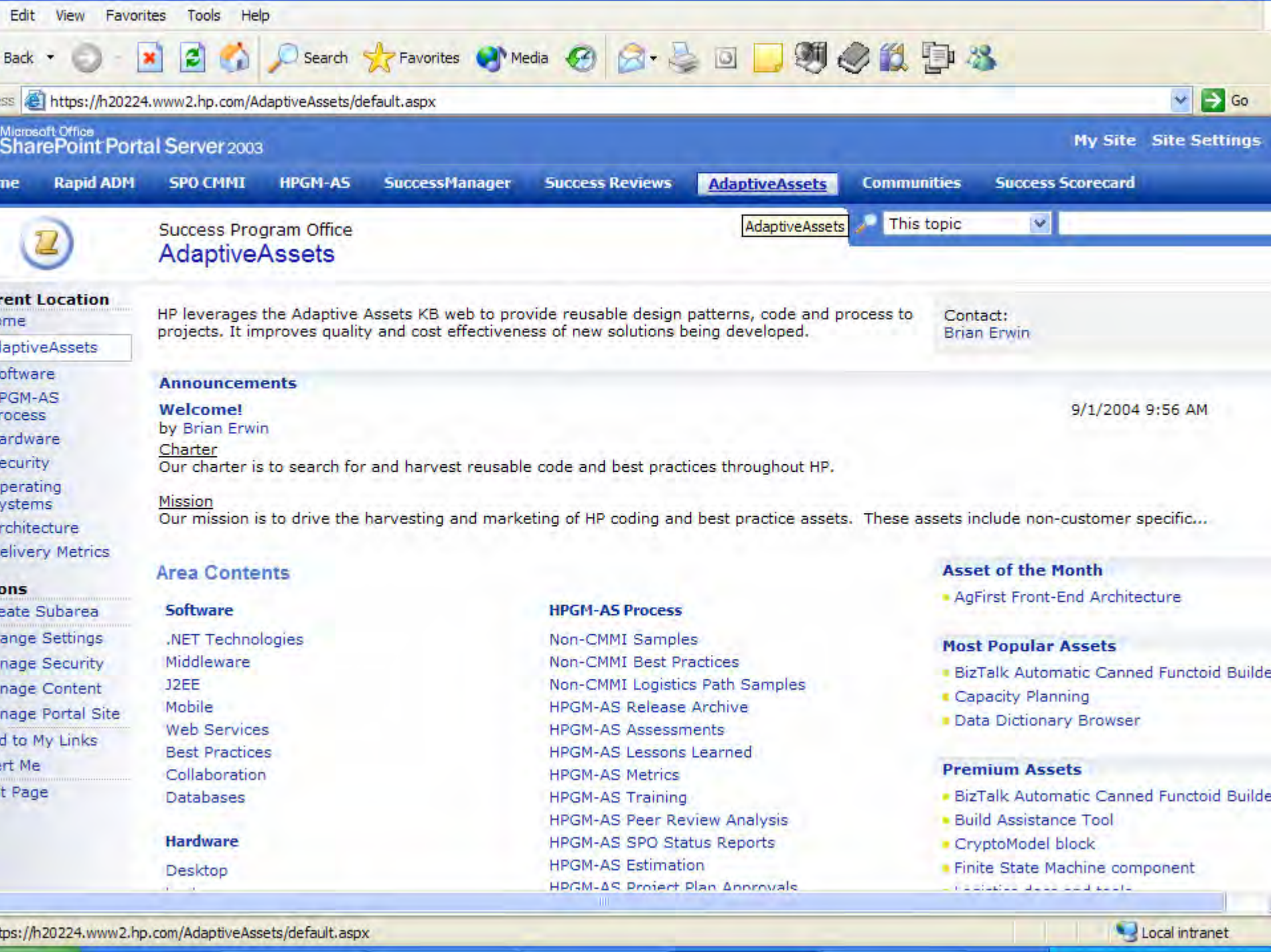
Success Review Findings 3/15/2005 6:02 AM
by Julie Kellum
Latest CMMI PPQA Success Review audit findings:
https://h20224.www2.hp.com/C2/SuccessReviews/Lists/NC%20List/AllItems.aspx

Add new announcement

Links

Success Review Reports
Success Review Summar
Archive of Records while Audits
Organizational QA Plan
Success Review Template
Organizational QA Plan (t
Success Review Kickoff M
Planning (for Interviewww)
Success Review Report (t
Success Review Summar
Success Review Plan (ten
SPO Audits of Success Re
BSI - Online Course - "Es
Sample Questions Checkl
Success Program Improv

Add new link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SharePoint Portal Server 2003
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t Page
HP leverages the Adaptive Assets KB web to provide reusable design patterns, code and process to projects. It improves quality and cost effectiveness of new solutions being developed.
Contact:
Brian Erwin
Announcements
Welcome!
9/1/2004 9:56 AM
by Brian Erwin
Charter
Our charter is to search for and harvest reusable code and best practices throughout HP.
Mission
Our mission is to drive the harvesting and marketing of HP coding and best practice assets. These assets include non-customer specific...
Area Contents
Software
.NET Technologies
Middleware
J2EE
Mobile
Web Services
Best Practices
Collaboration
Databases
Hardware
Desktop
HPGM-AS Process
Non-CMMI Samples
Non-CMMI Best Practices
Non-CMMI Logistics Path Samples
HPGM-AS Release Archive
HPGM-AS Assessments
HPGM-AS Lessons Learned
HPGM-AS Metrics
HPGM-AS Training
HPGM-AS Peer Review Analysis
HPGM-AS SPO Status Reports
HPGM-AS Estimation
HPGM-AS Project Plan Approvals
Asset of the Month
AgFirst Front-End Architecture
Most Popular Assets
BizTalk Automatic Canned Functoid Builde
Capacity Planning
Data Dictionary Browser
Premium Assets
BizTalk Automatic Canned Functoid Builde
Build Assistance Tool
CryptoModel block
Finite State Machine component
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Local intranet

Success Program Office

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Success program Office (SPO) web site for managing CMMI intiative

Contact:
Julie Kellum

HPGM-AS Release Schedule

Title	Release Link	Release Date	Release CRs
R1.5 HPGM-AS	R1.5	12/1/2004	n/a
R2.6 HPGM-AS	R2.6	4/18/2005	CLICK Here for list of CRs for this Release
R3.0 HPGM-AS	TBD	9/30/2005	CLICK Here for list of CRs for this release
R4.0 HPGM-AS	TBD	10/28/2005	CLICK here for list of CRs for this Release

Add new announcement

Primary SPO Links

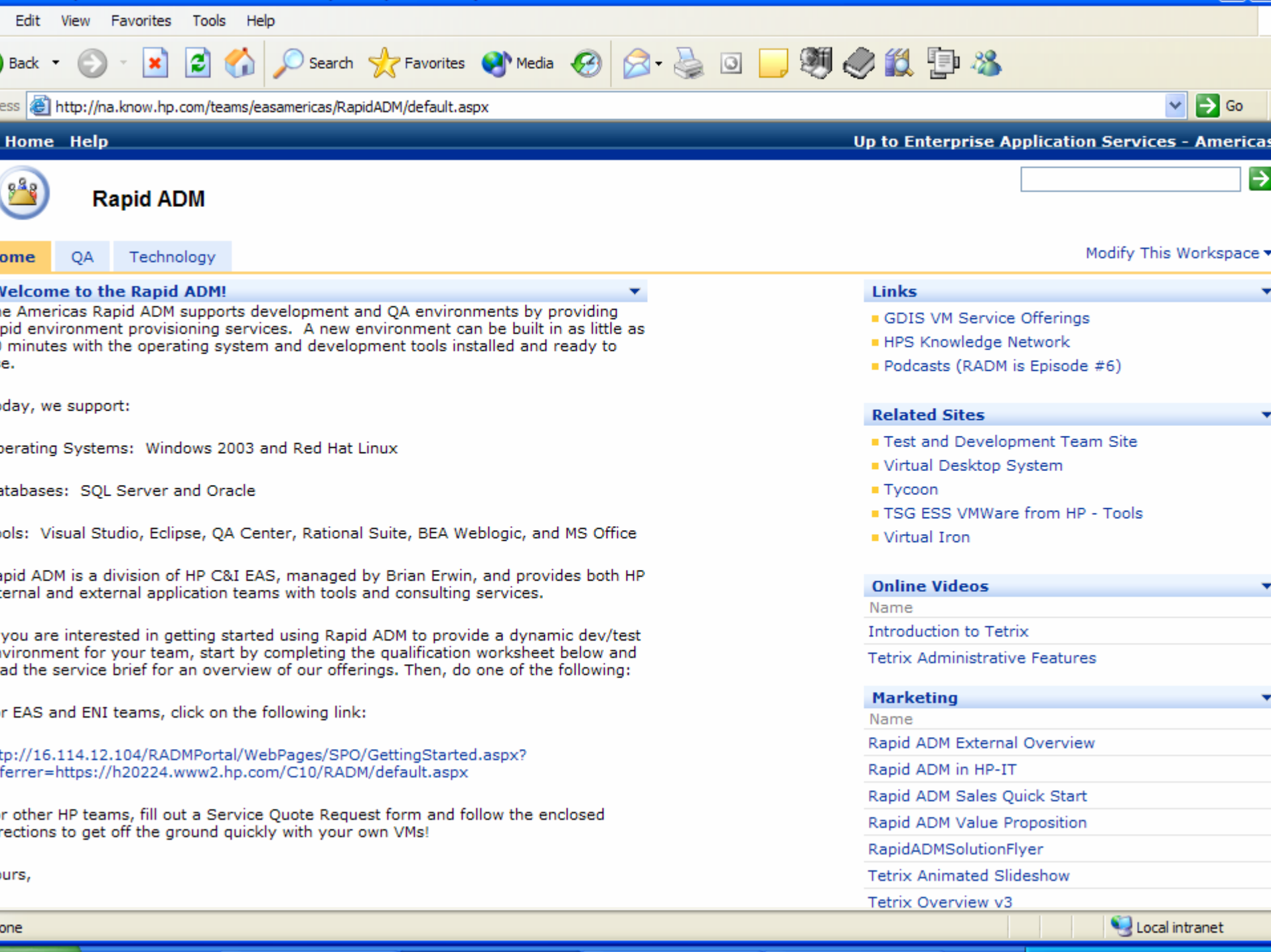
SPO Action Items
SPO Change Requests/Problem Reports (CR/PR)
SPO Issues

Add new link

SPO Workbench

New Item | Filter

SPO Id	Edit	Process Area	Category	SPO Activity LINK	Note
310		OT	Training	Individual Training Plans	HP Performance Plans - Contains Training Plans
330		OT	Training	Training Effectiveness Analysis	Contains quarterly assessment of training feedback and effectiveness an communication of analysis to the SMSC
300		OT	Training	Training Feedback Forms	Training feedback form used for eliciting feedback - used in Training Effectiveness Analysis - Note that original feedback forms kept on file for
290		OT	Training	Training Records	Contains the SPO Training records on process training completed as well links to Learn @HP which provides online training records for all employe Learn @ HP is leveraged to track training for skills outside of the HPGM-p training requirements
370		PPQA	Success	QA Plan (Success Review)	Online Schedule and status of Success Review audits planned; Used by t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Welcome to the Rapid ADM!
e Americas Rapid ADM supports development and QA environments by providing
pid environment provisioning services. A new environment can be built in as little as
minutes with the operating system and development tools installed and ready to
e.
day, we support:
perating Systems: Windows 2003 and Red Hat Linux
atabases: SQL Server and Oracle
ols: Visual Studio, Eclipse, QA Center, Rational Suite, BEA Weblogic, and MS Office
pid ADM is a division of HP C&I EAS, managed by Brian Erwin, and provides both HP
ternal and external application teams with tools and consulting services.
you are interested in getting started using Rapid ADM to provide a dynamic dev/test
vironment for your team, start by completing the qualification worksheet below and
ad the service brief for an overview of our offerings. Then, do one of the following:
r EAS and ENI teams, click on the following link:
tp://16.114.12.104/RADMPortal/WebPages/SPO/GettingStarted.aspx?
ferrer=https://h20224.www2.hp.com/C10/RADM/default.aspx
r other HP teams, fill out a Service Quote Request form and follow the enclosed
rections to get off the ground quickly with your own VMs!
urs,
Links
GDIS VM Service Offerings
HPS Knowledge Network
Podcasts (RADM is Episode #6)
Related Sites
Test and Development Team Site
Virtual Desktop System
Tycoon
TSG ESS VMWare from HP - Tools
Virtual Iron
Online Videos
Name
Introduction to Tetrix
Tetrix Administrative Features
Marketing
Name
Rapid ADM External Overview
Rapid ADM in HP-IT
Rapid ADM Sales Quick Start
Rapid ADM Value Proposition
RapidADMSolutionFlyer
Tetrix Animated Slideshow
Tetrix Overview v3
one
Local intranet

Outline

HP Overview

HP Improvement Objectives

HP Approach

Challenges and Lessons Learne

Questions and Answers

Success Program Vision

- Using a sales and delivery integrated approach, leverage existing, as well as grow new process and technical Adaptive Assets to :
  - Increase ability to compete in Federal bids through CMMI Level 3 compliance
  - Win more business through improved differentiation
    - IBM differentiation point
  - Increase Success of Projects
    - Synergistic Teams
    - Referencable Clients
    - On Time
    - In Budget/Profitable
    - Effective HP Global Methods Applied

Success Program ➔ What & Why

- Collection of specific process and technical assets used in pre-sales for differentiation and in delivery to increase project success
- CMMM Maturity Level 3 compliant to meet Federal bid requirements
- Externally accessible outside HP Firewall by delivery teams
- Major Areas:
  - Success Path HPGM-AS
  - Success Manager
  - Success Reviews
  - Adaptive Assets KB
  - Communities & Forums
- Best of breed IP from HP

Outline

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HP Approach

Leverage existing HP processes and templates:

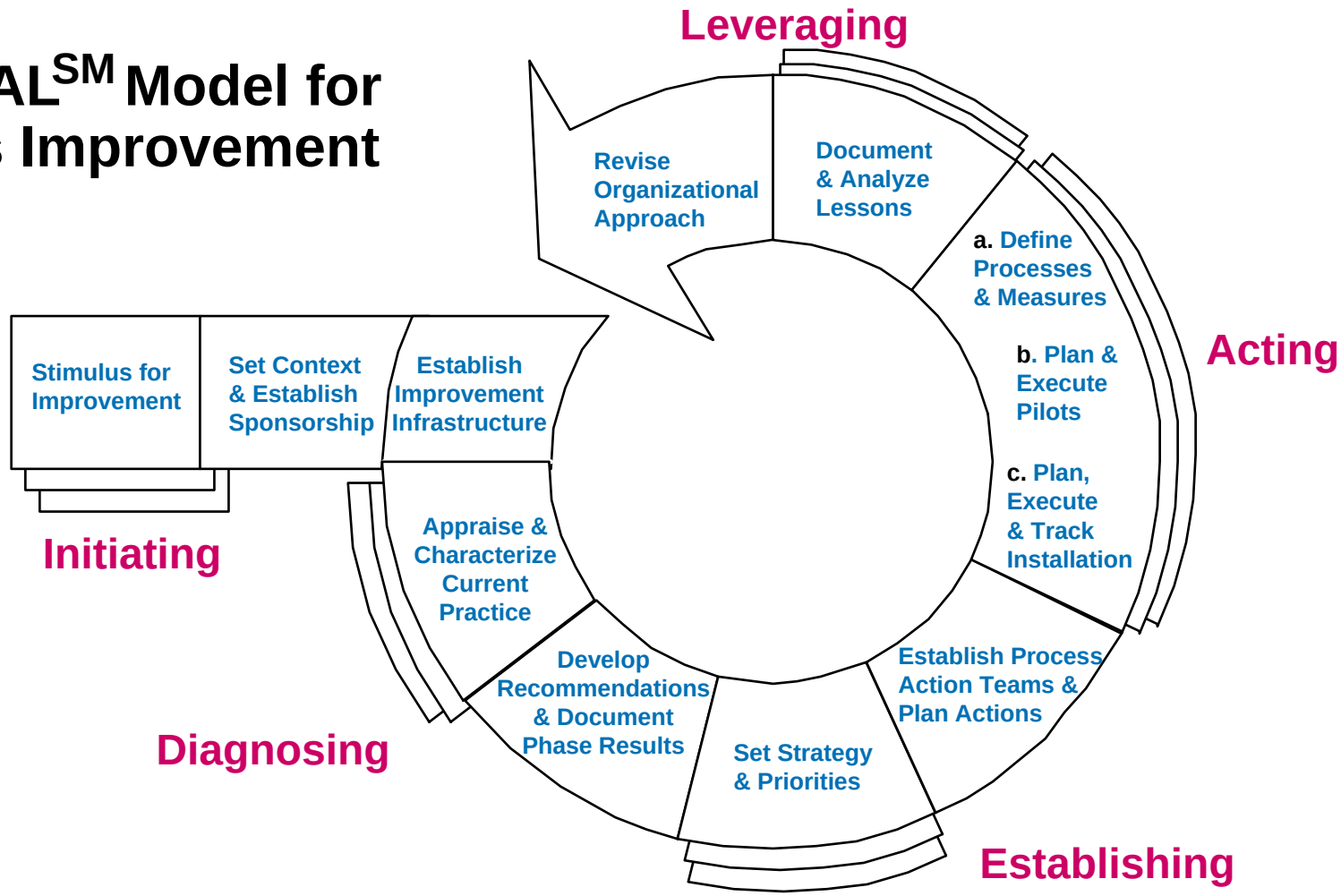
- Success Program
- HP India (CMMI Maturity Level 5)
- HP Global Methods for Application Services (HPGM-AS)
- HPGM for Project Management (HPGM-PM)

Deploy Tailored SEI IDEAL^{SM} Model and reuse existing processes to be CMMI compliant.

Leverage Best of breed IP from HP

SEI IDEAL^{SM} Model

SEI IDEAL^{SM} Model for Process Improvement



- SM IDEAL is a service mark of Carnegie Mellon University; Slide Adapted from SEI

Tailored SEI IDEAL^{SM} Model

Initiating: Sponsor sold idea to HP senior management.

Diagnosing: HP India performed a mini-appraisal (e.g., Class B).

Establishing: CMMI Consultant established high-level plan and HP established a CMMI Team.

Acting: Architected HP processes to be CMMI compliant in 2 months; Skipped piloting; Trained and implemented experienced projects.

Success: Performed independent SCAMPI A.

HP's "Lean" Process

HP Success Program is a very "lean" CMMI compliant process (about 25% of the size of the HP India process).

The process is completely online, and uses Microsoft SharePoint.

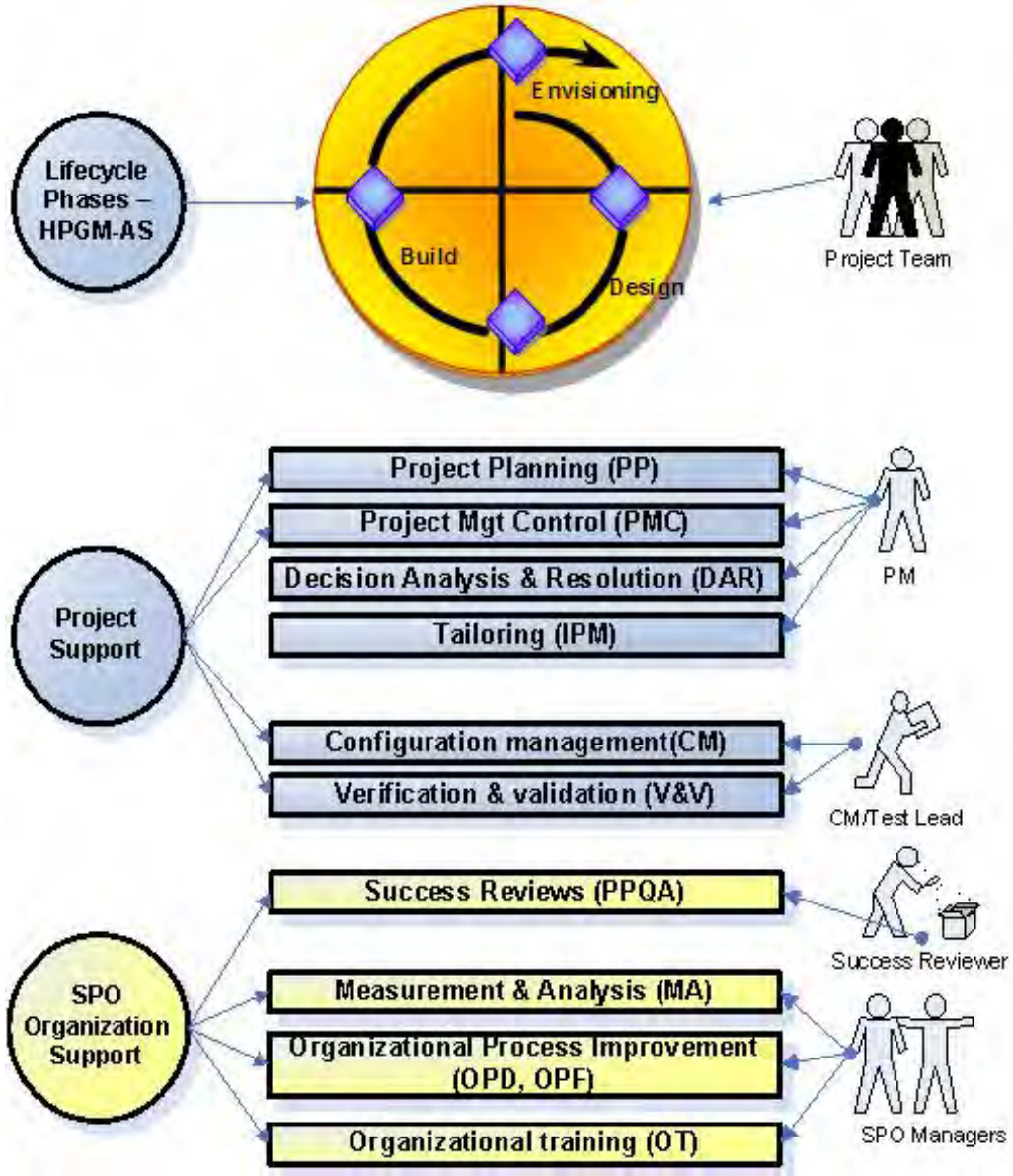
HP's process is only ~25web pages in size.

HP incorporated best practices in process definition

- e.g., "Defining Short, Usable Processes and Procedures", CrossTalk, Olson, Timothy G., June 2006.

HPGM-AS CMMI L3 Methodology

- 2 Paths depending on project profile
  - Large HPGM-AS CMMI Implementation
  - Small HPGM-AS CMMI Implementation
  - Excluded are projects required to use the customer's app dev methodology & staff aug
  - No existing projects asked to convert – new only
  - Large and Small Project implementations differ mainly
    - on use of Success Reviews and Deliverables Required



HPGM-AS Artifact Comparison Example

Small/Low Risk	Large/High Risk
Success Manager site (Issues List & Change Req/PR List)	Success Manager site (Issues List & Change Req/PR List)
Project Plan & Configuration Mgt Plan	Project Plan & Configuration Mgt Plan
Schedule	Schedule
Mini-Spec (Contains sections from all of these ➔)	Bus Req Spec (BRS) Systems Req Spec (SRS) Systems Architecture (SA) Detail Design (DD) V&V /Test Plan Req Traceability Matrix (RTM)
Peer Review Log/Checklist – Mini-Spec CM Audit Checklists – Success Manger, Product Milestone Review Phase Checklists	Peer Review Log/Checklist – Project plan, SRS, SA, V&V Plan CM Audit Checklists – Success Manager, Code, Product Milestone Review Phase Checklists

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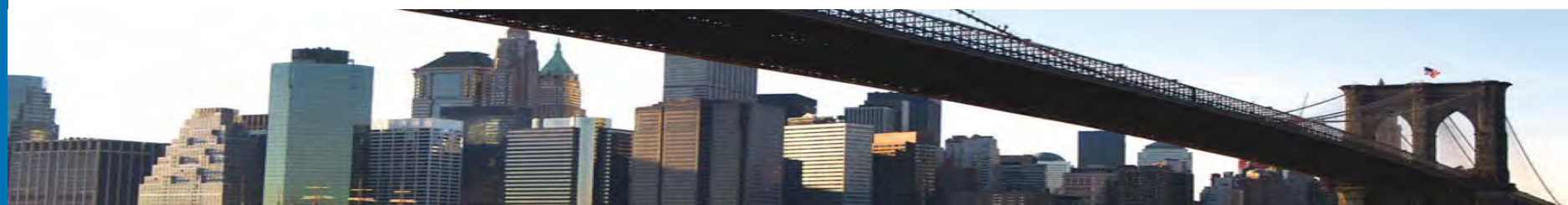
Challenges

- CMMI Resources were reallocated to the new high priorities.
- Resistance to change when people have gone through several changes without tangible results.
- Aggressive schedule
- Unexpected events such as team health and organizational changes

Lessons Learned

- It takes time, senior management support, and mentoring to change behavior
- Traditional Classroom training not enough – critical to have a local resource to mentor team on methodology/CMMi activities and artifacts
- Success Reviews critical for monitoring and mentoring on process use
- Critical to use centralized team collaboration tool for process support (i.e. PPQA, Peer Reviews, Lessons Learned, Issue Tracking/Project Change control, etc)



Lessons Learned

- Spend ample time in planning phase to lock down the scope of the project.
- Obtain and maintain executive sponsorship to keep driving the project on schedule.
- Define Configuration Management early in the process.
- Follow the Configuration Management process.
- There is no substitute for one-on-one mentoring for the late adopters.
- Ensure core team understands the entire process.
- Ensure the process is lean and relevant.

Lessons Learned

- Engage stakeholders throughout the process.
- Third party consultants can provide objective feedback.
- Build a diverse team and leverage diversity.
- Ensure CMMI expert resources are on the team.
- CMMI really does require continuous process improvement.

What Went Well

- Teams reap benefits of Peer Reviews, and Milestone Reviews
- Pilot projects implement a consistent delivery approach
- Improved metrics to track trends across projects
- Integration of virtualization through CM process
- Increased value to customer through improved communications thru SPO:
  - Success Manager Team Webs
  - Status Reporting
  - Automated Issues and Change Request tracking

What Went Well

- Expanded Rollout of Success program to ~300
- Implemented new Success Program processes:
  - HPGM-AS Bid Review (Pre-sales)
  - HPGM-AS Quickstarts (Pre-Delivery, 1 week) ➔ tailoring of the process by SEPG with PM and SA
- Implemented scalable training to replace classroom training:
  - PM CMMI Training Track (14 webinars)
  - Engineering CMMI Training Track (9 webinars)
- Implemented Success Reviews/PPQA based on peer PM resources - not separate SEPG PPQA staff
- *Totally integrated into existing funding mechanisms*

Outline

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Questions?

FAS*Track** *to* CMMI®

CMMI®
Technology Conference & Users Group
November 13-16, 2006
Denver Colorado

Presented by Al Florence
The MITRE Corporation

The author's affiliation with The MITRE Corporation is provided for identification purposes only, and is not intended to convey or imply MITRE's concurrence with, or support for, the positions, opinions or view points expressed by this author.

CMMI is a registered trade mark of the Software Engineering Institute
* FAS*Track* is coined by Al Florence for process improvement

Agenda

- **Impediments to Process Improvement (PI)**
- Real Examples of Impediments
- FAS*Track* to Process Improvement
- Real Examples of FAS*Track*
- Summary
- References
- ?s
- Contact Information

What are the Impediments to PI? (1 of 2)

- When improving processes in organizations the following often occurs:
  - Process Improvement (PI) is done for process sake
    - Needs to be done for business sake
  - Management wants immediate feedback
  - Management wants Level 3 in six months
  - Staff fails to “buy-in” to PI
  - PI efforts linger forever, are ignored, fail, or are cancelled
  - Recidivism sets in

- Management is not aware of effort required:
  - Fails to provide adequate funding
  - Fails to provide adequate schedule
  - Fails to provide adequate resources
  - Fails to provide adequate PI staff/skills

What are the Impediments to PI? (2 of 2)

- Management is not involved
  - Fails to provide leadership
    - Needs to be actively involved
    - Needs to "crack-the-whip"
- Organizations not ready for PI *(not addressed herein)*
  - If organizations are not ready for change PI will fail
  - All units in an organization need to want to improve
- Supplier mature in process but not acquirer *(not addressed herein)*
  - It is very difficult for a contractor to be Level 2 or Level 3 if the acquisition Agency is Level ***nothing***
  - A project will perform to the lowest level of either party
    - The lower level party brings the higher level one down to its level

Where are we?

- Impediments to Process Improvement (PI)
- Real Examples of Impediments
- FAS*Track* to Process Improvement
- Real Examples of FAS*Track*
- Summary
- References
- ?s
- Contact Information

Real Examples of Impediments (1 of 4)

Example 1

- An organization attempting Level 3
  - Management schedule is 6 months
  - Organization has no documented processes
  - Organization is not following many processes
  - Management fails to provide enforcement or support
  - Organization fails to achieve even Level 2 in six months
  - I quit

Example 2

- At a CMM conference
  - Overheard at dinner table about a company involved in PI
  - Someone asked how far they had gotten
  - In one year they had implemented a process for *conducting meetings*!

Real Examples of Impediments (2 of 4)

Example 3

- Large acquisition agency
  - Implements Quality Assurance (QA)
  - Lacks QA expertise
    - Extensive training and mentoring required
  - 3 MITRE staff - 80%, 3 Government staff - 300%
  - Insists on extensive process documentation
    - About 7 procedures for QA each about 13 pages
    - Extensive guidelines and training
    - Write, review, re-write, re-review... *(change "happy" to "glad")*
    - Preciosity sets in

Real Examples of Impediments (3 of 4)

Example 3 (comp.)

- Reorganizes several times
  - Each time new managers and staff need to agree on QA approaches
  - Each time new managers and staff need to be trained
- After about 9 months QA process in place
- Organization reorganizes several more times
  - New mangers and staff need to accept QA and be retrained
- QA falls apart
- QA effort restarted again two years later from scratch
- *Exactly the same scenario is experienced in attempting to implement Configuration Managment (CM)*

Real Examples of Impediments (4 of 4)

Example 4

- Project plans
  - System Engineering Management Plan
  - Software Development Plan
  - Configuration Management Plan
  - Quality Assurance Plan
  - Etc.
- Often takes months to develop
- Involve tons of people
- Cost in excess of $100K!
- I have experienced this many times on different projects at different corporations

Where are we?

- Impediments to Process Improvement (PI)
- Real Examples of Impediments
- FAS*Track* to Process Improvement
- Real Examples of FAS*Track*
- Summary
- References
- ?s
- Contact Information

FAS*Track* to Process Improvement (1 of 5)

- A solution to PI impediments may be in FAS*Track*
  - A process that is in need of time critical improvement is quickly implemented without much of the fanfare and tedious documentation that bogs down PI efforts
  - The process is quickly defined and executed immediately as a pilot
  - During the pilot's execution, the process is refined, as necessary, and the process documentation is enhanced as required
  - Data and artifacts are collected on the pilot's execution which may be used as proof that the process is, or is not, successful and for continued process improvement
  - Additional FAS*Track* pilots are executed as necessary throughout the PI efforts

FAS*Track* to Process Improvement (2 of 5)

- FAS*Track* implementation provides:
  - Early results to management
  - Buy-in from senior management and staff
  - Momentum to continue
  - Early process execution and artifact collection
  - Proof that process works
  - On-the-fly maturing of the processes
  - PI done for business sake

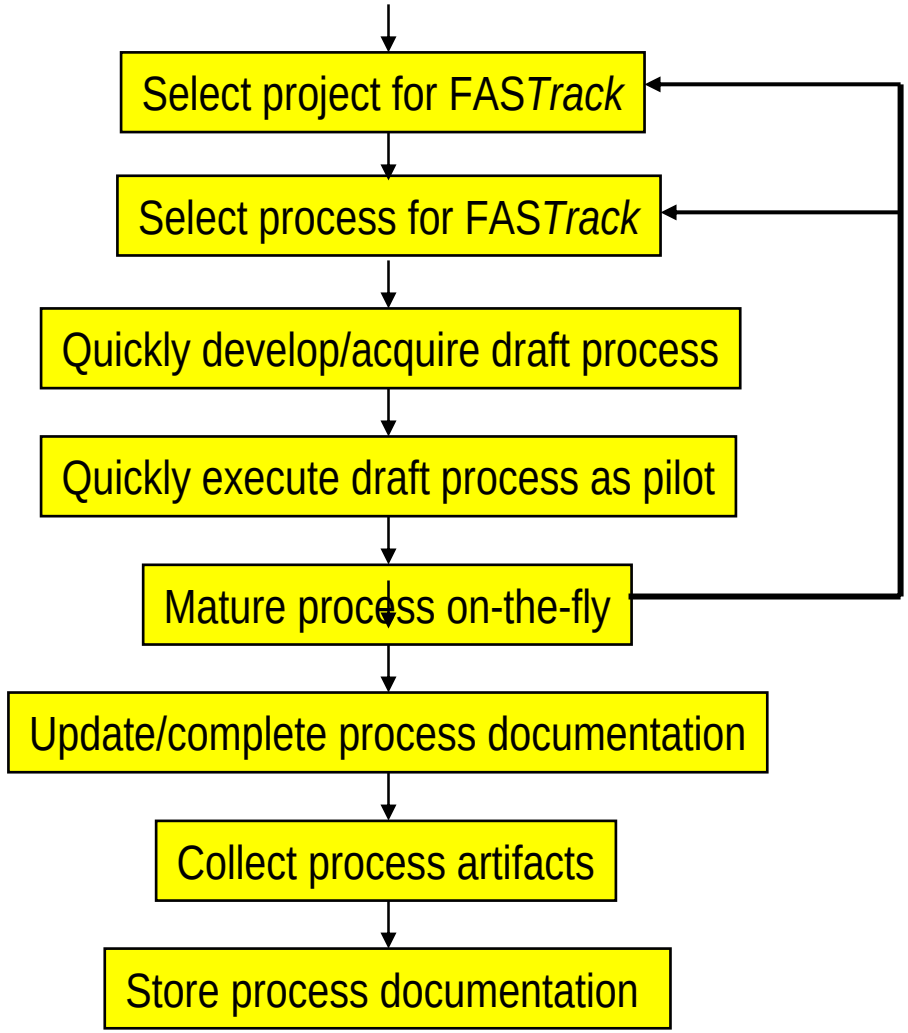
FAS*Track* to Process Improvement (3 of 5)

- Identify project/process for FAS*Track*
- If a process exists
  - Tailor and use
- If process does not exist quickly:
  - Develop draft
    - Process procedure
    - Procedure templates
    - Procedure guidelines
    - Procedure training
  - Select Standards
- Execute process
  - Start when draft procedure is developed
  - Continue as other drafts are done
- Collect artifacts

FAS*Track* to Process Improvement (4 of 5)

- Mature process (on-the-fly)
- Expand
  - Procedure
  - Templates/guidelines
  - Training
- Develop/Expand Process Policy
- Select other Standards
- Store in Process Asset Library (PAL)
- 2nd, 3rd, and subsequent FAS*Tracks* can begin anytime after the initial ones have started

FAS*Track* to Process Improvement (5 of 5)



FAS*Track** to CMMI®

Where are we?

- Impediments to Process Improvement (PI)
- Real Examples of Impediments
- FAS*Track* to Process Improvement
- Real Examples of FAS*Track*
- Summary
- References
- ?s
- Contact Information

Real Examples of FAS*Track* (1 of 19)

The following examples illustrate that process improvements and process installations can be done quickly, efficiently and effectively; FASTrack

Example 1

- Contractor developing the Galileo Probe to Jupiter
  - Micro processors, assembly language, firmware based
- Had never developed space firmware
- Had estimated effort at 3 developers for 6 months
  - Thought it was equivalent to a small FORTRAN program
- Had never developed real-time assembly/firmware code
- Had no software processes or standards

Real Examples of FAS*Track* (2 of 19)

Example 1 (cont.)

- As the software development manager, I quickly
  - Developed (in about 3 weeks) a software process compliant with many CMMI Level 2 processes
    - Documented in a development plan
  - Re-estimated the effort
  - Acquired qualified staff
- Management was shocked that software could follow an engineering process
- Galileo spacecraft and probe were very successful for NASA

Real Examples of FAS*Track* (3 of 19)

Example 1 (comp.)

"Al has generated software design, methodologies, design criteria and configuration control procedures for Galileo that will be a model for all programs. These procedures are unique in their completeness and quality for the Corporation for small software projects." *G. A Kravetz*

"Many of us in the program office were originally concerned that the newness of flight software and the specific complexity of the software would compromise our estimated cost and schedule. The well organized software approach that Al has formulated and implemented has completely removed any concern. It should be noted that the software management plan generated by Al has been adapted for the entire Galileo program including the flight software for the relay receiver and the system test software." *R. J. Drean*

Real Examples of FAS*Track* (4 of 19)

Example 2

- Management for a DoD contractor would accept new requirements from the acquisition agency (Theatre Battle Management) without conducting impact assessments and would instruct staff to implement them
- Staff was working overtime and on weekends to keep up with this requirements creep
- I was new to the organization as a senior systems engineer
- I convinced management that they needed to evaluate the state of their engineering/management practices
  - They seemed unaware that things could be done different
- They allowed me to attempt to fix this problem
- I quickly developed a CM process, in two days, which included a Configuration Control Board (CCB)
- I quickly trained staff and management on the process

Real Examples of FAS*Track* (5 of 19)

Example 2 (cont.)

- The next requirements request from the customer was given to me to evaluate
- I had staff:
  - System
  - Hardware
  - Software
  - Test
  - Quality Assurance
  - Configuration Management
  - Program Management
  - Contracts
- Conduct an impact assessment against their interests not limited to:
  - Function
  - Performance
  - Cost
  - Schedule
  - Interfaces

Real Examples of FAS*Track* (6 of 19)

Example 2 (comp.)

- The impact assessment showed that the request could not be implemented
- I told the CCB that we had to reject it
  - Can we do that?
  - Watch me!
- CCB recommended rejection
- Management accepted the recommendation
  - This was the first time they had ever rejected a customer request
- This started the organization down the path to process Improvement
  - Within a few years they had achieved CMM® Level 3

Real Examples of FAS*Track* (7 of 19)

Example 3

- Contractor developing a very large criminal database application
- Going into a System Design Review
- As the newly assigned Development Manager I reviewed the System Requirements Specification
  - Requirements very poorly written: ambiguous, inconsistent, not uniquely identified, untestable, unimplementable, etc. *(so what else is new?)*
- Convinced management and the customer to delay the review by one month to fix specification
- Quickly documented a methodology for the proper specification of requirements[1]
  - Had been using this method since 1978
- Trained the system, software, and test engineers on the methodology
- We rewrote the specification and passed the review without any action items assigned to us

Real Examples of FAS*Track* (8 of 19)

Example 4

- Same contractor developing a very large criminal database application
- Configuration Control Board (CCB) meeting once a week for 2 to 3 hours
  - CCB items ranged from requirements to design defects and every thing in between *(even the kitchen sink)*
  - Membership included all mangers and all technical leads
    - About 12 members
    - Program Manager (PM) Chair

Real Examples of FAS*Track* (9 of 19)

Example 4 (cont.)

- I convinced the PM to allow me to redesign the CCB and Configuration Management Process
  - CCB items ranged from baselined requirements to other important contractual, critical issues such as:
    - Statement-of-Work
    - Master Schedule
    - Costs, based on thresholds
  - CCB met monthly or as necessary
  - CCB membership
    - PM (Chair)
    - Deputy PM
    - Development Manager
    - Systems Engineering Manager
    - Test Engineering Manager
    - CM and QA Managers
    - Contracts (as necessary)

The project continued this approached and achieved, with the organization, CMM Level 3 less that 2 years after contract award without a Level 2 assessment.

[2] Unfortunately, we failed at to achieve Level 4 for many of the reasons listed earlier.

Real Examples of FAS*Track* (10 of 19)

Example 4 (comp.)

- Formed a Technical Review Board (TRB)
  - Winnow out items from CCB
  - Promote appropriate items to CCB
  - Conduct impact assessments on baseline changes
  - Make recommendations to CCB
- TRB met weekly
- TRB membership
  - Deputy PM (chair)
  - Development Manager
  - System Engineering Manager
  - Test Manager
  - CM and QA Managers
  - Technical Leads (as required)

Project continued to improve processes and acquired CMM® Level 3 compliance by Critical Design Review
It's parent organization was the first to achieve Level 3 in the corporation

Real Examples of FAS*Track* (11 of 19)

Example 5

- A DoD organization that acquires and also develops products is implementing both the CMMI® for development and the CMMI® Acquisition Module for acquisition
- Using a FAS*Track* approach
- Formed
  - Steering Committee (Senior Executive Management)
    - Approve, release, and enforce process policy
    - Approve process procedures
    - Oversee and approve Process Group's efforts
  - Process Group (3 MITRE staff 60% FTE, 5 DoD staff 25% FTE)
    - Provide status and recommendations to Steering Committee
    - Develop/acquire processes
    - Develop/acquire and present process training
    - Select projects for FAS*Track*
    - Select processes for FAS*Track*
    - Follow FAS*Track* approach

Real Examples of FAS*Track* (12 of 19)

Example 5 (cont.)

- Process Group
  - Developed Process Policy
  - Selected pilot project
  - Selected processes to pilots
  - Developed Schedule
    - Level 2 Appraisal,
    - Level 2 and Level 3 processes
    - Acquisition processes
  - Developing draft processes
  - Developing draft guidelines
  - Developing training on processes
  - Providing training
- Steering Committee
  - Signed Process Policy
  - Reviewed and approved FAS*Track* approach

Real Examples of FAS*Track* (13 of 19)

Example 5 (cont.)

- Pilot Project
  - Taking training
  - Applying FAS*Track* on processes
  - Maturing processes
- Organization had no documented procedures
- Pilot project followed undocumented methods and had some process artifacts
  - CCB Minutes
  - CM Plan
  - Baselined Requirements
  - Etc.

Real Examples of FAS*Track* (14 of 19)

Example 5 (cont.)

- Leveraged *CMMI® to develop draft procedures and training
  - Two or more processes developed and implemented per month *(note: 9 months to implement QA shown on Examples of Impediments, example 3, with many more resources)*
    - Developed draft procedure and guidelines
    - One to two procedure per process area *(3 to 4 pages vs. several procedures with up to 13 pages shown on Examples of Impediments, example 3)*
    - Developed and delivered process training (can be uses as guidelines)
- Piloting procedures on project
  - Provide mentoring
  - Mature process
  - Collect artifacts

*Credit given to SEI

Real Examples of FAS*Track* (15 of 19)

Example 5 (cont.)

QA Plan Tailoring (1 of 4)

1.	Introduction
1.1	Purpose
1.2	Scope
1.3	Plan Organization
1.4	Related Documents
1.5	Tailoring this Plan
1.6	Plan Maintenance
2.	Quality Goals and Objectives
3.	Quality Assurance Program
3.1	Process Steering Committee
3.2	Process Group
3.3	Enterprise-Level Quality Assurance
3.4	QA Manager
3.5	QA Personnel
3.6	Program/Project Management
3.7	Programs/Projects Personnel
3.8	QA Measurement and Metrics
3.9	QA Risks
4.	QA Resources
4.1	Facilities and Infrastructure
4.2	Tools
4.3	Costs
5.	QA Training
5.1	Senior Management Orientation
5.2	Program/Project Staff
5.3	QA Staff

APPENDIX A QUALITY ASSURANCE TASKS - TAILORING TABLE

A QA plan has been developed that is generic and should cover QA needs for most projects.

It has a tailoring mechanism built into an appendix where the detailed QA activities are described.

Projects use the appendix to appropriately tailor the plan to the project's specific needs and to the scope of the application.

Projects can accomplish this tailoring with minimum resources and costs.

Real Examples of FAS*Track* (16 of 19)

Example 5 (cont.)

QA Plan Tailoring (2 of 4)

Appendix A

Describes the activities to be executed to effectively administer the QA program. It provides a tailoring schema used to tailor this plan to be used on specific programs and projects.

Allows for quickly adapting plans to projects

All too often project plans: (Project Management Plan, System Engineer Plan, Software Development Plan, Configuration Management Plan, Quality Assurance Plan, etc.) take months and tons of people to developer, and can cost in excess of $100K.

Real Examples of FAS*Track* (17 of 19)

Example 5 (cont.)

QA Plan Tailoring (3 of 4)

Appendix to QA Plan
QUALITY ASSURANCE TASKS
TAILORING TABLE

QA tasks are shown in the table along with task numbers. Responsible organizations are shown along with QA process areas. References to procedures are included for those tasks that require them. The table allows programs and projects to tailor the QA process to the scope of a specific application by indicating "Y" for "used" and "N" for "not used". Additional QA tasks can be added at the end of each section, if needed, for a specific application. The main body of this plan should not be tailored since all QA tasks are included in this appendix.

TAILORED FOR PROJECT/PROGRAM:_____
Program/Project Manager:_____
Date:_____
OTC Process Group:_____
Date:_____
OTC Enterprise-Level Quality Assurance:_____
Date:_____
OTC Process Steering Committee_____
Date:_____

Real Examples of FAS*Track* (18 of 19)

Example 5 (cont..) Appendix *QA Plan Tailoring (4 of 4)*

	Y/N
3.4 QA Manager	
a. Primarily responsible for overseeing QA task assigned to programs/projects and to QA personnel	
b. Works closely with the Process Group and serves on the group whiled developing QA process artifacts and QA orientation and training	
c. Provides QA orientation and training	
d. Works with Program/Project Management in tailoring and applying QA.	
e. Attempts to resolve QA non-compliance with program/project management	
f. Escalates QA non-compliance to Steering Committee	
3.5 QA Personnel	
a. Support the development/acquisition of QA processes and best practices	
b. Support the development and tailoring QA plans	
c. Conduct product reviews on external products delivered by contractors and suppliers 1. QA Product Review Procedure	
d. Conduct product reviews at the enterprise level and on programs/projects 1. QA Product Review Procedure	
e. Conduct process audits at the enterprise level and on programs/projects 1. QA Process Audit Procedure	

Real Examples of FAS*Track* (19 of 19)

Level 2 Level 3 Level 4
Level 5 AM Unique

Example 5 (comp.) *Level 2 Appraisal in February 07 Scheduled*

Category	Process Area [Level]	CMMI®	CMMI®-AM	Timeline
Project Management	Project Planning [2]	YES	YES	May 06
	Project Monitoring and Control [2]	YES	YES	May 06
	Supplier Agreement Management [2]	YES	NO	Sep 06
	Integrated Project Management (IPPD) [3]	YES	YES	Oct 06
	Integrated Supplier Management (SS) [3]	YES	NO	Oct 06
	Integrated Teaming (IPPD) [3]	YES	YES	Dec 06
	Risk Management [3]	YES	YES	July 06
	Quantitative Project Management [4]	YES	NO	N/A
	Solicitation and Contract Monitoring [AM]	NO	YES	Sep 06
Support	Configuration Management [2]	YES	YES	Feb 06
	Process and Product Quality Assurance [2]	YES	NO	Mar 06
	Measurement and Analysis [2]	YES	YES	June 06
	Decision Analysis and Resolution [3]	YES	YES	Jan 07
	Organizational Environment for Integration (IPPD) [3]	YES	Imbedded	
	Causal Analysis and Resolution [5]	YES	NO	N/A
Engineering	Requirements Management [2]	YES	YES	Jan 06
	Requirements Development [3]	YES	YES	Jan 06
	Technical Solution [3]	YES	NO	Aug 06
	Product Integration [3]	YES	NO	Jan 07
	Verification [3]	YES	YES	Aug 06
	Validation [3]	YES	YES	Aug 06
	Transition to Operations and Support [AM]	NO	YES	Dec 07
Process Management	Organizational Process Focus [3]	YES	NO	Feb 07
	Organizational Process Definition [3]	YES	NO	Feb 07
	Organizational Training [3]	YES	NO	July 06
	Organizational Process Performance [4]	YES	NO	N/A
	Organizational Innovation and Deployment [5]	YES	NO	N/A

FAS*Track* on Schedule

Where are we?

- Impediments to Process Improvement (PI)
- Real Examples of Impediments
- FAS*Track* to Process Improvement
- Real Examples of FAS*Track*
- Summary
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- ?s
- Contact Information

Summary (1 of 2)

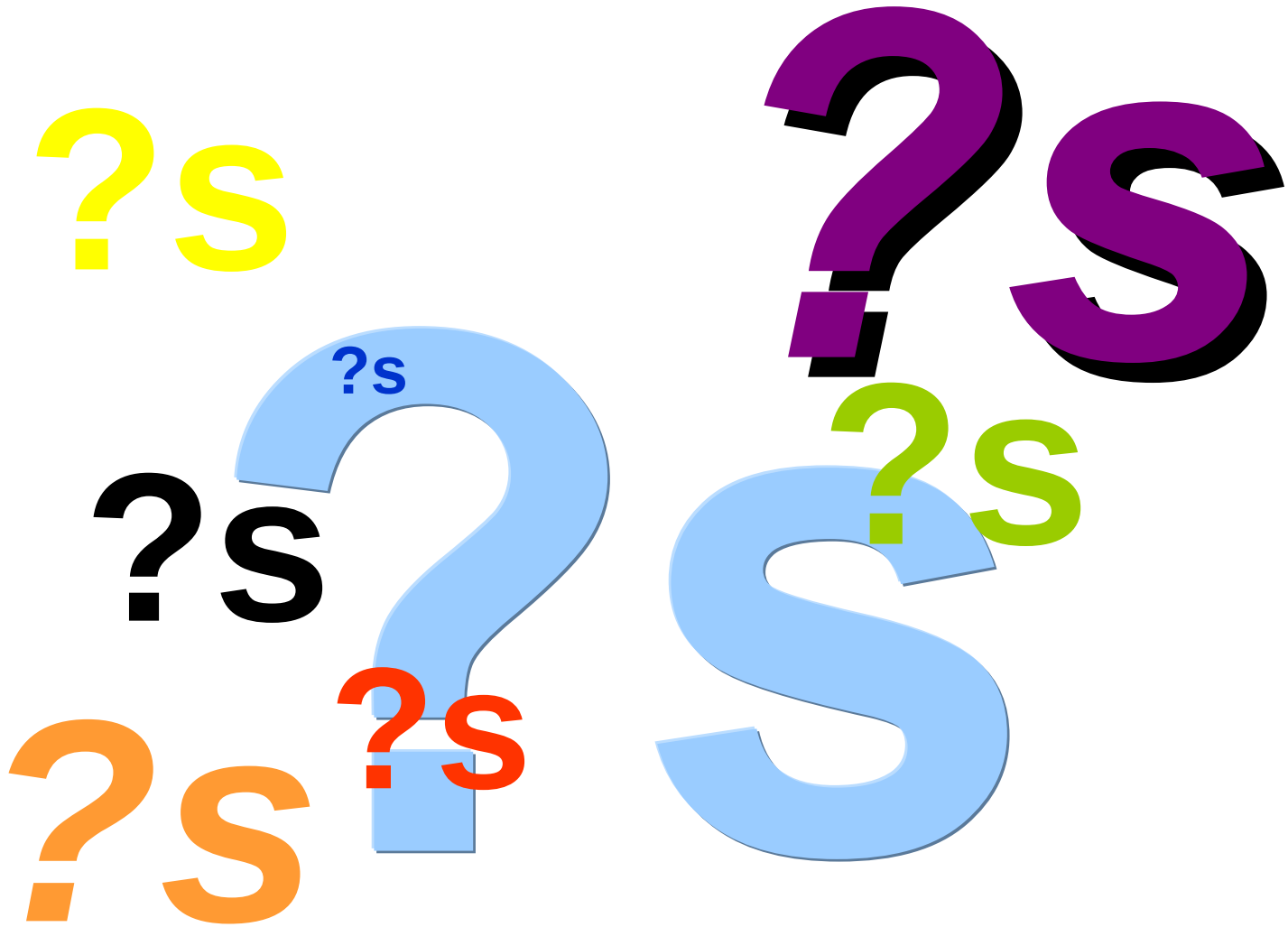
- CMMI implementation can be:
  - Costly
  - Time consuming
  - Prone to failure
- Many reason for this
  - Management support
  - Schedule constraints
  - Funding
  - Immediate expectations
  - Excessive process documentation
  - Failure to get buy-in
  - Etc.

Summary (2 of 2)

- FAS*Track* provides
  - Early results to management
  - Buy-in from senior management and staff
  - Momentum to continue
  - Early process execution and artifact collection
  - Proof that process works
  - On-the-fly maturing of the processes

References

1. Florence, Al. *Proper Specification of Software Requirements*;
   a. PSQT/PSTT Conference, March 2002.
   b. NDIA System Engineering Conference, October 2005
   c. SEPG Conference, March 2006
   d. CROSSTALK, The Journal of Defense Software Engineering. April 2002
      i. *Won best paper award at MITRE, 2003*
      ii. *Used by David A. Cook, Ph.D. as required reading by his graduate students in Systems Engineering*
   e. Quality Assurance Institute Journal, October 2003
2. Florence, Al*; Success at Level 3, Failure at Level 4, Lessons Learned;*
   1. Software Technology Conference (STC), Salt Lake City. 2001
   2. Software Engineering Process Group (SEPG) Conference, New Orleans. 2001
   3. CrossTalk, The Journal of Defense software Engineering; August, 2001
   4. Quality Assurance Institute Journal, April, 2002
3. *Capability Maturity Model® Integration (CMMI), Version 1.1.* Software Engineering Institute. March 200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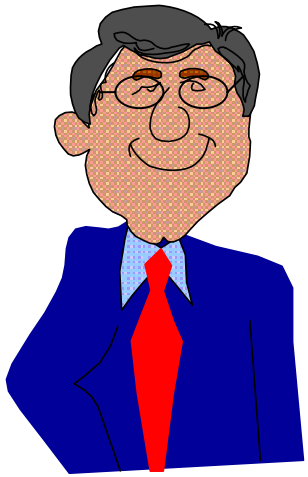

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Implementing CMMI-based Process Improvement Using the Rational Unified Process

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Rolf W. Reitzig – SEI Resident Affiliate

Tuesday, November 14th, 2006

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First Off...

Why are you here?

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Rational Unified Process Overview

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Introducing the RUP Platform

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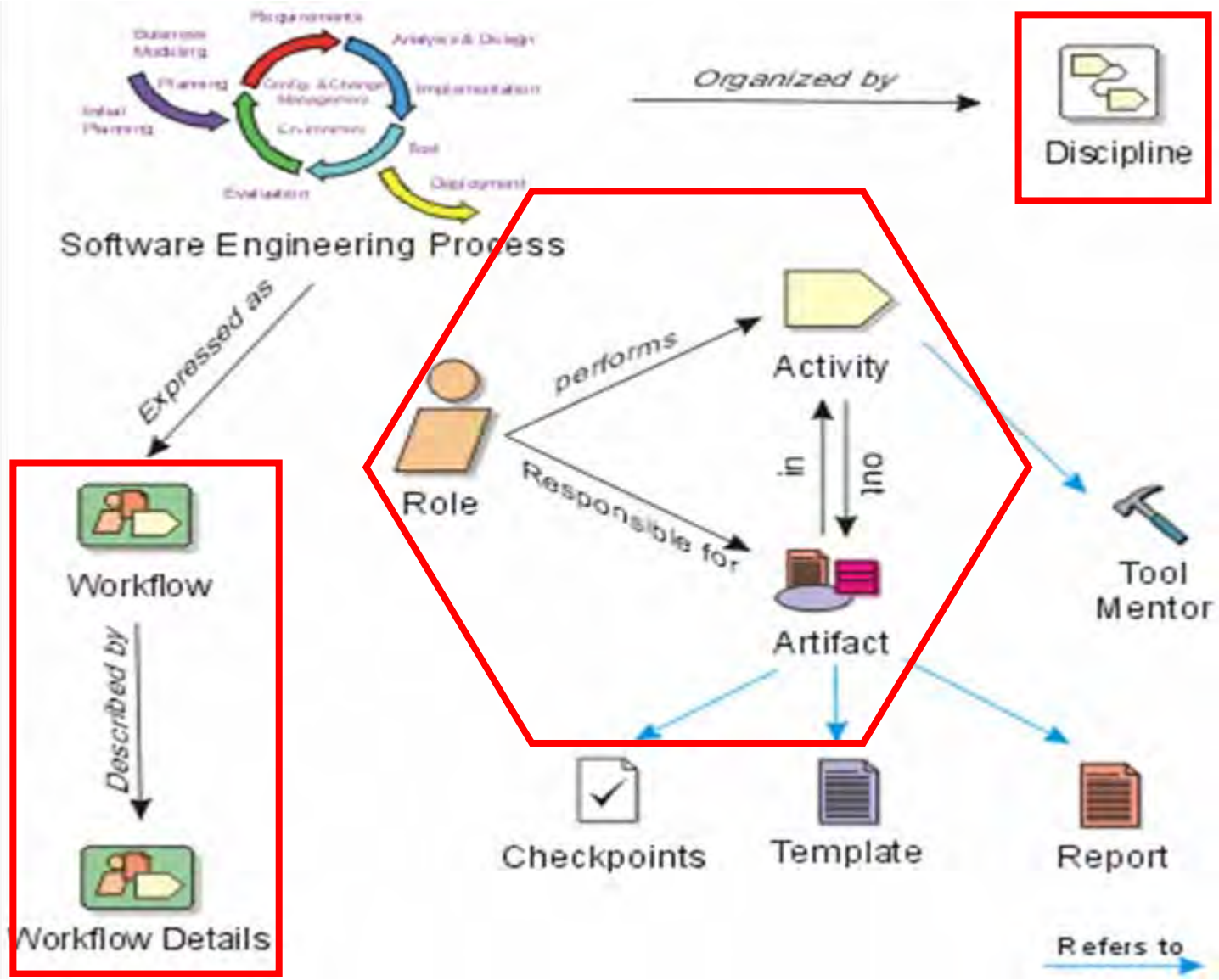
Basic Structure of RUP: Key Concepts



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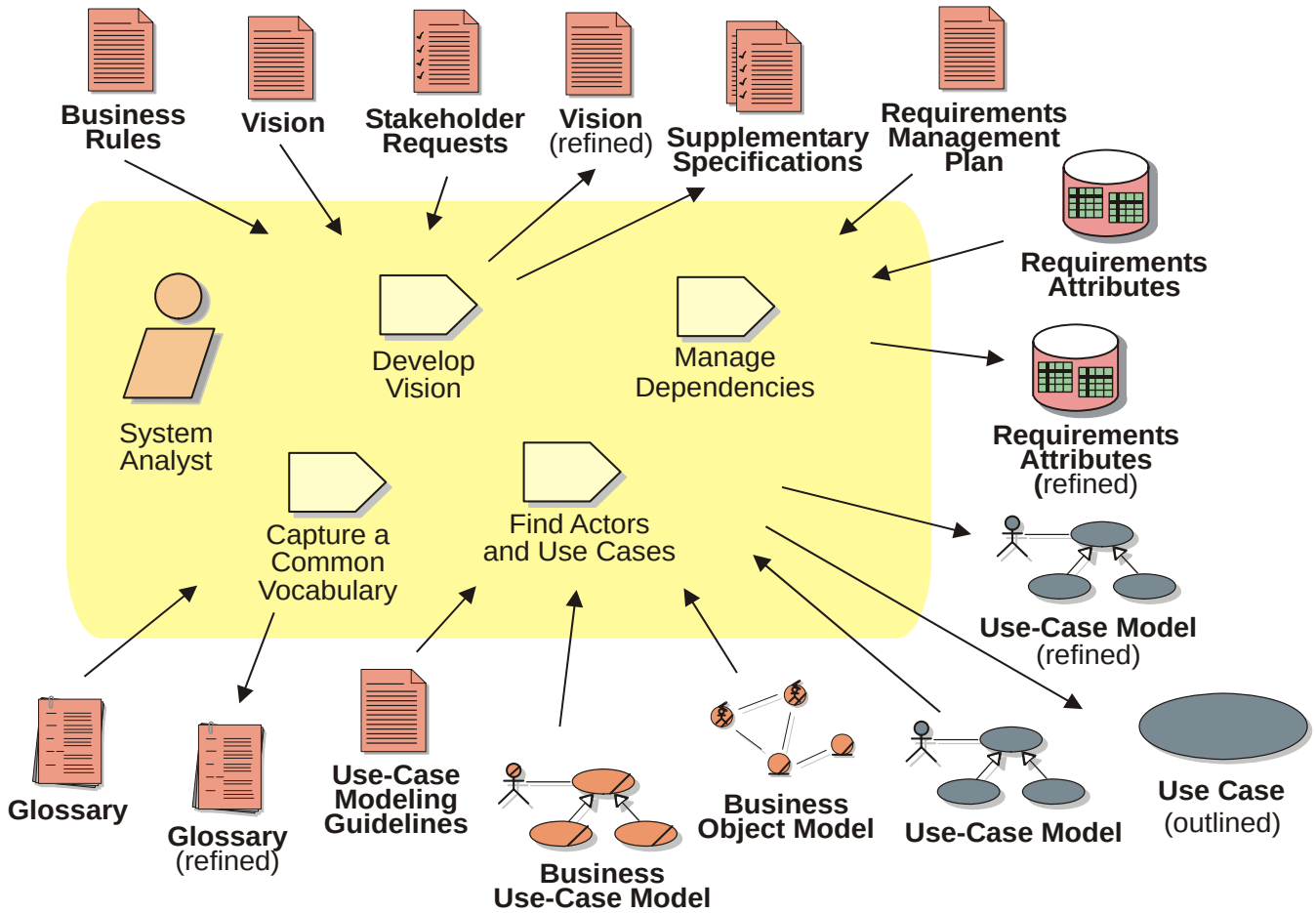
Roles Perform Activities and Produce Artifacts

Example:
Requirements->
Workflow Detail->
Define the System



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The Spirit of RUP

1. Attack major risks early and continuously… or they attack you
2. Ensure that you deliver value to your customer
3. Have a maniacal focus on working software
4. Accommodate change early in the project
5. Baseline an executable architecture early on
6. Build your system with components
7. Work closely together as one team
8. Make quality a way of life, not an afterthought

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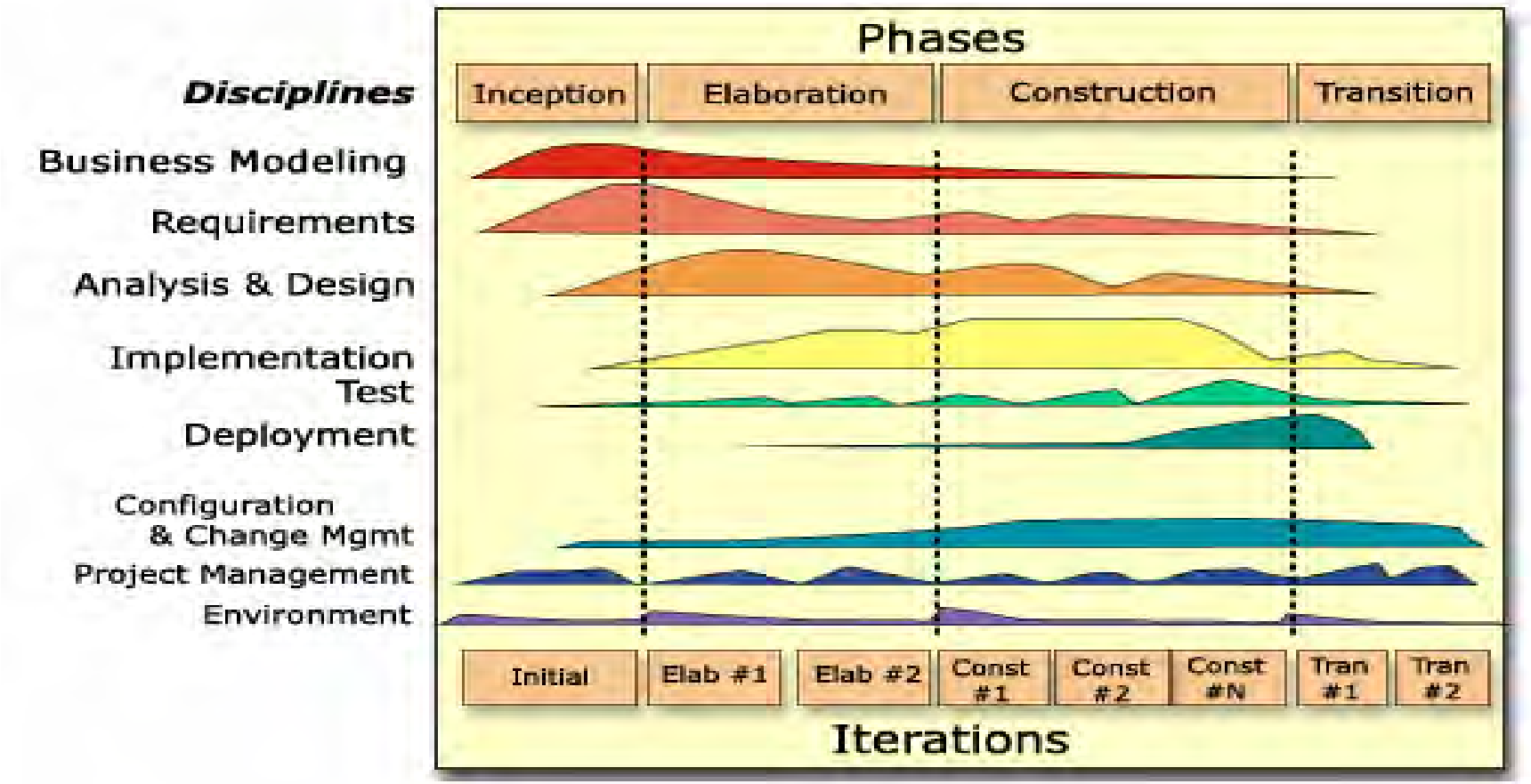
Iterative Development



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What Will RUP Get You?

- A collection of world best practices
- A mechanism for modifying them to suite your needs, as well as integrating other best practices and your own practices
- A mechanism for tailoring and deploying them to projects
- With Rational Portfolio Manager, a mechanism for managing projects according to projects' defined processes, and gathering important data critical to data-driven project management & future planning

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What Will RUP Not Get You?

- A guarantee that you'll perform better without some effort on your part
- Instant expertise in software engineering best practices
- Compliance with all CMMI maturity level 2 & 3 requirements out-of-the-box

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How Does RUP Fit In?

- The key to realizing benefits is
  - implementing organizational standard software engineering processes
  - that are deployed (franchised) into projects based on key characteristics
  - and are tailored, managed & measured
- A great way to start is a combination of
  - Rational Unified Process (RUP)
  - Rational Method Composer (RMC)
  - Rational Portfolio Manager (RPM)

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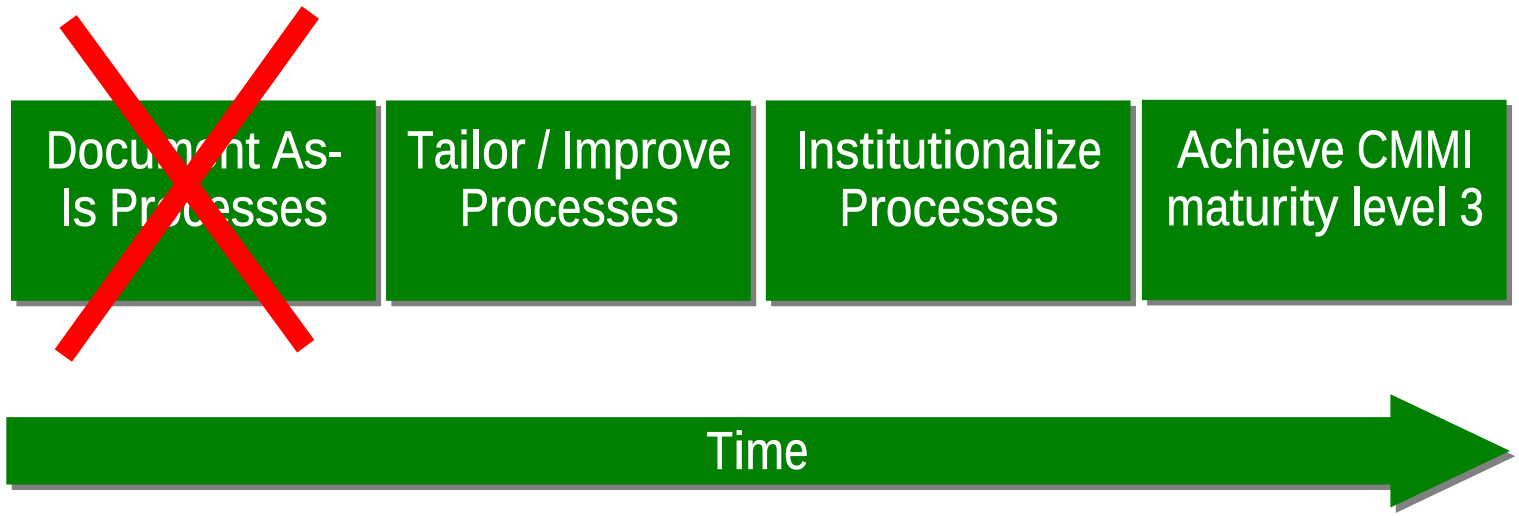
CMMI Maturity Level 3 Acceleration

- Use of the Rational Unified Process and IBM Rational automation tools will accelerate the achievement of CMMI maturity level 3



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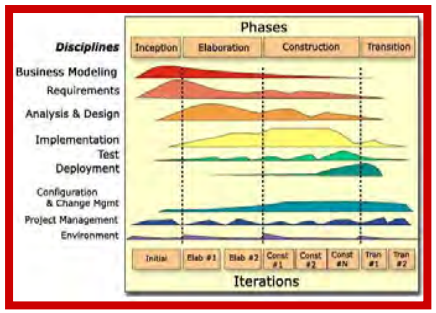
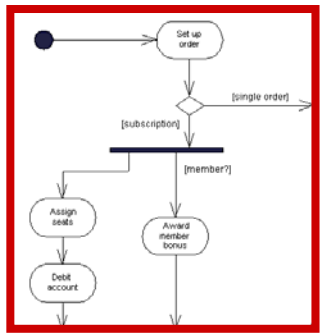
Delivering a Franchisable Process to Your Company

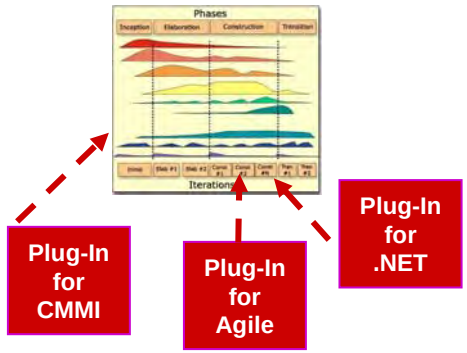
Core RUP



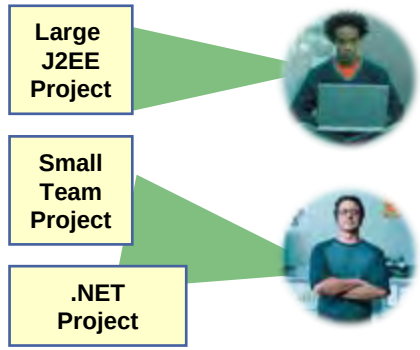
RMC



RMC



RPM



Development organization → **Process engineers, program/project offices** → **Project managers & team leads** → **Practitioners**

Common methodology

- Shared understanding of terminology, deliverables, and responsibilities

Process authoring

- Leverage internal knowledge and process assets

Process configuration

- Configure and deploy process for specific tools, technologies, domains

Process delivery

- Manage project instances
- Gather and report metrics

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RUP & CMMI

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Situation Description

- Evaluated RUP for Large Projects v7.0.1 against CMMI-DEV w/IPPD v1.2 maturity level 3
- RUP's processes, tasks, templates, etc. were reviewed and evaluated for compliance
  - Determined the risk of meeting the CMMI's intent in each ML 2 & ML 3 practice if the process & associated templates are implemented as described
  - Use of Rational tools was not considered
- Caveat: Actual results might vary based on project implementation and degree of RUP tailoring!

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Project Management Process Areas

Strengths

- RUP fundamentally provides a solid project management foundation
  - Planning, Tracking & Oversight, Risk Management

Areas for Improvement

- Supplier Agreement Management – RUP does not address SAM or the notion of suppliers at all
- Estimation and tracking of estimates leaves too much discretion to the project
- Planning for and managing project data – too code-centric

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Engineering Process Areas

Strengths

- Overall, RUP's Requirements, Design & Analysis, Implementation, Test, and Deployment disciplines handle CMMI requirements very well

Areas for Improvement

- Traceability without tool support may not be sufficient
- Determining criteria for alternative technical solutions
- Performing build/buy/reuse analysis
- Integration sequence, procedures, and criteria
- Reviews of interfaces for coverage & completeness
- Analysis of peer review data

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Support Process Areas

Strengths

- RUP's Configuration & Change Management discipline
- Measurement & Analysis

Areas for Improvement

- Decision Analysis & Resolution – RUP does not provide a process for DAR
- Process Quality Assurance is not called out strongly enough – projects may overlook this important process area
- Identification of configuration items is too focused on engineering work products and doesn't address other work products

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Process Management Process Areas

Strengths

- RUP's collection of best practices and mechanism (Rational Method Composer) for tailoring and deploying to a project

Areas for Improvement

- All Process Management guidance is project-centric - RUP does not address organizational-level processes for
  - Organizational Process Focus
  - Organizational Process Definition
  - Organizational Training

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Generic Practices

Strengths

- RUP's collection of best practices and mechanism (Rational Method Composer) for tailoring and deploying to a project

Areas for Improvement

- RUP does not provide any policies or guidance for policy development
- Identification, planning, scheduling, and involvement of stakeholders
- Identification and delivery of personnel training
- Feedback loop of project-level measurements and lessons learned to improve the organization's processes and planning capabilities

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Sounds Good, But How Do We Get There???

Implementation of software engineering best practices and integrated automation tools across an organization is difficult

Barriers

- Lack of understanding
- Poor planning
- Resistance to change

> "Radical, rapid change is crucial to success; incremental, unfocused changes have a better than 50% chance of failure"
>
> – Gartner

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RUP Implementation Roadmap

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Roadmap – Setting the Stage

1. Establish Executive Sponsorship with the expectation it is active, not passive
2. Clearly tie the effort to business goals
3. Establish a guiding coalition (MSG/EPG/SEPA) of movers and shakers from across the organization to drive the RUP implementation strategy, approach, and plan
4. Projectize the effort, assign a cost center, and treat it like a project with clear milestones and reviews
5. Tie improvement objectives to each individual's performance review

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Roadmap – Tailoring RUP - 1

1. Using Rational Method Composer, develop organizational processes for:
   - DAR, OPD, OPF, OT, SAM
2. Create detailed tasks for:
   - Policy development
   - Estimation & tracking of actuals
   - Identification and delivery of project-level training
   - Objective evaluation of processes
   - Feedback of measurement and lessons learned to organizational process assets
   - Build/Buy/Reuse decision making

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Roadmap – Tailoring RUP - 2

3. Improve existing guidance for:
   - Management of non-engineering CIs/project data
   - Stakeholder involvement
   - Traceability
   - Alterative technical solution criteria & evaluation (DAR)
   - Evaluation of peer review data
   - Integration sequence, procedures, & criteria
   - Interface reviews
4. Using *critical thinking,* determine the various RUP configurations your organization might use and establish them as approved lifecycles in RMC

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Roadmap – Introducing Improvements

1. Determine gaps in the knowledge and skills required in the organization, train people
2. Pilot on carefully selected projects, provide hypersupport
3. Identify pilot project lessons learned and incorporate improvements into the organization's processes
4. Iteratively deploy more broadly
5. Maintain the feedback loop, continuously improve

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End Result

- The outcome will be an integrated, organizationally cooperative process infrastructure (OSSP) that:
  - is the foundation for a successful organizational transformation and improvement
  - provides common processes for measurements & analysis
  - adopts industry best practices as embodied in RUP
  - facilitates software improvement based on consensus priorities
  - Delivers superior engineering results

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Questions/Discussion

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Improving Software Economics

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Backup

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Improving Software Economics

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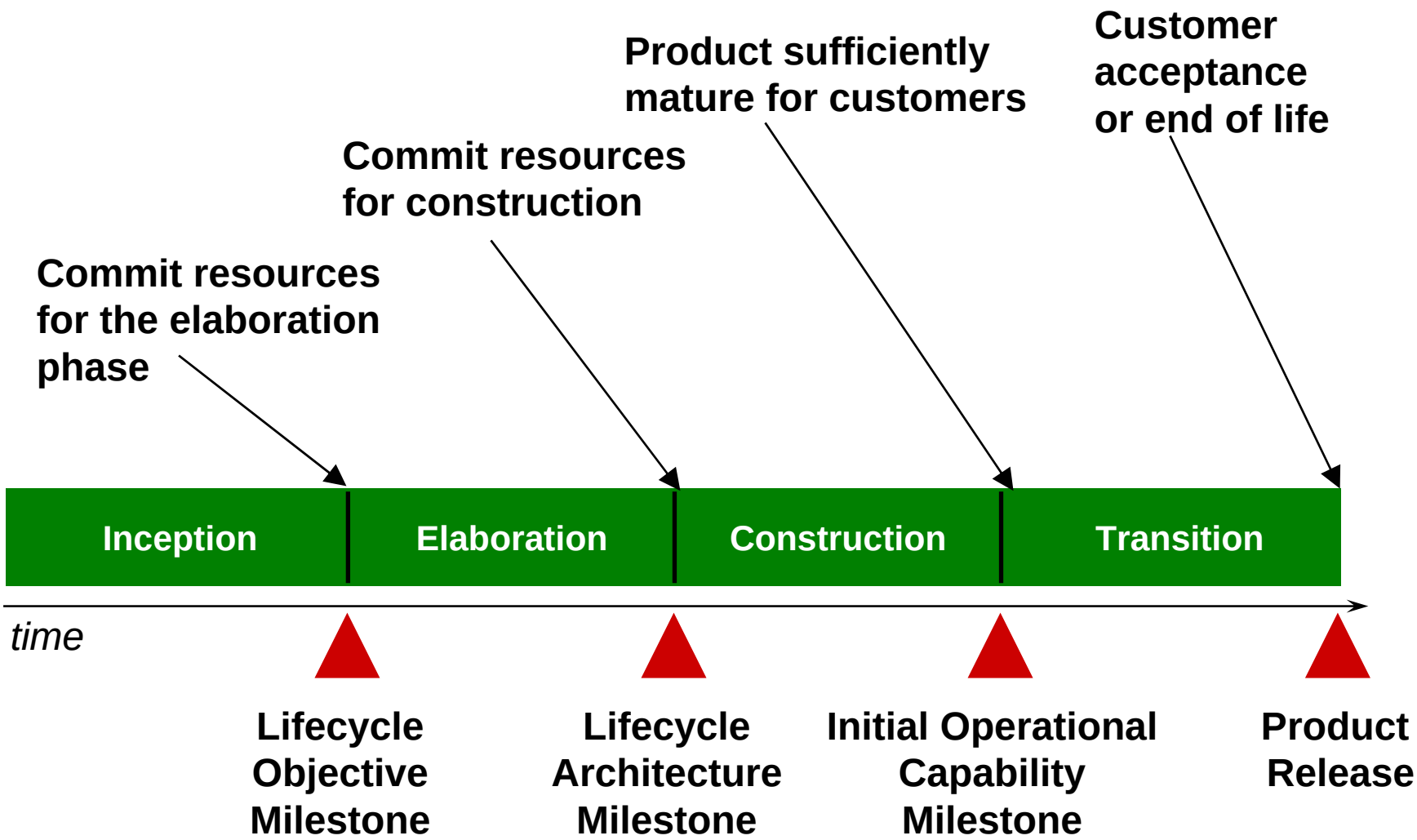
Major Milestones: Business Decision Points



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2. Ensure That You Deliver Value to Your Customer

- Focus on key requirements
  - Capture, document
  - Organize, prioritize
- Requirements will change
  - Evaluate impact of change and decide what changes to implement
  - Propagate changes to all team members
- Make requirements accessible

Requirements management leverages your ability to deliver products that meet user needs

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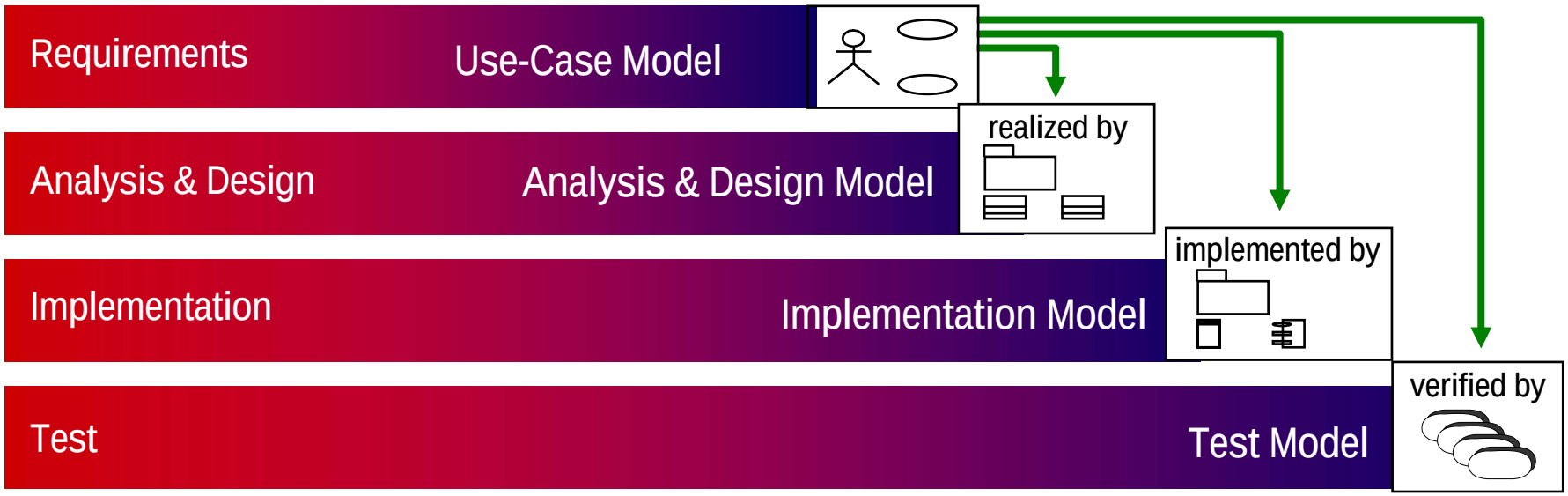
Use-Case Driven Development

- A use case describes complete and meaningful services that your system offers to users and other systems
- Use cases drive the work through each iteration
  - Planning of iterations
  - Creation and validation of the architecture
  - Definition of test cases and procedures
  - Design of user interfaces and creation of user documentation



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3. Have a Maniacal Focus on Working Software

- Measure progress primarily by reviewing executable code, and test results
  - Plans, requirements, designs and other by-products often provide a false perception of progress and status
- Focus on the final, delivered product, and only the artifacts that matter to get at this goal consistently
  - Streamline the process
  - Do not use all of the RUP! Only use what makes sense to your project – tailor it to suite your organization's and project's needs.

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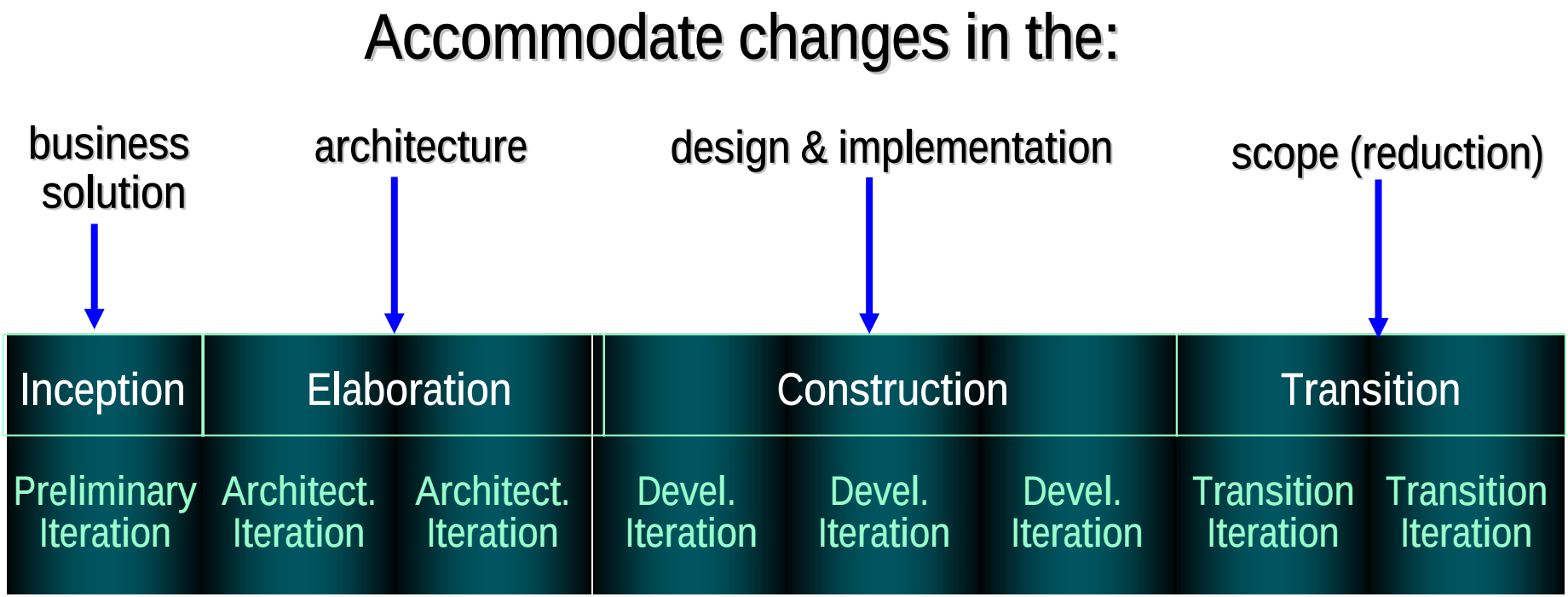
4. Accommodate Change Early In the Project

- Today's systems are too complex to get the requirements, architecture, design, implementation and scope right the first time



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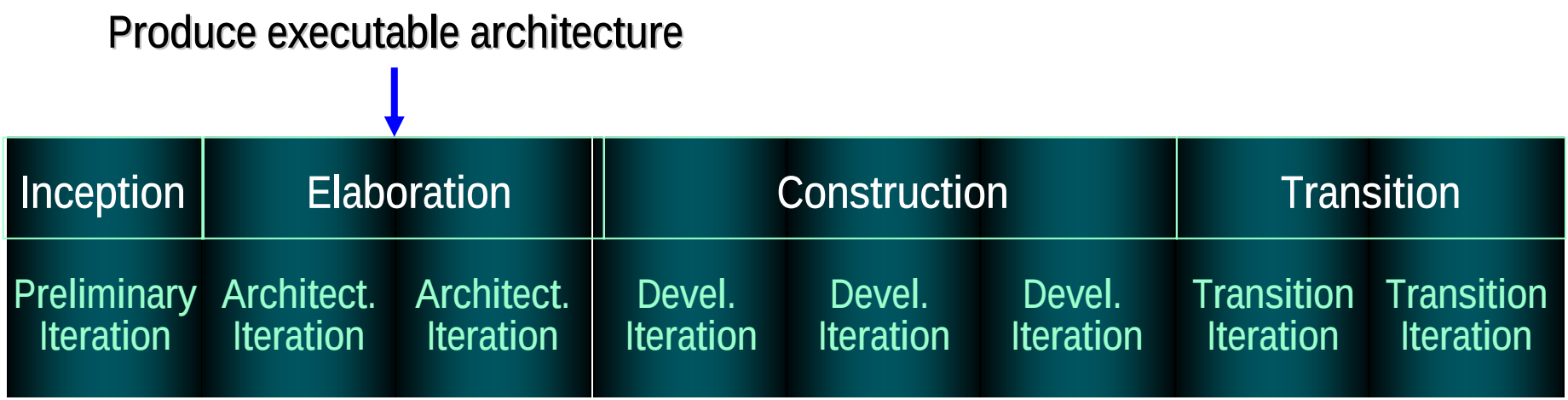
5. Baseline an executable architecture early on

- Architecture provides a skeleton structure of your system
  - Subsystems, key components, interfaces, architectural mechanisms (solutions for common problems, such as persistency, inter-process communication, ..)
- Implementing and testing the architecture mitigates most technical risks



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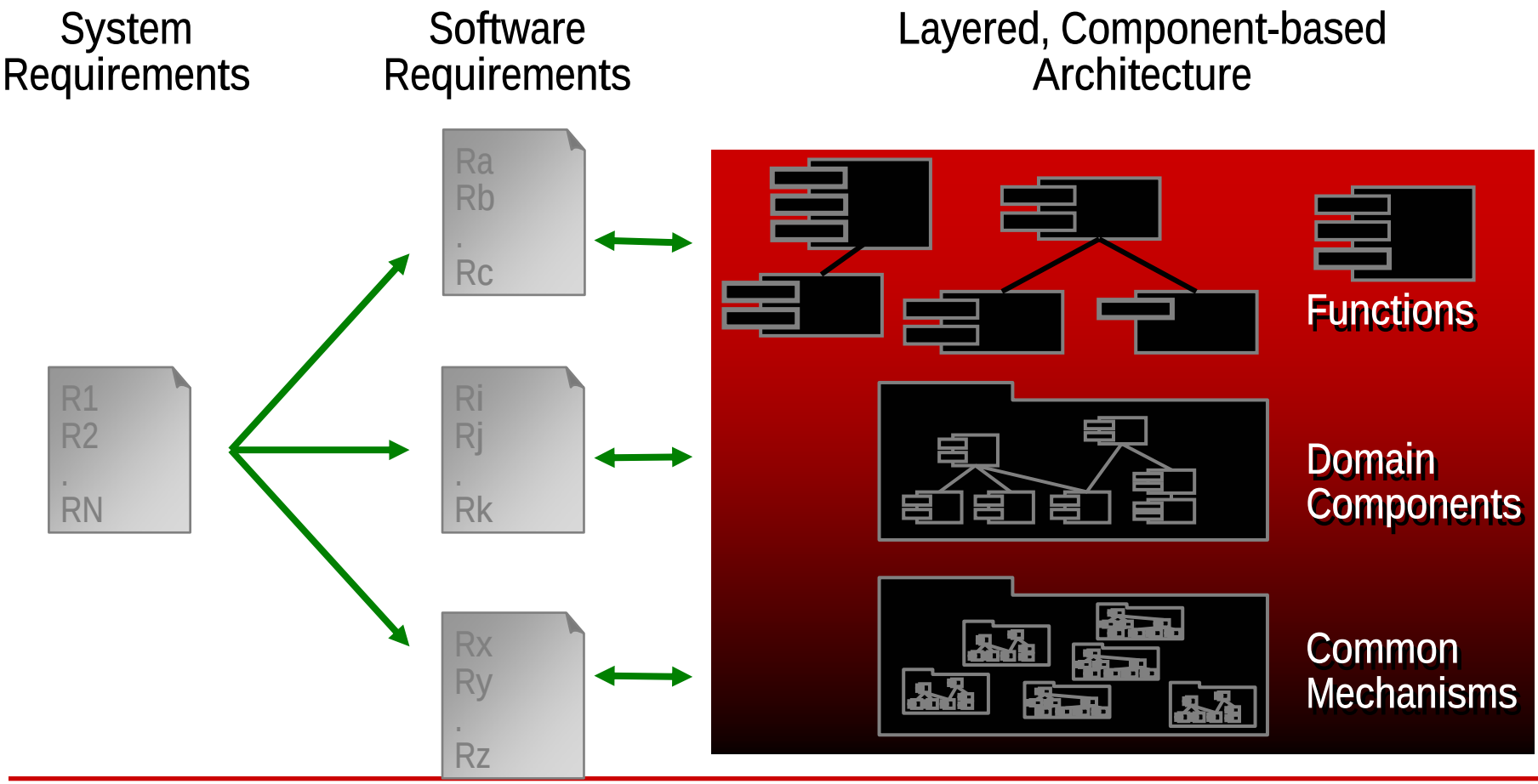
6. Build Your System With Components

- Architecture-driven, Component-based Design
- Component architecture provides flexibility



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7. Work Closely Together As One Team

- Empowered and self-managed
  - Clear vision
- Accountable for team results
  - Clear expectations
  - All for one, one for all
    - avoid “My design was good, your code didn’t work”
- Optimized communication
  - Effective process (right-sized for your project)
  - Organize around architecture, not around functions
  - Get the right tool support
    - Easy access to current requirement
    - Private workspaces
    - Easy access to defects….
    - …

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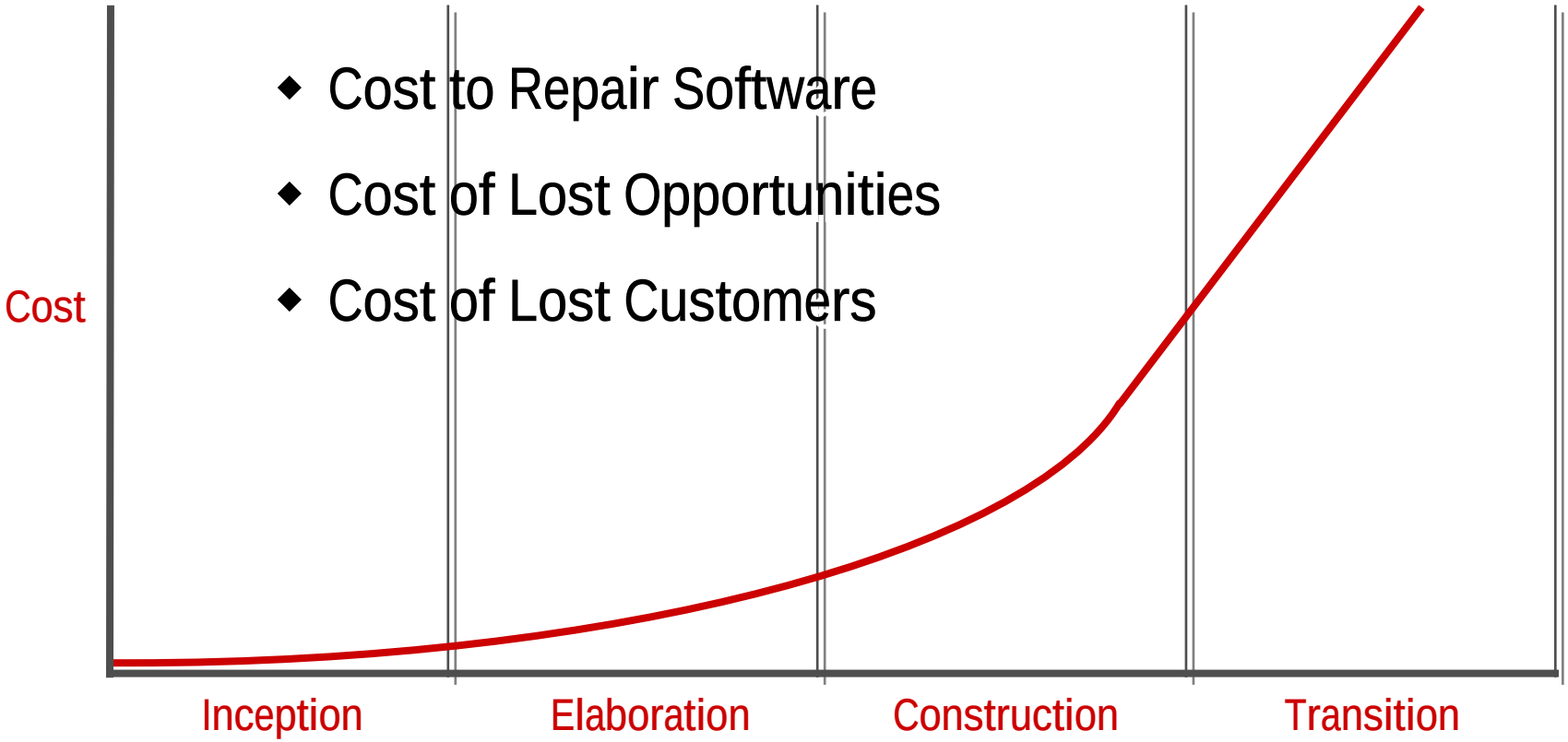
8. Make Quality a Way of Life, Not an Afterthought

Software problems are
100 to 1000 times more costly
to find and repair after deployment



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Right Turns and Wrong Turns to Level 5

Thomas Lienhard
Raytheon Missile Systems

Timothy Davis
Retired – Raytheon Missile Systems

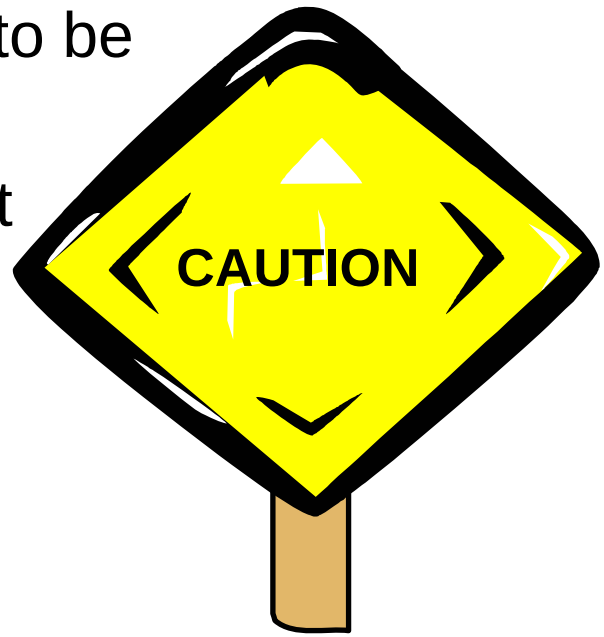
Special Thanks – Kathy King

Agenda

- Typical views of organizational and project roles for High Levels of CMMI Maturity
- Risks in using these roles in certain environments
  - Using homogenous assumption in non-homogenous environments
  - Assumption that each project contributes equally to organizational goals
- Improved organizational and project statistical management approach
- Actual example
- Translation into QPM and OPP terms
- Summary

Typical View of Organizational Role at High Maturity

- Organizational quantitative business goals and objectives are injected as project objectives
- Focus on development part of lifecycle
- Organization's process performance baselines and predictive models are established to be common and applied to all projects
- Process performance baselines consist of highly aggregated data



Typical View of Project Role at High Maturity

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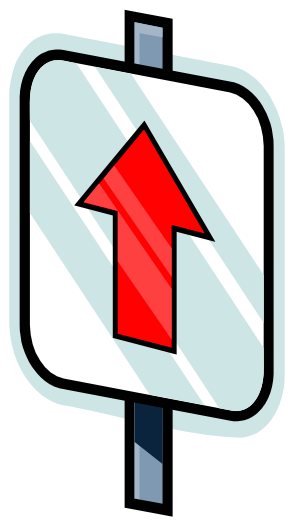
- Project objectives are “given” by the organization
- Selection of critical processes and product parameters
  - Directed by organization, or
  - Performed once, during planning phase
- Projects are managed using organizational process performance baselines and models
- Projects contribute project measurements of sub-process measurements to refine existing organizational process performance baselines and models
- Special cause analyses assume models and baselines are applicable to all projects



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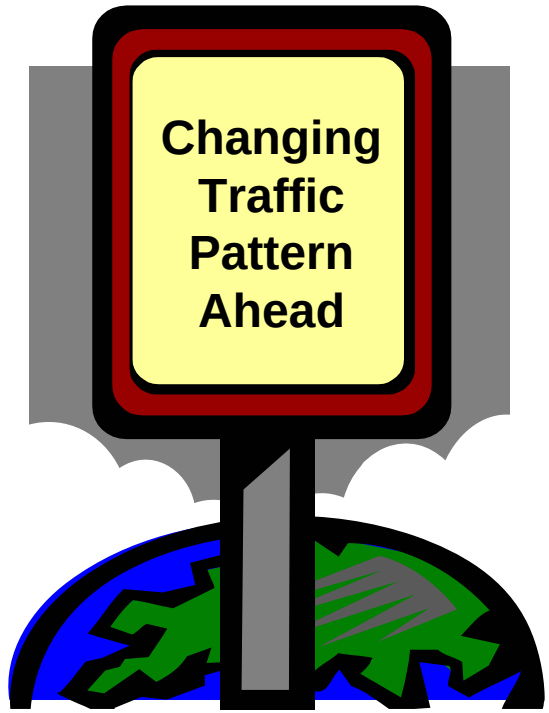
Organizational Changes Drive Implementation Changes

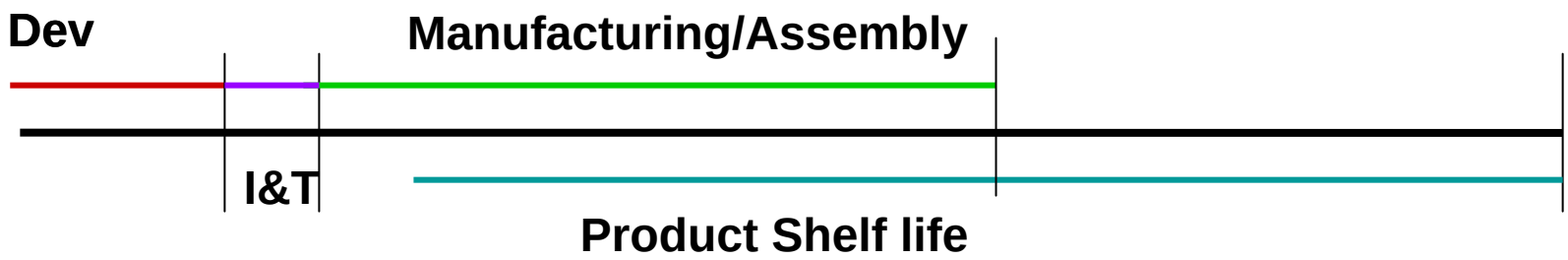
- Organizations are becoming less homogenous
  - Expanding boundaries
    - Multiple sites
    - Strategic acquisitions
    - Multiple disciplines
  - Breadth of organizational responsibilities growing
    - Development
    - Sustainment and Maintenance
    - Services
- Product development is evolving
  - New products are based on existing products
  - Cost and profitability are critical components



Interpretation of High Maturity needs to be revisited as well

Today's Environment

- The business model is now to provide complete solutions not just components, disciplines, etc.
- Development is only small part of solution (lifecycle) for more and more programs
- Models generally need iterative refinement to incorporate real data as it becomes available as the product matures
- Project solution space extends beyond technical requirements, to include business factors like cost, affordability and producibility



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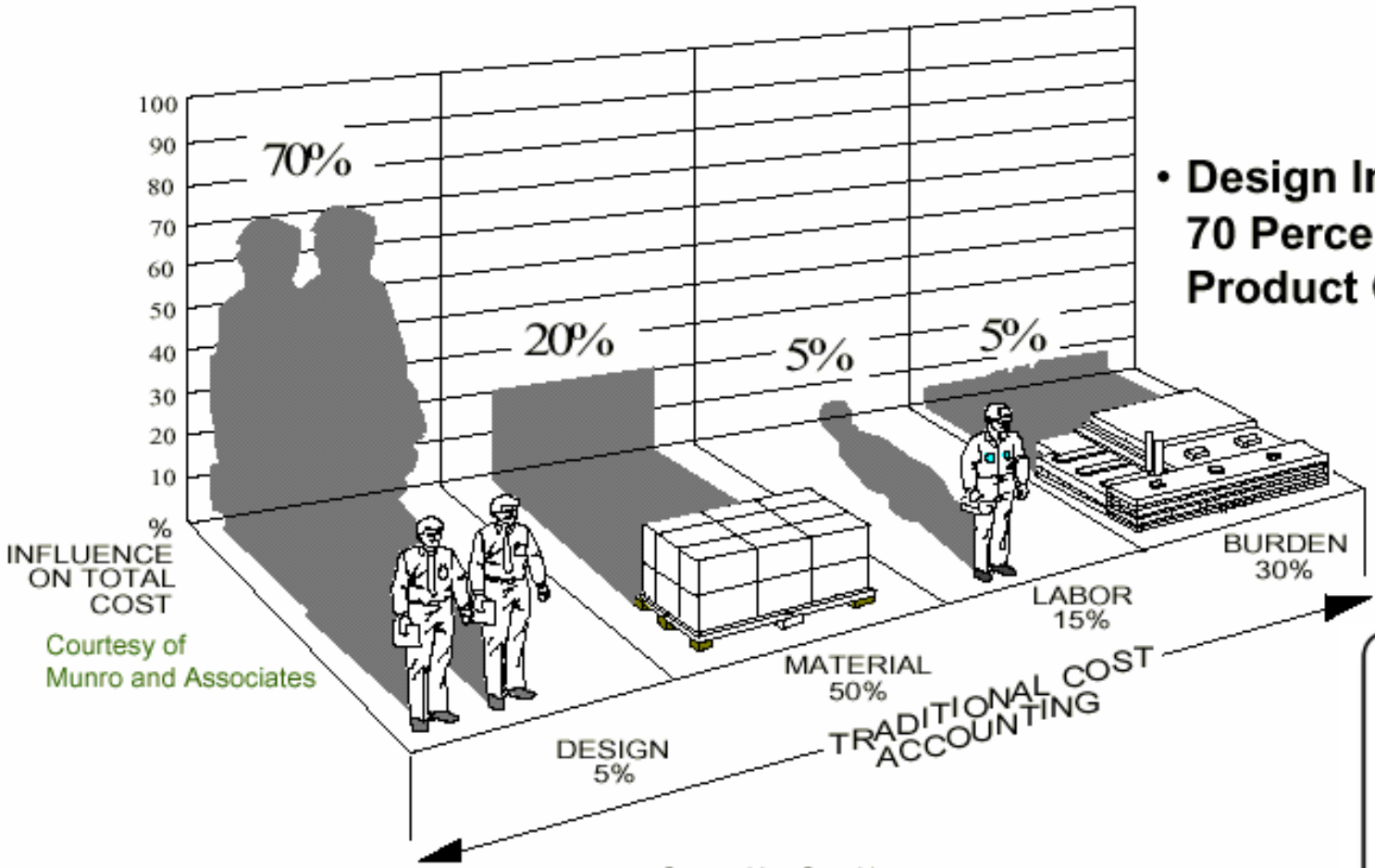
Product Costs Must be Addressed Early



Courtesy of Munro and Associates

- **Design Influences 70 Percent of Initial Product Cost**

RIGHT TURN

Potholes With Typical Approach - 1

- Organizations tend to search for commonalities that transcend each project
  - Common lifecycle phases may not share same criticality
  - Models tend to be single dimensional – cost, affordability and producibility not integrated with technical performance parameters
  - Aggregated data from multiple projects increases variability thus reducing usefulness
  - Unique objectives for projects not always taken into account

- Organizational models and baselines fail to provide needed project insight
  - Expected range typically not tight enough to aid projects
  - Subprocesses which are statistically managed aren't the ones that are key to project success
  - Lack of rational subgrouping leads to baselines common to all but useful to none
  - Models are not always calibrated/rerun as actual data becomes available

Potholes With Typical Approach - 2

- Not working for the project
  - Same allocation of organization objectives to all projects
  - Having “directed” subprocess stable and capable doesn’t always guarantee success
  - Not enough insight into what is key
  - Takes time and money to chase non-critical measures
  - Focus is diverted away from what is truly critical to project success
- Not working for the organization
  - Customers aren’t always satisfied
  - Not enough insight into what needs to be fixed

Project and organizational achievement of business goals is sub-optimized

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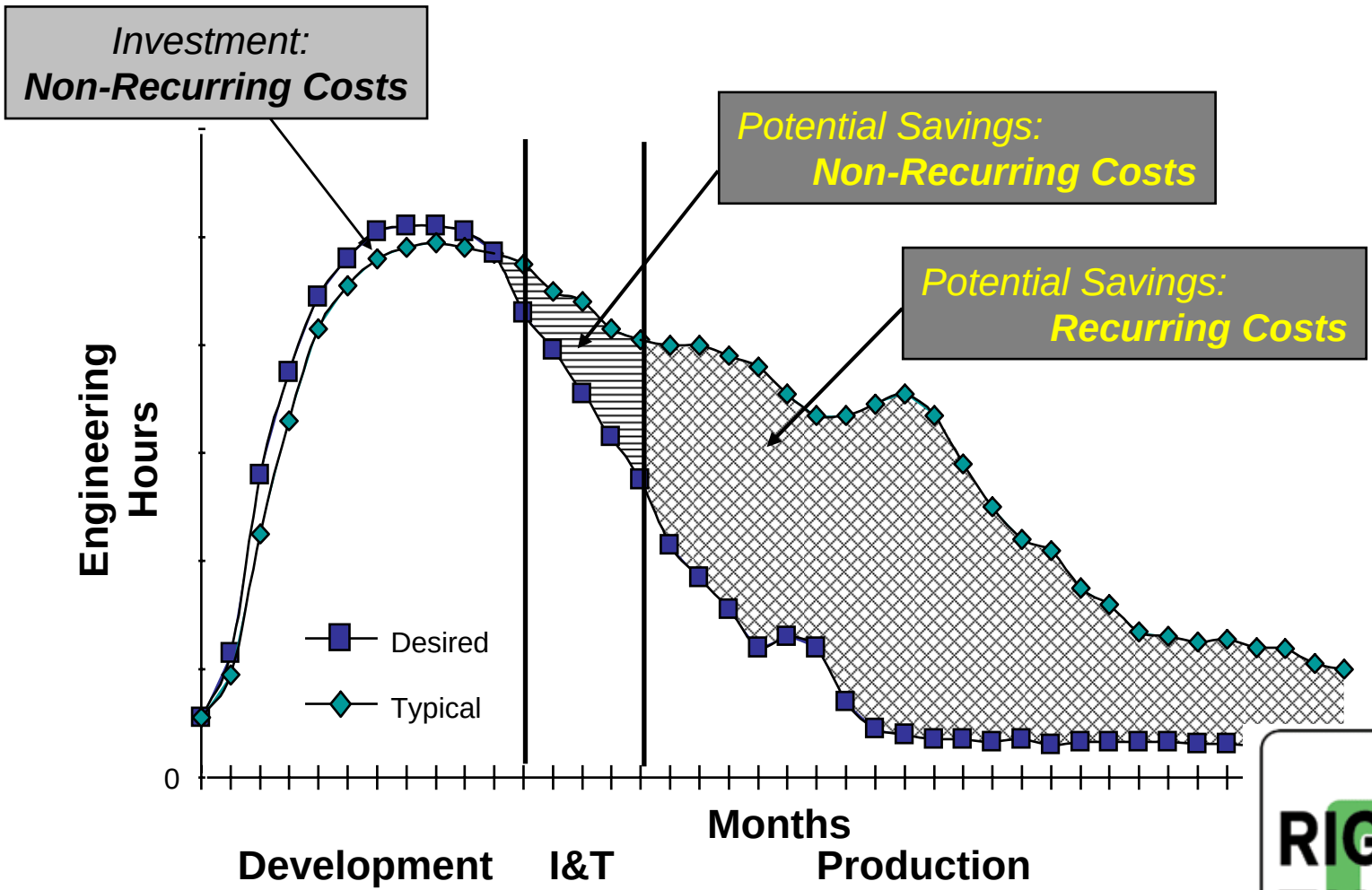
Understanding What's Critical



RIGHT TURN

Need to address the characteristics critical to each project's success

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The Idea is to Predict Performance Early……

- Understand the voice of the customer – what is this product's objectives?
- Determine product characteristics that affect the voice of the customer
  - Key Product Characteristics (KPC)
- Understand what influences the KPCs
  - Key Control Characteristics (KCC)
- Use existing methods, models and simulations to determine where to set the KCCs to maximize probability of achievement of the product's objectives
- By statistically managing these, it will be possible to predict whether the project will be able to achieve its objectives

…To increase the probability of meeting project requirements, at reduced cost and in less time.

RIGHT TURN

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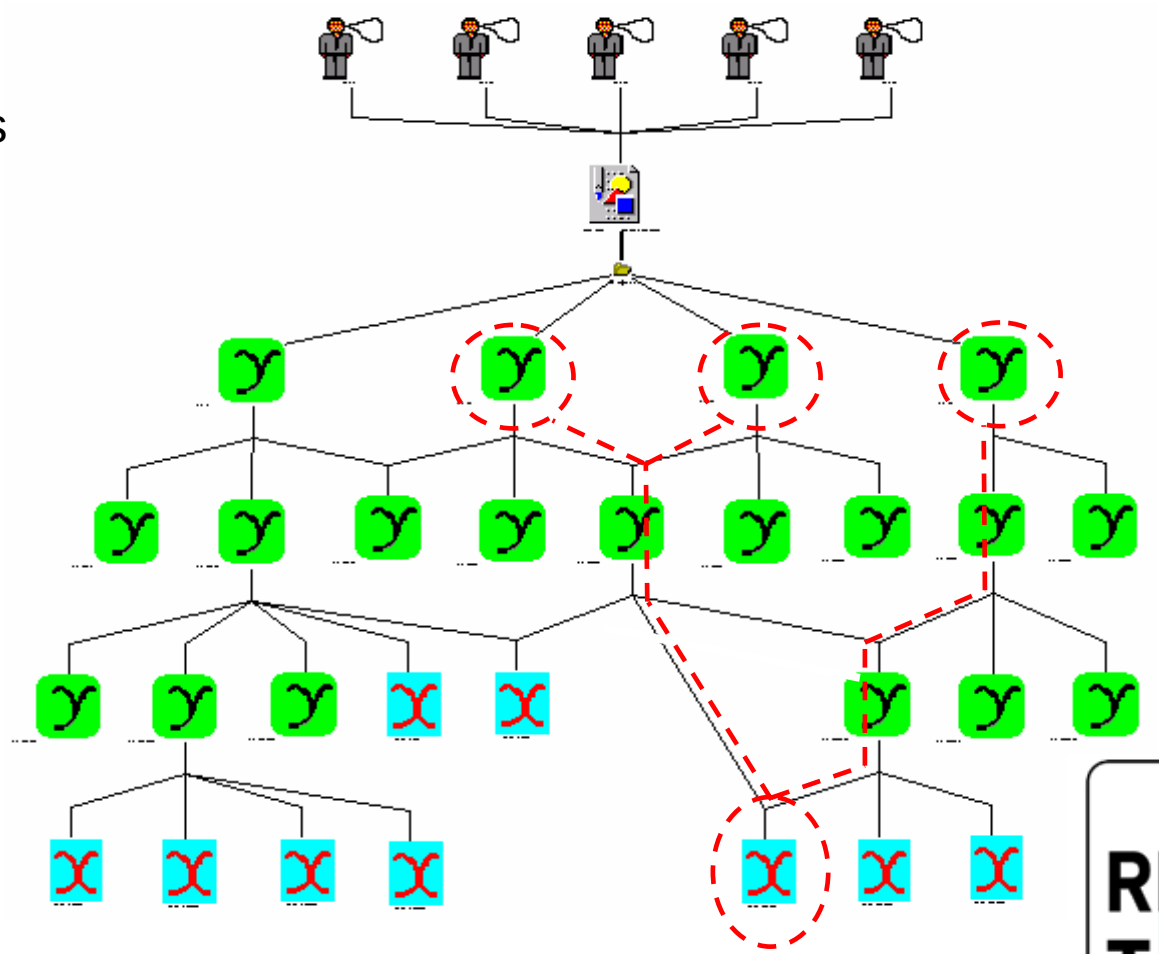
Identify Key Control Characteristics

Programs identify Key Product Characteristics (KPC)

Continued identification of KPCs to lower levels through Functional Analysis

Finally identify Key (Process) Control Characteristics (KCC)



Simple Example of a KCC Affecting Several KPCs

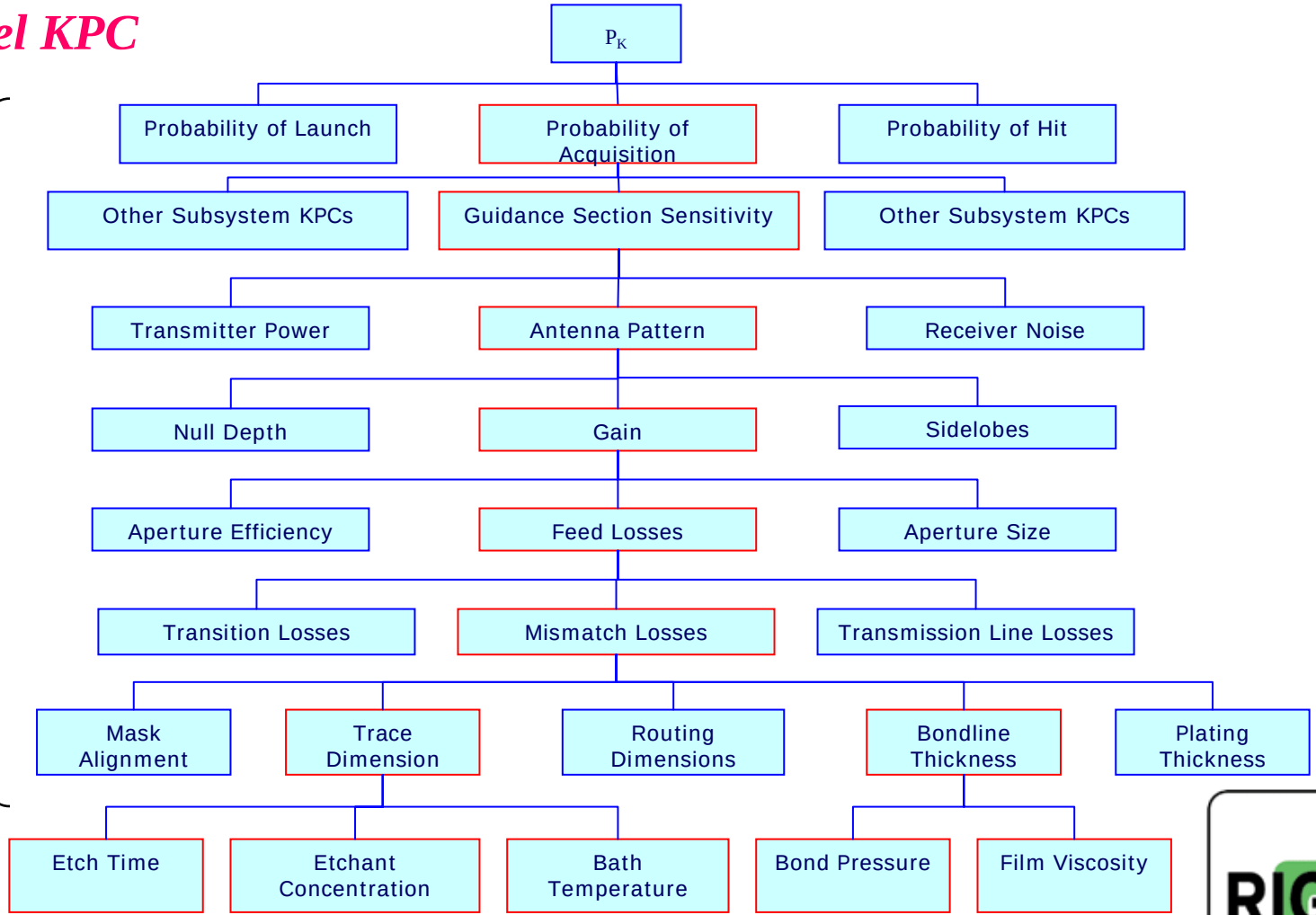
RIGHT TURN

Example of Key Characteristic Development

System Level KPC

KPCs

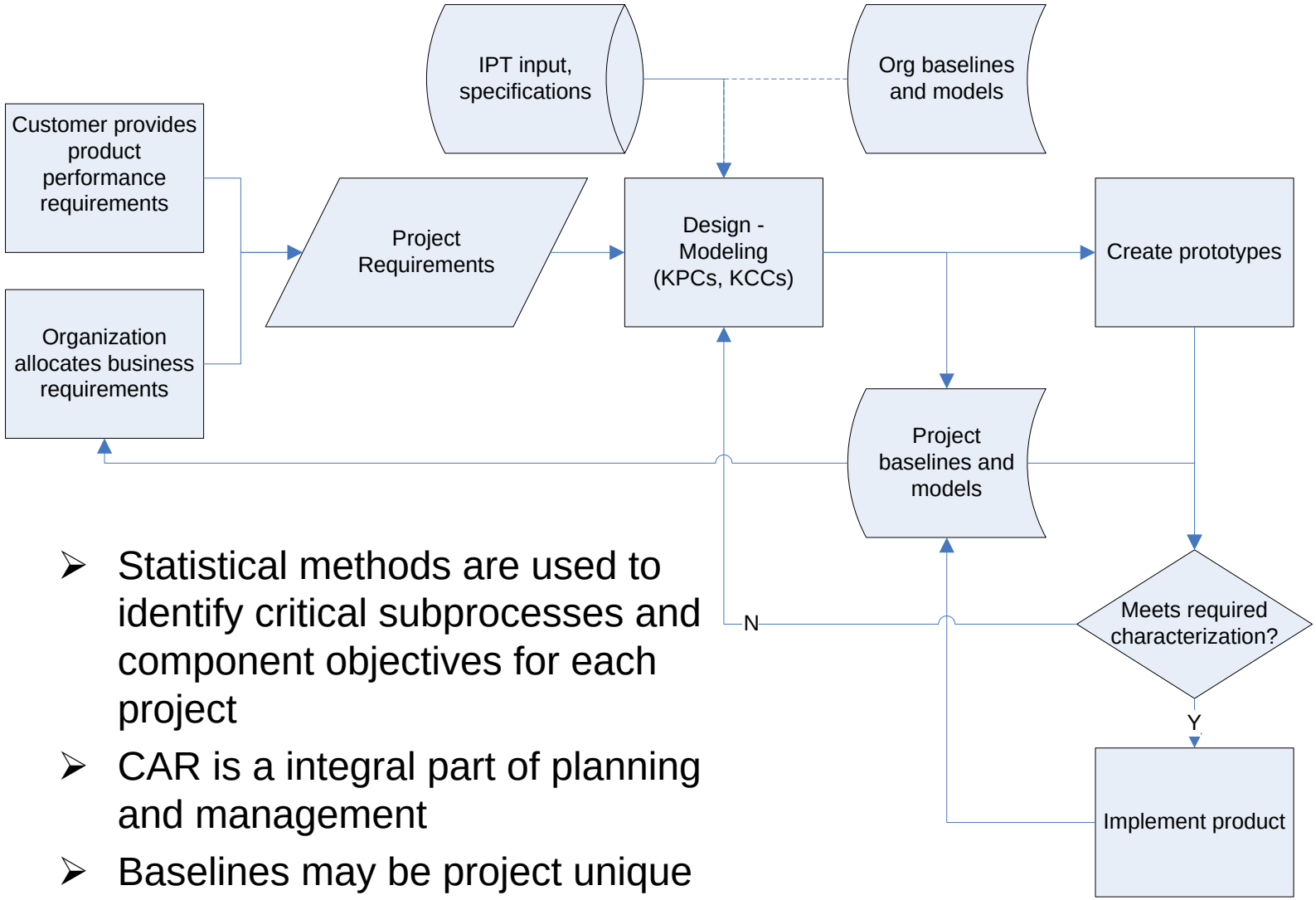
KCCs



System Level KPC driven by lower KPCs and KCCs

RIGHT TURN

Quantitative Project Management



- Statistical methods are used to identify critical subprocesses and component objectives for each project
- CAR is a integral part of planning and management
- Baselines may be project unique

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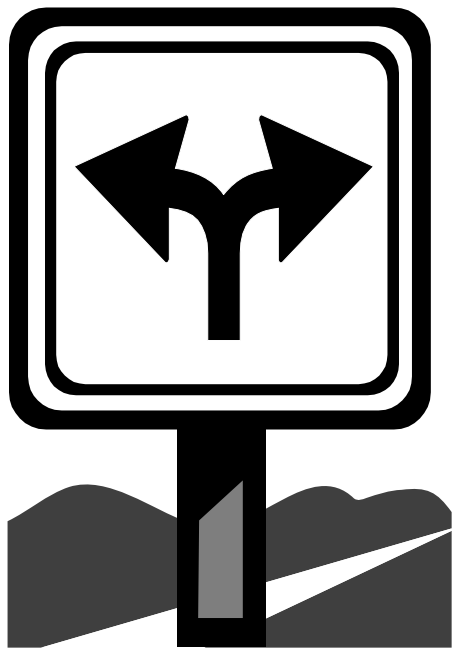
Helps From Design through Manufacturing, All the Way to End User

- ***Helps managing the design complexity*** of a large system, leading to a ***robust design***, by concentrating on the features which significantly impact key objectives
- ***Forces attention*** at those design aspects that are ***most critical to satisfy Customer needs,***
- ***Ties Critical Parameters*** on lower design levels ***back to customer needs*** and quantify their impact,
- ***improves design quality*** by driving a ***"whole system view" mindset*** throughout the design teams and ***increases predictability/reduces risk*** for integration, design/development and manufacturing.
- ***Increase predictability/reduce risk*** for design/development, integration, mfg and ***mission success***.
- Reduces overall development cycle time and cost

Summary - 1

- Organizations with homogenous projects benefit from organizational commonality for quantitative management
  - Selecting critical subprocesses may be pre-determined
  - Baselines and models already exist and only need calibration with use
  - Lessons learned and improvements translate easily to projects throughout the organization



Summary - 2

- Organizations with non-homogenous projects
  - Organization objectives need to be allocated to individual projects/programs
  - Projects identify component characteristics and subprocesses whose variation has greatest impact on all project/program objectives
  - As real data is available models are recalibrated
  - The entire product life-cycle needs to be taken into consideration
- Organizational role
  - Provide baselines and models at component level
  - Manage Organizational Set of Standard Processes (OSSP) to meet organizational objectives

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Questions

Contact:
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Timothy_J_Davis@WillWork4U.com

Top Software Engineering Issues in the Defense Industry

NDIA Systems Engineering Division

and Software Committee

September 26, 2006

Task Description

Identify Top 5 Software Engineering problems or issues prevalent within the defense industry

- NDIA Workshop August 24-25, 2006, Washington D.C.

Document issues

- Description and current state
- Rationale and SW impacts
- Develop recommendations (short term and long term)

Generate task report

- Submit to OSD

Task Group Participants

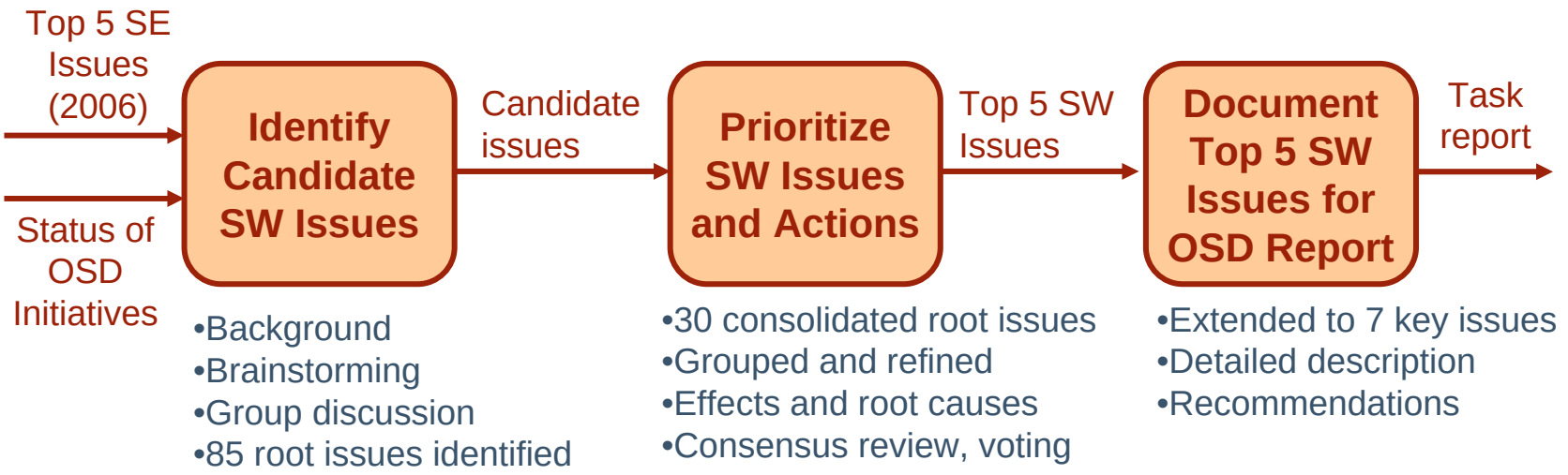
26 workshop participants from industry, government, academia

- **Additional inputs received via email**

BAE Systems
The Boeing Company
Center for Strategic and Intl. Studies
Computer Sciences Corporation
Department of Defense (DoD)
Defense Contract Mgmt. Agency (DCMA)
Florida Institute of Technology
Harris Corporation
Jacobs Technology
Lockheed Martin Corporation
Massachusetts Institute of Technology (MIT)
The MITRE Corporation
Naval Air Systems Command
OUSD (A&T)
Open Systems Joint Task Force
Raytheon Company
RDECOM ARDEC
Asst. Secy. of the Air Force (Acq), SE Division
Software Engineering Institute (SEI)
Systems and Software Consortium
U.S. Air Force Aeronautical Systems Center

Task Group Leads:
Geoff Draper (Harris)
Jeff Dutton (Jacobs Technology)

Task Group Activities



Common Themes Noted

Increasing demands for rapid response to changing threats

- New warfighter capabilities
- Unprecedented complexity
- Increasing dependence on large, software-intensive systems

Evolving acquisition environment

- Innovative and aggressive acquisition strategies
- Extensive reuse of legacy components and system portfolios
- Reductions in acquisition work force due to force-shaping measures

Current approaches for acquiring, developing, verifying, and sustaining software enabled systems are inadequate to deal with the complexities of a dynamic and changing acquisition environment.

Top Software Issues

1. The impact of requirements upon software is not consistently quantified and managed in development or sustainment.
2. Fundamental system engineering decisions are made without full participation of software engineering.
3. Software life-cycle planning and management by acquirers and suppliers is ineffective.
4. The quantity and quality of domain-knowledgeable software engineering expertise is insufficient to meet the demands of government and the defense industry.
5. Traditional software verification techniques are costly and ineffective for dealing with the scale and complexity of modern systems.
6. There is a failure to assure correct, predictable, safe, secure execution of complex software in distributed environments.
7. Inadequate attention is given to total lifecycle issues for COTS/NDI impacts on lifecycle cost and risk.

Issue 1: The impact of system requirements upon software is not consistently quantified and managed in development or sustainment.

Discussion Points:

- Impacts of changes to requirements not addressed consistently.
- SW requirements are not always adequately addressed in system level requirements or solicitations/contracts.
- Conditions leading to SW reqts changes are not clearly understood.
- Weak linkage to SW requirements for capabilities, portfolios.

Recommendations:

Enforce effective software requirements development and management practices, including assessment of change impacts, for both the acquirer and supplier organizations.

- Strengthen policies/guidance for full requirements traceability.
- Evaluate effectiveness of models for estimating SW and changes.
- Improve involvement of SW and acquisition expertise
  - Early requirements definition (JCIDS)
  - Balance user requirements with cost/schedule constraints
  - Impact assessment and communication of requirement changes

Issue 2: Fundamental system engineering decisions are made without full participation of software engineering.

Discussion Points:

- SW not consistently involved in architectural decisions early in the life cycle.
- Must have authority to participate in system-level decision making and trades.
- SE and SW life cycles, processes, and products are not always consistent or harmonized for meaningful cross-discipline integration to occur.
- Segregation of SE/SW proposal inputs can impede coordination.
- System development methods do not properly leverage SW ability to rapidly field enhanced capabilities.

Recommendations:

Institutionalize the integration and participation of software engineering in all system engineering activities.

- Designate an empowered SW architect (acquirer and supplier) early.
- Update policies, standards, guidance to emphasize SW in decision-making.
- Promote effective SE/SW communications and cross-training.
- Adopt acquisition strategies and development approaches that leverage rapid SW development cycles (iterative capability, sustainability).

Issue 3: Software life cycle planning and management by acquirers and suppliers is ineffective.

Discussion Points:

- SW risks and life cycle costs are not consistently accommodated in planning.
- Realistic schedule and effort (cost) estimates are often rejected or constrained.
- Pressure to rapidly procure new capabilities can inhibit balance of life cycle cost, schedule, performance expectations to achieve executable programs.
- Lack of SW expertise applied in planning and management.
- SW processes/methods improperly selected, tailored, executed, monitored.
- SW measures are not used effectively or acted upon.

Recommendations:

Establish a culture of quantitative planning and management, using proven processes with collaborative decision-making across the software life cycle.

- Establish collaborative contractual relationships enabling joint ownership of issues.
- Change culture to base expectations on historical data and realistic constraints.
- Emphasize selection of appropriate processes/methods and codify in contract.
- Incentivize life-cycle perspective and iteration to circumvent near-term thinking.

Issue 4: The quantity and quality of domain-knowledgeable software engineering expertise is insufficient to meet the demands of the government and the defense industry.

Discussion Points:

- Insufficient highly skilled domain-knowledgeable SW professionals to meet the growing demand, due to inadequate funding, insufficient career incentives, competition, downsizing, etc.
- Insufficient infrastructure to rapidly transition skilled staff to new programs.
- Inadequate SW staffing across the system life cycle (architecture, trades, etc.)
- Career path incentives are insufficient to attract SW professionals.

Recommendations:

Collaborate on innovative strategies to staff to appropriate levels and to attract, develop, and retain qualified talent to meet current and future software engineering needs in government and industry.

- Develop a Software Competency Roadmap, with strategic decisions about the future workforce (competencies, downsizing, R&D, etc.)
- Establish joint government, industry, academia working group to identify strategies for expanding SW resource pool and skill sets.
- Cross-train among functional disciplines (PM, SE, etc.) to expand SW engineering pool and extent of domain knowledge.

Issue 5: Traditional software verification techniques are costly and ineffective for dealing with the scale and complexity of modern systems.

Discussion Points:

- Over-reliance on testing alone rather than robust SW verification techniques.
- Manual testing techniques are labor-intensive, scale poorly, and are unproductive relative to the large investment of resources.
- Compliance-based tests do not adequately cover risks or failure conditions.
- Tests are over-documented with disproportionate effort on detailed procedures.
- Education, training, certifications are inadequate to develop effective test skills.

Recommendations:

Study current software verification practices in industry, and develop guidance and training to improve effectiveness in assuring product quality across the life cycle.

- Sponsor a study of state-of-the-practice verification and testing approaches.
- Review/update testing policies and guidance to emphasize robust, productive approaches that maximize ROI.
- Review adequacy of verification plans/approaches early in the acq. life cycle.
- Emphasize skilled investigation throughout the life cycle, based on coverage, risk mitigation, high volume automation.
- Strengthen curricula, training, certifications, career incentives for testing roles.

Issue 6: There is a failure to assure correct, predictable, safe, secure execution of complex software in distributed environments.

Discussion Points:

- SW is inherently vulnerable to widespread SW assurance threats – we must be confident in the supply chain pedigree.
- Current techniques are inadequate to verify assured components with well-understood properties.
- Assurance of systems, and SoS, cannot be easily inferred from components due to issues such as composability, emergent behavior.
- Exhaustive testing to rule out vulnerabilities is not feasible.

Recommendations:

Collaborate with industry to develop approaches, standards, and tools addressing system assurance issues throughout the acquisition life cycle and supply chain.

- Establish collaborative initiatives to develop and deploy comprehensive system assurance approaches.
  - Resistance to intrusion and compromise
  - Commercial standards to address vulnerability throughout the supply chain
- Define SW assurance quality attributes for addressing in architectural trades.
- Sponsor system assurance research, policy, guidance, training..

Issue 7: Inadequate attention is given to total lifecycle issues for COTS/NDI impacts on lifecycle cost and risk.

Discussion Points:

- Inadequate estimating methods for COTS/NDI (reuse, open source, GOTS, …)
- COTS/NDI best practices are known but not consistently implemented.
- Inadequate attention to sustainment issues early in the life cycle.
- Open source licensing issues can expose organizations to liability, loss of data rights, potentially large rework.
- Customer expectations for customization reduce benefits of COTS solutions.
- Insufficient infrastructure to create and facilitate reuse across organizations.

Recommendations:

Improve and expand guidelines for addressing total lifecycle COTS/NDI issues.

- Encourage adoption of COTS/NDI best practices (SEI, AIAA, etc.)
- Ensure COTS/NDI life cycle processes are addressed in program plans.
- Review COTS/NDI life cycle support issues and tradeoffs at program milestones and reviews.
- Ensure COTS/NDI issues are addressed in OSD policy and SW Assurance initiative.

Summary Recommendations
Top SW Issues 2006

1. Enforce effective software requirements development and management practices, including assessment of change impacts, for both the acquirer and the supplier organizations.
2. Institutionalize the integration and participation of software engineering in all system engineering activities.
3. Establish a culture of quantitative planning and management, using proven processes with collaborative decision-making across the software life cycle.
4. Collaborate on innovative strategies to staff to appropriate levels, and to attract, develop, and retain qualified talent to meet current and future software engineering needs in government and industry.
5. Study current software verification practices in industry, and develop guidance and training to improve effectiveness in assuring product quality across the life cycle.
6. Collaborate with industry to develop approaches, standards, and tools addressing system assurance issues throughout the acquisition life cycle and supply chain.
7. Improve and expand guidelines for addressing total lifecycle COTS/NDI issues.

CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ How to do them In One Fell Swoop

Or: How do we do this in order to save time and money?

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ How to do them in one fell swoop

Why do this?

Many corporations are ISO Certified, but want to get to CMMI Maturity Level 3 for contracts and competitive advantage. Other companies want to see their products overseas, and ISO Certification is required

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ **Why do this? It can be done! Without Fear of Disaster!**

There are many similarities between the CMMI-Dev 1.2 and ISO 9001.

The book that can be used to look at the similarities and differences is: *Systemic Process Improvement Using ISO 9001:2000 and CMMI* by Mutafelija and Stromberg

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

How do we go down this road and merge the requirements for the Standard and the Model? How do we make sure that we are not going down a blind tunnel without direction?

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

There are Prerequisites to performing an Appraisal/Audit in an organization:

1) Education
2) Application of the Necessary Knowledge

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

- **Education: is the key: educate your folks!**

If you are ISO 9000 Certified you already have an internal audit group (8,2,2), also if you are CMMI Maturity Level 3, you are performing many of the practices in OPF.

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ Resources for Quality and Process

ISO 9001 States:

Section 8.2.2 Internal Audit, of the Standard reads "the organization shall conduct internal audits at planned intervals to determine whether the quality management system a) conforms to the quality management system requirements and b) is effectively implemented and maintained.

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits How to do them in one fell swoop

➡ Resources for Audits

Audits have to be planned, with the processes and areas to be audited identified, as well as the previous audit results.

Actions have to be taken to answer the nonconformities found during the audits along with their causes. Audit criteria, scope, frequency and methods are to be defined.

Name 2 Process Areas that relate to these activities.

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits How to do them in one fell swoop

➡ Activities for Process Improvement

For OPF, the purpose is to 'plan, implement, and deploy organizational process improvements based on a thorough understanding of the current strengths and weaknesses of the organization's processes and process assets.'

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits How to do them in one fell swoop

➡ Activities for Process Improvement

In OPF, the responsibility for facilitating and managing the organization's process improvement activities, including coordinating the participation of others, is typically assigned to a process group. The organization provides the long-term commitment and resources required to sponsor this group and to ensure the effective and timely deployment of the improvements

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits Where am I going with this when I say 'Educate'?

➡Understanding the Standard

Ensure that those performing internal audits have had training on the ISO Standard and also understand how to audit

➡ Understanding the Model

Ensure that those who work with PPQA and OPF, should take an Intro to the CMMI class or equivalent.

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ **The Resources that are required for the ISO Standard can be the same resources required for the model.**

The resources (People, time, $)used for both the Standard and the Model can be combined to be the same group. Leverage the intellectual capital in your organization. Use the people's brains!!!! Do not create two different groups to perform the same function!

CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ Application: An Example

Quality Manual

Requirements for a Quality Manual per Secti
Standard:

A Quality Manual must exist. It must contain all documented procedures that have been established to cover all the procedures for the Quality Management System (QMS).

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ Application: An Example

Quality Manual

The manual covers the scope of the QMS, including details and justification for any exclusions.

The manual covers descriptions of the interactions between the processes of the QMS.

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ **Application: An Example**

Organizational Process Definition

SG 1 Establish Organizational Process Assets
- **SP 1.1 Establish Standard Processes**
- **SP 1.2 Establish Lifecycle Model Descriptions**
- **SP 1.3 Establish Tailoring Criteria and Guidelines**

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ **Application: An Example**

Organizational Process Definition = Quality Manual

If you have implemented OPD and/or have a Quality Manual, you most likely have satisfied both the model and the standard.

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

- **Application: Bottom Line Organizational Process Definition = Quality Manual**

Do NOT produce another set of procedures for you ISO or CMMI effort if you ALREADY have procedure in place.

Make what you have work for you. Do not do more work than you have to.

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ **Application: An Example**

Training: Model Requirements for Organizational Training

The purpose for OT is: to develop the skills and knowledge of people so they can perform their roles effectively and efficiently.

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ Application: An Example

Informative material from CMMI v1.2, OT:

An organizational training program involves the following:

-Identifying the training needed by the organization
-Obtaining and providing training to address those needs
-Establishing and maintaining training capability
-Establishing and maintaining training records
-Assessing training effectiveness.

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ Application: OT SGs and SPs

SG 1 Establish an Organizational Training Capability
-SP 1.1 Establish the Strategic Training Needs
-SP 1.2 Determine Which Training Needs Are the Responsibility of the Organization
-SP 1.3 Establish an Organizational Training Tactical Plan
-SP 1.4 Establish Training Capability
SG 2 Provide Necessary Training
-SP 2.1 Deliver Training
-SP 2.2 Establish Training Records
-SP 2.3 Assess Training Effectiveness

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ Application: 6.2.2 Competence, awareness and training

Organization shall
a) determine the necessary competence for personnel performing work affecting product quality (SP 1.1)

b) provide training or take other actions to satisfy these needs (SP1.2, 1.4)
c) evaluate the effectiveness of the actions taken (SP 2.3)

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ Application: 6.2.2 Competence, awareness and training

Organization shall
d) ensure the its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives, and (SP1.4)

e) maintain appropriate records of education, training, skills and experience (SP2.2)

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ Now the answer you have all been waiting for:

Appraisals:

SCAMPI A,B,C?
Internal Audit by your folks, or external by your Registrar?

What are your needs?

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ **Now the answer you have all been waiting for:**
Appraisals/Audits:

Where are you in your implementation?

SCAMPI C: only one person necessary who can do the Internal ISO Audit as well as a B,C Team Leader

SCAMPI B: a team of at least 4, all having the team requisites and all being internal ISO auditors

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ **Now the answer you have all been waiting for:**
Appraisals/Audits:

Where are you in your implementation?

SCAMPI A: Of course a Lead Appraiser, who is also an internal ISO auditor (at least), and one representative who is from the Registrar (having attended the approved SEI intro class).

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CMMI® Version 1.2 Appraisals and ISO 9001 Appraisals/Audits

➡ How to do them in one fell swoop

Example:
A Tool to help you put it all together…….

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Carnegie Mellon
Software Engineering Institute
Pittsburgh, PA 15213-3890

CMMI®

The CMMI® Product Suite and International Standards

Dave Kitson, Jeanie Kitson, Terry Rout and Pedro Sousa

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Agenda

Evolution of Capability Maturity Models® and ISO/IEC 15504

ISO/IEC 15504 Overview and Status

CMMI Synergy with International Standards

Work to be Done

Future Directions

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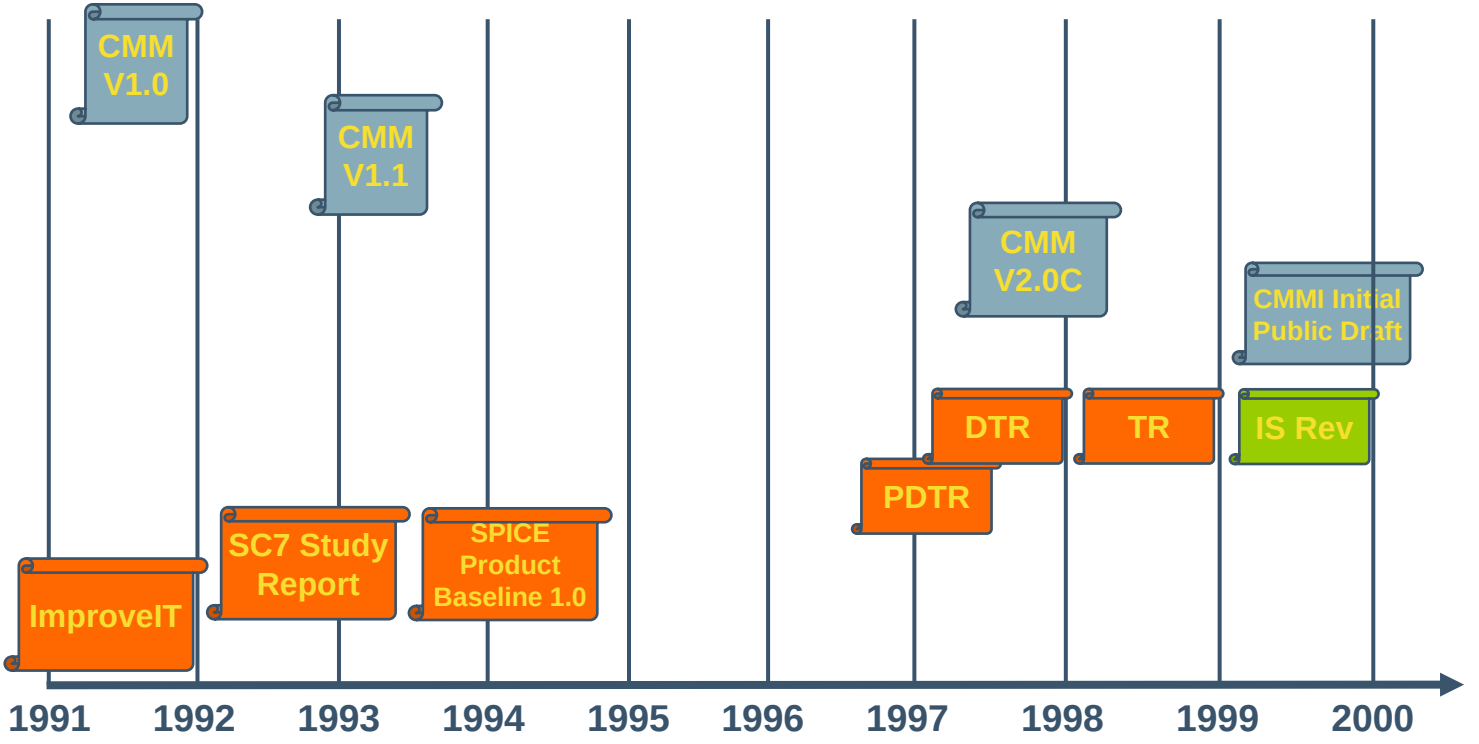
Progression of CMMs® and 15504 -1



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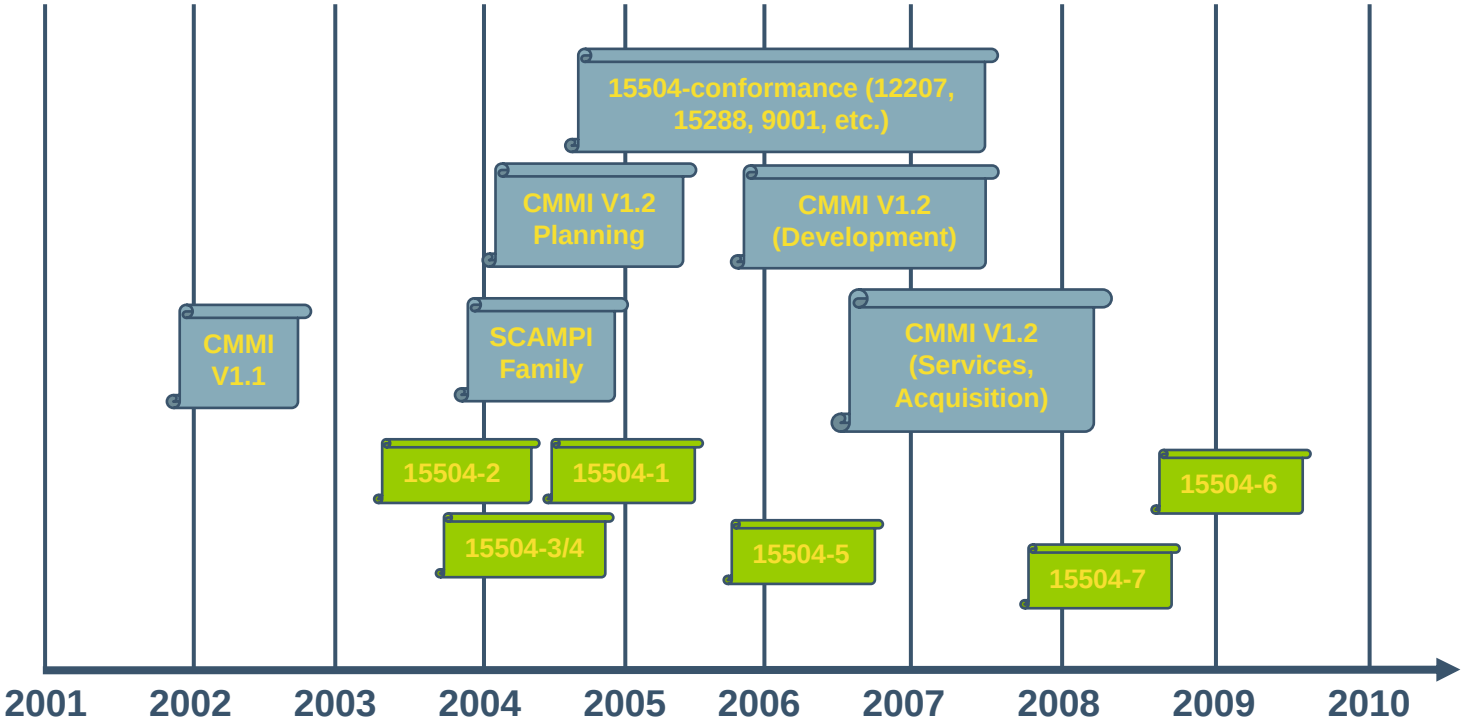
Progression of CMMs and 15504 -2



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What EXACTLY is 15504?

ISO/IEC 15504 is an international standard being progressed by WG10 - a working group established by ISO/IEC/JTC1 SC7.

Prescribes requirements for process assessment; is a framework standard.

Consists of 5 documents (15504-1, …, 15504-5); note that all parts are now published.

Not the same as ISO/IEC TR 15504 – this is a 9-part set of documents published as ISO Technical Reports in 1998.

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Key Premise Underlying 15504

Assessments of process capability will yield results which are comparable as long as:

- the process assessment model satisfies 15504 model compatibility requirements
- the assessment process satisfies 15504 assessment requirements
- the assessment contexts are similar

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Evolution of 15504 Specificity

1st generation (pre-Pilanesburg) - practices were HARD-WIRED into 15504 (as a normative component - BPG)

2nd generation (pre-IS) - process definitions were HARD-WIRED into 15504 (as a normative component - 15504-2)

3rd generation (IS) - compliance requirements for Process Reference Models (PRMs) HARD-WIRED into 15504 (as a normative component - 15504-2):

- PRMs will be externally specified
- 12207 includes as an amendment a PRM encompassing TR 15504-2 process definitions (and more)

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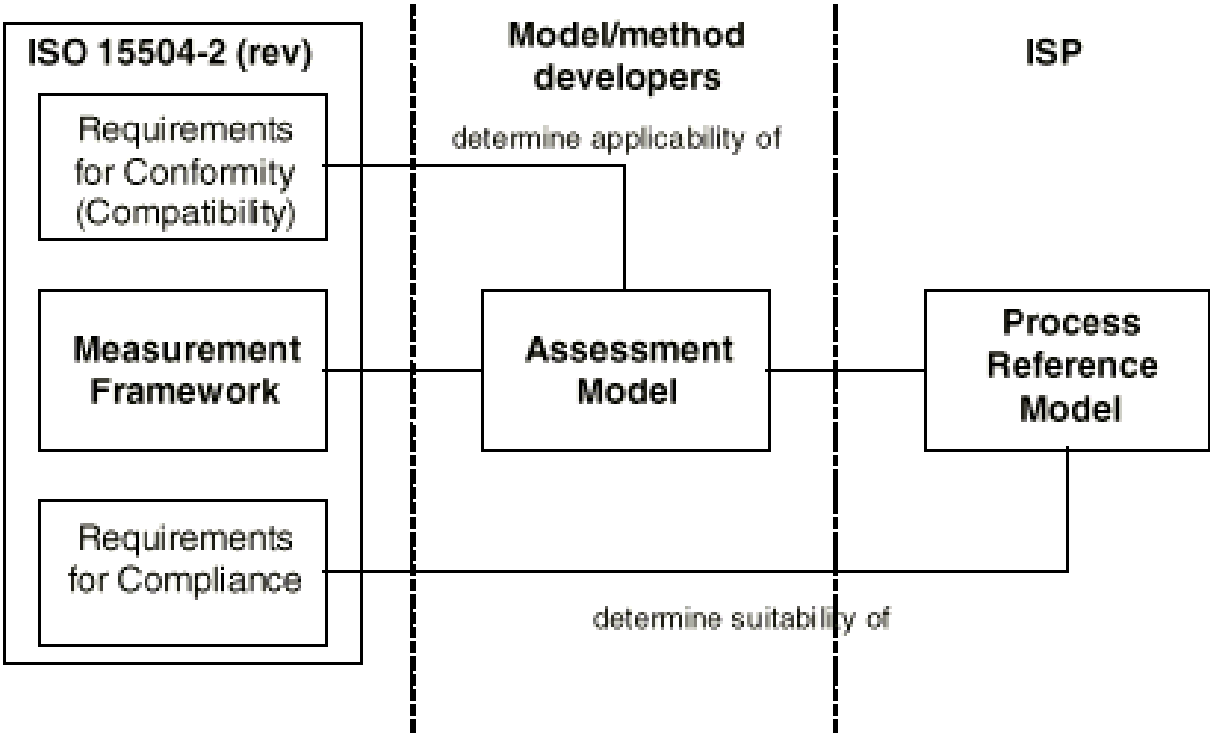
Architecture for 15504



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CMMI and 15504

A-spec requirements relevant to international standards:

"2.3 Reference Documents

2.3.1 Applicable ISO/IEC documents, including ISO/IEC 12207 and ISO/IEC 15504."

"3.1 Development User Requirements

3.1.6 The CMMI Product Suite shall be consistent and compatible with ISO/IEC 15504."

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Synergy With Selected International Standards -1

Identify areas where there are opportunities for synergy between key international standards and the CMMI Product Suite

Exploit these opportunities by developing appropriate work products and/or liaising with appropriate individuals and organizations

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Synergy With Selected International Standards -2

Two of the key areas identified to date are the ISO 9000:2000 family of standards and the ISO/IEC 15504 standard

Note that 15504 provides a mechanism for establishing important relationships to other important process-related international standards such as ISO 9001:2000, 12207, 15288

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Key Supplements Needed

Identification of suitable process reference models,

Mappings between CMMI model (s) and PRM (s) satisfying 15504 -2 requirements,

Translation mechanism

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Translation Mechanism

Purpose: for representing the results of an assessment as a set of process attribute ratings for each process selected from the specified Process Reference Model

How?:

1. **direct translation of Process Assessment Model ratings into a process profile**
2. **or the conversion of the data collected during the assessment (with the possible inclusion of additional information) through further judgment on the part of the assessor.**

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Status

A detailed mapping has been developed from CMMI to:

- the Measurement Framework in ISO/IEC 15504; and
- the Process Reference Model included in ISO/IEC 12207.

A possible approach has been developed for verifiable conversion of results.

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An Approach for Data Conversion - 1

For the Process Dimension:

- Collect data and generate observations for all Specific Practices in Process Areas within the scope of the assessment.
- Using the mapping tables, assign the data observations to all Process Outcomes and Attributes indicated from the mapping.
  - Thus, if a Specific Practice maps to multiple Process Outcomes, assign the data to all of the possibilities.
- Review the assigned data and remove observations that are not relevant.
- Judge whether the remaining data is adequate to enable judgement of achievement of the outcomes.

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An Approach for Data Conversion - 2

Where adequate data is available, consolidate the data to the process level and rate the performance of the process (Process Attribute 1.1).

If the data is not adequate, either:

- Collect additional data; or
- Remove the process from the 15504 scope of the appraisal.

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An Approach for Data Conversion - 3

Repeat the exercise for the Generic Practices and Process Attributes 2.1 – 5.2.

Additional data will need to be collected to address gaps in the mapping

- **Most notably in Process Attribute 3.2**

In some cases, evidence from Advanced Practices may also be relevant to a particular Process Attribute for a specific Process or set of Processes.

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Tool Support

To achieve this form of conversion is complex and difficult, without tool support.

A tool (the Appraisal Assistant) has been developed for managing evidence and ratings in CMMI appraisals, with a specific focus on conversion of data to generate ISO15504 Process Profiles.

The tool automatically generates lists of data for a Process Attribute based upon detailed ratings tables.

- It permits de-selection of data judged to be not relevant.
- It highlights areas where there may be a lack of relevant evidence.

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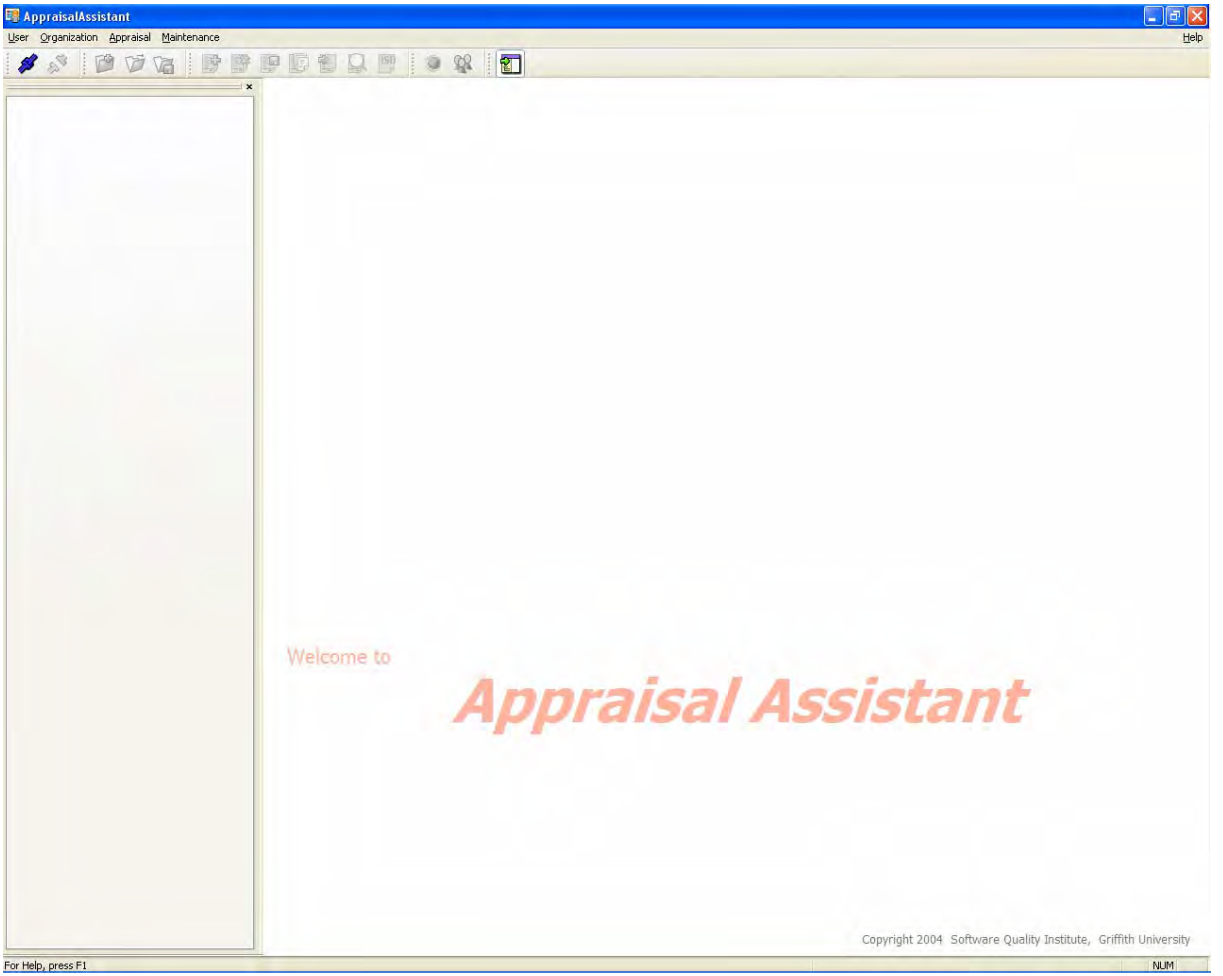
The Appraisal Assistant



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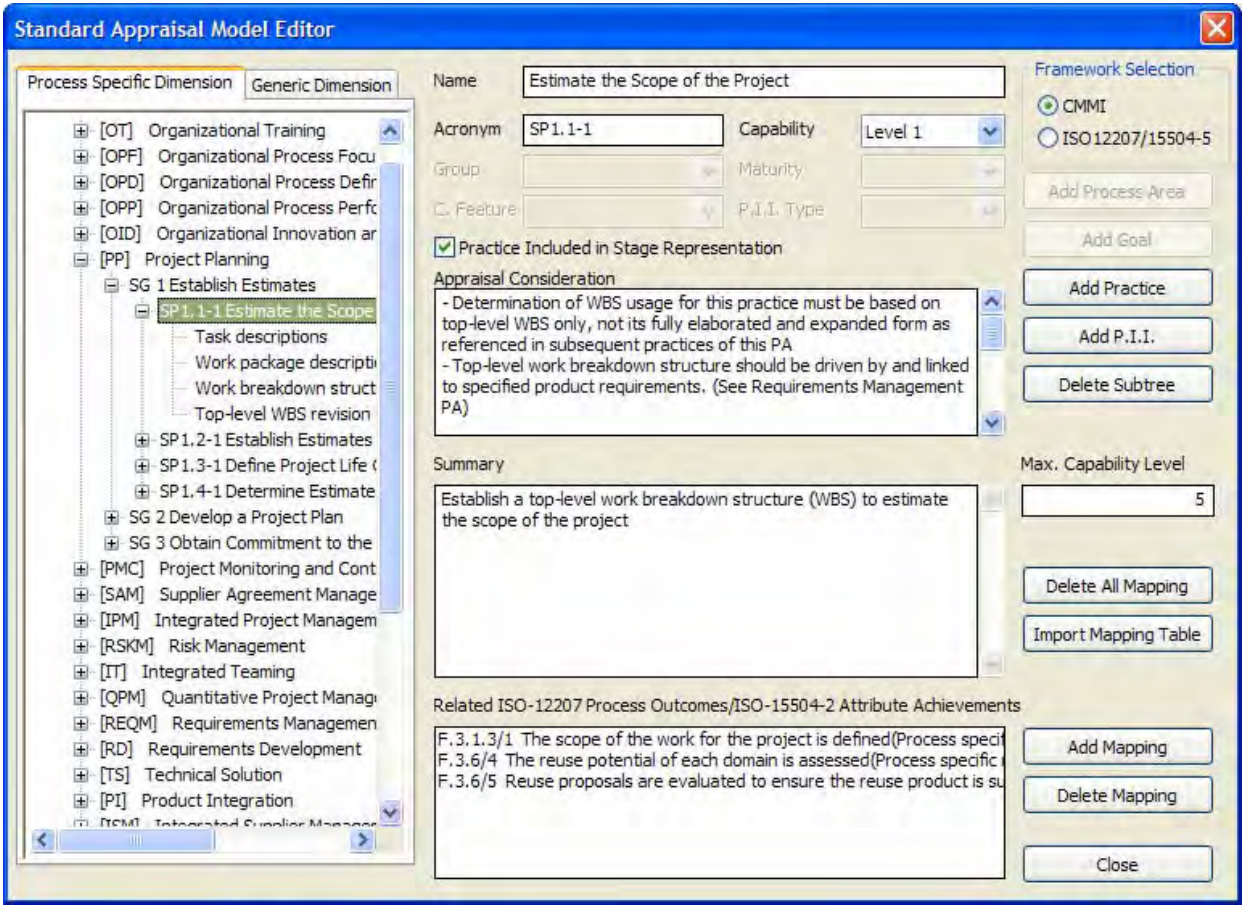
Model Details



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Pilot Appraisal

15504-conformant SCAMPI A appraisal conducted at Critical Software, SA during February-March 2006

- **Maturity level 3 scope**
- **Process reference model embedded in ISO/IEC 12207 (amended)**
- **Mapping between CMMI and 12207 provided by Software Quality Institute**
- **Appraisal team included 3 SCAMPI Lead appraisers , one ISO 9001 auditor and one SPICE assessor**
- **Support automation provided by Software Quality Institute – Appraisal Assistant**
- **Subset of 15504 process profiles generated as well as selected ISO 9001 outcomes.**

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Project Management Process

Maps to elements from the following Process Areas:

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Requirements Management
- Integrated Project Management
- Quantitative Project Management

With minor linkages to

- Organizational Process Performance
- Risk Management
- Verification

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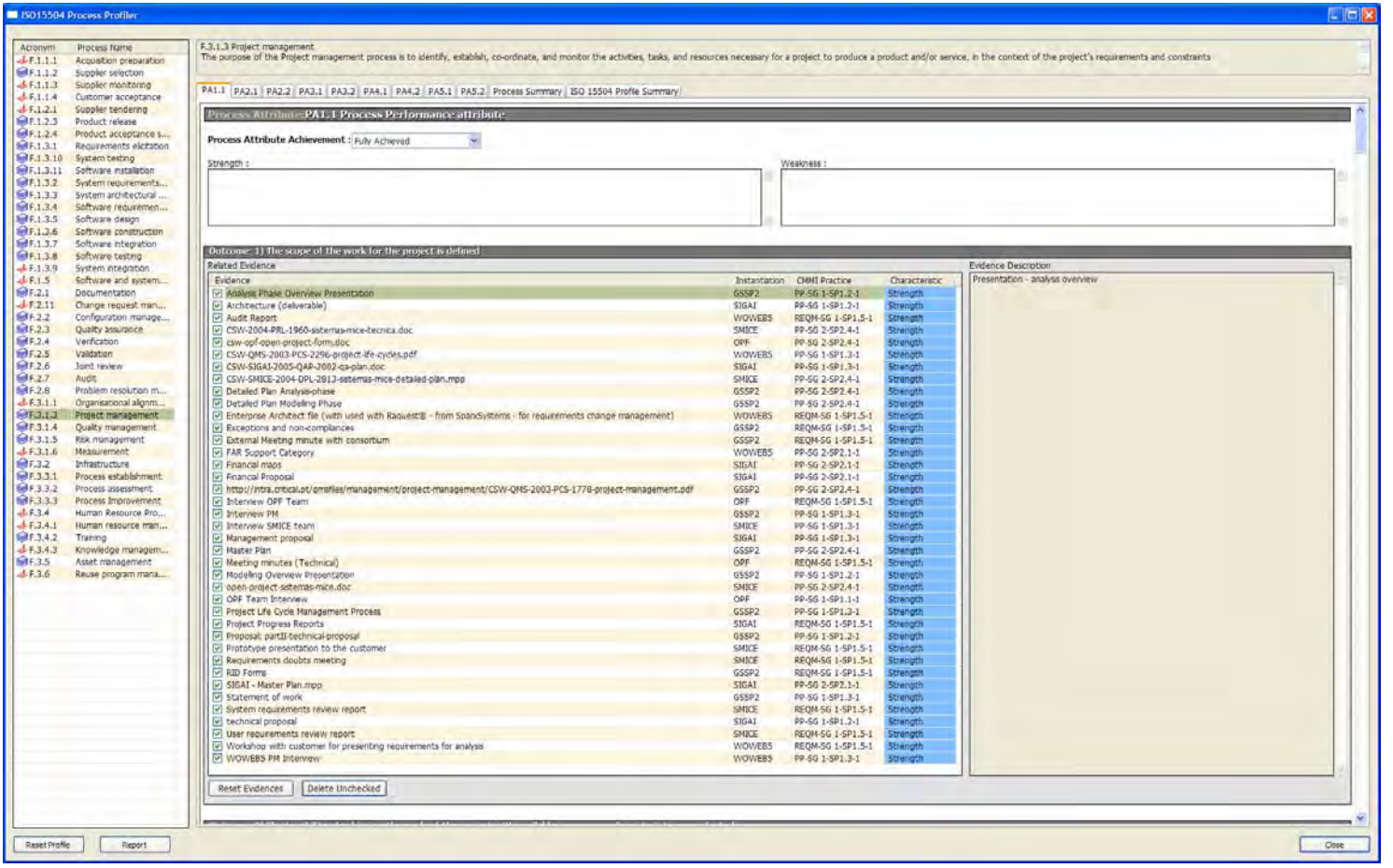
Project Management Process



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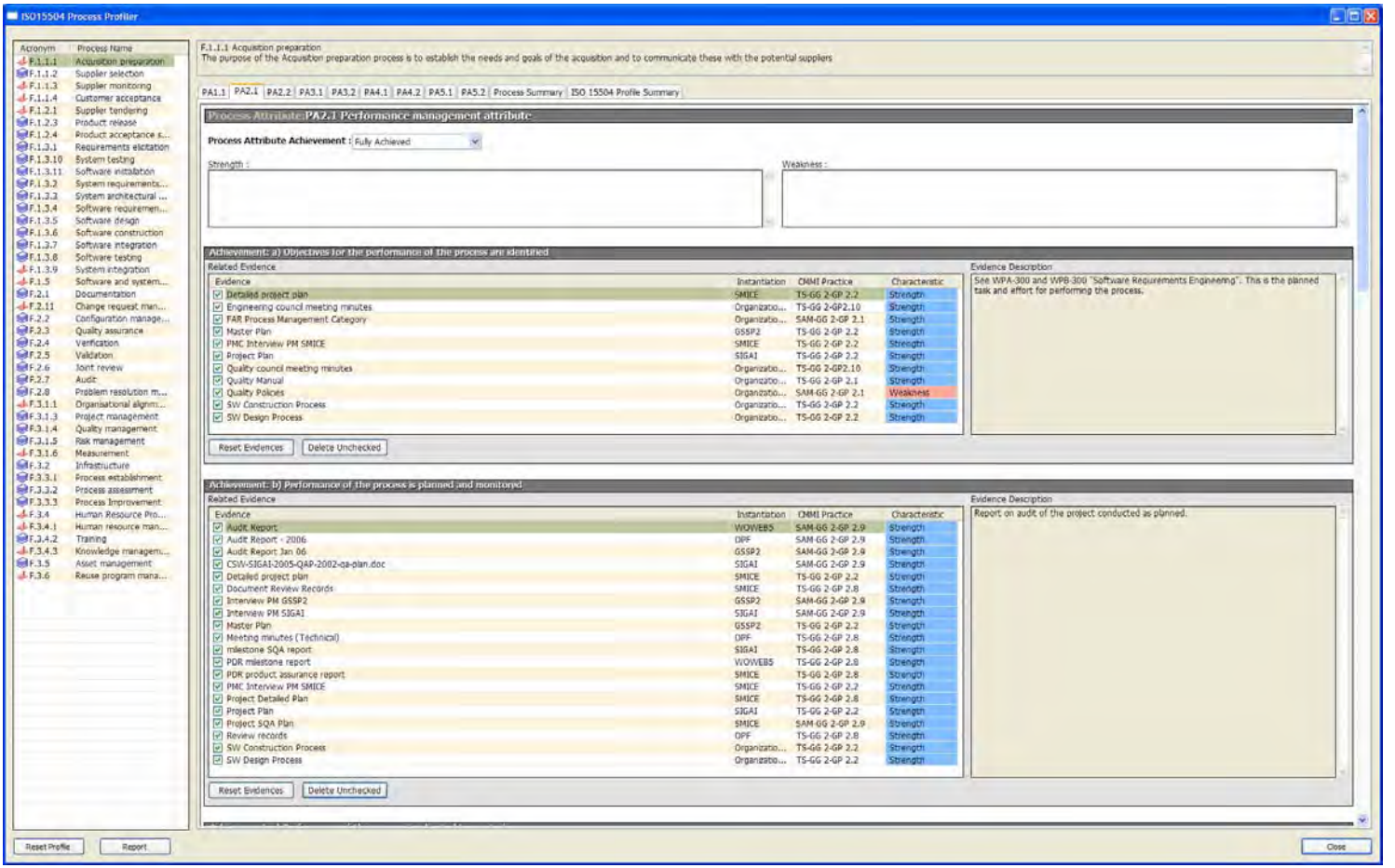
PA 2.1 – Process Management



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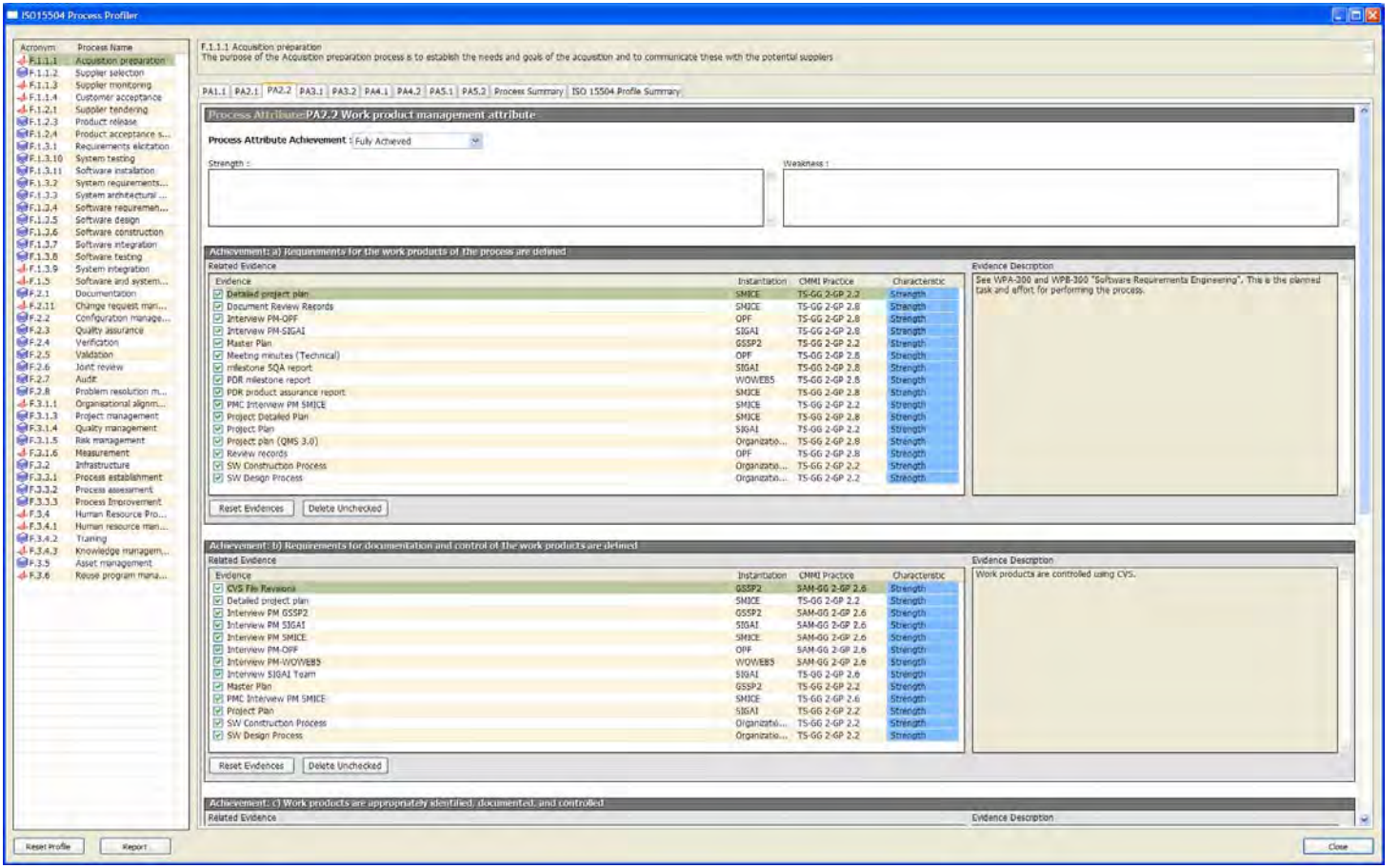
PA 2.2 – Work Product Management



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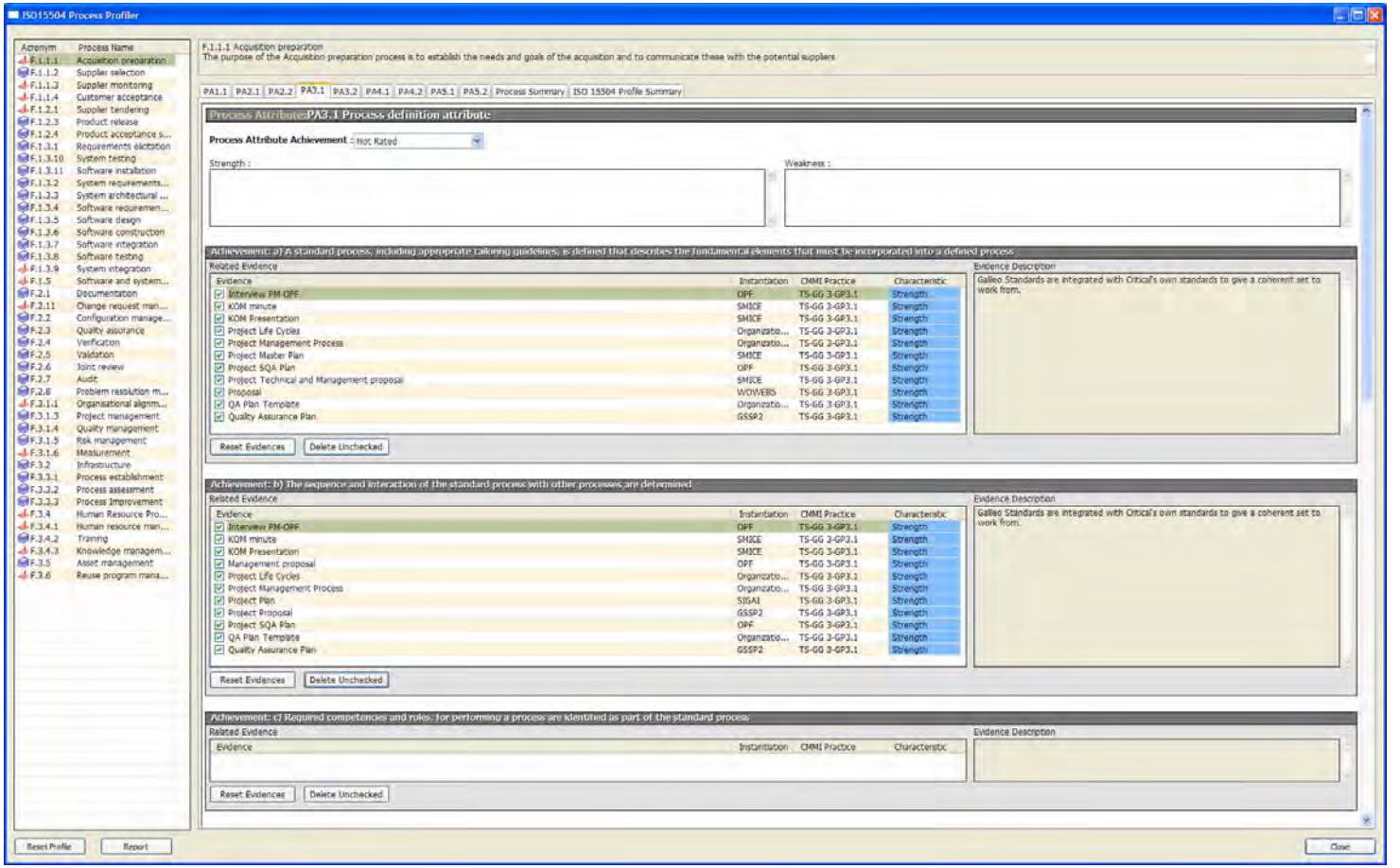
PA 3.1 – Process Definition



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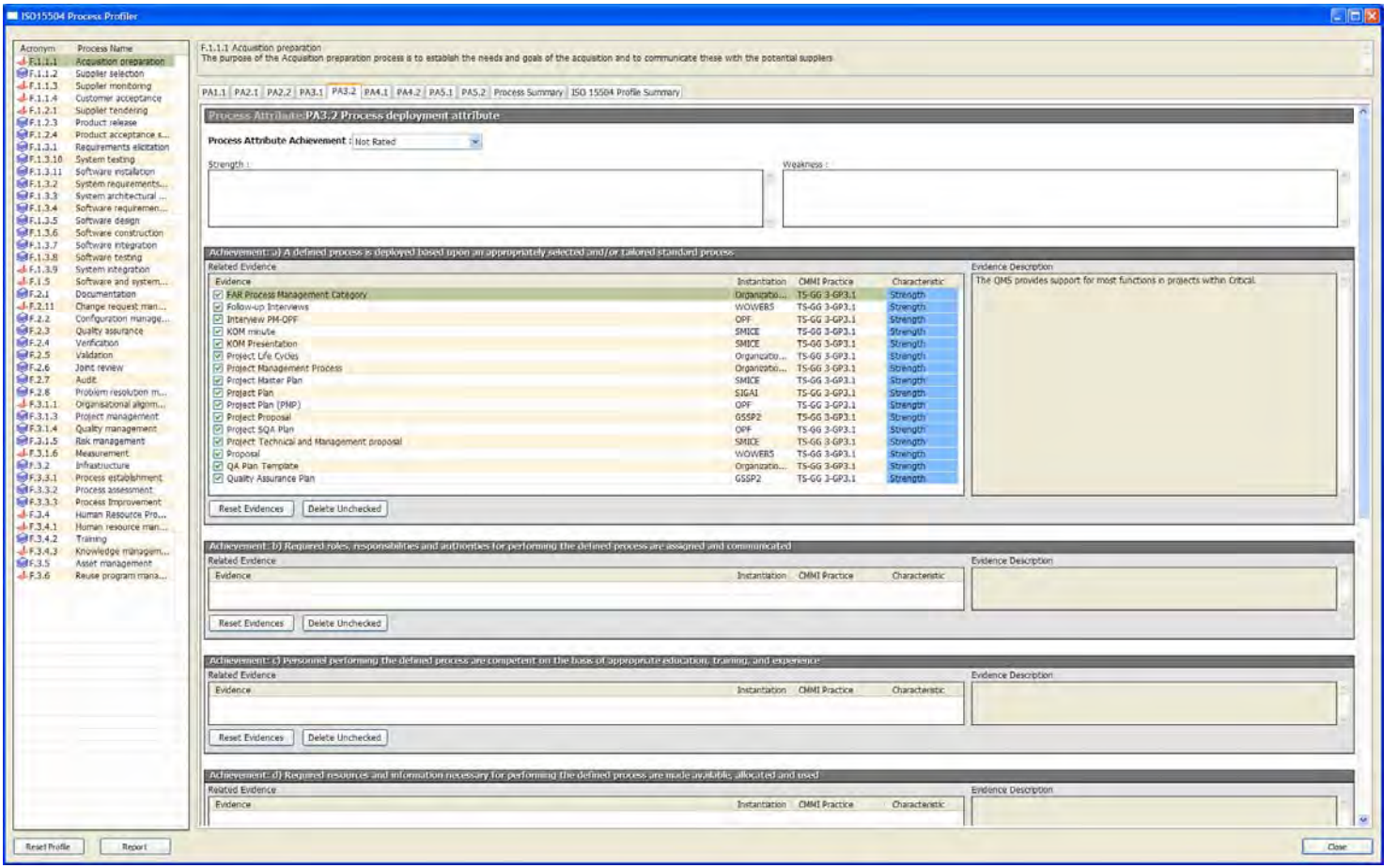
PA 3.2 – Process Deployment



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Pilot Appraisal Report

Result considered a successful demonstration of ability to fulfill 15504 requirements and generate 15504 process profile relative to a separate process reference model,

Demonstrated criticality of adequate supporting automation

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Pilot Observations

Improvement opportunities were identified for support automation

Sample of 12207 processes were rated and a sample of 9001 clauses were examined

Observed consistency between CMMI findings and prior 9001 audit reports as well as prior SPICE assessments, given the expected progress of the improvement program at Critical.

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Issues from the Pilot Appraisal

Model-related:

- **Deficiencies previously identified in the relationship between CMMI Generic Practices and the 15504 Measurement Framework had a significant impact on assessment of Level 3 Process Attributes.**

Technology-related:

- **Significant issues in usability of the "translation" functions.**
- **Need to incorporate the ability to capture additional evidence where needed.**

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Further effort

Additional pilot appraisals are required to identify any additional issues and to raise confidence in the translation mechanism as well as the translation requirements of 15504.

Ideally a combined CMMI / SPICE assessment using two independent teams should be undertaken.

The ability to perform “bi-directional” translation would be useful (i.e. determine CMMI capabilities from a SPICE assessment) would be useful.

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Beta-2 Release

Significant improvements to the Evidence Registry and to Ratings Generation.

CMMI – ISO 15504 mapping functions improved in line with findings from the Pilot Appraisal.

Available for download from
http://www.sqi.gu.edu.au/AppraisalAssistant

The SQI is committed to two further beta releases of the Appraisal Assistant in 2007.

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Beta Test Programme

Initial release 2005

Beta 2 release 28 July 2006

503 registered beta testers

217 downloads of Beta 2 version

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More Information

The Appraisal Assistant:

- http://www.sqi.gu.edu.au/AppraisalAssistant

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- Terry Rout T.Rout@griffith.edu.au

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(Abstract Reference: Abstract ID: #3746)

Quick Win Strategy in CMMI Transition

Angel Liu

Motorola Software Group, China

HERE

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- History of Process Improvement
- Strategy of Transition
- Manage Transition
- Use OID in CMMI Transition
- Result of Transition

Quick Win Strategy in CMMI Transition

(From CMM L5 To CMMI L5)

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MOTOROLA

History of Process Improvement

- GSG was formed in 1991
- Funded from Motorola CEO
- 14 Centers with +5000 Engineering Talents
- GSG China established in 1993
- GSG China has 3 branch offices with 1200+ employees

Motorola Global Software Group

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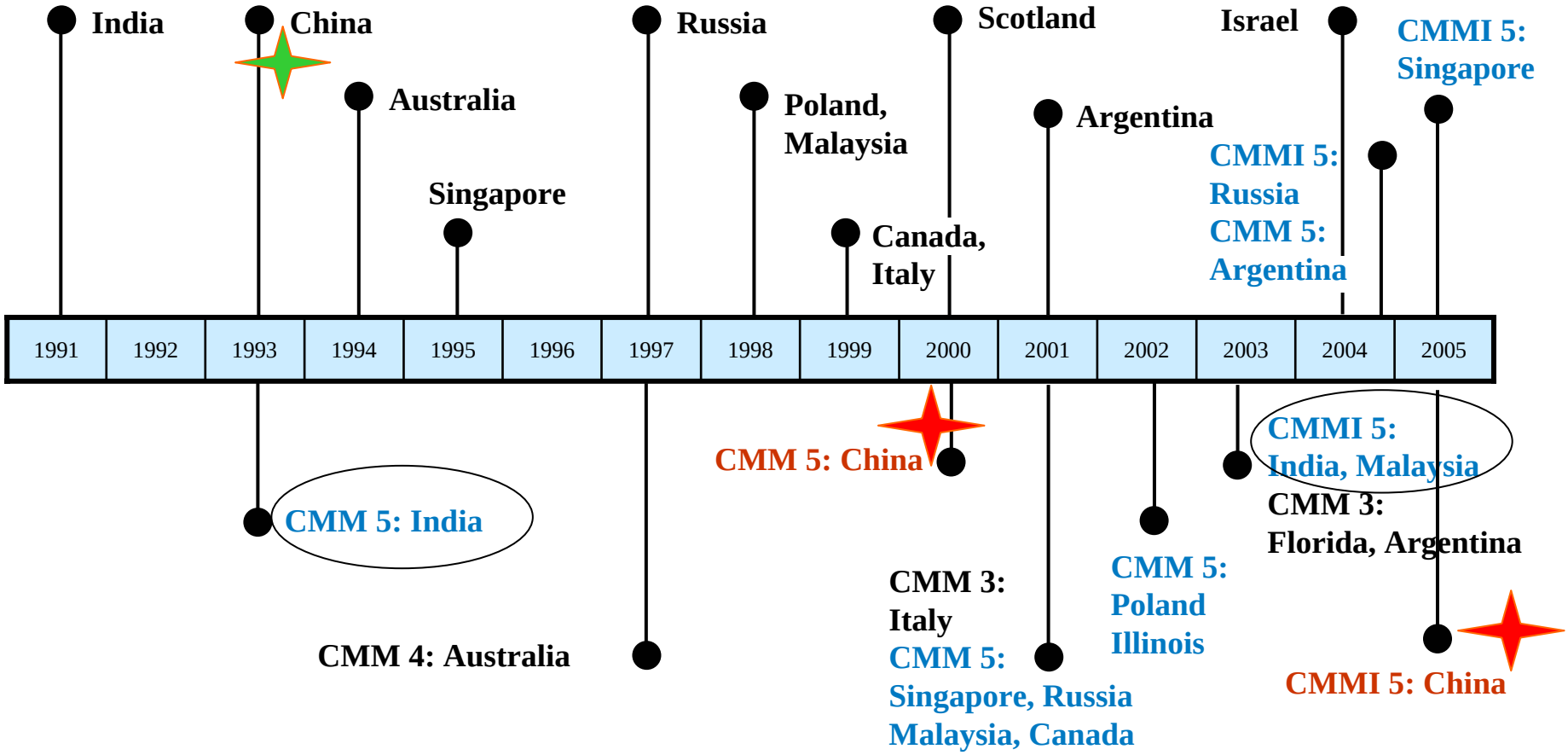
Motorola Global Software Group History



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GSG China Software Improvement

摩托罗拉中国软件中心

1993
We are the first one in China who started to practice CMM

1996
Achieve CMM L4

1999
Reassessment at CMM L4

2000
We are the **FIRST** S/W organization in China assessed **SEI CMM L5**

2005
CMMI L5 (SCAMPI A)

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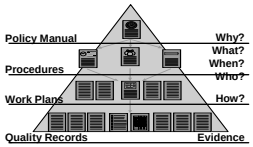
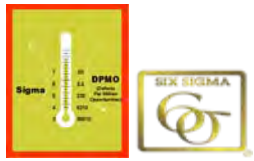
Motorola Process and Quality Initiatives



Capable Quality System

Align and Link Individual Goals,Business Goals and Motorola's Strategic Goals



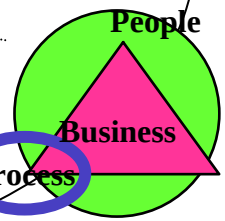
Six Sigma Concept First from Motorola (1980's) and Re-launch Digital 6 Sigma (2000')

Build Quality Culture

Malcolm Baldridge Award 1988, 2002

Black Belt Initiative,Apply DMAIC Process and Tools to Projects

Total Customer Satisfaction



SEI Focus

First SEI Assessment in 1980's

Start Transition to CMMI From 2001

Use QSR to Achieve Registration to ISO 9001/QS9000 Standard

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MOTOROLA

- History of Process Improvement
- **Strategy of Transition**
- Manage Transition
- Use OID in CMMI Transition
- Result of Transition

Quick Win Strategy of Transition

- Sponsorship and Commitment
- Driving as one initiative linked to business goal
- Commitment and Involvement -+60% population direct involvement
- Managing the transition using project management process
- Design with Reuse
- Implementing CMMI incrementally
- Automating Process environment to reduce process overhead

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- History of Process Improvement
- Strategy of Transition
- **Manage Transition Project**
- Use OID in CMMI Transition
- Result of Transition

Transition Planning

- **Sponsor from Senior Management of CMMI adoption**
  - **Understand the business value of transition and setup as business goal**
- **Establish Target Profile based on organization needs**
- **Develop CMMI experts to drive the transition**
- **Reinforce SEPG and re-organize SME team better support CMMI structure**
- **Identify gaps using SCAMPI C**

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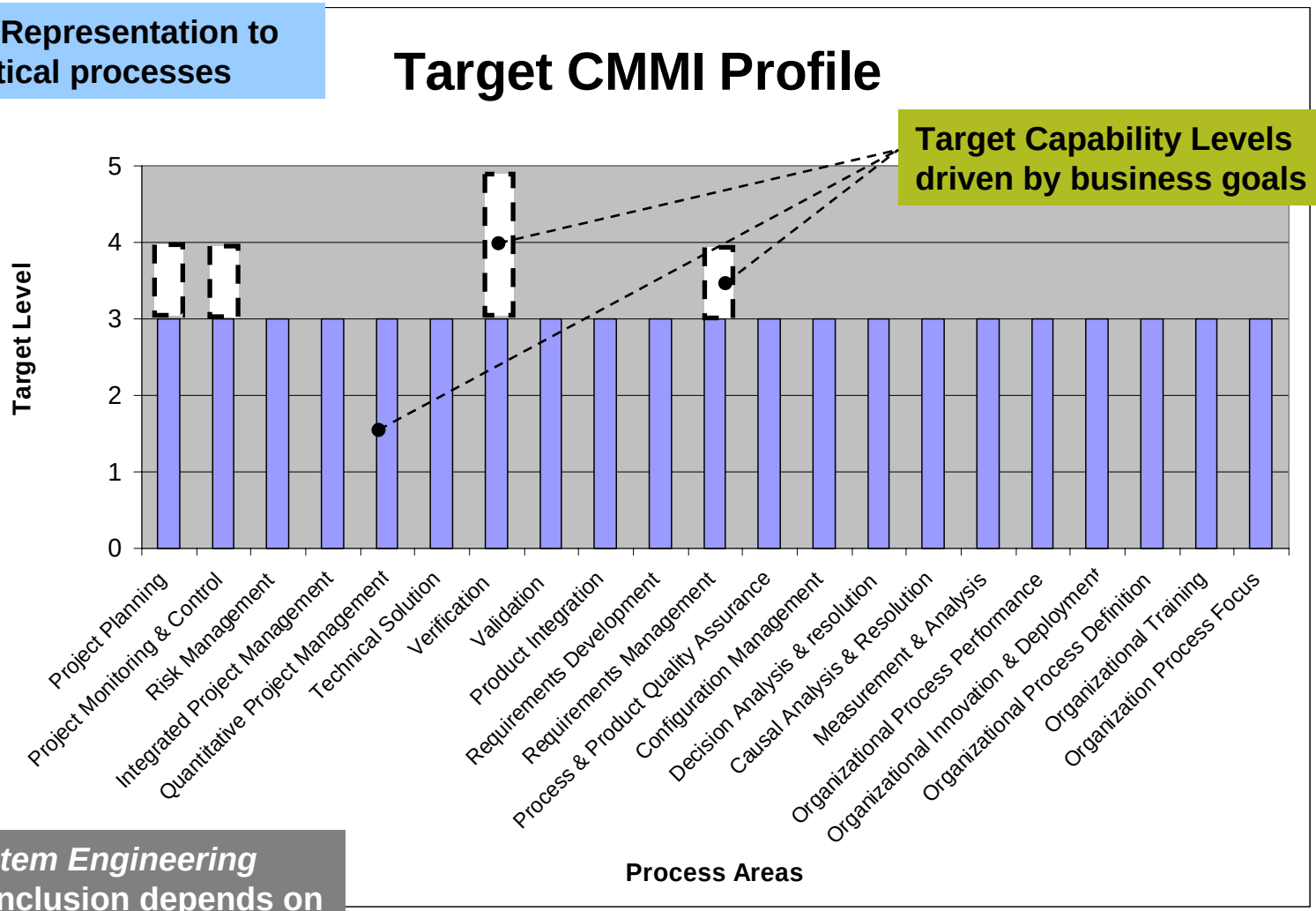
Defining the Target Profile

Continuous Representation to focus on critical processes



IPPD & System Engineering
Discipline inclusion depends on project nature

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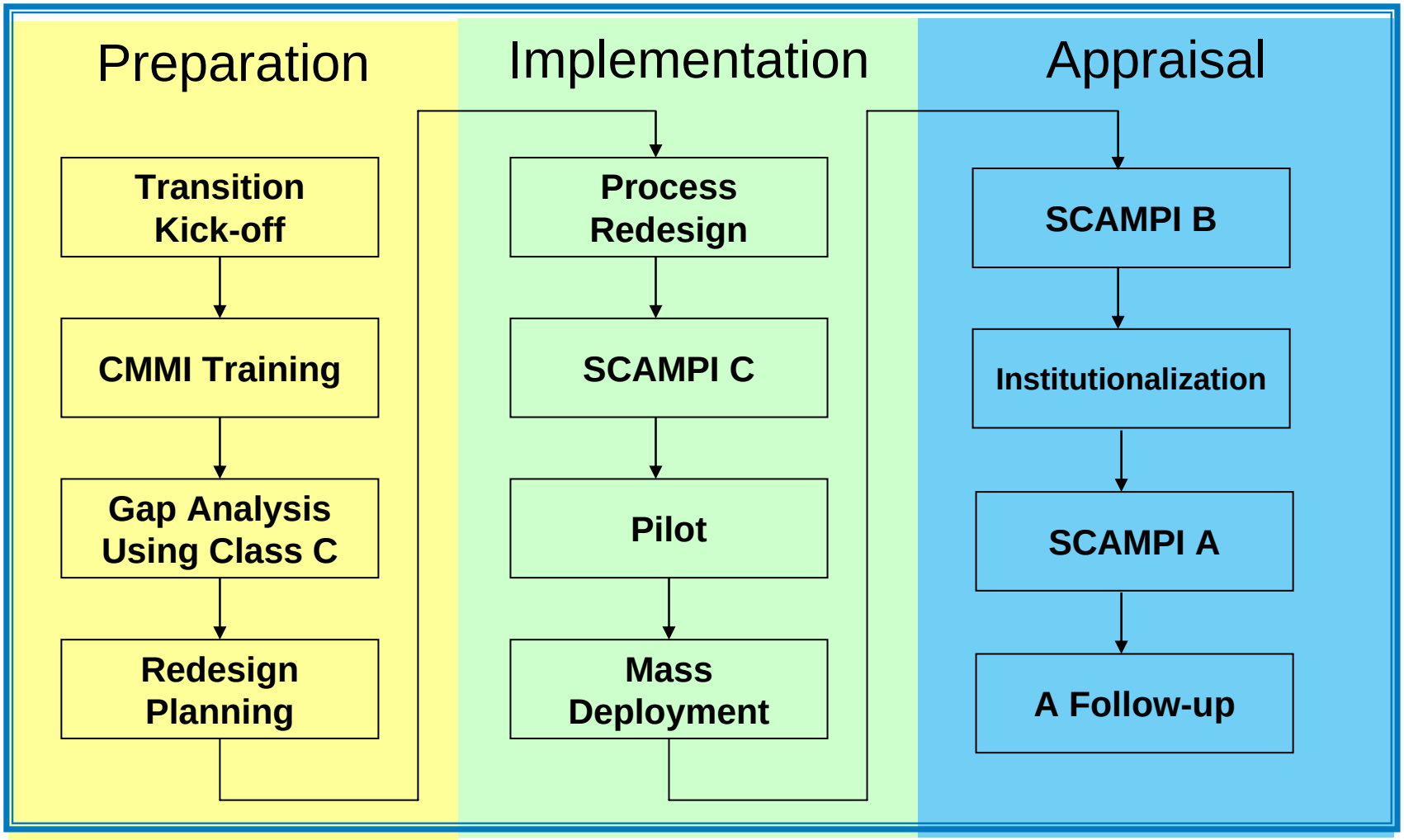
Transition Life Cycle



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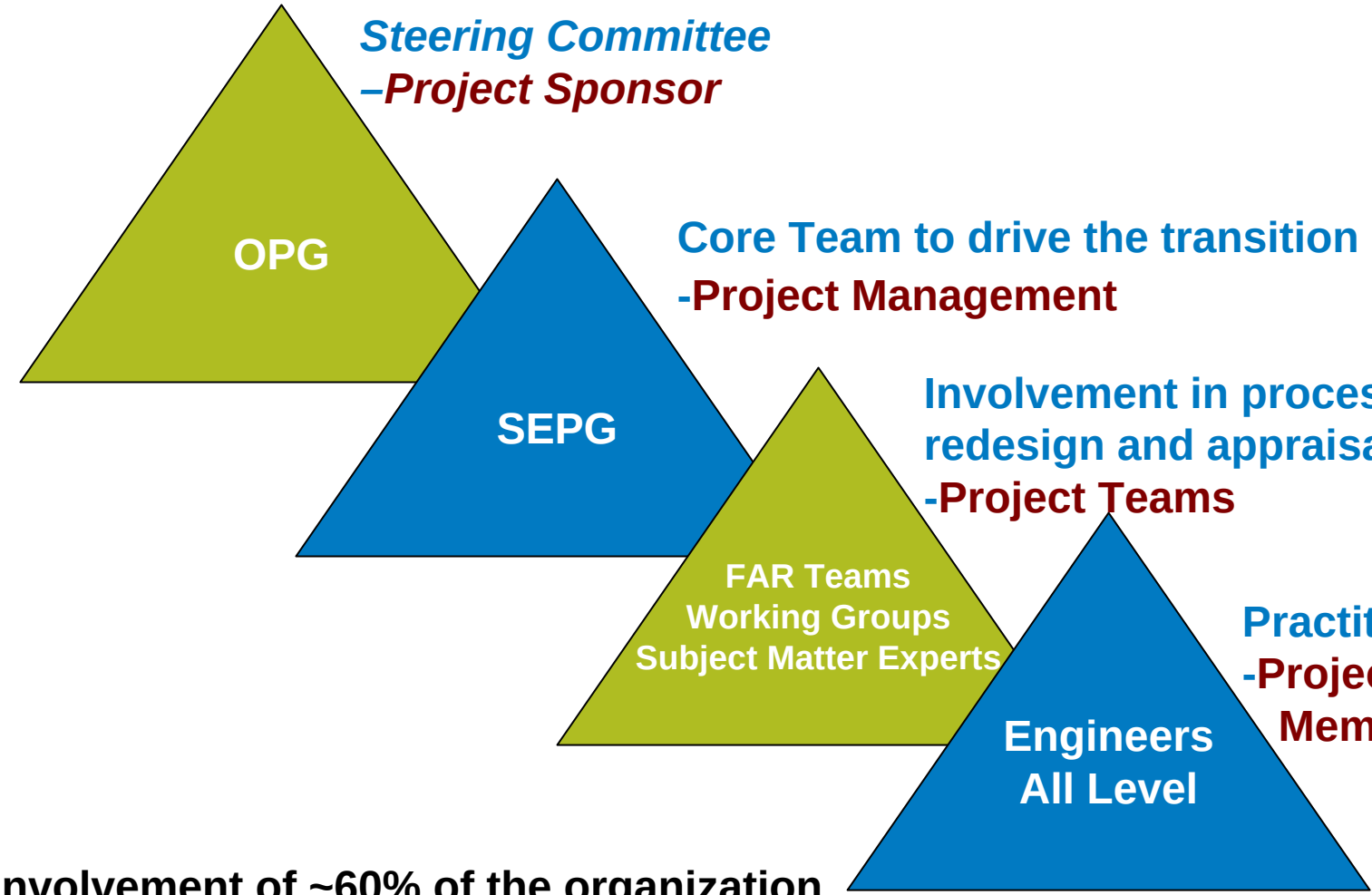
Transition Teams



Direct involvement of ~60% of the organization

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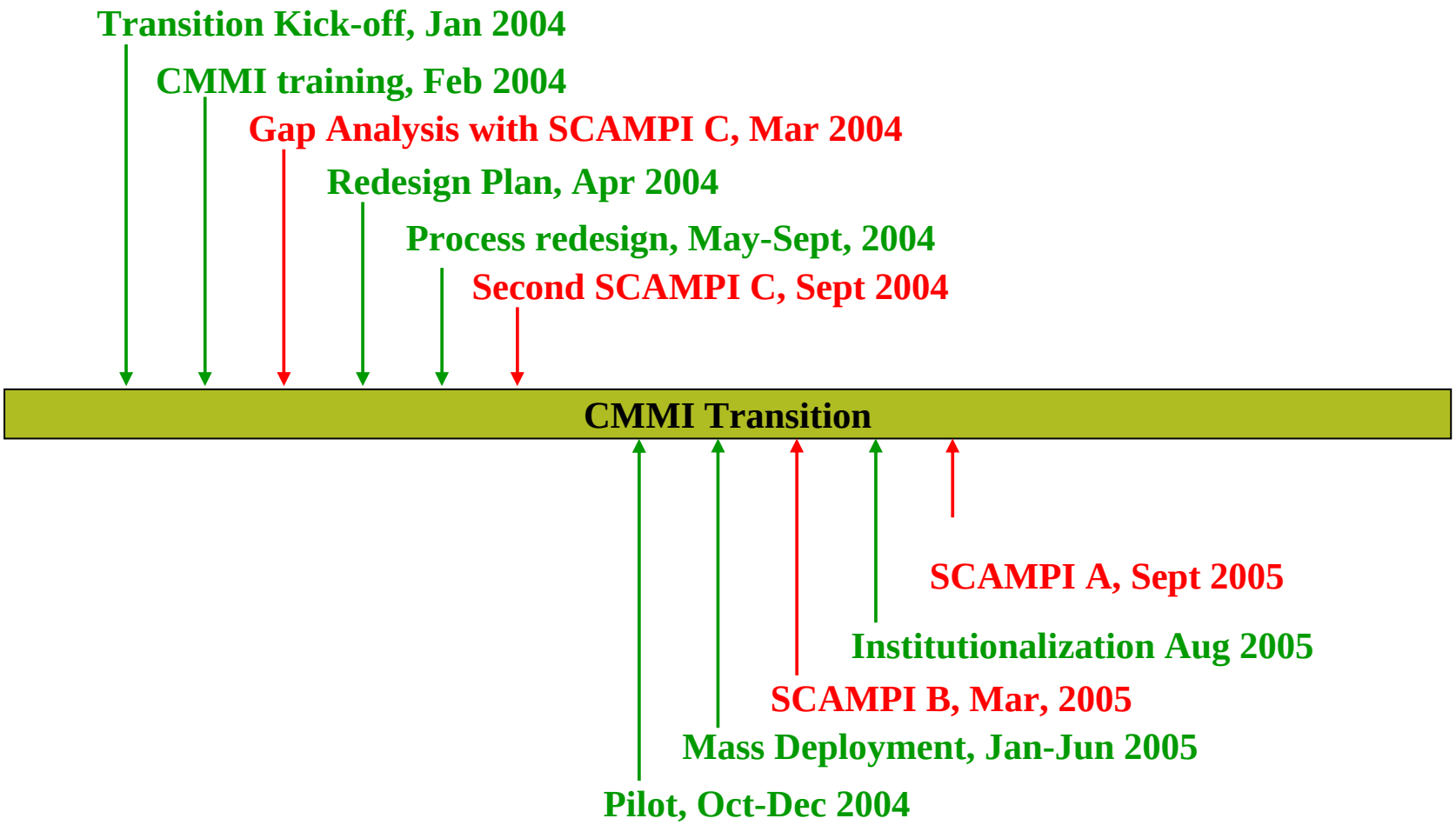
Sample Transition Timeline*



TOTAL: 1 year and 8 months

*** Based on GSG-China data**

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- ◆History of Process Improvement
- ◆Strategy of Transition
- ◆Manage Transition
- ◆Use OID in CMMI Transition
- ◆Result of Transition

Planning &Req Analysis

☞ **Formal CMMI Transition Plan-**Taking advantage from disciplined project management

☞ **Estimates, milestones, dependencies, risks etc.**

☞ **Define transition process and setup quality control gate**

☞**Progress tracking within teams and by senior management**

☞ **Group team using PA categories. Each PA has PA 2 owners plus a support SME team.**

☞ **Understand Transition Requirement**

- ***Take SCAMPI C result as the input of requirement***
- ***Take Target Profile as the input of requirement***
- ***Process Opportunity Request Database***

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- History of Process Improvement
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Process Design Strategy

☞ **Use OPD as guide to design Process and Process Asset**

☞ **Develop template to provide the guide on how to develop process asset**

☞ **Review and refine Process Architecture before process asset design**

☞ **Design the process asset as an integrity system**

- ✍ ***How to present GP in OUR system***
- ✍ ***How to design support PA in OUR system***
- ✍ ***Interface design and control***

☞ **Design with quick-win strategies (fast, practical, easy, cheap, tool support, etc)**

☞ **Inspections, SCM ,Audits & Quality control.**

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Process Design Focus

- ☞ **Engineering Process Improvement**
- ☞ **Process integrity and process interface**
  (eg how Support Pas support the Prj &Engineering Pas)
- ☞ **High Maturity Pas (QPM, CAR, OID, etc) and the critical sub-processes (PP,RM,VER)**
- ☞ **Guideline on process tailoring and measuring**
- ☞ **Tool Support planning synchronous with process design**

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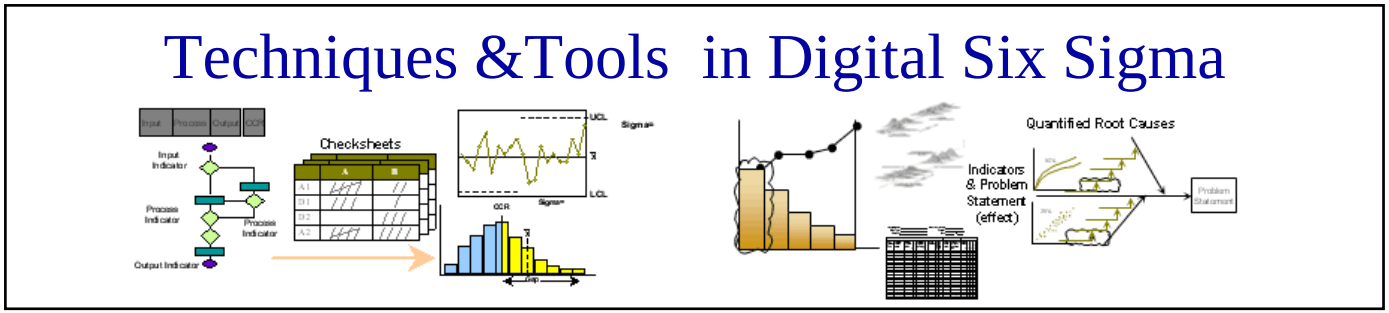
Using High Maturity Level Process Area

Using of Support Process Area



1. Provide analysis techniques
2. Provide statistical method to understand variation

SPC method and tool to support baseline and model establishment

1. Quantitatively identify improvement opportunities
2. Cost-benefit analysis
3. Measure improvement effect by performance analysis

1. Provide analysis techniques
2. Provide statistical method to understand variation

QPM

CAR

OPP

OID

Goals, baselines, models

POR

POR

Project Data

POR

Defects and other problems

Project Management & Engineering

Using of High Level Process Area

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GSG Process Measurement Environment

Business Partner Environment

Defect Tracking

EPMS Proj Mgmt

Inspection/Review DB

Change Mgmt

Asset Characterization

Beijing Team

Australia
Dev Team

Project Metrics Data

Project Metrics Database

PMBOOK

Project Record

Center Goals/Baselines

Center Metrics Database

Site Metrics Database

Global Central
Metrics Database

G SG Metrics Database

SMSC

Manage By Data

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Implementation

- **Plan the training at the early phase and deliver training incremental based on role**
- **Using OID as guide to transfer the process change into organization**
- **Using OPF/POR system to track the process change during transition**
- **Monitor the overall change status and trend.**
- **Assess and control the major change**
- **Pilot, Controlled deployment and mass deployment based on the risk assessment and business cases.**

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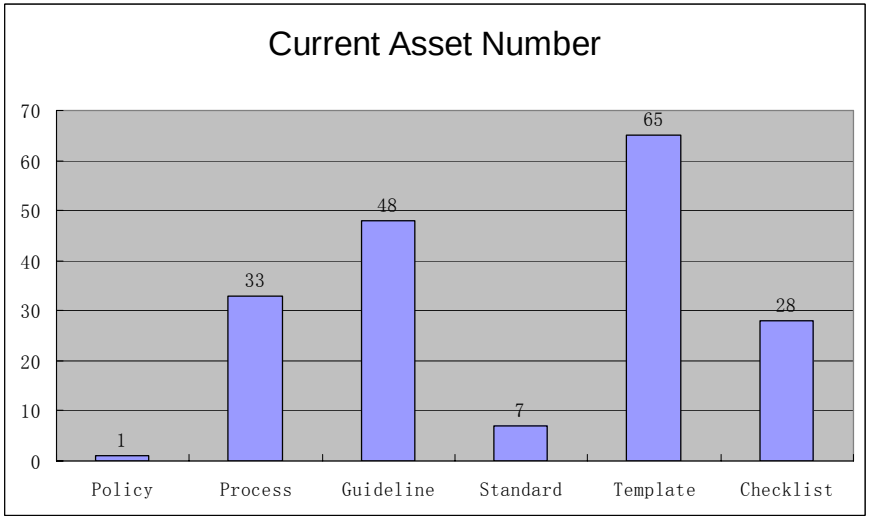
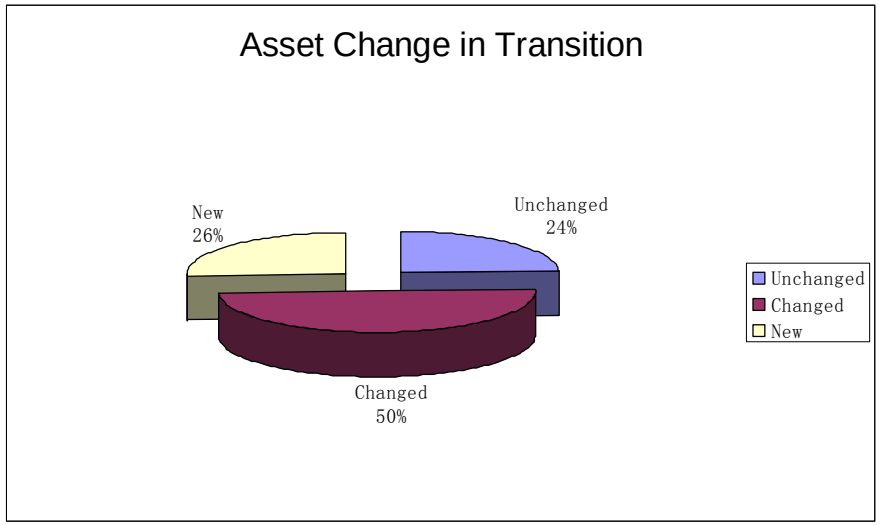
Process Assets after Transition



☞ Total 182 assets, including 33 processes, 48 guidelines and 93 templates & checklists.

☞ Among the 47 new assets, there're 6 processes. Others are guidelines, templates and checklists that better facilitate the implementation of our process.



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Pilot

- Select pilot projects and prioritize the pilot package
- Design the pilot package for pilot projects during different development phase to reduce pilot cycle time (product integrity and coverage)
- Define Pilot successful criteria, goal and their measurement
- Leverage pilot cost, cycle time, pilot coverage and quality
- Formal plan and kickoff to get commitment
- Timely pilot feedback via POR &SQE
- Organizing SCAMPI C to check “Approach”

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Deployment

☞Plan the training at the early phase and deliver training incremental

- ☝ Role-Based
- ☝ Focus on the CHANGE and new process
- ☝ Interactive workshop vs “teaching”

☞ Define different deployment approach to new project and “on the way” project

☞Develop deployment handbook to facilitate the usage to process

- ☝Understand process from perspective of life cycle
- ☝Understand process from perspective of PA
- ☝ Use of process asset type

☞ Process Handbook to build mapping between CMMI, Organization process and practice.

☞ Manager review and Audit

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Institutionalization

- Upgrade new hire entry training to CMMI and SPP++
- Plan the training at the early phase and deliver training incremental
  - Role-Based
  - Focus on the CHANGE and new process
  - Interactive workshop vs “teaching”
- Define different deployment approach to new project and “on the way” project
- Develop and maintain PIIDs
- Use sample project as “role model” for sharing

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Appraisal Planning

- **Plan SCAMPI C (2), B,C**
- **Using SCAMPI as a tool to identify the process improvement opportunities and milestones in transition**
- **PIIDs development and maintenance paralleled with process development and deployment**
- **SCM control and PIIDs Tool**
- **SME Team focus on driving the deployment of high maturity practice especially in critical sub-process areas**
- **Good practice in critical process areas traceability monitoring at organization level**

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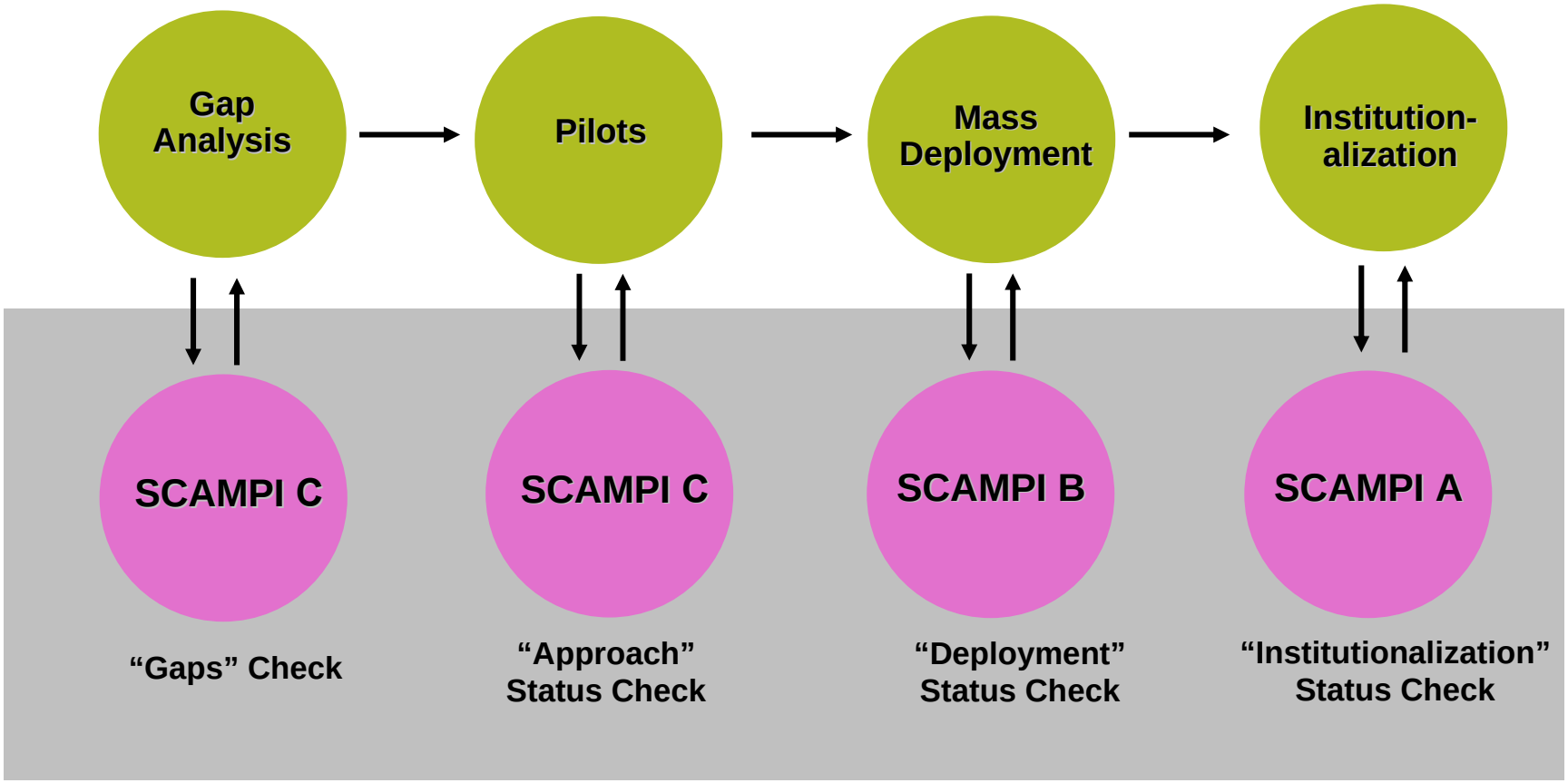
Controlling deployment via successive SCAMPIs



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Appraisal Planning

- Sample Project Selection
  - Overall Coverage
  - Applicability
  - Representative from location, business, domain, project category, current phase,etc

- Pre-site Preparation.
- Overview of organization
- Overview of Process System , Projects for Appraisal team
- Demo of Process Environment &Tool for FAR team

- Pre-site Document Review and data collection request tracking

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Lessons in Transition Project

- ◆History of Process Improvement
- ◆Strategy of Transition
- ◆Manage Transition
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☞ **Develop CMM expert and understand SCAMPI method and process at early phase**

☞ **Develop, maintain PIIDs at the early phase.**

☞ **Understand PIIDs and provide right information at first time**

☞ **Multi-site team overhead could be reduced through more effective coordination.**

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Transition Statistics

	A	B	C	China
Overall Transition Effort (staff*months)	**124**	**51**	**83**	**211**
Overall Duration	**2Y 2M**	**1Y 11M**	**1Y 7M**	**1Y 8M**
System Engineeringin included the scope	Y	N	Y	N
IPPD included in the scope	Y	N	N	N
SAM included in the scope	Y	N	N	N
Sw Population during transition period	~1200	~300	~220	~900
# of sites appraised	2	1	1	3
Number of PAs in SCAMPI C scope	25	15	n/a	21
Number of PAs in SCAMPI B scope	25	15	21	21
Number of PAs in SCAMPI A scope	25	21	21	21

Factors impacting data variance

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CMMI Transition Approach Summary

Elements of CMMI Transition Approach	Faster	Better	Cheaper
Organizing transition like a project	✖	✖	✖
Focus on key PAs during SCAMPI C&B	✖		✖
PIIs preparation/update during SCAMPI C&B (up to 1.5 effort reduction)		✖	✖
Early feedback on process deployment (SCAMPI C&B) & Removal of significant weaknesses before Class A		✖	
Extensive training	✖	✖	
Balanced team membership (GSG and Businesses)		✖	
Keeping Core Appraisal team throughout a series of SCAMPIs	✖	✖	
Several rounds of Redesigned Process review		✖	✖

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Major Improvement After CMMI

☞QPM processes were modified to focus more on critical processes aligned with business objectives

☞ Using QPM,CAR,OID process and techniques to support critical process effectiveness

☞Shifted its focus on CAR processes from DP to the broader problem prevention focus in CMMI

☞Use Enterprise Project Management System as a common project management platform while use Project Pamphlet as a supply of EPMS

☞The Engineering processes, particularly for RM,UT,VAL now provide more practical guidelines, templates, techniques, and tools.

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Major Improvement After CMMI

☞ CAR and OID-based processes were used to improve VER process effectiveness without compromising quality in specific classes of cases.

☞ The RM/RD process was improved. Late additions and changes to requirements are measured.

- ☝ Setup Organizational Baseline to quantitative manage requirements volatility.
- ☝The measured and estimated impact of changes led to new project re-plan, estimation, and a factual basis for negotiation with customers.

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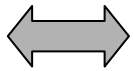
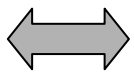
CMMI Performance Results of GSG China

Metrics	Trend	Improvements
Cost of Quality		33%
Fault Density		40%
Effort Estimation Accuracies		31%
Schedule Estimation Accuracies		84%
Requirement Phase Containment		Sustains at 90%
Design Phase Containment		8%
Code Phase Containment		12%
Customer Satisfaction		Sustains +9/10

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Process Excellence to Business Excellence

- ***Consistently exceed customer satisfaction with outstanding satisfaction score 9 out of 10***
- ***40% business growth and 30% margin every year since 2003***
- ***100% on time delivery of all programs with high quality***

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Conclusion

- Transition to CMMI requires substantial effort and strong commitment
- Disciplined project management is one of important success factor for transition
- From GSG experience, the iterative CMMI transition path with successive application of various SCAMPI appraisal types is proved to be effective mechanism for identifying gaps and controlling the CMMI deployment

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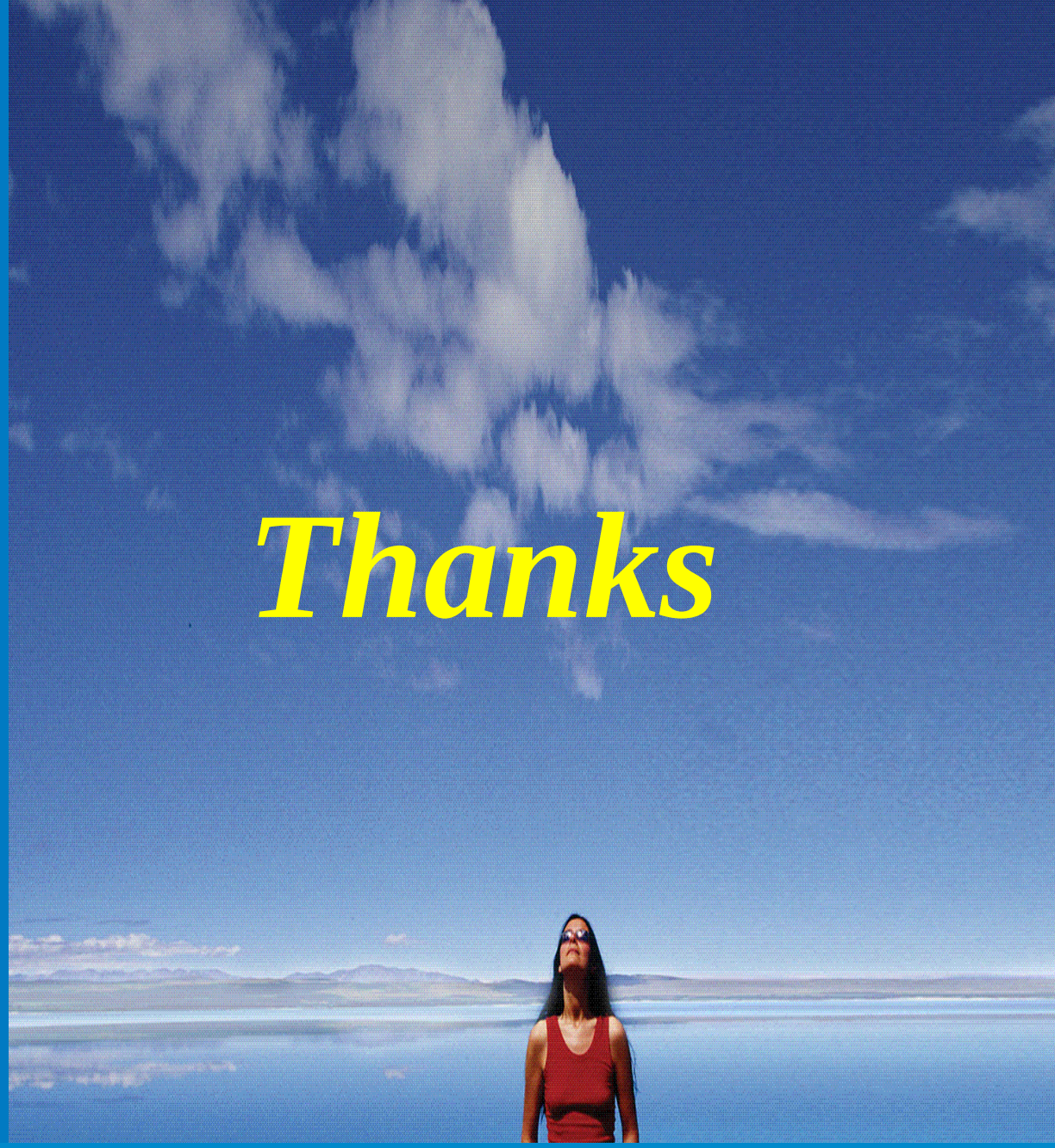

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Rosetta Stone ROI Model

Fionbarr McLoughlin
Ita Richardson
University of Limerick, Ireland

Contents

- Current state of play
- Rosetta Stone Model – Introductory concepts
- IGSI-ISM Benefits/Objectives Model
- CMMI Level 2 (Staged) Benefit mapping
- How to achieve specific Benefits

Funding provided by B4-Step/Science Foundation of Ireland (SFI)

Where are we currently?

- A lot of studies available on benefits of CMM/CMMI
- Many benefits are high-level benefits e.g. increased productivity, increased ROI
  - What do they mean? Where do they come from?
  - How are benefits related to each other?
  - How do they translate to concrete benefits?
- Smaller companies tend to want to focus on specific benefits
- Companies already have some metrics available to them – can they re-use them?

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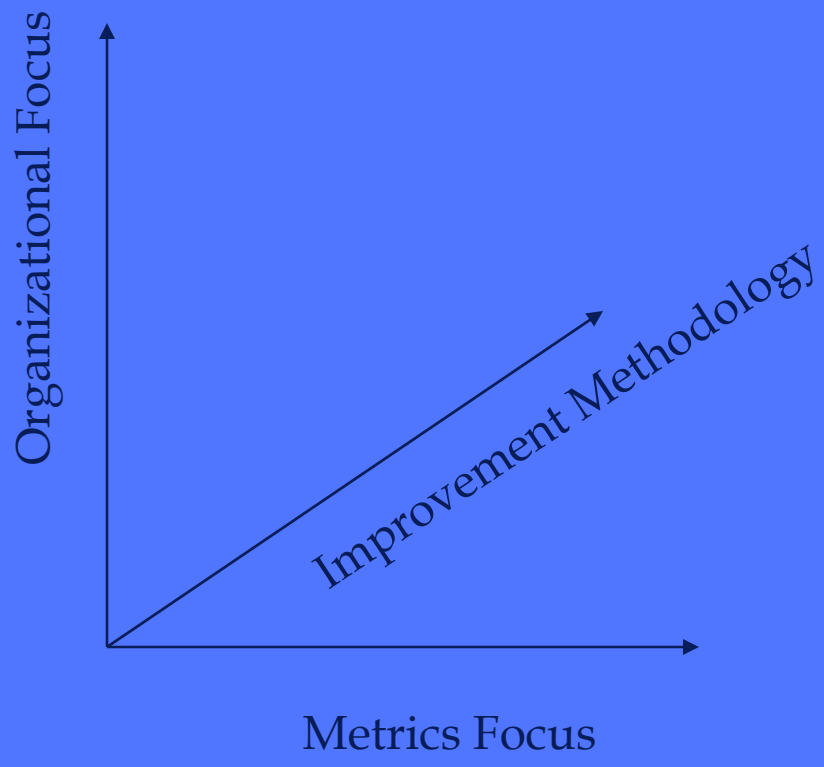
Where are we currently (cont.)



Many valuable studies of the benefits resulting from implementation of CMM/CMMI and Software Process Improvement (SPI) in general have been undertaken over the last several years. These studies may be viewed as having at least separate three axes

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Why use the Rosetta Stone ROI (RSROI) Model?

- Provides a flexible framework that can be modified if needed
- Hierarchy of Business Objectives or Benefits – how one benefit can impact others
- Benefits fine-grained
- Allows re-use of metrics where appropriate
- Allows targeting of specific benefits

Funding provided by B4-Step/Science Foundation of Ireland (SFI)

The Rosetta Stone

- Wiki - http://en.wikipedia.org/wiki/Rosetta_Stone
- The **Rosetta Stone** is an ancient stele inscribed with the same passage of writing in two Egyptian language scripts and in classical Greek. It was created in 196 BC, discovered by the French in 1799, and translated in 1822. Comparative translation of the stone assisted in understanding many previously undecipherable examples of hieroglyphic writing.

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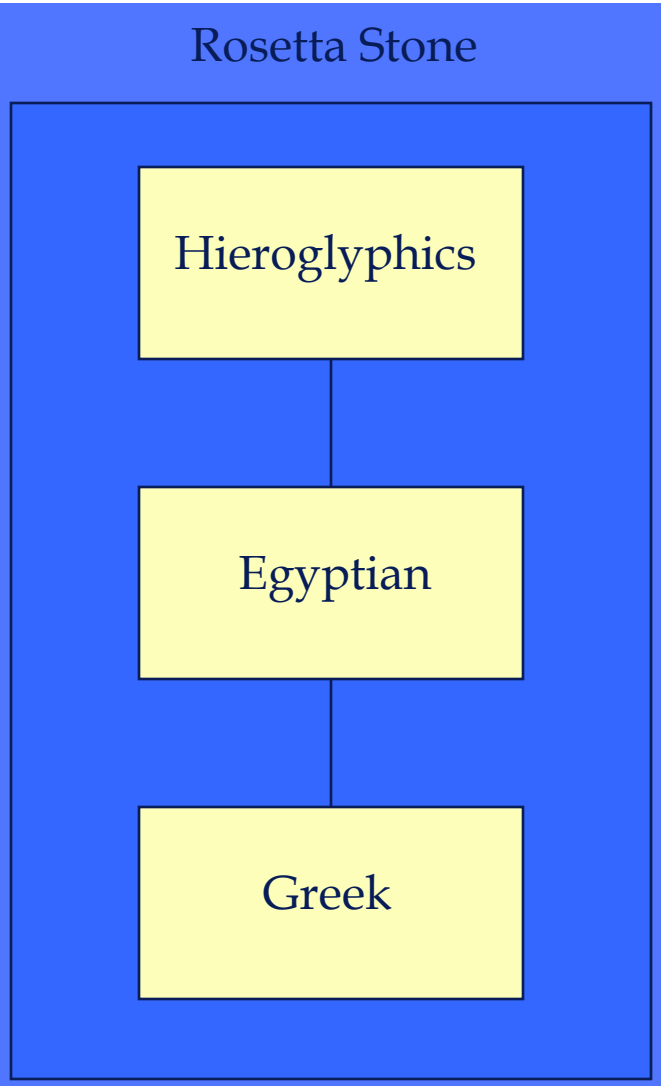
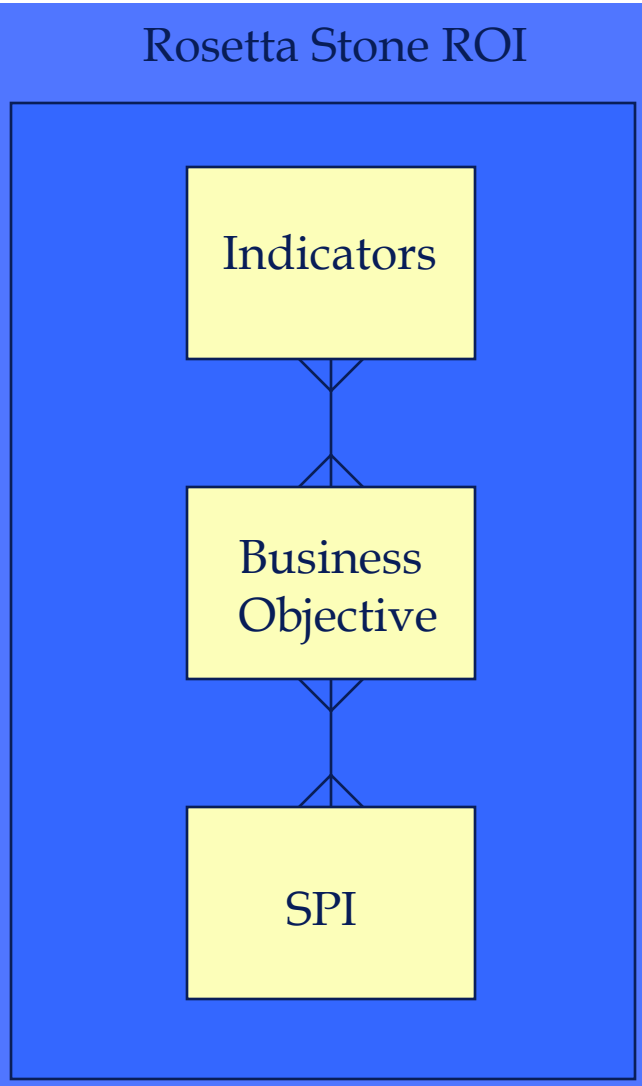
Rosetta Stone and the Rosetta Stone ROI Model





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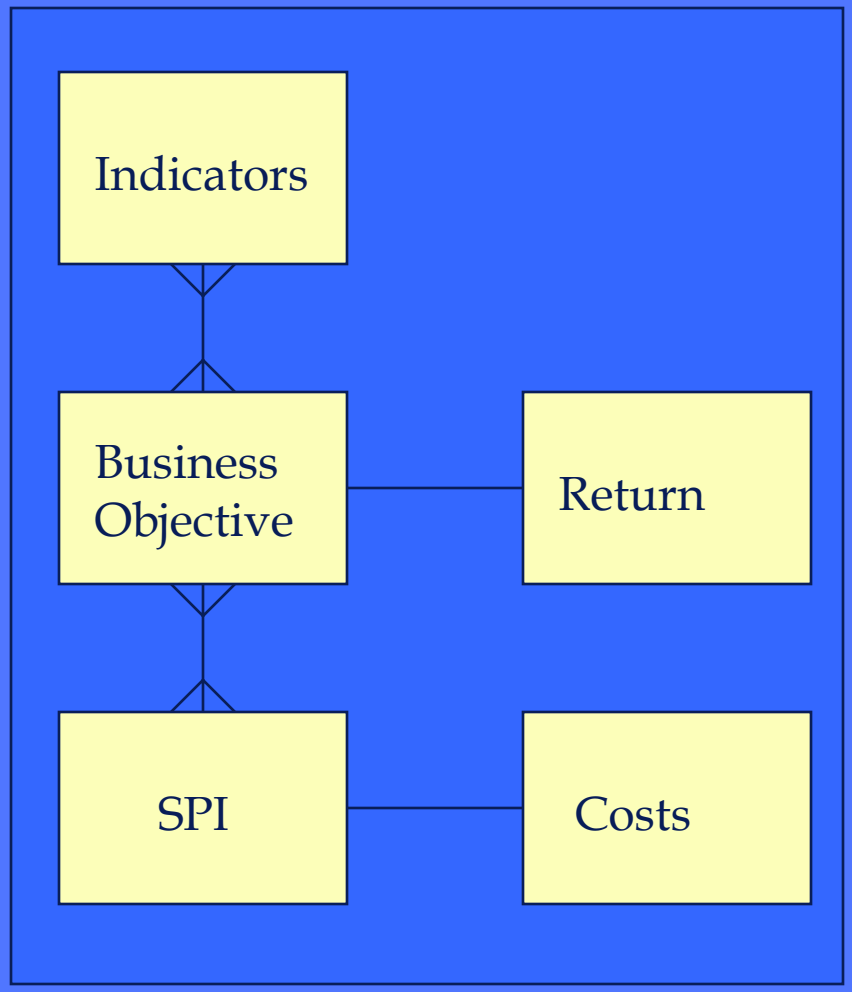
What is the Rosetta Stone ROI Model?



- a well-defined and extensible hierarchical set of Business Objectives associated with Software Process Improvement in general and CMMI in particular
- a mapping of those benefits by CMMI Process Areas
- an extensible set of performance measures and indicators. Users of the model are free to add any pre-existing, custom, or about-to-be-initiated performance measures that they may have, thus allowing them to re-use any existing work they have already undertaken or are about to undertake

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Benefits/Objectives

- Goyal et al. [1], as part of research undertaken on the benefits of SPI for IBM Global Services, India (IGSI), held two workshops that used consensus-based responses as inputs for an Interpretive Structural Modeling (ISM) methodology to develop a model of the needs and consequences of SPI
- This model is called the IGSI-ISM ROI Model and shows the relationships between the various benefits that can be derived from SPI. Using this model, there are 21 separate identifiable benefit areas.

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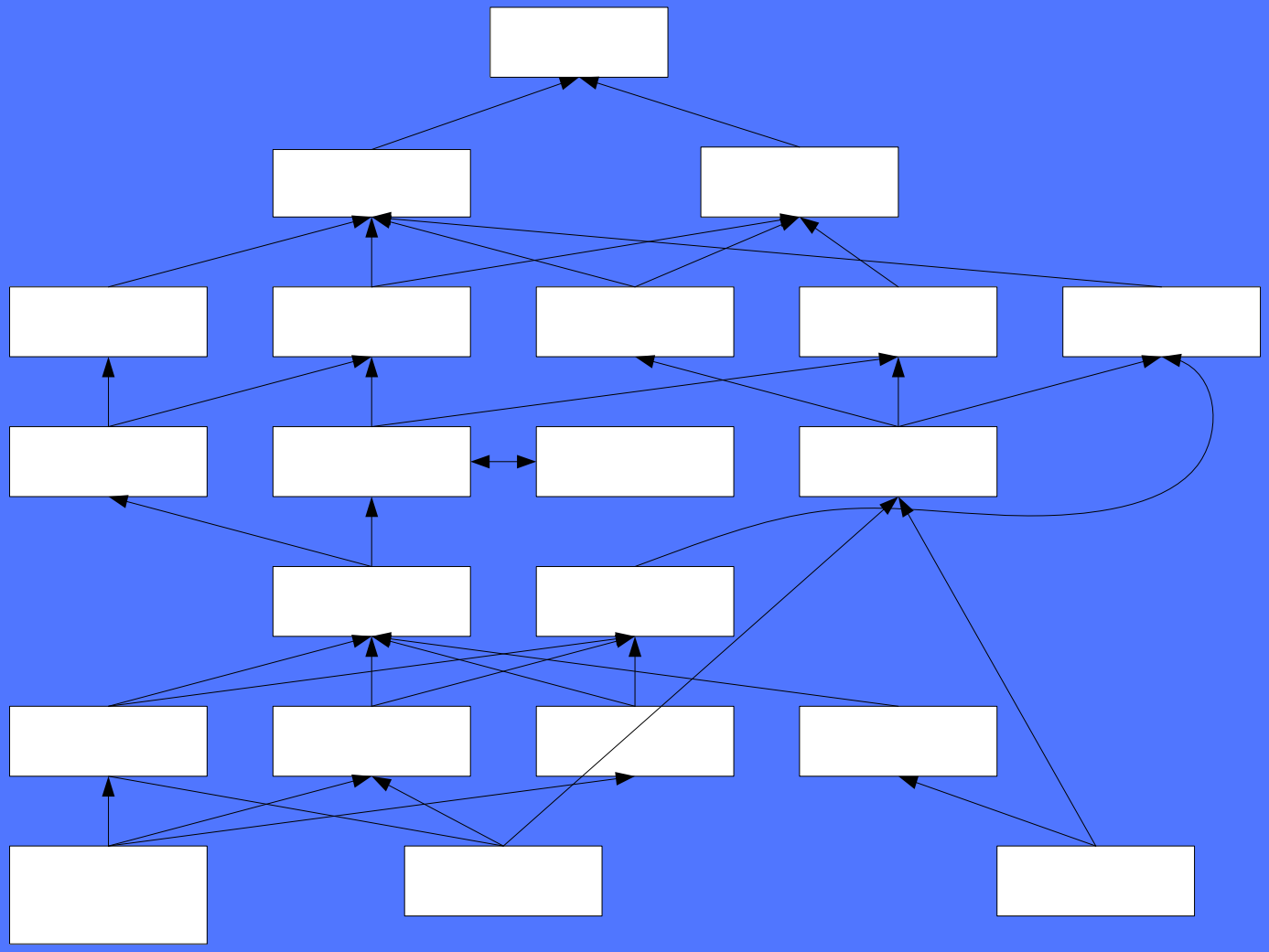
IGSI-ISM Benefit/Business Objectives Model

B4 - STEP
Building a Bi-directional Bridge
Between Software ThEory and Practice



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Benefit Types

- Primary
  - Brought about as a direct result of implementation of a PA/SPI where the cause and effect relationship between the Process Area implementation and the benefit is very strong
- Derived
  - IGSI-ISM model is a hierarchical graph. Benefits elements that are closer to the root of the tree automatically accrue from benefits that are farther down if there is a path/relationship between them – these are *derived*

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Indicators/Metrics and SPI

- Indicators/Metrics
  - Metrics or indicators that will allow us to measure increased (or decreased) success in achieving benefits. In effect, these metrics act as proxies for the general benefit area
- SPI
  - Applicable to any SPI. For the purposes of this presentation we are interested in CMMI

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Costs, Return & ROI

- Benefits should ultimately lead to a monetary impact on the organization
- Some benefit impact may be difficult to quantify – how much does increased morale save an organization?
- SPI costs effort/money

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ROI

- ROI is typically some ratio of benefit to cost
- There are several popular methods for evaluating projects [2-4]:
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)
  - Return on Investment (ROI)
  - Profitability Index (PI)

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How RSROI Applies to CMMI – Level 2 Staged

- Requirements Management
  - Benefits - Better Risk Management, Understanding customer needs, Lower time to market
- Project Planning
  - Benefits – Better quality product, Better risk management, Efficient resource management, Understanding customer needs, Setting right customer expectations, predictability, Competitive proposals

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How RSROI Applies to CMMI – Level 2 Staged (cont.)

- Project Monitoring & Control
  - Benefits - *Better quality product, Better risk management, Efficient resource management, Setting right customer expectations, Predictability*
- Supplier Agreement Management
  - Benefits - *Better quality product, Better risk Management, predictability, Lower time to market*
- *Measurement & Analysis*
  - *Benefits - Better quality product, Better risk Management, predictability, Lower time to market*

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How RSROI Applies to CMMI – Level 2 Staged (cont.)

- Process and Product Quality Assurance
  - Benefits - *Improved institutionalization of Tools / Process / Methods, Better quality product, Better risk Management, predictability, Lower time to market*
- **Configuration Management**
  - Benefits - *Better quality product, Better risk management, Teaming / Synergize*

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CMMI Level 2 to Benefit Map

PA Identifier	Staged Level	Process Area	Expected Primary IGSI ROI Benefits	Expected Derived IGSI ROI Benefits
2-1	2 - Managed	Requirements Management	4-2, 4-4, 5-2	5-1, 2-1, 4-3, 7-3, 3-4, 3-5, 2-1, 2-2, 1-1
2-2		Project Planning	4-1, 4-2, 3-4, 3-5, 3-3, 4-3, 4-4	3-2, 3-4, 2-2, 1-1, 3-1, 3-3, 3-5, 2-1, 1-1
2-3		Project Monitoring and Control	4-2, 4-1, 4-3, 3-4, 3-3	3-1, 3-2, 3-3, 3-4, 2-1, 2-2, 1-1
2-4		Supplier Agreement Management	4-2, 4-1, 3-4, 5-2	3-1, 3-2, 3-3, 3-4, 2-1, 2-2, 1-1
2-5		Measurement and Analysis	4-2, 4-1, 5-2, 3-4	3-1, 3-2, 3-3, 3-4, 2-1, 2-2, 1-1
2-6		Process and Product Quality Assurance	4-1, 4-2, 5-2, 7-1, 3-4	6-1, 6-2, 6-3, 5-1, 5-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
2-7		Configuration Management	6-3, 4-2, 4-1	5-1, 5-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1

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Meeting the Business Objectives of an Organization

- Approach/Process
  - Identify specific benefit you want to achieve/improve
  - Determine potential benefits for each PA
  - Determine relevant PAs
  - Identify indicators/metrics that can be used as proxies for benefits
  - Order implementations of PAs
  - Implement!
- Example - Lower Time to Market (5-2)

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Lower Time to Market

B4 - STEP
Building a Bi-directional Bridge
Between Software ThEory and Practice

- Lower Time to Market (5-2) depends on:

IGSI-ISM Id	Objective Name
6-1	Skill development Facilitation by Management
6-2	Effective Information Management
6-3	Teaming/Synergize
7-1	Improved Institutionalization of Tools/Process/Methods
7-2	Business Focus

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What Process Areas are linked to Business Objectives?

PA Identifier	Staged Level	Process Area	Expected Primary IGSI ROI Benefits	Expected Secondary IGSI ROI Benefits
2-1	2 - Managed	Requirements Management	4-2, 4-4, 5-2	5-1, 2-1, 4-3, 7-3, 3-4, 3-5, 2-1, 2-2, 1-1
2-4		Supplier Agreement Management	4-2, 4-1, 3-4, 5-2	3-1, 3-2, 3-3, 3-4, 2-1, 2-2, 1-1
2-5		Measurement and Analysis	4-2, 4-1, 5-2, 3-4	3-1, 3-2, 3-3, 3-4, 2-1, 2-2, 1-1
2-6		Process and Product Quality Assurance	4-1, 4-2, 5-2, 7-1, 3-4	6-1, 6-2, 6-3, 5-1, 5-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
2-7		Configuration Management	6-3, 4-2, 4-1	5-1, 5-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
3-1	3 - Defined	Requirements Development	5-2, 4-4, 4-2, 4-1	4-3, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
3-6		Organizational Process Focus	7-1, 7-2, 7-3	6-1, 6-2, 6-3, 6-4, 5-1, 5-2, 4-1, 4-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
3-7		Organizational Process Definition	6-2, 7-1	6-1, 6-3, 5-1, 5-2, 4-1, 4-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
3-8		Organizational Training	6-1, 6-3	5-1, 5-2, 4-1, 4-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
		Integrated Project Management	6-3, 4-1, 4-2, 4-3, 4-4	5-1, 5-2, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
3-9		Integrated Project Management for IPPD	6-3, 4-1, 4-2, 4-3, 4-4	5-1, 5-2, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
3-11		Integrated Teaming	6-3, 4-1, 4-3, 4-2, 4-4, 6-2	5-1, 5-2, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
3-12		Integrated Supplier Management	7-3, 6-3, 6-4, 4-1, 4-2, 7-2, 3-4, 5-2	5-1, 5-2, 4-3, 3-1, 3-2, 3-3, 3-5, 2-1, 2-2, 1-1
3-14		Organizational Environment for Integration	6-2, 6-3, 7-2, 5-2, 7-1	6-1, 6-2, 6-4, 5-1, 5-2, 4-1, 4-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
4-1	4 - Quantitatively Managed	Organizational Process Performance	7-1, 7-2, 7-3, 6-2	6-1, 6-3, 5-1, 5-2, 4-1, 4-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
4-2		Quantitative Project Management	4-1, 4-2, 4-3, 5-2	4-3, 4-4, 2-1, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
5-1	5 - Optimizing	Organizational Innovation and Deployment	7-1, 7-2, 7-3	6-1, 6-2, 6-3, 6-4, 5-1, 5-2, 4-1, 4-2, 4-3, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 2-2, 1-1
5-2		Causal Analysis and Resolution	6-2, 5-2, 4-1, 4-2, 4-3, 7-1	6-1, 6-3, 5-1, 4-4, 3-1, 3-2, 3-3, 3-4, 3-5, 2-1, 3, 1-1

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Prioritization of Implementation

- Factors:
  - More consideration should be given to those PAs that **primarily** satisfy a particular objective. By this we mean that those PAs that satisfy an objective as a primary objective should be given higher ranking than those that do not.
  - More consideration should be given to those PAs that, in the Staged Model, are **lower** in the Stage phases.

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A *Recommended* Order of Implementation

PA Identifier	Process Area	Expected Primary IGSI ROI Benefits
2-1	Requirements Management	4-2, 4-4, 5-2
2-4	Supplier Agreement Management	4-2, 4-1, 3-4, 5-2
2-5	Measurement and Analysis	4-2, 4-1, 5-2, 3-4
2-6	Process and Product Quality Assurance	4-1, 4-2, 5-2, 7-1, 3-4
3-1	Requirements Development	5-2, 4-4, 4-2, 4-1
3-12	Integrated Supplier Management	7-3, 6-3, 6-4, 4-1, 4-2, 7-2, 3-4, 5-2
3-14	Organizational Environment for Integration	6-2, 6-3, 7-2, 5-2, 7-1
4-2	Quantitative Project Management	4-1, 4-2, 4-3, 5-2
5-2	Causal Analysis and Resolution	6-2, 5-2, 4-1, 4-2, 4-3, 7-1
2-7	Configuration Management	6-3, 4-2, 4-1
3-6	Organizational Process Focus	7-1, 7-2, 7-3
3-7	Organizational Process Definition	6-2, 7-1
3-8	Organizational Training	6-1, 6-3
3-9	Integrated Project Management for IPPD	6-3, 4-1, 4-2, 4-3, 4-4
3-11	Integrated Teaming	6-3, 4-1, 4-3, 4-2, 4-4, 6-2
4-1	Organizational Process Performance	7-1, 7-2, 7-3, 6-2
5-1	Organizational Innovation and Deployment	7-1, 7-2, 7-3

Funding provided by B4-Step/Science Foundation of Ireland (SFI)

References

- [1] A. Goyal, S. Kanungo, V. Muthu, and S. Jayadevan, "ROI for SPI: Lessons from Initiatives at IBM Global Services India," presented at SEPG 2001, 2001.
- [2] E. F. Brigham and L. C. Gapenski, *Financial Management - Theory and Practice*: Dryden Press, 1994.
- [3] R. C. Higgins, *Analysis for Financial Management*, vol. 5th: Irwin/McGraw-Hill, 1998.
- [4] S. A. Ross, R. W. Westerfield, and J. Jaffe, *Corporate Finance*, 5th Ed. ed: Irwin/McGraw-Hill, 1999.

Funding provided by B4-Step/Science Foundation of Ireland (SFI)

Questions?

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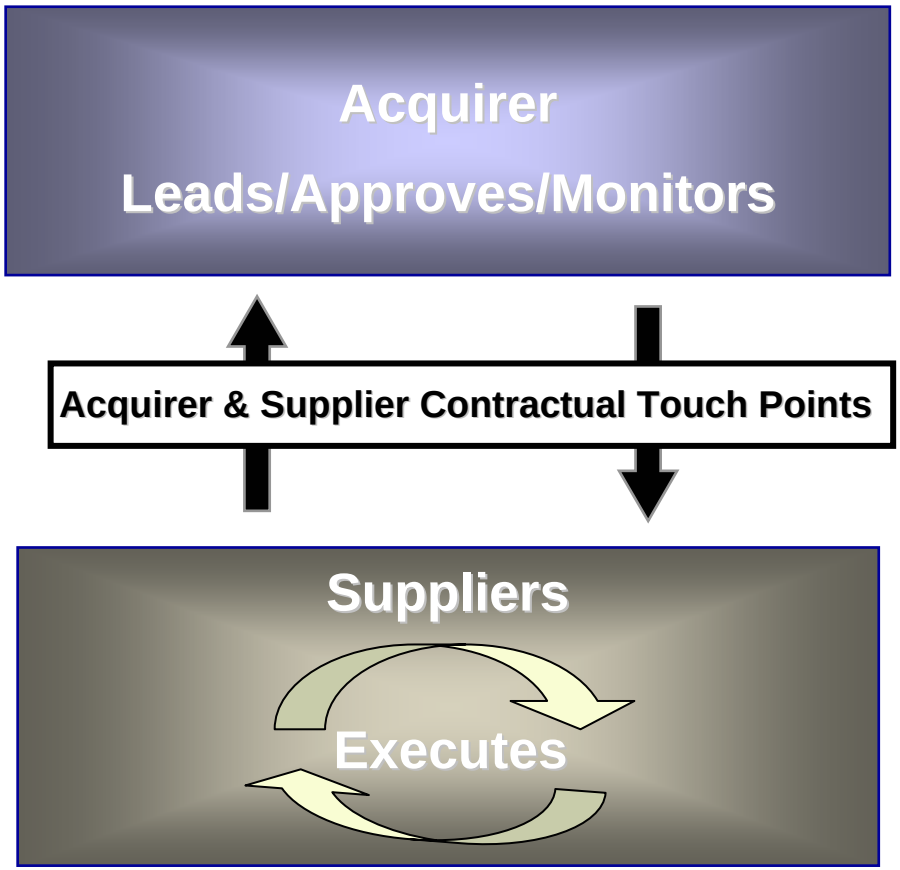
"The Hidden Truths of Being a Successful Acquirer"

Hubert Hofmann
General Motors Corporation
Deborah Yedlin
Borland Software Corporation

November 14, 2006
Denver Colorado

Acquirer vs. Supplier Roles



Key Acquirer Roles*

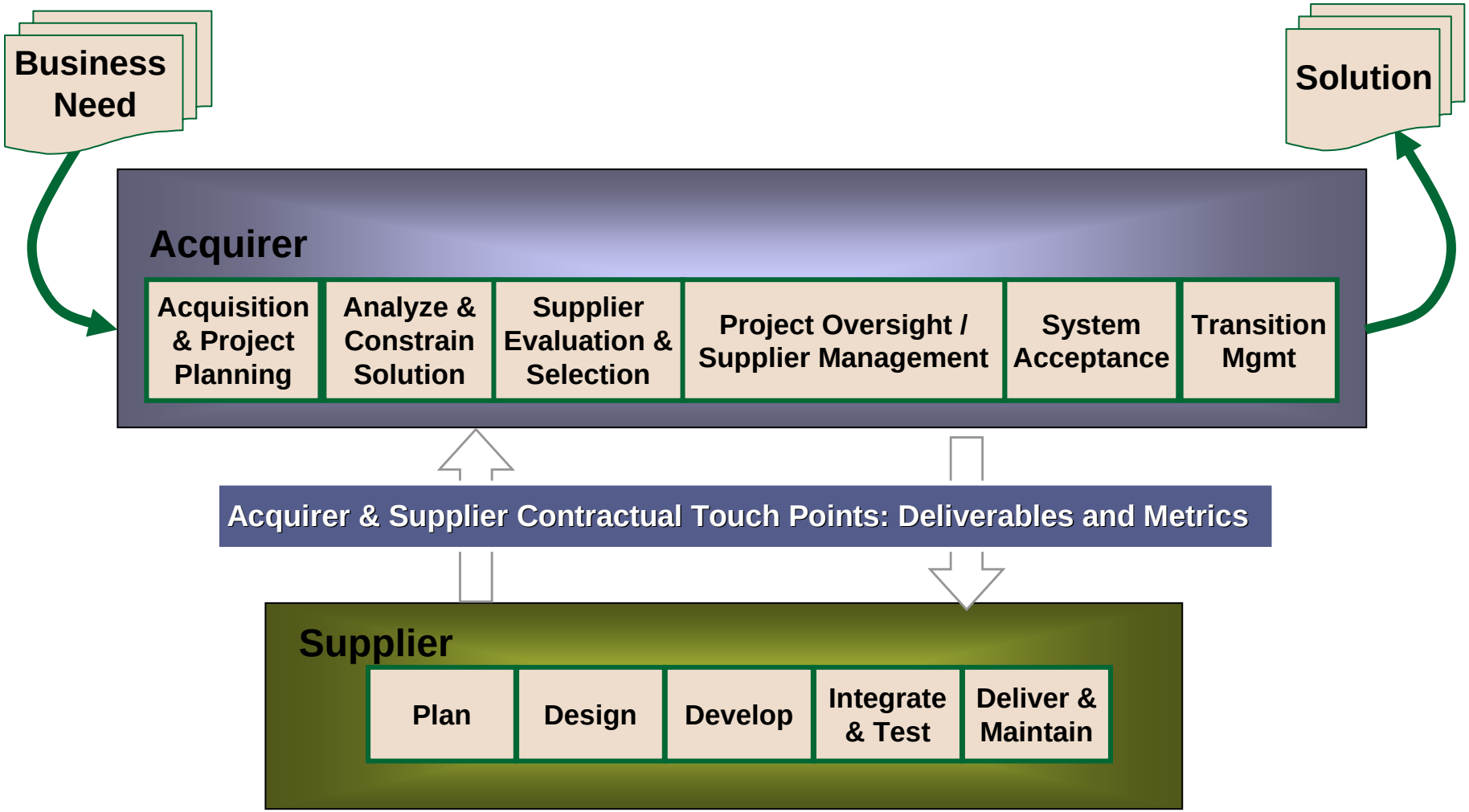
- Business analysis/relationship management (incl. requirements)
- Contract development & supplier management
- Program ownership / project management
- Technical architecture, standards, security

Key Supplier Roles

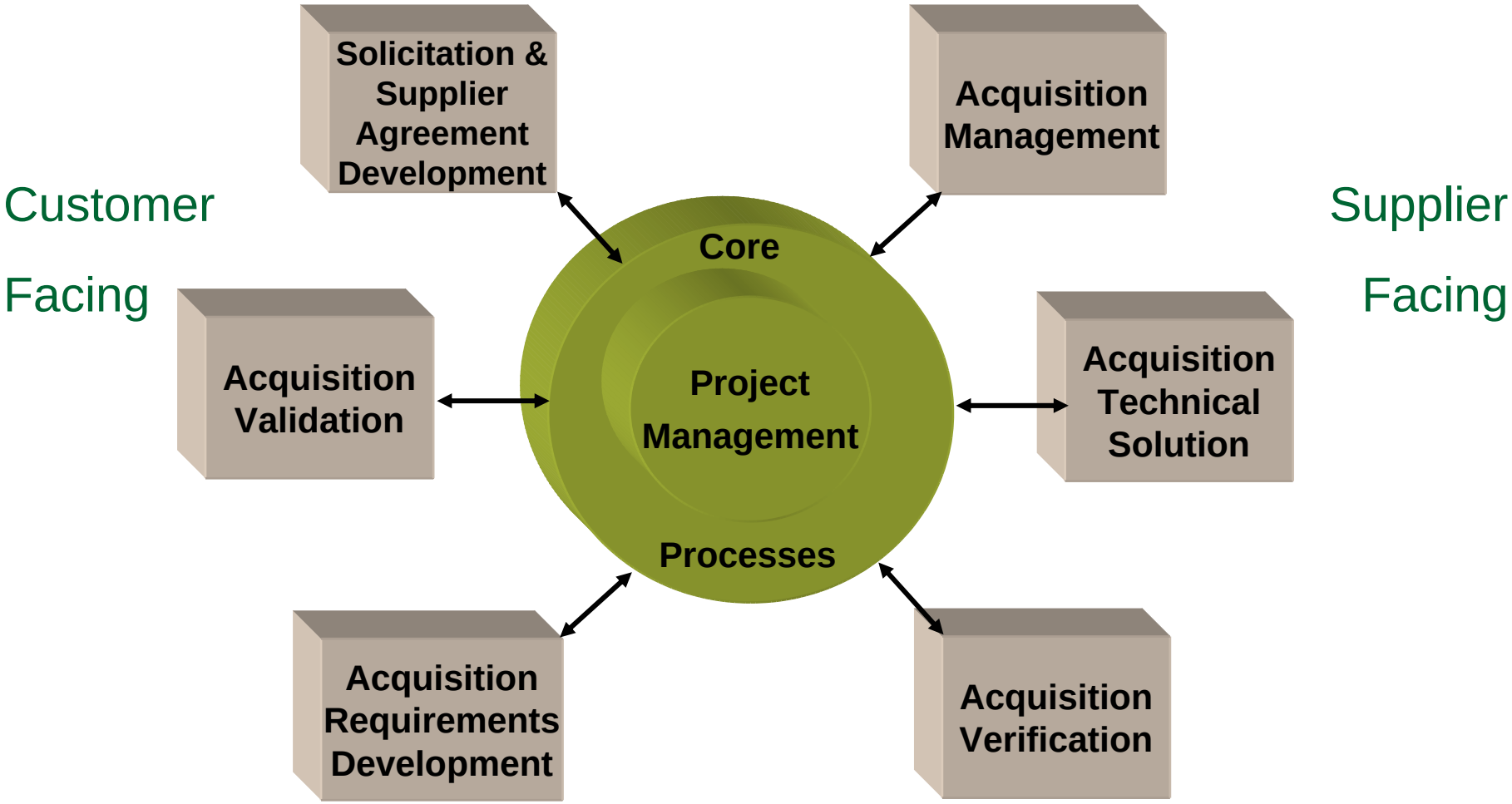
- Application Design/Development
- System Maintenance
- Desktop / Service / Help Desk
- Hosting
- Data center / mainframe

*** Based on Forrester, "Functions to Retain when Outsourcing" (July 2004)**

Minimum Set of Acquirer Practices



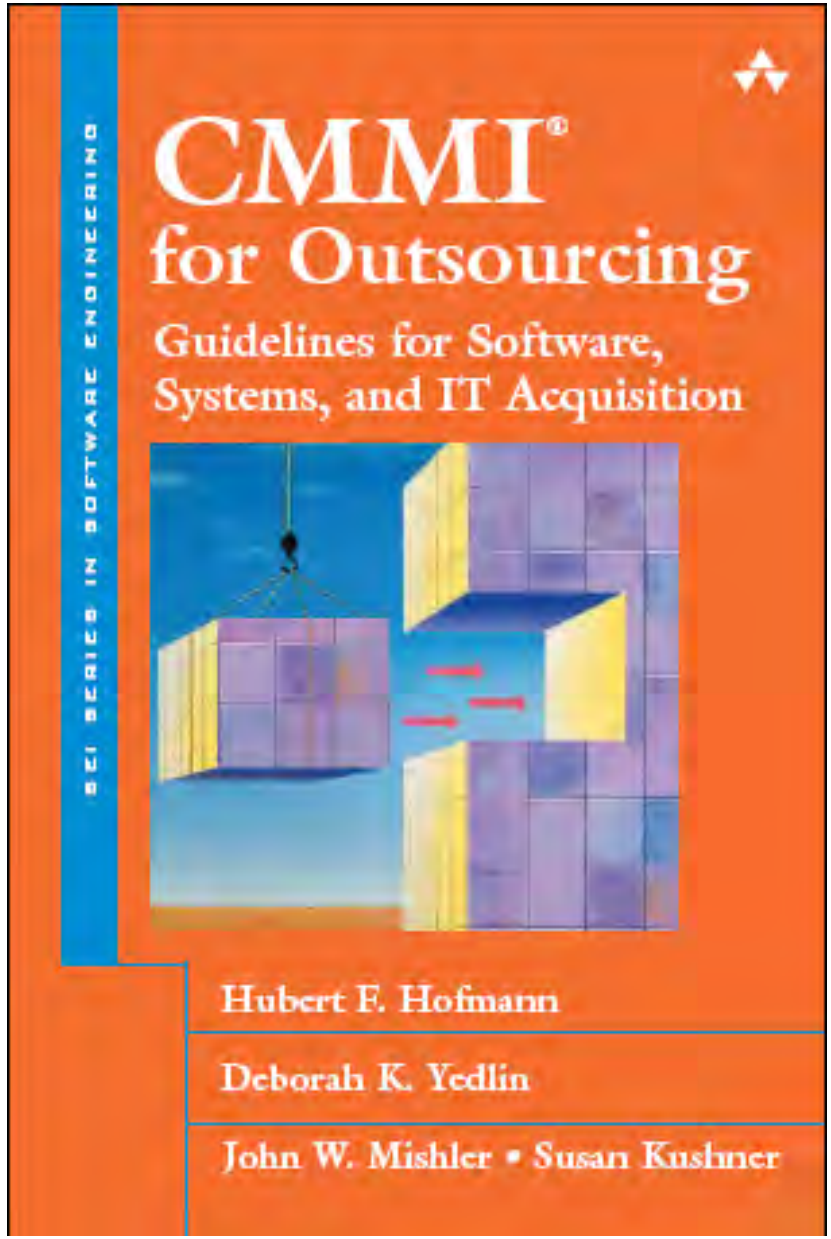
Initial CMMI for Acquisition: A Lean Model



Tips for Success

"…three-years, and then align them with the monies available to continue to support technology. The acquisition strategy covers the acquisition approach, business considerations, supplier agreement types and support of the technology solutions. Each of these strategy elements offers a …"

Tip: Carefully calibrate strategic choices for the acquisition strategy



When CMMI-AM

No Longer Suffices

November 14, 2006

All opinions, conclusions, recommendations, either expressed or implied, are the speaker's. They do not necessarily represent the views of the DoD, IRMC, NDU, or any other government organization.

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Presentation Overview

- **Presentation is a two-person “tag team” presentation.**

- **1st part presents a general argument for a new integrative [CMMI] perspective.**
  - CMMI-centered.
  - How the landscape has changed and the need for a more holistic approach

- **2nd part presents an argument for smarter strategic sourcing (commercial definition) processes.**
  - Strategic Sourcing-centered.
  - Expectations of order of magnitude change in sourcing efficiencies and effectiveness to survive,
  - Post contracting management focus over the contract itself as a driver of success,
  - How value realization overshadows cost management in a non-commodity environment,
  - Utilizing collaborative solutioning to outperform competitive forces,
  - Performing the critical balancing act of relationship management and tough negotiations to maximize success.

CMMI Vision

The initial vision for CMMI was to integrate the competing maturity models and provide more consistent process improvement

- Cause integration of the *functional disciplines* within organizations and across programs
- Increase *systems engineering* process maturity as organizations migrate from the sun-setting CMMs to CMMI

Build on and improve the significant work done on CMM-like Models

6

How we got where we are

- CMMI Sponsors opted to pursue staged and continuous models to preserve legacy
  - SW-CMM, staged
  - SECM, continuous

We created "level-mania" instead of continuous improvement

Have we lost sight of the goal?

The end goal of CMMI is to provide a model for continuous process improvement, to achieve:

- Reduced cycle times
- Meeting cost & schedule targets
- Improve quality

When achieving a level replaces the focus on continuous improvement, we've lost sight of the goal

Level-mania
The Solution

- DoD desires to shift focus from maturity levels to capability profiles
  - Remove the enticement of maturity levels and "one size fits all" syndrome
- Discourage use of maturity levels as selection criteria and replace with targeted CMMI-based risk and capability assessments & profiles
- Develop meaningful measures of process capability based not on a maturity level, e.g. Level 3, but on process performance

Goal is to improve the impact of CMMI on program performance

Summary

- CMMI has the potential to do even greater things for development of Systems
- "Continuous Improvement" is just as important for the CMMI product suite as it is for organizations

The Department would like to increase focus on understanding the capabilities of both our organizations and our industry partners, instead of merely achieving maturity levels

CMMI Workshop, Sept 7&8, 2005

- The workshop addressed several significant aspects of utilizing CMMI in the DoD and federal acquisition process that have been troublesome, and developed recommendations that the CMMI Steering Group, and DoD or federal acquisition agencies can address. Some issues that were discussed include:
  - Background on how organizations approach CMMI appraisals and why
  - Use of Appraisal Disclosure Statement by acquiring organizations
  - Formal guide to CMMI Usage for DoD
  - Training for DoD Acquisition Organizations in the use of CMMI for DoD
  - Government lack of understanding of need for mature SE content and practice
  - Specifying or requiring CMMI in RFPs
  - CMMI Appraisal expiration date

Schaeffer, Workshop and Summit on CMMI Use in DoD Programs, September 7, 2005.

Industry to DoD: 5 + 1 => 0

Workshop Findings

- Programs execute at lower maturity levels than their organizations have achieved and advertised
- Appraisals use small samples—don't cover all projects
- You can't judge a program without appraising it
- How can an organization's level be for "Life" when people and processes change?
- High-maturity practices are not consistently applied at the project level after contract award
- Is the completeness of appraisal disclosure statements adequate?
- Low-maturity acquirers and high-maturity suppliers

Sound Familiar?

7

IRMC Information Resources Management College

Schaeffer, DoD and CMMI, NDIA, Nov 15, 2005

The New(est) look at CMMI for ACQ and DEV

- In the current marketplace, there are maturity models, standards, methodologies, and guidelines that can help an organization improve the way it does business. However, most available improvement approaches focus on a specific part of the business and do not take a systemic approach to the problems that most organizations are facing.

- By focusing on improving one area of a business, these models have unfortunately perpetuated the stovepipes and barriers that exist in organizations.

- Capability Maturity Model® Integration (CMMI®) provides an opportunity to avoid or eliminate these stovepipes and barriers through integrated models that transcend disciplines. [pg 3]

- Since 1991, CMMs have been developed for a myriad of disciplines. Some of the most notable include models for systems engineering, software engineering, software acquisition, workforce management and development, and integrated product and process development.

- Although these models have proved useful to many organizations in different industries, the use of multiple models has been problematic.

Dodson, et al, Adapting CMMI for Acquisition Organizations: A Preliminary Report. Improving Processes for Better Products, CMU-2006-SE-005. June 2006.

CMMI ACQ ASSESSMENT OF SITUATION

- **Although these models have proved useful to many organizations in different industries, the use of multiple models has been problematic.**
- **Many organizations would like their improvement efforts to span different groups in their organizations.**
- **However, the differences among these discipline-specific models used by each group, including their architecture, content, and approach, have limited these organizations' ability to broaden their improvements successfully.**
- **Further, applying multiple models that are not integrated within and across an organization is costly in terms of training, appraisals, and improvement activities. [pg 6]**

Dodson, et al, Adapting CMMI for Acquisition Organizations: A Preliminary Report, Improving Processes for Better Products, CMU-2006-SE-005. June 2006.

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CMMI ACQ BASIC ARCHITECTURE: 16 + 6

- **The initial draft CMMI-ACQ contains unique acquisition practices in six process area that cover solicitation and supplier agreement development, acquisitions management, acquisition requirements development, acquisitions technical solution, acquisition validation, and acquisition verification.**

- **The six process areas are supplemented by 16 process areas that cover project management, organizational and support process areas.**

- **These 16 processes are necessary but not sufficient to executing as a successful acquirer. [ACQ] [pg 8]**

CMMI-ACQ's TWO 'IMPROVEMENT' APPROACHES

- **Levels are used in CMMI to describe an evolutionary path recommended for an organization that wants to improve the processes it uses to acquire its products and services. Levels can also be the outcome of the rating activity of appraisals.**

- **Appraisals can apply to organizations that comprise entire companies, or to smaller groups such as a small group of projects or a division within a company. [ACQ]**

- **CMMI supports two improvement approaches.**
  - **The first utilizes what is called the continuous representation; the continuous representation is based on capability levels.**
  - **The second utilizes what is called the staged representation; the staged representation is based on maturity levels. [ACQ] [pg 19]**

Integration => A new Acquisition Framework

In The Beginning Models	Capability Maturity	First Phase Model Integration	Second Phase Model Integration	'Final' Phase ?
MS 2167a Prescriptive Unidirectional Standards	SW-CMM + SE-CMM + SA-CMM +	CMMI w/ 2 reps phased/continuous + CMMI AM	CMMI ACQ CMMI DEV CMMI SVC	ONE MODEL: CMMI "ACQ"
NONE	MANY	FEW	3-in-1	ONE ?

Capability Maturity Model® Integration (CMMI®) Version 1.2 Overview

SM CMM Integration, IDEAL, SCAMPI, and SEI are service marks of Carnegie Mellon University.
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Stellar Solution: Constellations

Carnegie Mellon
Software Engineering Institute

CMMI

The CMMI Framework

The CMMI Framework is the structure that organizes the components used in generating models, training materials, and appraisal methods.

The CMMI Product Suite is the full collection of models, training materials, and appraisal methods generated from the CMMI Framework.

The components in the CMMI Framework are organized into groupings, called constellations, which facilitate construction of approved models.

- During v1.2 development, CMMI-SE/SW/IPPD/SS was moved to the CMMI for Development (CMMI-DEV) constellation.
- Two new constellations have been commissioned by CMMI Steering Group:
  - CMMI for Services (CMMI-SVC)
  - CMMI for Acquisition (CMMI-ACQ)

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3-in-1

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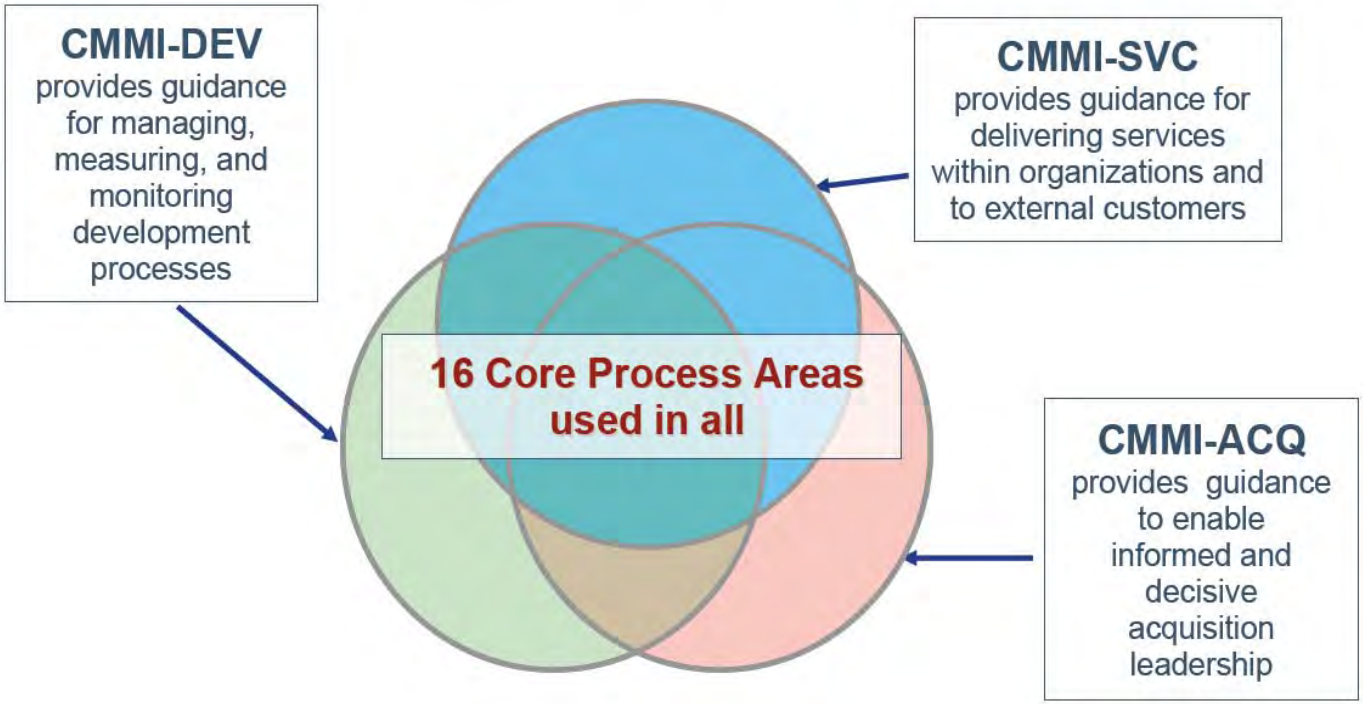
CMMI

Three Complementary Constellations



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EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

May 20, 2005

MEMORANDUM FOR CHIEF ACQUISITION OFFICERS
CHIEF FINANCIAL OFFICERS
CHIEF INFORMATION OFFICERS

FROM: Clay Johnson III
Deputy Director for Management

SUBJECT: Implementing Strategic Sourcing

The federal government spends approximately $300 billion on goods and services each year, and federal agencies are responsible for maximizing the value of each dollar spent. Therefore, agencies need to leverage spending to the maximum extent possible through strategic sourcing. Strategic sourcing is the *collaborative* and *structured* process of critically analyzing an organization's spending and using this information to make business decisions about acquiring commodities and services more effectively and efficiently. This process helps agencies optimize performance, minimize price, increase achievement of socio-economic acquisition goals, evaluate total life cycle management costs, improve vendor access to business opportunities, and otherwise increase the value of each dollar spent.

Each agency's Chief Acquisition Officer (CAO), Chief Financial Officer (CFO), and Chief Information Officer (CIO) are responsible for the overall development and implementation of the agency strategic sourcing effort, which begins with a spend analysis and the identification of commodities for which strategic sourcing should be implemented. The CAO shall lead the CAO/CFO/CIO development team and will take the following actions:

1. Not later than October 1, 2005, the CAO shall identify no fewer than three commodities that could be purchased more effectively and efficiently through the application of strategic sourcing, exeluding software that could be purchased under the SmartBuy program. Agencies may include existing strategic sourcing efforts for this purpose.

2. The CAO shall lead the collaborative development of an agency-wide strategic sourcing plan in coordination with the agency CFO, CIO, representatives from the agency's Office of Small and Disadvantaged Business Utilization, and other key stakeholders, as appropriate. The plan should reflect the application of sound program and project management principles. At a minimum, the plan should include the following elements:

a. Strategic Sourcing Governance – A charter should be developed outlining the members, roles, responsibilities, and operations of an agency-wide Strategic Sourcing Council and any commodity councils to be formed.

b. Strategic Sourcing Goals and Objectives – The Strategic Sourcing Council should establish annual strategic sourcing goals and objectives, by fiscal year. These goals and objectives should include existing strategic sourcing efforts, as well as prioritizing new initiatives. In addition to cost and performance goals, any strategic sourcing plan must be balanced with socio-economic goals for small businesses, small disadvantaged businesses, women-owned small businesses, veteran-owned businesses, service-disabled veteran-owned businesses, HUB-Zone and preference programs (e.g., Javits-Wagner-O'Day), and others, as appropriate.

c. Performance Measures – The agency Strategic Sourcing Council should establish agency-wide performance measures and reporting requirements in order to monitor and continuously improve the strategic sourcing program.

d. Communications Strategy – The Strategic Sourcing Plan should also include a communication strategy that clearly conveys senior management's commitment to the effort, describes the scope of the effort, and identifies any organizational changes. The communications strategy should also include steps to make agency employees aware of awarded strategic sourcing contracts and how they are to be used.

e. Training Strategy – The plan should identify actions necessary to educate agency personnel to support effective and efficient strategic sourcing implementation and management.

3. Beginning in January 2006, the CAO shall report annually to the Office of Federal Procurement Policy (OFPP) regarding, at a minimum, reductions in the prices of goods and services, reductions in the cost of doing business, improvements in performance, and changes in achievement of socio-economic acquisition goals at the prime contract and, if possible, the subcontract level. Agencies shall develop methodologies for establishing baseline data and subsequent changes to this baseline and shall consistently apply this methodology throughout the strategic sourcing process.

Using information from the agency reports and other data sources, OFPP may identify several commodities that could be strategically sourced government-wide, and will establish an interagency structure for managing the acquisition of these commodities.

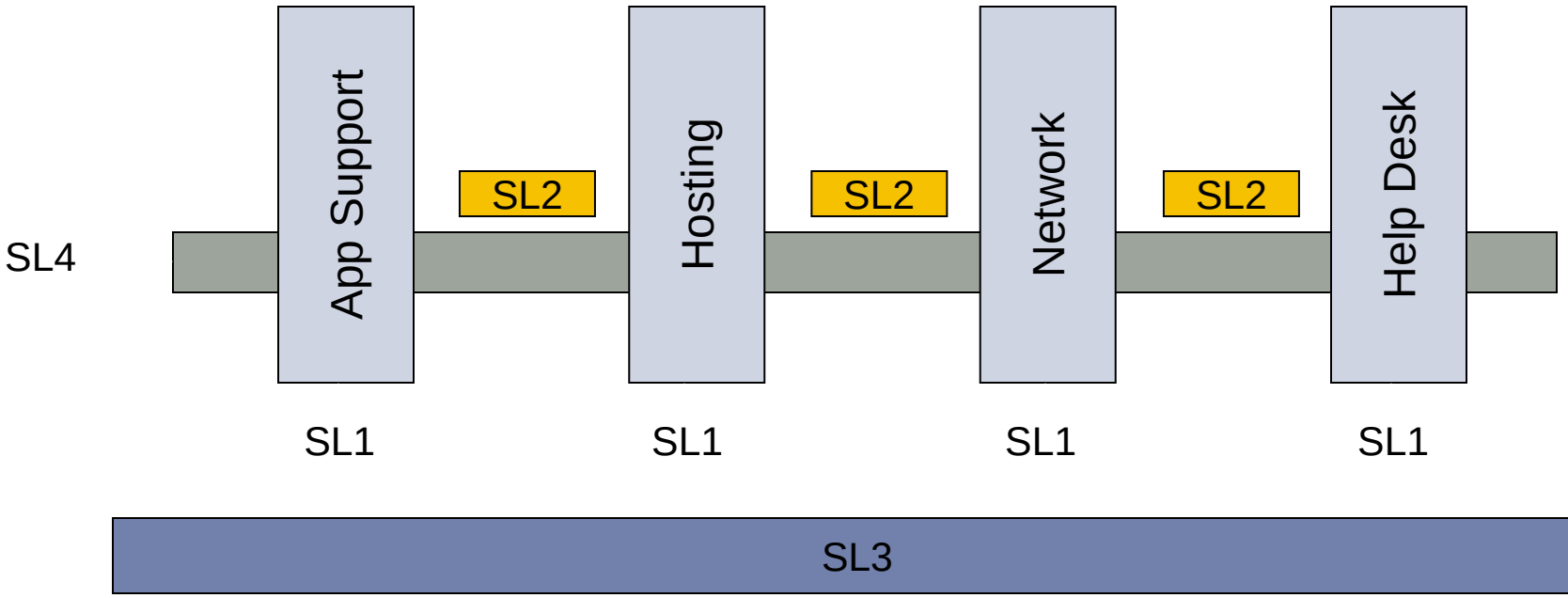
To facilitate the development of a strategic sourcing community and build a subject matter expert network, agencies shall identify a strategic sourcing point of contact. Please submit the person's name, title, telephone number, and e-mail address to Lesley Field at OFPP by July 1, 2005 (lfield@omb.eop.gov).

Maximizing value for taxpayers is a top priority for OMB, and I look forward to working with the acquisition community on this important initiative.

An Acquisition Process Conceptual Model

This Acquisition Process model contains four types of service levels:

[Marais, Global Sourcing in an Increasingly Outsourced Environment, SIM ITPWG, 2006.]



SL1: Component Level

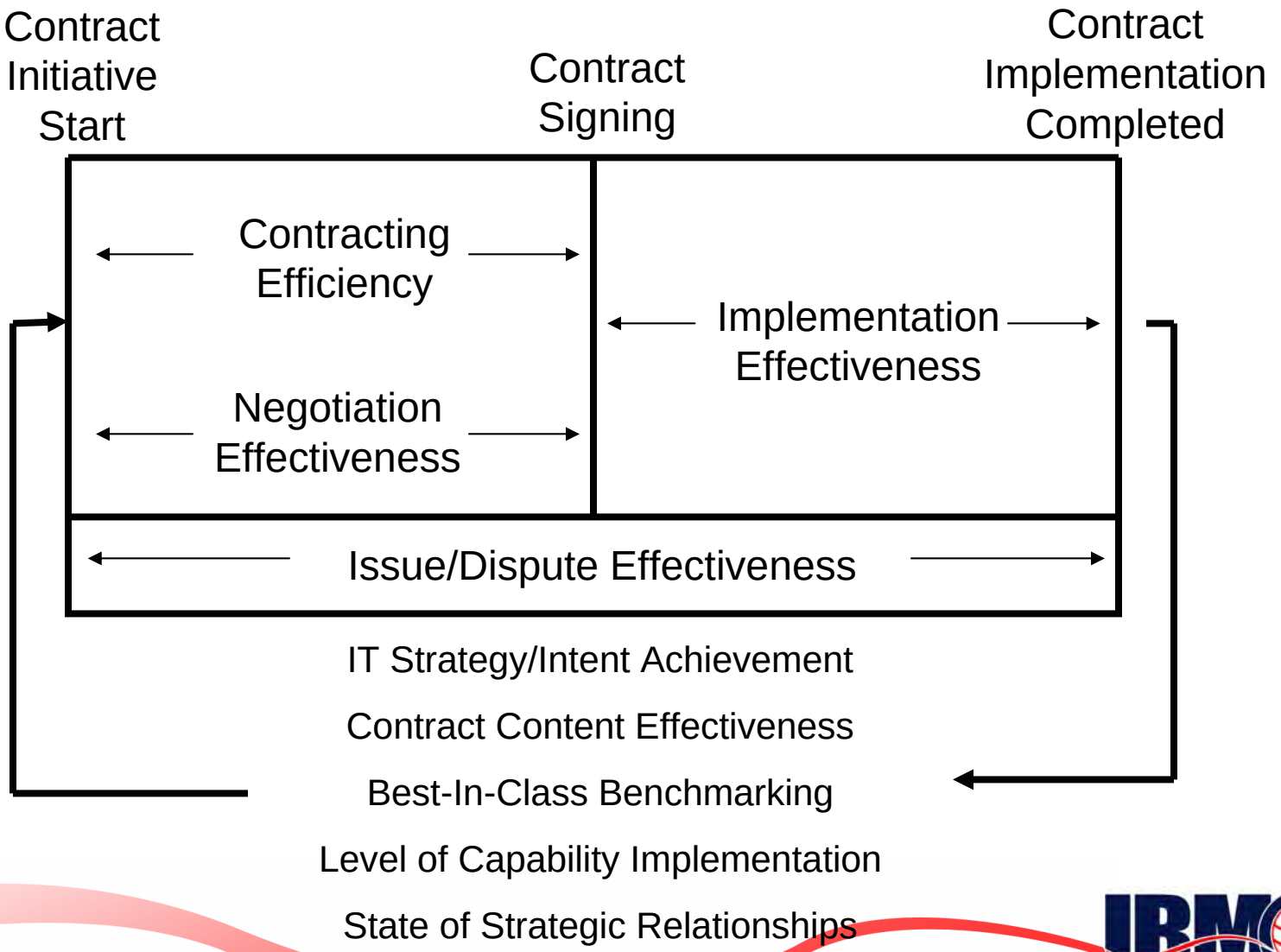
SL2: Interface / Handoff

SL3: Collaborative Process

SL4: End-to-End

IRMC Information Resources Management College

Closed Loop Contract Management Life Cycle



Information Resources Management College

Marais, Global Sourcing in an Increasingly Outsourced Environment, SIM ITPWG, 2006.

Framework for Acquisition Relationship Management Program

- **Acquisition effectiveness is judged by what you measure**
- **Acquisition process models should measure the necessary elements *bilaterally* in each of the following categories:**
  - **Partnership**
  - **Process**
  - **Continuous Improvement**
  - **Performance**
- **Acquisition process models should differentiate between tough negotiations and good relationships which are not mutually exclusive**
- **"Where's the Meat?"**
  - **Good acquisition processes depend on the bridging processes in the middle.**
  - **Acquisition processes which focus on the two halves of the bun miss the meat.**
- **One Unified Acquisition Process model for Acquirer and Provider solves the "gap in the middle" problem.**

IRMC Information Resources Management College

Modified from Marais, Global Sourcing in an Increasingly Outsourced Environment, SIM ITPWG, 2006.

CMMI Acquisition Module

- New CMMI Acquisition Module (CMMI-AM) should prove valuable in assisting program offices in improving acquisition process
  - Recent pilot efforts indicate positive effect
- Results not expressed as "Levels" but as Capability Profile
- Self-initiated, for internal use
- Will help put program offices on path to acquisition process improvement

Strategic Sourcing: Acquisition as an Integrated End-to-End Model

- **Industry Best Practices in "strategic sourcing" [might] represent a useful approach to consider for framing [future] integration efforts within the CMMI model "family"**
  - **The conceptual view of one CMM model for each end of a dumbbell (CMMI ACQ + CMMI DEV) might be found to work less well than one integrated model for whole process:**
    - **Focus on acquirer processes [one end]**
    - **Focus on supplier processes [one end]**
    - **Focus on acquirer-supplier processes [bidirectional evaluative gap-bridging processes] in the middle**

References

- Bernard, et al, CMMI Acquisition Module (CMMI-AM), Version 1.1, CMU/SEI-2005-TR-011, ESC-TR-2005-011. May 2005.
- Dodson, et al, Adapting CMMI for Acquisition Organizations: A Preliminary Report, Improving Processes for Better Products, CMU-2006-SE-005. June 2006.
- Marais, Global Sourcing in an Increasingly Outsourced Environment, SIM ITPWG, 2006.
- Rassa, Chittister, CMMI: Current State and Future Plans, NDIA CMMI Conference, Denver, Nov 16, 2004.
- Schaeffer, DoD Systems Engineering and CMMI, NDIA CMMI Conference, Denver, Nov 17, 2004.
- Schaeffer, Workshop and Summit on CMMI Use in DoD Programs, September 7, 2005.
- Schaeffer, DoD and CMMI, NDIA, Nov 15, 2005
- Software Engineering Institute (SEI) Capability Maturity Model Integration (CMMI) Version 1.2 Overview, 2006.

Speaker Biographies

- **Claude Marais is a seasoned sourcing and technology executive with more than 20 years global experience in major corporations such as General Motors and Coca-Cola. His background includes application development, global sourcing and outsourcing management with budgets of up to $3 Billion per year. As a thought leader in sourcing management he has played key roles in industry organizations. Amongst others, he is a Fellow and Honorary Vice-President of the International Association for Contract and Commercial Management and the founder of the Society for Information Management IT Procurement Working Groups.**

- **Dr. Carl Clavadetscher is Professor of Systems Management at the Information Resources Management College (IRMC), National Defense University (NDU). Dr. Clavadetscher currently heads the acquisition portion of the IRMC Advanced Management Program (AMP) and IRMC CIO program. Prior to joining IRMC, Dr. Clavadetscher was Professor of Information Systems and Chair of the Computer Information Systems Department at Cal Poly Pomona, a department DPMA recognized as the nation's best (1988). Dr. Clavadetscher has held appointments at IBM's Los Angeles Research Center, Los Angeles Water and Power MIS, and the Rockwell Corporation. He is a combat decorated veteran of Vietnam (MACV). Dr. Clavadetscher has been an active speaker and author on IT issues for almost 30 years.**

Raytheon

Customer Success Is Our Mission

No Doubt – The LRAS3/FS3 Story of Mission Assurance

Jill Brooks

Sheleen Johnson

Network Centric Systems

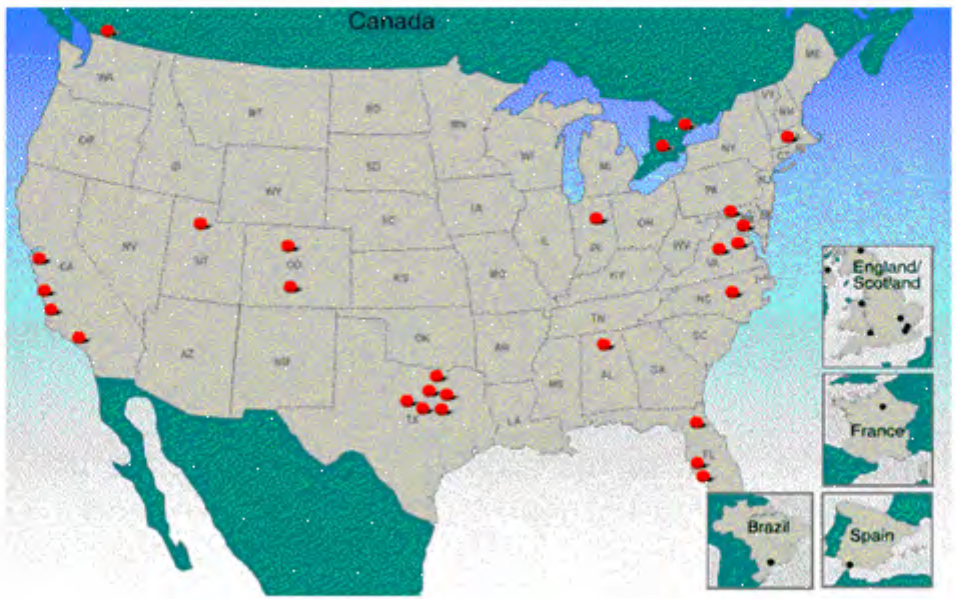
Agenda

- Introduction to Raytheon
- LRAS3/FS3 Overview
- Sound Engineering Processes
- Partnership With The Customer
- Results Speak For Themselves
- Summary

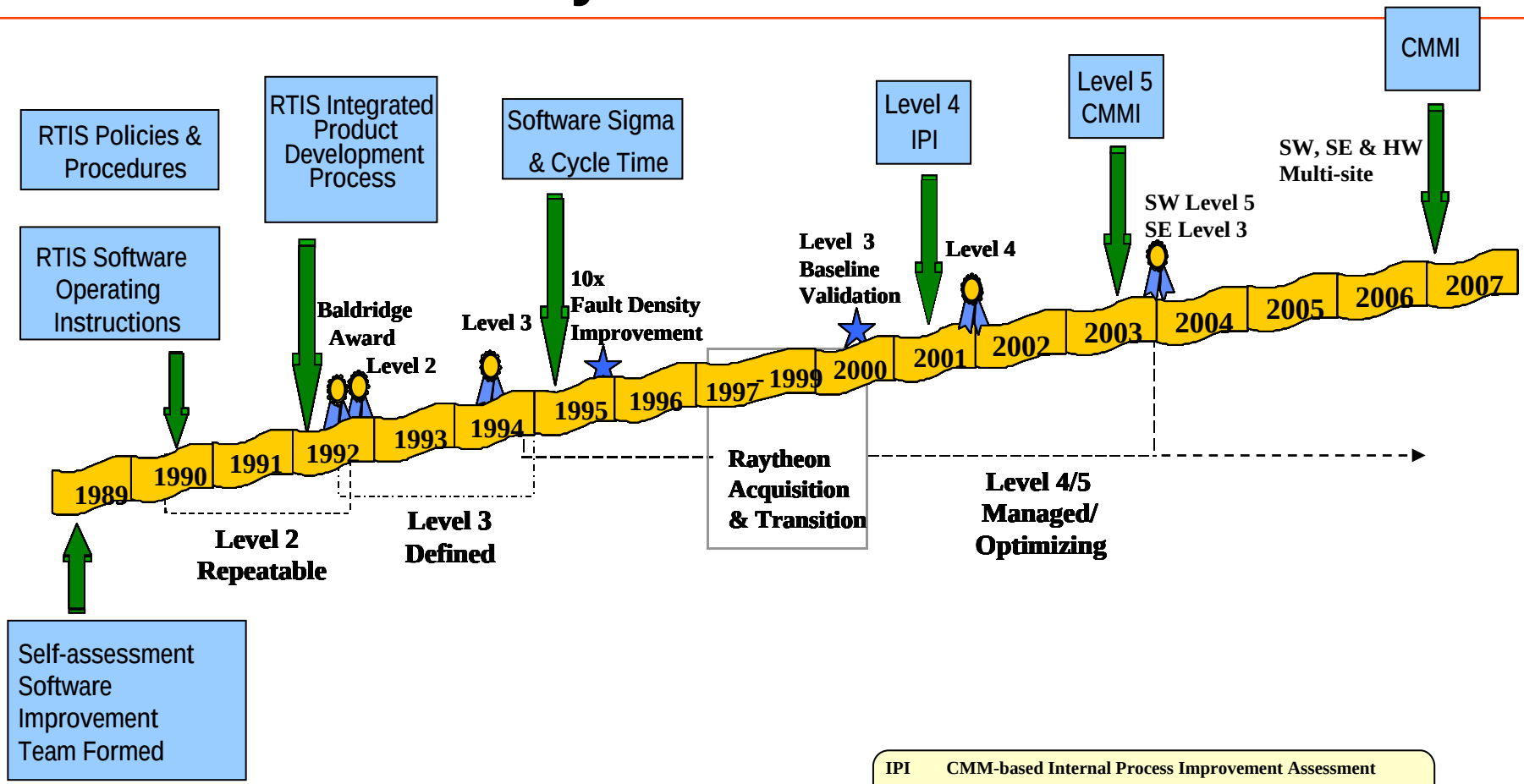
Introduction to Raytheon

- Raytheon is an industry leader in defense and government electronics, space, information technology, technical services, and business aviation and special mission aircraft

- Network Centric Systems (NCS) develops and produces mission solutions for networking, command and control, battlespace awareness, and air traffic management



Introduction to Raytheon – continued



IPI CMM-based Internal Process Improvement Assessment
RTIS Raytheon/TI Systems
CMMI CMM Integrated

LRAS3/FS3 Overview

- The LRAS3/FS3 is a long range reconnaissance and surveillance multi-sensor suite system with the capability to determine far target location (FTL) coordinates, and to provide real-time target detection, recognition, and identification capability to the scout while permitting 24-hour adverse weather operations. In addition, the FS3 variant provides laser designation of a target for laser guided weapons.

LRAS3/FS3 Product supports scout and fire support missions

LRAS3/FS3 Overview – continued

- FS3 product supports Knight fire support missions. The LRAS3 product supports scout operations and is operable in both a stationary vehicle mounted configuration and in an autonomous dismounted configuration The host vehicle for the system is the High Mobility Multi-purpose Wheeled Vehicle (HMMWV) and Stryker Armored Vehicle.

LRAS3/FS3 Product supports scout and fire support missions

Sound Engineering Processes

- SW engineering processes assessed as CMMI Level 5, in 2003
- Rigorous approach to engineering practices, key examples include:
  - Requirements Management
    - Used DOORs tool to support bi-directional traceability
    - Ensures that the impact of changes to requirements is understood and addressed through out the system
  - Configuration Management
    - Used through out the life-cycle of the product from Requirements Definition, through design, implementation, test and maintenance
    - A multi-tiered approach that has different requirements for different artifacts and for different points in an artifact's lifecycle

Engineering process supports Mission Assurance

Sound Engineering Processes – continued

Raytheon

- Additional engineering practices that played a key role in the mission assurance success of LRAS3/FS3:
  - Peer Reviews
    - Not the “glamorous” part of the process, but rigorous application pays off
    - Verification by Quality Engineering
  - Verification, Validation
    - An iterative approach
    - Back to basics, back to the requirements
  - Quality Engineering
    - Maintained independence, but an integral part of the program
    - Ensured adherence to defined processes
    - Worked with program to find solutions

Engineering process supports Mission Assurance

Partnership with the Customer

- A series of demonstrations and user juries were conducted to refine the Raytheon understanding of the customer requirements:
  - User Jury #1
    - Combined with PDR (Preliminary Design Review) to ensure requirements are understood
  - User Jury #2
    - Paper copies of the display screens
    - End user participation requested (several different ranks)

Demonstrations and User Juries were key tactics

Partnership with the Customer – continued

Demonstrations and User Juries were key tactics

Partnership with the Customer – continued

Raytheon

- Demonstrations and user juries (continued):
  - Engineering Confidence Test: Demonstration #1
    - Fire LDM (Laser Designator Module) from external run box
    - External mounted camera - alleviate delays for packaging/fabrication
    - Insert filters in front of camera to simulate end system performance
  - Program Gate: Demonstration #2
    - Interim demonstration of more integrated system at longer ranges
  - Tactical Demonstration
    - After completion of the Vehicle Sensor Mount and end system development

Demonstrations and User Juries were key tactics

Partnership with the Customer – continued

Raytheon

- Customer participation in major reviews
  - PDR – Preliminary Design Review
  - CDR – Critical Design Review
  - TRR – Test Readiness Review
  - IPR – Interim Progress Review
  - All of these reviews involved customer participation and an agreement regarding actions and authorization to proceed

Formal Reviews were a key tactic

Partnership with the Customer – continued

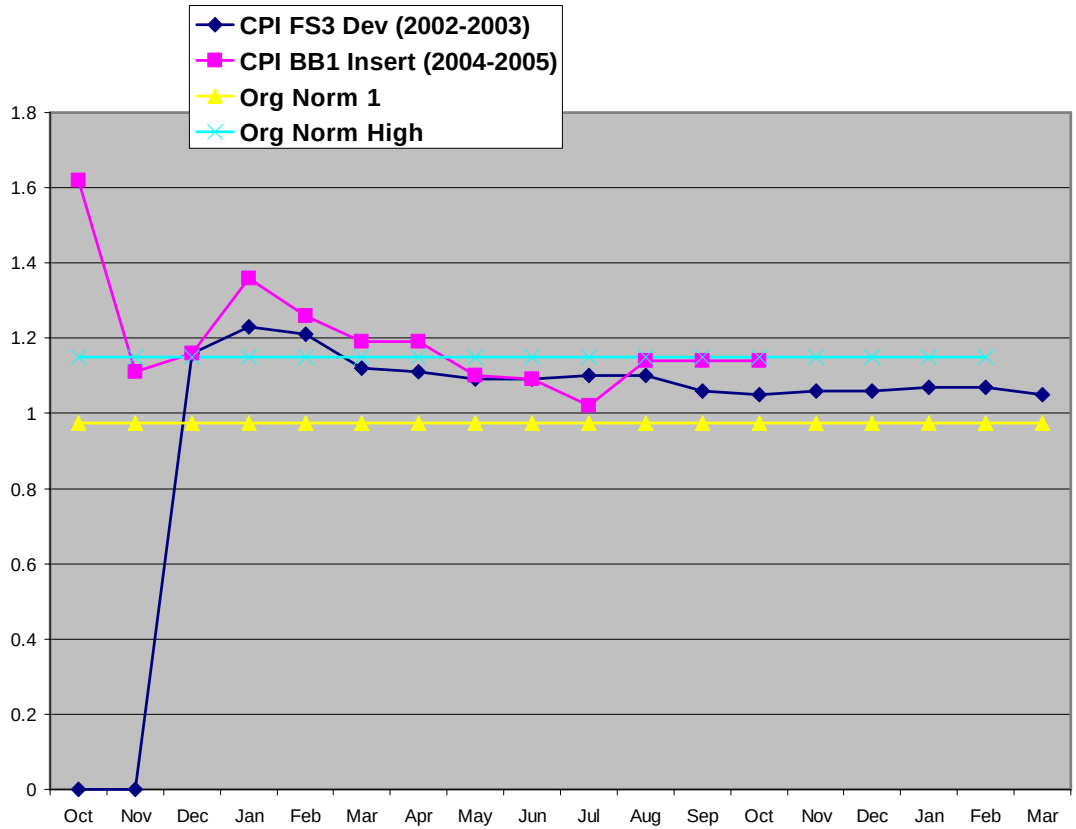
Raytheon

- Field Service Representative in place to facilitate maintenance issues for deployed systems.

Maintaining systems assumes high priority.

Results Speak for Themselves

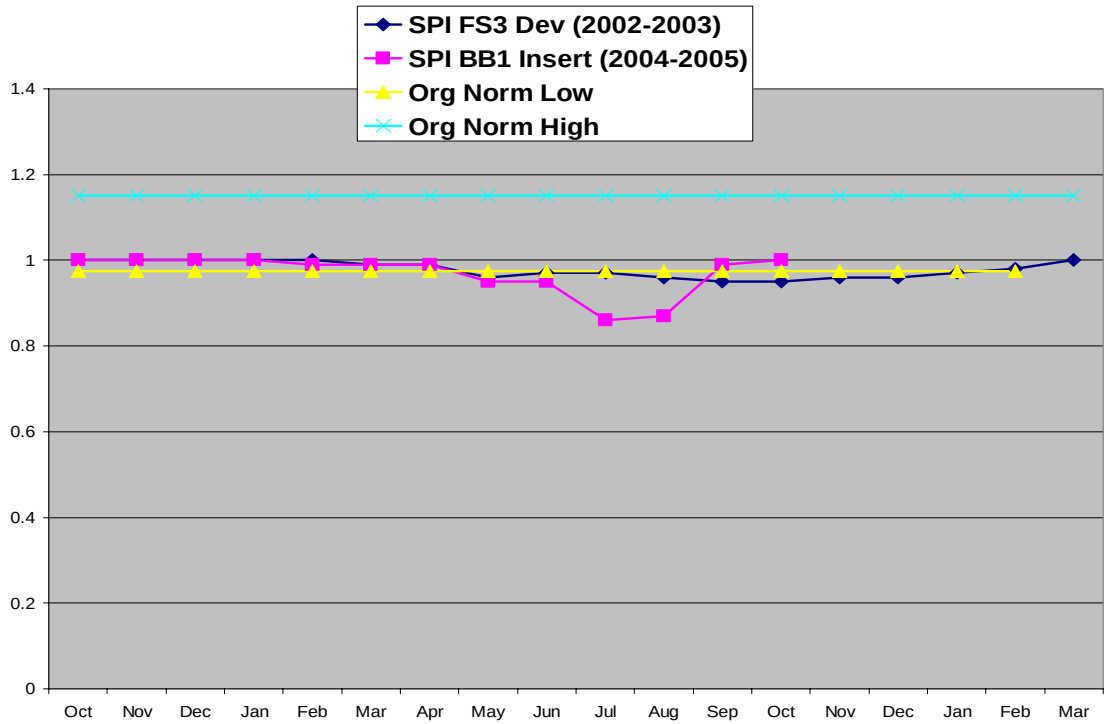
- Software CPI has consistently stayed within organizational limits for several years



Achieved Budget as well as Mission Assurance

Results Speak for Themselves – continued

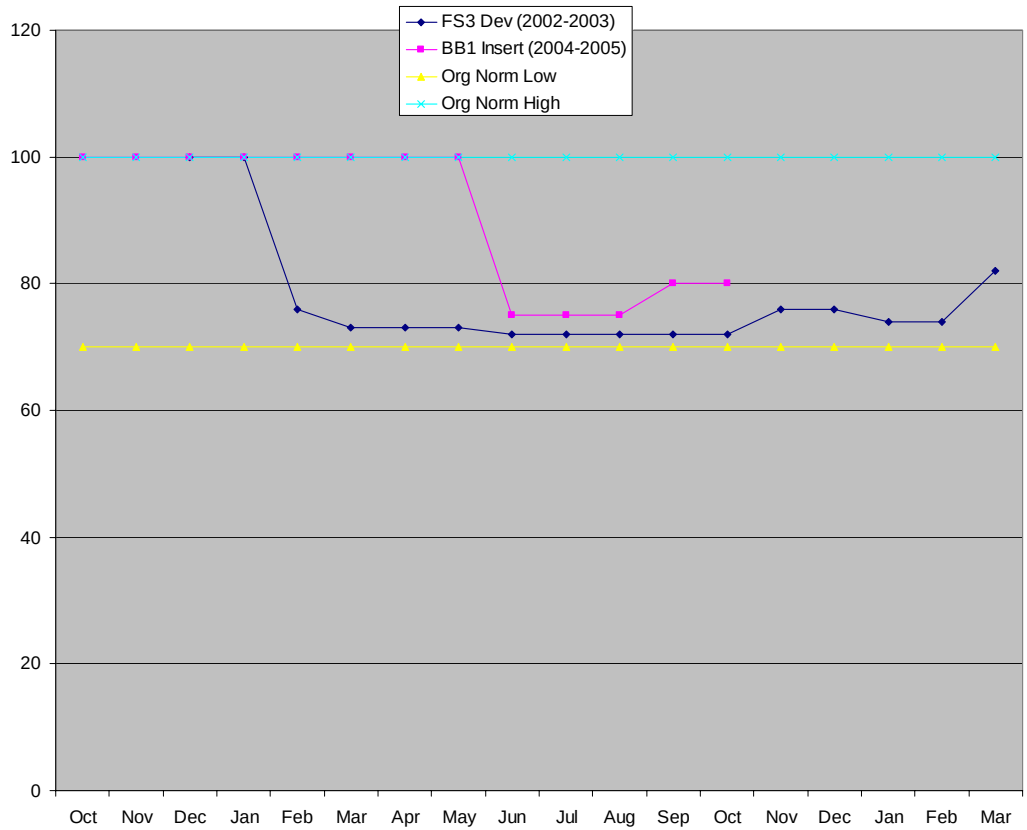
- Software SPI has consistently stayed within organizational limits for several years

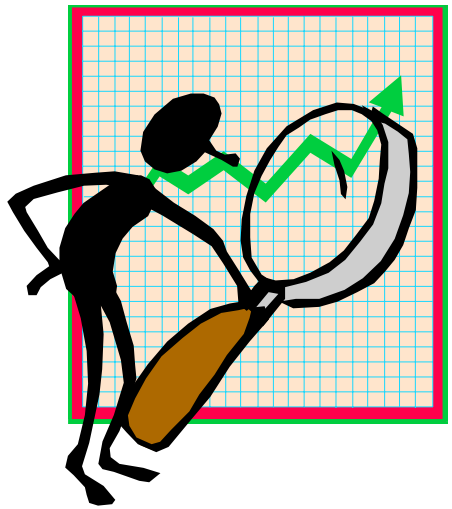


Achieved Schedule as well as Mission Assurance

Results Speak for Themselves – continued

- Defect containment metrics for software remained within organizational limits over multiple development efforts





No Doubt – A Mission Assurance Success Story

Results Speak for Themselves – continued

Raytheon

- To date, there have been two follow-on software maintenance contracts in addition to development effort to enhance software and hardware

No Doubt – A Mission Assurance Success Story

Results Speak for Themselves – continued

- Positive feedback from in-theatre user community
  - Highly positive feedback in multiple applications
  - Not originally designed for mounting on buildings, but modified and used on rooftops to monitor borders / surveillance

No Doubt – A Mission Assurance Success Story

Results Speak for Themselves – continued

"Best damn investment the Army ever made" ..Army Scout

No Doubt – A Mission Assurance Success Story

Summary

- Sound Engineering Processes coupled with a partnership with the Customer have led to success for the LRAS3/FS3 program, Raytheon, and the Army:
  - A program that is within budget and on time
  - A product that performs – with no doubt

No Doubt – LRAS3/FS3: A Mission Assurance Success Story

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Questions

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DEFINING THE FUTURE

Using Voice of Customer to Advance OID – *Giving The Customer a Vote In Improvement*

CMMI Technology Conference
Denver, Colorado

November 11, 2006

Donald R. Corpron
Division Manager – Six Sigma
Northrop Grumman Corporation

SRD-06/018

Preview…

- Intent of Organizational Innovation and Deployment
- Definition of “Voice of Customer”
- Means to Gather Voice of Customer
- Translating VoC into Criteria to Select Improvement Projects

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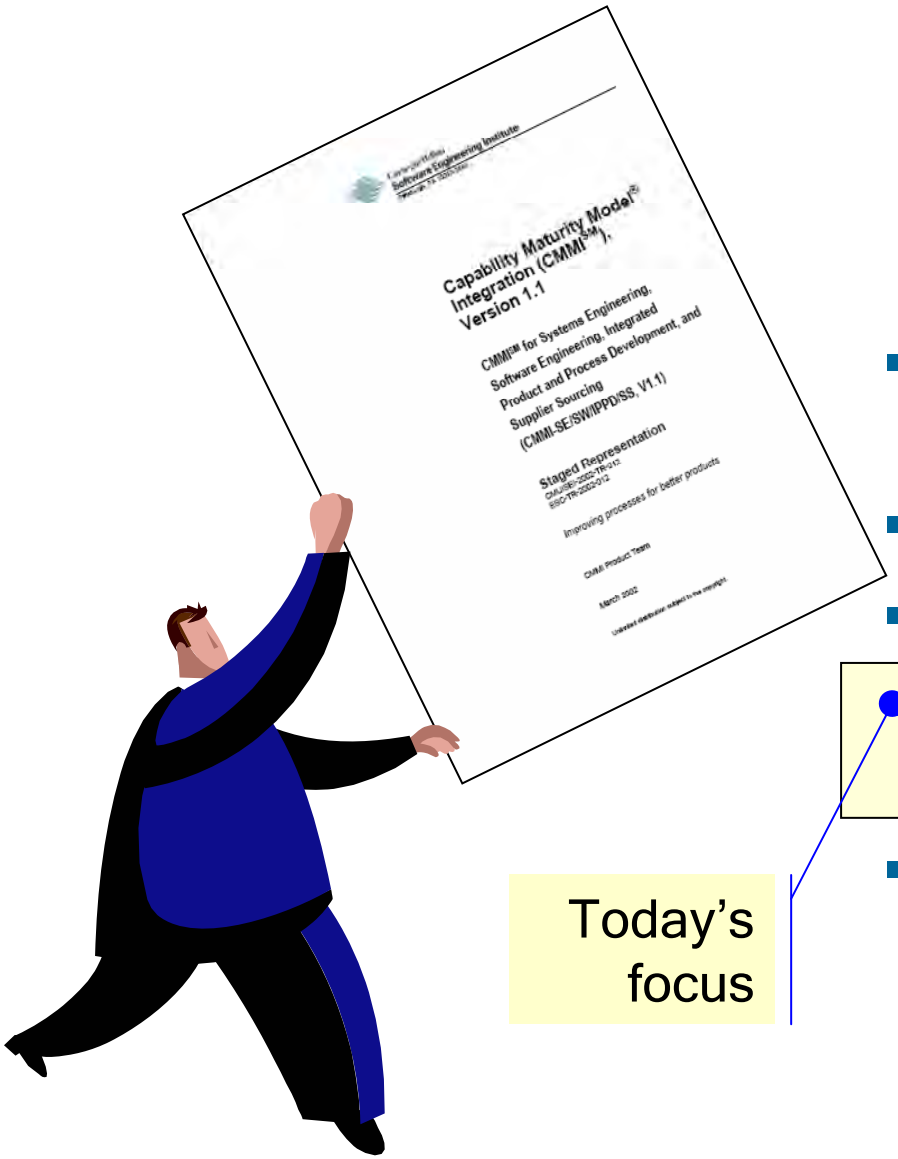
About Organizational Innovation and Deployment…



Quality and process-performance objectives that this process area might address include the following:

- Improved product quality (e.g., functionality, performance)
- Increased productivity
- Decreased cycle time
- **Greater customer and end-user satisfaction**
- Shorter development or production time to change functionality, add features, or adapt to new technologies

Today's focus

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“Voice of Customer” is…

“Voice of the Customer” (VoC) means to describe the wants and needs of our Customers and their perceptions of quality

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VoC is important because…

- High maturity organizations recognize the tie between high quality and Customer loyalty, referenceability and it's effect on business
- Quality is all non-price attributes of a product or service, tangible and intangible
- Only Customers define quality; should hear what they have to say
- Organizations need process improvements that align to "quality that Customers can see"

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Understanding quality is difficult…

- Customers don't know all of their needs, or can't articulate what they are, or assume that you know them
- Customers often state their needs in fuzzy terms like, "Easy to Use"
- Customers needs and wants frequently change
- Quality is perceived, and not quantitatively measured

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Follow six steps…

② Discover Their Needs with Interviews

④ Prioritize Needs

⑥ Choose Improvements Based On Criteria

① Identify Customers/ end-users

③ Categorize Needs

⑤ Survey to Determine What Really Matters

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Gather Voice of Customer with Reactive or Proactive Systems…

Two basic types of VoC systems exist…

- Reactive Systems
- Proactive Systems

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Reactive systems are…

Reactive systems are those where Customer information comes to you whether you want it or not, *e.g.,*

- Customer complaints
- Award Fee Letters
- Help Desk Calls
- Contractor Performance Assessment Reports

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Proactive systems are…

Proactive systems are those where we seek out information about Customers needs and wants, e.g.,

- Interviews
- Surveys
- Focus Groups
- Executive Visits
- Benchmarking

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Customer interviews are good to discover needs…

- **Interviews** are proactive systems to discover Customers discover needs or wants
- Capture verbatim comments that describe needs or wants (on index cards or Post-It® notes)

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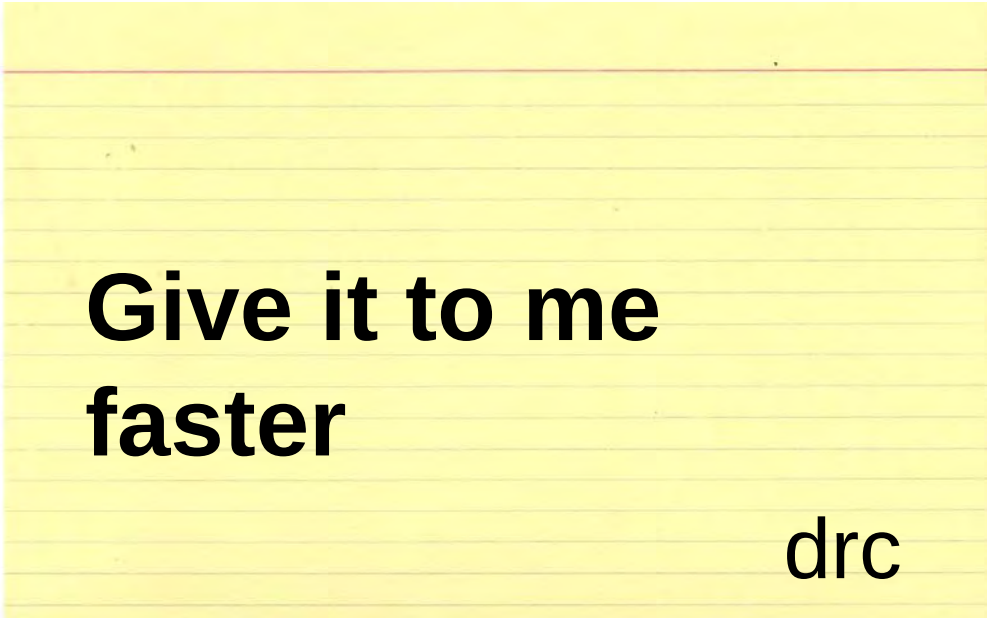
Record Customers' verbatim comments on cards…



For capturing comments…

- Cards should have independent thoughts or ideas
- Write large enough so that they can be seen from afar
- Put initials on the card

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The approach to interviews…

- Provoke images and listen
- Employ open ended questions that don't imply a right or wrong answer
- Tailor questions to the situation

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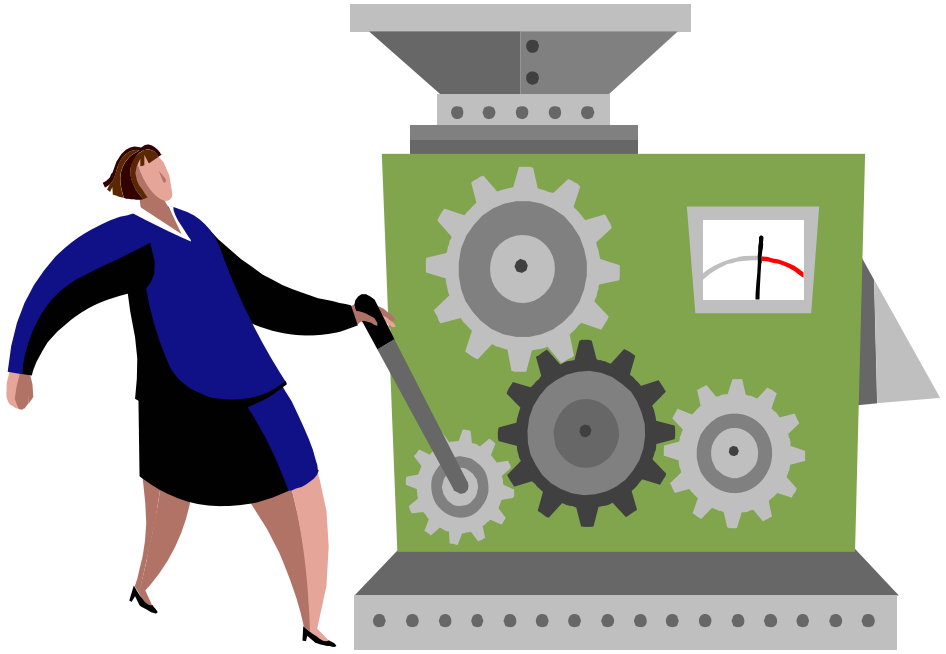
Find out about Customers' current approach…



How do you use the current system?

- Tell us about the last few times.
- How do you get service?
- Who or what provides the service?
- When is the service available?
- How much time to respond?
- What method to respond?

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Explore what is working well…

Tell us what works well with the current approach?

- What not to change
- What advantages now

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Probe problem areas…

Tell us about problems you have with the current system…

- Tell us about problems.
- Which most important to fix? Why?
- Any work-arounds?
- Any costs and negative consequences?

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Ask about the ideal solution…

Describe what you see as an ideal system…

- What would it look like?
- How would you interact with it?
- Any other systems you've seen or heard about it?
- Who does it best?

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Explore the future…

What changes do you anticipate in the next couple of years? Include changes in…

- Technology
- Your work
- Document types
- Presentation types
- Delivery formats
- Client demands or expectations
- World events

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Needs Customers might tell you…

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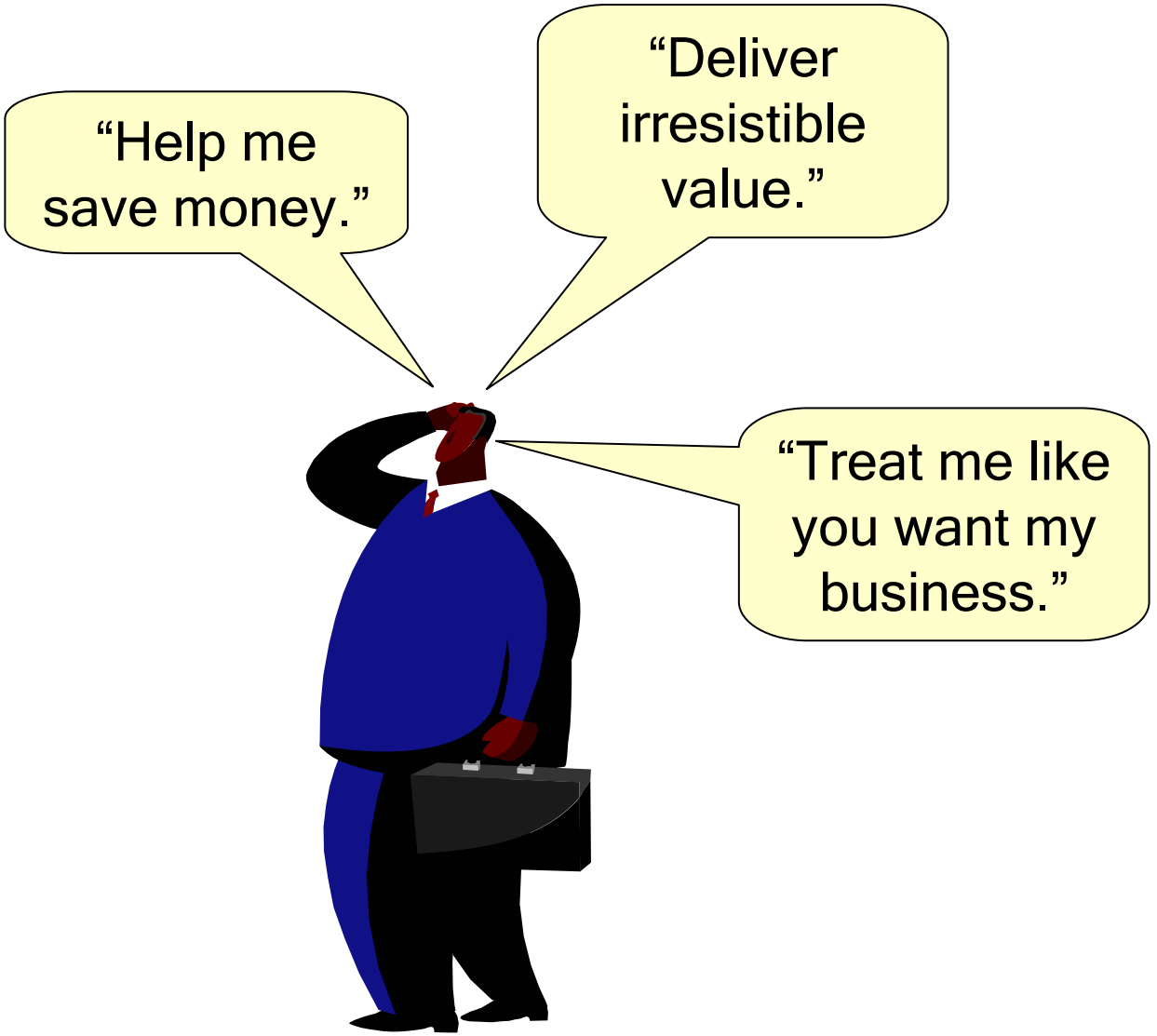
More needs Customers might tell you…



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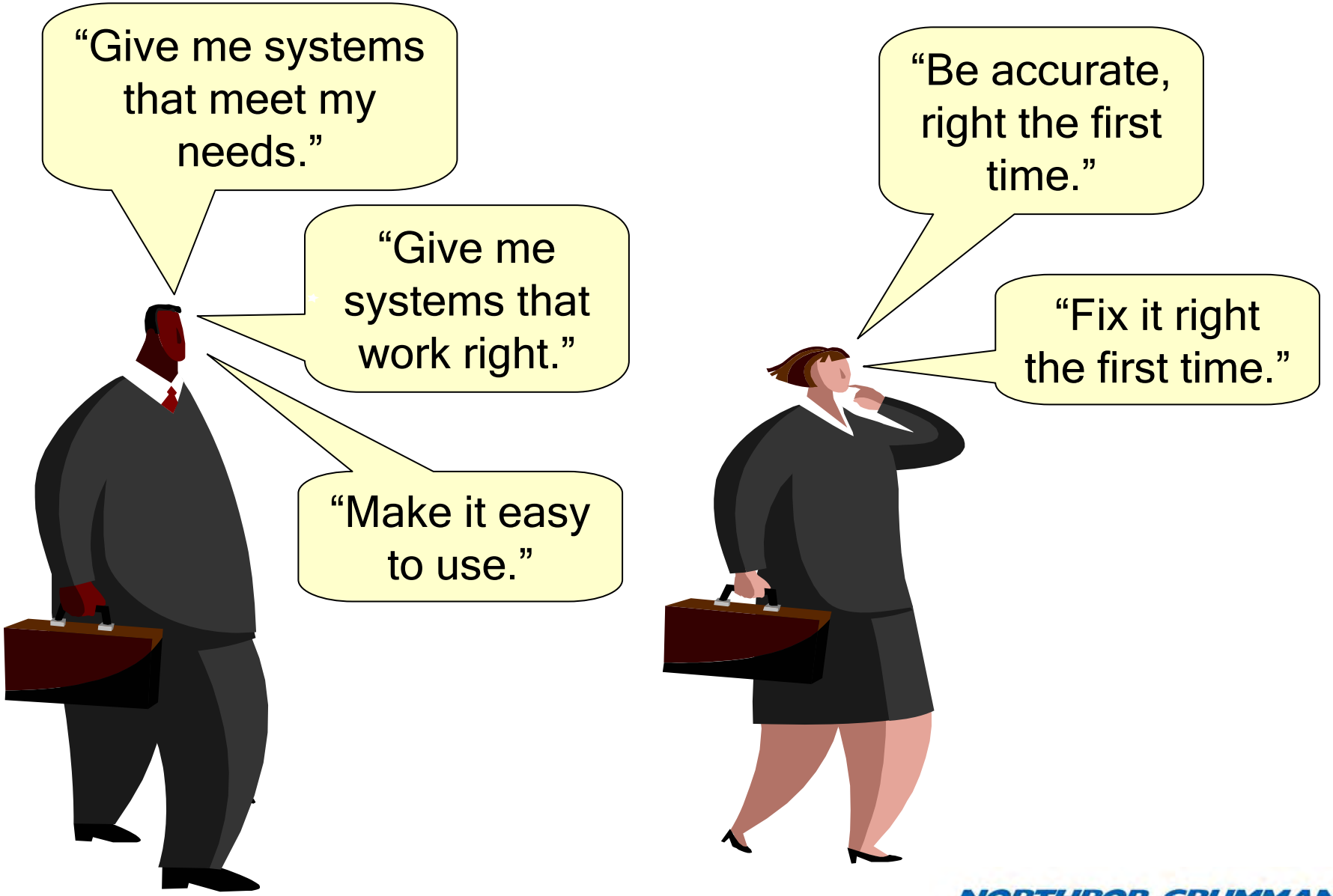
Even more needs Customers might tell you…



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About affinitizing needs or attributes…

- The affinity diagram, or KJ method is one of the most widely used of the Japanese management and planning tools
- The affinity diagram was developed to discover meaningful groups of ideas within a raw list
- Important to let the groupings emerge naturally, using the right side of the brain, rather than according to preordained categories

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Start by posting all the verbatim comments…

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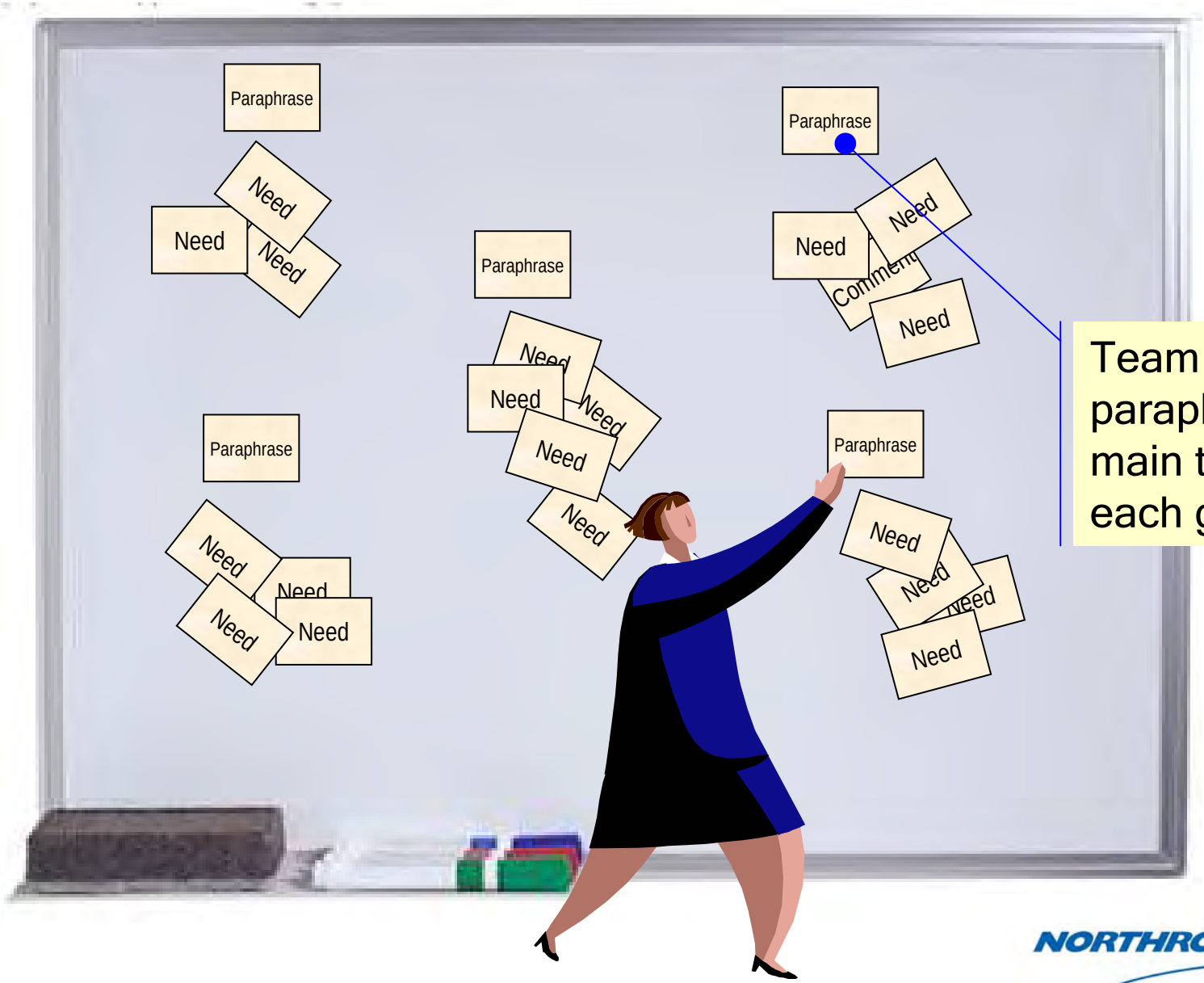
Team sorts cards into groups with a common thread…

Need
Need
Need

Someone works with the team to paraphrase the essence…



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About surveys…

- Surveys are another proactive system to collect information about Customer needs
- Combined with Likert scaling, surveys can prioritize needs

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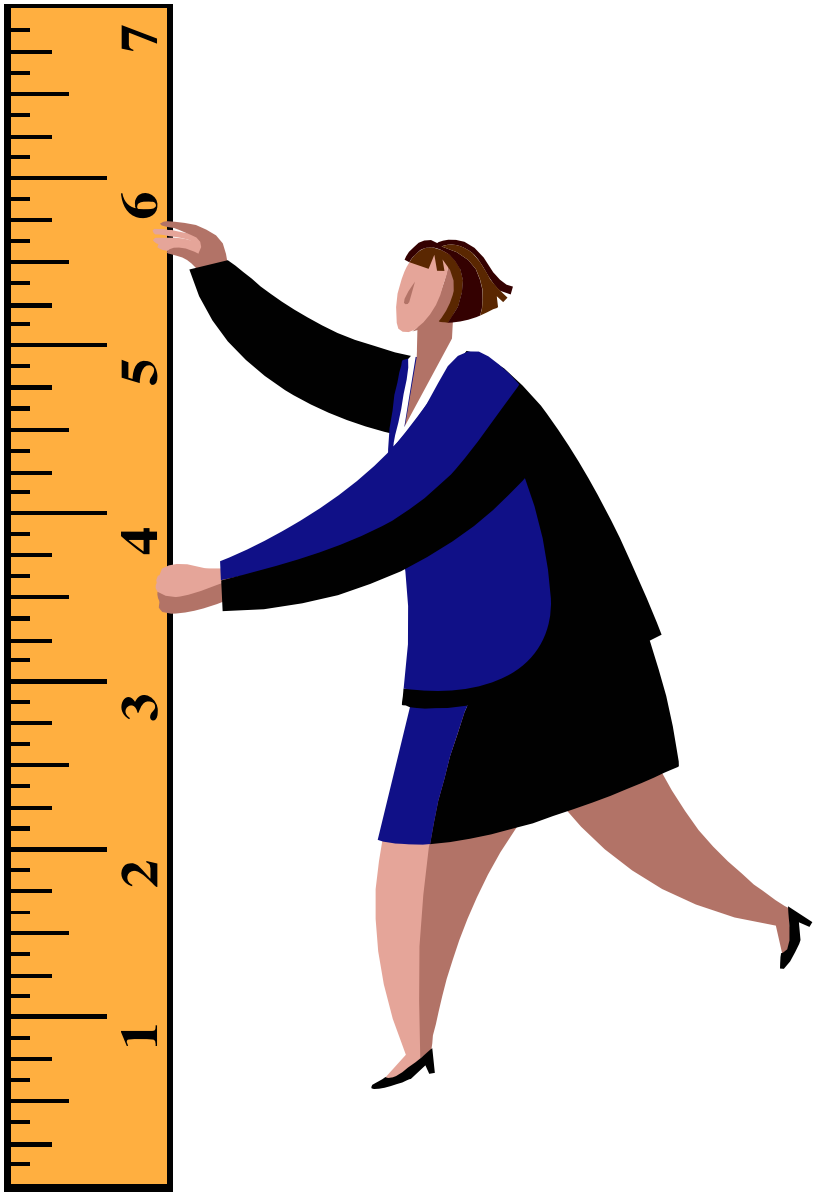
A Likert scale is…



A Likert scale is a type of survey question where respondents rate the level at which they agree or disagree with a given statement, e.g.

The system is easy to use.
1. Strongly Agee
2. Agree
3. Somewhat Agee
4. Neutral
5. Somewhat Disagree
6. Disagree
7. Strongly disagree

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Likert scales are effective to…

- Measure “soft” things like perceptions, attitudes, or satisfaction
- Capture the state of information about process performance where only notions of performance exist.
- Verify Customer’s perception of differences in “before” and “after”
- Validate that “hard” measures are good predictors of what Customers’ see

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Especially in software…

- In software evaluation, we can often objectively measure efficiency and effectiveness with performance metrics such as time taken or errors made
- But, Likert scales and other attitudinal scales help get at the emotional and preferential responses people have to the design

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Steps to survey…

② Compose questions from interviews

④ Analyze with logistic regression

① Determine the “Money Question”

③ Administer the survey

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Determine the "Money Question"…

The "Money Question" is a question that addresses the overall trait of interest, *e.g.*,

- "Overall, I am satisfied with the systems and services that Northrop Grumman delivers"
- "Overall, this training will help me do my job better"
- "Overall, I am satisfied with Northrop Grumman as a place to work"

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Good practices…

- Frame all questions as positive statements even if you are looking for problems
- Use the same scale on all questions
- Choose the number of cells on the scale, that is, five or seven, so that you will get at least five responses in each cell
- More cells are better, subject to the constraint of five in a cell

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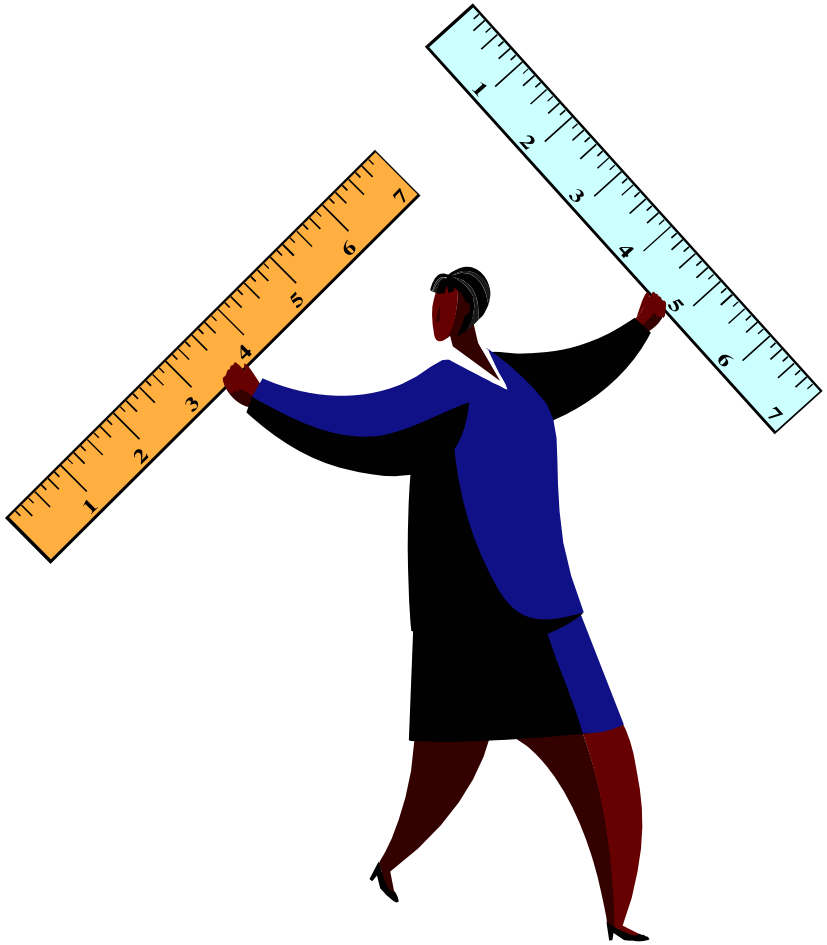
Several types of Likert scales exist…



Likert scales exist for…

- Quality
- Importance
- Agreement
- Frequency
- Likelihood

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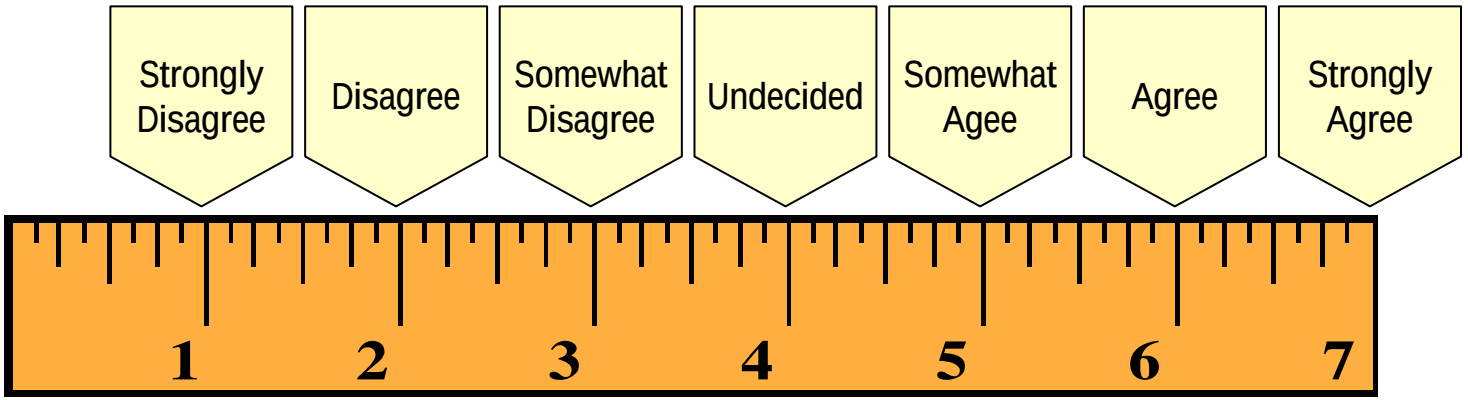
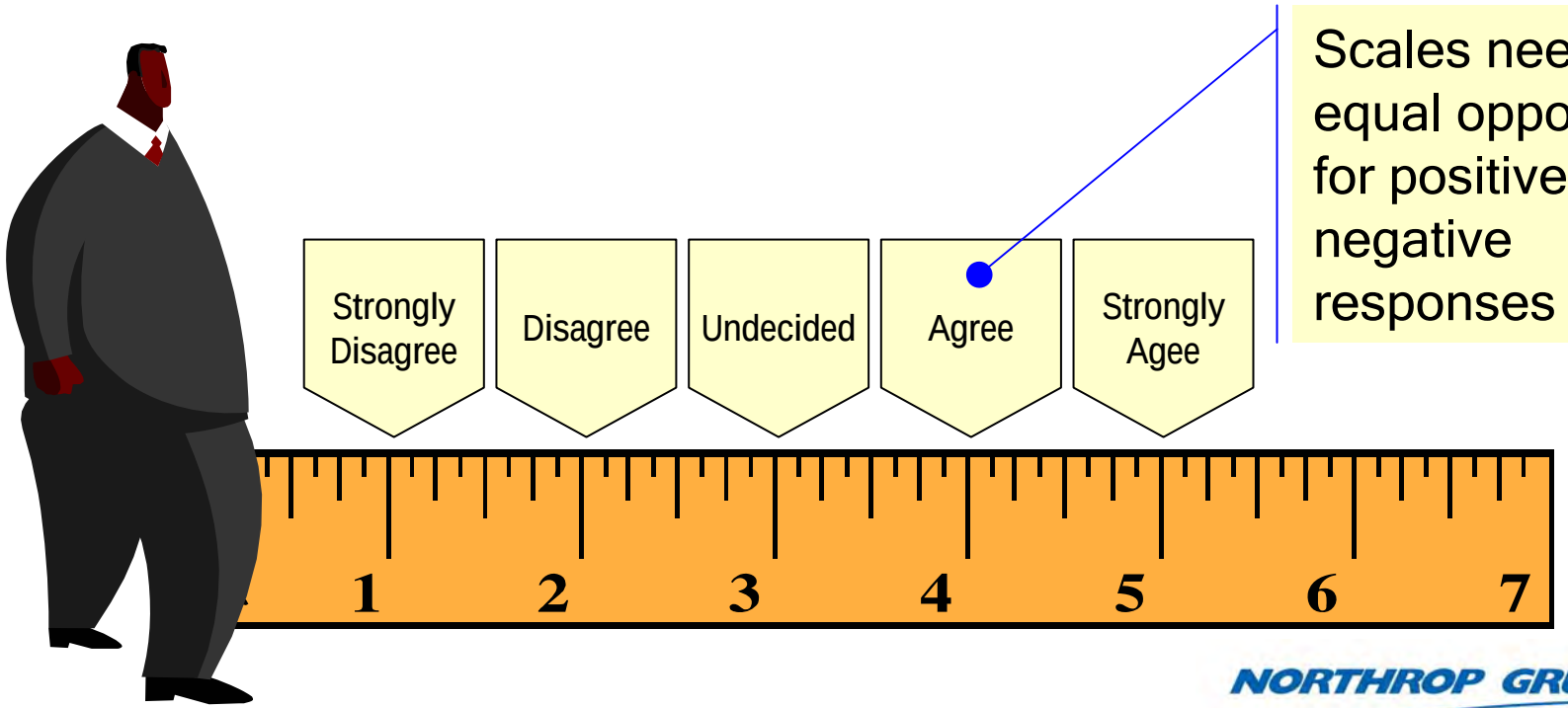
Scales for agreement…





Scales need equal opportunity for positive and negative responses

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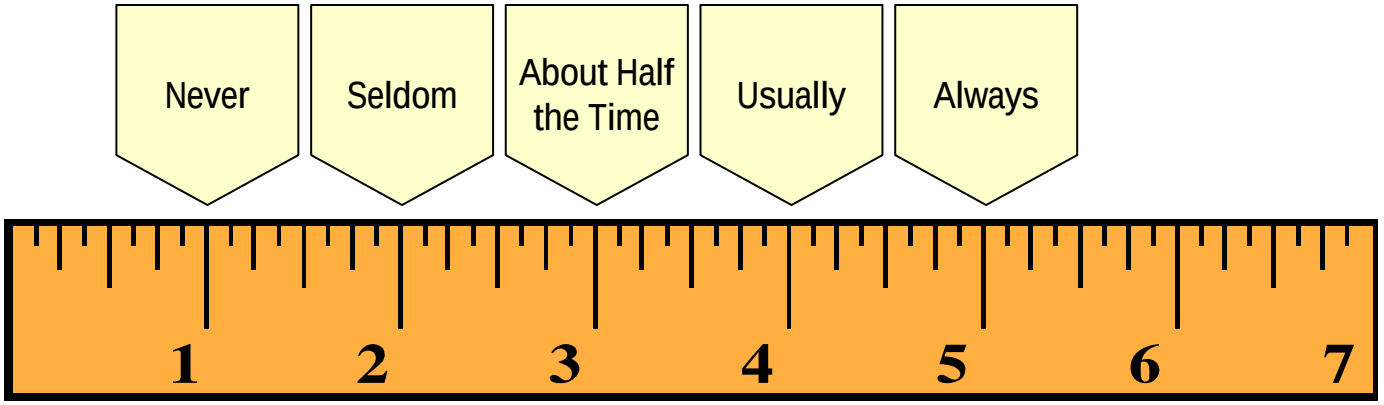
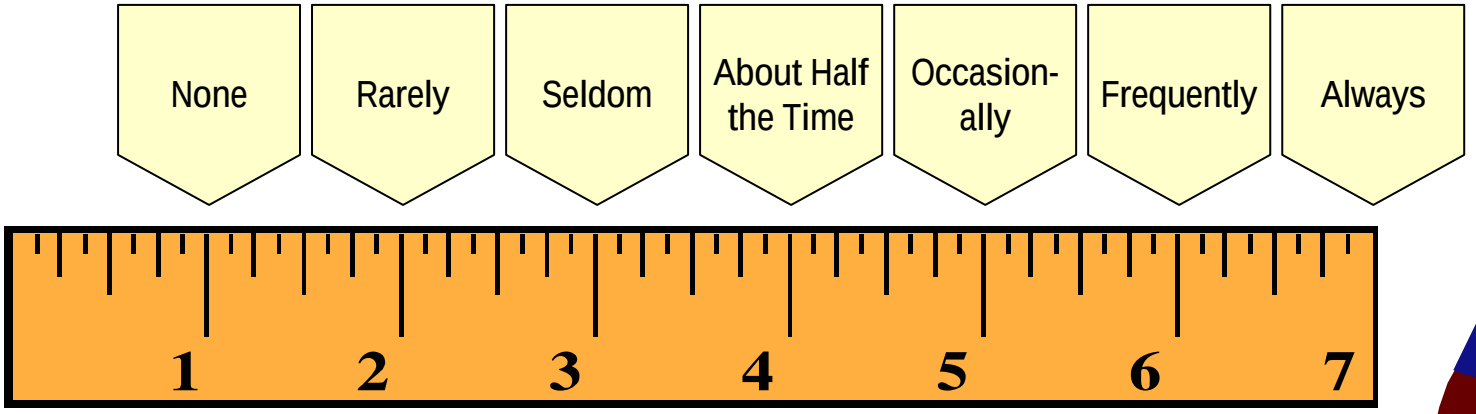
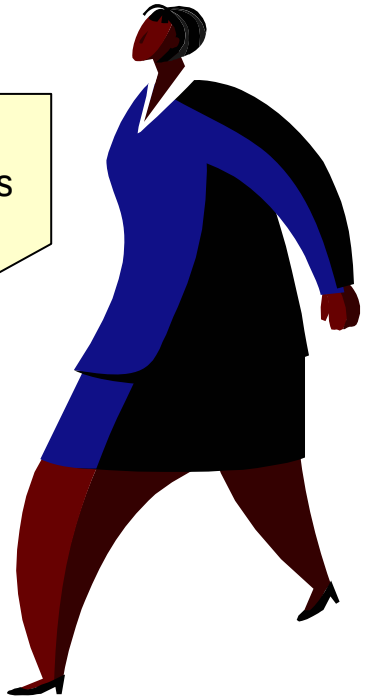
Examples of scales for frequency…







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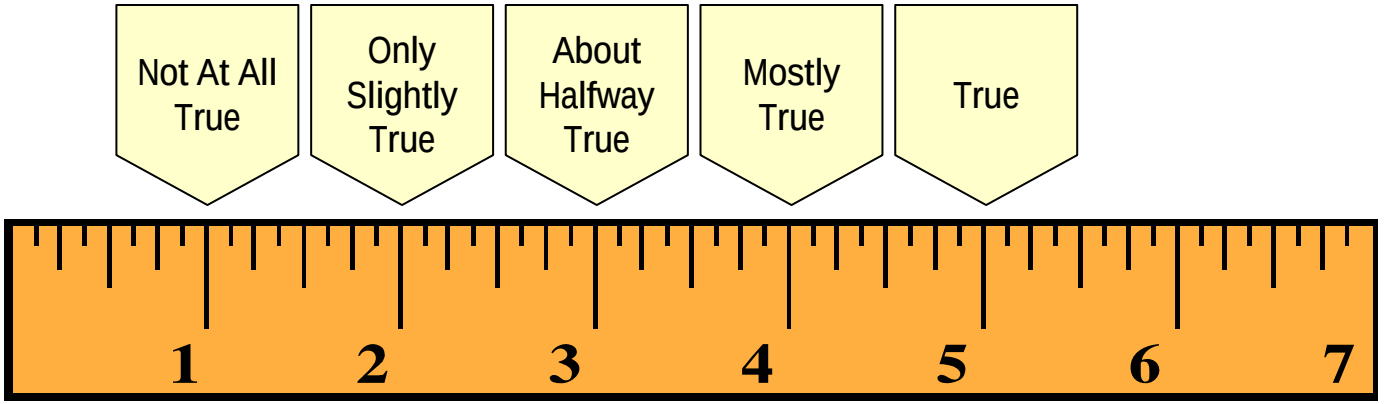
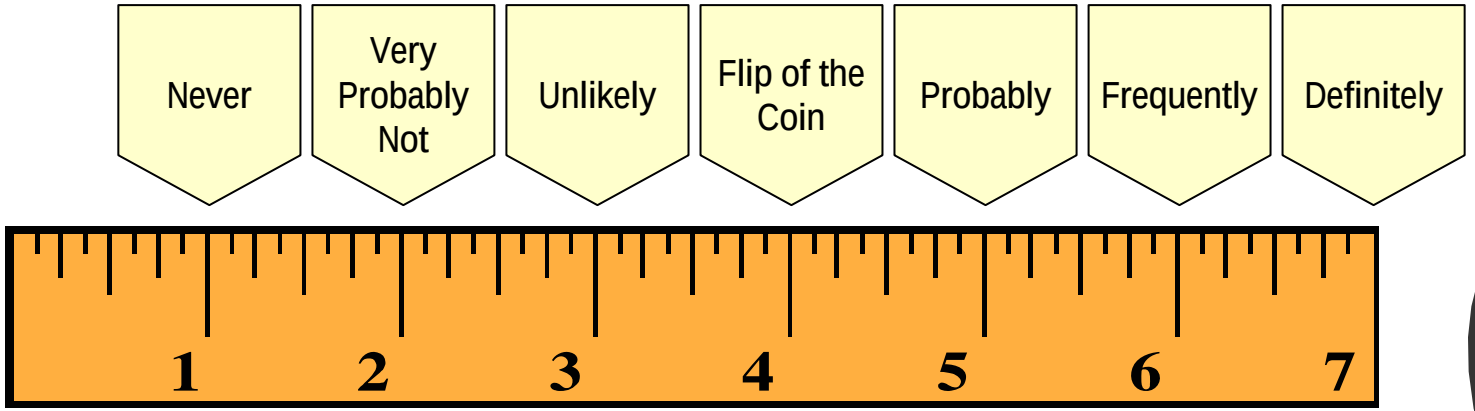
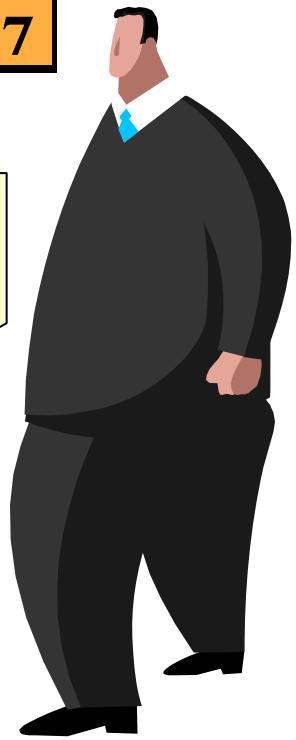
Examples of scales for likelihood…







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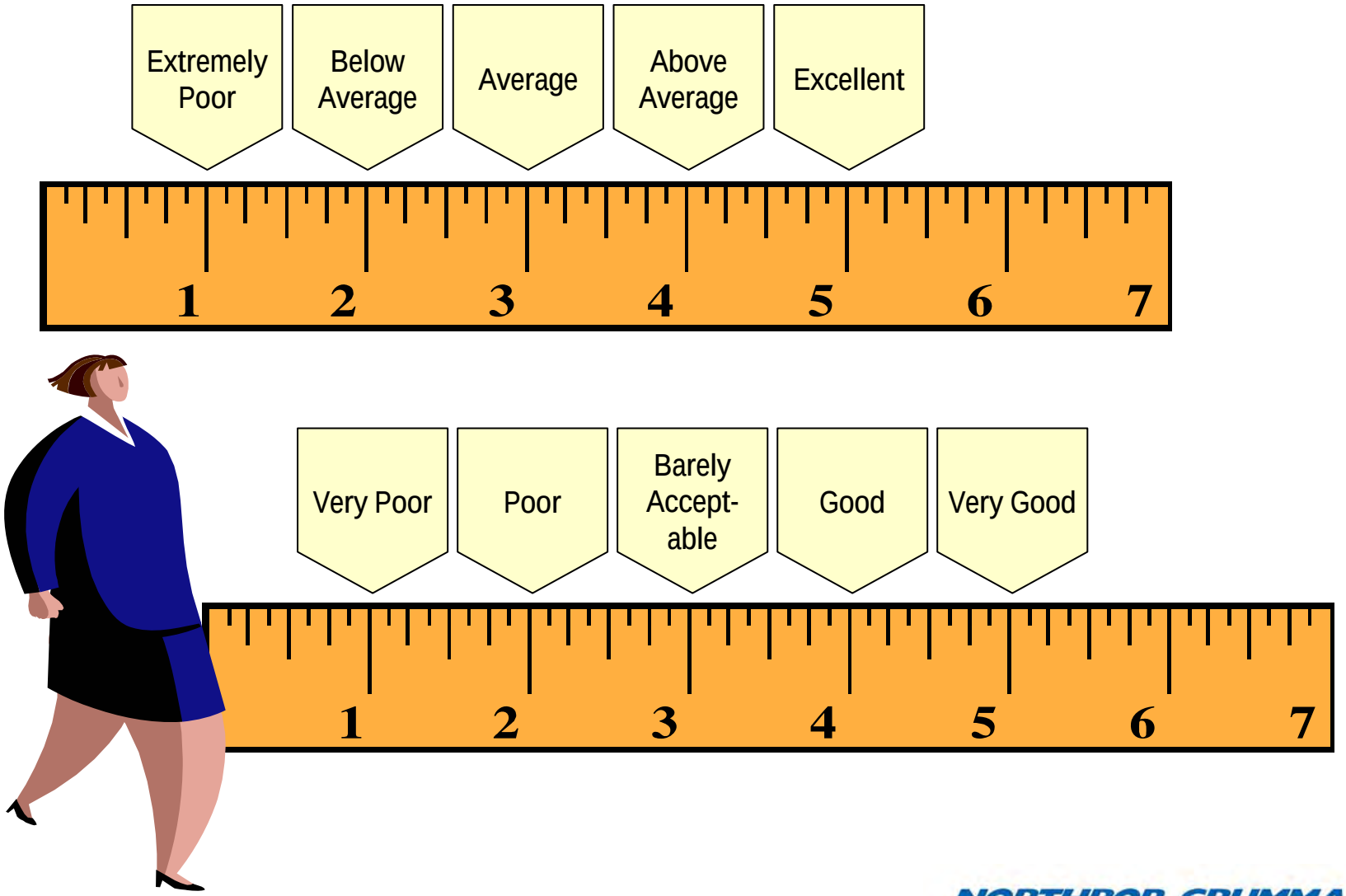
Example of scales for quality…



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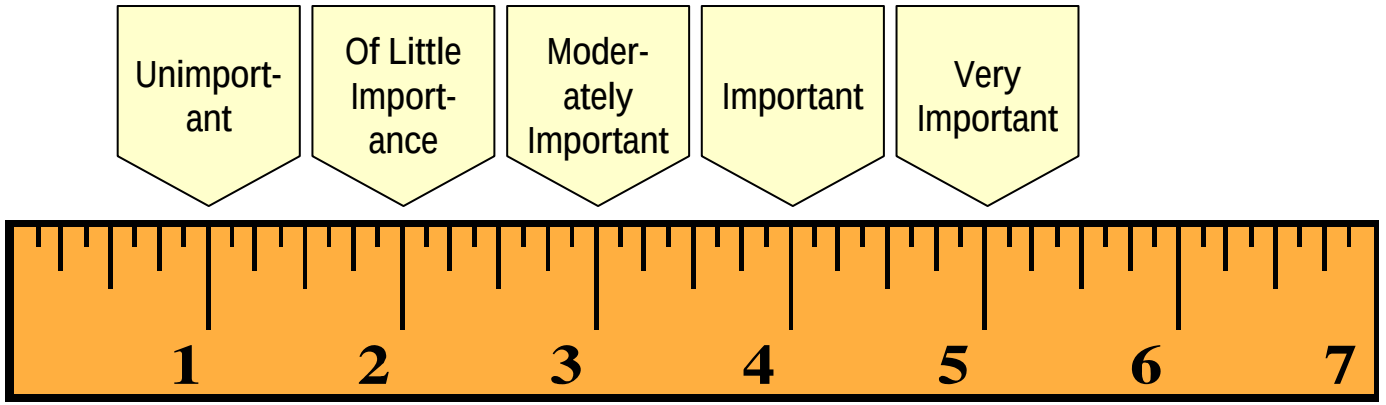
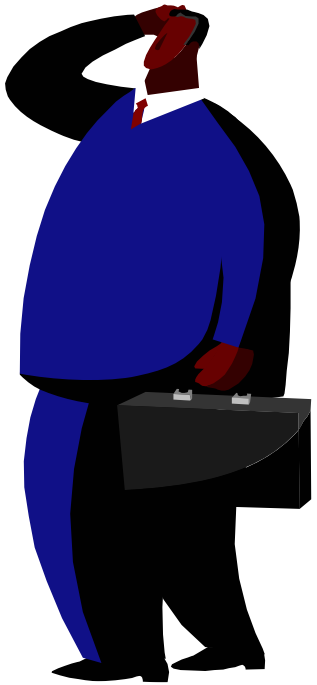
Example for importance…





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Sample survey…

Customer Satisfaction Survey Exit this survey >>

1. Northrop Grumman provides systems that are easy to use.

	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
Agreement:	○	○	○	○	○

2. All in all, I am satisfied with the products and services that I receive from Northrop Grumman.

	Strongly Disagree	Disagree	Undecided	ee	Strongly Agree
Agreement:	○	○	○		○

3. Northrop Grumman makes commitments that meet my ne

	Never	Seldom	About Half the Time	Usually
Frequency:	○	○	○	○

4. When my system goes down, Northrop Grumman restores it quic

	Never	Seldom	About Half the Time	Usually
Frequency:	○	○	○	○

5. Northrop Grumman provides systems with the functionality need.

	Never	Seldom	About Half the Time	Us
Frequency:	○	○	○	

6. Northrop Grumman delivers on their commitments.

	Never	Seldom	About Half the Time	Usually	Always
Frequency:	○	○	○	○	○

7. Northrop Grumman provides us with systems that work as they should.

	Never	Seldom	About Half the Time	Usually	Always
Frequency:	○	○	○	○	○

8. Northrop Grumman provides us good value with their systems and rvices.

	Not At All True	Only Slightly True	About Halfway True	Mostly True	True
ikelihood:	○	○	○	○	○

Northrop Grumman treats me like they want my business.

	Never	Seldom	About Half the Time	Usually	Always
quency:	○	○	○	○	○

When I need help, Northrop Grumman responds quickly.

	Not At All True	Only Slightly True	About Half True	Mostly True	True
ood:	○	○	○	○	○

Done >>

* Survey created on SurveyMonkey.COM

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Sample Results…

Surveyee	Q1	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q2
1	1	4	3	1	4	4	5	5	3	5
2	5	4	1	2	2	1	4	4	2	4
3	3	3	3	3	1	5	4	3	4	3
4	5	4	5	1	1	1	2	4	2	4
5	1	4	1	2	4	1	4	4	2	4
6	4	5	3	5	4	3	3			5
7	3	5	3	3	4	5	2			5
8	2	4	3	2	3	4	3			4
9	3	5	3	1	1	4	1			5
10	3	4	3	3	2	4	4			4
11	5	5	2	2	5	5	3			4
12	1	4	1	3	5	5	2			4
13	3	5	2	4	5	5	2			5
14	3	4	5	4	3	3	1			4
15	2	5	5	1	3	1	5			5
16	1	4	1	4	5	5	4			4
17	5	5	3	4	3	2	1			5
18	2	4	1	5	5	5	4			4
						1	1			4
						1	4	4	1	5
						3	4	4	4	4
						5	4	3	2	3
						2	1	3	3	4
						5	5	5	3	5
						2	5	2	2	2

These are dummy data for purposes of illustration

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Analyze with ordinal logistic regression…

Response Information

Variable	Value	Count
Q2	2	1
	3	2
	4	13
	5	9
	Total	25

Logistic Regression Table

Predictor	Coef	SE Coef	Z	P
Const(1)	25.2405	14.2487	1.77	0.076
Const(2)	31.5295	16.0354	1.97	0.049
Const(3)	41.4778	20.1191	2.06	0.039
Q3	-8.36040	3.95140	-2.12	0.034
Q4	-0.841817	0.847503	-0.99	0.321
Q5	0.296463	0.775667	0.38	0.702
Q6	0.127389	0.742109	0.17	0.864
Q7	0.401630	0.750945	0.53	0.593
Q8	-1.35140	1.35373	-1.00	0.318

* Regression is performed with Minitab® Release 14.2

- Conventional least squares regression doesn't work on this kind of data
- Question #2 is set as the response variable, i.e., the y-variable
- All others are set as predictor variables, i.e., the x-variables
- Question #3 shows a significant relationship as its p-value is less than .05; all others are "noise."

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Throwing out all the “noise” leaves a prediction equation based on Q3…

Response Information

Variable	Value	Count
Q2	2	1
	3	2
	4	13
	5	9
	Total	25

Logistic Regression Table

Predictor	Coef	SE Coef	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Const(1)	13.5565	4.46888	3.03	0.002			
Const(2)	18.6461	5.32721	3.50	0.000			
Const(3)	25.4195	6.58253	3.86	0.000			
Q3	-5.60258	1.45034	-3.86	0.000	0.00	0.00	0.06

Log-Likelihood = -7.642

Test that all slopes are zero: G = 36.648, DF = 1, P-Value = 0.000

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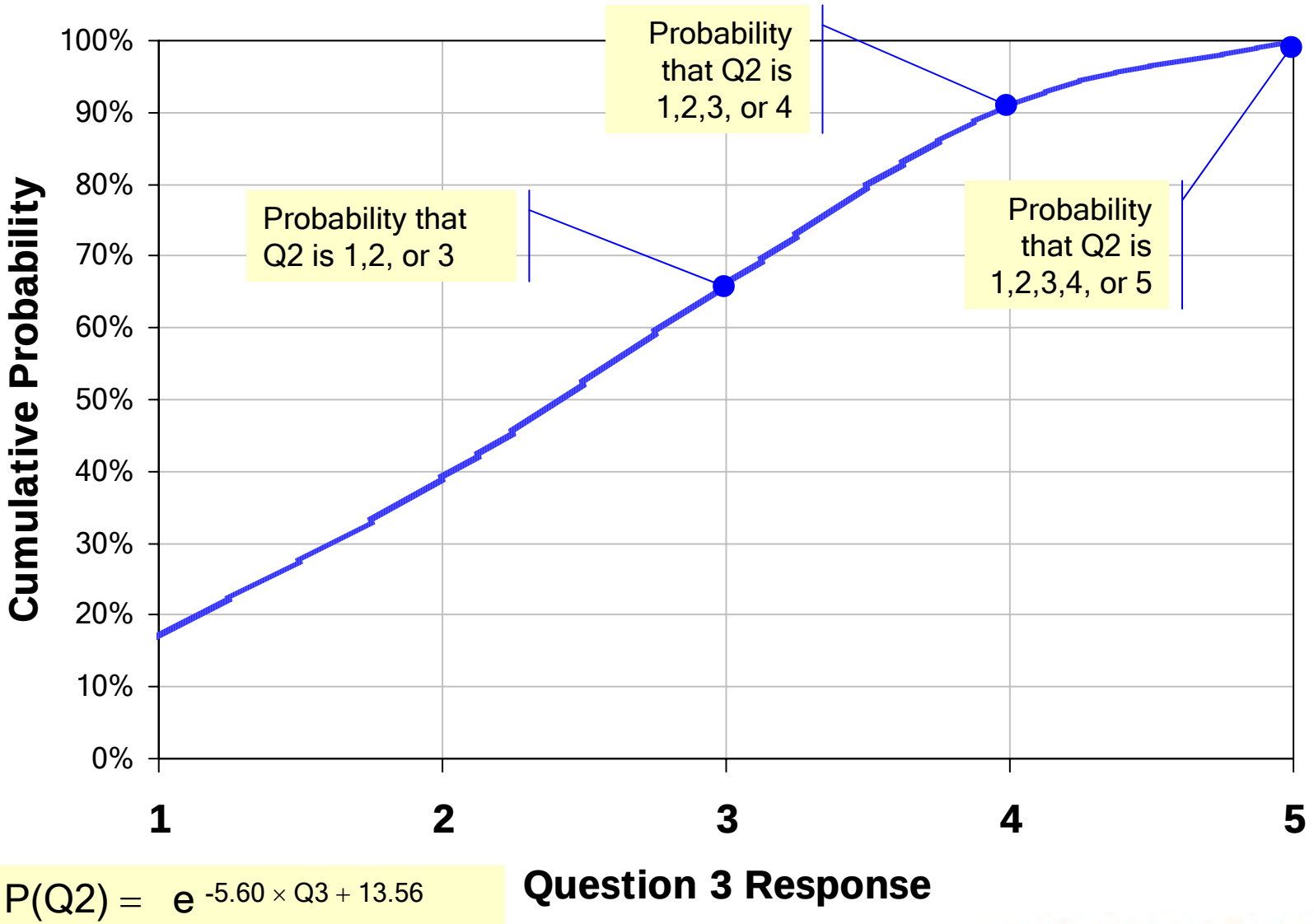
Q3 proves to be a good predictor of the response to Q2…



$$P(Q2) = \frac{e^{-5.60 \times Q3 + 13.56}}{1 + e^{-5.60 \times Q3 + 13.56}}$$

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Choose improvements with a Pugh concept selection matrix...

Concept Selection	
Better	1.0
Same	0.0
Worse	-1.0

Direction of Improvement	
Maximize	1.0
Target	0.0
Minimize	-1.0

		Direction of Improvement	Importance	Status Quo	Proposal #1	Proposal #2	Proposal #3	Proposal #4
		1	2	1	2	3	4	5
Addresses Commitment Fidelity	1	↑	9	☆	+	☆	+	☆
People to Implement	2	↓	3	☆	-	-	☆	+
Difficultly to Implement	3	↓	3	☆	-	-	-	-
Cost to Implement	4	↓	3	☆	-	-	-	-
Weighted Score	1			0.0	0.0	-9.0	3.0	-3.0
Sum of Sames	2			18	0	9	3	9
Sum of +'s	3			0	9	0	9	3
Sum of -'s	4			0	9	9	6	6
Sum of Correlation Values	5			0	-2	-3	-1	-1
				1	2	3	4	5

Best choice

* Pugh Matrix is produced with QFD/Capture Professional Edition

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Summary…

- Since Customers are the only ones that define quality, it's useful to get their "Voice" in selecting improvement projects
- Statistic methods like logistic regression can be used to infer Customer's importance from survey responses
- Combine VoC with other factors in a Pugh matrix to aide selections

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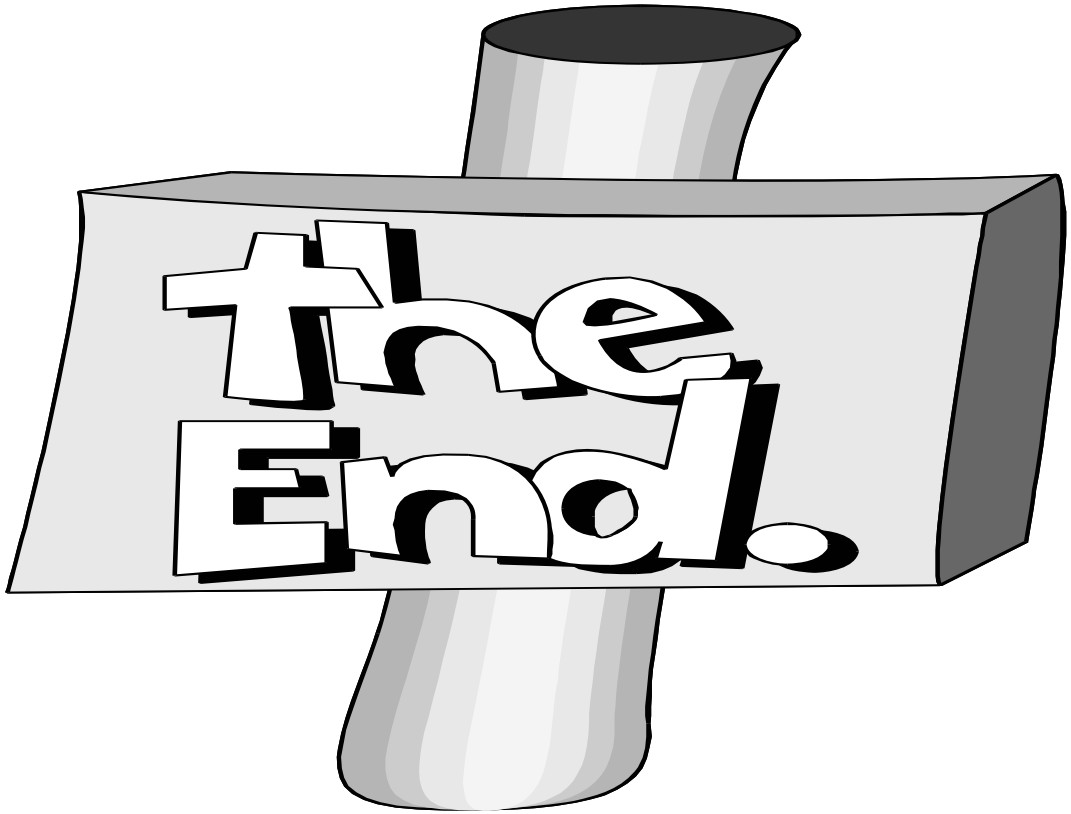

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Using Business Process Management Technology to Implement a CMMI-compliant Agile Software Development Approach

Bob Moore, Business Transformation Institute, Inc.

Introduction

- This presentation will show how Business Process Management (BPM) technology may be used to create process support tools that let Scrum developers be agile while still being CMMI-compliant.
  - Scrum is a popular agile software development method developed by Ken Schwaber and Jeff Sutherland in the early 1990s.

What is BPM?

- BPM tools are next-generation software development tools oriented to process implementation.
- The BPM community has blossomed in the past five years:
  - There are more than 50 leading tools.
  - Gartner Group predicts the BPM tool license market alone (not including implementation services) will exceed $3B in 2006 .
- BPM provides a rapid, low-cost means to develop process support tools that are designed to meet each organization's specific processes.

BPM Capabilities

- BPM is more than work-flow automation, though work-flow and BPM tools have much in common.
- The typical capabilities of BPM tools are to:
  - Model a process, typically in a graphical format,
  - Integrate a variety of processes, external applications, and databases with the defined process,
  - Manage step-by-step process execution across multiple personnel roles,
  - Create exception handling and alternative processes,
  - Monitor the health and fulfillment cycle of the process,
  - Simulate the execution of the defined process based on either empirical results or user-provided parameters,
  - Assign roles to personnel either by user direction within the process or based on current workload queues, and
  - Collect metrics on process execution.

BPM Tool Specifics

- This presentation is based on the use of Metastorm Inc.'s "Metatstorm BPM" tool (formerly e-Work) because:
  - It is prominent in Gartner's survey of BPM tools on a continuing year-to-year basis,
  - It has an appreciable share of the BPM license market, and
  - The author's familiarity with the use of the tool. (Most important!)

What are Agile Software Development Methods?

"The Manifesto for Agile Software Development" summarizes agile methods as those that value:

"Individuals and interactions	over	**processes and tools**
Working software	over	**comprehensive documentation**
Customer collaboration	over	**contract negotiation**
Responding to change	over	**following a plan**

That is, while there is value in the items on the right, we value the items on the left more."

Some Scrum Vocabulary

- The project leader is called a Scrum Master—abbreviated here as SM.
- The list of requirements to be implemented is called a product backlog.
- One cycle in the project life cycle is a sprint. Sprints last for 30 days.
- The list of requirements to be worked in a particular sprint is a sprint backlog.
- A daily status meeting is a daily scrum.
- That accomplishments of the sprint are reviewed and demonstrated to the customer at the end of each sprint.

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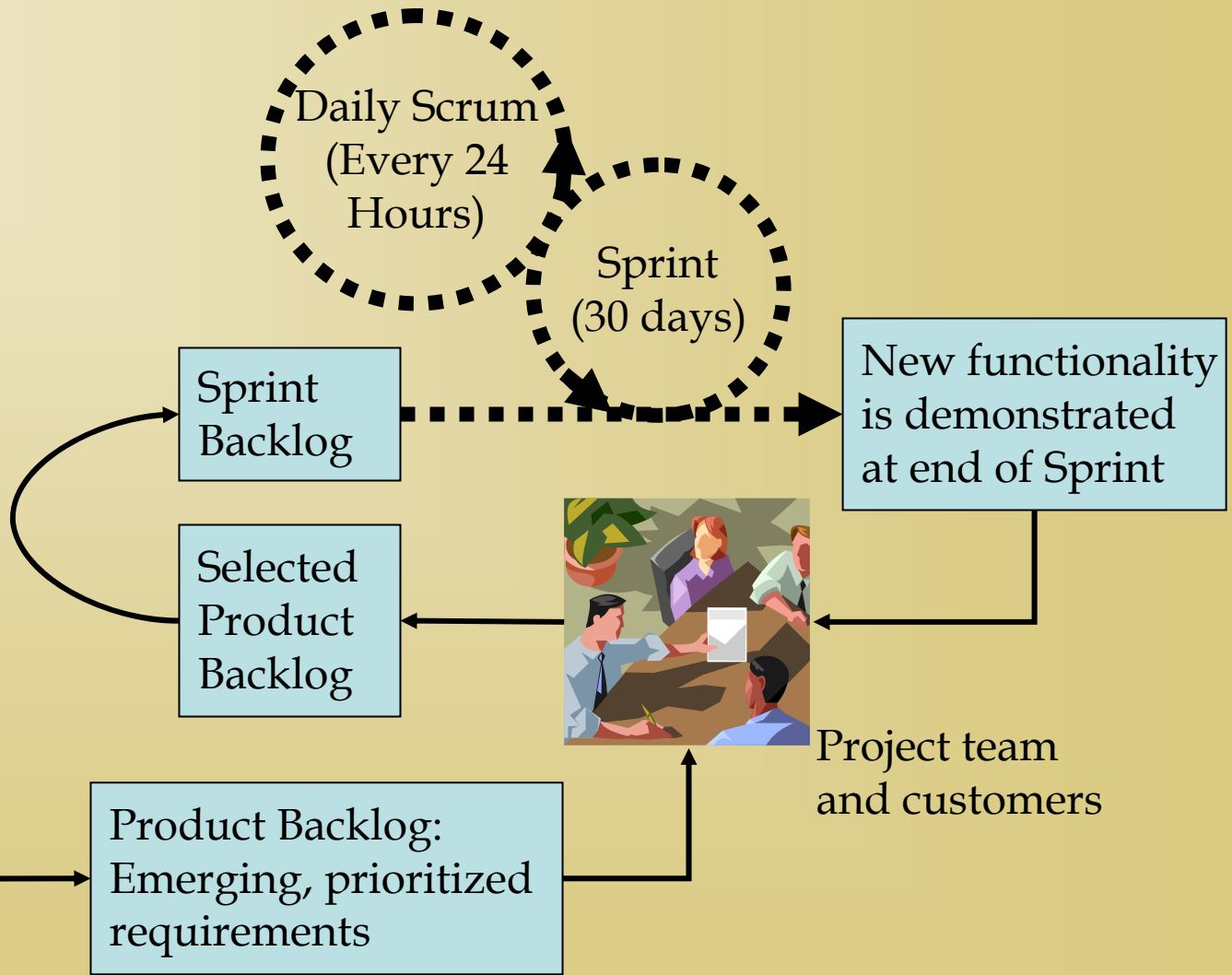
What is Scrum?

According to Ken Schwaber's Agile Project Management with Scrum, Scrum operates as follows:



The Agile Development vs. CMMI Challenge

- Agile software developers often believe that CMMI compliance and the benefits of an agile approach are incompatible.
- Likewise, many CMMI practitioners view the typical agile implementation as a "do what you want to do" rather than a disciplined environment.
- These perceptions are false, yet they persist.

Why Do Agile Developers Feel Agile is Incompatible with CMMI?

- Many agile "gurus" characterize CMMI implementations as documentation-heavy and more interested in process adherence than satisfying customer needs.
- Agile thinking is often somewhat counter-cultural and CMMI is viewed as a creation of the military-industrial establishment.

Why Do CMMI Implementers View Agile Methods Like Scrum as Undisciplined?

- Scrum is an empirical process control method. This tends to emphasize:
  - Short planning cycles—hence fewer formally documented planning artifacts that are used over long periods.
  - Personal interaction among the development team—hence fewer formally documented project monitoring and control artifacts.
  - Personal interaction between the team and the customer—hence fewer formally documented requirements management artifacts.
  - Adjusting the process implementation to suit the situation as it is actually being experienced—hence PPQA process compliance audits are less clear.

Fundamental Premises

1. CMMI and Scrum are compatible.
   - This statement is offered without direct proof.
   - However, compatibility will be demonstrated using examples from a BPM implementation of Scrum processes with mapping to CMMI artifact requirements.
2. Being able to achieve Maturity Level 2 or better is sufficient evidence of a process's compliance with CMMI.
   - Note: Scrum contains a subset of the ML 2 specific and generic goals:
     - Scrum addresses many practices associated with PP, PMC, and REQM.
     - The implementing project or organization must still address CM, PPQA, and SAM in addition to Scrum implementation.
     - Some aspects of MA are covered by implementation of the Scrum processes through the BPM tool.

How Does the BPM Implementation of Scrum Support CMMI?

- BPM supports Scrum in a CMMI context in two ways:
  - By supporting the natural implementation of Scrum in a manner that does not differ from the way developers expect Scrum to be implemented:
    - The BPM tool provides sprint planning and management tools.
  - By accumulating direct and indirect artifacts needed for a successful CMMI appraisal:
    - Capturing planning, project monitoring, requirements management, and stakeholder interaction artifacts without interfering in the Scrum implementation,
    - Capturing key metrics associated with the processes, and
    - Providing process audit trails that support CMMI appraisals and PPQA audits.

How We Will Proceed

- The BPM environment can support process implementation much more comprehensively than described here.
  - However, in this case the BPM environment was used to implement a Scrum process, so support is limited to what Scrum itself does.
  - For more information on general BPM support of CMMI implementation, see http://www.biztransform.net/
- We won't cover every aspect of every process, but provide the highlights to guide the way to how CMMI and Scrum are mutually reinforced through the BPM tool support.

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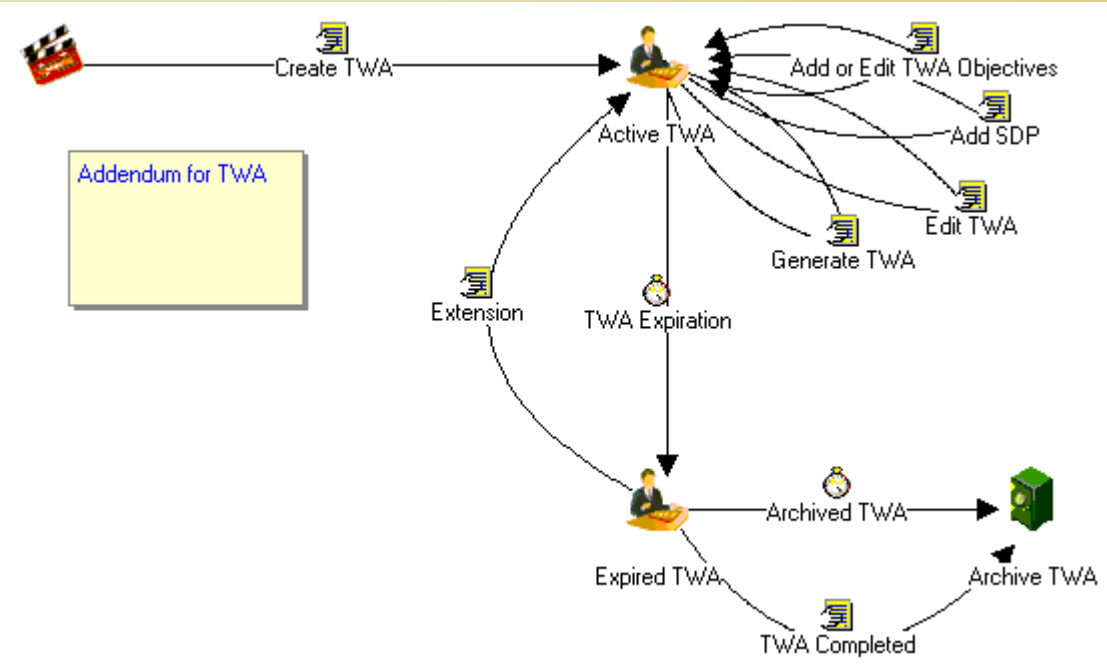
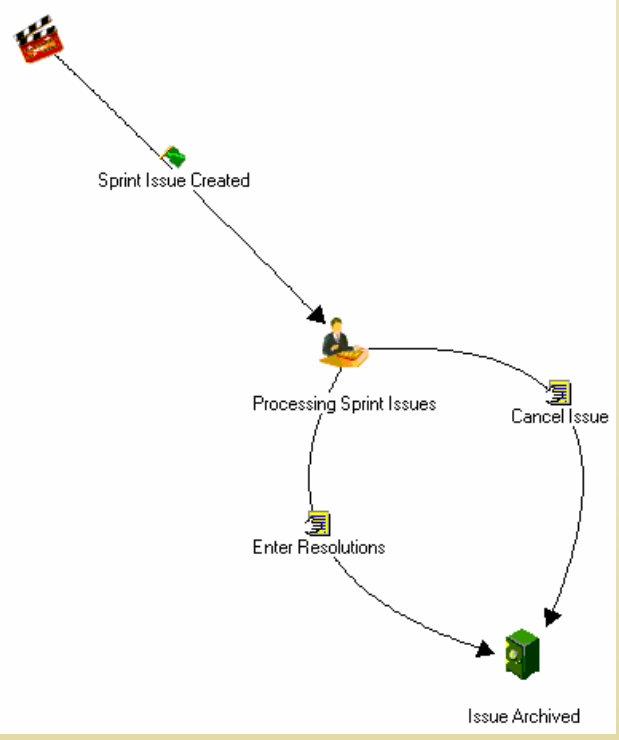
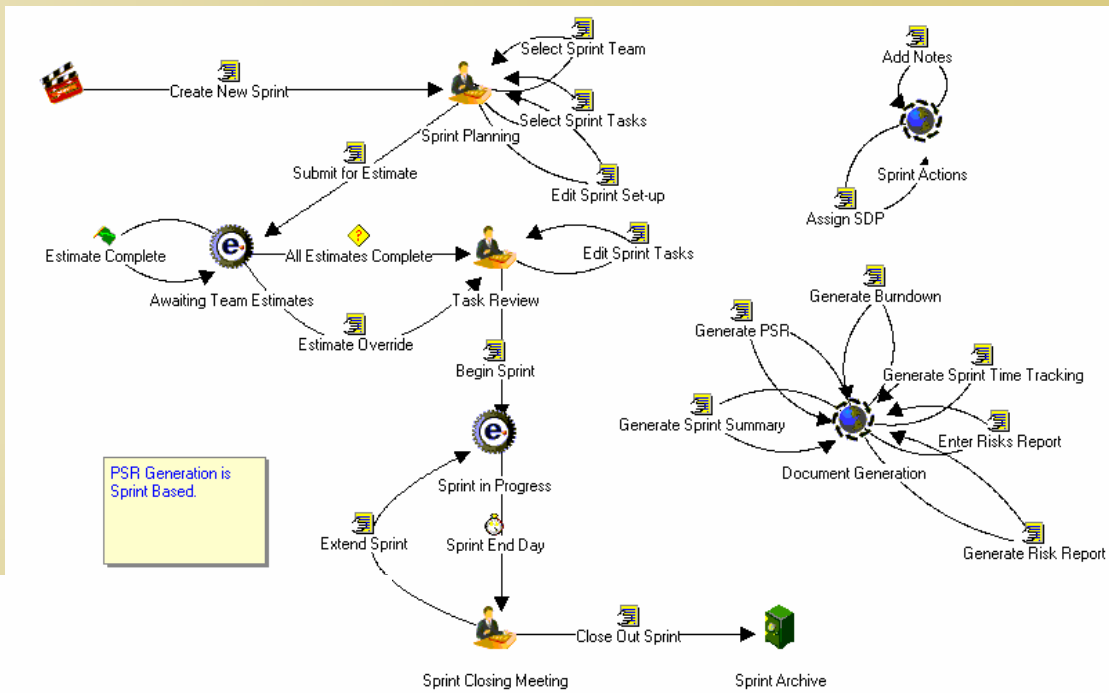
Tactical Working Agreement Process Map

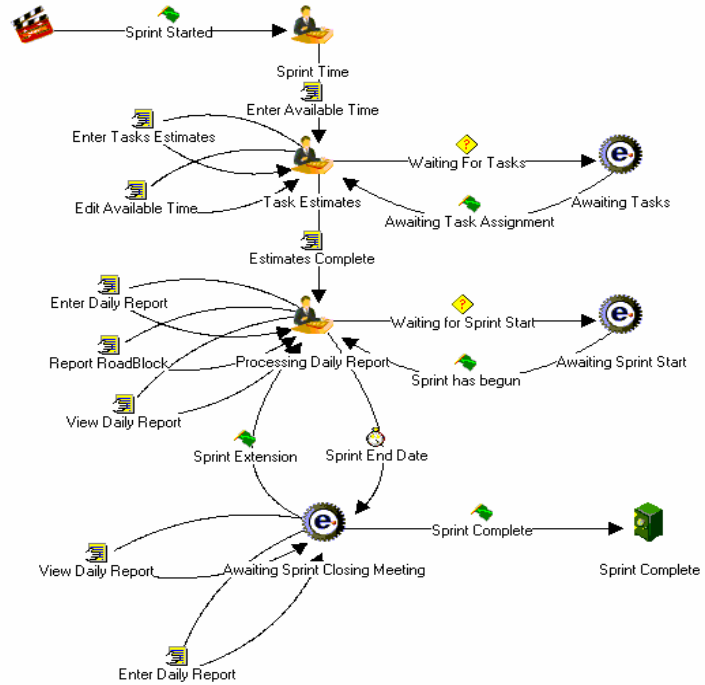
- This is a high-level agreement with the customer that covers the general work objectives.
  - Not standard Scrum terminology.



Sprint Planning and Execution Process Maps







Specific Practices
General Discussion

- At the simplest level of implementation, a BPM tool provides a static electronic checklist that requires the user to record the actions that he or she is executing while following the process.
  - The checklist, like any quality checklist, is built to reflect the steps and roles involved in the process.
  - As the checklist is completed inside the BPM environment, the tool records an indelible audit trail of who completed each checklist step and when the step was completed.
    - This audit trail can be used to monitor implementation of the process.
    - The audit trail is also an indirect artifact that can be used in a CMMI appraisal.

Specific Practices
General Discussion (continued)

- In a more sophisticated implementation, the BPM Scrum tool provides an executable process checklist for PP, PMC, and REQM practices.
  - The tool begins by allowing selected users to commence a process.
    - For example, start prioritizing the product backlog with the customer (REQM).
  - As the process begins, the user is presented with potential next steps that can be taken in the process
    - For example, determine customer sub-objectives for the next sprint given the customer's stated objectives (needs and wants) (REQM).

Specific Practices
General Discussion (continued)

- At each step along the way, the tool informs each user involved in the process about the list of process steps that the user must execute due to a triggering activity.
  - For example, in response to the team members completing their estimates of how much time a sub-objective task will take (PP), the tool presents the SM with the team's estimates and prompting the SM to finalize the sprint plan (PP).
- The BPM tool also records an audit trail of activities completed, completion dates and times, and personnel involved. It also prepares end-of-sprint reports used by management to understand progress and status (PMC).

Specific Practices
General Discussion (continued)

- From the CMMI appraisal perspective, the tool captures:
  - Direct artifacts: outputs from executing the process (e.g., product backlog discussions and task estimates) with respect to:
    - PP—Specific practices 1.1, 1.2, 1.4, 2.1, 2.2, 2.6, 2.7, 3.2, 3.3
    - PMC—Specific practices 1.1, 1.2, 1.3, 1.5, 2.1, 2.2, 2.3
    - REQM—Specific practices 1.1, 1.2, 1.3
  - Indirect artifacts: the audit trail is an indirect artifact for the SPs listed above.

Measurement and Analysis Specific Practices 2.1-2.4

- The BPM Scrum tool provides the means to collect data on any given task's execution duration.
- This data can be stored and run through a variety of different analyses.
- The raw data, and the analyses, can be automatically exported to other tools or sent directly to a "management dashboard" that displays measurement information.
- From an appraisal perspective, the tool provides:
  - Direct artifacts: collected data and records of data collection, records of analyses, evidence of data and analyses storage, evidence of data reporting to managers
  - Indirect artifact: the tool itself is a resource for MA and can be used as an indirect artifact.

Generic Practice 2.1 (PP, REQM, PMC)

- Although the BPM Scrum tool can help in advertising a policy's existence by reminding users of the policy at crucial process steps, it cannot create a policy.
- As we have implemented it, the Scrum process as represented inside the BPM environment is the *only* way to accomplish the activities associated with certain PP-, PMC-, and REQM-related processes.
  - For example, the only way to get review and approval of a sprint plan is through the sub-objective construction and task estimation process in the BPM tool.

Generic Practice 2.1 (continued)

- Given that a policy's essence is that it expresses the expectations of an organization's leaders, this "locking down" of how work may be performed is an expression of the policy.
  - If management declares that the product backlog prioritization and task estimation processes must be followed, and no other means of accomplishing a desired result is available except through the BPM Scrum tool then adherence to management's policy is more effective than any written policy document could ever be.
- From the appraisal perspective, the tool provides:
  - Direct artifacts: Demonstration using the BPM Scrum tool of the enforcement of the processes as described above in the specific practice discussions for the PP, PMC, and REQM process areas.
  - Affirmations: Testimony that there is no alternative method for accomplishing the intended results of the process.

Generic Practice 2.2 (PP, REQM, PMC)

- Planning a process involves laying out the approach to be taken, in the context of an organization or project, to implement the process.
- The BPM-implemented Scrum process does *not* provide all the plans to be used by the project in implementing all process.
  - The BPM Scrum tool does put into practice the process to be followed in creating particular plans, such as software development and project management plans.

Generic Practice 2.2 (PP, REQM, PMC) [continued]

- From the appraisal perspective, the tool provides:
  - Direct artifacts: The BPM tool itself encapsulates the plan for some PP-, PMC-, and REQM-related processes since it creates and publishes the Working Agreement (contract equivalent), Service Delivery Plan (project plan equivalent and requirements specifications), and the 30 day sprint plan (requirements analysis and task planning).
  - Indirect artifacts: Records of the activities completed, completion dates, and personnel involved in executing the planning processes.

Generic Practice 2.3 (PP, REQM)

- The BPM Scrum tool has a directory of personnel in various roles that may perform work in implementing the software project.
- At the start of each overall project and sprint planning cycle, the BPM Scrum tool provides this directory to the SM as a list of names to be assigned to working on the customer's sub-objectives (requirements), working agreement creation, and service delivery plan creation.
- The tool causes each personnel resource to estimate their availability on a weekly basis throughout the duration of the next sprint.

Generic Practice 2.3 (PP, REQM) [continued]

- From the appraisal perspective, the tool provides:
  - Direct artifacts:
    - The BPM Scrum tool is a resource in supporting the planning process, so the existence of the process as implemented in the BPM tool is itself an artifact for GP 2.3 in PP and REQM.
    - The records of personnel availability and subsequent assignment to work based on task estimates are also direct artifacts.
  - Indirect artifacts: the audit trail records showing the assigned personnel working on the requirements, project planning, and project implementation processes.

Generic Practice 2.4 (PP, PMC, REQM)

- The BPM Scrum tool helps a SM assign responsibility in two ways:
  - Each Scrum process has a set of roles associated with each process step. This set of roles provides the basis for assigning responsibility.
  - The tool provides the SM with an inventory of personnel who are available to work on a process, to whom the SM can then assign responsibilities.
    - As SM associates personnel with the process, the tool documents this assignment and informs the personnel thus assigned about their responsibilities as the process is executed.

Generic Practice 2.4 (PP, PMC, REQM) [continued]

- From an appraisal perspective, the tool provides:
  - Direct artifacts: records of assignment of personnel to roles and the association of roles with Scrum activities.
  - Indirect artifacts: The record of personnel fulfilling their assigned responsibilities as captured by the BPM Scrum tool's audit trail.

Generic Practice 2.5 (all supported Process Areas)

- The BPM Scrum tool provides context-sensitive help for users engaged in any given process step.
- The tool also guides the user through implementing the process by limiting their choices with respect to the next possible steps.
- From an appraisal perspective, the tool:
  - Direct artifacts: records of the user referencing the context-sensitive help (a weak direct)
  - Indirect artifacts: none

Generic Practice 2.6 (PP, PMC, REQM)

- A BPM Scrum tool does not *directly* manage the configuration of items produced by the process.
- However, the tool can forward designated products resulting from process execution to the configuration management (CM) system.
  - For example, when a sprint plan is being circulated during construction and approval, the BPM tool can capture the plan at various stages and provide it to the CM system for version control or baselining.
- The BPM Scrum tool is part of the CM system since the products to be controlled through this mechanism may be selected from the PP-, PMC-, and REQM-related PA's designated configuration (or control) items (CIs) and the stages at which the CIs are to be captured is programmed into the BPM Scrum tool.

Generic Practice 2.6 (PP, PMC, REQM) [continued]

- From an appraisal perspective, the tool provides:
  - Direct artifacts: a demonstration of the BPM tool's ability to capture CIs at different stages in support of the CM system is a direct artifact.
  - Indirect artifacts: none

Generic Practice 2.7 (PP, PMC, REQM)

- By its nature, a BPM-implemented process requires the identification and involvement of stakeholders who are relevant to each process step.
  - As any given process (e.g., processes related to PP, PMC, REQM) is programmed in the BPM environment, the roles associated with each process step must be designated.
  - Either before or during process execution, these roles are associated with specific personnel.
  - These personnel are the CMMI's "relevant stakeholders".
  - As the process executes in the BPM Scrum environment, these personnel are involved in whichever step(s) of the process is assigned to them.

Generic Practice 2.7 (PP, PMC, REQM) [continued]

- From an appraisal perspective, the tool provides:
  - Direct artifacts:
    - The creation of process roles and the assignment of personnel to these roles are jointly demonstrate "identifying stakeholders". T
    - The BPM Scrum tool audit trail demonstrates "involving relevant stakeholders" requirement by recording the involvement of the designated personnel in the processes.
  - Indirect artifacts: none.

Generic Practice 2.8 (PP, PMC, REQM, technical activities)

- The BPM Scrum tool assists the SM in monitoring and controlling a process in two ways:
  - The SM can monitor project participants recording of their daily Scrum meeting minutes, recording of time spent on tasks, and completion of assigned sprint tasks in real time through his or her process "watch list".
  - The BPM Scrum environment can also feed data into a "management dashboard" that provides metrics on the sprint's status with respect to tasks completed, amount of time spent on tasks, etc.
- From an appraisal perspective, the tool provides
  - Direct artifact: the tools ability to provide information, along with proof that management is using these functions, jointly provide a direct artifact.
  - Indirect artifact: none.

Generic Practice 2.9 (all supported Process Areas)

- The BPM Scrum tool does not itself directly provide objective insight into the adherence of PP-, PMC-, or REQM-related processes to their descriptions, standards, etc.
- However, BPM Scrum helps an organization comply with generic practice 2.9 as follows:
  - First, implementation of a process (e.g., sprint reviews, sprint planning, backlog prioritization) in the tool means that the personnel who are executing the process cannot deviate from the process as defined.
  - The inability to circumvent process steps (or the entire process) reduces the need to monitor process execution as closely as is normally required with "paper-based" processes.
  - Additionally, the BPM Scrum tool process audit trail provides a log of the process steps performed, by whom the steps were performed, and when they were performed.

Generic Practice 2.9 (all supported Process Areas) [continued]

- From an appraisal perspective, the tool provides:
  - Direct artifacts: none.
  - Indirect artifacts: the audit trail is an indirect artifact if it is used in assessing process compliance.

Generic Practice 2.10 (all supported Process Areas)

- The BPM Scrum tool supports higher-level management's reviews with respect to a process in a several ways:
  - The higher level manager can have a set of process activities (e.g., sprint planning, task status) on his or her "watch list". This enables the manger to view activity status of the processes at any time.
  - The BPM Scrum tool can also feed data into a "management dashboard" that provides measurement data on sprint planning duration, task duration, requirements approved by the customer.
- From an appraisal perspective, the tool provides:
  - Direct artifacts: a demonstration of the BPM tool's ability to provide information, along with proof that this information is supporting higher level management's reviews, is jointly a direct artifact.
  - Indirect artifacts: none.

Summary

- BPM supports Scrum in conjunction with CMMI by:
  - Helping the Scrum Master and project team members plan and manage sprints.
  - By accumulating direct and indirect artifacts needed for a successful CMMI appraisal without project members realizing the CMMI is going on in the background.
- This presentation covers the basics.
  - For more information about applying BPM in a CMMI context, see http://www.biztransform.net/
  - For more information on Scrum see any of the books published by Ken Schwaber (just ignore what he says about CMM/CMMI processes).

Contact Information

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  - rlmoore@biztransform.net

Message Over the Medium:

Communication Loops in the CMMI

First Things First...

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- Elements of communication

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Elements of Communication

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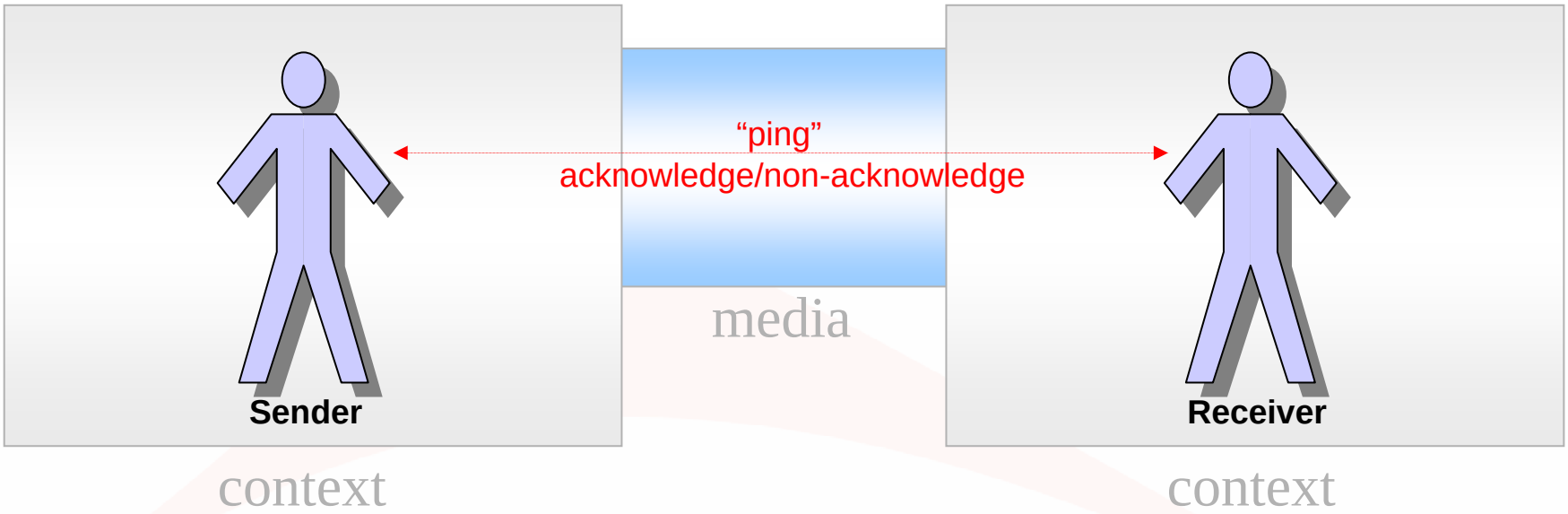

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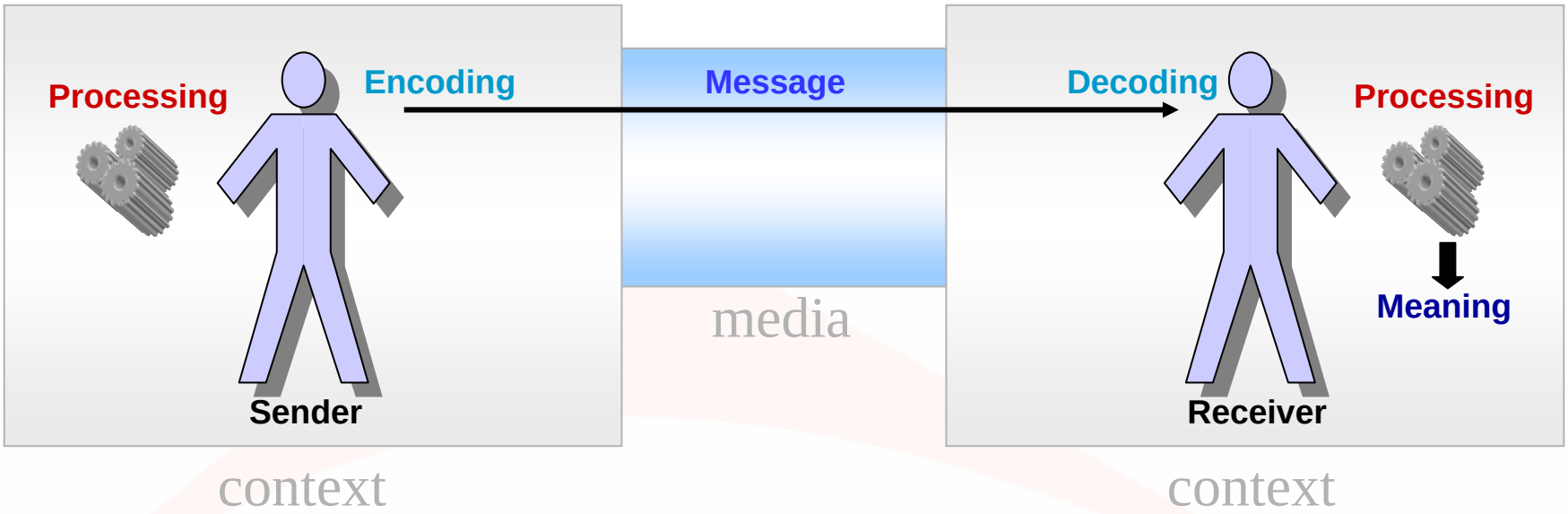

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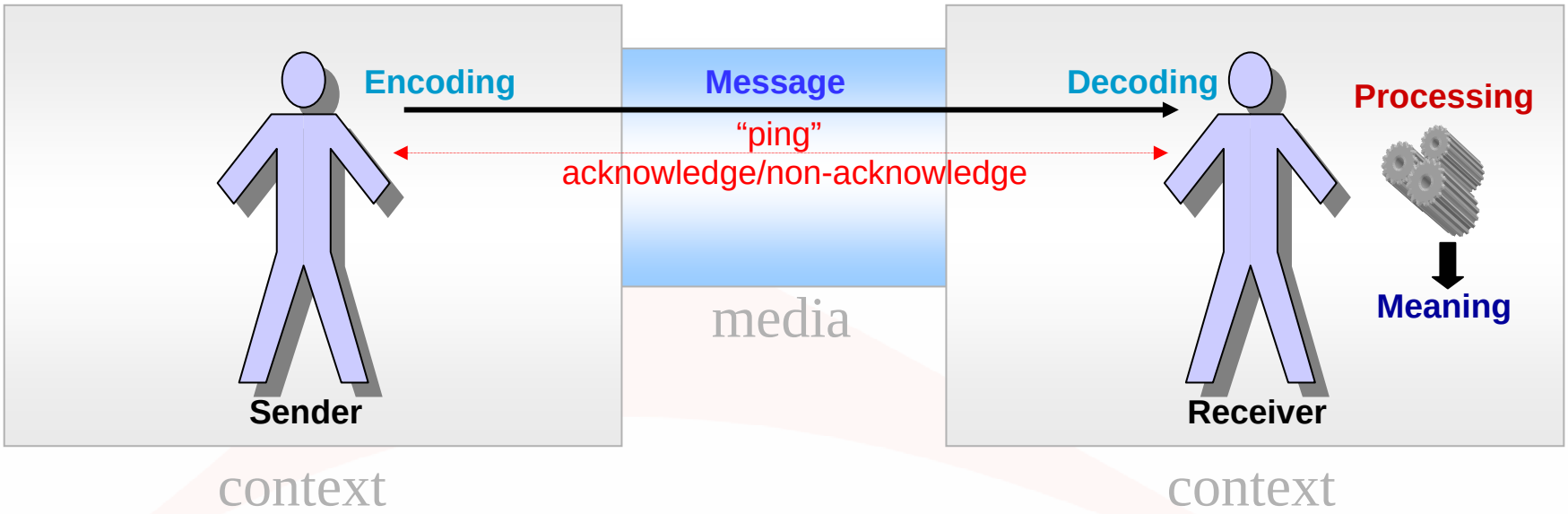

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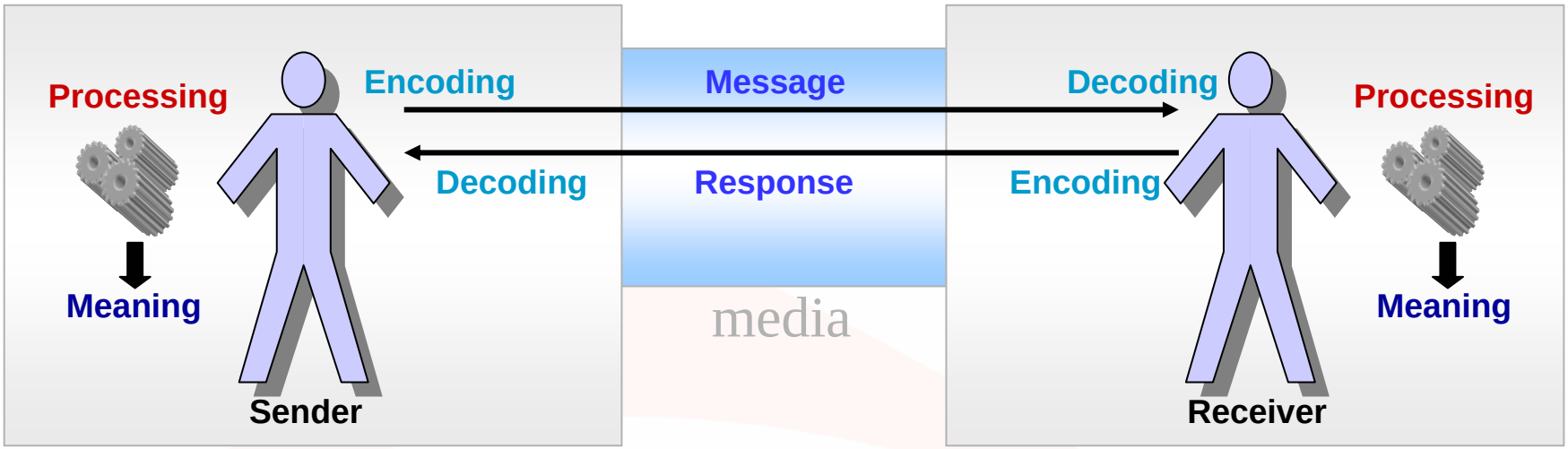

Elements Summary

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- Sender
- Receiver
- “Handshaking”
- Medium
- Message
- Contexts
- Meaning

Potential Issue – Noise via Overload

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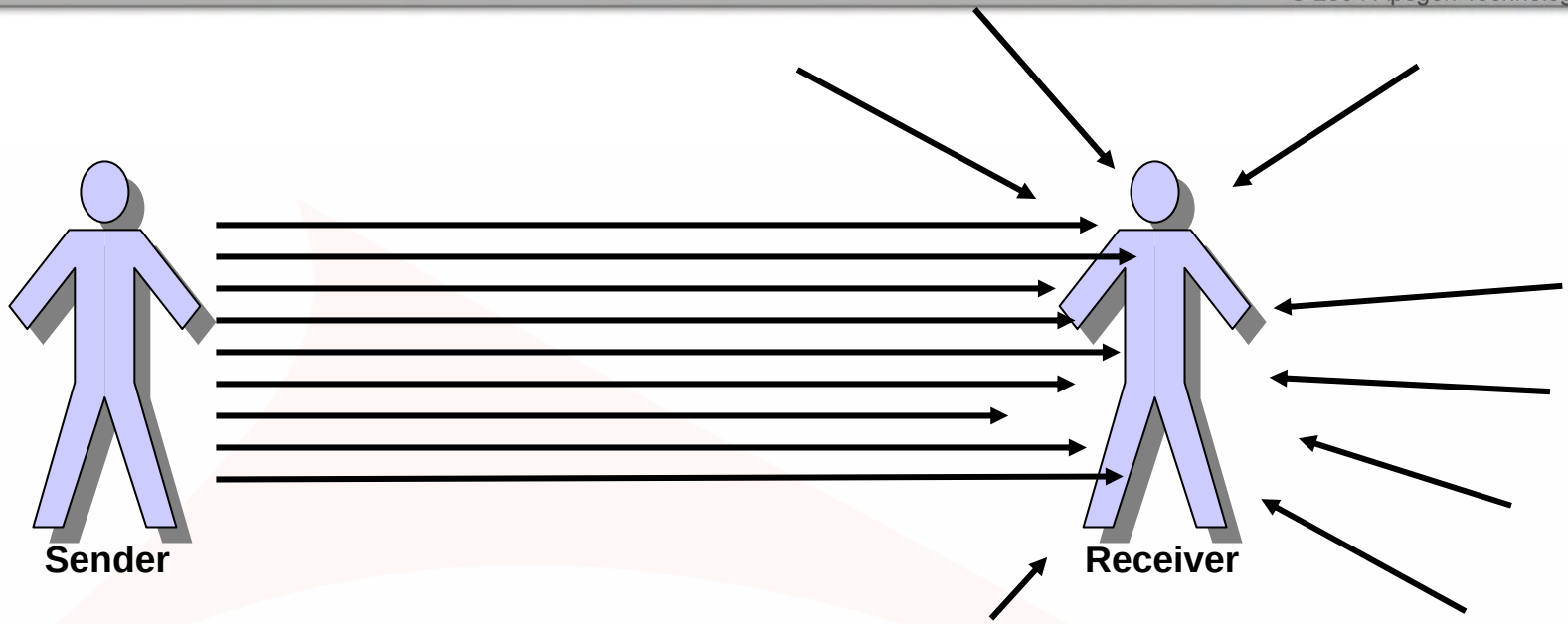

- Unfiltered communication
- Environmental factors
- Input Selection challenges
  - Mission and objectives clarity
  - Sender coordination
  - Recipient filtering

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Potential Issue – Noise via Distortion

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- Context mismatch
- Medium unreliability
- Faulty encoding/decoding
- Synchronization issues
- Mixed Messages
- Interrupted signals

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Issues with CMMI Application

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- Typical Errors
  - Confusing the model with process
  - Neglecting the bottom line
  - Compartmentalization of improvement efforts
    - By project domain
    - By function
  - Maturity Level Mandates
- Common consequence: inability to measure and discuss impact of changes
- Usual Outcome: using the documentation (medium) as indicators of success

How Issues Arise

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- Encoding, decoding, context issues often are intangible
- The medium is tangible and attracts attention
- The “medium over the message” syndrome surfaces
- Focusing on the medium can aggravate noise issues, resulting in a vicious cycle

Common Symptoms of Media Fixation

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- Format Wars
- Referring to documents (not the combinations of tools, personnel, and methods) as “the process.”
- Top-down-only view of process definition

Solution: Focus on Communication

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- The model implies all components of communication loops
- The model doesn't tell us specifically what we should say
- The model does indicate what we should be able to communicate about

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The Generic Practices

Loop – Policy and Reporting

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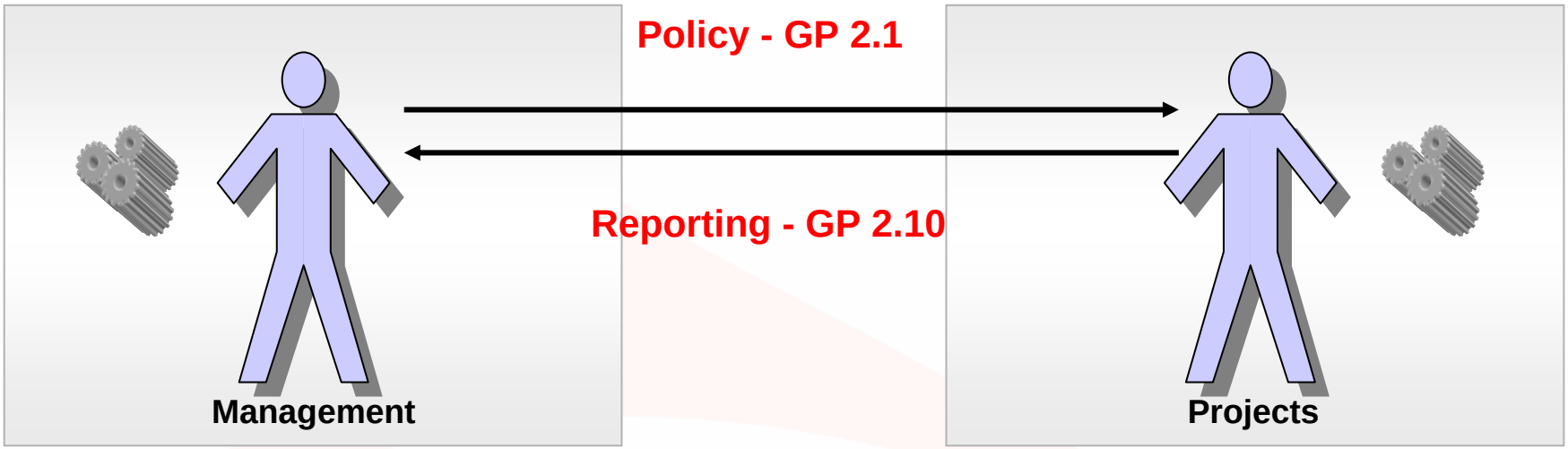

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Policy and Reporting -

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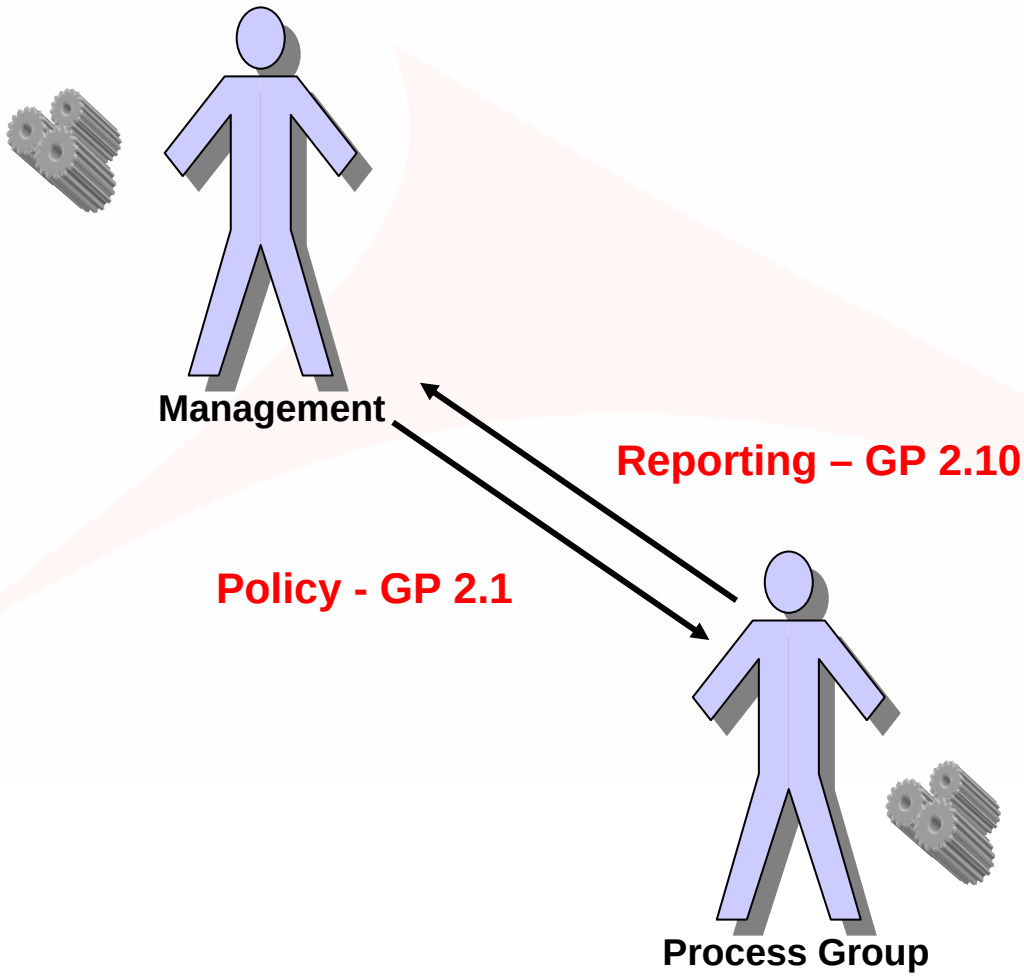

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Loop – Process Communication

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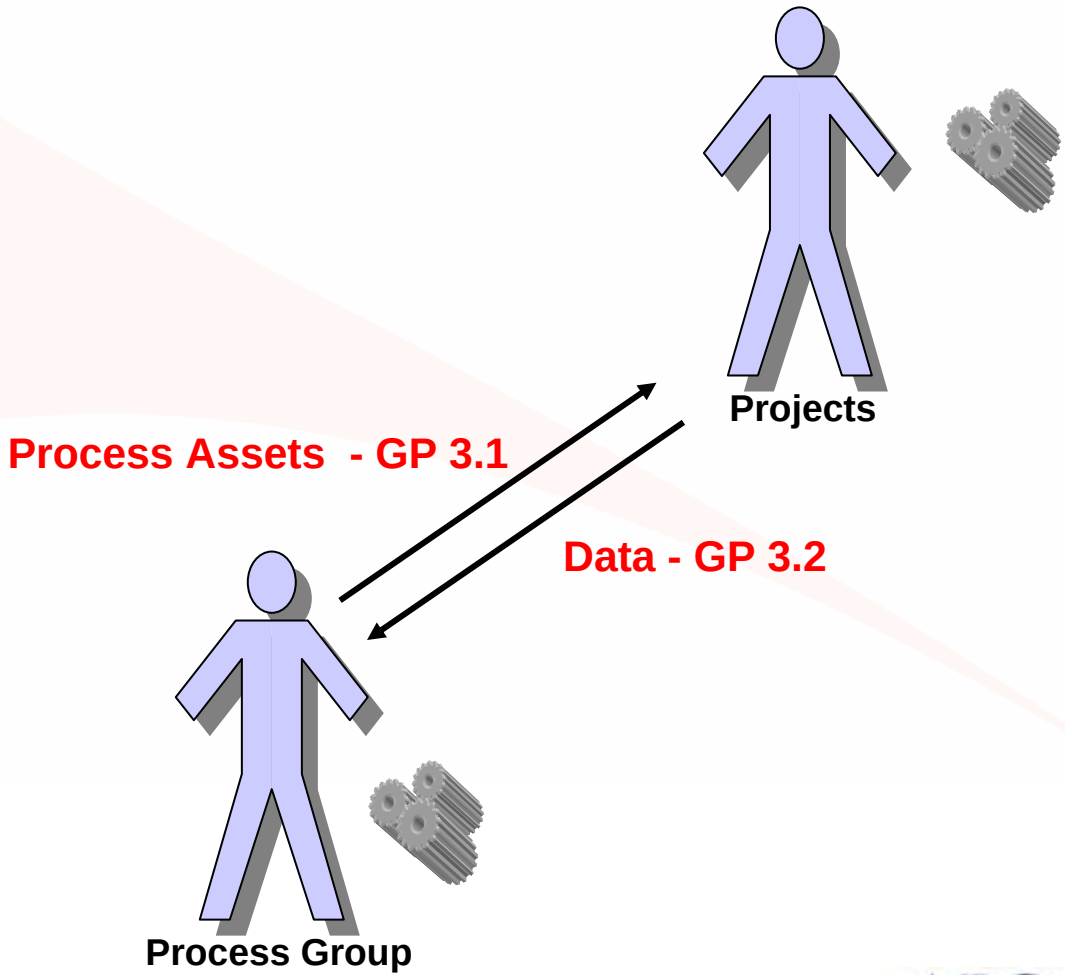

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Multi-Level Communication

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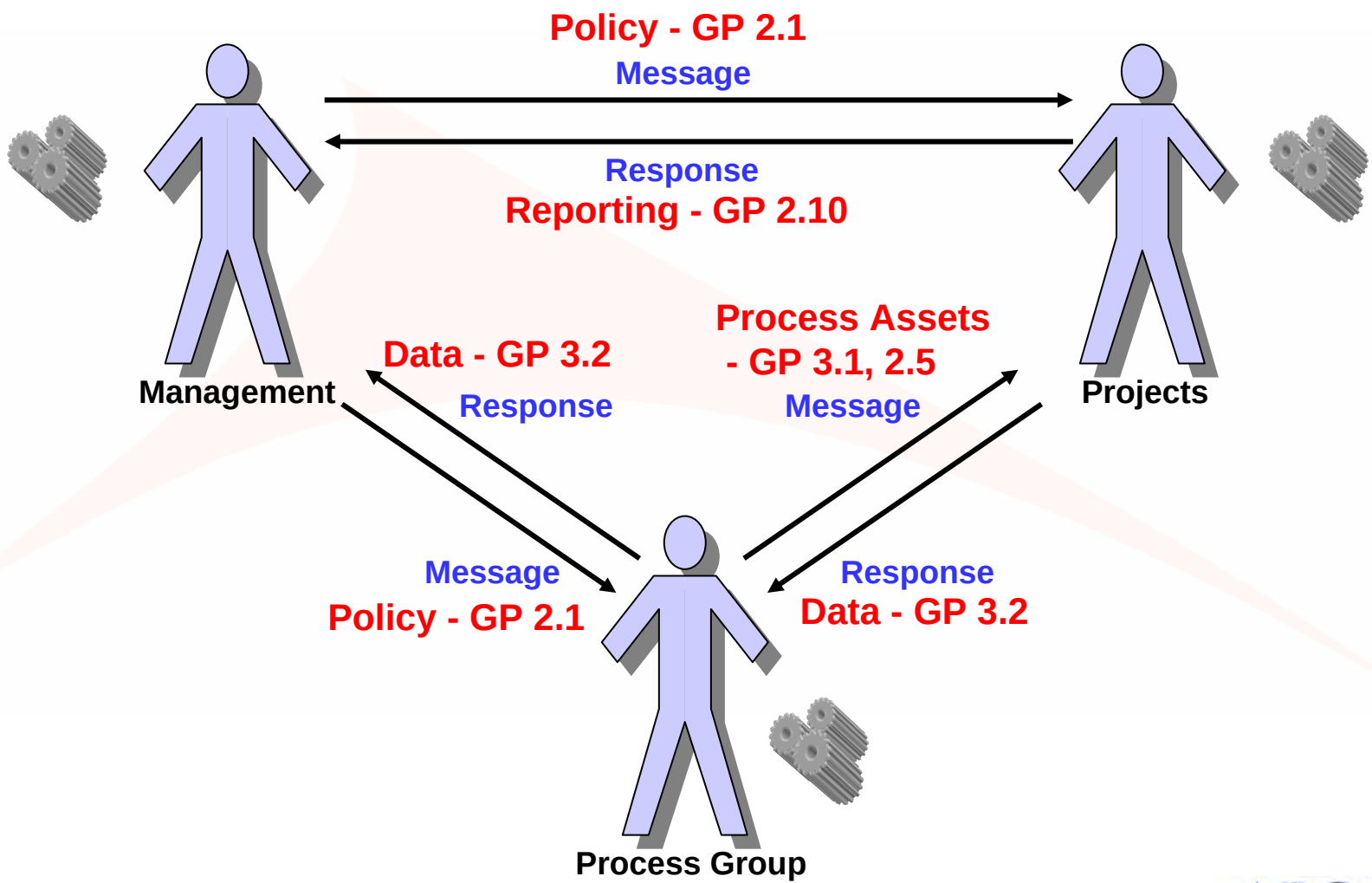

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Loop – Objective Evaluation

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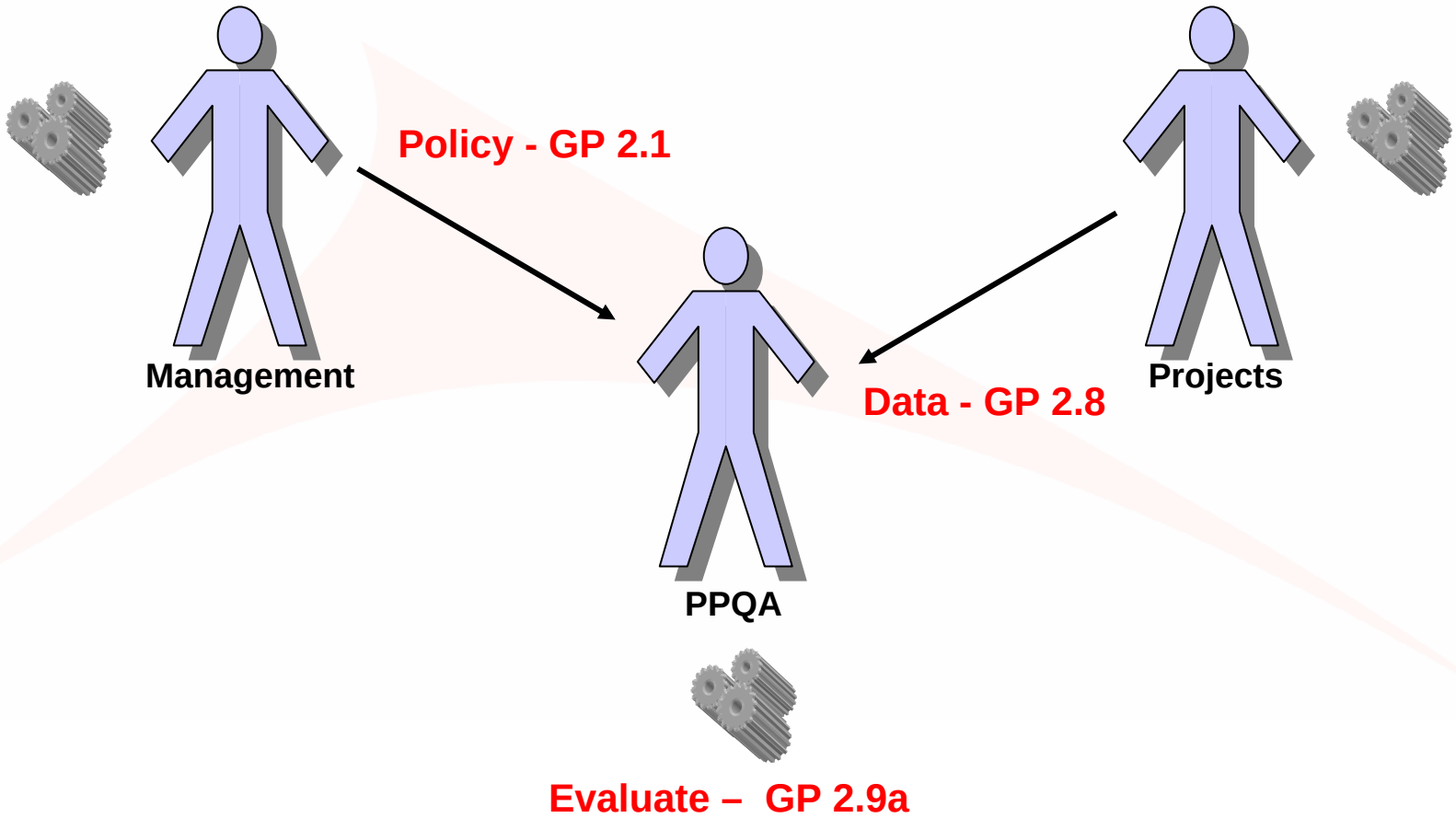

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Adherence

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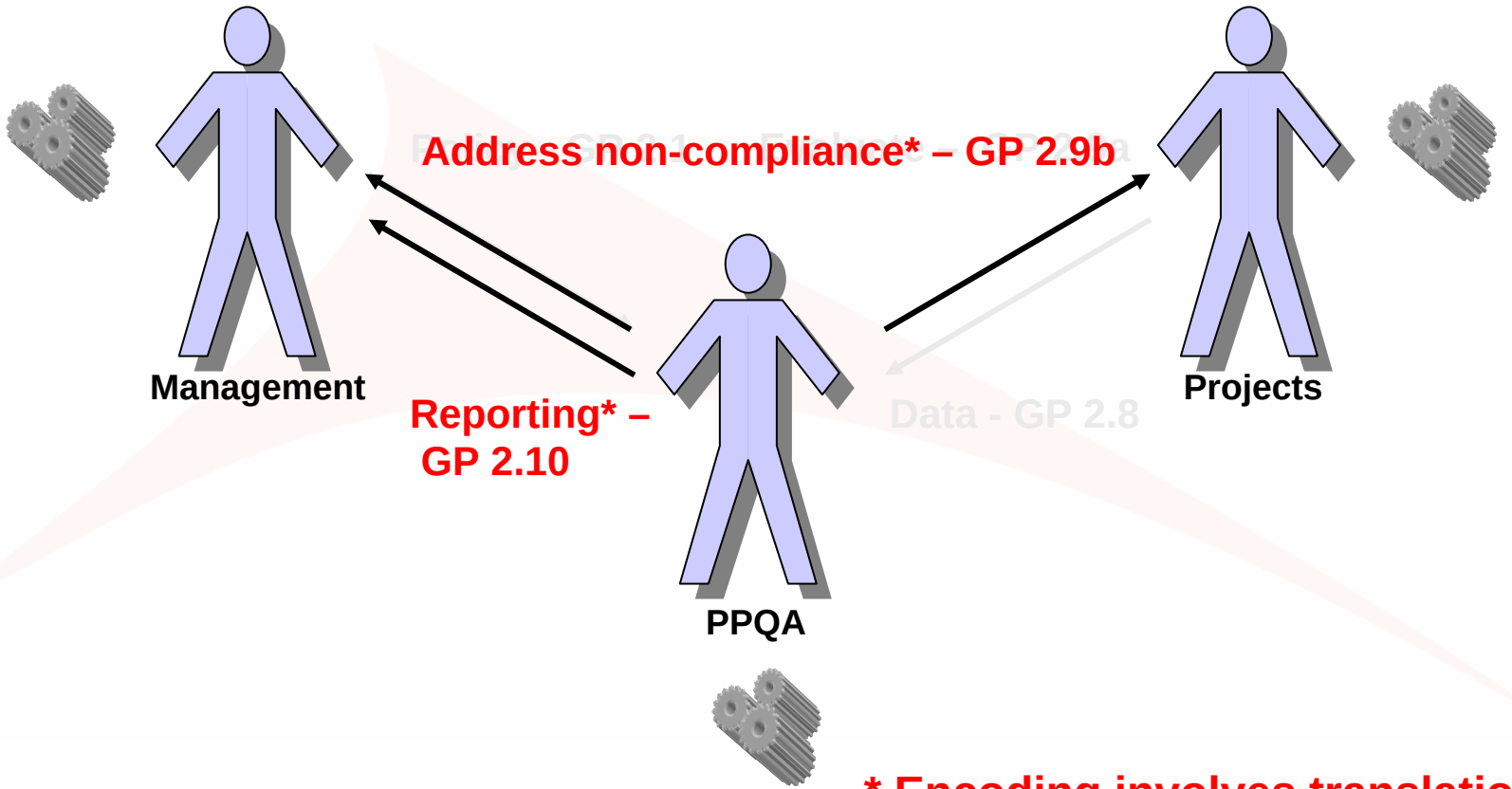

* Encoding involves translation

Objective Reporting

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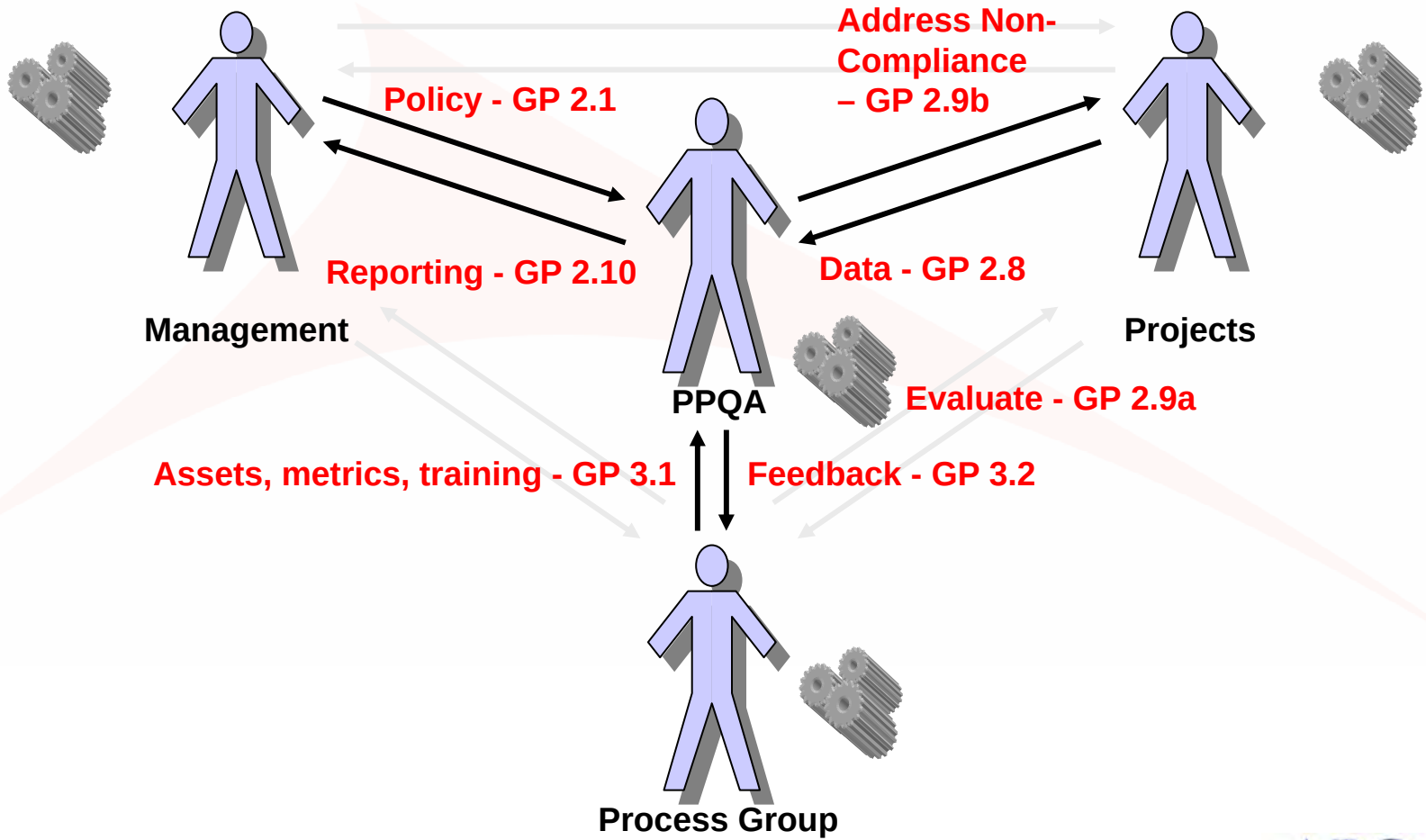

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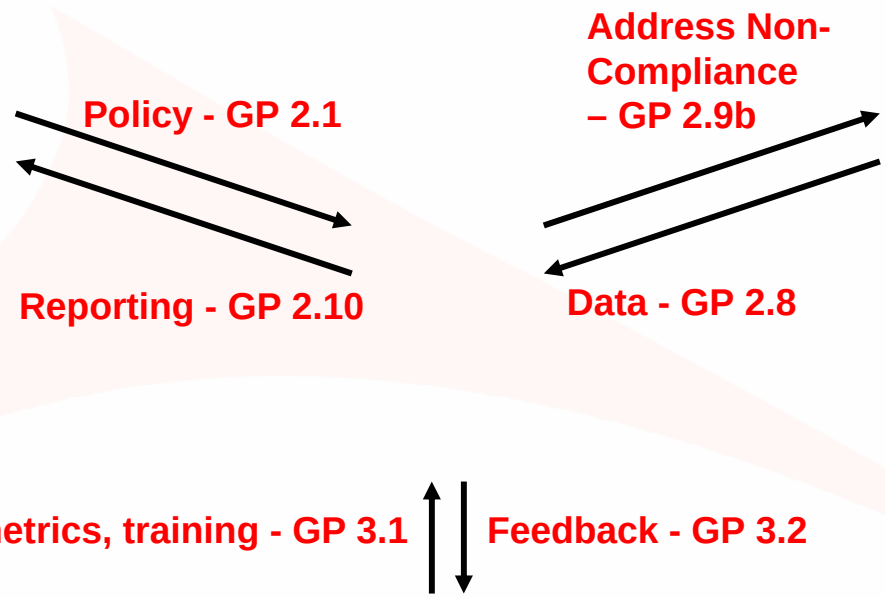

Loop – Skills and Responsibilities

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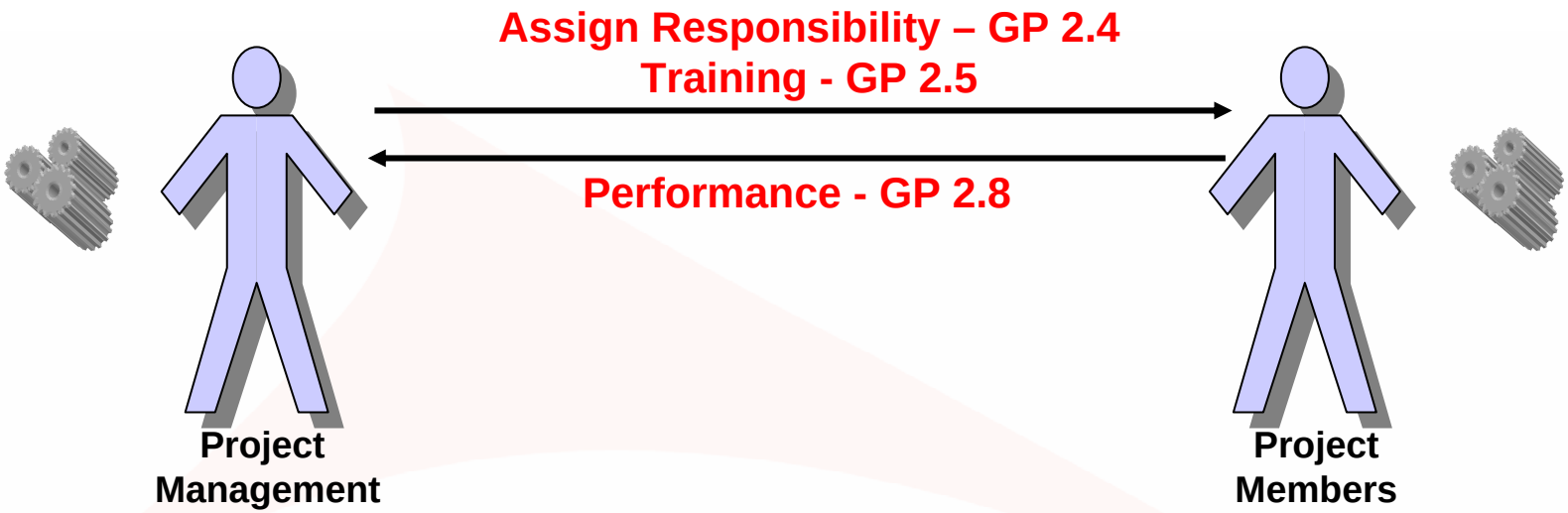

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Loop - Stakeholders

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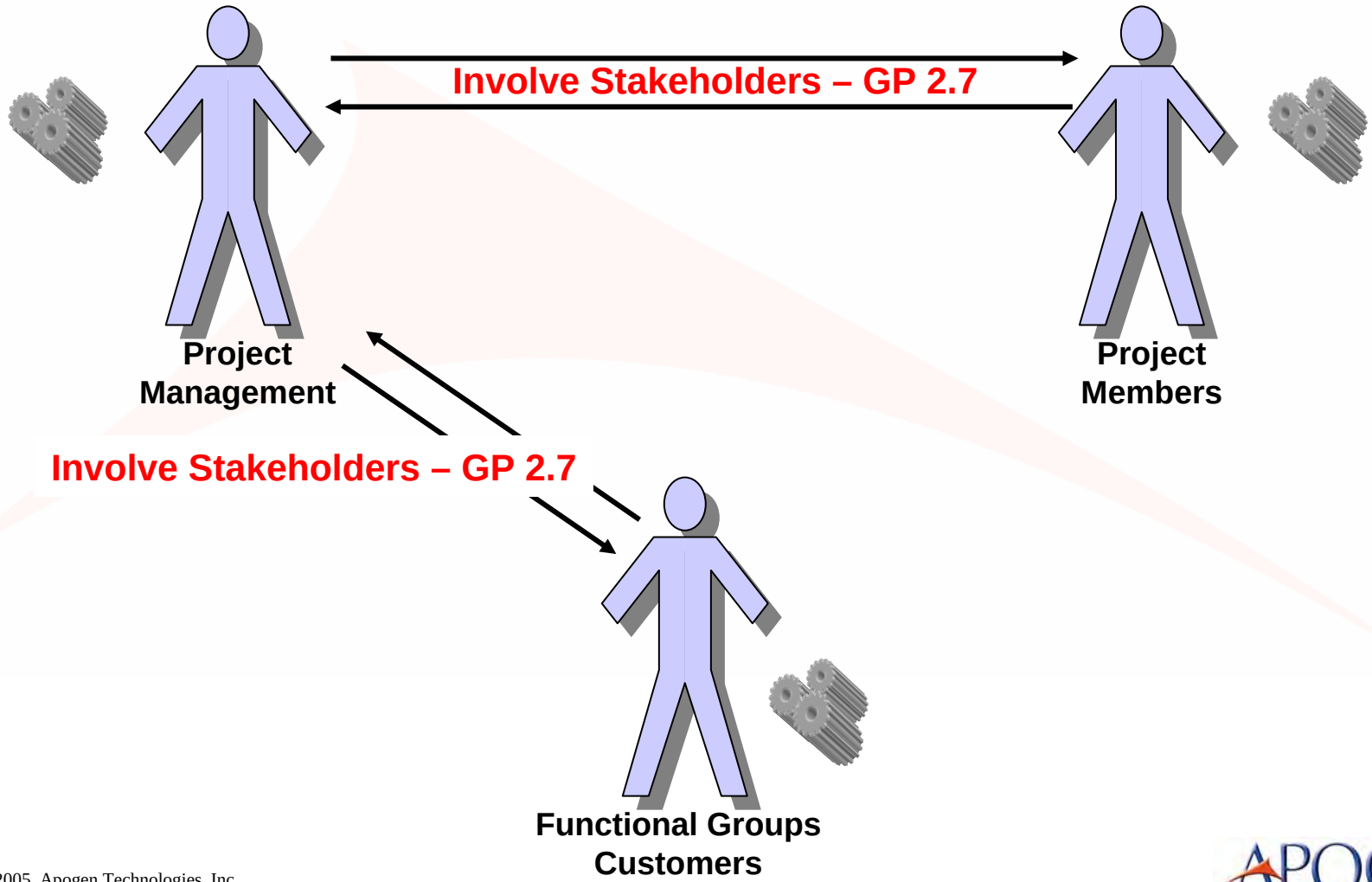

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Loop – Tools and Resources

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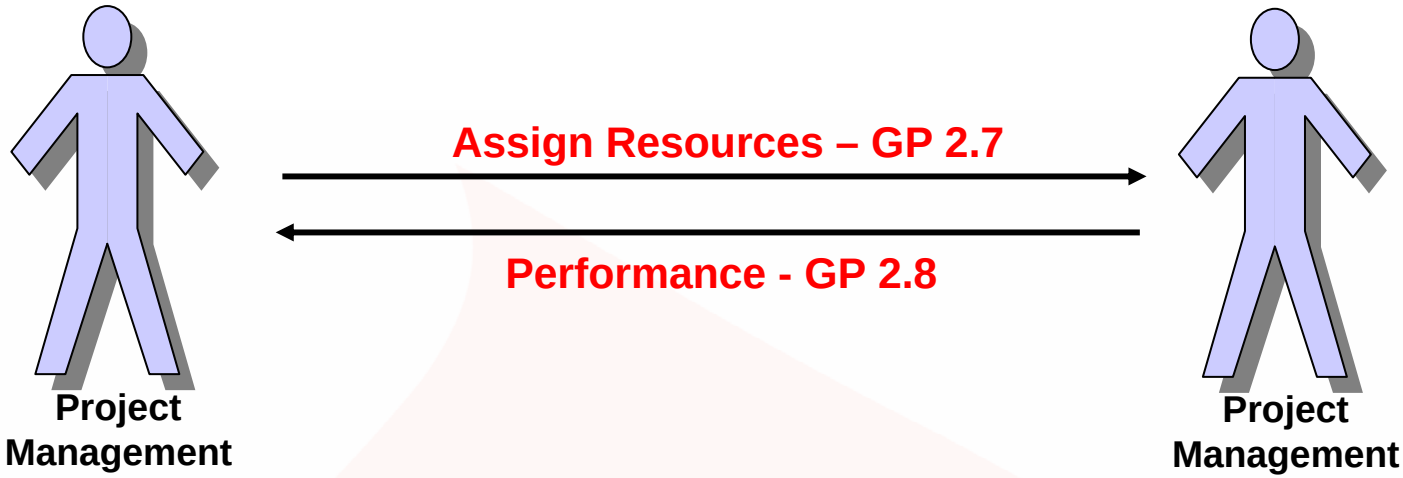
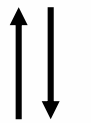
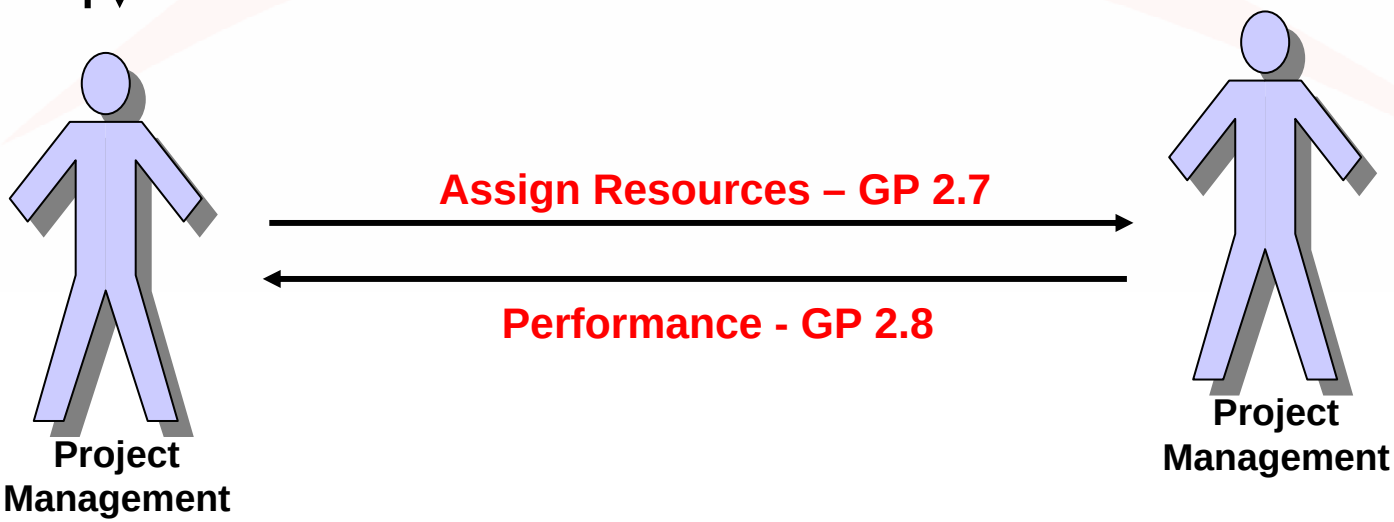




Assign Resources – GP 2.7
Performance - GP 2.8



Specific Practices

Key Topics

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- Communication Infrastructure
  - Sustaining channels (media)
  - Providing access
- Communication Relationships
  - Management-project communications
  - External communications
  - Intra-group communications within projects
  - Communications between projects and supporting groups
- Communication Contexts
  - Product development
  - Process management activities
  - Commitments and agreements
  - Action item management
  - Status reporting

Critical enablers

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- Common lexicon and operational definitions
- Understanding of business context at applicable levels
  - The model contains roughly 75 references to business context, drivers, situations, etc.
- Identification of appropriate stakeholders

Examples from the Specific Practices

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- Product Development
  - RD.SP.3.2 “Establish a definition of required functionality” → “…communicates the manner in which the product will be used.”
  - PI.GP.2.7 “Communicating new, effective product integration processes to give affected people the opportunity to improve their performance”
- Process Management
  - RD.SP.3.2 “Establish a definition of required functionality” → “…communicates the manner in which the product will be used.”
  - PI.GP.2.7 “Communicating new, effective product integration processes to give affected people the opportunity to improve their performance”
  - MA.SP.1.2.3 “Specify Operational Definitions” → “Communications” establishes context for communication

Examples (continued)

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- Agreements
  - SAM.SP.1.3 “Establish Supplier Agreements” implies a host of communications.
- Action Item Management
  - VER.SP.2.2 “When issues arise during the peer review, they should be communicated to the primary developer of the work product for correction.”
  - PPQA.SP.2.1 “Communicate and ensure resolution of noncompliance issues”
- Status Reporting
  - PMC.SP.1.3.3 “Monitor project risks” → “Communicate risk status to relevant stakeholders.”
  - PMC.SP.1.6.1 “Conduct Progress Reviews” → “Regularly communicate status on assigned activities and work products to relevant stakeholders “
  - CM.SP.3.1.2 “Ensure…access,” Examples of “…communicating configuration status.”
  - MA.SP.2.4 “Communicate Results”

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Summary

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- The CMMI describes communications, both explicitly and by implication
- Media *is* a critical element, but not the only one
- The media serves the messages in communication
- Improper focus on the media may distort or completely subvert the message
- Understanding complete communication loops and how the CMMI relates to them preserves the critical messages

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Knowledge Management

at the Heart of CMMI ML3

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Ltc. (ret.) Yair Dembinski
Knowledge Manager

Presentation Overview

- About RAFAEL
- The Organization at Maturity Level 3
- Principles of Knowledge Management
- KM Systems at RAFAEL
- Nympha – An Example of a KM System
- Q&A

RAFAEL

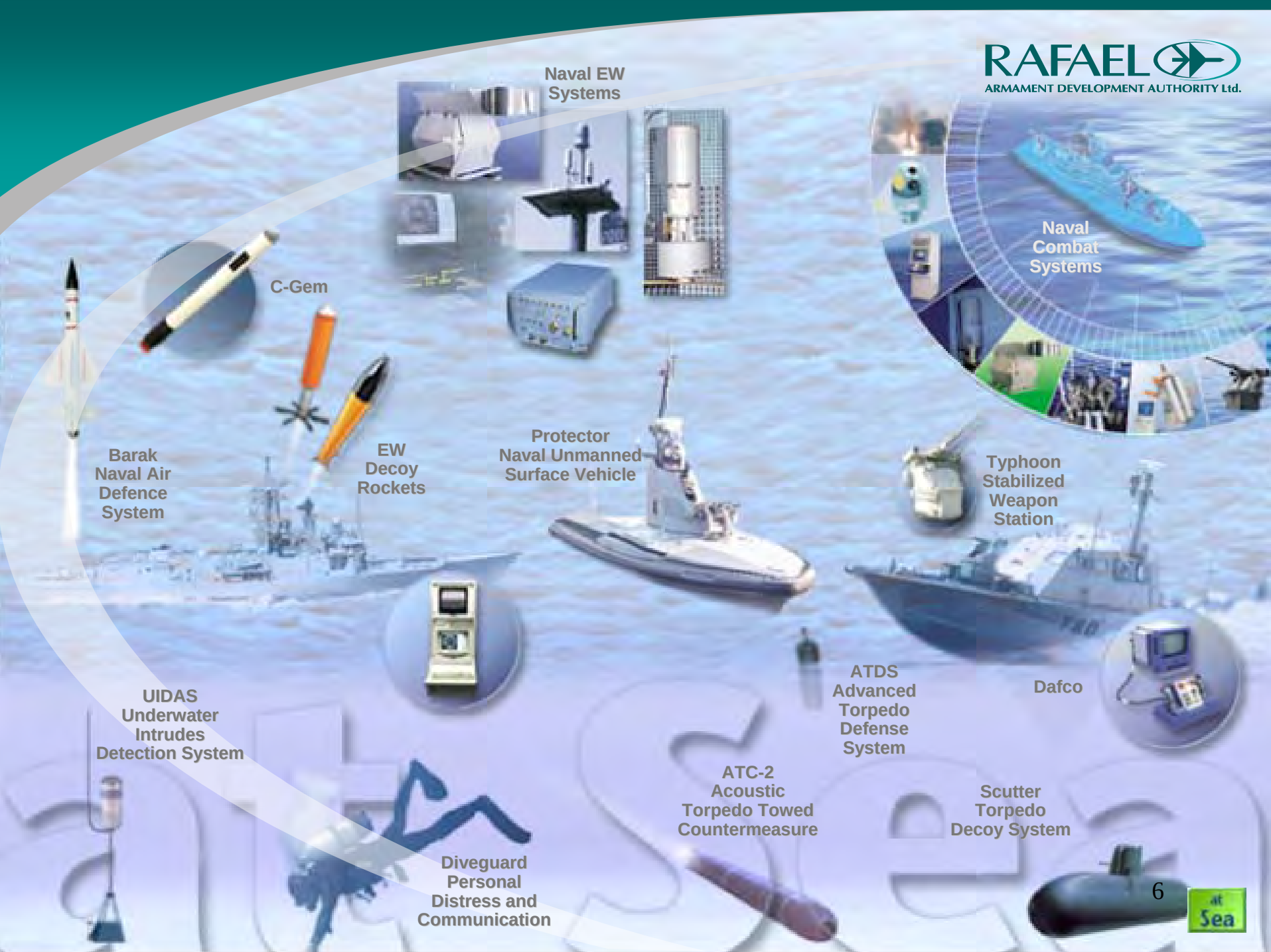
ARMAMENT DEVELOPMENT AUTHORITY Ltd.

Mini Satellites
Britening
Communication Systems
Helistar Electro-Optical Protection Suite
Helicoat
Golden Bay Real Time Imagery Processing System
Skylite
Spike Family
Toplite Electro-Optical Payload
Reccelite Reconnaissance Pod
Blue Bay Ground Imagery Exploitation System
Airborne EW Systems
Python 5 Full Sphere IR Missile
Litening Targeting and Navigation Pod
Popeye Have Lite Air-to-Ground System
Sky Shield
Spice Guidance Kit
Black Sparrow Air Borne Ballistic Target
Barak Air Defense
Derby Air-to-Air System
Derby Air Defense System
REAPS
RITA
SLA
Aerostat-borne Surveillance Systems

RAFAEL
ARMAMENT DEVELOPMENT AUTHORITY Ltd.

on Land

RAFAEL
ARMAMENT DEVELOPMENT AUTHORITY Ltd.



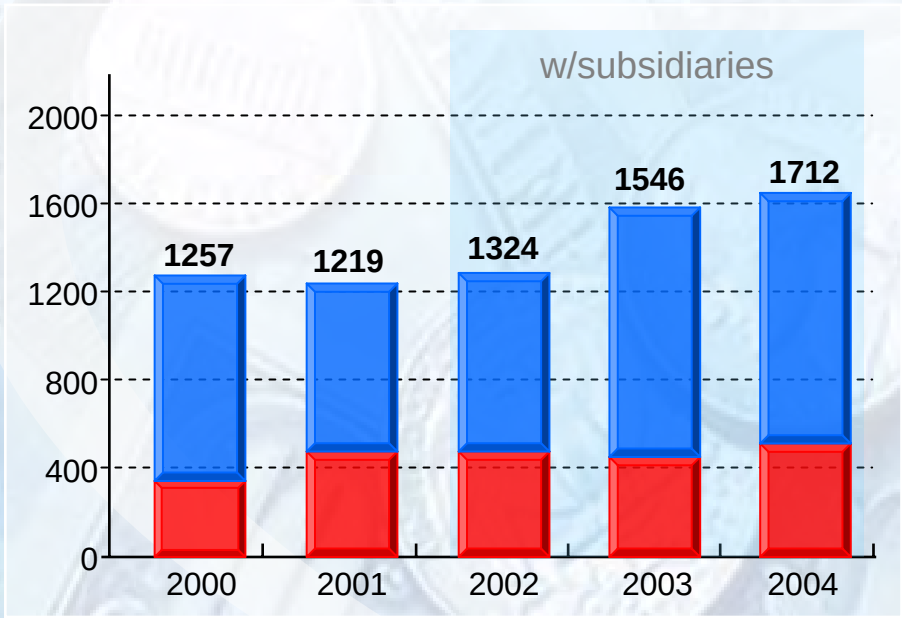
at Sea

RAFAEL
ARMAMENT DEVELOPMENT AUTHORITY Ltd.

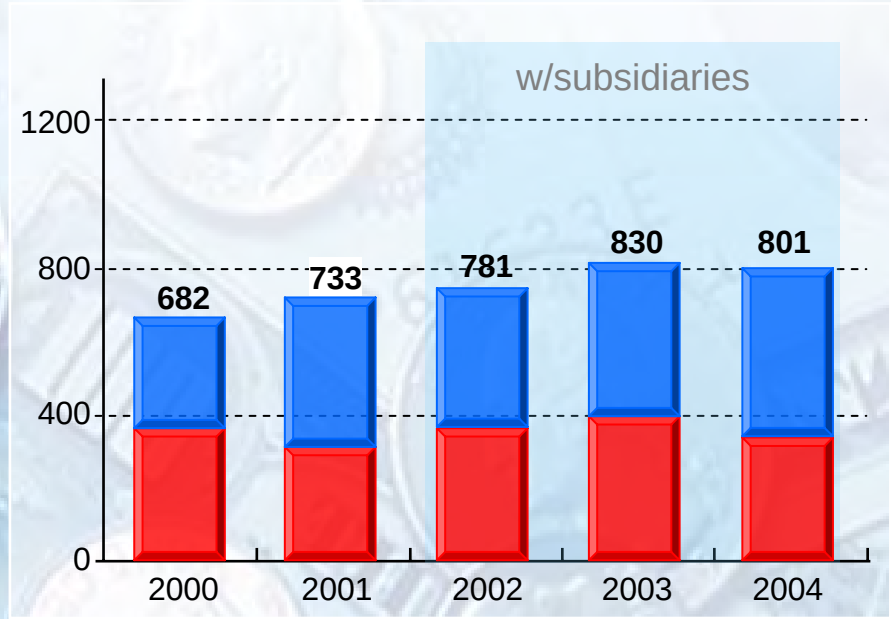
Financial Data

~5000 Employees

BACKLOG ($M/year)



SALES ($M/year)



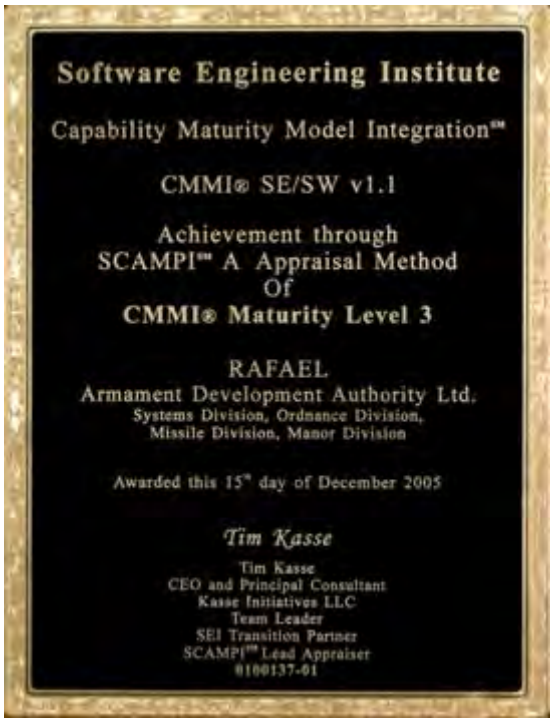
R.O.W

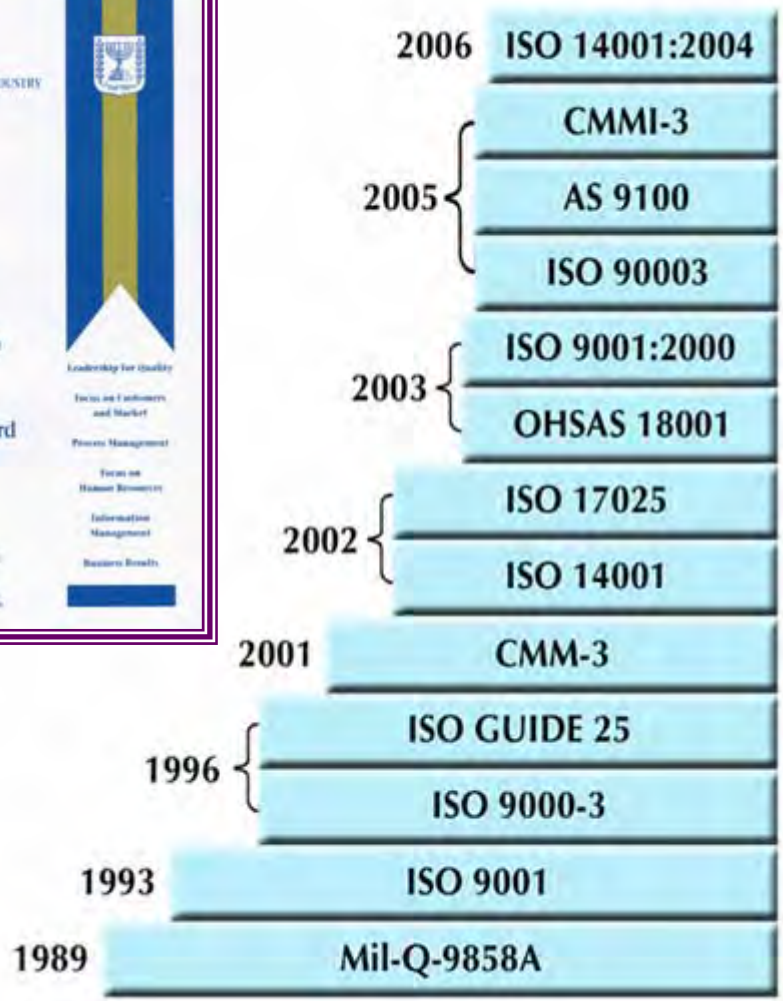
ISRAEL

Core Capabilities

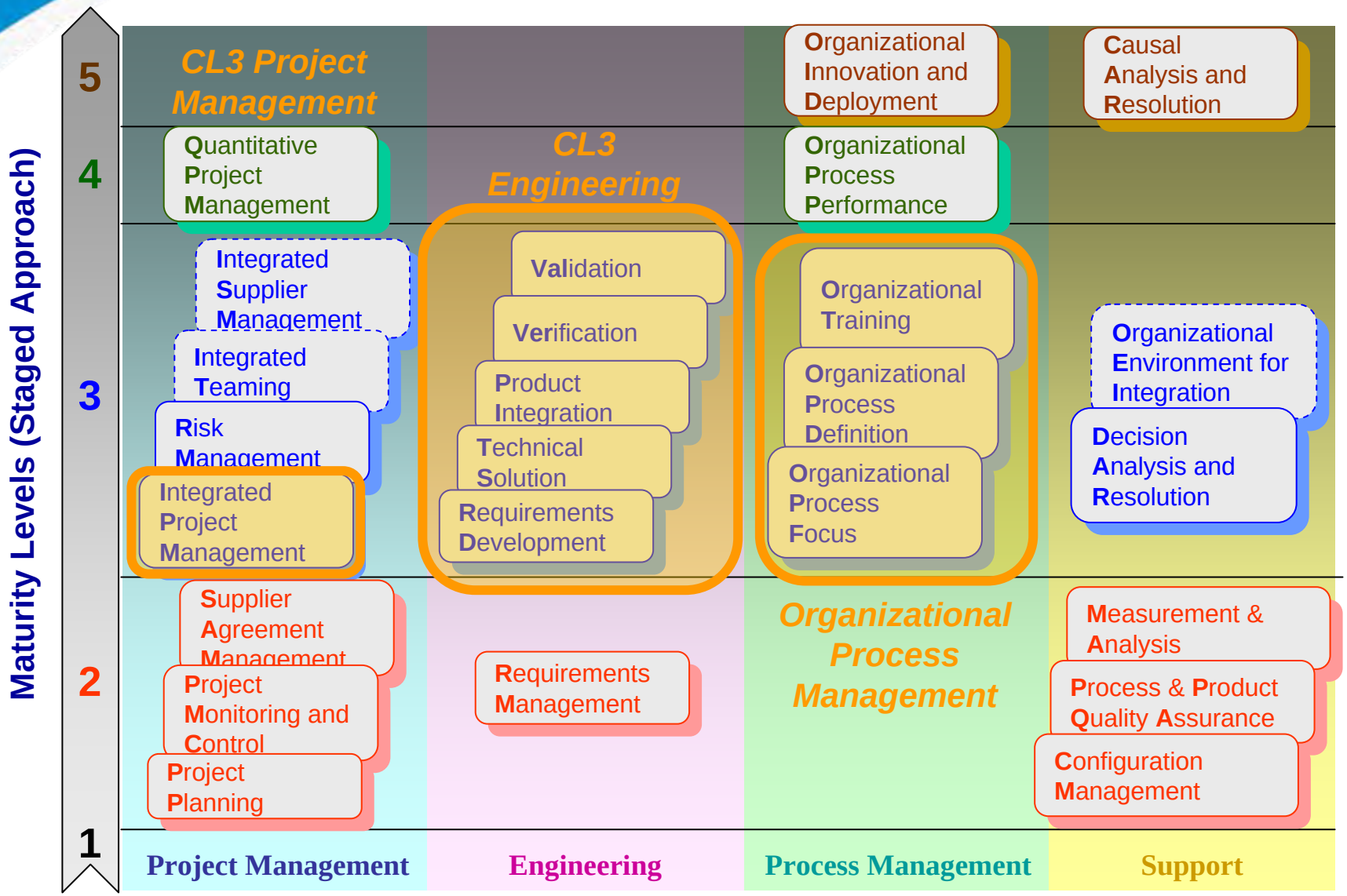
- Seekers and electro-optical payloads
- Guidance and navigation
- Image processing - trackers
- Rocket motors
- Explosives
- Warheads and fuses
- Acoustics
- Thermal batteries
- High power microwave
- Materials and processes composites, optical elements and coating metallurgy
- MMIC
- Antennas and radomes
- Electronic warfare
- Communication, secure data links
- Terminal ballistics
- Simulators, trainers, training systems
- Armor and protection

Excellence through Standards





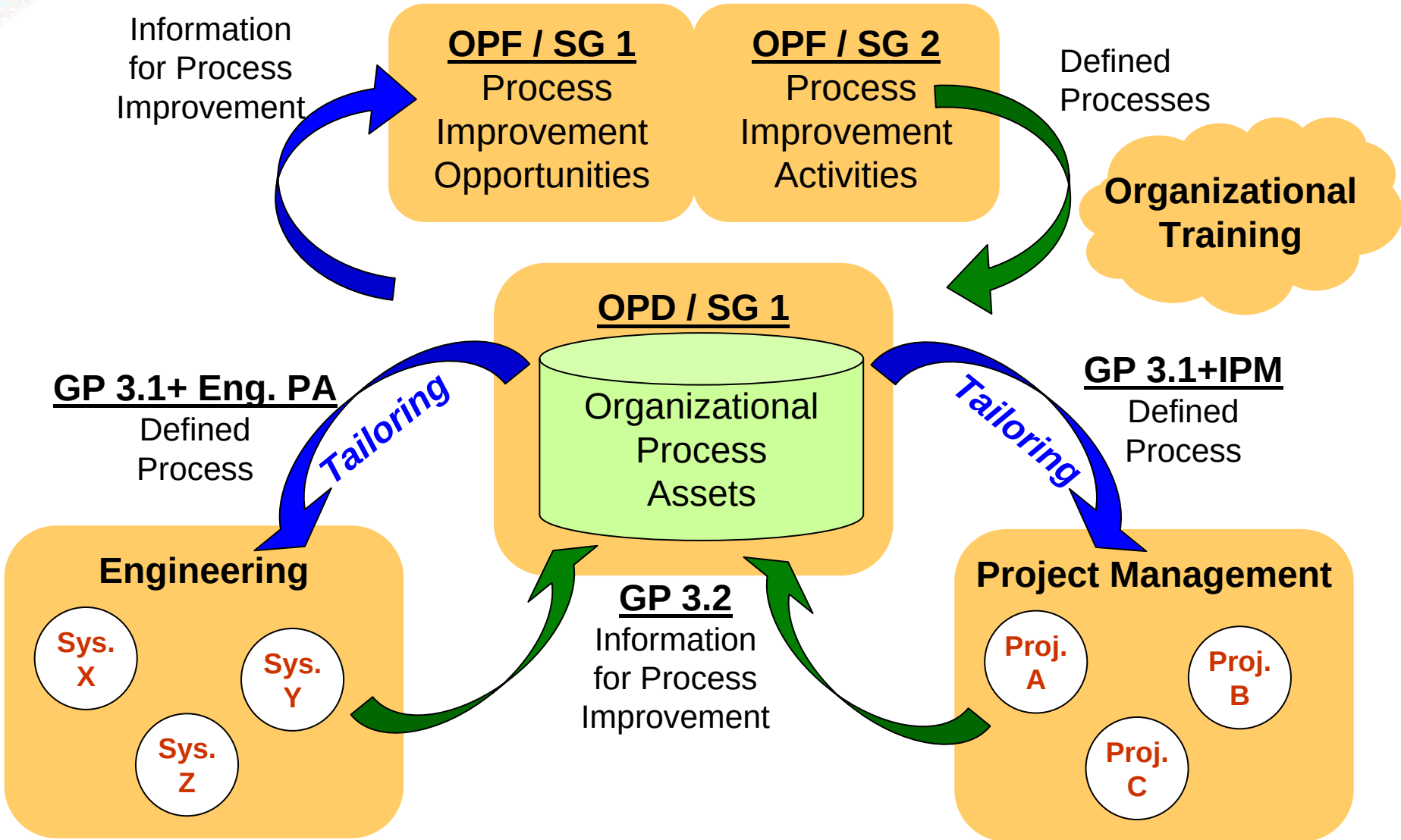
The Essence of Maturity Level 3



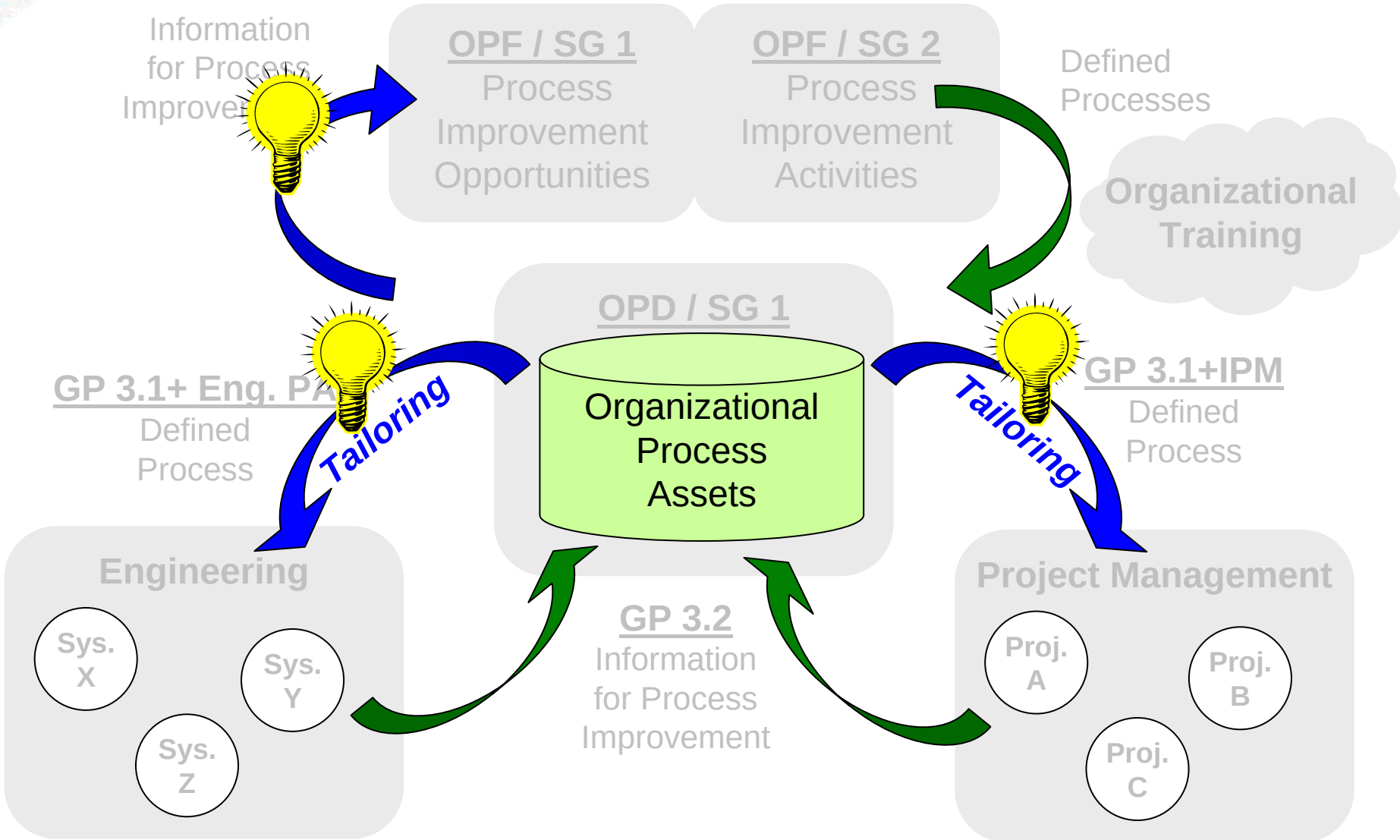
The Essence of Capability Level 3

- Generic Goal 3
  - The process is institutionalized as a defined process
    - Generic Practice 3.1
      - Establish and maintain the **description of a defined process**
    - Generic Practice 3.2
      - Collect work products, measures, measurement results, and **improvement information** derived from planning and performing the process to support the future use and improvement of the organization's processes and process assets

The Organization at Maturity Level 3



Same Information – Different Use Contexts!



Organizational Process Assets

- The organization's process asset library is a collection of items maintained by the organization for use by the people and projects of the organization
- This collection of items includes:
  - descriptions of processes and process elements
  - descriptions of life-cycle models
  - process tailoring guidelines
  - process-related documentation
  - process-related data
- The organization's process asset library supports organizational learning and process improvement by allowing the sharing of best practices and lessons learned across the organization.

Knowledge Management – The Motivation

- At the Individual Level
  - Capability to perform tasks and to make decisions in a higher level of quality
    - Process knowledge
    - Professional knowledge
    - Business knowledge
    - Expert identification
    - …
- At the Organization Level
  - Knowledge is the most important resource of the organization
  - Appropriate management of the knowledge improves organizational performance
    - Knowledge sharing and knowledge assets
    - Visible and invisible knowledge
    - Technology
    - Organizational processes and culture
    - …

RAFAEL's KM Objectives

- Support the Organizational Core Processes
  - Improve the effectiveness and efficiency of sales
  - Improve project process efficiency
    - Reduce errors
    - Decrease "wheel inventions"
  - Improve proficiency and effectiveness in development
    - Generate relevant connections among people
    - Improve the availability of relevant information and knowledge
  - Improve field-test success ration
  - Improve business intelligence in marketing and sales phases
  - Support of innovation in all areas
- Implement Effective and Efficient Solutions
  - Construct appropriate KM infrastructure over all aspects
    - Technology
    - Process
    - Culture

Types of Needs

- Knowledge Sharing by People with Common Subjects
- Accessibility to Information within Specific Context
- Handling “Know-How”
- Accessibility to Professionals
- Decision Support

Types of Solutions

- "Know-How" Management
- After-Action Reviews and Lessons Learned
- Knowledge Communities
- Contents Management
- Organizational Infrastructure

Knowledge Communities

Definition

- A group of people with a common subject
  - Not part of the organizational structure
  - Conduct dynamics of sharing
    - Meetings
    - Web site / Forum

• Knowledge Community Objectives

- Knowledge sharing within the group
- Common learning from outer sources
- Generating new knowledge
- Organizational lobbying for the subject

Contents Management

- Definition
  - Organization of contents in a form which enables convenient retrieval when needed
- Contents Management Principles
  - Every contents item
    - Exists in exactly one location
    - Accessible from a large variety of locations
    - Access is according to relevant context
- Contents Management Solutions
  - A large variety of solutions exist
  - A specific solution should be chosen after careful analysis of the needs
  - All solutions should be supported by the organizational infrastructure
  - “Network Based Contents Management” is the advanced type of solutions

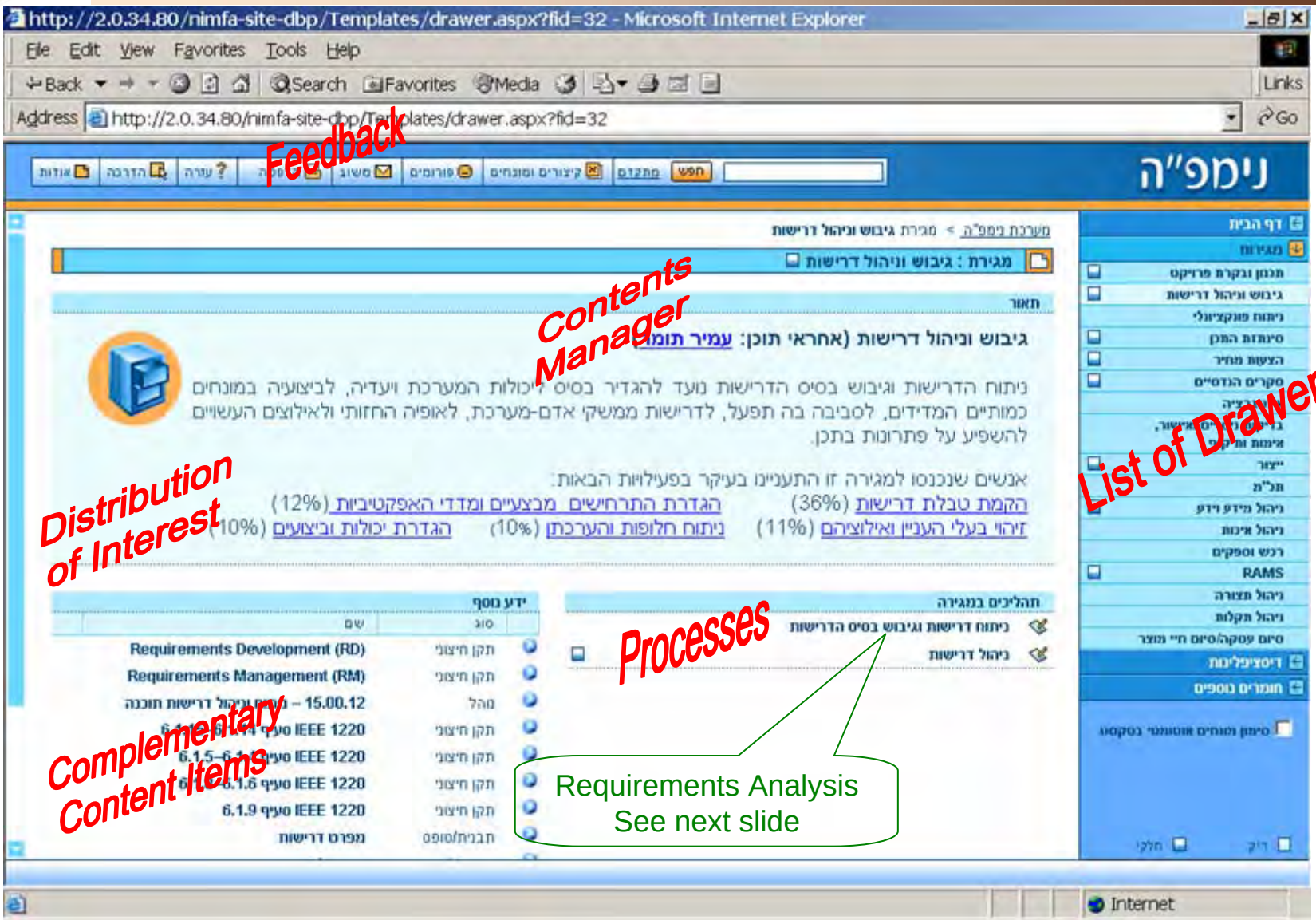
Examples of KM Systems in RAFAEL

- "Nympha"
  - The knowledge source for PM and SE Processes
    - Will be discussed next
- After Action Review (AAR) System
  - Methodology-based system to support AAR and lessons learned from failures and successes
  - Lessons and recommendations are structured in retrievable formats
  - Root cause statistics caters for process improvements
- Shemesh – Business Information Source
  - An integrative system for storing and retrieving relevant business knowledge
    - Competitive Products
    - Visitors
    - Exhibitions
    - Meetings
    - Customers
    - Business trips
    - Contracts
- Conference Participation Optimization
  - Classified conference catalog with priorities
  - Coordination between conference participants
  - Registration and report process

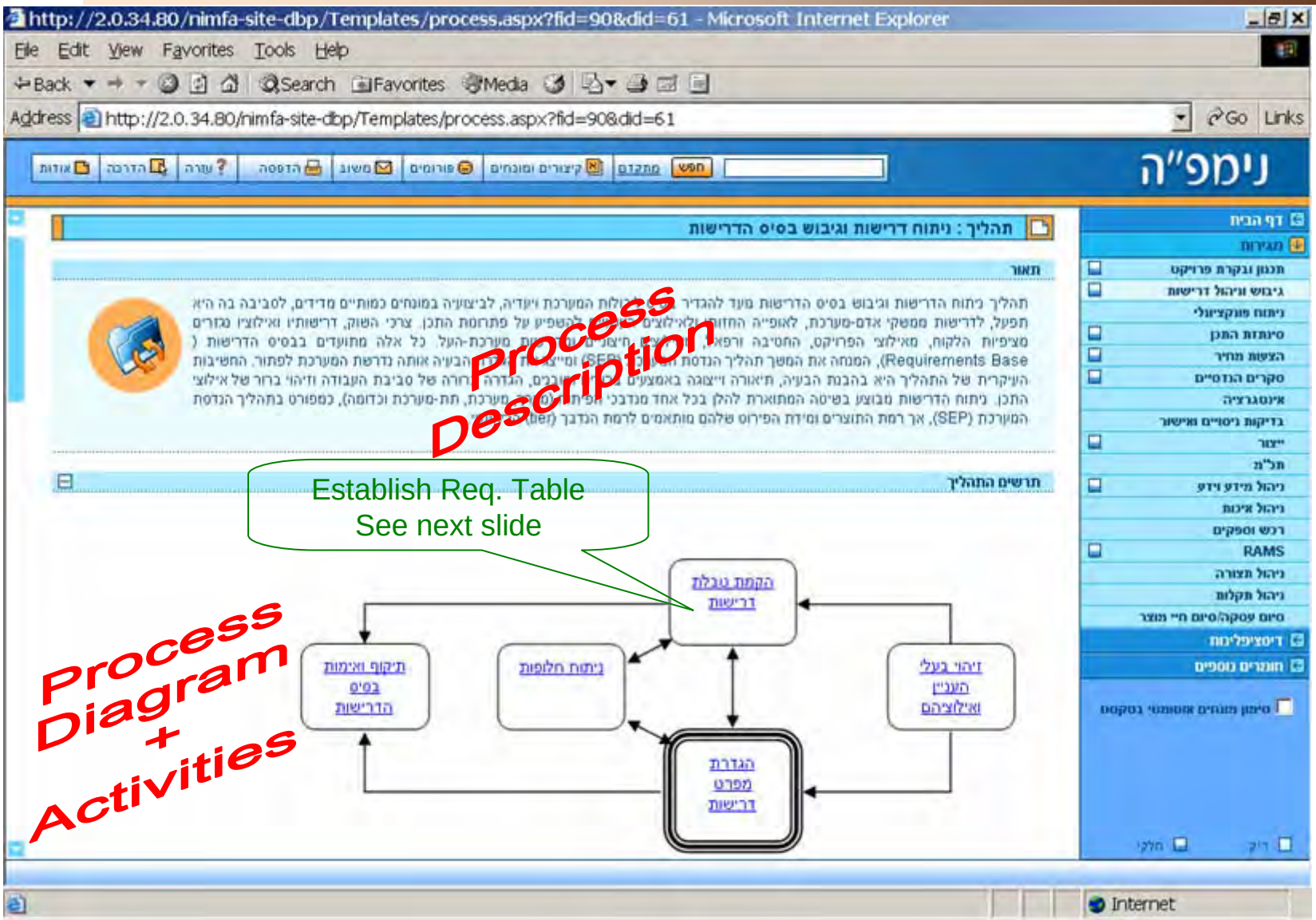
"Nympha" – The PM and SE Knowledge System

- The Material is Organized in "Knowledge Drawers" (Process Areas)
  - E.g. Requirements Management, V&V, ILS
- Each drawer has a "Drawer Manager"
  - A domain expert
  - Responsible for reviewing new materials
  - Responsible for updating the contents
- Each drawer contains two types of items
  - Internal items – specific contents that do not exist elsewhere
  - Links to external items which exist in other sources on the network
    - Procedures and Methods Libraries
    - After Action Review System
    - Document Management System

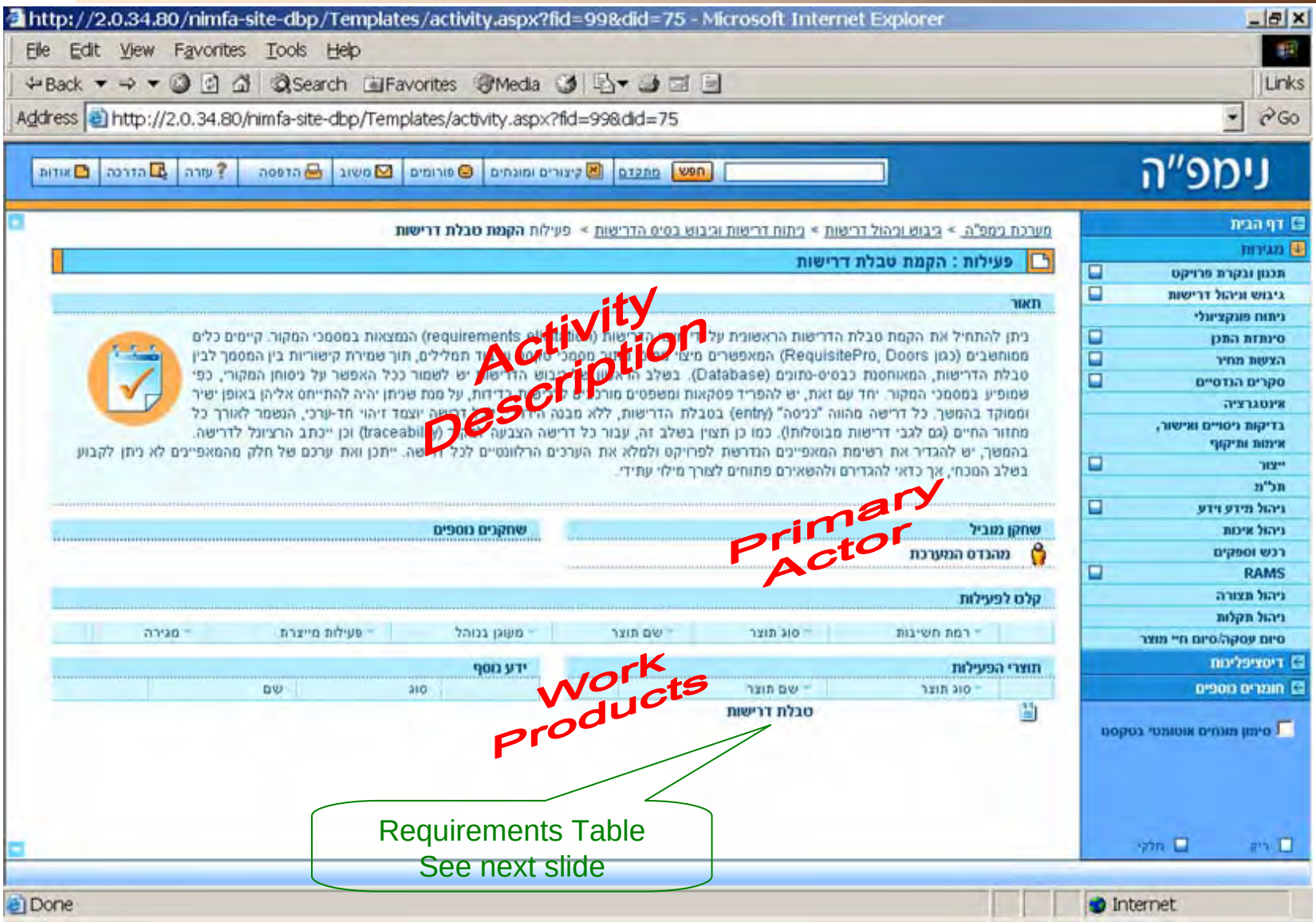
Nympha Drawer: Requirements



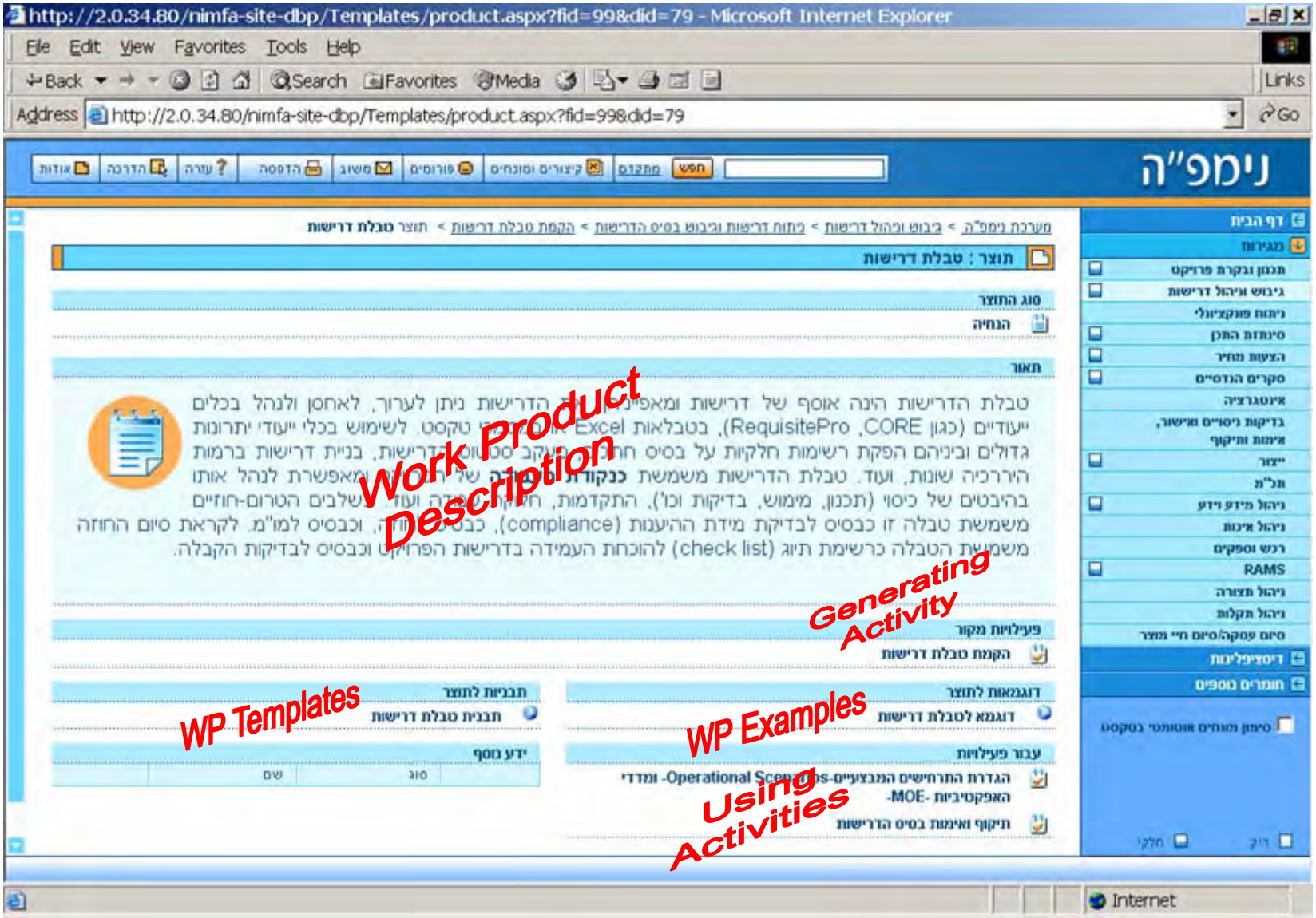
Requirements Drawer Process: Requirements Analysis



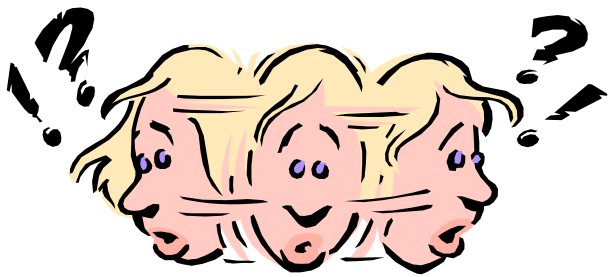
Requirements Analysis Activity: Establish Req. Table



Establish Req. Table Work-Product: Req. Table



Thank you for listening



Any Questions?

Abstract Reference: Abstract ID: #3745)

Performance Effect of CMMI Based Process Improvement in Motorola

Angel Liu

Motorola Software Group, China

HERE

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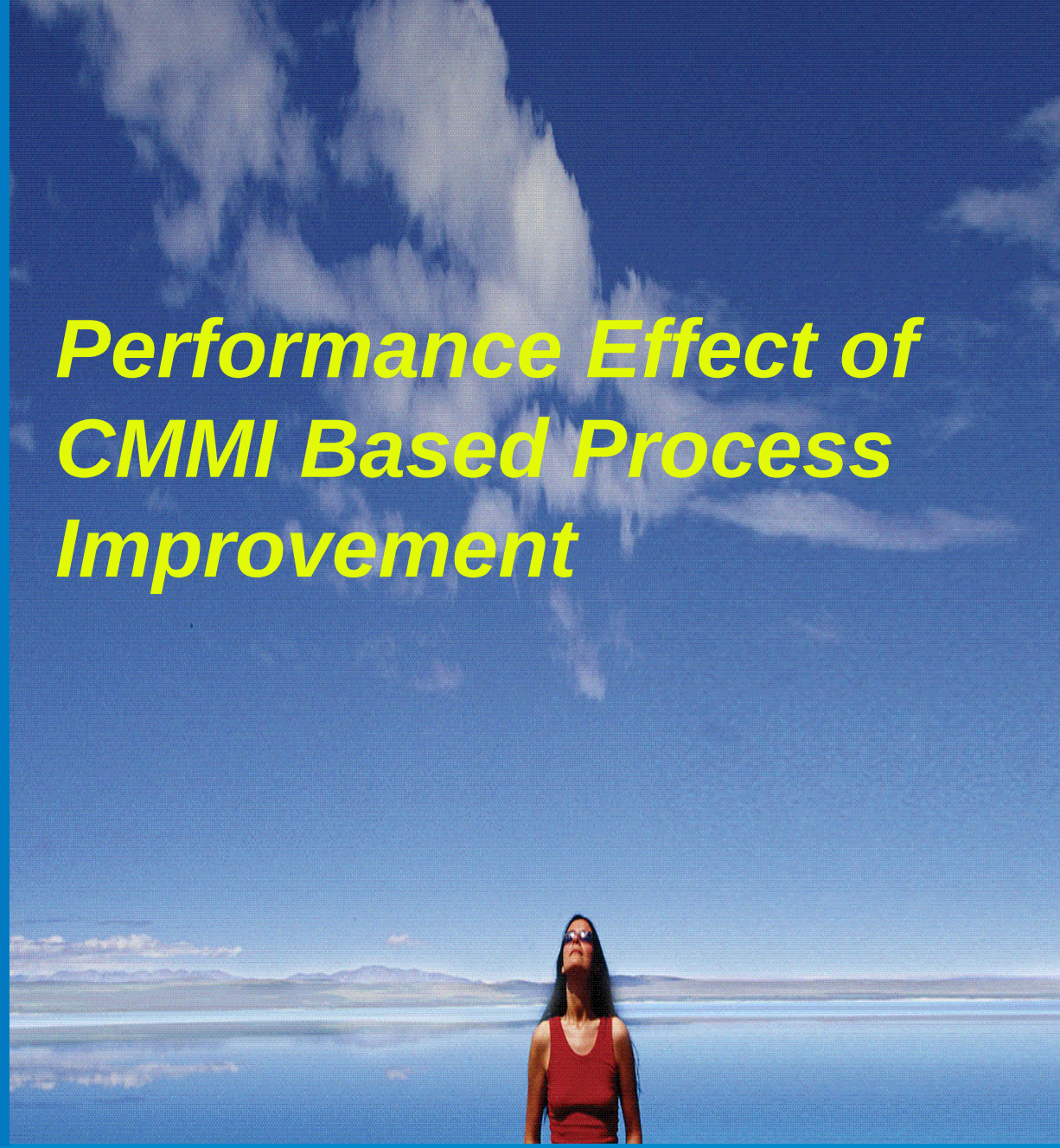
Performance Effect of CMMI Based Process Improvement

- Why to Measure
- How to Measure
- What to Measure
- What to Be Measured
- What Changes to Lead the Result
- Performance Result & Benefit



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Why it is important to measure the CMMI Performance Result?

- ◆Why to Measure
- ◆How to Measure
- ◆What to Measure
- ◆What to Be Measured
- ◆What Changes to Lead the Result
- ◆Performance Result & Benefit

We are often questioned about the cost & return of CMMI-based process improvement?

- ◆ Sponsor - Why sponsor? What is the value to business?
- ◆ Project Manager – Why process? My customer only care about the schedule
- ◆ Engineer - Why measure? Does it measure my performance?

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Why it is important to measure CMMI Performance Result?

- ◆Why to Measure
- ◆How to Measure
- ◆What to Measure
- ◆What to Be Measured
- ◆What Changes to Lead the Result
- ◆Performance Result & Benefit

◆Building continuous commitment and sponsorship

◆Understanding the value of CMMI to Motorola business

Process Improvement is oriented by business and is expected to benefit business

◆ Benchmarking with other organizations

◆ Set up the baseline for continuous improvement

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- Why to Measure
- How to Measure
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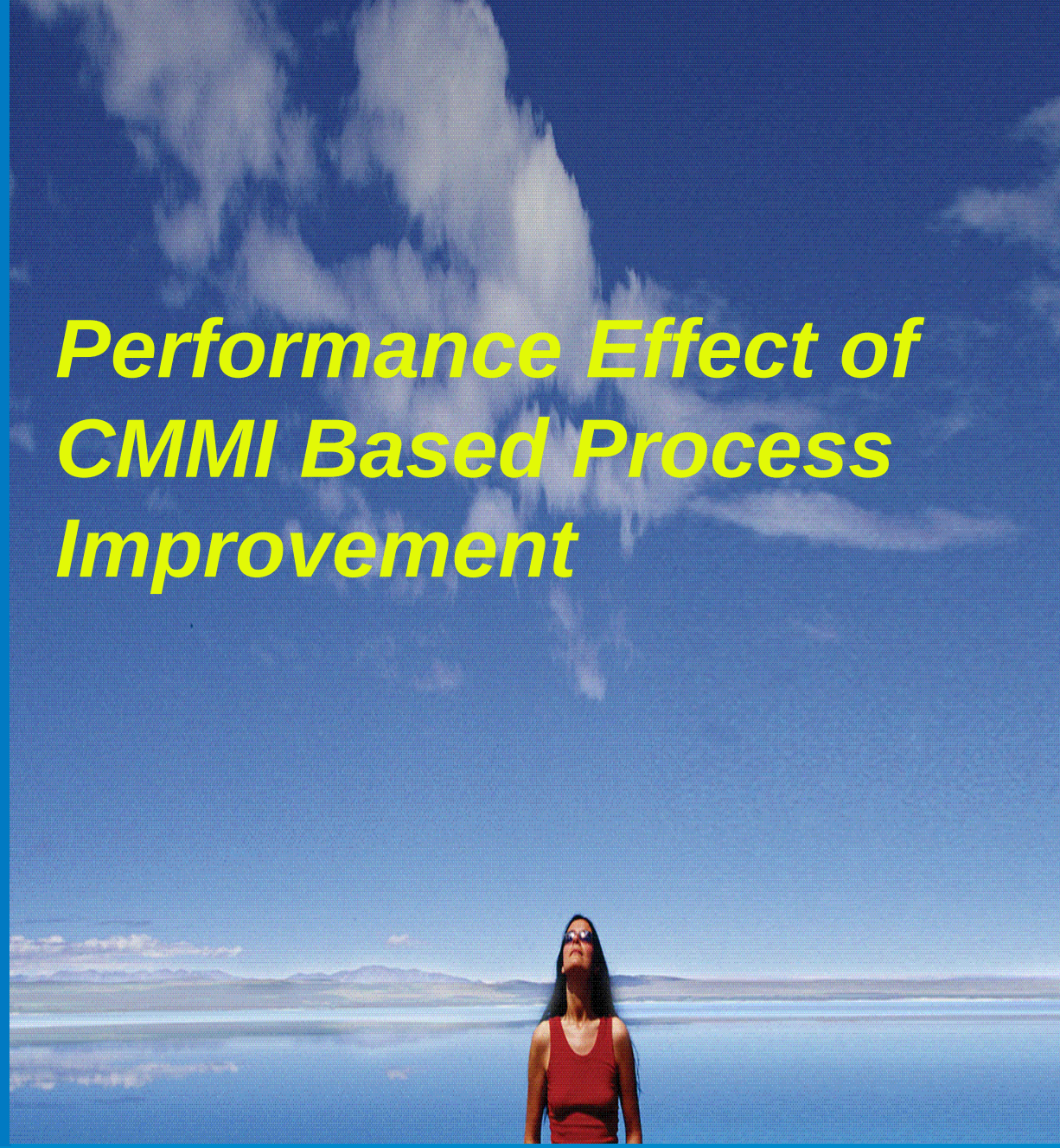
Performance Effect of CMMI Based Process Improvement



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◆How to Measure

Measure Performance in Business Context

- Understand what are the BUSINESS NEEDS
- Analyze what are the business goal of CUSTOMER
- Analyze what's PERFORMANCE & Quality Trend
- Benchmark and know what's our Position
- Calibrate the analysis result and setup business goal
- Know our performance RESULT

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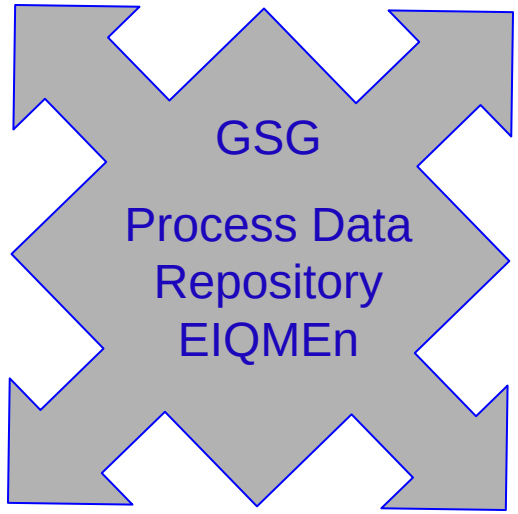
Measurement System Overview

Global Metrics-CCB & Site Metrics-CCB

- Metrics Core Team
- M-CCB Mechanism
- Org. Data Audit Team
- PQ Monthly Review

Project Level Focus

- Goal Setting (SQAP)
- Monthly Project Review
- Post-mortem/Causal Analysis
- Lessons Learned , POR



Site Level Focus

- Yearly Goal Setting & Monthly Tracking Mechanism
- Org Data Audit Mechanism (Org Audit + SQE Audit + Tool Validation)
- Yearly Baseline Mechanism (YBL/PCB)
- Quality Trend Analysis & POR Mechanism

Process Assets and Standards

- Q Data & SQAP Template
- SW Metrics Spec & Data Collection Guideline
- MA/QPM/OPP process & MA/QPM guideline
- Process Model Usage Guideline
- Metrics Automation Tools

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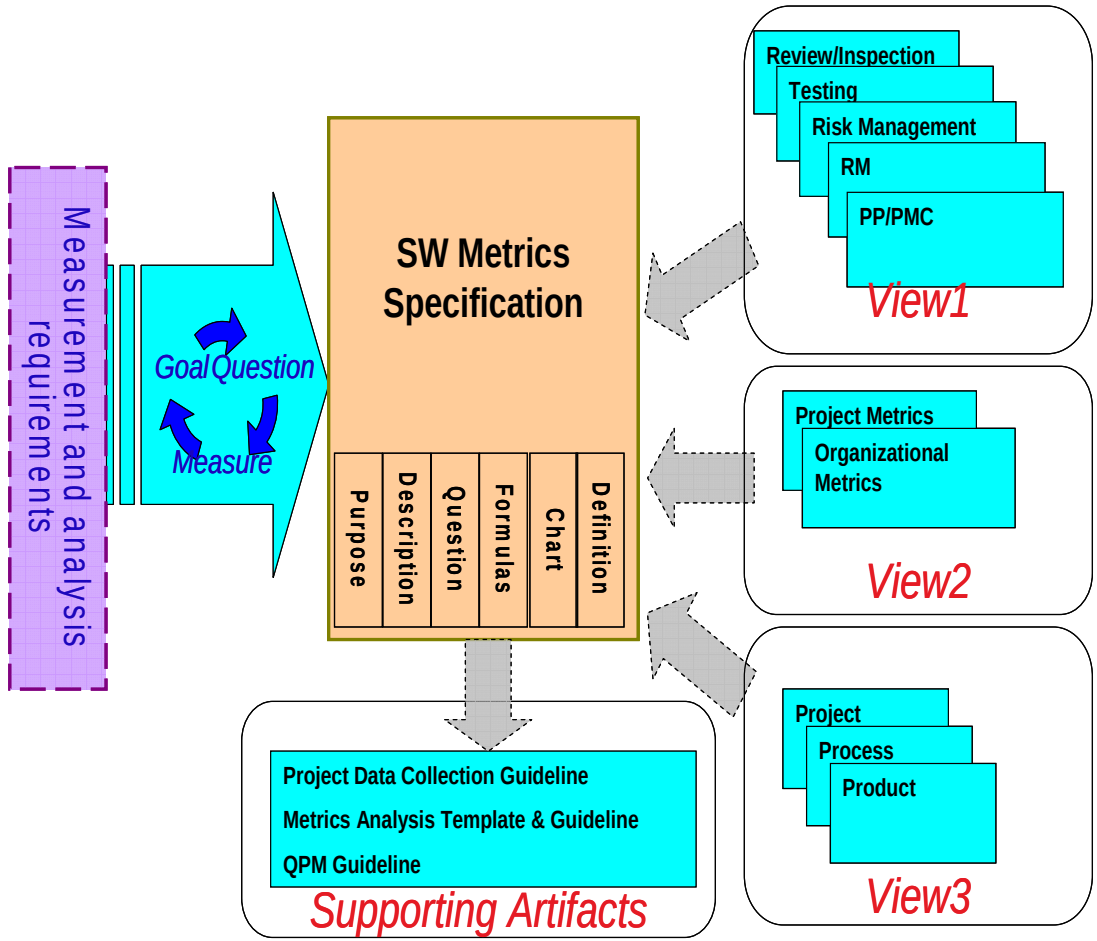
Metrics Dictionary

Define Common Measures of Performance

Business Needs &Value

Measures of
- **CMMI PA**
- **Product**
- **Project**



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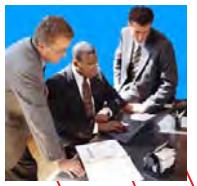
GSG Process Measurement Environment



Business Partner Environment

Manage By Data

Defect Tracking

EPMS Proj Mgmt

Inspection/Review DB

Change Mgmt

Asset Characterization

Beijing Team

Australia Dev Team

Project Metrics Data

Project Metrics Database

PMBOOK

Project Record

Center Goals/Baselines

Center Metrics Database

Site Metrics Database

Global Central Metrics Database

GSG Metrics Database

SMSC

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- Why to Measure
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- **What to Be Measured**
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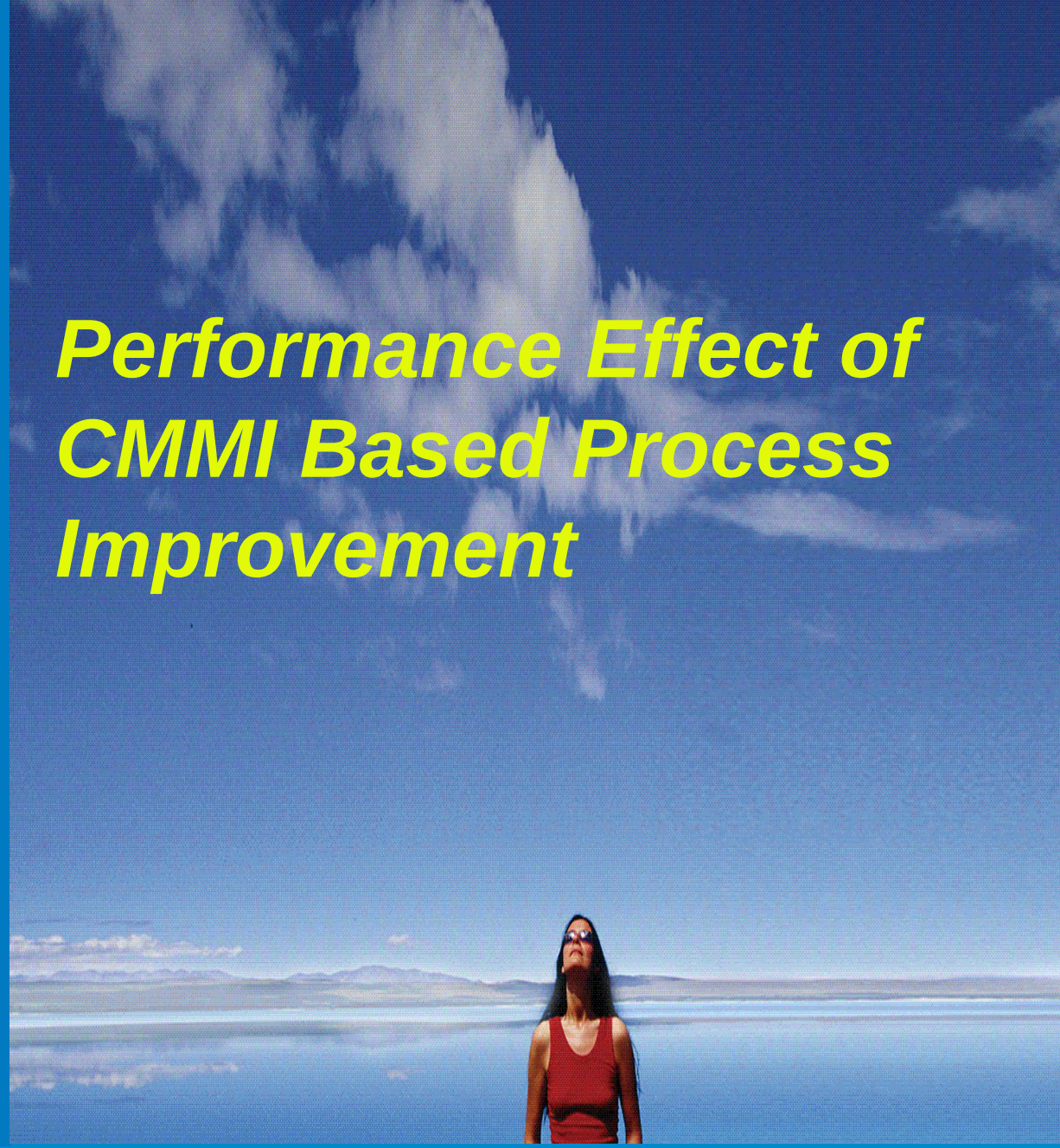
- Performance Result & Benefit

Performance Effect of CMMI Based Process Improvement



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ives & Benefit Analysis

Business Goal & Benefit

- *Productivity*
- *Schedule*
- *Cost of Quality*
- *Cost of Poor Quality*
- *Cycle Time*
- *ROI*
- *On Time Delivery*
- *Customer Satisfaction*

	BG1	BG2	BG3	BG4	BG5	BG6	BG7	BG8
PI-1 (PP)	✓	✓						✓
PI-2 (RSK)			✓		✓			
PI-3 (RM)	✓	✓			✓		✓	
PI-4 (CAR)					✓			
PI-5 (MA)						✓		
PI-6 (OID)			✓				✓	
PI-7 (VER-PR)				✓		✓		
PI-8 (VER-Test)				✓	✓	✓		
PI-9 (OPP)				✓				
PI-10(OID-2)						✓	✓	

Process Initiatives : All major initiatives will have ROI analysis in POR System

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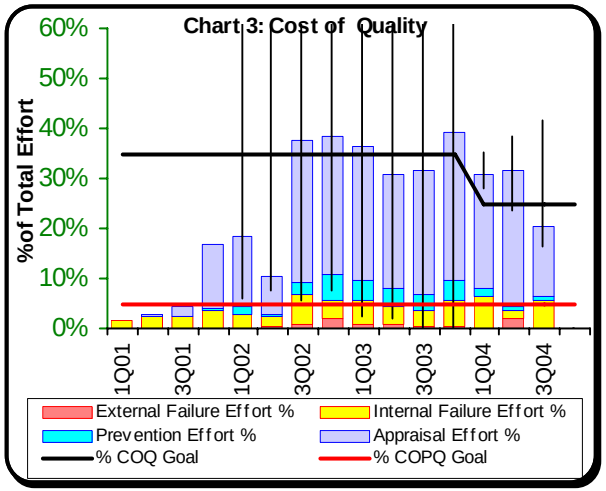
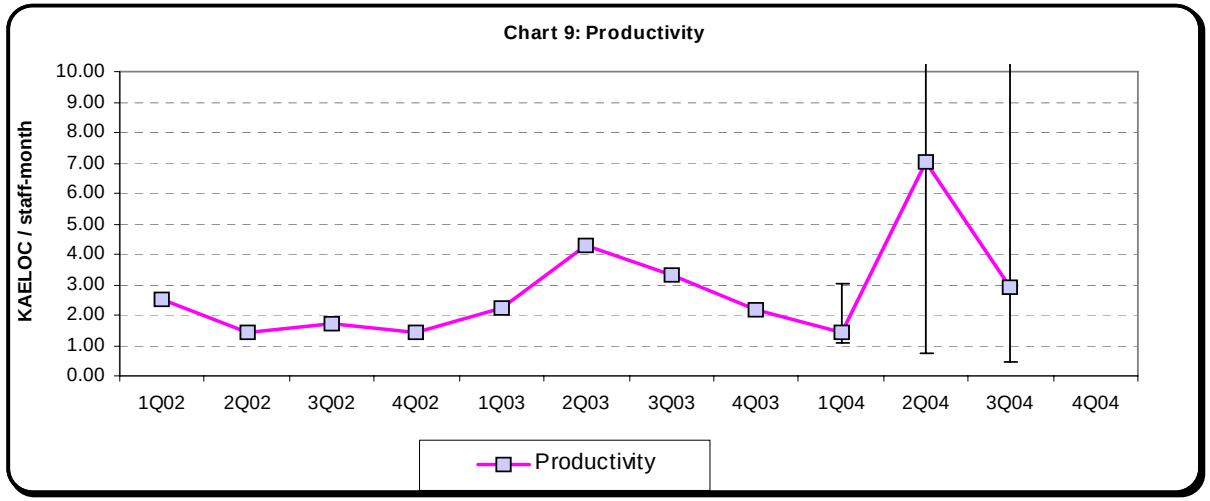
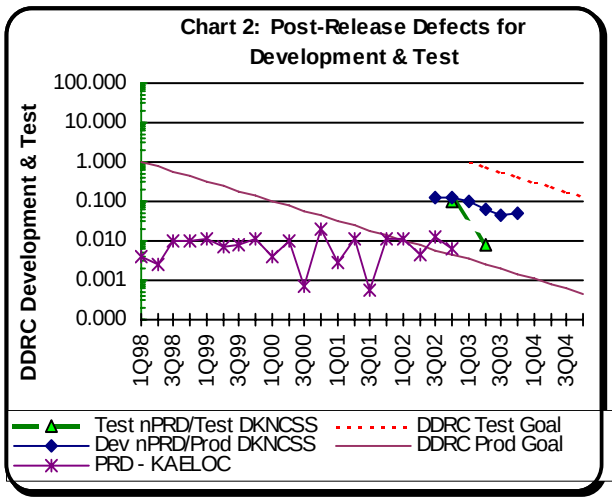
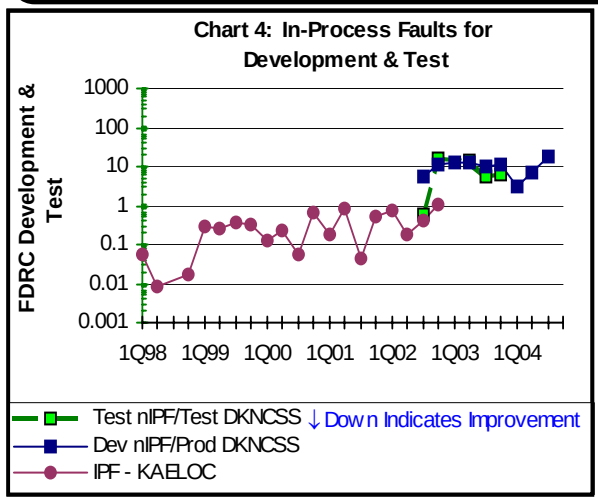
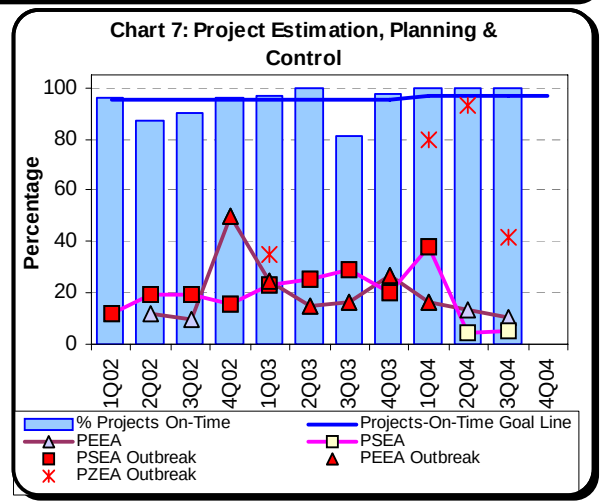
Organization Performance Tracking











GSG Software Metrics Summary Chart (SMSC)

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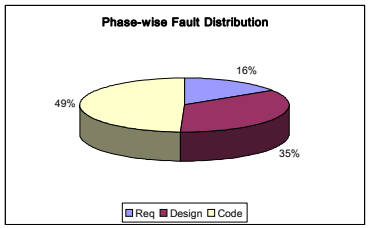
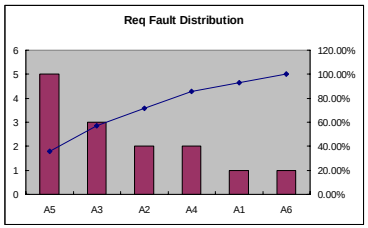
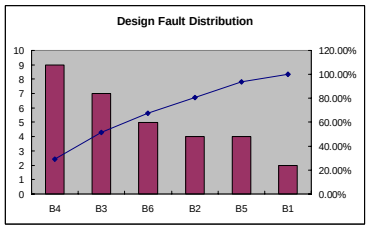
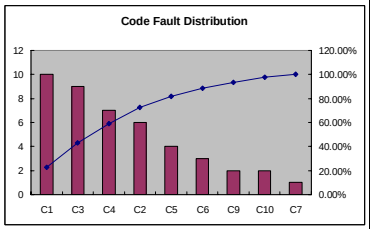
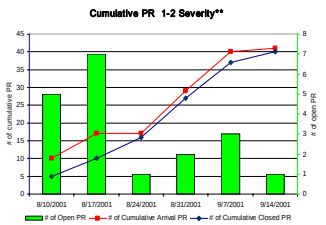
Project Performance Dashboard

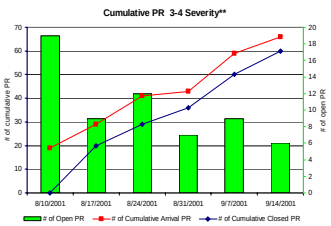


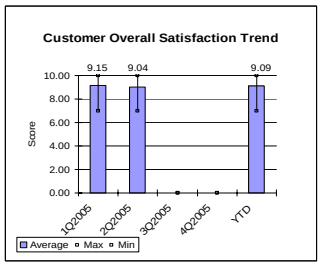


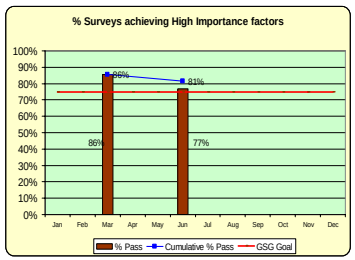












Current Phase: [ ]

Key Metrics Summary Chart

As up to: [mm/dd/yyyy]

Project Category: [DEV/CLC/POR-DEL/VSP]

	Actual	Est.latest	Est.Initial
Effort(Stf Wks):			
Cycle Time(Wks):			
Prod. Size(DKNCSS):			
Prod. Size(KAELOC):			

SPR1(LOC/Staff Hour)			
Current		Goal	
Baseline		UCL	
Avg.		LCL	

SPR4(LOC/Staff Hour)			
Current		Goal	
Baseline		UCL	
Avg.		LCL	

IPF - Total(nIPF/DKNCSS)			IPF - Major
Current			
Goal			
Baseline		UCL	
Avg.		LCL	

COQ			
Current		Goal	
Baseline		UCL	
Avg.		LCL	

COPQ			
Current		Goal	
Baseline		UCL	
Avg.		LCL	

		Phase Detected					Statistics	
		Req	Design	CUT	IT	ST	Projected Faults	Actual Faults
Phase Introduced	Req							
	Design							
	CUT							
PCE Actual								
PCE Goal								
PSE Actual								
PSE Goal								

Measure the Performance at different level

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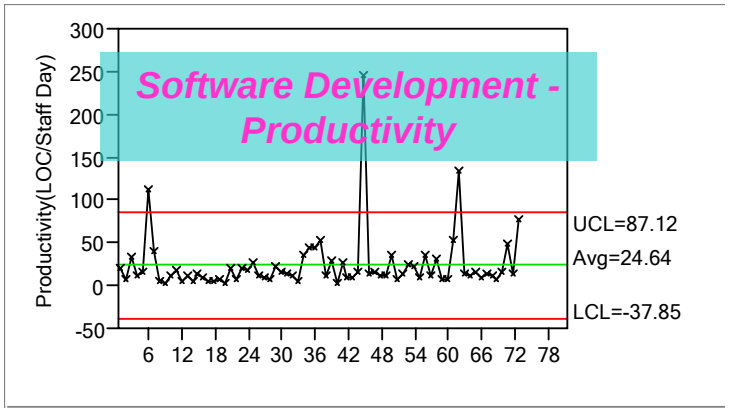
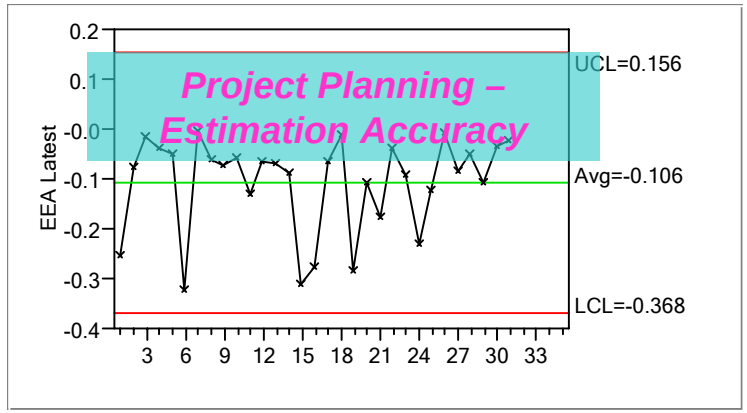
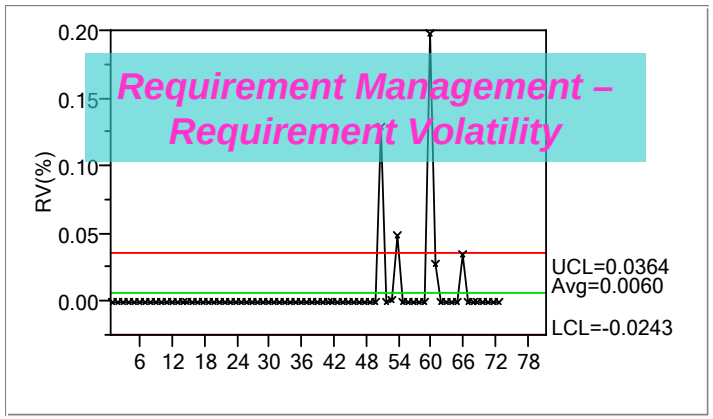
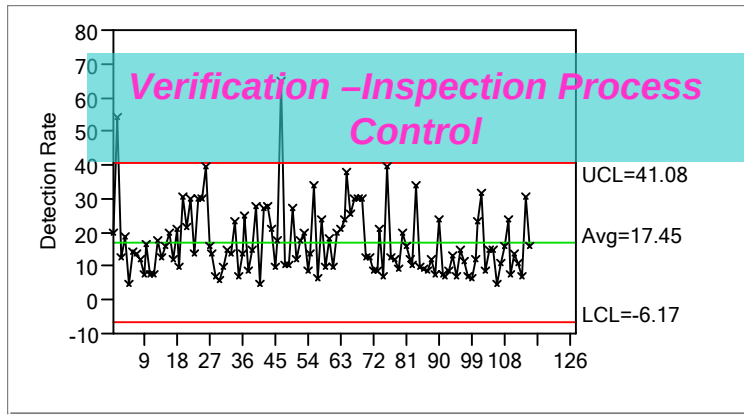
Process Performance Baseline









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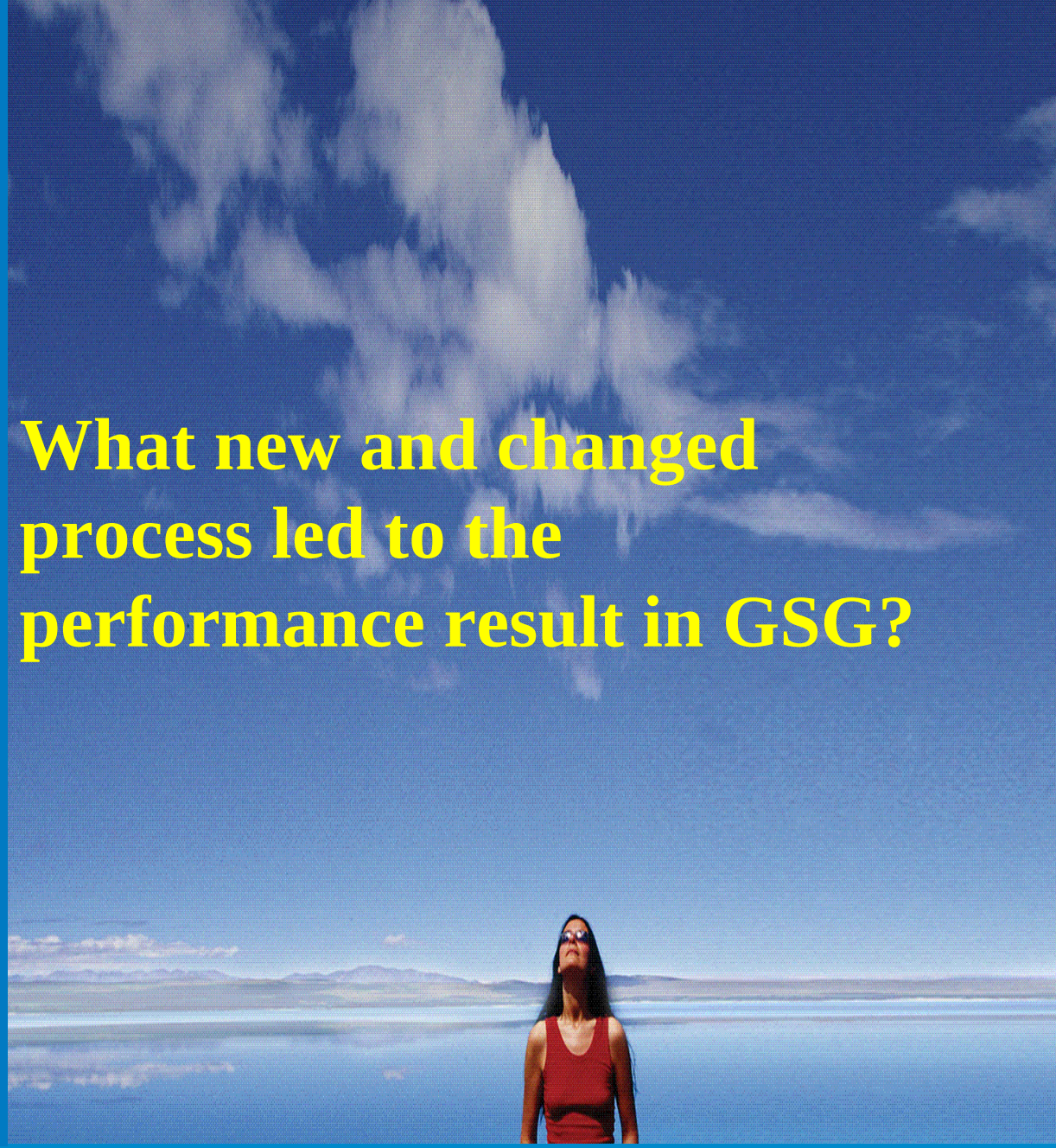
- Why to Measure
- How to Measure
- What to Be Measured
- **What Changes to Lead the Result**
- Performance Result & Benefit



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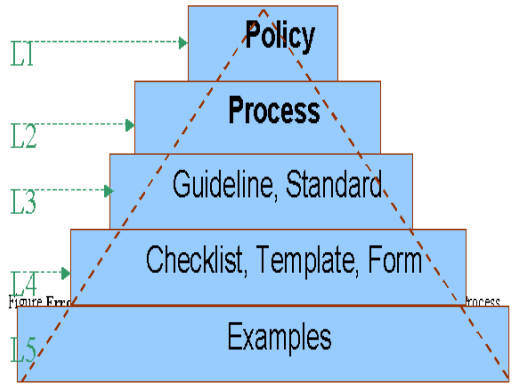
Process Architecture and Integrated Project Process

- GSG Process Hierarchy Structure

  Adapted to accommodate process changes due to CMMI.



- Tailoring Flexibility

  Organized to assist the projects on process model selection, and provides guidance and flexibility to select and tailor the processes at a detailed sub-process level.

- Easy Access

  The process asset library can be accessed by several criteria, including CMMI process areas, phase, process templates, checklists, and other types of documents.

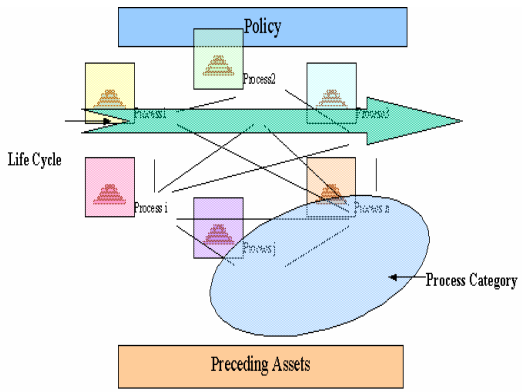


Figure 2-1 Overview of Organizational Process Hierarchy

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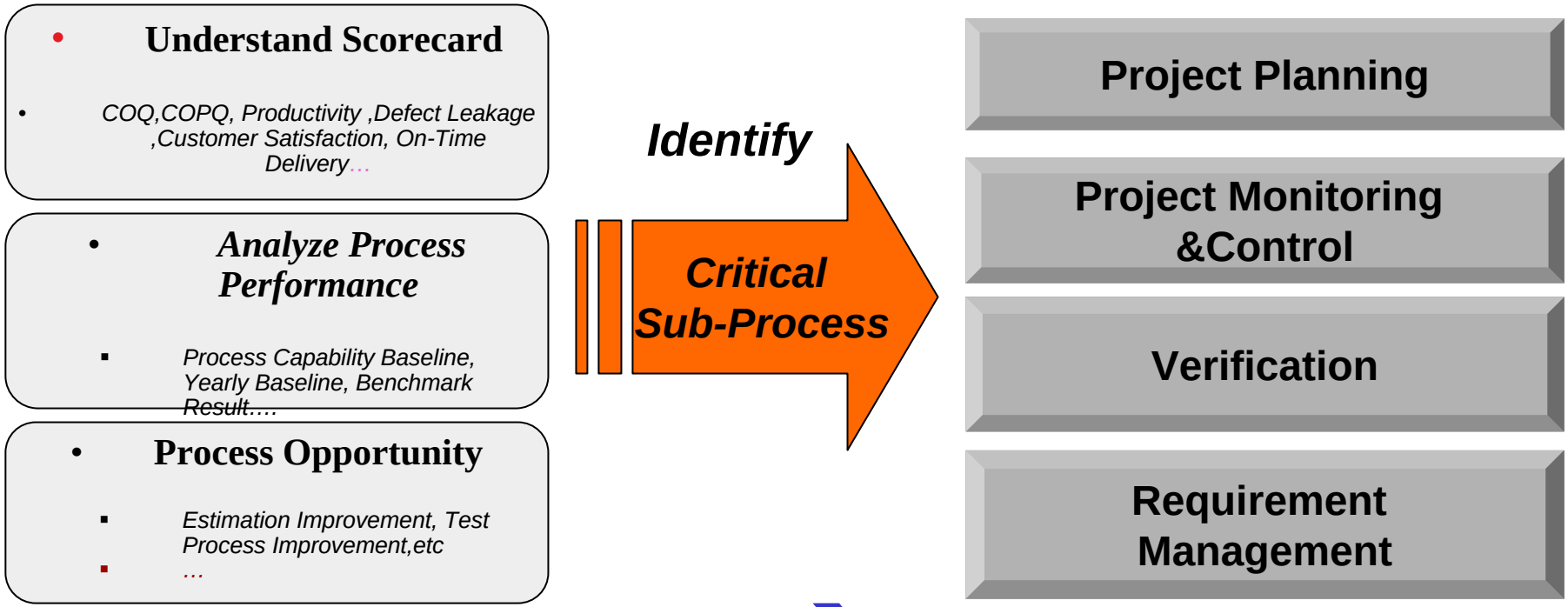
Quantitative Project Management Process

Focus more on critical processes aligned with business objectives, particularly in the areas of requirements management and verification.



Define the Measures › Measure Performance › Monitor Performance › Stabilize Process
› Control Process › Improve Process Performance › Measure the Benefit Result

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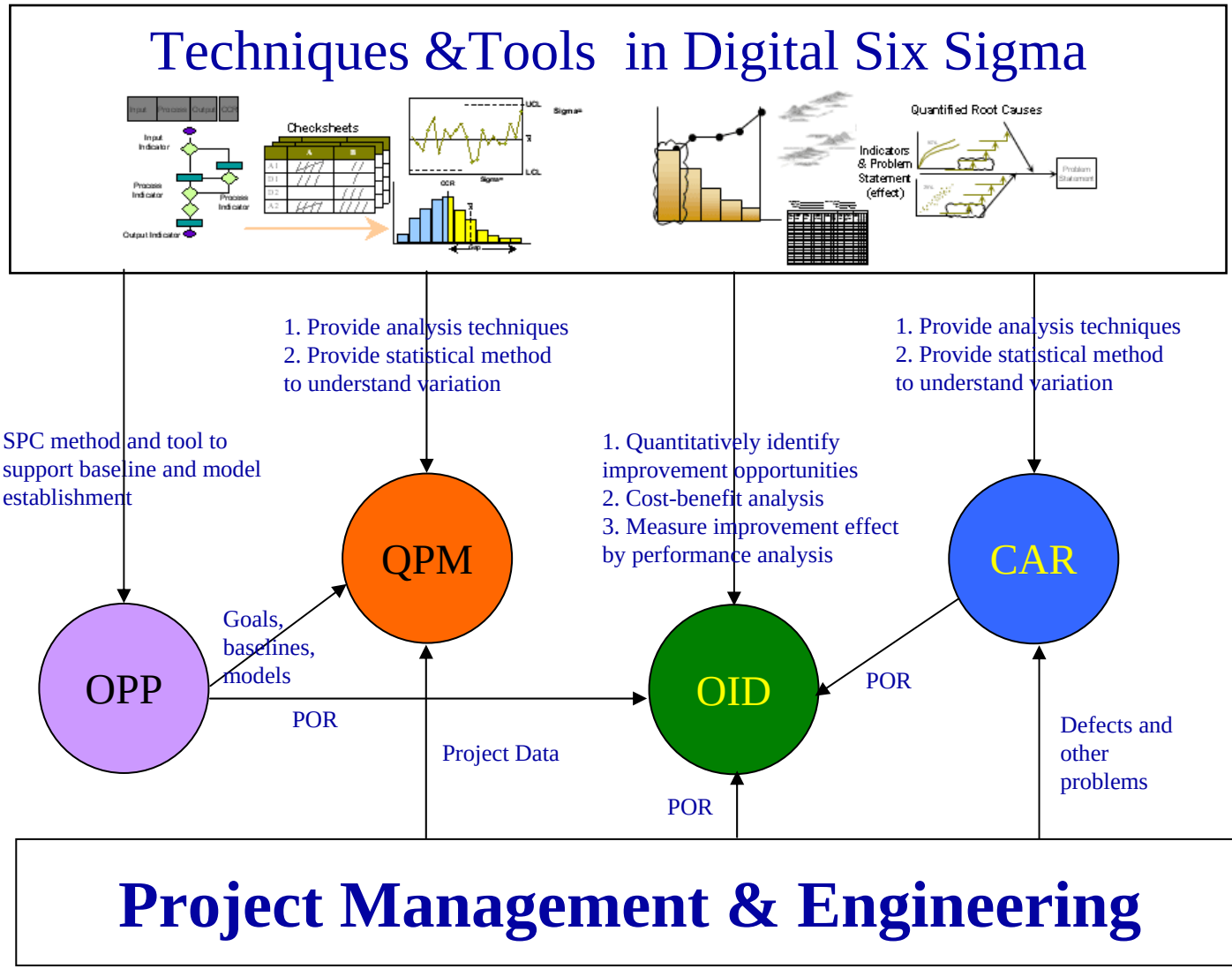
Using of High Level Process Area

Using of Support Process Area



Using of High Level Process Area

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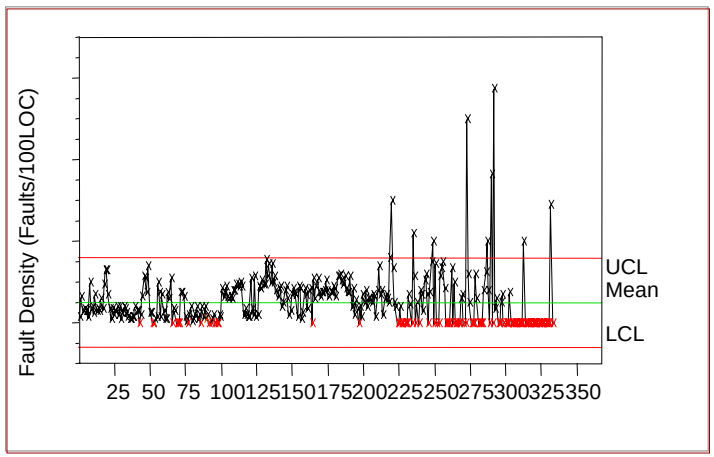
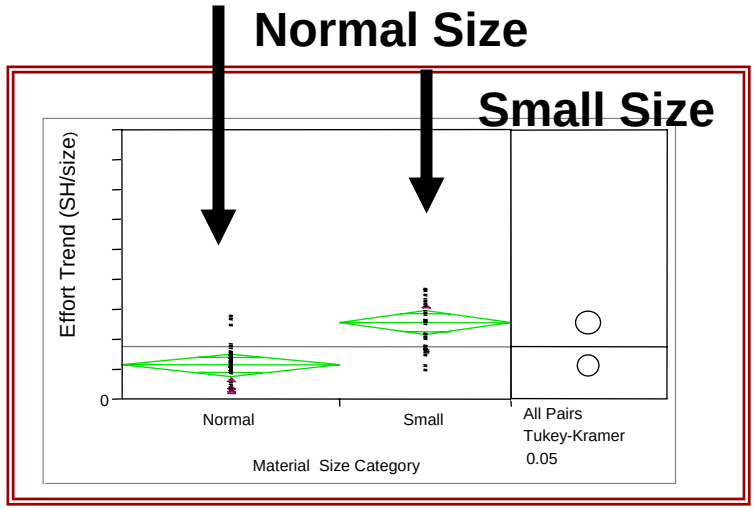
Support Verification Process Improvement

◆CAR and OID-based processes were used to improve verification process effectiveness without compromising quality in specific classes of cases.

◆The formal process rules the Center previously used were less effective for smaller documents and project teams.





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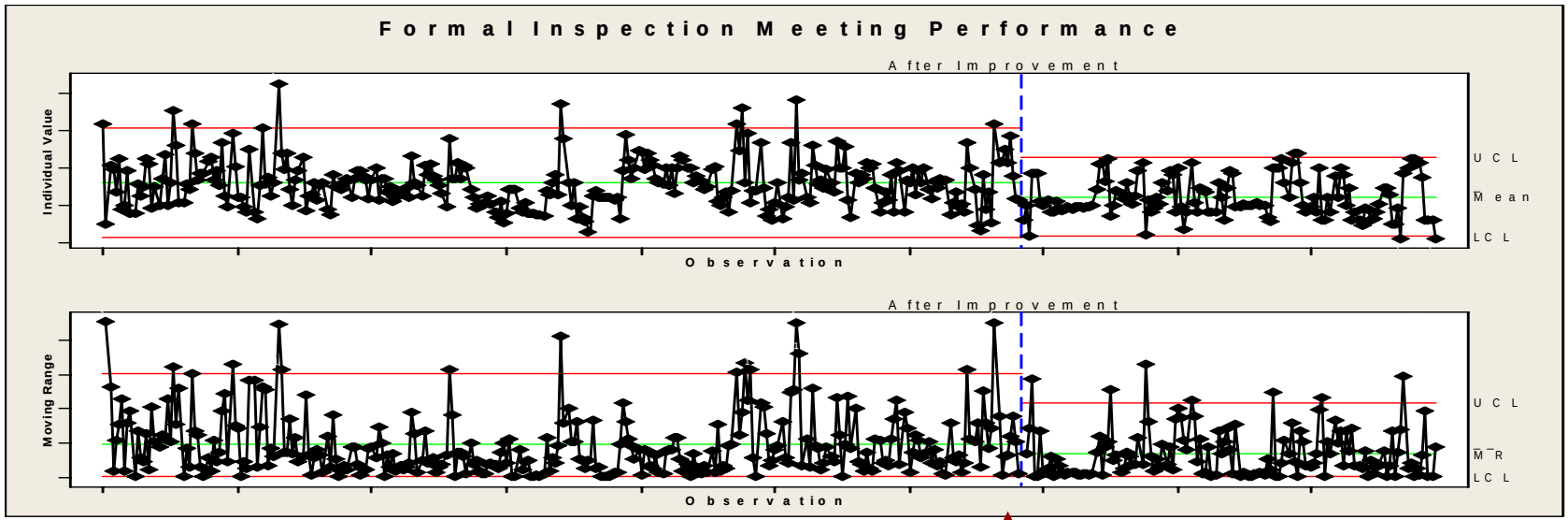
Inspection Process Improvement

◆Mini-reviews and mini-inspections were introduced; effort and cost were reduced without affecting defect density. The results were used to establish new baselines for planning and quantitative project management.



Before Improvement → After Improvement

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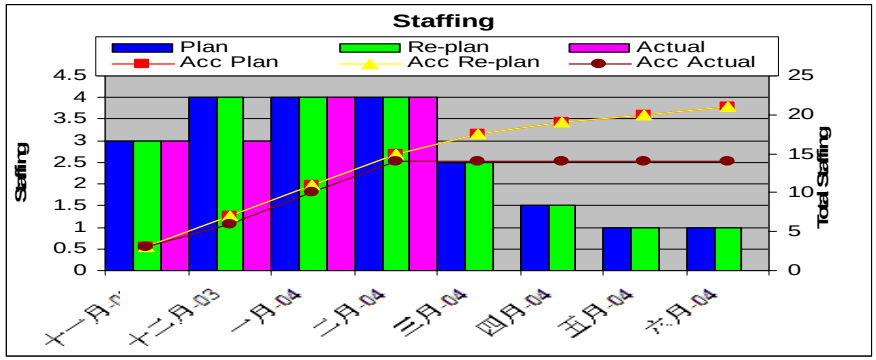
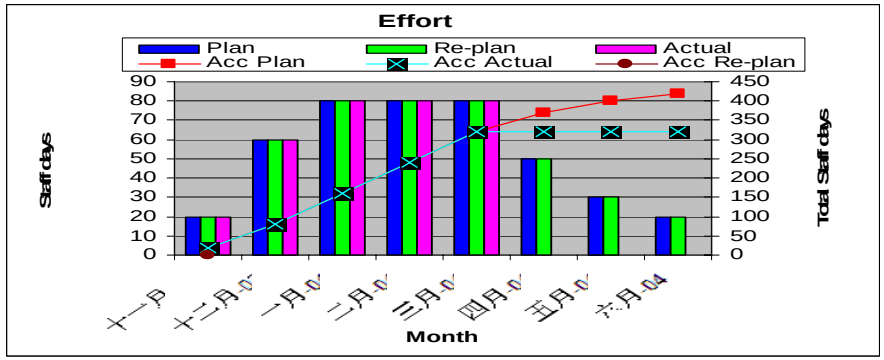
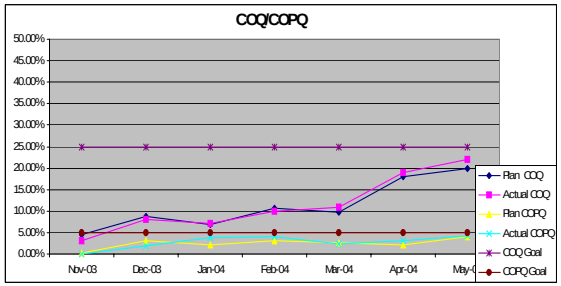
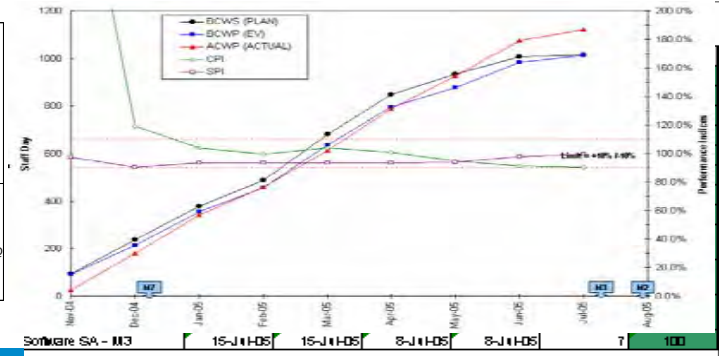
Enterprise Project Management System

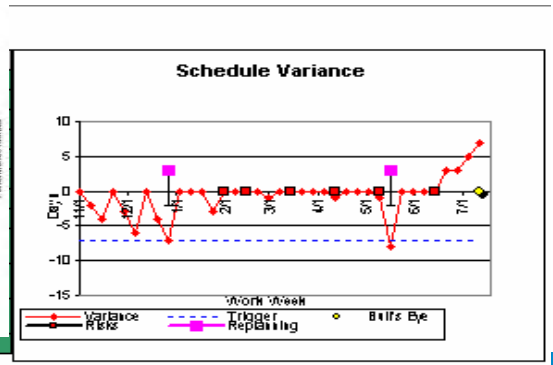
- **Use Enterprises Project Management System (EPMS) as a common project management platform to manage global team**
- **Use Project Pamphlet as a local supply tool of EPMS for PM performance tracking**











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Requirement Management Process Improvement

RM Improvement is based on guidance in CMMI

◆**Requirement Volatility**

Late additions and changes to requirements are measured.

◆**RM Process Performance and Management**

F *The project level results then are rolled up to the organizational level for senior management insight*

F*Set control limits for future use in quantitative process management of requirements volatility*.

◆**Use of RM Measure Result**

The measured and estimated impact of the requirements changes

F*Led to new project processes for replanning, estimation, and*

F*A factual basis for negotiation with customers.*

Better Manage the Change	Better Project Management	Delight the Customer

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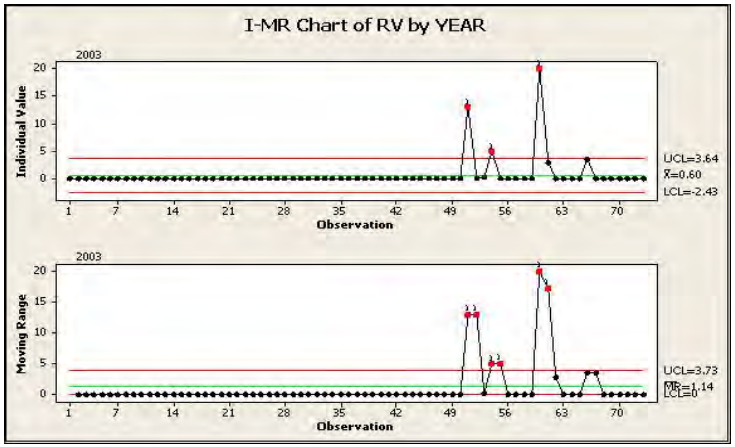
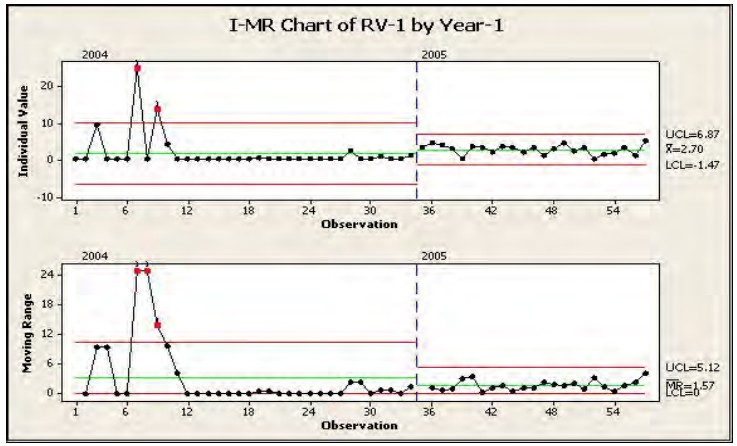
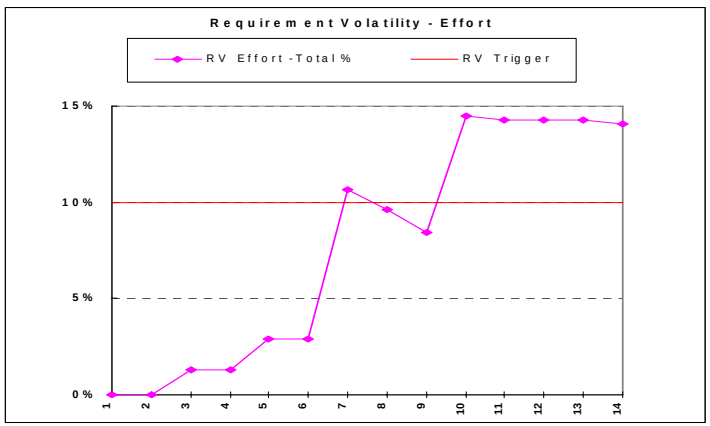
Requirement Management Process Improvement

2003 – Before CMMI



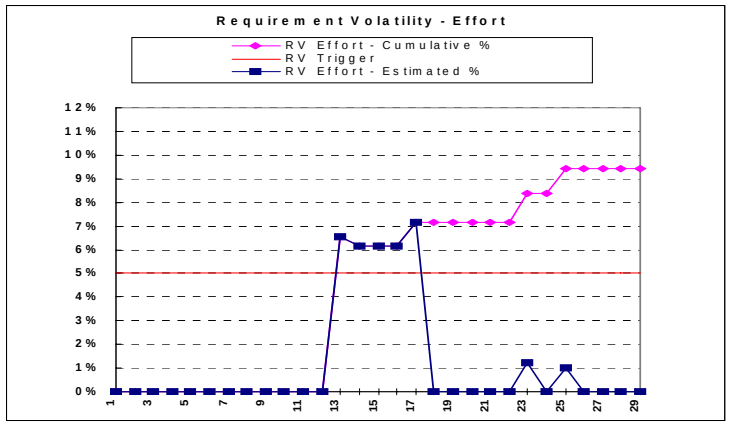
2004/2005 – After CMMI





Improvement Action:

1. RM process
2. IAD template
3. RM TRMX template
4. RV data sheet



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Decision Analysis and Resolution

◆New practices based on the CMMI Decision Analysis and Resolution (DAR) process area were used to improve the Center's managerial and engineering processes, particularly those that map to *Technical Solution, Configuration Management, and OID process areas*

.

◆These DAR-based practices have been applied to improve decision making effectiveness at both the organization and project level.

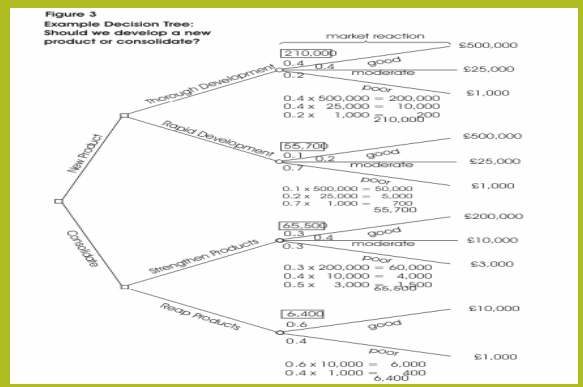
Decision ⟵ ***ROI Analysis***

Weighted-Average

Project Name: xxx

Criteria >>>	Cost	Schedule Impact	Benefit	Customer Satisfaction	Performance	
Relative Importance >>>	6	10	10	6	4	
Alternatives	Ranking					Weighted Average
A1	3	2	4	7	3	3.7
A2	2	6	4	5	3	4.3
A3	6	3	3	3	5	3.7
A4	1	8	3	2	5	4.1
	0	0	0	0	0	0.0
	0	0	0	0	0	0.0
	0	0	0	0	0	0.0
	0	0	0	0	0	0.0

Weighted-Average



Decision Tree

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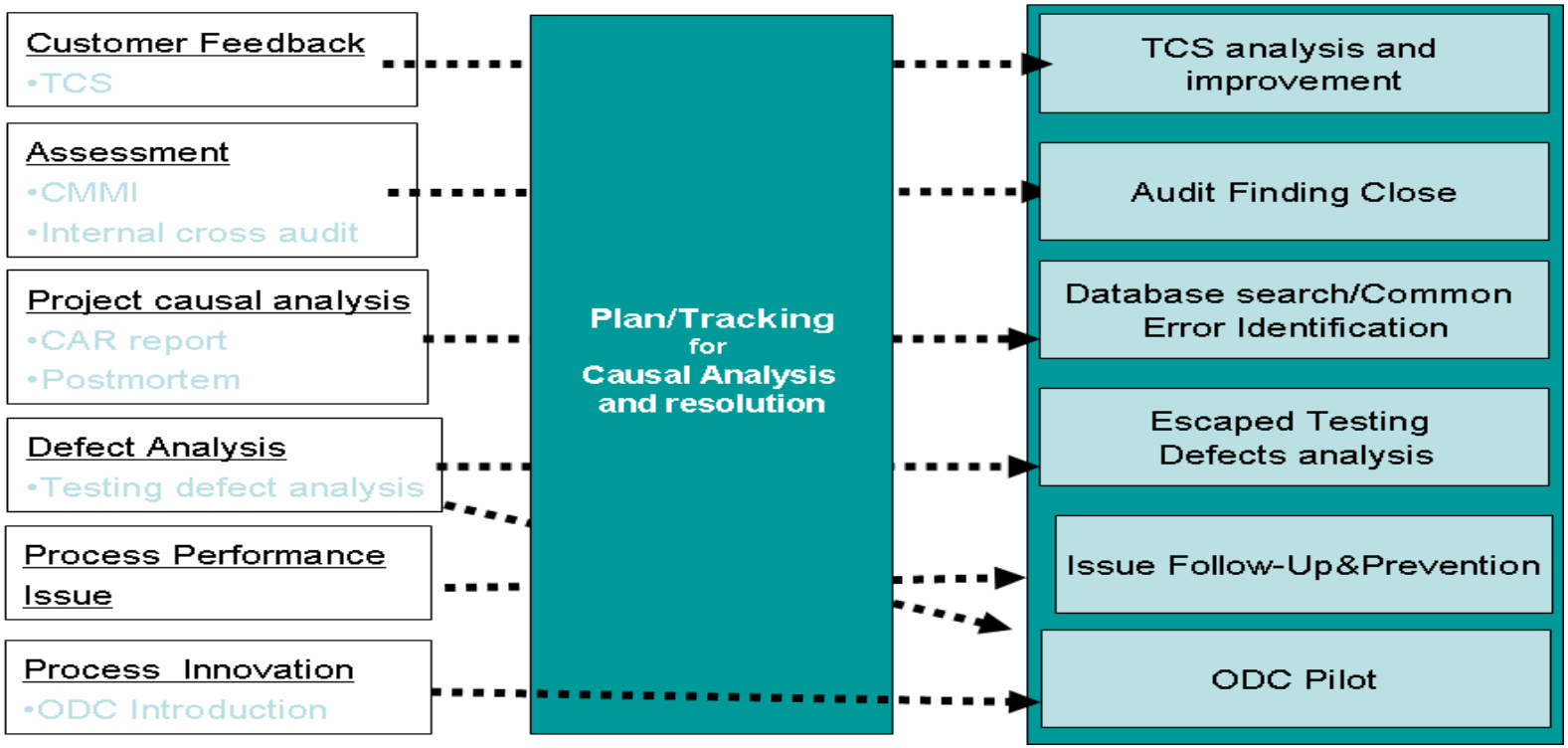
Causal Analysis Improvement

Shifted its focus on causal analysis processes from the relatively narrow defect prevention perspective in the SW-CMM to the broader problem prevention focus in CMMI



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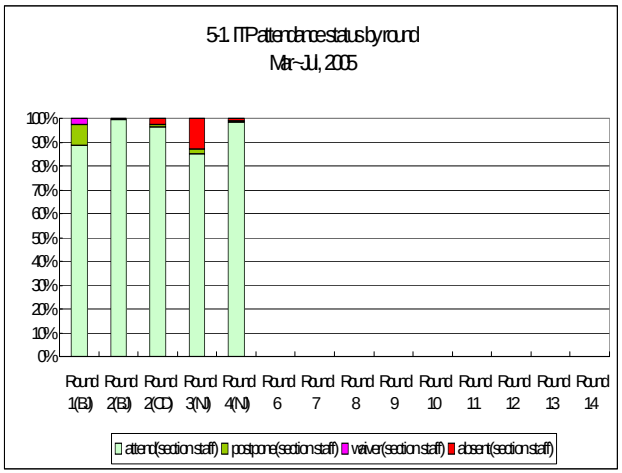
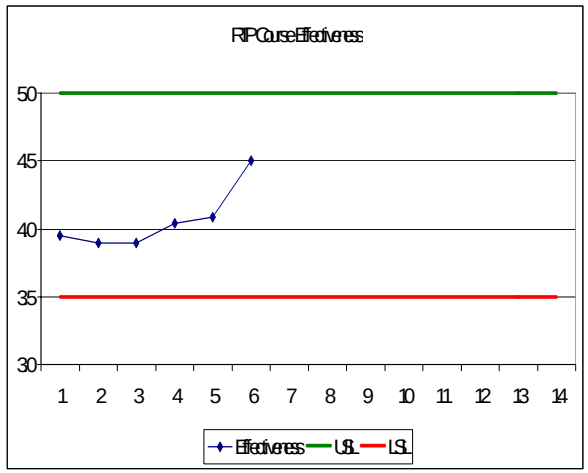
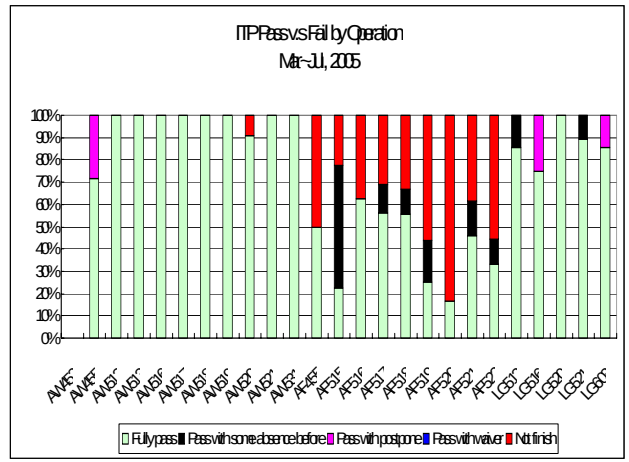
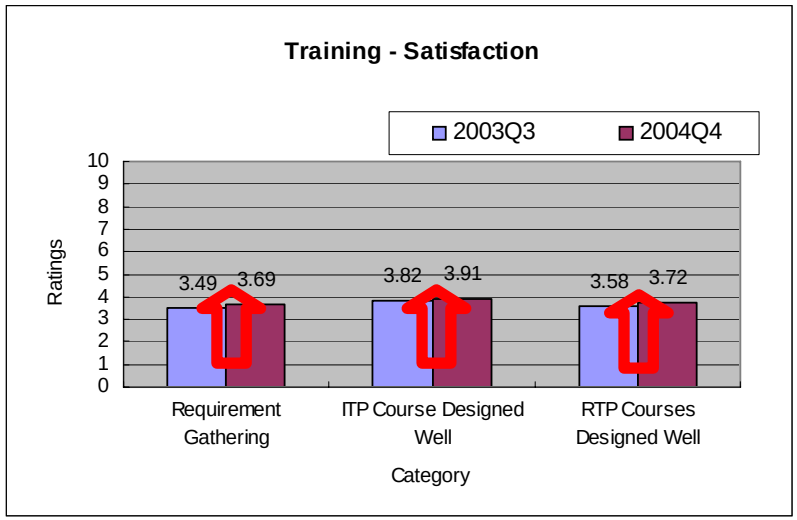
Improve Training Measurement ->

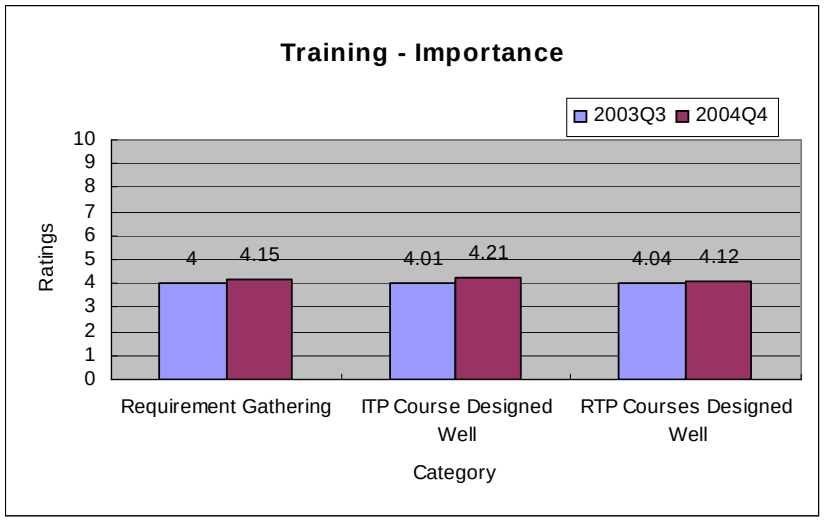
Improve Training Cost Effectiveness











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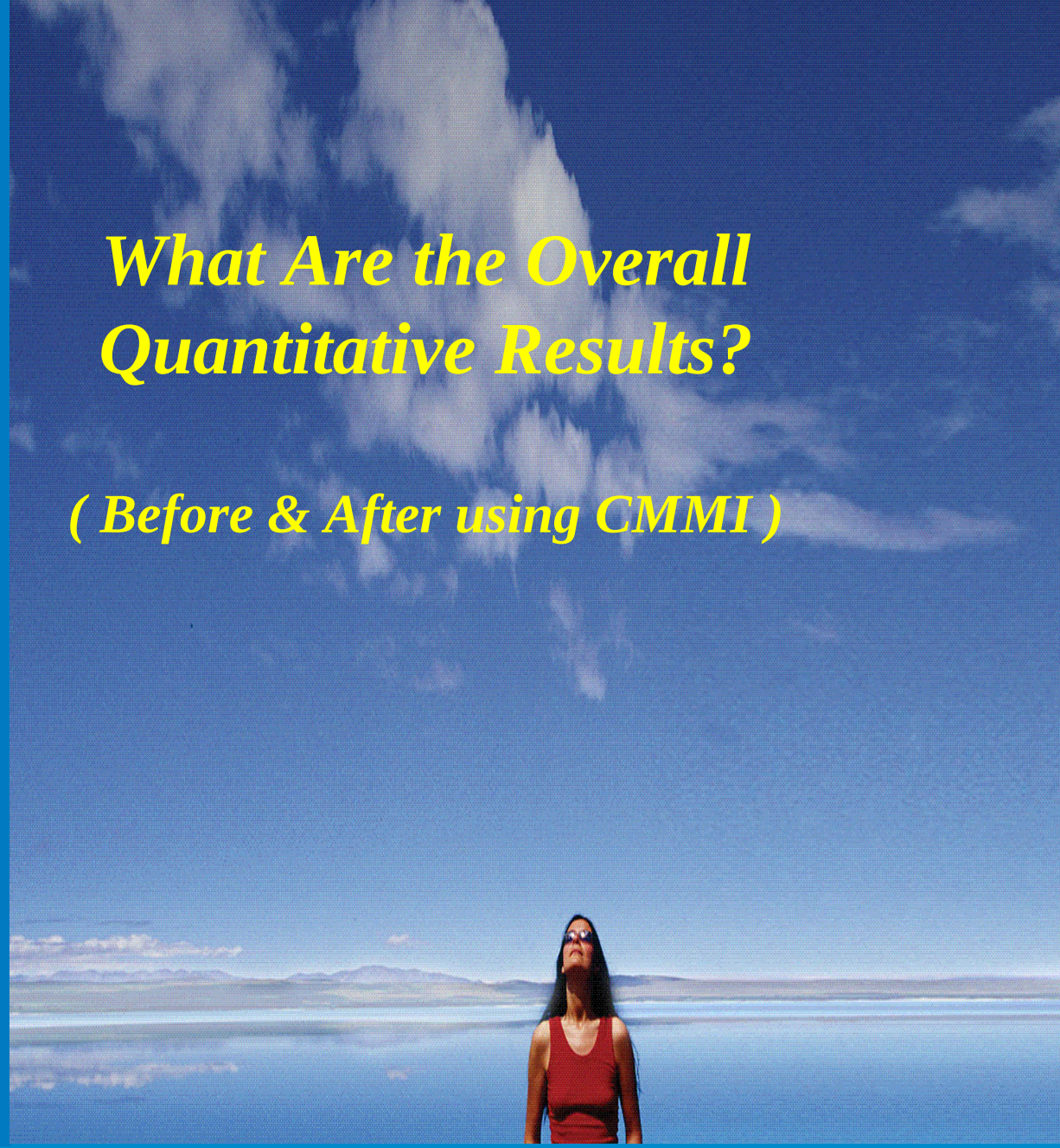
- Why to Measure
- How to Measure
- What to Be Measured
- What Changes to Lead the Result
- Performance Result & Benefit

What Are the Overall Quantitative Results?

(Before & After using CMMI)



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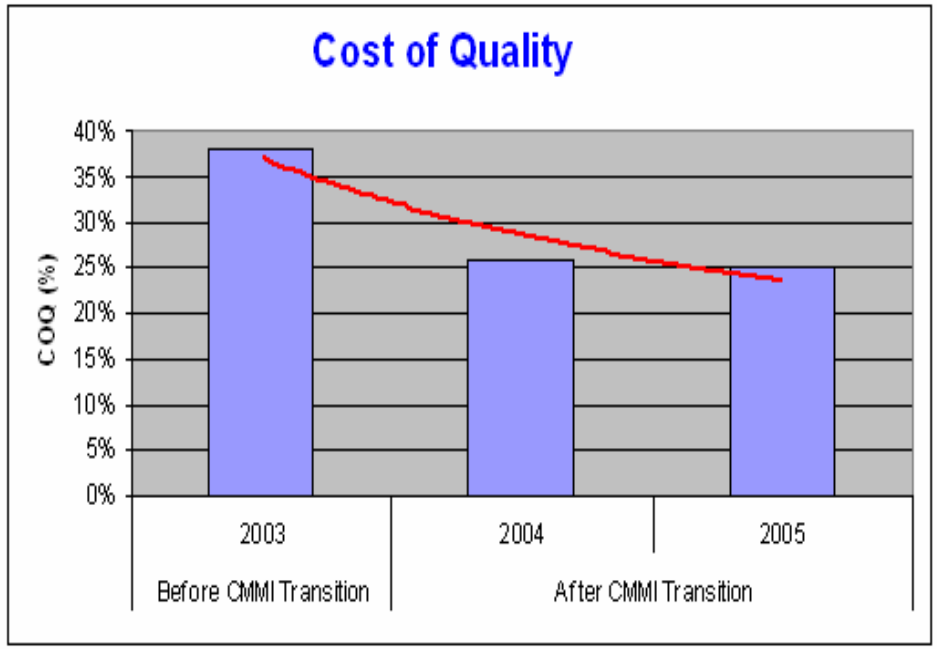
◆Performance Result & Benefit

- COQ
- IPF
- EA
- PCE
- TCS

Reduction of Cost of Quality



COQ Reduction by one-third from pre-CMMI baseline due to improvement in verification, peer review and software test process.

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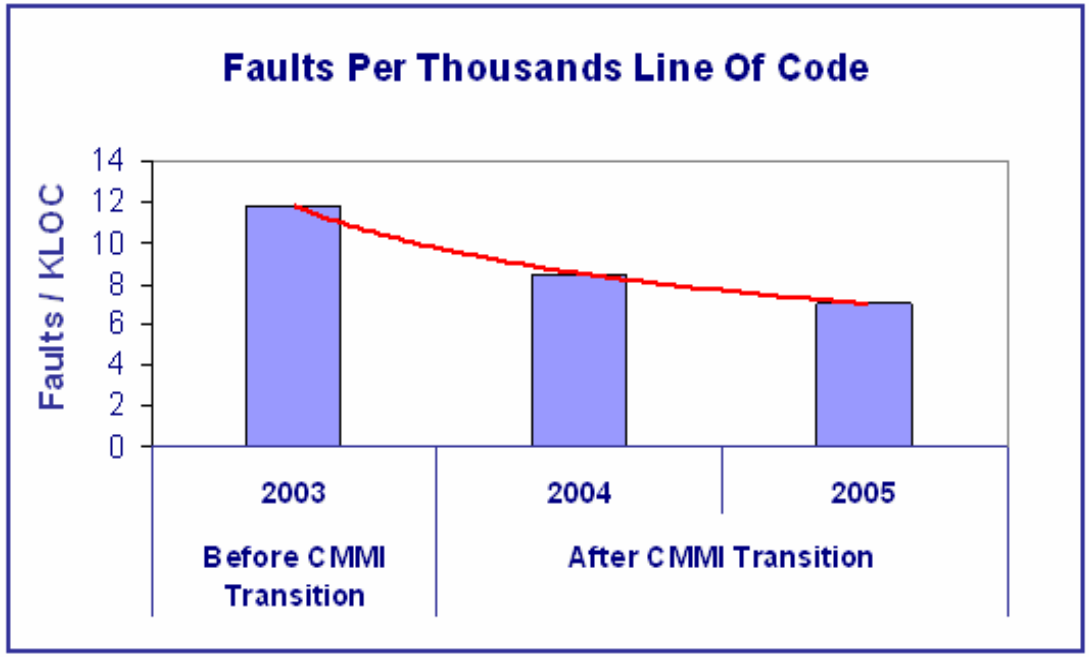
◆Performance Result & Benefit

- COQ
- IPF
- EA
- PCE
- TCS

Improvement in Fault Density



IPF Reduction by 40% due to improved Casual Analysis and Resolution (CAR) procedures by implementing real time RCA and by improved verification process

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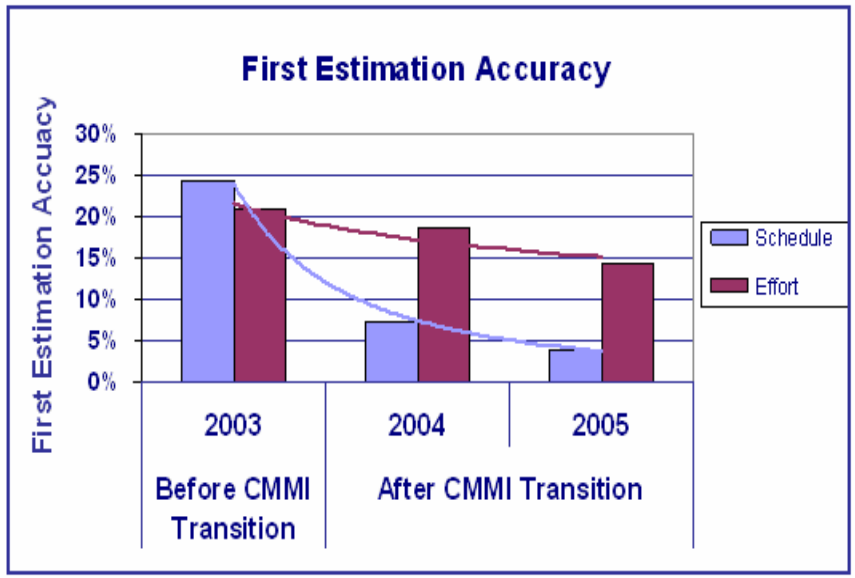
Improvement in Estimation Accuracies

◆Performance Result & Benefit

- COQ
- IPF
- **EA**
- PCE
- TCS



Improvement in Effort Estimation accuracy by 31% and Schedule duration by 84% - due to improved Project Planning and tracking practices.

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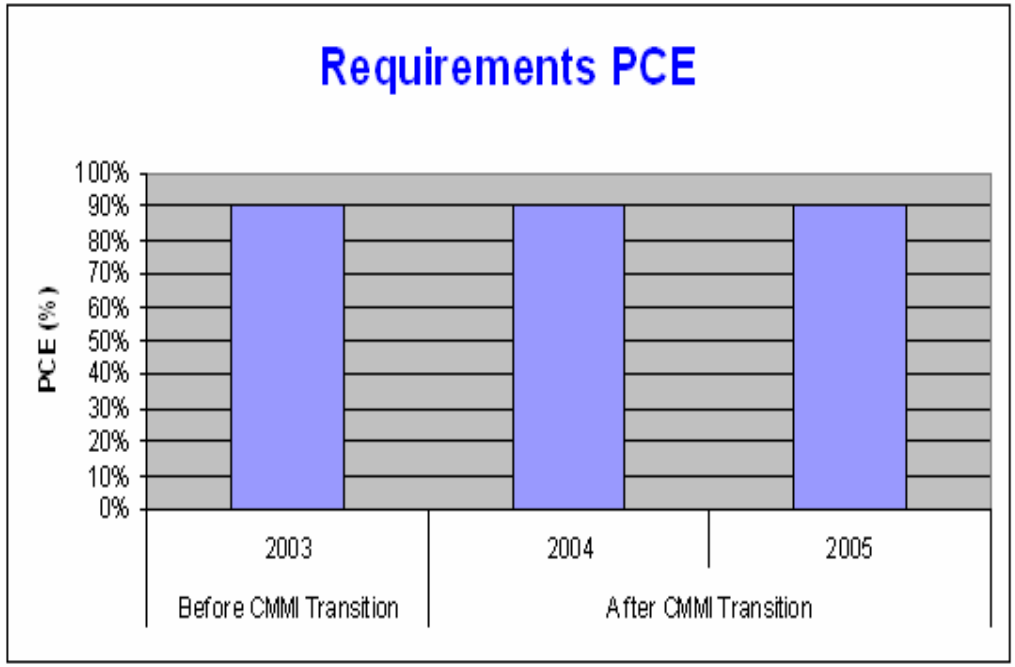
Requirement Phase Containment

◆Performance Result & Benefit

- COQ
- IPF
- EA
- PCE
- TCS



Requirements PCE sustained at 90%

in spite of enormous organizational growth and constant requirement churn in number of projects.

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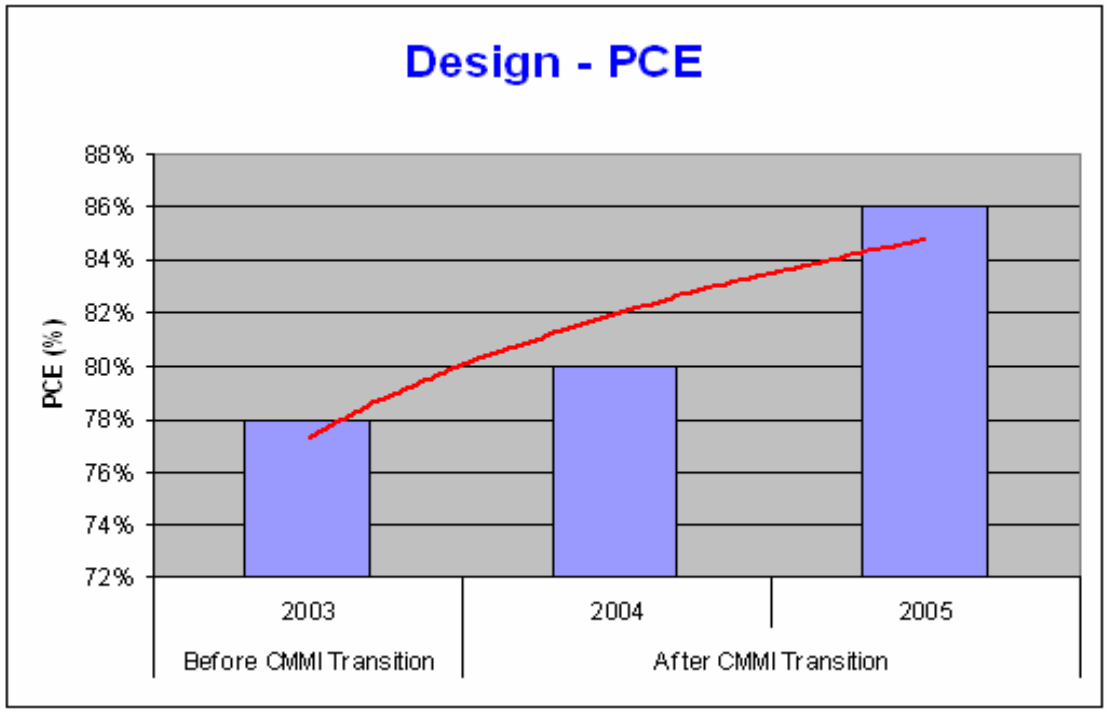
◆Performance Result & Benefit

- COQ
- IPF
- EA
- PCE
- TCS

Design Phase Containment



Design PCE improved by 8%

Improvements were due to improved Verification, Technical Solution and Organization Training process areas

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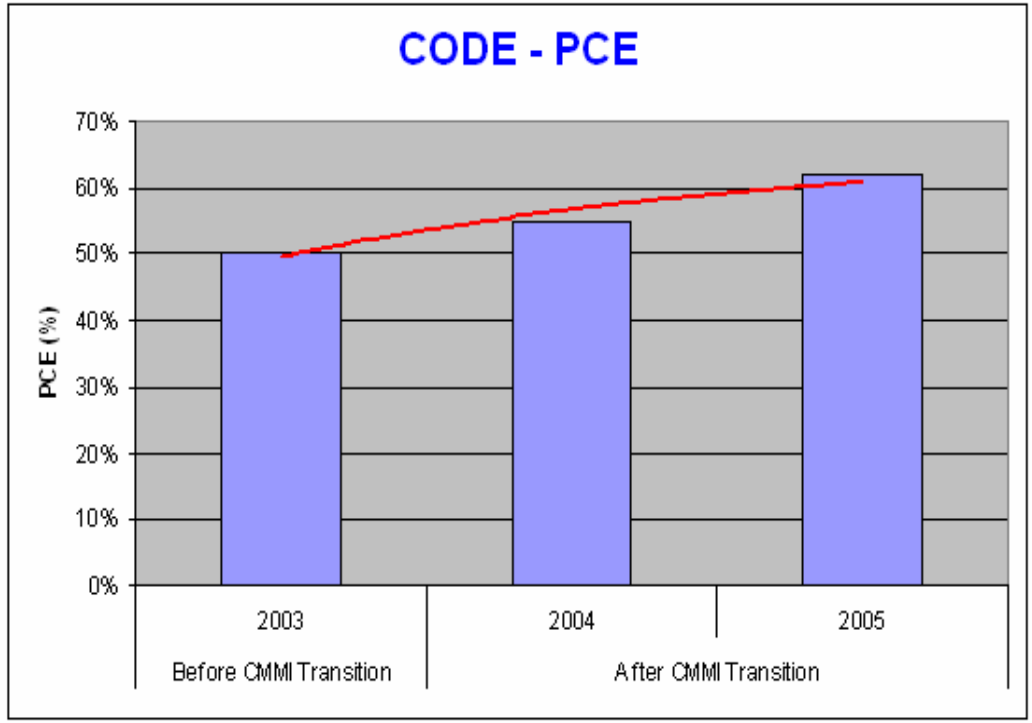
Code Phase Containment

◆Performance Result & Benefit

- COQ
- IPF
- EA
- PCE
- TCS



Code PCE improved by 12%

Improvements were due to improved Verification, Technical Solution and Organization Training process areas

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Customer Satisfaction

◆Performance Result & Benefit

- COQ
- IPF
- EA
- PCE
- TCS

J Consistently received high TCS scores (9/10) with a sustained 100% on-time delivery rate

J Continued to exceed customers' expectations to show the ability to deliver cost effective, high quality products on time by providing excellent technical solutions and project execution.

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- Why to Measure
- How to Measure
- What to Be Measured
- What Changes to Lead the Result
- Performance Result & Benefit

Business Benefit

F Customer Satisfaction
Sustain to exceed customer expectation (+9/10)

F Business Growth
GSG Population 2225 (Y2000) - > 6840 (2006)

FEngagement Capability
Model Level->System Level->Product Level

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- Why to Measure
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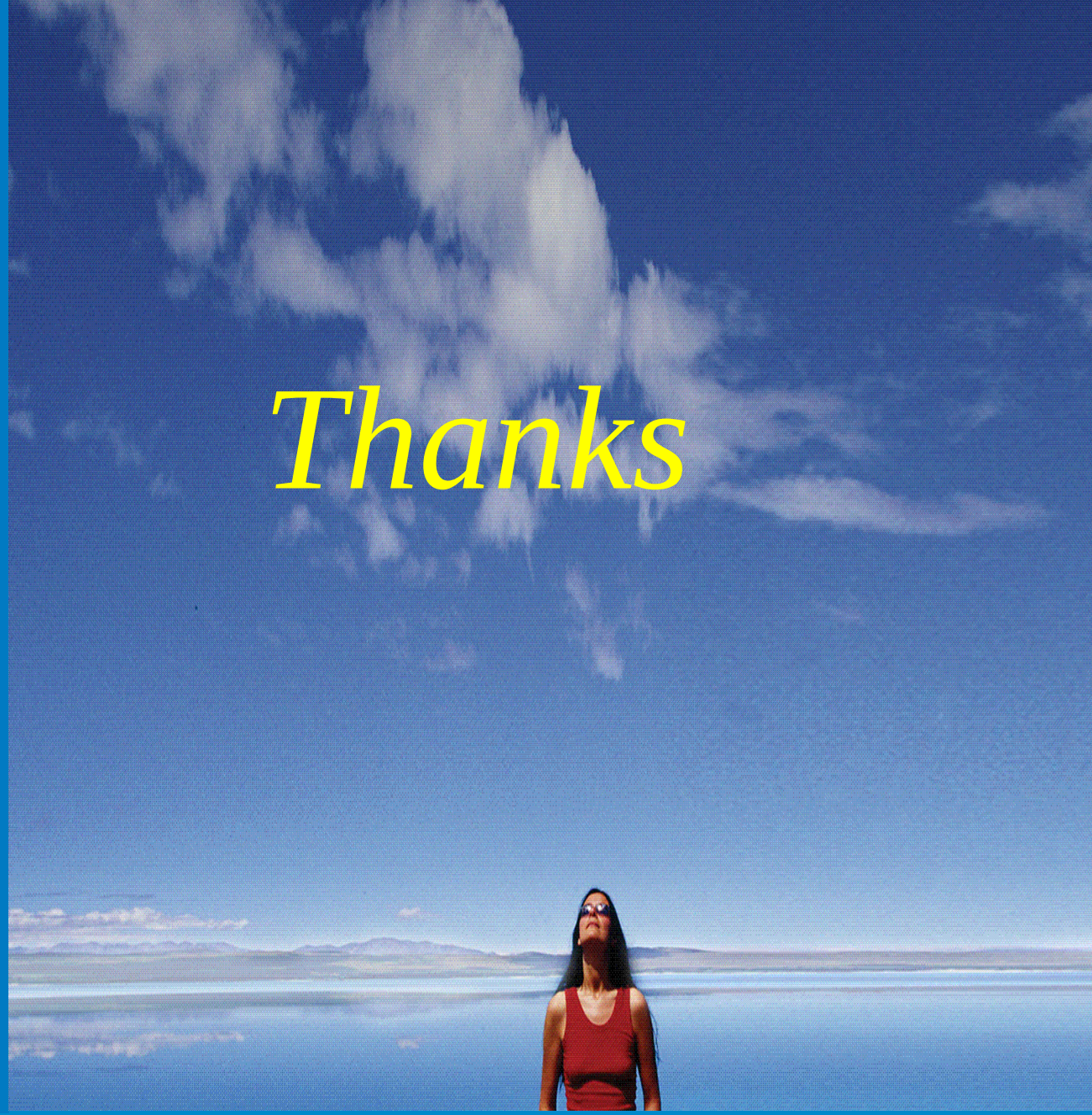

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Raytheon

Customer Success Is Our Mission

Do you understand why Level 3 comes before Level 4 which comes before Level 5?

National Defense Industrial Association
***6th Annual* CMMI® Technology Conference and User Group**
November 13-16, 2006

Author's Name(s): Nancy M. Raymond
Linda A. Kovar

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Introduction

- This presentation describes key items that help in the understanding and communication of the relationships between CMMI® Levels 3, 4, and 5, including
  - how Quantitative Project Management (QPM) activities build on the Measurement and Analysis (MA) activities
  - how Organizational Process Performance (OPP) feeds QPM and QPM feeds OPP
  - how Organizational Innovation and Deployment (OID) activities build on the Organizational Process Focus (OPF) activities
  - how QPM is tied to both the OID and Causal Analysis and Resolution (CAR) activities
  - how the Raytheon Six Sigma™ process relates to the CAR process area
  - the Level 4 and 5 inter-relationships from the program and organization perspectives

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Importance of Understanding the Relationships

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- Consistency in CMMI interpretation is essential to a successful appraisal
- The organization focus should be on "Does it make good business sense and does it meet the intent of the CMMI model?"
- Understanding the Level 4 and 5 relationships within the CMMI model helps clarify how the business meets the intent of the model

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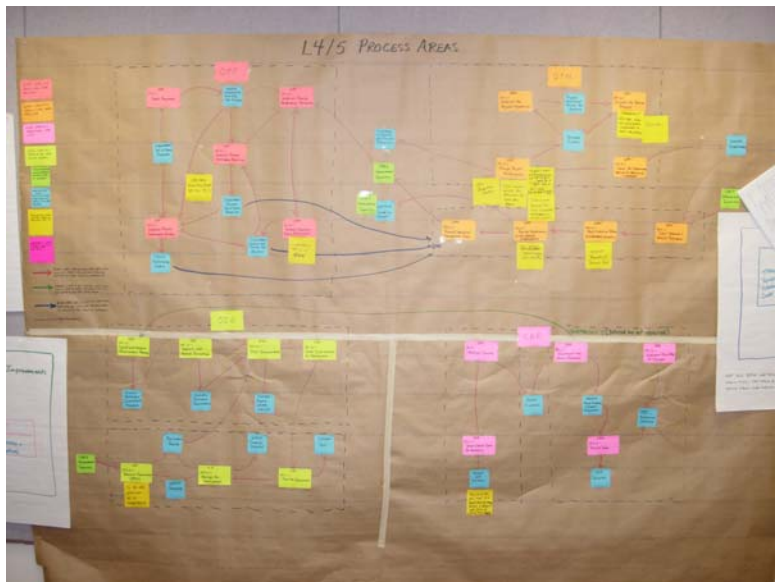
Process to gain understanding

- After Class C SCAMPIs it was clear there was:
  - Misunderstanding and miscommunication about the Level 4 and 5 **interpretation and expectations**

- To address the issue, our organization held an **in-depth model review** of the CMMI Level 4 and 5 process areas **with key members** of both the **appraisal team and the Enterprise Process Group (EPG)**
  - Performed an in-depth model review
  - Documented our understanding
  - Mapped our processes to the model



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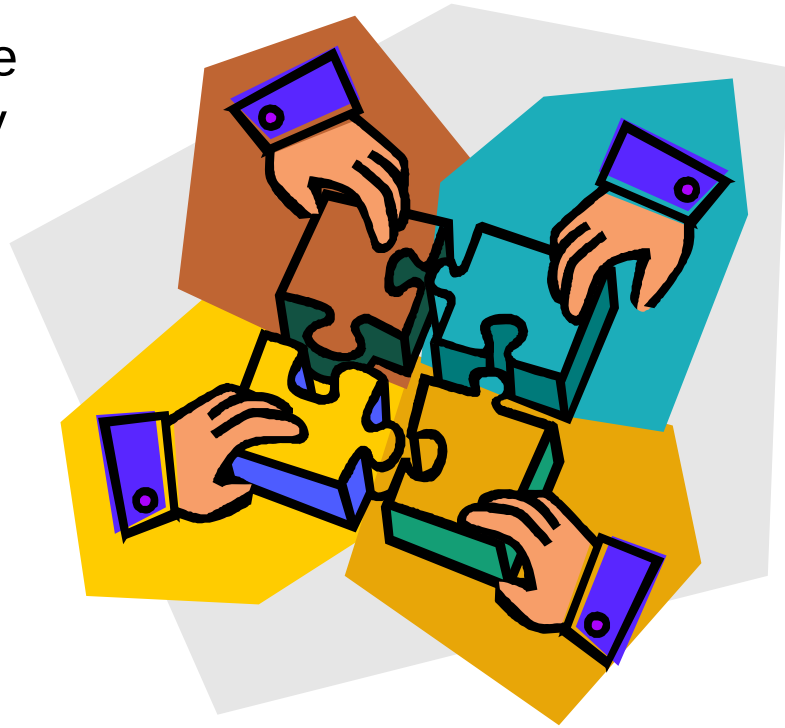
Results of the Meetings

- The time spent in coming to a common understanding of the model helped:
  - Clarify the key interfaces amongst the Level 4 and 5 practices and how they build on a Level 3 organization
  - Reveal how our organization is meeting the intent of the practices
  - Increase the programs' understanding of the information needed to provide evidence of their Level 4 and 5 activities.



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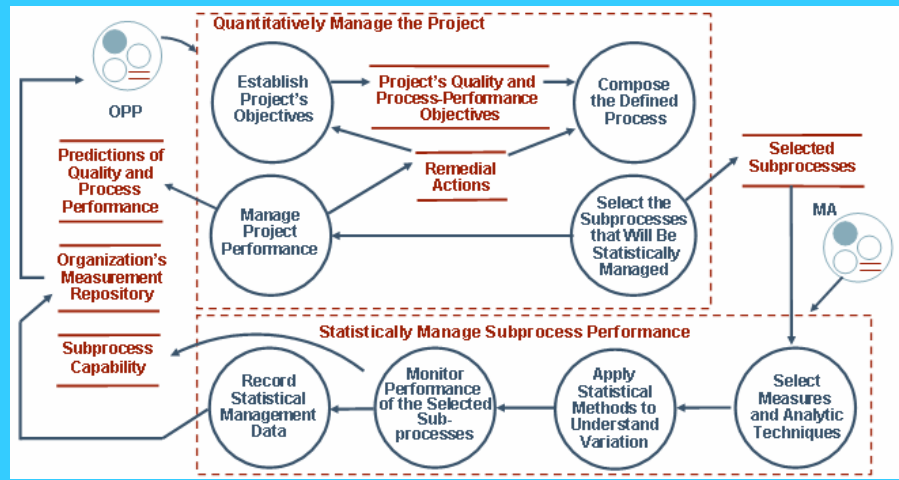
Discussions

- The CMMI context diagrams were used as the starting point for discussion
- Discussions included
  - The relationships of the specific practices within a process area
  - The interfaces between specific practices of each process area to other process areas
  - Types of evidence expected for both the specific and generic practices



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- The following slides address some of the key items that help in the understanding and communication of the relationships

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Organizational Process Performance (OPP)

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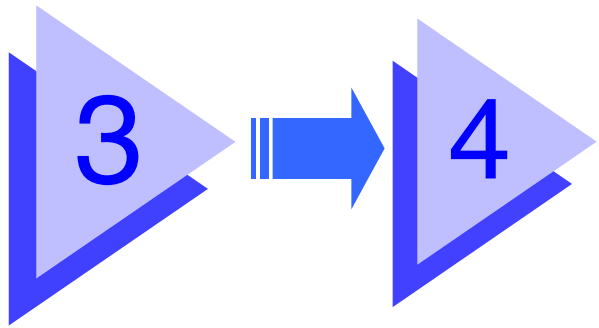
- The organization needs to be operating at Level 3 in order to perform the OPP activities



- For Level 4, the organization adds
  - Statistical analysis of its process capability based on historic data
    - Generation of process performance baselines
    - Development of process performance predictive models
  - Definition of the organization's **quantitative** quality and process performance goals and objectives
  - Direction and support to the programs on the use of the organization's defined goals and objectives

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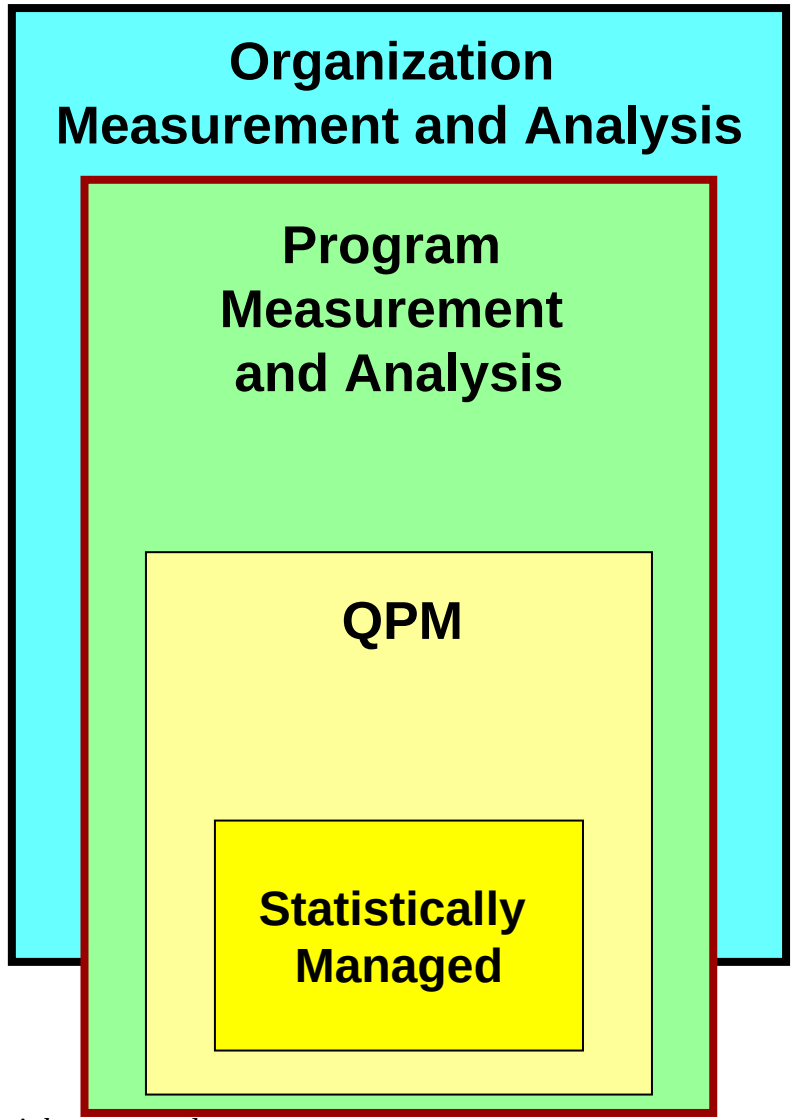
4 Quantitative Project Management (QPM)

Raytheon

- Builds on Measurement and Analysis foundation
- Includes quality and process-performance objectives (program, customer and organization)
- QPM measures are typically a subset of the program's measures
- Not all QPM measures are statistically managed

Key to understand the difference between quantitatively and statistically managed measures.



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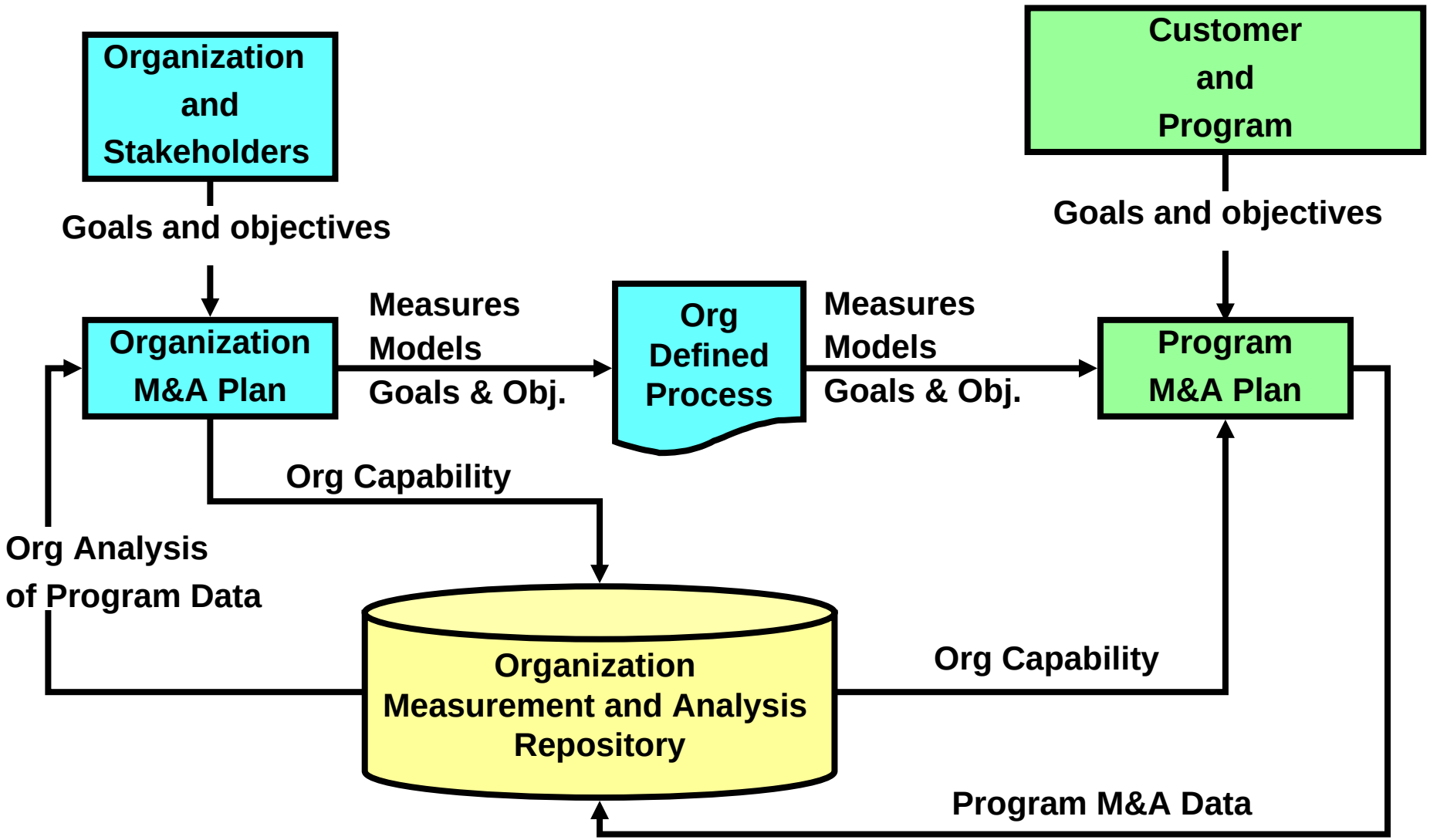
OPP and QPM Interaction



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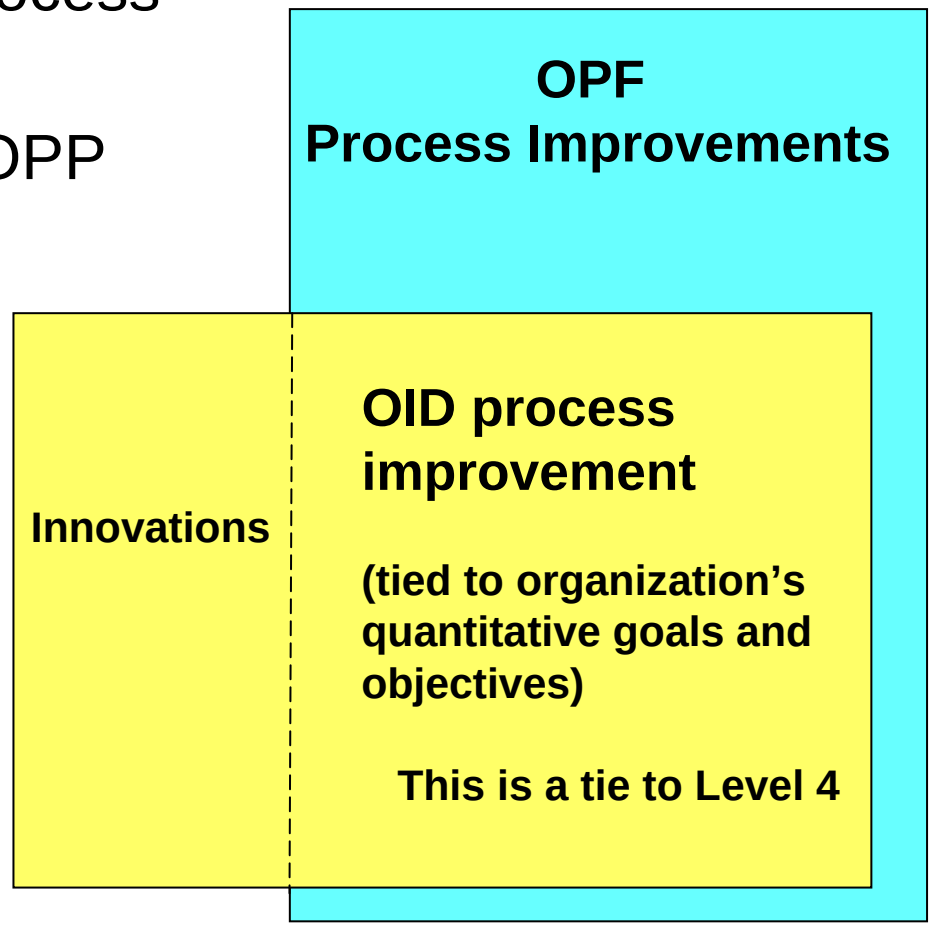
5 Organizational Innovation and Deployment (OID)

Raytheon

- Builds on the Organization Process Focus (OPF) foundation
- Improvements are driven by OPP and QPM activities (org and program)
- Effect on the organization's quantitative goals and objectives are measured
- A Level 5 organization is a learning organization



Link to the organization's quantitative goals and objectives is key.

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5 Causal Analysis and Resolution (CAR)

Raytheon

- CAR process can be applied regardless of the organization's maturity level
- CAR process maps well to the Raytheon Six Sigma™ process
- Not all R6σ® projects meet the CMMI Level 5 model
- Level 5 R6σ® projects are driven by the program's quantitative goals and objectives

Link to the program's quantitative goals and objectives is key to Level 5.

R6σ® Projects/Process

R6σ® Raytheon Six Sigma

R6σ® for QPM
(not necessarily Statistically Managed)

Tied to the program's quantitative goals and objectives

This is a tie to Level 4

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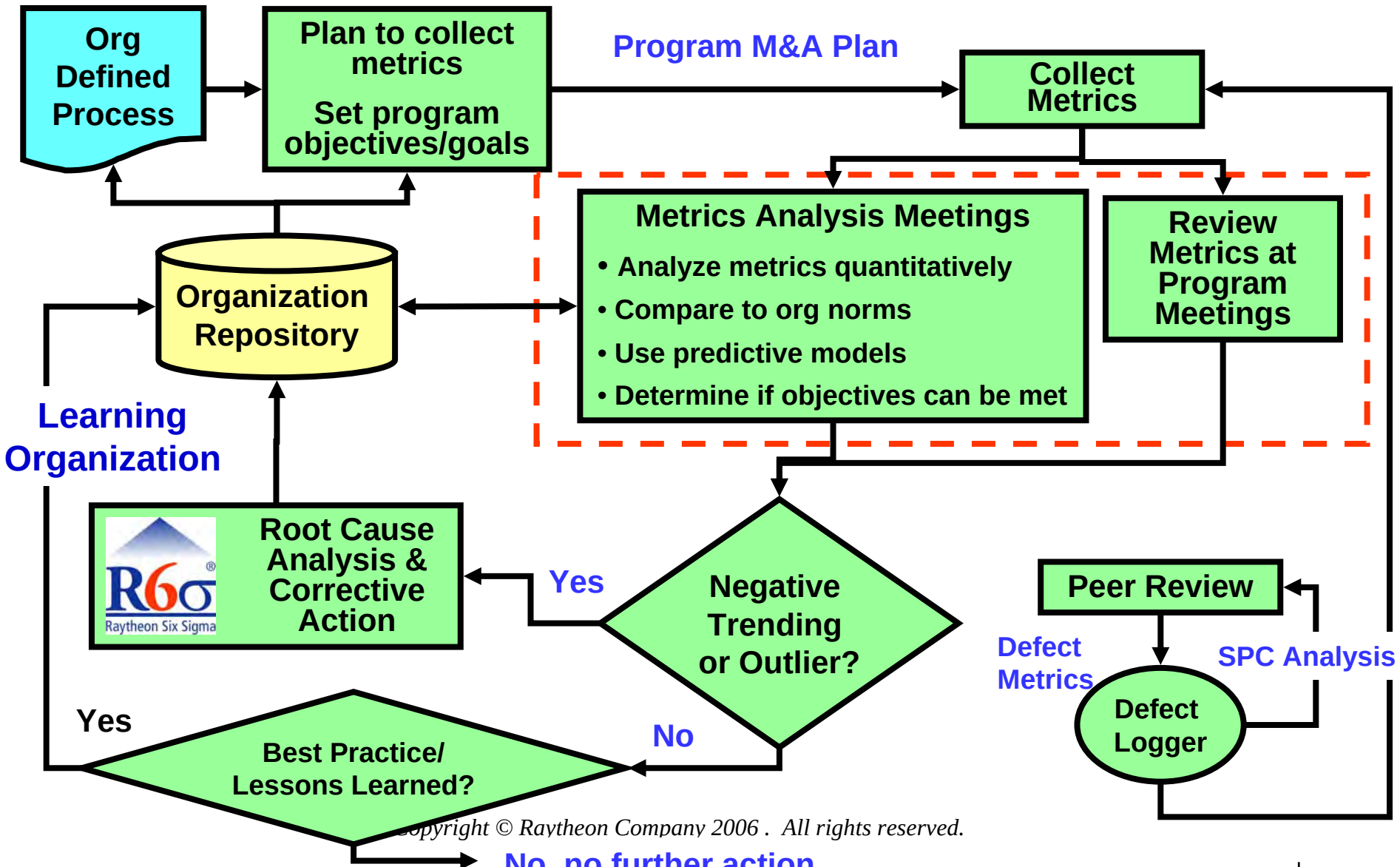
SAS Program Representation of Level 4 and 5

Raytheon



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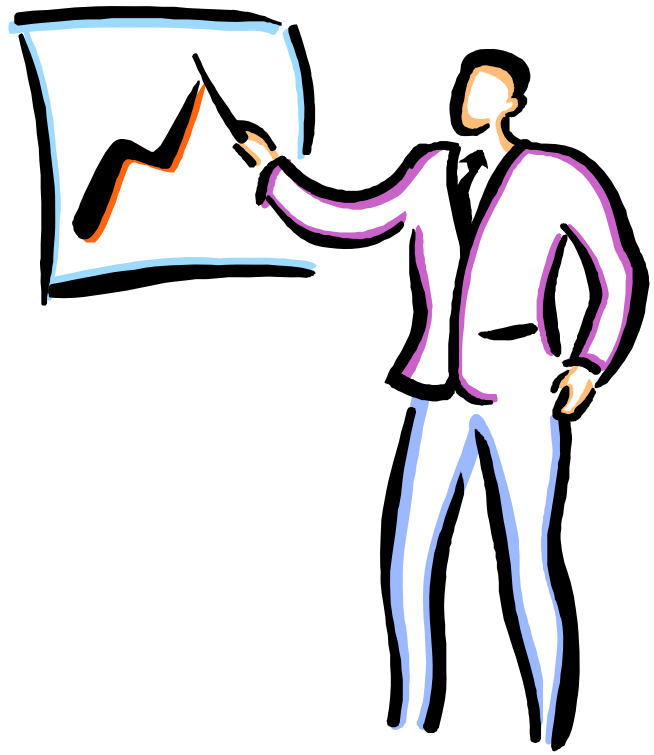
Using the information from the Level 4 and 5 model review

Raytheon

Use the documented understanding of Levels 4 and 5

- To educate and inform
  - EPG members
  - Persons collecting evidence for a SCAMPI
  - Program personnel involved in the Level 4 and 5 activities
- To relay the organization's Level 4 and 5 processes to the appraisal team members
  - Through meetings and discussions
  - Through organization and program demonstrations of the Level 4 and 5 activities



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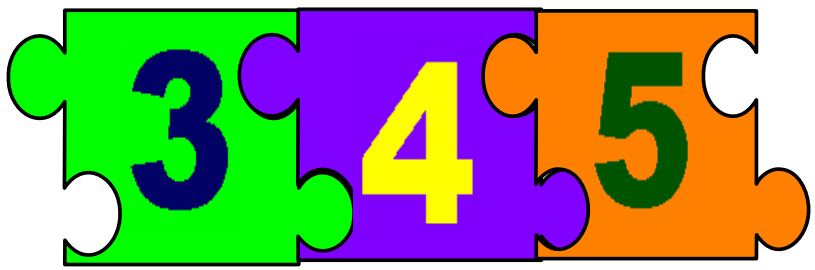
Summary

- A Level 4 or 5 organization must be built on an established Level 3 foundation
- Consistency in CMMI interpretation is essential to a successful appraisal
- The organization must understand and be able to present how it is meeting the intent of the practices
- Show how you make the pieces fit together!



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Questions

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Biography

- Nancy Raymond is the Deployment Support Cross Product Team Lead in the Space and Airborne Systems Enterprise Process Group. Nancy has been with the company for 28 years. For most of her time at Raytheon, Nancy has been a software and process engineer on programs and within the organization. Nancy's specialties include software planning, estimation and metrics. Nancy has been involved with the development and deployment of CMM/CMMI compliant processes for more than 10 years. Nancy has a Masters Degree in Mathematics from Carnegie-Mellon University.

- Linda Kovar is a Senior Manager of Programs at Raytheon Space and Airborne Systems in El Segundo, California. She is the Enterprise Process Group (EPG) lead for their process improvement activities. In August 2005, she successfully led the activities in achieving a combined Systems, Software and Hardware CMMI Level 3 for the business unit which encompasses 7000 engineers in several states. She is currently leading the Enterprise Process Integration activities to focus on a CMMI Level 5 maturity across all of SAS Engineering. Linda has 25 years with Raytheon where she has held positions in Program Management, Functional Management, Technical Staff, Test Program development and software engineering. She is a certified Raytheon Six Sigma expert, has a BS degree in Computer Engineering from the University of California Los Angeles and is a graduate of the Anderson School of Executive Management.

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National Defense Industrial Association
6th Annual CMMI Technology Conference
November 2006

The Value of Systems Engineering

What do we know about it?

How do we discover more?

Al Mink
Systems Value / GMU

Value of SE
Overview

1. **The Problem**
2. **What We Know Today**
3. **The Race to Discover More**
4. **Conclusions**

Value of SE

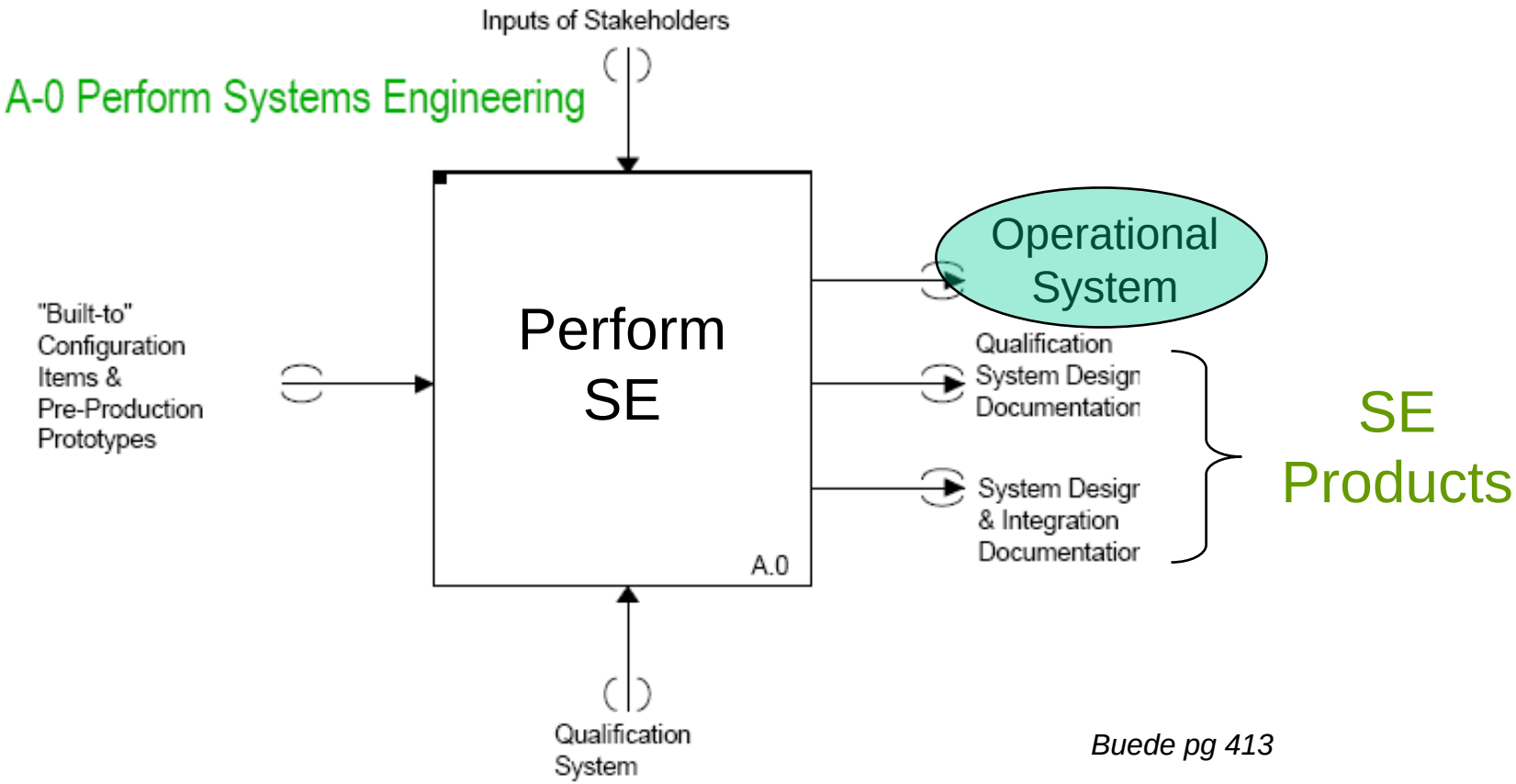
The Problem (Stakeholder Analysis)

What – and how much – SE is appropriate for a particular system development program?

- **Customers**
  - **Unsure of how to evaluate bids**
  - **May not receive best value for the systems they acquire**
  - **DoD #1 SE Issue – "Inconsistent SE Practices across life cycle"**
- **Industry (System Developers & Integrators)**
  - **Unsure of what to bid, and later loath to add SE costs**
- **Associations & Academia**
  - **Unable to fully satisfy their members and students**
- **SE professionals**
  - **Lack rigorous justification for their recommendations**

Value of SE

The Problem (IDEF 0 View)

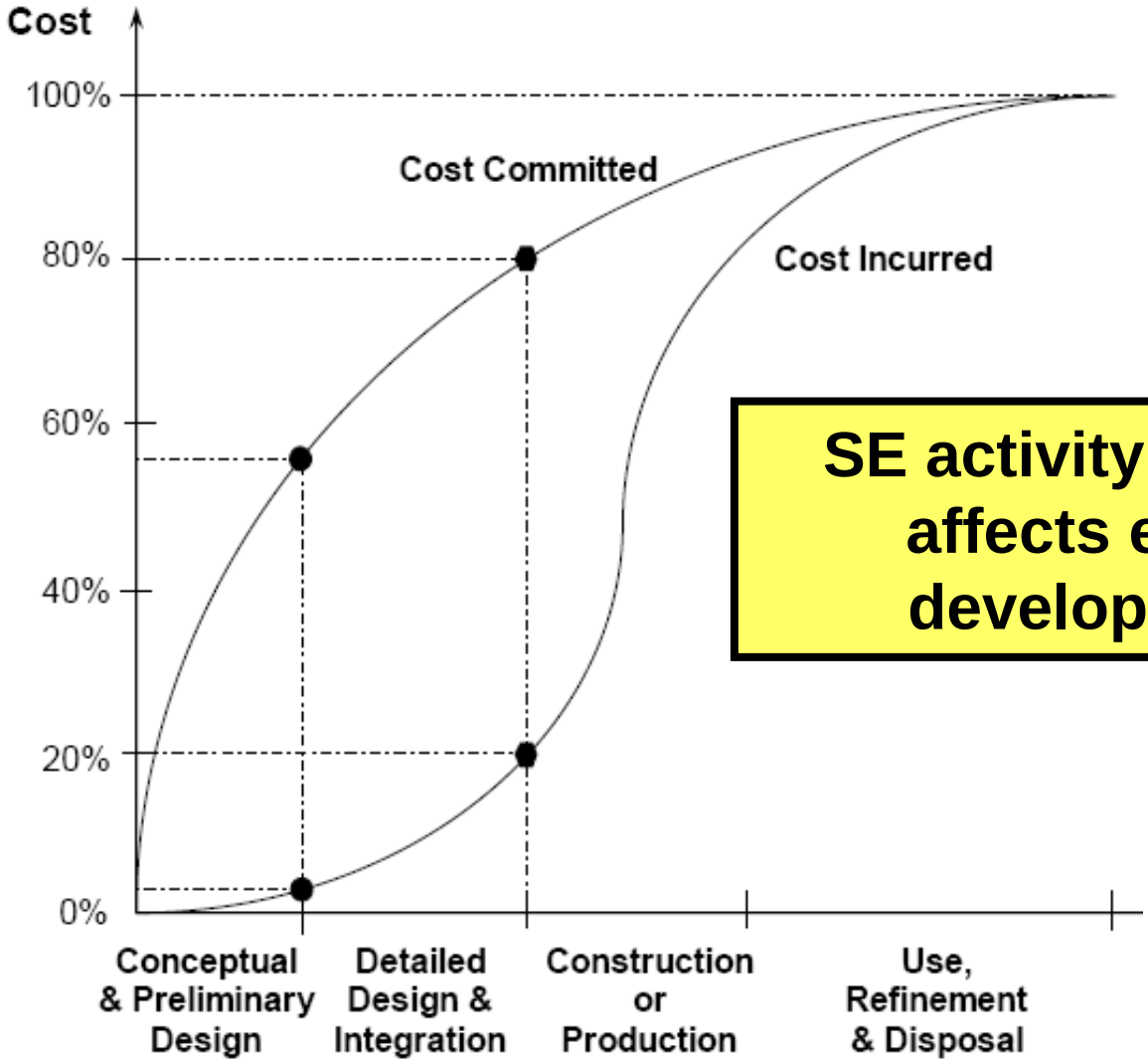


Buede pg 413

SE produces more than products -- It affects the value of operational system produced

Value of SE

The Problem (Pareto View)



SE activity upfront affects entire development

Buede, Figure 1.2

Value of SE

What we know today – Studies & Models

Gruhl, National Avionics and Space Administration (NASA), 1992

Compared upfront expenditures to eventual cost growth

Herbsleb, Software Engineering Institute (SEI), 1994

Studied ROI on process improvement in software

Honour, International Council on Systems Engineering (INCOSE), 2002

Surveyed industry to compare SE Effort to cost & schedule

Boehm & Valerdi, SE ROI (COCOMO), 2006 (Draft)

Analyzed SE activities from COCOMO II

Valerdi & Boehm, Constructive System Engineering Cost Model (COSYSMO), 2004

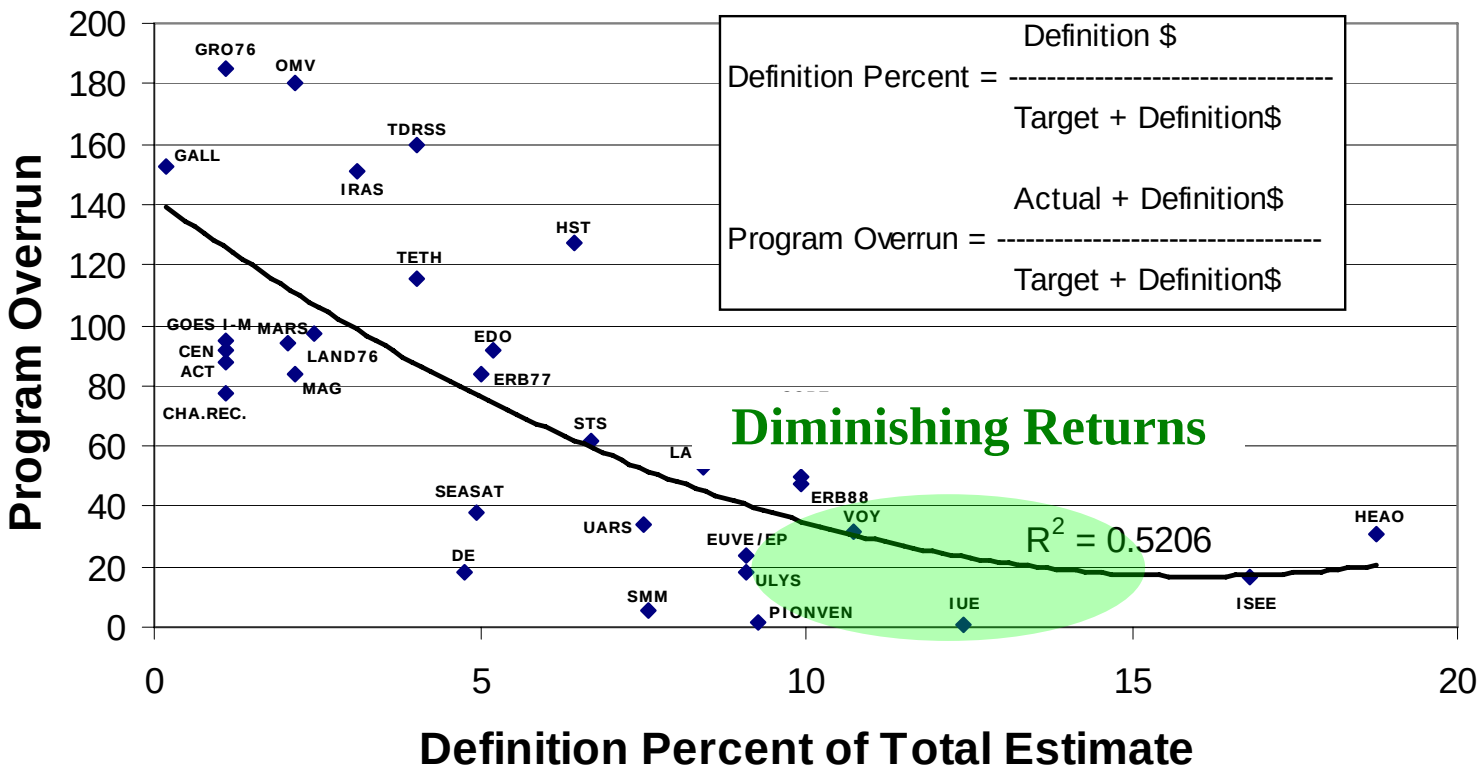
Developed parametric estimation model similar to COCOMO

Others…

Value of SE

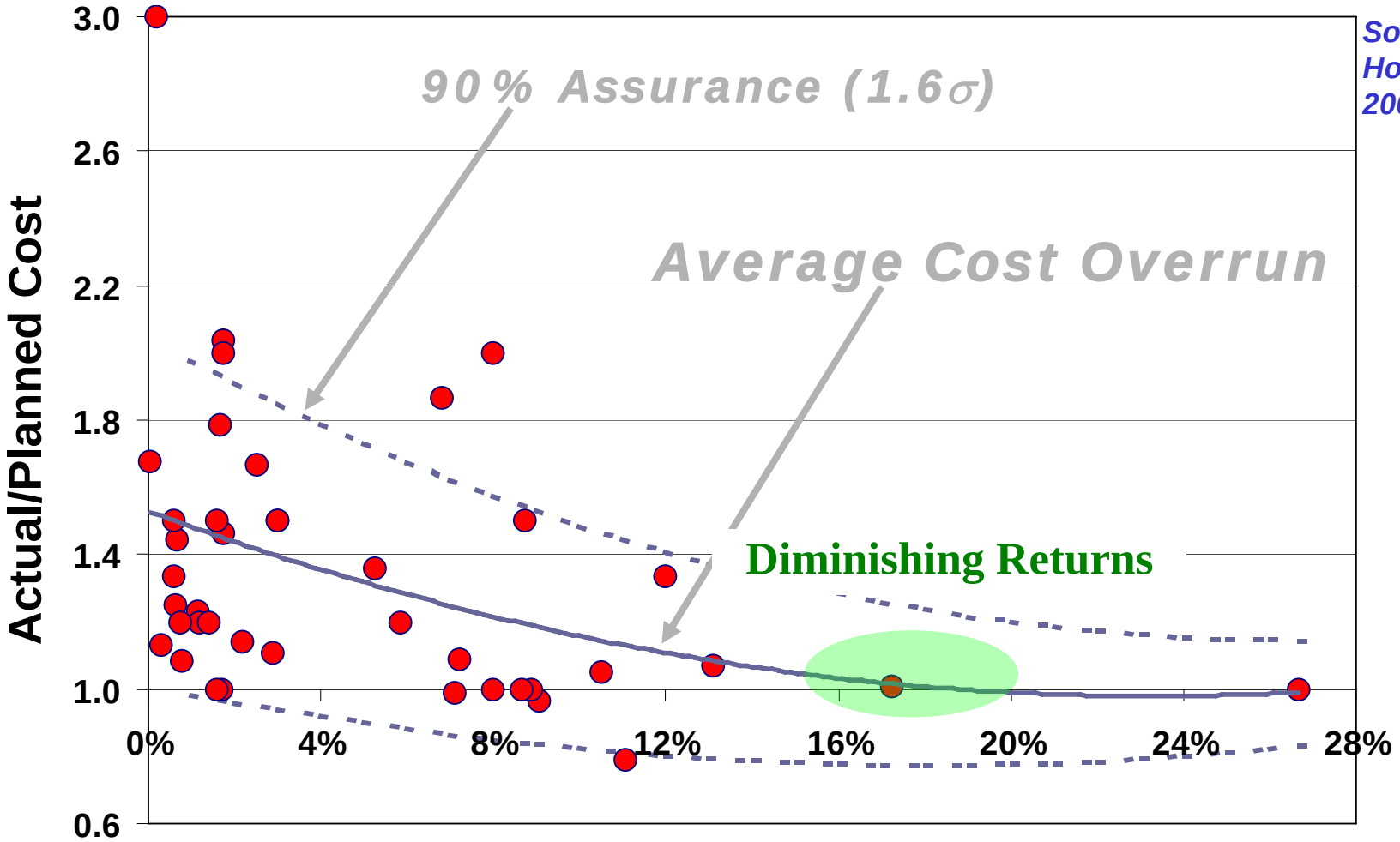
What we know today – NASA Study

Source Werner Gruhl
NASA Comptroller's Office
& Honour 2004



Value of SE

What we know today – INCOSE Study



Value of SE

What we know today – ROI of SE

SE ROI by Software Size of System

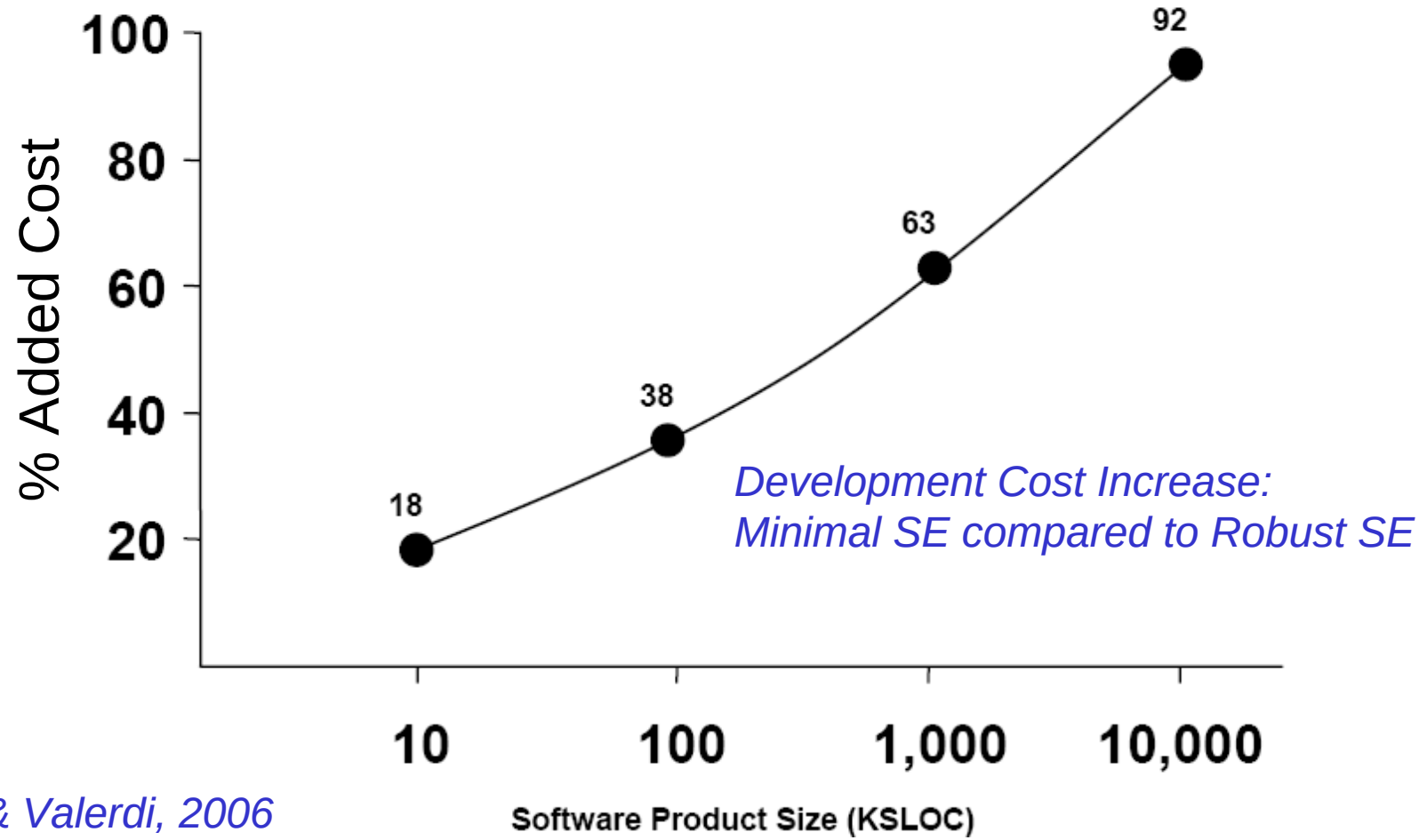
KSLOC	Very Low	Low	Nominal	High	Very High	Extra High
10	-	52%	-20%	-45%	-58%	-77%
100	-	248%	80%	18%	-10%	-54%
1,000	-	512%	204%	91%	42%	-30%
10,000	-	840%	356%	177%	99%	-4%

Boehm & Valerdi, 2006

Value of SE

What we know today – ROI of SE

SE Activities Affect Software Development

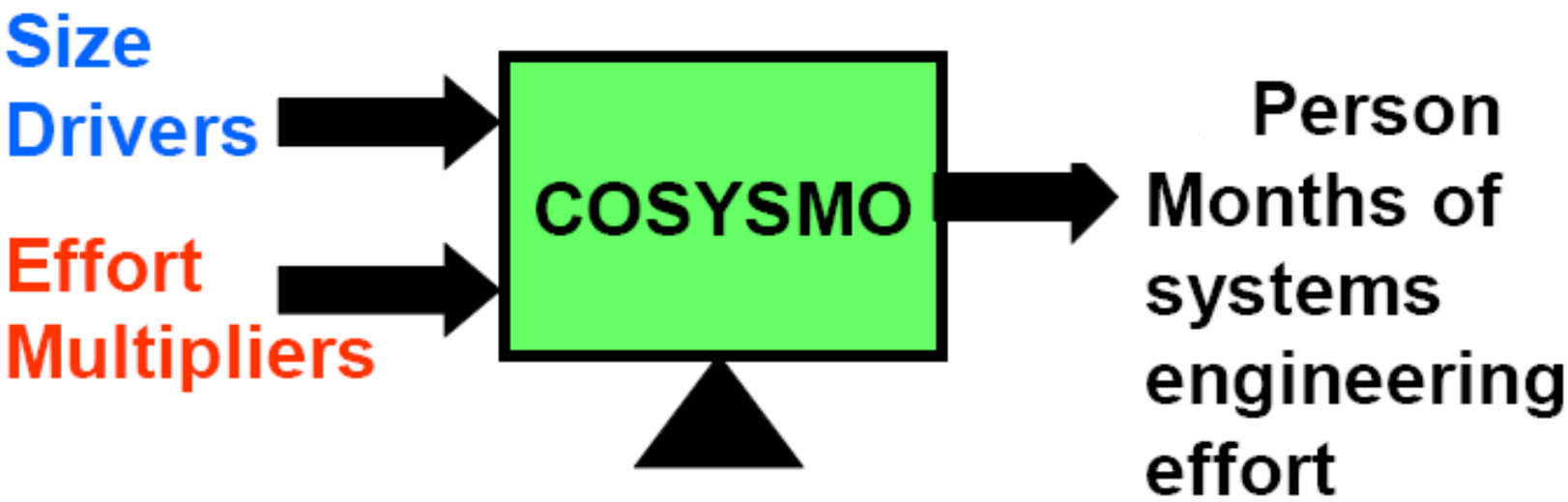


Boehm & Valerdi, 2006

Value of SE

What we know today – COSYSMO

Limited ability to estimate "effort"



Pred(30) 50% uncalibrated

Pred(30) 70% calibrated

Valerdi, 2005

Value of SE

What we know today – COSYSMO

SE Effort Across ANSI/EIA 632 Fundamental Processes

ANSI/EIA 632 Fundamental Process	Average	Standard Deviation
Acquisition & Supply	7%	3.5
Technical Management	17%	4.5
System Design	30%	6.1
Product Realization	15%	8.7
Technical Evaluation	31%	8.7

Valerdi & Wheaton 2005

Value of SE

What we know today – COSYSMO

SE Effort Across IOS/IEC 15288 Lifecycles

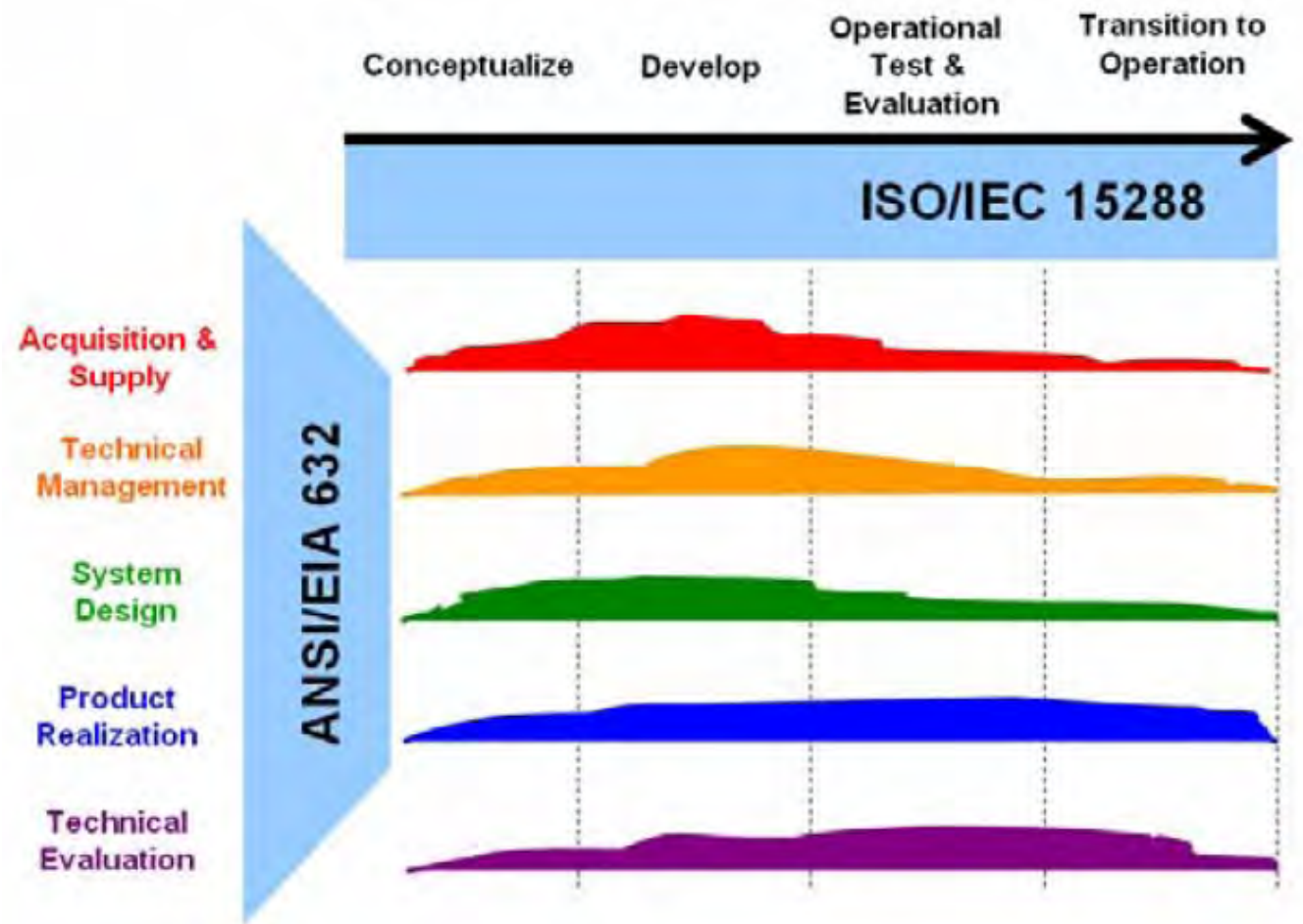
23%	36%	27%	14%	%Effort
12	16	13	9	STDEV

Valerdi & Wheaton 2005

Value of SE

What we know today – COSYSMO

SE Effort Across IOS/IEC 15288 Lifecycles



Valerdi & Wheaton 2005

Value of SE

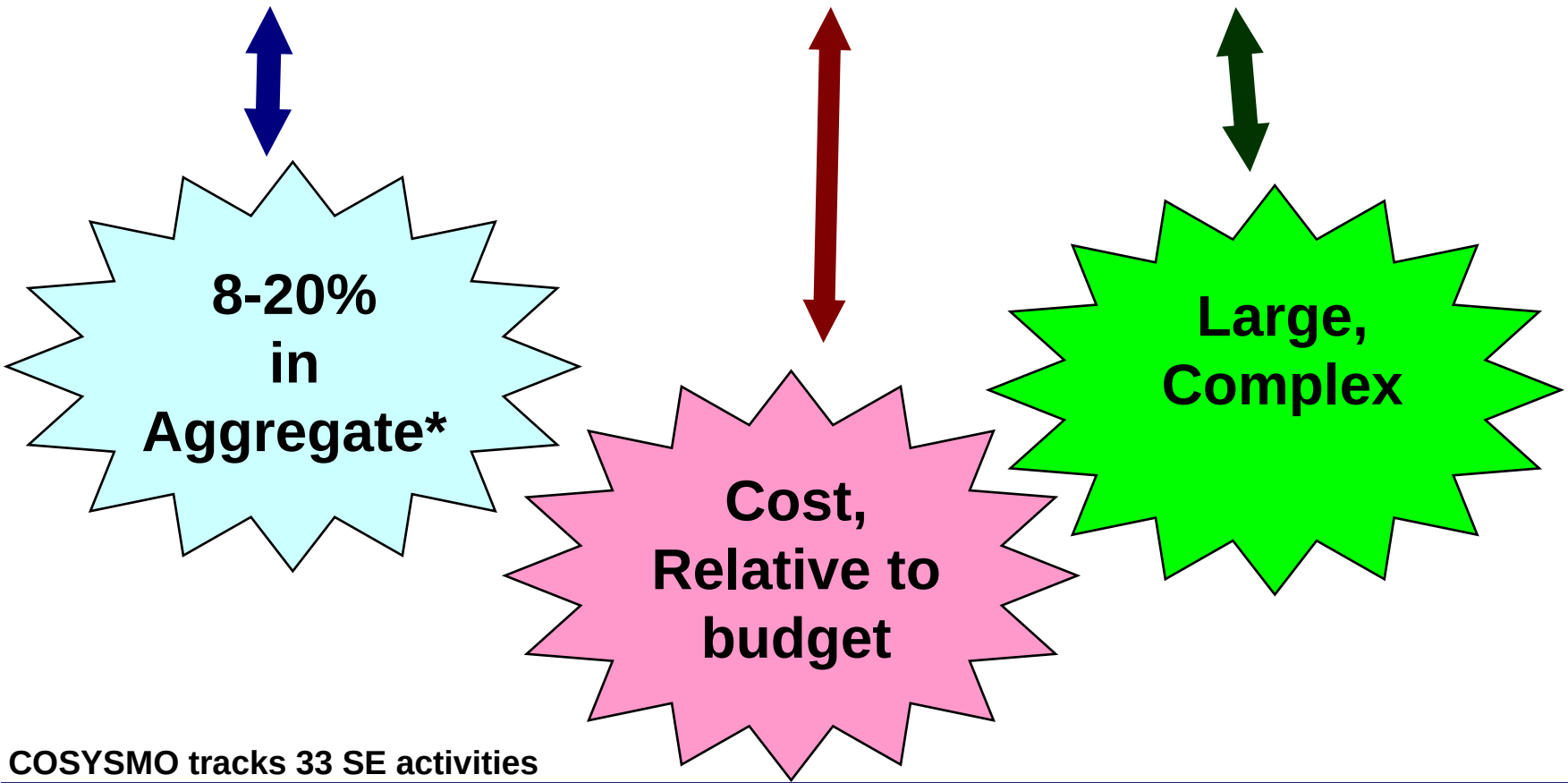
What we know today – Summary

STUDY		APPLICABILITY		
Author & Background	**Findings**	**SE Activities**	**Definition of Success**	**Characteristics of Project**
Gruhl (1992) 32 NASA Pgms	8-15% Upfront Best	First two of five development phases	Cost (Less cost overrun)	Large; Complex; all NASA
Herbsleb (1994) 13 CMM Companies	Process Improvement ROI 4.0 – 8.8	CMM Process Areas	Cost (Cost reduction through SE investment)	Various; federal contracting
Honour (2004) Survey INCOSE SEs	15-20% of project should be SE	Overall SE level of effort (Cost) & related SE quality	Cost & Schedule	Various sizes (measured by total project cost)
Boehm & Valerdi (2006) COCOMO II	SE importance grows with project size	COCOMO II RESL (Architecture and Risk)	Cost	Various sizes, but software systems only
Boehm & Valerdi (2004) COSYSMO	Estimate within 30% effort 50% - 70% of time	33 activities defined by EIA 632	Cost	Mostly successful projects from federal contractors
Ancona & Caldwell (1990) Boundary Management	Managing team boundary 15%; more is better	Team boundary activities – interface between team and external	Product Performance (Successfully marketed products)	Technology products
Frantz (1995) Boeing side-by-side projects	More SE yielded better quality & shorter duration	Defined by Frantz	Product Performance & Schedule (Quality of product and duration of project)	Three similar systems for manipulating airframes during assembly

Value of SE

What we know today – Summary

Today we posses a *limited* understanding of the SE effort required for success of a project



* COSYSMO tracks 33 SE activities

Value of SE

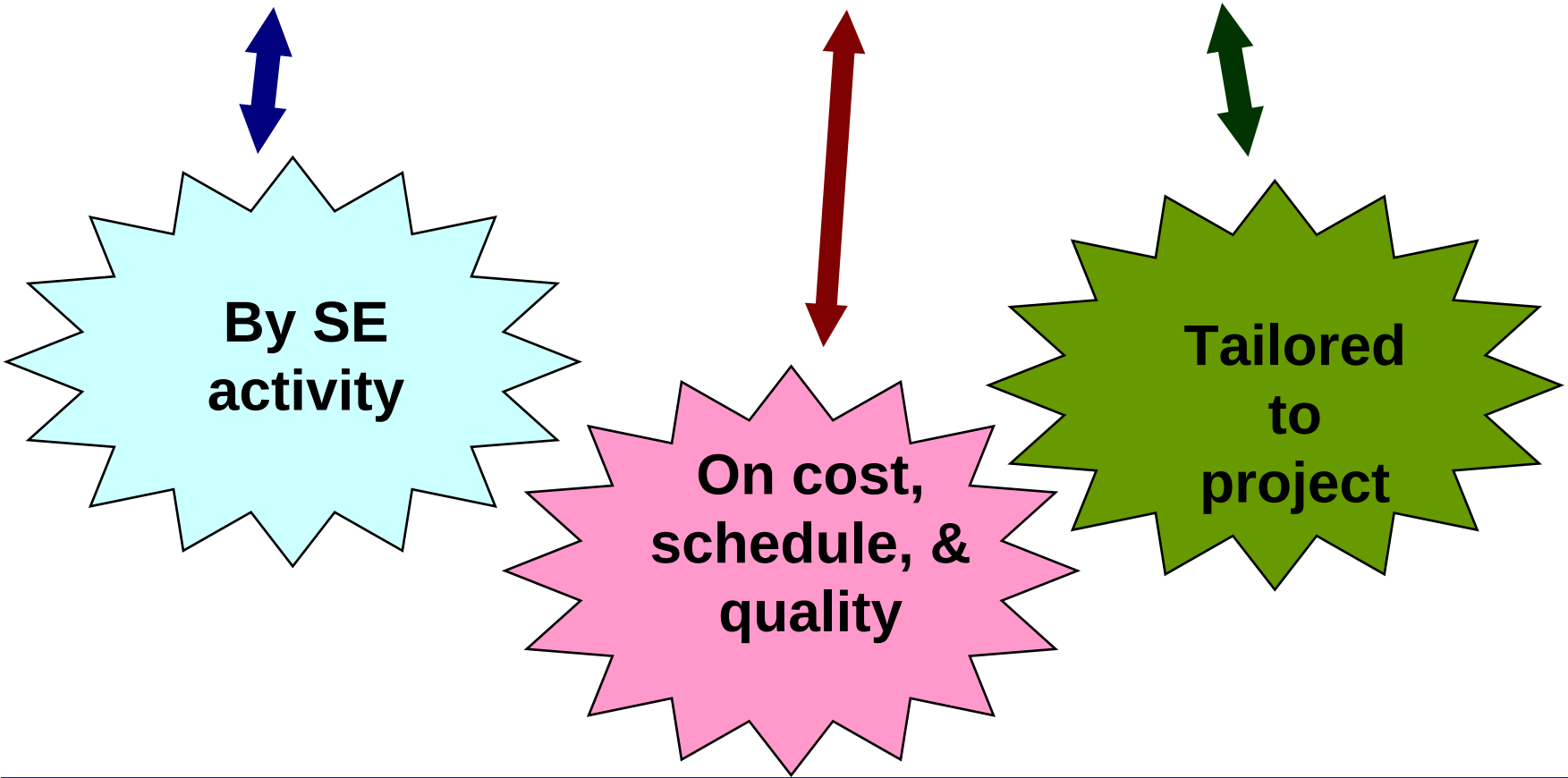
The Race to Discover More

Four Separate Efforts Underway

Value of SE

The Race to Discover More

All four should increase our understanding of the SE effort required for success of a project



Value of SE

The Race to Discover More - Methodology

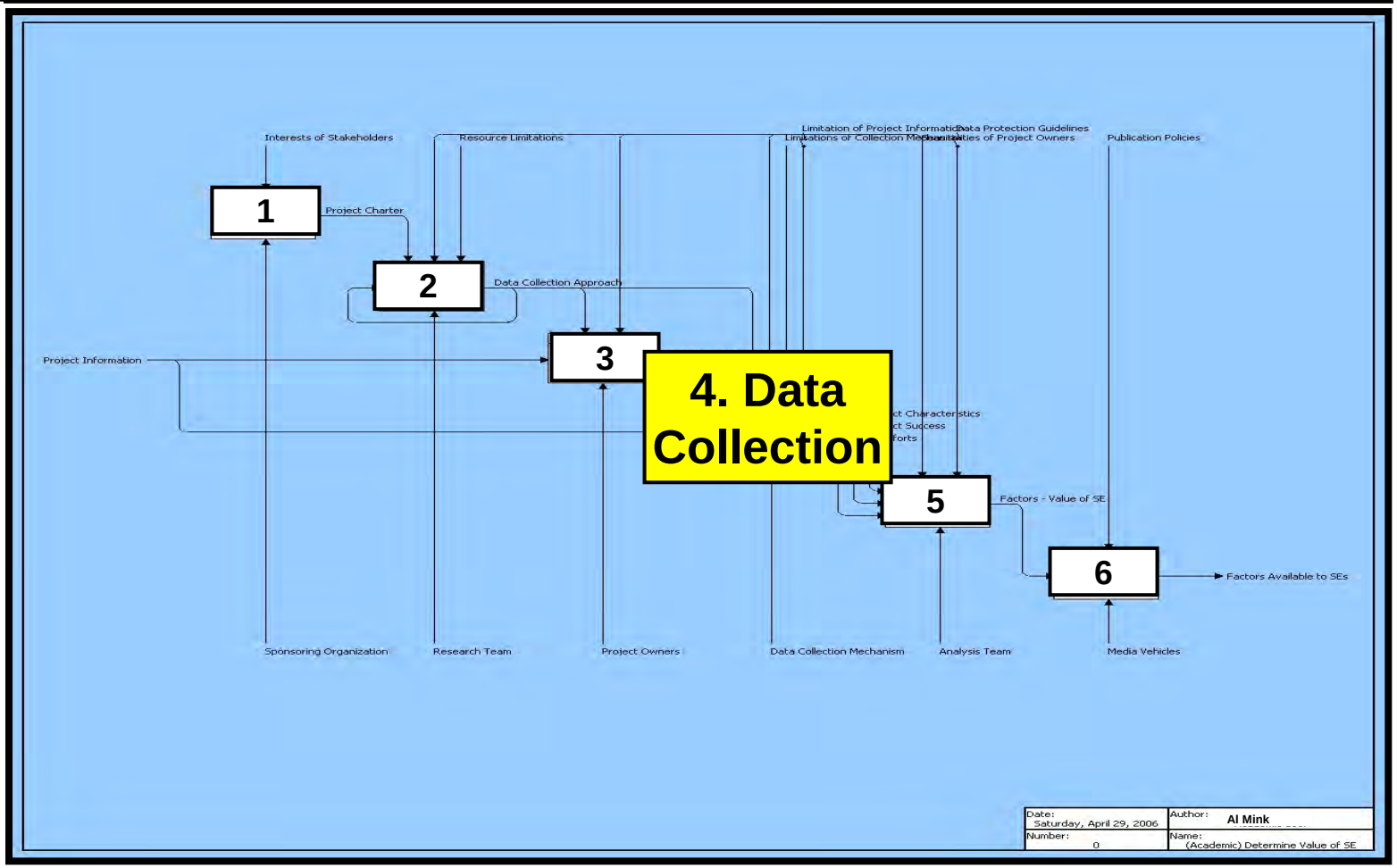
All Four Appear to Follow a General Approach

1. **Form Team**
2. **Develop Approach**
3. **Identify Projects**
4. **Collect Data**
5. **Analyze Data**
6. **Publish Results**

Value of SE

The Race to Discover More - Methodology

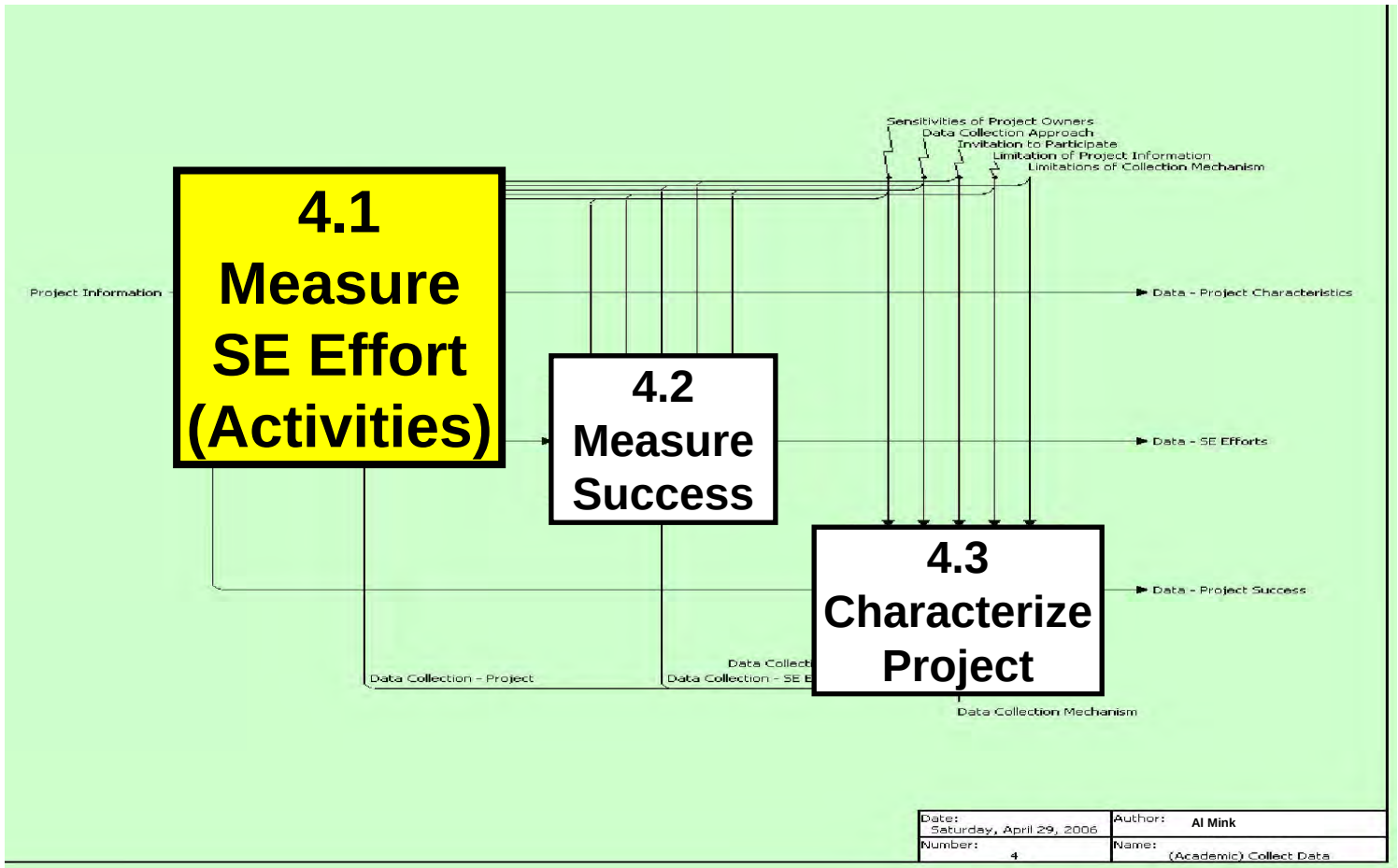
How the pieces fit together



Value of SE

The Race to Discover More

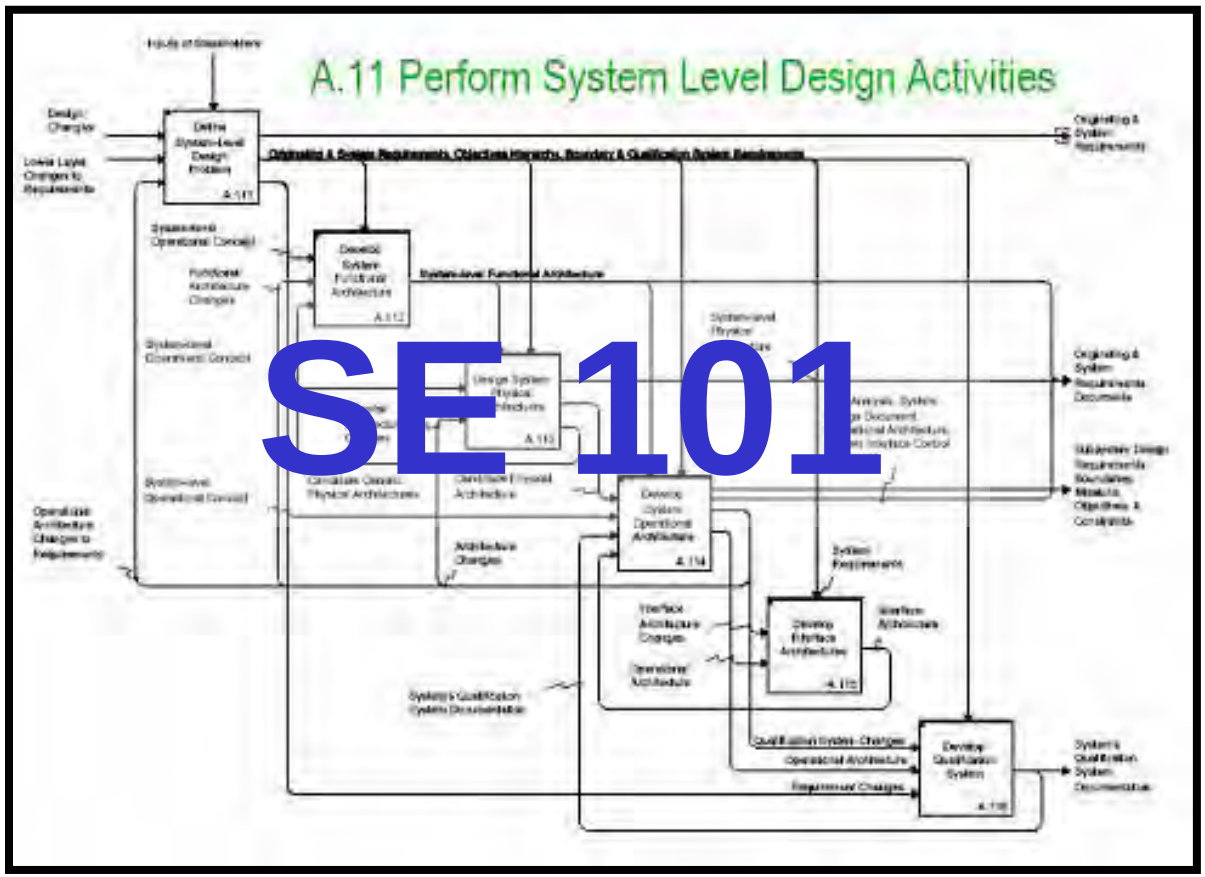
Capturing Data – Three Categories



Value of SE

The Race to Discover More – Define SE Activities

Defining "SE Activities" – One View



Buede pg 416

Value of SE

The Race to Discover More – Define SE Activities

Defining "SE Activities" – Many Views

Fragmented by domain opinions

- Military – DOD/MOD
- Space - NASA/ESA
- Commercial products
- Aircraft
- Automobiles
- Nuclear waste
- Process engineering
- Tool vendors
- Etc. Etc. Etc.

Fragmented by discipline opinions

- Technical leaders
- System architects
- System analysts
- Requirements engineers
- Operations analysts
- Design engineers

Fragmented by standards

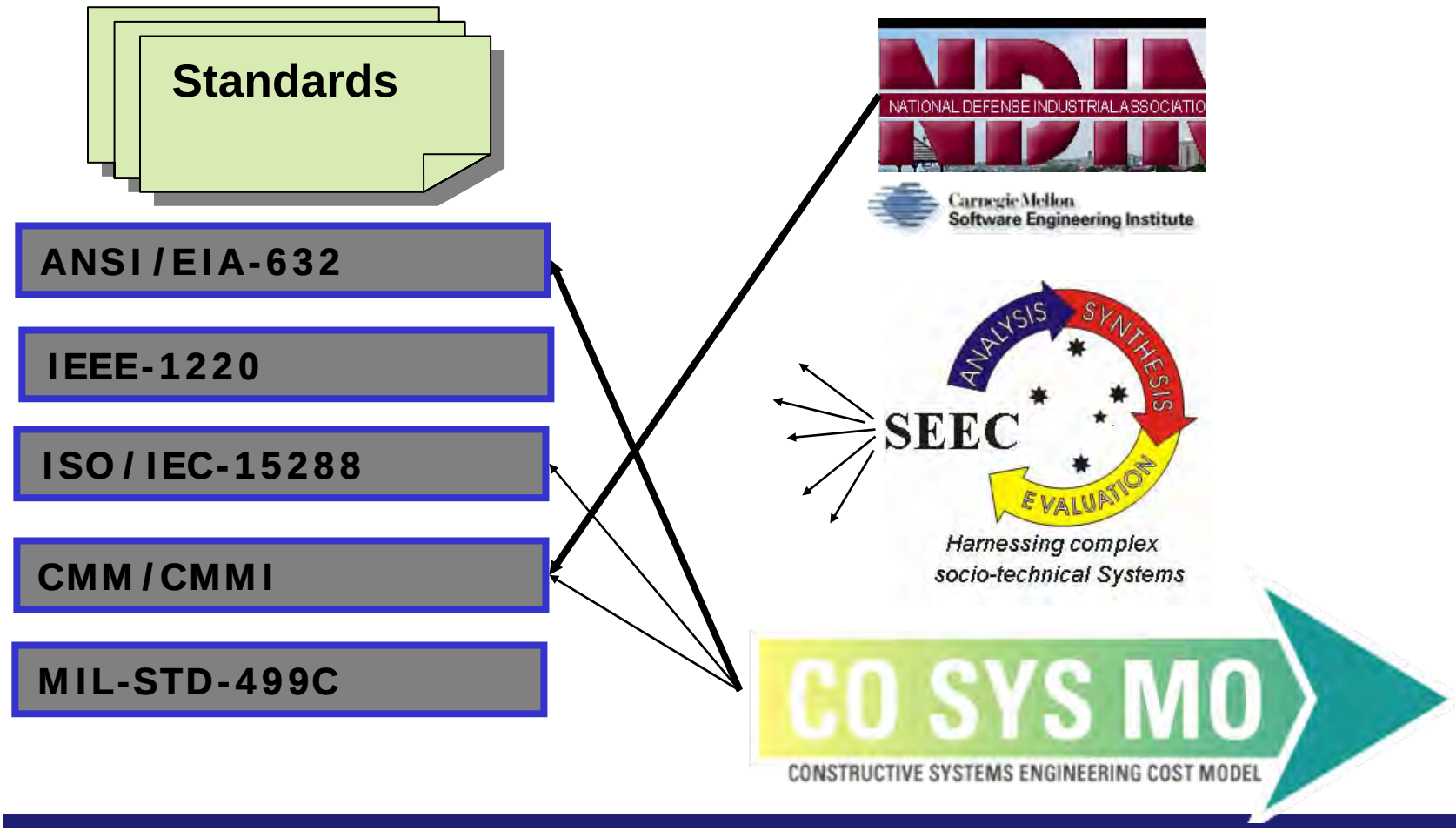
- ANSI/EIA-632
- IEEE-1220
- ISO-15288
- CMMI
- MIL-STD-499C

Honour
2005

Value of SE

The Race to Discover More – Define SE Activities

How the Different Efforts Define "SE Effort"



Value of SE

Emerging Approaches to Move Forward – Define Other Measures

In addition to defining & measuring SE Effort…

Cost, schedule, & quality

Success factors

- *EVMS*
- *Award Fee*
- *Requirements Trace*
- *Others…*

Tailored to project

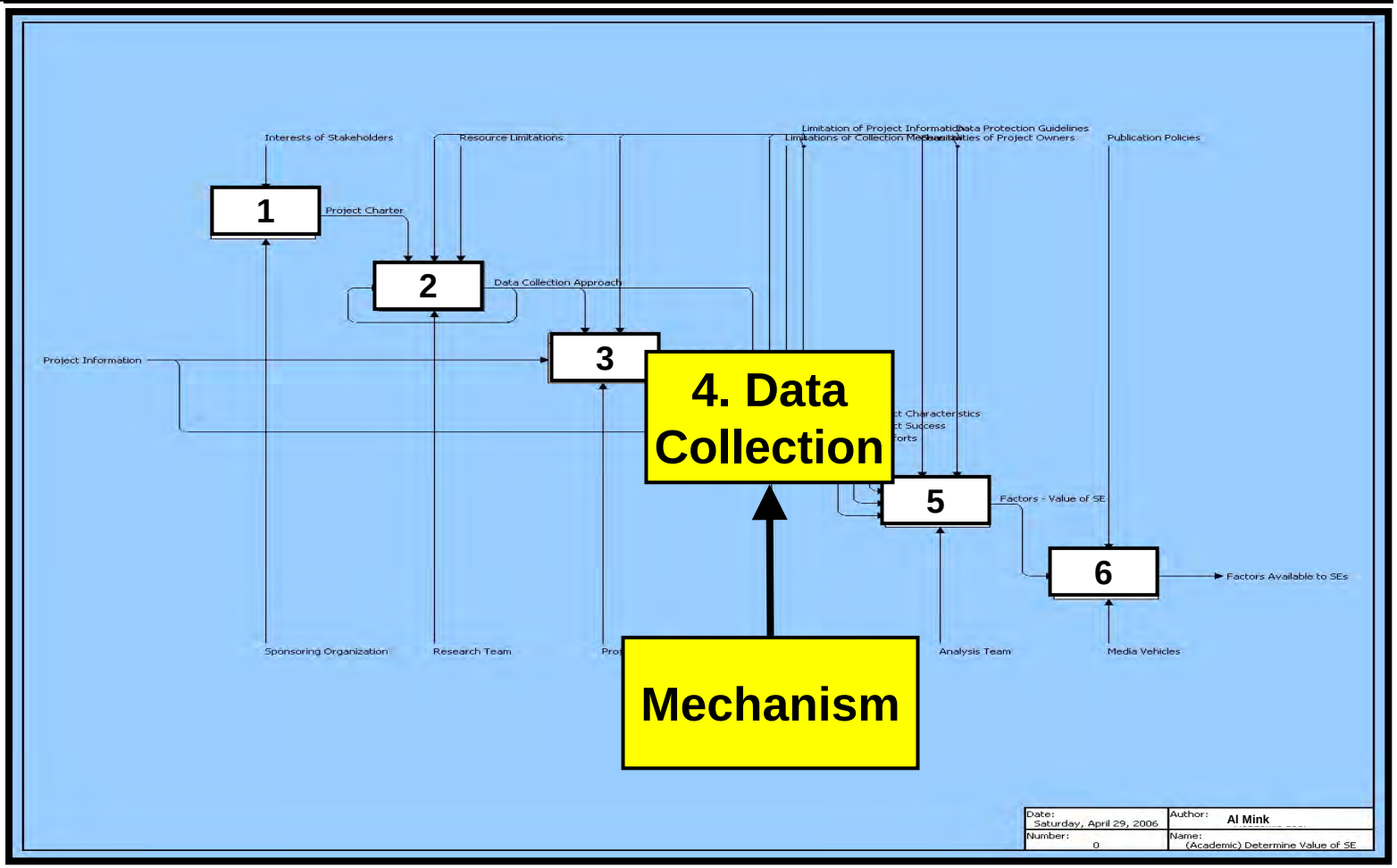
Project characteristics

- *Size ($)*
- *Size (hours)*
- *Technology*
- *Complexity*
- *Others…*

Value of SE

The Race to Discover More - Methodology

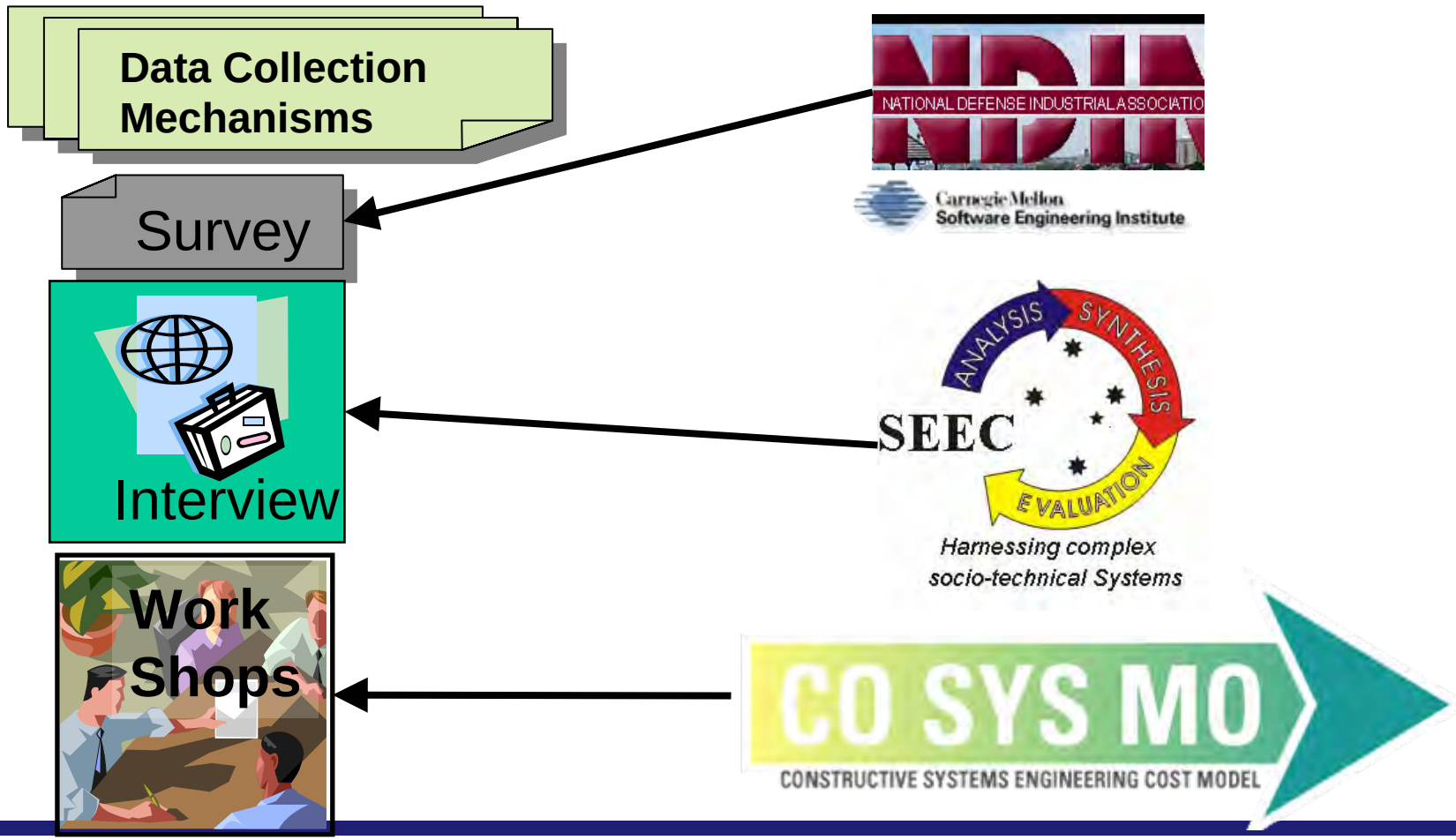
One Other Difference – Collection Mechanism



Value of SE

The Race to Discover More – Define SE Activities

How the Different Efforts Collect Data



Value of SE
Conclusions

- ***Value of SE***
  - **Remains fundamental to furthering SE as a respected discipline**
- **Four approaches underway to determine SE Value**
  - **With a fifth – Bob Bruff – on the horizon…**
- **They share commonalities, but also differ:**
  - **Differing types of projects**
  - **Differing SE Activities & Deliverables**
  - **Differing success factors (cost, schedule, quality, etc.)**
- **Challenges Remain**
  - **Useful project data – may not be widely available**
  - **Four separate projects – what if they report different results?**
  - **Success may be elusive – "The Shangri-La of ROI" (Sheard 2000)**
- **Make a difference! Support these approaches**

Value of SE
Conclusion

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Value of SE

Questions?

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Carnegie Mellon
Software Engineering Institute

Portland State
University

Evaluating the Impact of The QuARS Requirements Analysis Tool Using Simulation

David M. Raffo, Ph.D., Portland State University
Robert Ferguson, Software Engineering Institute

Agenda

Motivation
What is QuARS?
What is Process Simulation?
What are the Benefits?
Discussion
Conclusions

Motivation

Good new technologies are wasted unless there is a compelling business case to use them

Without such a case:

- Managers not convinced
- No reallocation of scarce resources

Good technology: QuARS Requirements Checking Tool

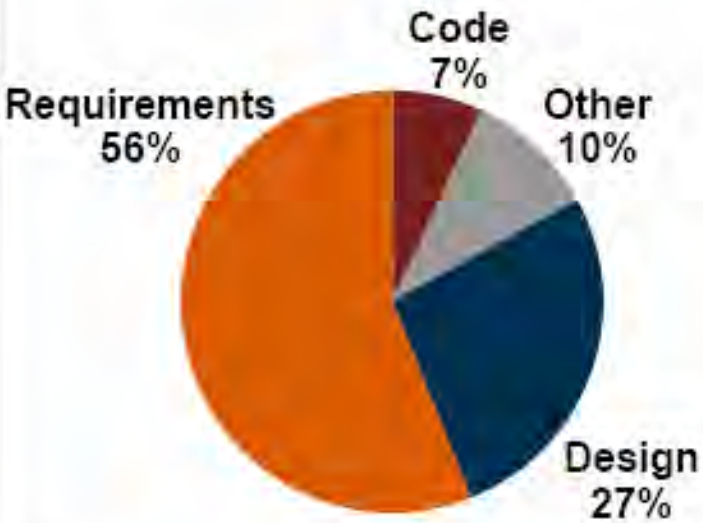
- Increased PDs (probability of detection) (enables better detection capability during human inspection)
- Low cost

This talk:

- Present the business case
- Developed using process simulation

Requirements Best Illustrate Our Challenge

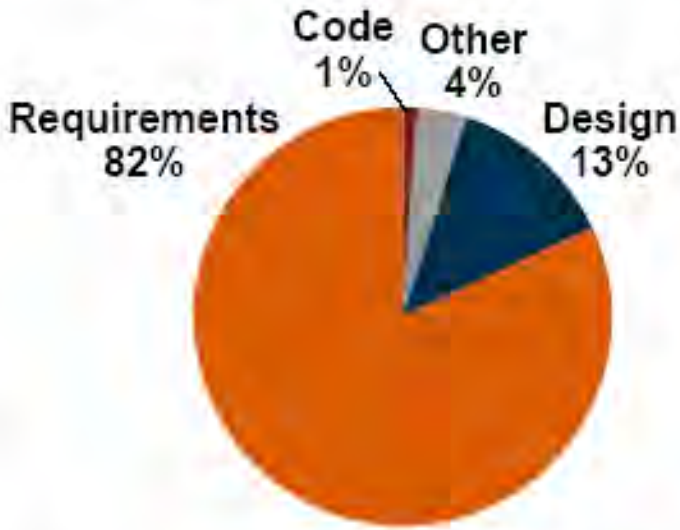
Distribution of Defects



Over half of software defects are attributed to requirements problems

Source: James Martin

Distribution of Effort to Repair Defects



Over 80% of rework effort is spent on requirements-related defects

Source: Dean Leffingwell

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Analyzing Requirements$_1$

An endemic and enduring problem

- Vague requirements with unstated performance criteria

QuARS: A part of the solution

- Quality Analyser for Requirements Specification
- Lexical, and syntactic analyses of requirements documents

Uses:

- Real-time editing of requirements defects
- Inspections and quality assurance
- Tracking and improvement of requirements analysis processes
- Contract acceptance and appraisals

Analyzing Requirements$_2$

Why use it?

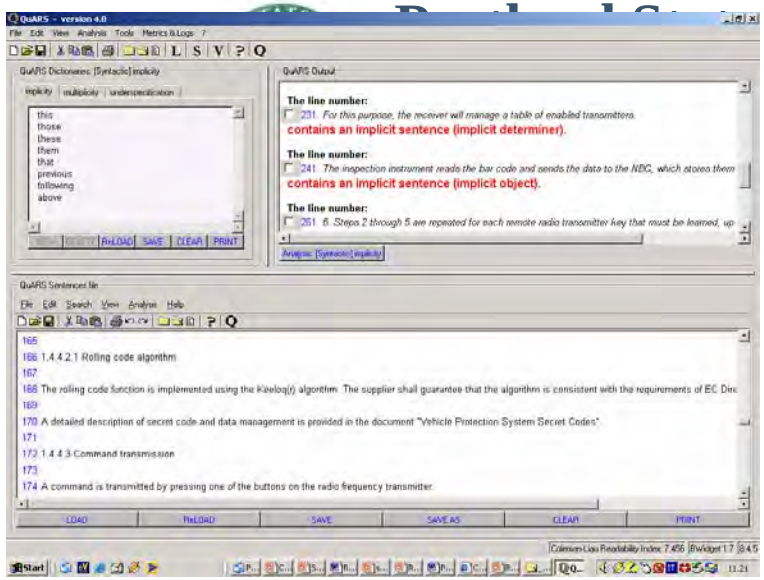
- Reduce cycle time and effort while producing better results than possible with tedious manual review
- Early detection and correction of often costly errors
  - Captures most common classes of errors
  - Often missed in inspections and quality assurance
  - Allowing analysts to focus on more difficult problems

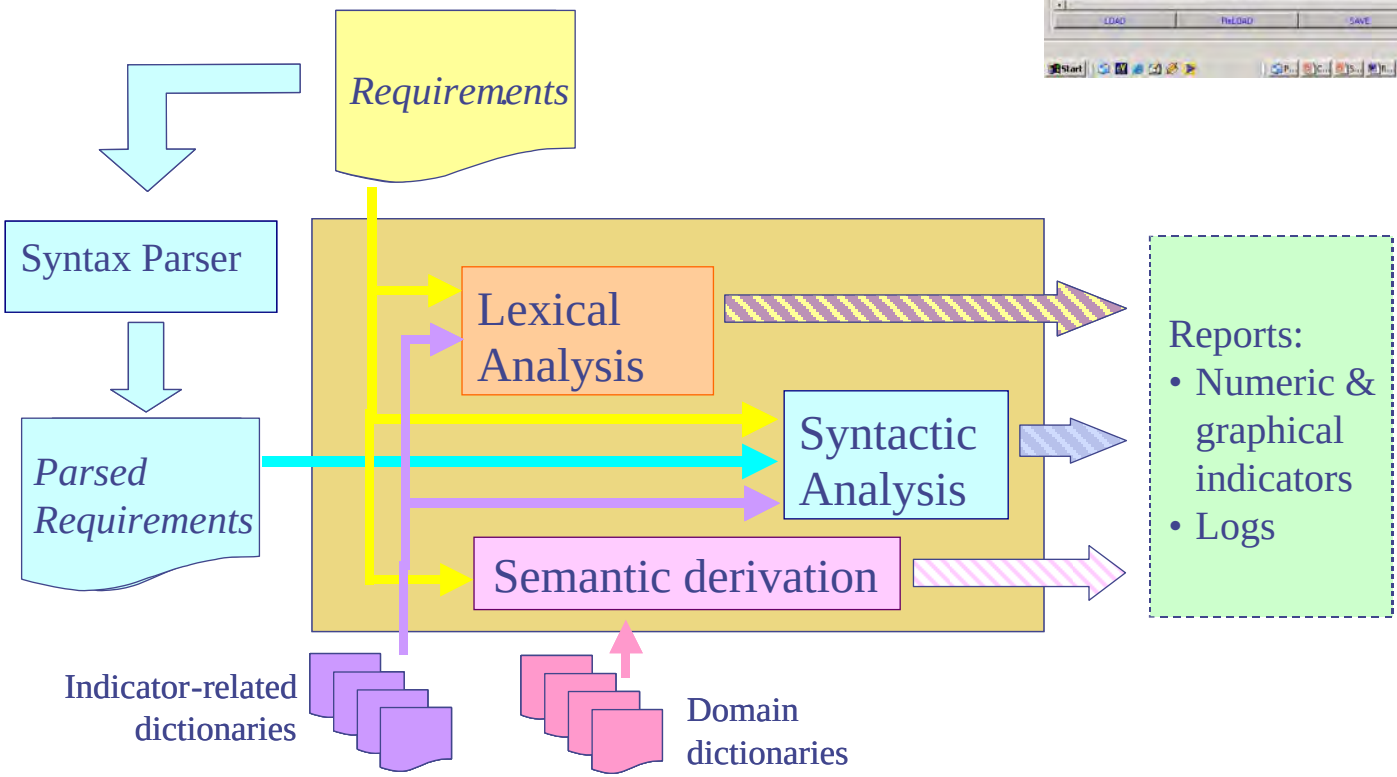
Analyzing Requirements$_3$

How does it work?

- Natural language analysis of requirements text
- Lexical: vague, weak, optional, subjective, other terms
- Syntactic: multiple, implicit, under specified statements
- Semantic:
  - Allows screening for consistency, completeness, etc
  - Arbitrary combinations of domain, component, functionality, product quality attributes and so on

QuARS


QuARS - version 4.0
QuARS Output
The line number:
231 For this purpose, the receiver will manage a table of enabled transmitters.
contains an implicit sentence (implicit determiner).
The line number:
241 The inspection instrument reads the bar code and sends the data to the NEC, which stores them
contains an implicit sentence (implicit object).
The line number:
251 6 .Steps 2 through 5 are repeated for each remote radio transmitter key that must be learned, up
QuARS Sentences file
165
166 1.4.4.2.1 Rolling code algorithm
167
168 The rolling code function is implemented using the Keeloq(r) algorithm. The supplier shall guarantee that the algorithm is consistent with the requirements of EC Dire
169
170 A detailed description of secret code and data management is provided in the document "Vehicle Protection System Secret Codes".
171
172 1.4.4.3 Command transmission
173
174 A command is transmitted by pressing one of the buttons on the radio frequency transmitter.
LOAD
ReLOAD
SAVE
SAVE AS
CLEAR
PRINT


Requirements
Syntax Parser
Parsed Requirements
Lexical Analysis
Syntactic Analysis
Semantic derivation
Reports:
• Numeric & graphical indicators
• Logs
Indicator-related dictionaries
Domain dictionaries

What is Process Simulation?

- Process simulation models focus on the dynamics of ***systems*** development, maintenance and acquisition projects
- They represent the process
  - as currently implemented (as-is, as-practiced, as-documented), or
  - as planned for future implementation (to-be)
- Simulation Features
  - Use Graphical interfaces
  - Utilizes actual data/ metrics
  - Predict performance
  - Supports “What if” Analyses
  - Support business case analyses
  - Reduces risk

Applying Process Simulation = High Value Add

Evaluate Strategic Issues

- Quality Assurance, V&V and IV&V Strategy
- Distributed Software Development
- Supply Chain Design

Plan Processes

- Identify better process alternatives
- Assess the Costs and Benefits of New Tools
- Evaluate Impact of Process Improvements

Architect, Design, and Document Processes

Manage Projects Quantitatively

Estimate Project Costs from the Bottom Up

Train Project Managers

How do we use Process Simulation?

Architect the Process Model

Calibrate the Data Set

Run Options

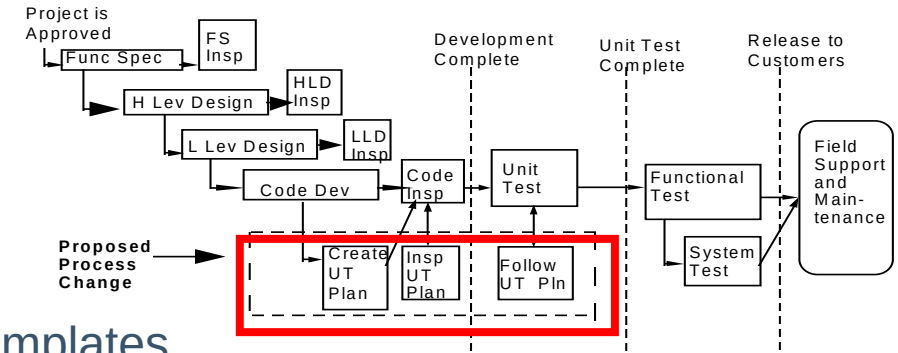
See the Return on Investment

Creating Process Simulation Models

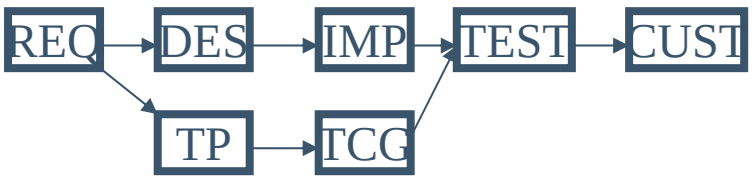
Management Dashboard

Process Simulation Model

PATT Project Database

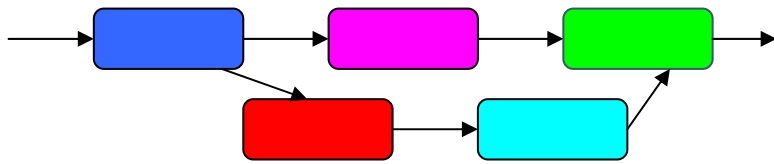


Life Cycle Model Templates



- IEEE 12207
- Spiral
- Incremental
- Product Line
- Rapid Prototyping

Generic Process Model Blocks



Generalized Process Components

- Development
- Inspection
- Testing
- Rework
- IV&V
- Joint Reviews

Carnegie Mellon
Software Engineering Institute

Portland State University

Development Projects

Better Process Decisions

Project and Process Data

CSCI Data (Follows)

No. of CSCIs 8
CSCI names: C&DH Guidance & N EPS Ground DIVINER LAMP LOLA LROC
Estimated SLOC

C&DH

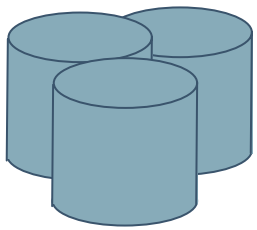
CSCname	Reuse	Re-eng	New	Lang	Totals	Ptotals	IVVTotals	EP	CP
C&DH	25000		75000		100000	120000	150000		
Total	25000	0	75000		100000	120000	150000	3	1

Guidance & Nav

CSCname									
Guidance & Nav	25000		12000		37000	37000	39000		
Total	25000	0	12000		37000	37000	39000	2	3

Financial Benefits NPV, ROI

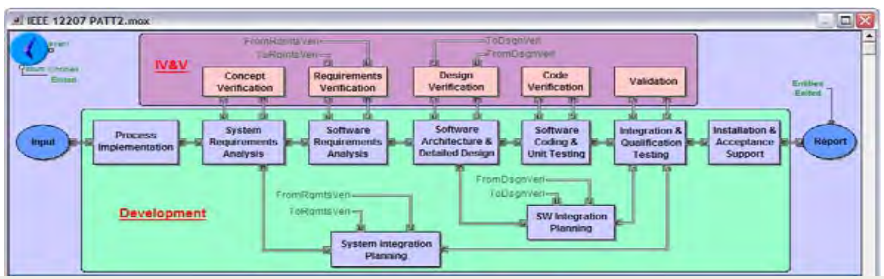
- Organizational
- Site and Project
- Industry Standard



PATT Project Database

Project Performance

SW Process Simulation Model

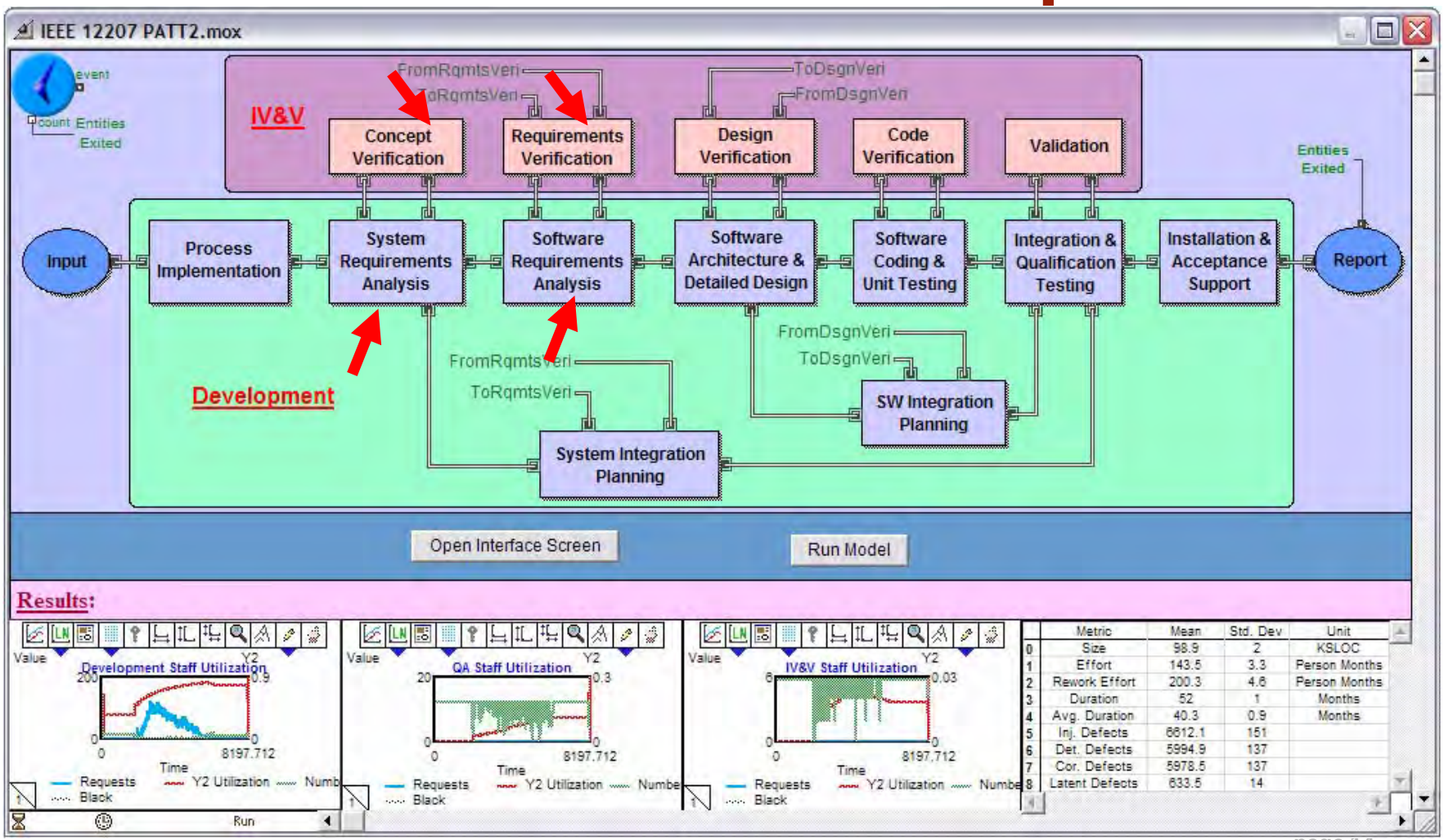


Development Project Statistics

Project Id: 1

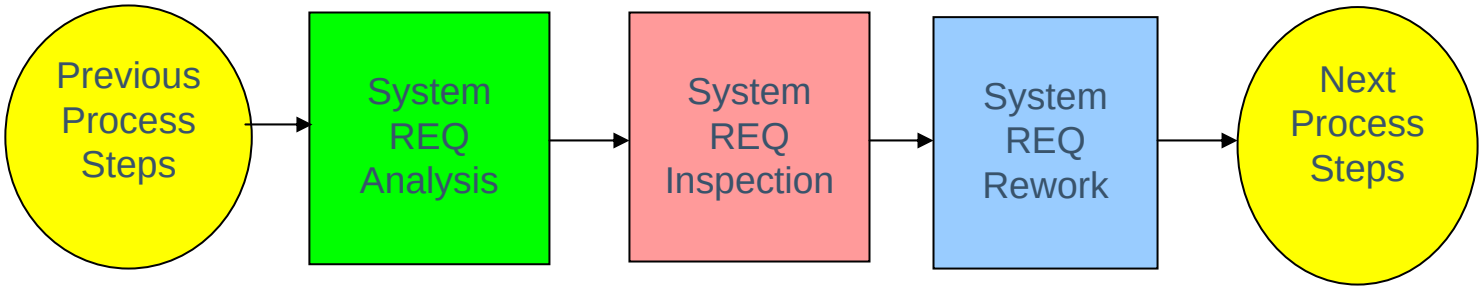
Run Set	Size Mean / Std. Dev	Effort Mean / Std. Dev	Rework Effort Mean / Std. Dev	Duration Mean / Std. Dev	Avg. Duration Mean / Std. Dev	Corrected Defects Mean / Std. Dev	Latent Defects Mean / Std. Dev
1	58.00 / 1.63	54,321.35 / 1,484.76	10,568.58 / 217.46	3,572.02 / 68.39	2,381.00 / 55.76	2,756.13 / 77.96	143.66 / 3.72
2	58.00 / 1.63	53,666.85 / 1,511.91	9,573.17 / 298.02	3,457.40 / 68.54	2,266.06 / 66.44	2,759.38 / 76.79	140.40 / 4.82
3	58.00 / 1.63	54,321.35 / 1,484.76	10,568.58 / 217.46	3,572.02 / 68.39	2,381.00 / 55.76	2,756.13 / 77.96	143.66 / 3.72
4	58.00 / 1.63	53,920.04 / 1,445.09	9,043.53 / 202.73	3,500.52 / 52.74	2,310.60 / 53.75	2,758.30 / 77.41	141.49 / 4.30

NASA Model – Includes IV&V Layer with IEEE 12207 SW Development LC

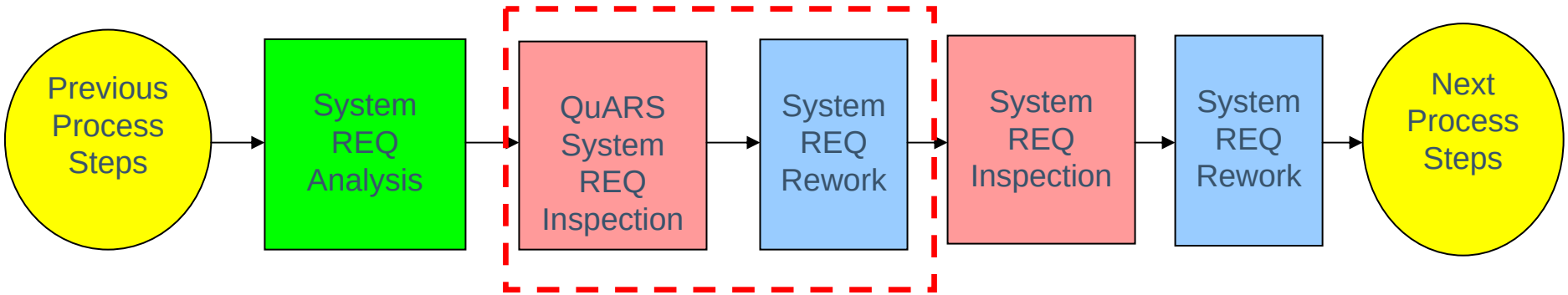


System and Software Requirements Processes

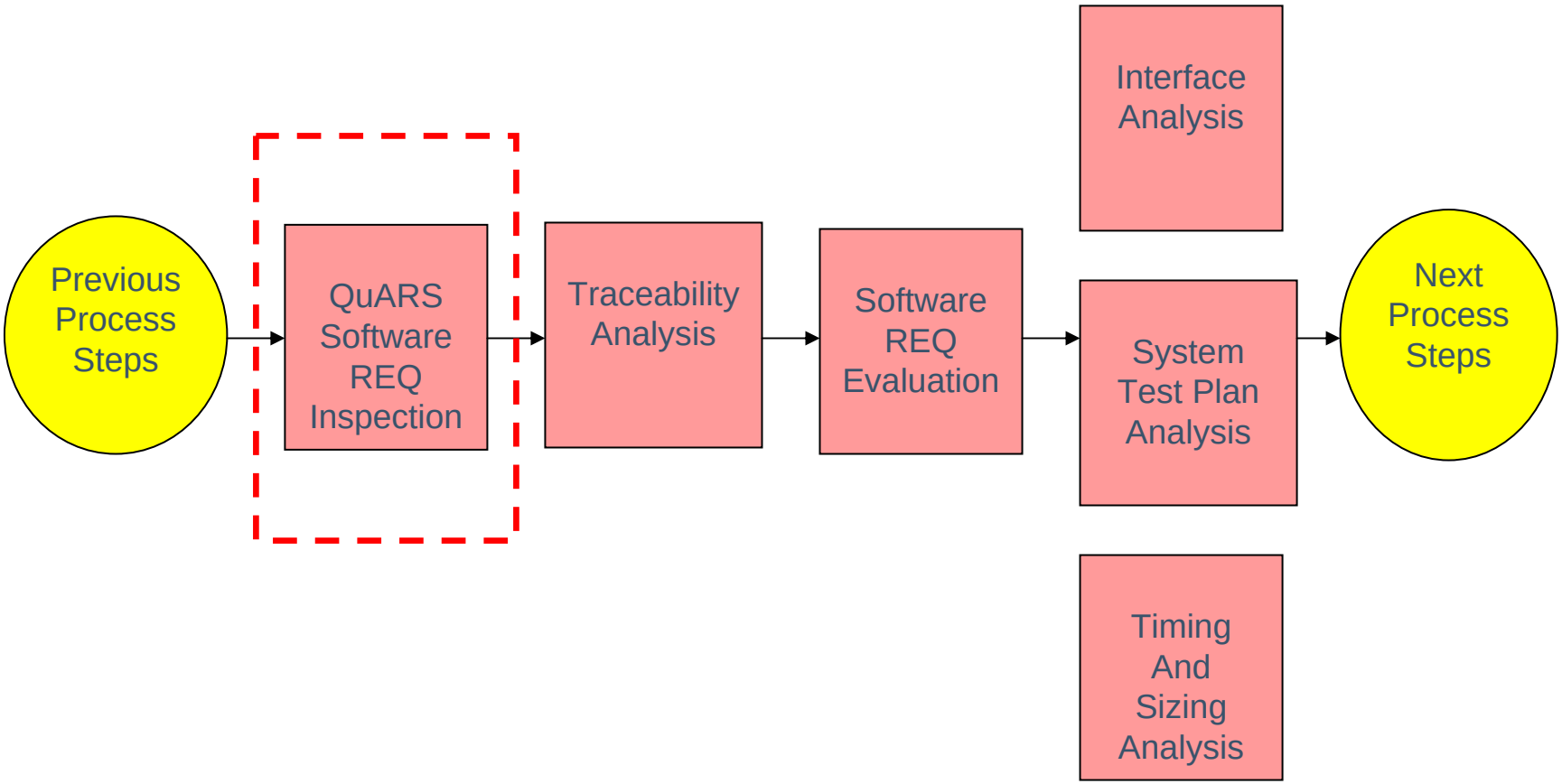
AS-IS



TO-BE



IV&V at Requirements Verification



Impact of QuARS - Assumptions

Have the ability to look at a variety of process improvements

Assumptions:

- Typical Manned Mission using IEEE 12207 Process
- Includes IV&V
- 100 KSLOC Project
- Industry standard data for Earned Value, defect detection rates
- Organizational data for productivity, defect injection rates
- Project specific data for IV&V
- Pilot study data for capabilities of QuARS

Impact of QuARS - Assumptions

In the case of QuARS

1. Productivity of the tool => 10 KLOC/ Person hour
2. QuARS type defects => 37% of Requirements Defects
3. QuARS detects 100% of lexical and (i.e. QuARS detectable defects)
4. Improves defect detection capability at Requirements Inspections (+5 to10%)
5. Cost of training and associated SEPG activities 1 person-month
6. Cost of tool TBD

Secondary Effects of Using QuARS

1. Improves clarification of requirements (i.e. improves productivity in design of + 5%
2. Improves Engineering design decisions (reduced injection of design defects of - 5%
3. Improves test planning and test case generation productivity + 5%)
4. Improves test case generation (i.e. less investigation and rework -5%)

Cases Looked at

QuARS as a V&V activity within the project.

- Look at applying QuARS at the Systems Requirements and Software Requirements phases, both.
- Assuming 100% and 50% Requirements inspections
- Before and after inspection
- When injection of QuARS type defects is at minimum (i.e. 20%)

QuARS as an IV&V activity outside of the project

- Look at applying QuARS at the Systems Requirements and Software Requirements phases, both.
- Assuming 100% and 50% Requirements inspections
- When injection of QuARS type defects is at minimum (i.e. 20%)

Key Questions Evaluated

Did QuARS provide a value?

Is the tool more effective in V&V or IV&V mode?

Under what project conditions is the tool most useful?

- Applying QuARS before or after Requirements Inspection
- Applying QuARS when different amount of requirements are inspected

Is QuARS still worth using when lexical defects are at a minimum? (max reduction through training achieved)

What is the amount that NASA should be willing to pay for the tool?

Results - Applying QuARS in V&V Mode at Different Phases

Comparison to Baseline

	Effort incl. IV&V	Effort	RWK_Efrt	IV&V Effort	Duration	Avg. Dur	Crctd_Dfcts	Ltnt_Dfcts
QuARS at Sys Req	1,659	1,670	1,312	(11)	103	49	34	18
p value	0	0	0	1	0	0	1	0
QuARS at Sw Req	5,142	5,128	4,779	14	377	72	(10)	55
p value	0	0	0	1	0	0	1	0
QuARS at Sys & Sw Req	5,268	5,285	4,926	(17)	362	81	(10)	59
p value	0	0	0	1	0	0	1	0

- Application of QuARS at Systems and Software Requirements offers a value
- Sweet spot is to apply QuARS after Software Requirements
- QuARS is approximately +10% to +15% benefit when applied before Requirements inspection rather than after
- QuARS has approximately +3% increased performance when project does not have IV&V

Results – Less Than 100% of Project is Inspected

Comparison to Baseline

		Effort incl. IV&V	Effort	Rwrk_Efrt	IV&V Effort	Duration	Avg. Dur	Crctd_Dfcts	Ltnt_Dfcts
SC5.1		2133	2165	1800	-32	118	37	26	26
	p value	0	0	0	1	0	0	1	0
SC5.2		6590	6576	6208	13	503	57	-32	75
	p value	0	0	0	1	0	0	1	0
SC5.3		6287	6340	5973	-53	443	73	-23	71
	p value	0	0	0	0	0	0	1	0

- The value of QuARS increases when applied to projects that experience less than 100% inspections (this instance = 50%)
- At 50% inspection, +20% to +30% increased effort savings, +17% to +%42% reduction in latent defects

Results - Applying QuARS in IV&V Mode at Different Phases

Comparison to Baseline	Effort incl. IV&V	Effort	Rwrk_Efrt	IV&V Effort	Duration	Avg. Dur	Crctd_Dfcts	Ltnt_Dfcts
QuARS at Concept IV&V	1,448	1,679	1,322	(231)	114	69	32	17
p value	0	0	0	0	0	0	1	0
QuARS at REQ IV&V	2,427	2,717	2,341	(290)	191	64	19	29
p value	0	0	0	0	0	0	1	0
QuARS at both IV&V	2,900	3,374	2,976	(474)	237	98	11	36
p value	0	0	0	0	0	0	1	0

Value of QuARS is significantly reduced when applied in IV&V mode. 87%, 47%, 55% for effort; 94%, 52%, 61%

Secondary effects not experienced by the project

Slight make up on effort due to cost shift to IV&V

Results – QuARS Under Different Defect Injection Rates

Lexical defects reduced from 37% of Requirements defects to 20% (46% reduction)

Believed that even with training and other defect prevention measures, lexical defects will still exist at 20% level or greater

For V&V
- Effort savings reduced by 28% to 36%
- Quality savings reduced by 28% to 38%

For IV&V
- Effort savings reduced by 35% to 43%
- Quality savings reduced by 26% to 36%

Results – QuARS Under Different Defect Injection Rates

Comparison to Baseline

	Effort incl. IV&V	Effort	Rwrk_Efrt	IV&V Effort	Duration	Avg. Dur	Crctd_Dfcts	Ltnt_Dfcts
QuARS at Sys Req	1,186.78	1,199.64	858.23	(12.86)	58.17	42.36	39.21	13.08
p value	0.02	0.02	0.00	0.84	0.25	0.08	0.51	0.04
QuARS at Sw Req	3,179.53	3,187.55	2,890.71	(8.02)	212.62	44.53	13.00	34.37
p value	0.00	0.00	0.00	0.90	0.00	0.05	0.83	0.00
QuARS at Sys & Sw Req	3,354.04	3,295.10	2,994.34	58.94	235.76	62.62	13.69	36.25
p value	0.00	0.00	0.00	0.33	0.00	0.01	0.82	0.00

Comparison to Baseline

	Effort incl. IV&V	Effort	Rwrk_Efrt	IV&V Effort	Duration	Avg. Dur	Crctd_Dfcts	Ltnt_Dfcts
QuARS at Concept IV&V	874.24	1,174.63	833.20	(300.39)	17.48	41.67	36.16	12.66
p value	0.08	0.02	0.00	0.00	0.71	0.08	0.54	0.05
QuARS at REQ IV&V	1,571.89	1,747.96	1,396.61	(176.07)	123.17	45.22	30.78	17.48
p value	0.00	0.00	0.00	0.00	0.01	0.06	0.60	0.01
QuARS at both	1,643.16	2,123.36	1,758.96	(480.20)	86.25	61.77	24.49	23.22
p value	0.00	0.00	0.00	0.00	0.07	0.01	0.68	0.00

Return on Investment Inputs

Input Parameters for Financial Calculation					
Input					
Cost of Development Staff per Hour	$ 100.00		Org internal investment rate cut-off (aka hurdle rate)	20.00%	
Cost of IV&V Staff per Hour	$ 100.00				
Implementation Cost (Tool Cost)	$ -	To be determined			
Increase in Revenue per Month	$ -	if release early			
Cost to Correct Latent Defects	$ 25,500.00	per defect			
	1.5 person-month to fix 1 defect				
Assumptions					
Work Hours per Month	170		Work Hours per Year	2,040	
Latent Defects will be corrected within the first	36	months			
If releasing the system early by	3	months or more, there will be an increase in revenues (due to ar			
Effort saving occurs at time = duration					
Duration saving occurs at time = duration +	1	month		170	hours
Latent defect saving occurs at time = duration +	36	month		6120	hours

NPV and Risk Results Summary

Config.	QuARS Value	
	Mean	Std Dev
SC1	$282,813	$24,649
SC2	$869,221	$45,055
SC3	$933,118	$54,769
SC4.1	$265,149	$20,884
SC4.2	$837,796	$48,780
SC4.3	$876,587	$46,510
SC6	$266,008	$19,413
SC7	$435,653	$29,121
SC8	$541,538	$34,524

Config.	QuARS Value	
	Mean	Std Dev
SC1	$202,714.31	25,167.62
SC2	$539,454.13	30,814.83
SC3	$576,941.35	35,664.52
SC6	$182,139.63	16,474.07
SC7	$270,398.43	19,742.96
SC8	$333,364.85	22,189.47

- PR(NPV>0)=100%
- PR(NPV>$100K) = 100%
- Overall, QuARS shows a reduced NPV between -28% to -38% compared to higher defect injection rate (Lowest NPV = $182K)

Scenario Descriptions

SC 1: Turn on QuARS at System Requirments
SC 2: Turn on QuARS at Software Requirements
SC 3: Turn on QuARS at both Systems and Software
SC 4.1: Turn on QuARS after System Requirments Insp
SC4.2: Turn on QuARS after Software Requirments Insp
SC4.3: Turn on QuARS after both System and Software Requirments Insp
SC6: Turn on QuARS at Concept Verification
SC7: Turn on QuARS at Requirements Verification
SC8: Turn on QuARS at Concept Verification and Requirements Verification

Discussion

Straight forward and quick analysis (1 week)

- Main effects analysis
- Secondary effects analysis
- Sensitivity analysis
- Management Questions
- Results

NASA is currently engaged in conducting a 6 month trial of three different requirements analysis tools

Will use results of their study to validate the model

Still need to run simulation model to compute overall impact of the tool and perform business case analysis

Conclusions

QuARS is worth while

- Value to the project @ 20% hurdle rate ranges from $280K to $930K in V&V mode and $266K to 540K in IV&V mode
- Cost of tool is not set yet
- PR(NPV>100K) = 100%

Analysis showed that results were sensitive to

- % of project inspected
- % Lexical defects injected
- Labor rates, rework costs, hurdle rate

For these parameters, it is important to be clear about their values for projects that NASA plans to implement QuARS to

Straight forward analysis took about 1 week.

Conclusions

Process Simulation is NOT a Silver Bullet

Many High Value Add Ways to Use Process Simulation

- Evaluate Strategic Issues - Quality Assurance Strategy
- Plan Processes
  - Assess the Costs and Benefits of New Tools
- Architect, Design, and Document Processes
- Manage Projects Quantitatively (CMMI L4)
- Estimate Project Costs from the Bottom Up
- Train Project Managers

See SEI Technical Report on Transitioning Process Simulation into Organizations (Spring 2007)

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The End

Understanding and Leveraging a Supplier's CMMI Efforts: A Guidebook for Acquirers

Lawrence T. Osiecki

Software Engineering & System Assurance

OUSD(AT&L) SSE/SSA

15 November 2006

Briefing Outline

- Background
- Guidebook need
- Content Authors
- Issues
- Published Maturity Levels
- Guidebook Contents
- Format of the Guidebook
- Current Status
- Path Forward
- Summary

Background

- NDIA hosted “Use of CMMI in Acquisition: Summit & Workshop” in Sep 05
- Purpose of the Summit was to look at a set of existing issues (representative):
  - Background on how organizations approach CMMI appraisal and why
  - Use of the Appraisal Disclosure Statement
  - Formal Guide for CMMI Usage for DoD
  - Training for DoD Acquisition Organizations in the use of CMMI
- Findings (Action Items) resulting from the Summit included (not comprehensive):
  - Complete Guidebook for use of CMMI in Acquisition
  - Recommendation for Guidebook topic coverage
  - Generate suggested input to RFP section L & M

Background - 2

- The Summit Results suggested the following Guidebook topics:
  - Interpreting the Appraisal Disclosure Statement (ADS)
  - List sources for help (FFRDCs, DCMA, others)
  - Generate suggested content for RFP Sections L & M
  - Background/description of CMMI esoteric content/issues
  - Getting processes transitioned/implemented rapidly on new programs
  - Processes in the IMP/IMS/SOW (achieving contractual commitment to execute)
  - Offeror approach to verifying compliance to proposed processes
  - Past performance measures to provide evidence of process performance
  - Appendices:
    - Checklists
    - Contract Language
    - RFP language

Content Authors

- OSD and the CMMI Steering Group (CMMI-SG) identified this gap
- The CMMI-SG chartered a committee of Government, Industry, and Academic contributors to develop guidance for acquirers

Hal Wilson (Northrop Grumman Corp)
Linda Rosa (Mitre)
Mike Nicol (ASC/EN)
Jeff Dutton (Jacobs Engineering)
Gene Miluk (SEI)
Joe Wickless (SEI)
Mike Phillips (SEI)
Brian Gallagher (SEI)
Joe Elm (SEI)

- Government Team is coordinating the final effort
  – taking this body of work and structuring it in Guidebook format for use by Program Managers

Issues

CMMI-DEV in an acquisition environment

Intended Use:	CMMI (the original CMMI model) is designed for use within development organizations for internal process improvement, not from acquirers perspective
Size:	CMMI is a comprehensive process model that exceeds 700 pages. Just another tome the PM must have knowledge on how to implement
Training:	CMMI training focuses on the use of CMMI-DEV for process improvement, not leveraging the activities from an acquirer's perspective
Marketing:	"level-mania" too often has defeated desired behavior of deploying process improvement at program startup and throughout the development life cycle

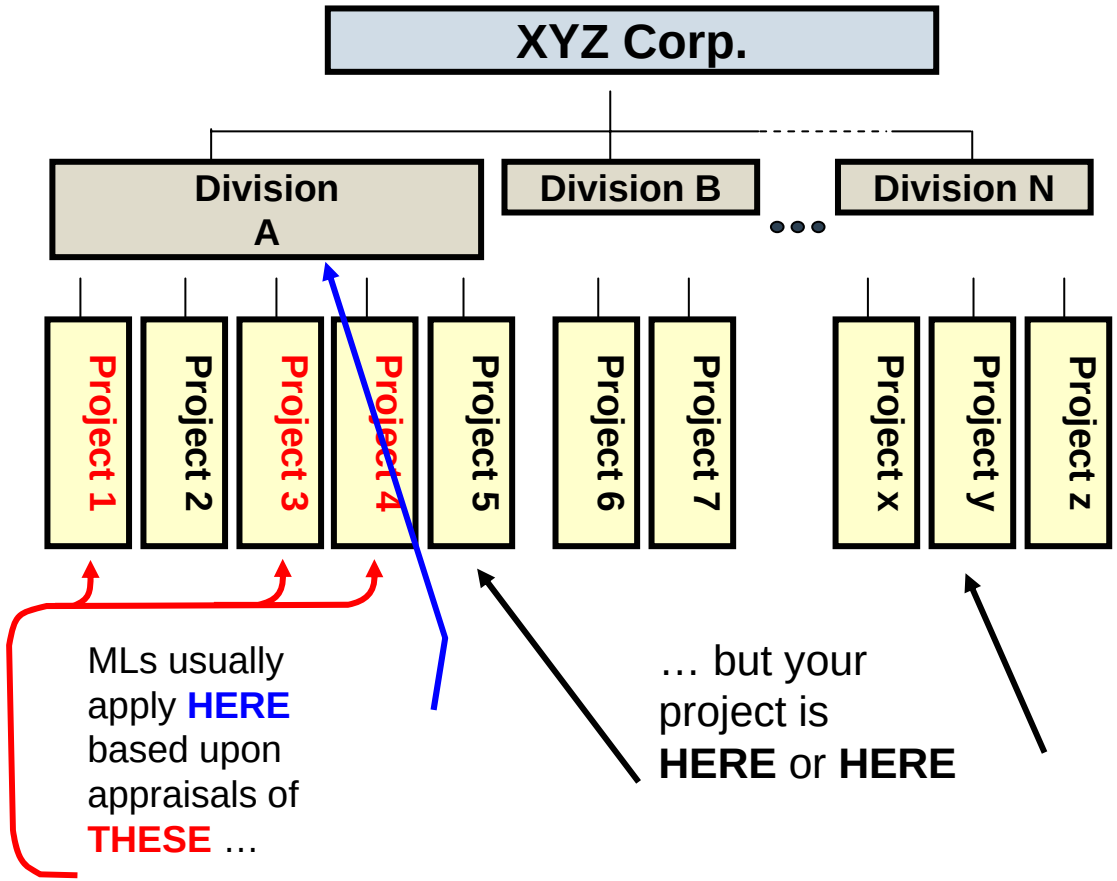
Guidance in the effective use of CMMI-DEV by Acquirers does not exist

Issues -2

- These Issues lead to difficulty in:
  - understanding what specific benefits CMMI provides for the acquiring program office
  - understanding how CMMI reduces program risk
  - determining what to ask for regarding process capability
  - interpreting developer's claims regarding maturity level ratings
  - discriminating between the process capability of competing suppliers
  - separating the "practitioners in the marketing department" from the "practitioners on the shop floor"
  - monitoring developer's process capability and their implementation as applied to current programs
  - understanding how broadly the rating applies to the organization of interest to the acquirer
  - belief in the myth that CMMI is the "silver bullet"

Published Maturity Levels

- Published Maturity Levels may be based on a single Division or location



The new ADS will help clarify these claims

Executive Summary

- This Guidebook intends to help acquisition organizations understand and apply CMMI-DEV in three ways:
  - to provide guidance on how to request, interpret, and use the results of CMMI appraisals
  - during source selection, to help identify and evaluate strengths, weaknesses, and risks that may be associated with a particular offeror/team approach
  - throughout the execution of an acquisition program, to gather and interpret information for effectively monitoring contractor processes

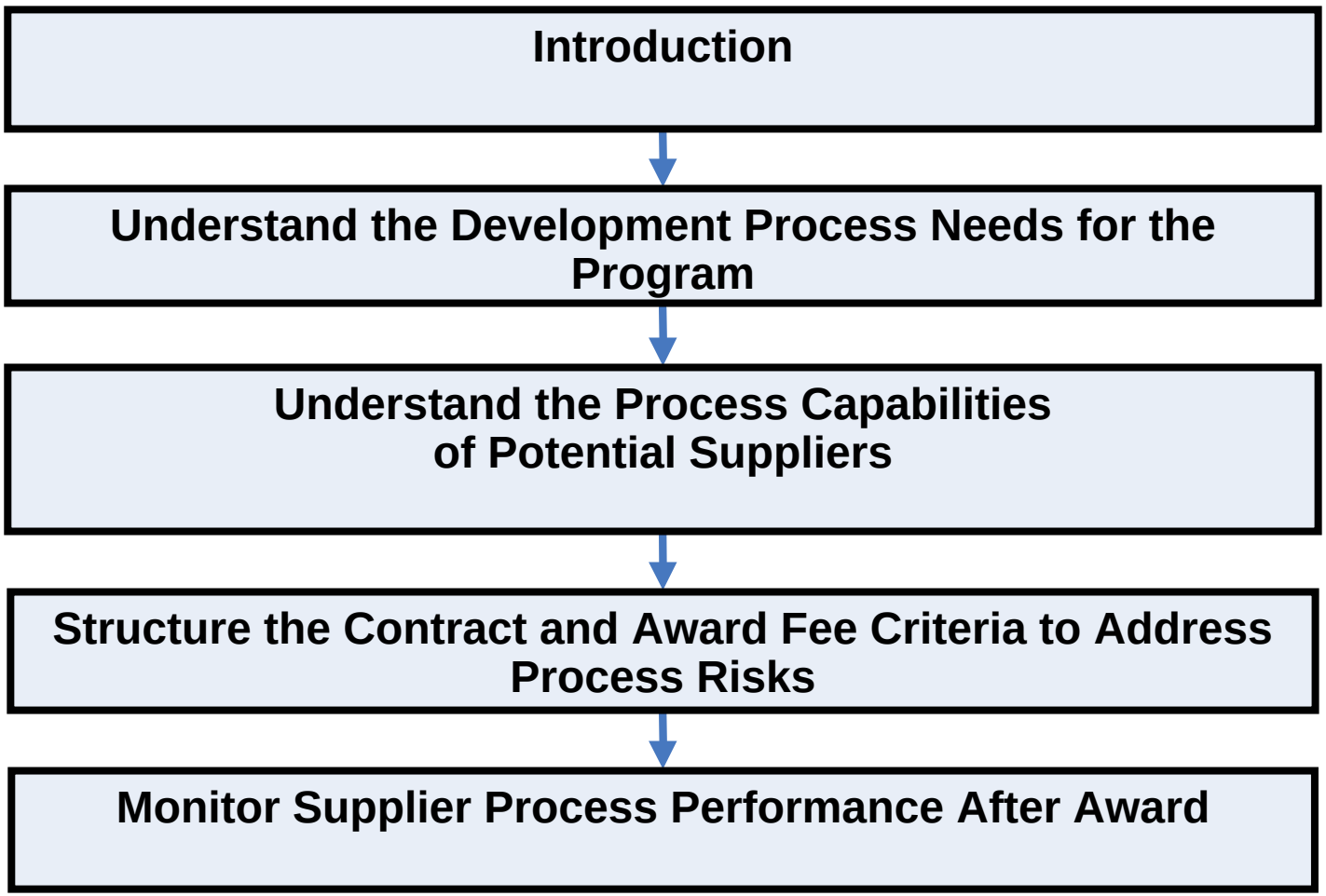
Provide insight to what CMMI is… and is not

Guidebook Contents

- The guidebook provides the basic information that acquirers need in order to understand CMMI use by suppliers
  - explanations of capability and maturity levels
  - differences between continuous and staged model representations
  - high maturity/capability levels (levels 4 & 5)
  - addresses obscure elements of CMMI, such as equivalent staging
- Cautions that high capability and maturity level ratings do not of themselves guarantee program success
- This Guidebook intends to help clarify what high capability and maturity ratings can and cannot do for a program

Guidebook intends to demystify these terms

Guidebook Chapters (draft)



Guidebook Chapter 1 (draft)

- Introduction
  - CMMI Fundamentals
  - CMMI Appraisals
  - Interpreting CMMI Ratings
  - The Structure of the Guidebook

Guidebook Chapter 2 (draft)

- Understand the Development Process Needs for the Program
  - Estimate Exposure to Process Risk
  - Build Process Capability into the Program
  - Relate Processes to the Program Life Cycle
  - Assess the Process Needs of the Program

Guidebook Chapter 3 (draft)

- Understand the Process Capabilities of Potential Suppliers
  - Request Recent Appraisal Results
  - Request Integrated Master Plan Documentation of Proposed Processes
  - Request Process Proposals in Critical Areas
  - Request Approach to Integration with Subcontractor Processes
  - Request Approach to Integration with Acquirer Processes
  - Request Historical Data on Process Performance
  - Evaluate Compliance of CMMI Process Deployment to ISO 9001-2000
  - Use Recent Post Award Appraisal Data from other Programs
  - Request Incorporation of Process Reviews into Proposed Program Schedules
  - Enable Process Compliance Evaluation During Execution
  - Perform Pre-Award Process Appraisals

Guidebook Chapter 4 (draft)

- Structure the Contract and Award Fee Criteria to Address Process Risks
  - Incorporate Process Reviews into the Program Schedule
  - Specify Post Award Appraisal
  - Specify Process-Based Award Fee Determinants
  - Require Risk Mitigation Plans and Activities
  - Specify Reporting of Process Statistics
  - Specify Access to Selected Process Artifacts
  - Approaches when Process Capability not Addressed in the Solicitation

Guidebook Chapter 5 (draft)

- Monitor Supplier Process Performance After Award
  - Process Monitoring through Artifact Review
  - Process Monitoring through Review of Process Metrics and Audits
  - Contractor Team Process Reviews

Guidebook Appendices (draft)

- Appendix A - Questions & Checklists
- Appendix B - Understand the Development Process Needs of the Program (Implementation Guidance)
- Appendix C – Understand the Process Capabilities of Potential Suppliers (Implementation Guidance)
- Appendix D – Structure the Contract and Award Fee Criteria to Address Process Risks (Implementation Guidance)
- Appendix E – Monitoring Supplier Process Performance after Award (Implementation Guidance)
- Appendix F – SCAMPI-A Appraisal Disclosure Statement (ADS) Example Template
- Appendix G - Acronyms

Format for the Guidebook

- Readable (small) 40 pages for the PM
- Electronic delivery of additional material designed for implementation
- Linked appendices for online version
- Printed version (40 pages) with CD or with linked appendices

- Part of the CMMI Product Suite
- Incorporate into DAU training
- Update as our learning occurs

Current Status

- Committee chartered by CMMI Steering Group
- First draft completed and submitted for Steering Group review (Jul 06)
- Second draft completed and submitted for government review (Aug 06)
- Government team assumes leadership role for Guidebook completion (Oct 06)
- Guidebook content being restructured based on Government reviews on the initial drafts (Oct 06)

Path Forward

- Implement remaining set of comments from Government Review Team (Nov 06)
- Government review team to comment on restructured and revised Guidebook content (Nov 06)
- Incorporate Government Review Team comments (Dec 06)
- Quality, Integrity Checks (Jan 07)
- Public review (end of Jan 07)

Summary

- The Guidebook intends to provide information in three areas:
  - guidance on how to request, interpret, and use the results of appraisals
  - identify and evaluate strengths, weaknesses, and risks that may be associated with a particular offeror/team approach
  - gather and interpret information for effectively monitoring contractor processes
- The Guidebook provides the basic information to apply CMMI-DEV on acquisition programs
  - explanations of capability and maturity levels
  - differences between continuous and staged model representations
  - defines equivalent staging & high maturity/capability levels (levels 4 & 5)
- The Guidebook designed for use by the Program Manager as a ready source of information and by the Program Management Staff by including detailed implementation guidance in referenced Appendices

Open Discussion

Air Armament Center

Deliver war-winning technology, acquisition, test, sustainment …expeditionary capabilities to the warfighter

Strengthening Systems Engineering Discipline

to NDIA CMMI Conf

15 Nov 2006

Mr. Ian Talbot

AAC/EN

ian.talbot@eglin.af.mil

U.S. AIR FORCE

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited.

AAC Portfolio

Outline

- Direction & Goals
- Approach
  - Process Focus
  - Multiple Spirals
- Spiral 1
  - Defining SE
  - Establishing a Baseline
  - Results & Observations
- Path Ahead
  - Analysis & Mining
  - Coaching ... Mentoring Improvement
  - Re-evaluating
- Final Thoughts

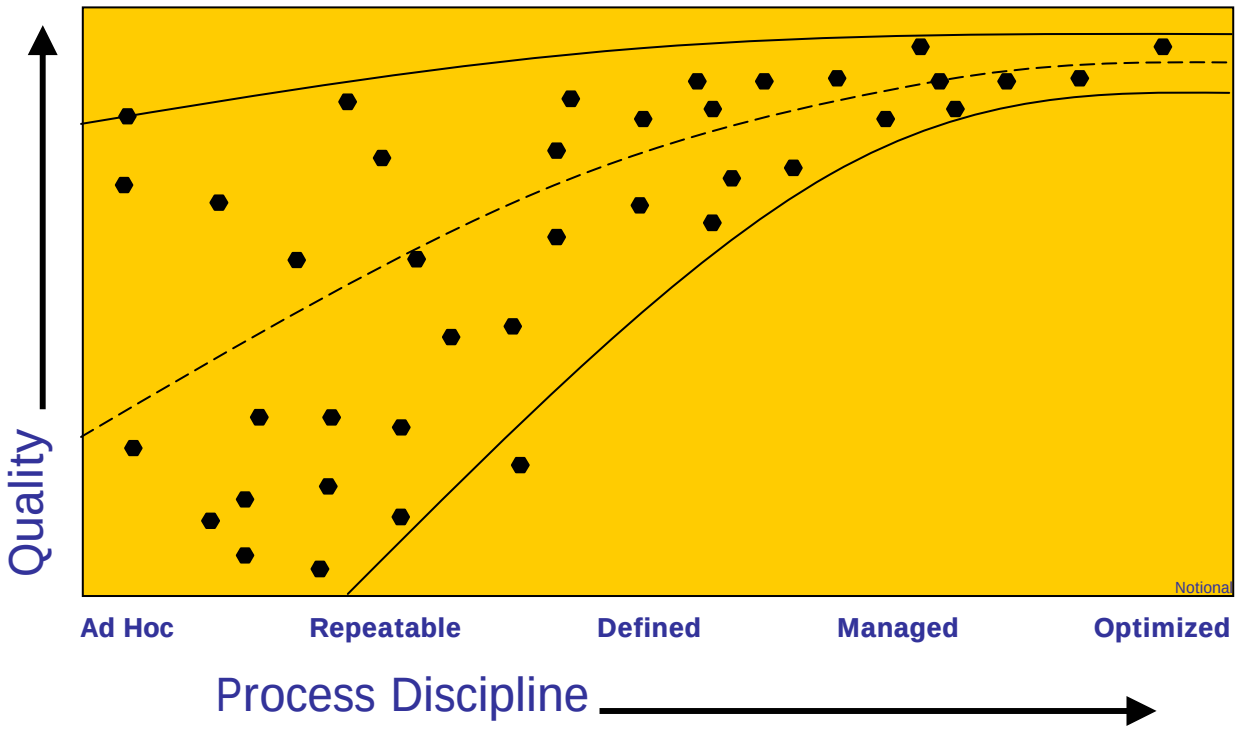
Direction & Goals

- Poor Systems Engineering Identified as Factor in Acquisition Program Problems & System Failures
- Recognized Need to Revitalize SE
- Engineering Tasked to:
  - Perform a Center-wide SE Assessment by Oct 06
  - Where are we?
  - Baseline Enterprise Process Improvement
- Improve Program Performance & Reduce Technical Risk
- Ensure a Consistent Understanding of SE
- Ensure Core SE Processes are in Place and Being Practiced
  - Identify Opportunities for Continuous Improvement
  - Clarify Roles and Responsibilities
  - Institutionalize “Best Practices”

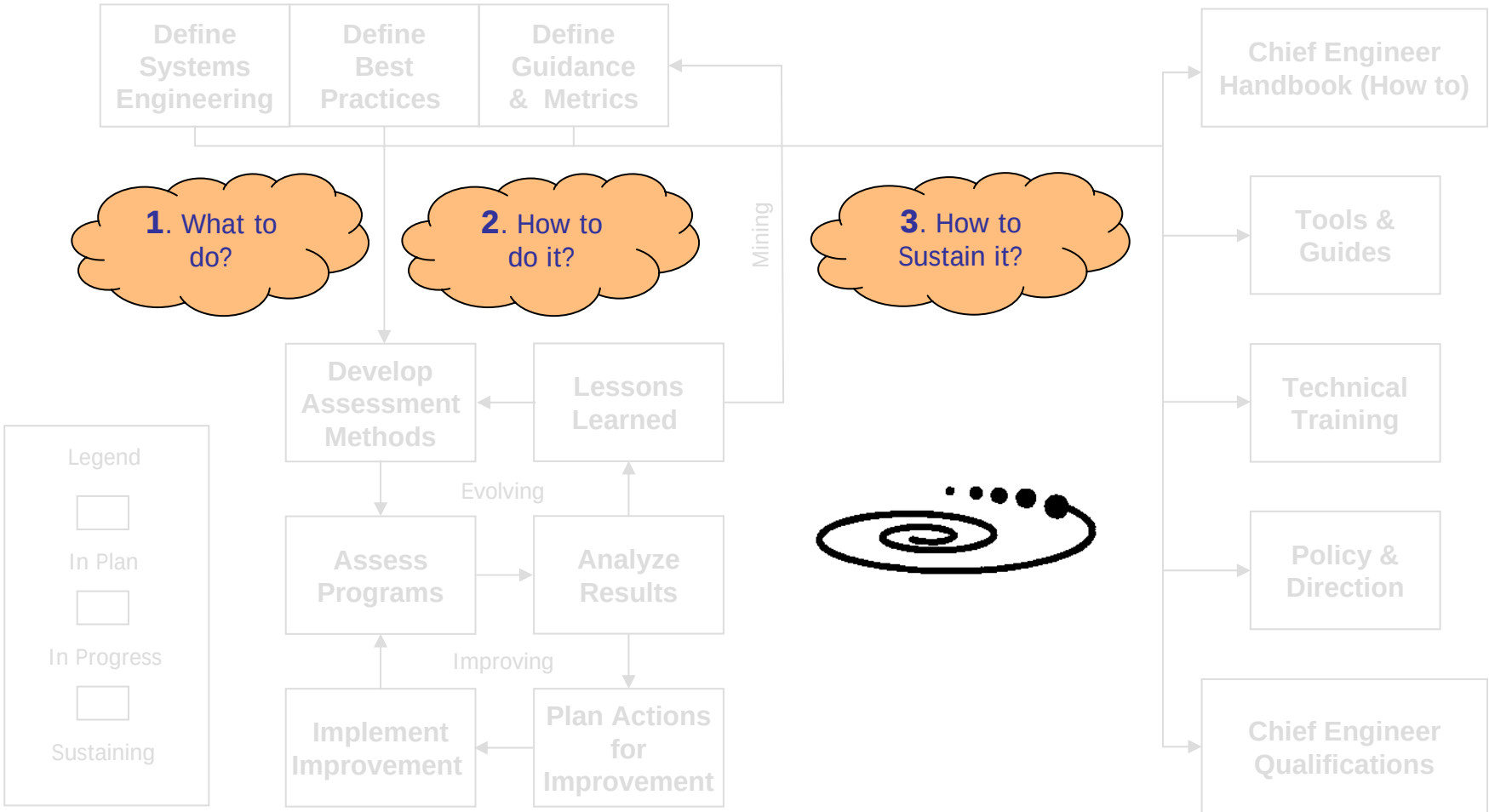
Institutionalized Process Driven SE » Lower Risk Technical Programs

Why Focus on Process

- Process Discipline Leads To
  - Predictable Program Performance
  - Ability to Deliver on our Commitments

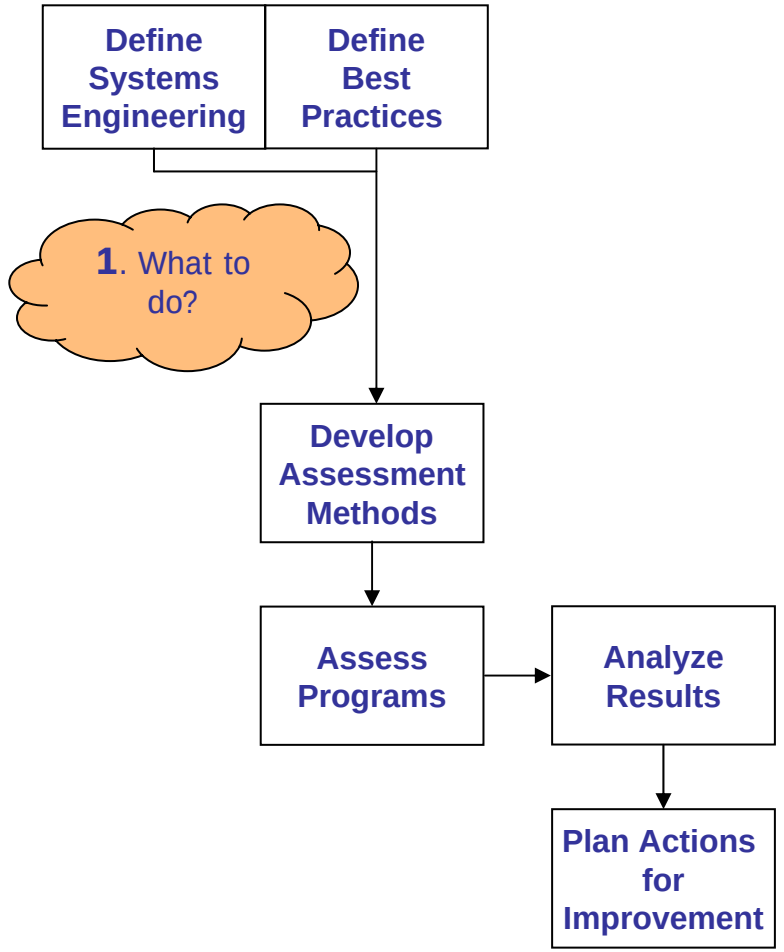


Spiral Approach



Institutionalized Process Driven SE » Lower Risk Technical Programs

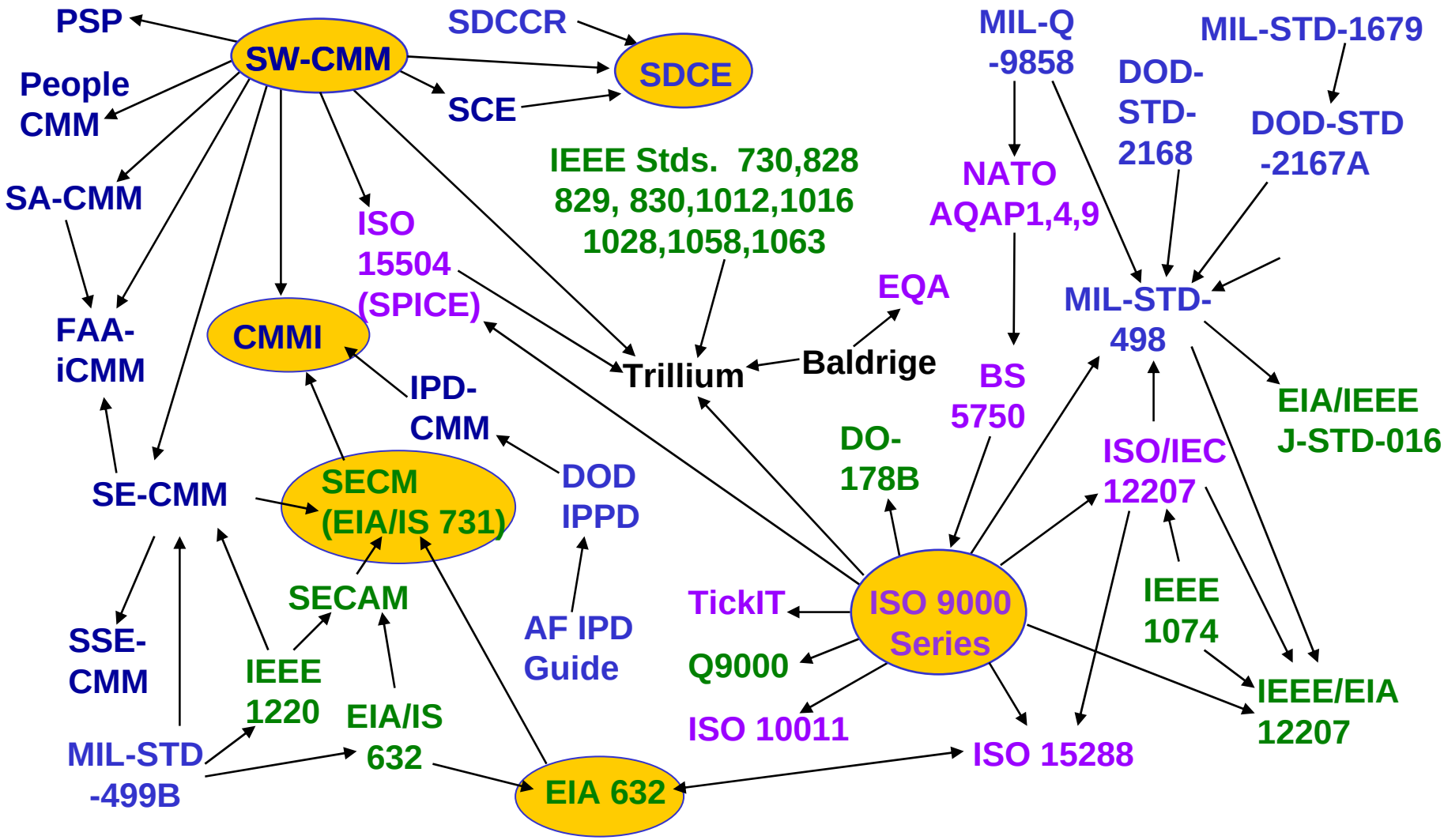
Spiral 1



- CY06
  - Define SE & Best Practices
  - Develop Assessment Methods & Tools
  - Train & Assess Programs
  - Analyze Results
  - Initiate Actions for Improvement

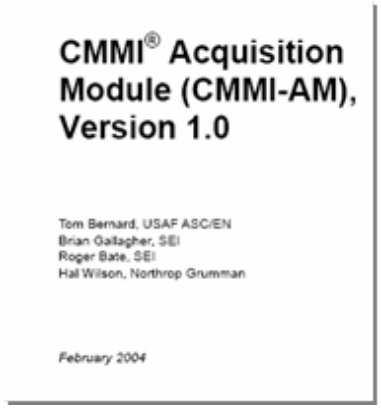
Focus is on Process/Practices not “Health” of Implementation

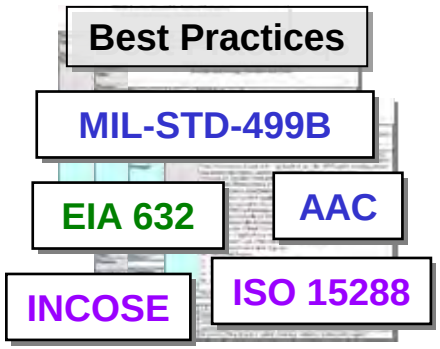
SE Models & Frameworks



Defining SE

- Center Engineering Steering Council
  - Defined Criteria
  - Approved Module & Approach





- 9 Key Process Areas
- 29 Goals
- 117 Practices
- 9 Generic Practices
- Qualifying Questions
- 43 Pages

OSD Guidance
- DAG
- SEP Guidance

Industry/Academia
- SEI, NDIA, Boeing, Raytheon,etc.
- USC, AFIT, etc.

AF Guidance
- AFI 63-1201
- AFPD OSS&E

AFMC Guidance
- AFMCI 63-1201
- OSS&E

Other Centers
- ESC
- SMC

Key Process Areas

- Technical Processes
  - Requirements
  - Design
  - Verification/Validation
  - Transition
- Technical Management Processes
  - Planning
  - Risk Management
  - Configuration Management
  - Decision Analysis
  - Technical Assessment

CNMG-AM
Tailored for
Air Armament Center
System Engineering
Implementation
Assessment
(TSEI) Version 3.0
5 May 2006

Consistent with OSD Policy, Defense Acquisition Guide,
Draft AFI on Systems Engineering & AFMCI on OSS&E

CMMI-AM Tailoring

- What was tailored out
  - Elements not directly related to Systems Engineering (Contracting, Integrated Project Management, Logistics Support)
  - Section of Executive Questions that was Program Management and Enterprise Focused
  - Appendix addressing organizational process improvement

CMMI-AM Tailoring

- What was tailored in
  - Combined measurement and analysis and project monitoring and control and placed it in Technical Assessment
  - Strengthened reviews and audits in Technical Assessment
  - Combined requirements development and management in Requirements
    - Expanded to include elements from ISO-15288
  - Combined verification and validation
  - Developed Design consisting of Technical Solution, Architectures, Integration, Interface management
    - Drawn largely from CMMI-SE/SW/IPPD
    - Added “ilities” and Robust Engineering
  - Added DODAF architectures to Requirements and Design
  - Elevated Configuration Management from a generic practice and added some data management features
  - Added Manufacturing and OSS&E to Transition
  - Reduced Generic Practices from 12 to 9 and reordered them
  - Added Qualification Questions for each Goal

Example

Key Process Area: Requirements

Goal: RG5 - Requirements are managed and controlled, and inconsistencies with technical plans and work products are identified.

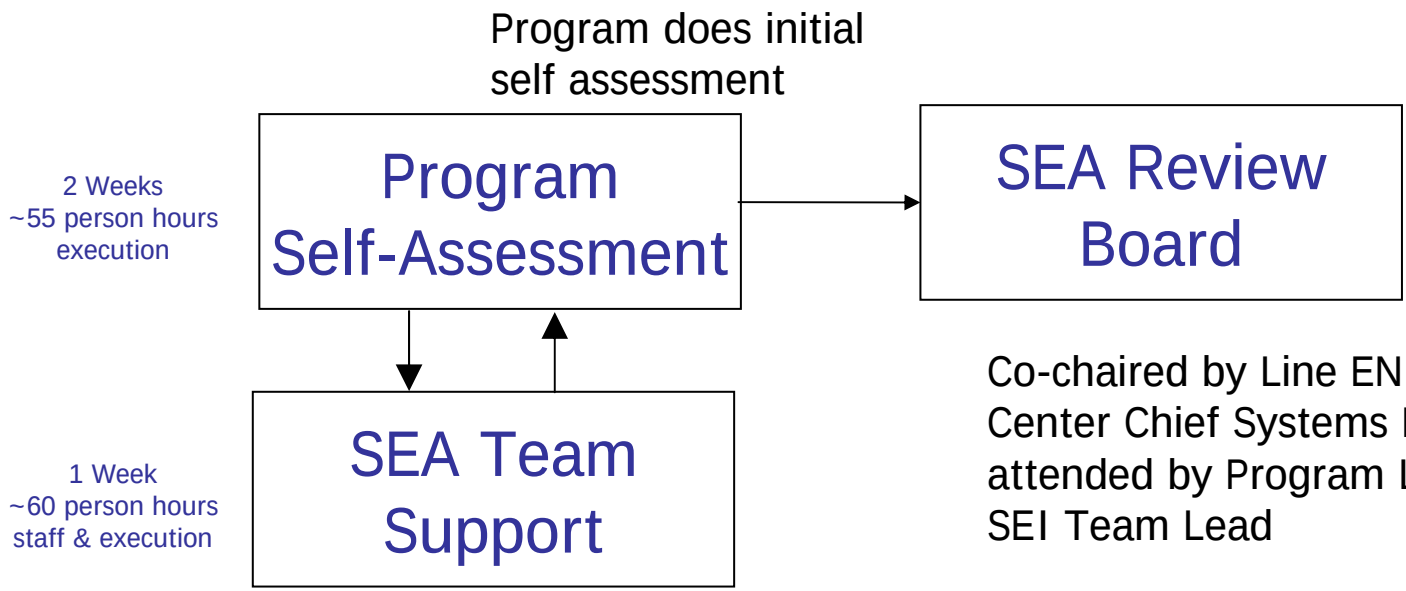
Practice:

P1 Use a disciplined process for accepting, vetting, approving and providing requirements and changes to the developer through a single focal point.

This process should prevent developers from receiving requirements changes from unauthorized sources that are outside the flow of the acquirer's established configuration management process. Each change to a controlled requirement should be assessed for impact to the program's performance, cost, and schedule baselines and to program risk. The existing cost, schedule, and performance baselines should be changed, as required, to accommodate the requirements change. "Requirements creep" must be avoided. A new requirement must be backed with money and vetted through a control process.

Self Assessment Consists of Answering Yes, No or Not Applicable with Supporting Rationale to each of 117 Practices

SEA Methodology



Spiral 1: Assess What Practices are Implemented NOT How Well they are Being Executed

Spiral 2: Shift Focus to “How To” and Quality of SE Implementation

Enterprise View

Legend

R – Requirements **V - Ver/Val** **P – Planning** **CM - Config Mgmt** **TA - Tech Assessment**
D - Design **T - Transition** **RM - Risk Mgmt** **DA - Decision Analysis**

Key Process Areas

as of 18 Oct 06	R	D	V	T	P	TA	RM	CM	DA	Pgm
Program #1										B
Program #2										A
Program #3										C
Program #4										B
Program #5										B
Program #6										C
Program #7										C
Program #8										F
Program #9										C
Program #10										B
Program #11										
Program #12										C
Program #13										A
Program #14										B
Program #15										B
Program #16										B
Program #17										
Program #18										
Program #19										C
Center Average	**C**	**B**	**B**	**B**	**C**	**B**	**B**	**A**	**F**	**C**

High Bar

Scoring Criteria

Process Criteria
- **>90% of Practices**
- **65-89% of Practices**
- **<65% of Practices**

Program Criteria
- **>90% of Practices, No Red**
- **65-89% of Practices, NTE 1 Red**
- **<65% of Practices, 2 or More Red**

Portfolio Criteria
- **95% Programs Green**
- **75%-95% Programs Green, <10% Programs Red**
- **<75% Programs Green or >10% Programs Red**

Process Area View

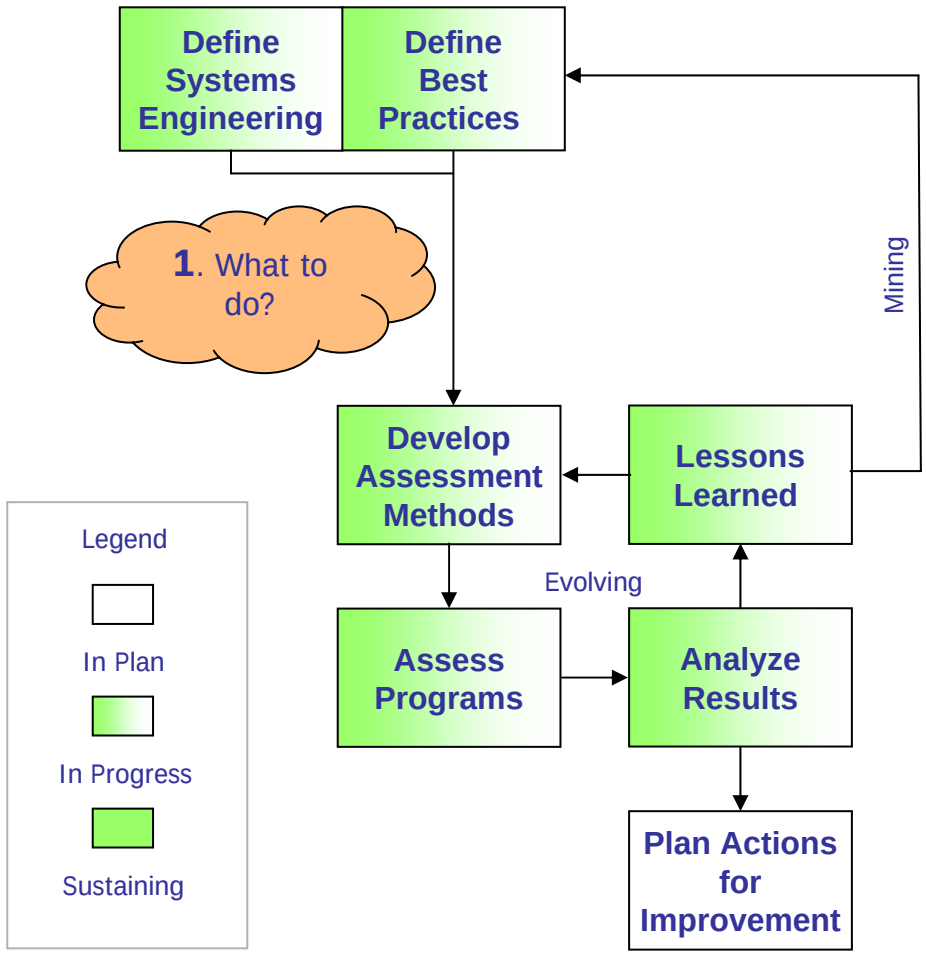
Decision Analysis	**RED**
Planning	**YELLOW**
Requirements	
Technical Assessment	
Risk Management	
Verification & Validation	
Transition	
Design	
Configuration Management	

Better

Scoring Criteria

Process Criteria
- **>90% of Practices**
- **65-89% of Practices**
- **<65% of Practices**

Spiral 1 Observations



- Process
  - Mostly Well Received
  - Training was a Time Saver
  - More Emphasis Needed
    - Production/Integration & Sustainment
- Programs
  - Few Documented Processes
  - Greater Benefit for Smaller
  - Some Saddled with Difficult SE Strategies
    - 1067s, not COTS
- Wants
  - Chief Engineers Handbook
  - Offeror Capability Reviews
  - Metrics for SE Health

Analyze Results

- Systemic Analysis
  - Enterprise Wide Issues – Gaps
    - Understanding
    - Standards
    - Training
  - Specific Areas of Strength
    - Mining of Best Practices
  - Leadership from the Functional
- Programmatic Analysis
  - Program Specific Practice Shortfalls
  - Leadership from Line Functionals
  - Functional Organization Provides Support

Systemic Analysis

Legend

R – Requirements **V - Ver/Val** **P – Planning** **CM - Config Mgmt** **TA - Tech Assessment**
D - Design **T - Transition** **RM - Risk Mgmt** **DA - Decision Analysis**

Weakness

Strength

Key Process Areas

R	D	V	T	P	TA	RM	CM	DA
69	95	86	84	85	97	97	100	49
94	97	93	81	86	100	94	100	71
81	97	81	92	69	76	43	97	58
89	94	64	89	89	86	92	97	76
81	65	90	94	57	79	71	94	0
42	33	38	54	32	40	66	38	38
82	89	67	89	81	81	94	92	76
49	54	89	46	64	43	85	47	79
77	86	73	86	78	86	67	94	49
90	100	100	86	86	86	100	100	71
88	100	89	83	86	100	70	100	49
86	100	82	100	86	92	86	100	74
88	100	96	92	82	83	80	94	76
43	70	90	86	82	86	92	94	46
76	**84**	**81**	**83**	**76**	**81**	**81**	**89**	**58**

EN Directorate Focus on Areas Indicating Enterprise Weakness
- e.g. Decision Analysis, Requirements, Planning

Systemic Issues/Actions

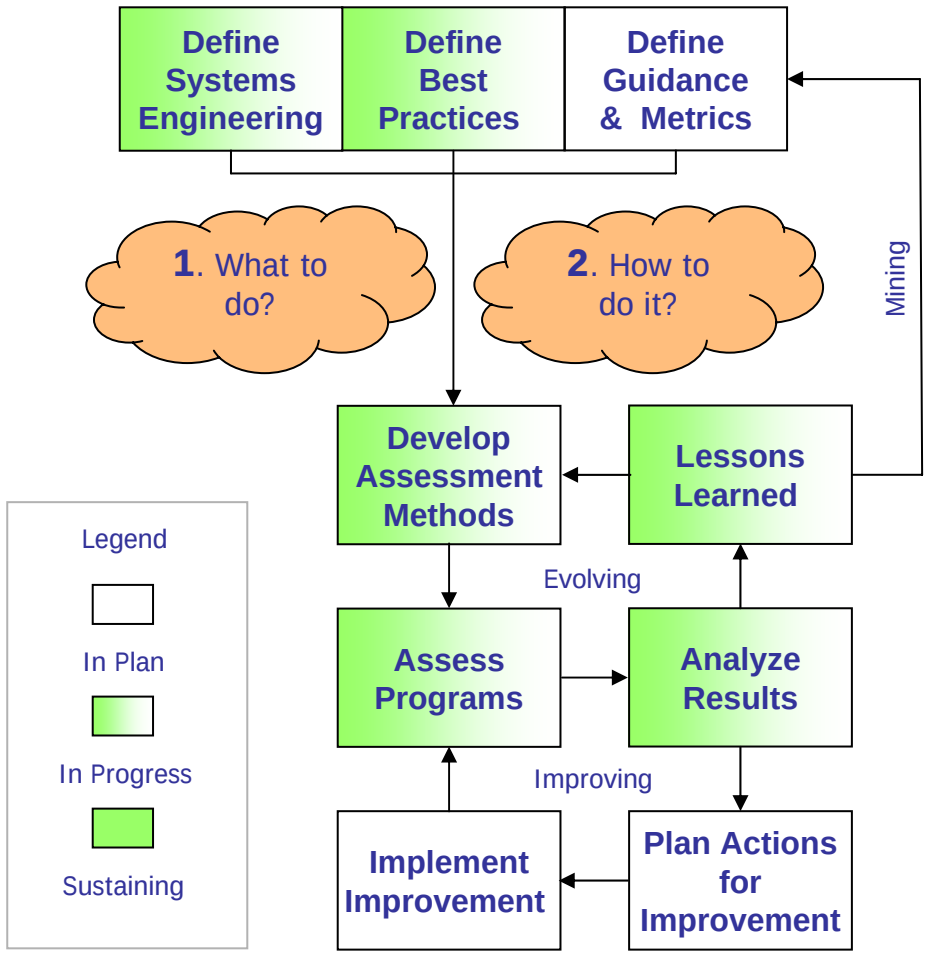
- Planning & SEPs
  - Lack of Clear Definition for Technical Planning, AF Policy Advancing
  - Refine Local Process Guidance, Tailoring, Add Elements & Train
- Requirements
  - Lack of
    - Comprehensive Use Cases / Mission Profiles
    - Requirements Validation
    - Life Cycle Stakeholder Involvement
  - Specific Shortfalls Treated through General Training & Technical Planning Course
- Decision Analysis
  - Lack of Rigorous Process
  - Define Process
  - Obtain Buy In
  - Establish & Train Process

Mined Best Practices

- Requirements Control & Verification Working Group
- Iterative Requirements & Design Trade-off Working Group
- Concurrent Engineering to Ensure Successful Transition to Production
- Contract Incentives for Reducing Cost and Increasing Reliability
- Full Trust Integrated Teaming
- Integrated & Overarching Risk Management Strategy

"Following MIL-STDs was Better than Having no Process at all"

Spiral 2



- FY07
  - Continue Analysis of Results to Identify Gaps & Mine "How to" Best Practices
  - Evolve Assessment Methods
  - Implement Mechanisms & Framework for Coaching / Advising ... Programs
    - Share Results & Coordinate Improvement Efforts
    - Continue Development of Community of Practice
    - Initiate Development of Chief Engineers Handbook
  - Implement Specific Action Plans to Address Areas of Weakness

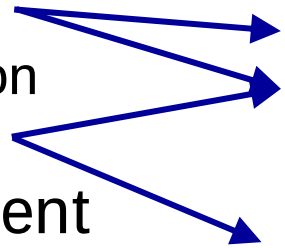
Shift Focus to "How To" and Quality of SE Implementation

Evolve SEA Methods

- Gaps
  - "Valley of Death"
  - Need to get to "Health"
  - AFMC Policy
    - Sustainment Emphasis
- Action Plans
  - Mine Lessons Learned from Programs that Bridged the Valley
  - Mine Willoughby Templates
  - Map Shalls from New AF Policy
  - Expand Module to "Health"

Tool Expansion/Reorg

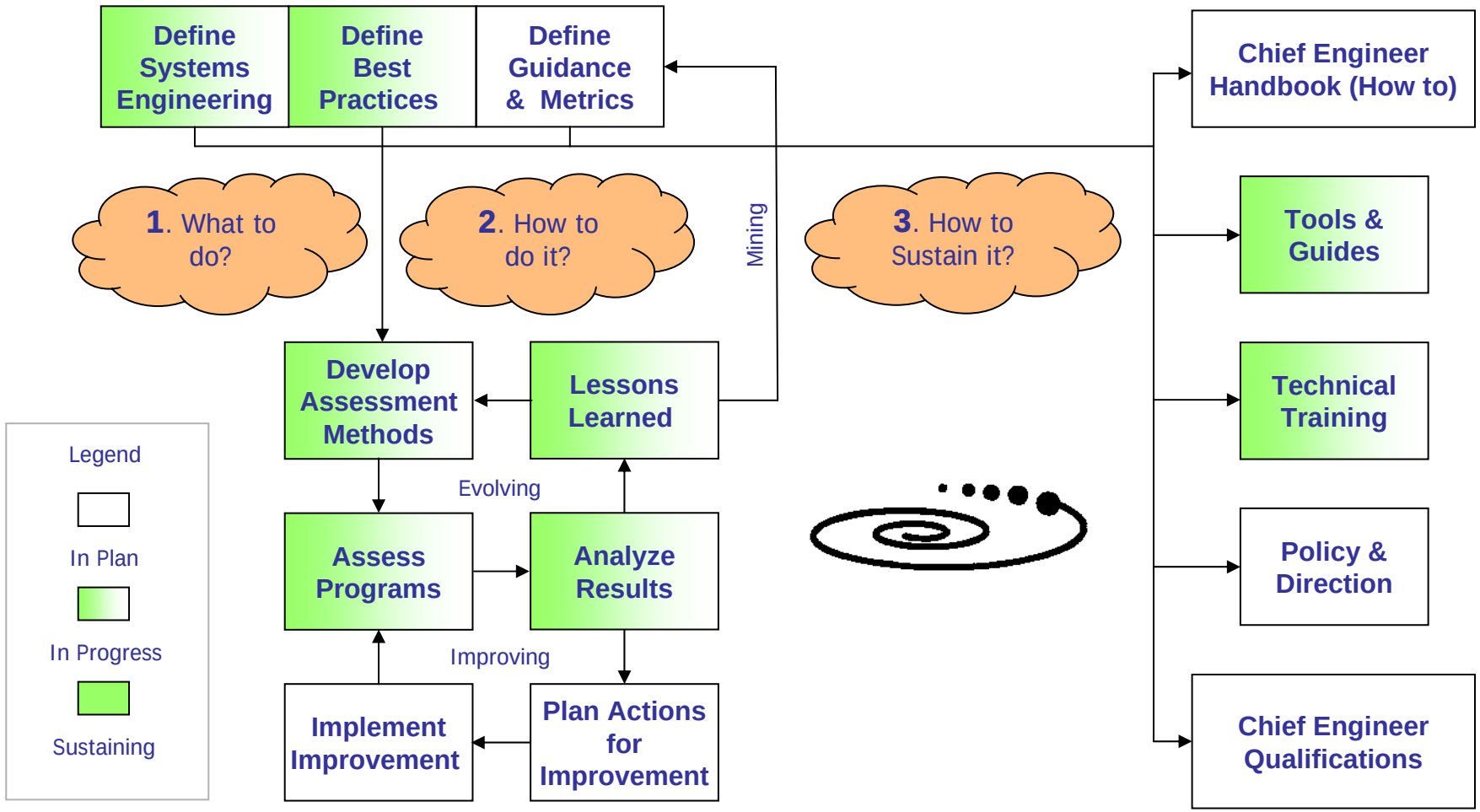
- Technical Processes
  - Requirements
  - Design
  - Verification/Validation
  - Transition
- Technical Management Processes
  - Planning
  - Risk Management
  - Configuration Management
  - Decision Analysis
  - Technical Assessment



- Technical Processes
  - Requirements
  - Design
  - Transition (to production)
  - Verification/Validation
  - Sustainment
- Management Processes
  - Planning
  - Risk Management
  - Configuration Management
  - Decision Analysis
  - Technical Assessment

Improve Alignment Between AAC Tools and AFMCI

Spiral 3



Institutionalized Process Driven SE » Lower Risk Technical Programs

Final Thoughts

Credit to Jeff Haars

- Process Orientation
  - AAC History of Success Due to “Heroes”
    Not Rigorous Process
  - Process Approach Will be Paradigm Shift
- Enterprise Process Group
  - Process Approach Needs a Process Group
  - Dedicated Group
  - Process “Keepers”
  - Mentors ... Coaches
- Self-Assessment
  - Easy Entry to Process Approach
  - Followed-up by External Audit
- Investment Required
  - Vetting and Maintaining Documentation and Compliance Measures...
  - Audits, Auditors, Process Group...
  - Education & Training

Where there is no standard there can be no Kaizen
– Taiichi Ohno

NDIA CMMI Technology Conference & User Group

Denver, CO

CMMI Opens the Gate:
The Practical Relationship between CMMI and Stage-Gate® Decision Models

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Agenda

- ABB Overview
- Stage-Gate® Process
- CMMI
- How Stage-Gate® and CMMI Complement Each Other
- Summary

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ABB Overview

- Leader in power and automation technologies
- Enable utility and industry customers to improve performance while lowering environmental impact
- The ABB Group of companies operates in more than 120 countries and employs approximately 110,000 people
- ABB became the first company in the world to sell 100,000 robots
- A vast majority of products at ABB have software and hardware components

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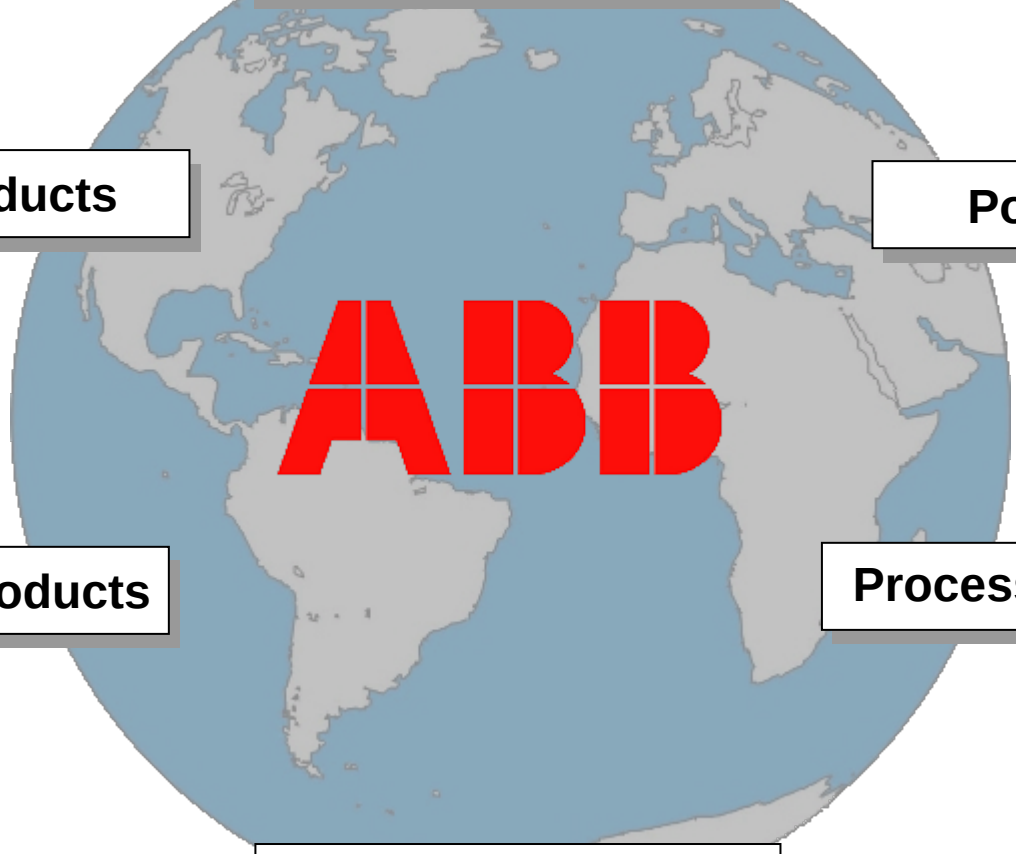
ABB's Organizational Structure



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ABB's Products

- Power Products
- Power Systems

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ABB's Products

- Automation Products
- Process Automation
- Robotics

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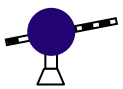
Stage-Gate® Process

- Conceptual and operational roadmap for moving a new-product project from idea to launch.
- The Stage-Gate® process is divided into a series of *Stages* (activities) and *Gates* (decision points).

Stage

- *Stages* consist of a set of cross-functional, parallel activities within a project. In order to proceed from one stage to the next, these activities must be successfully completed and confirmed by passing a gate.



- *Gates* are passed during *gate review meetings*
  - Decision is made to either continue or stop a project based on whether a set of predefined Gate criteria have been met
  - Gates serve as quality control checkpoints
  - Gates decide the path forward for a project, including resource commitments
  - Gate decisions are based on
    - the set of deliverables from the preceding stage
    - a set of criteria/questions/metrics used to evaluate the project and its deliverables
  - Gate decisions:
    - Continue to the next stage
    - “Kill” the project
    - Hold or “freeze” the project
    - Recycle the project (re-scope and restart)

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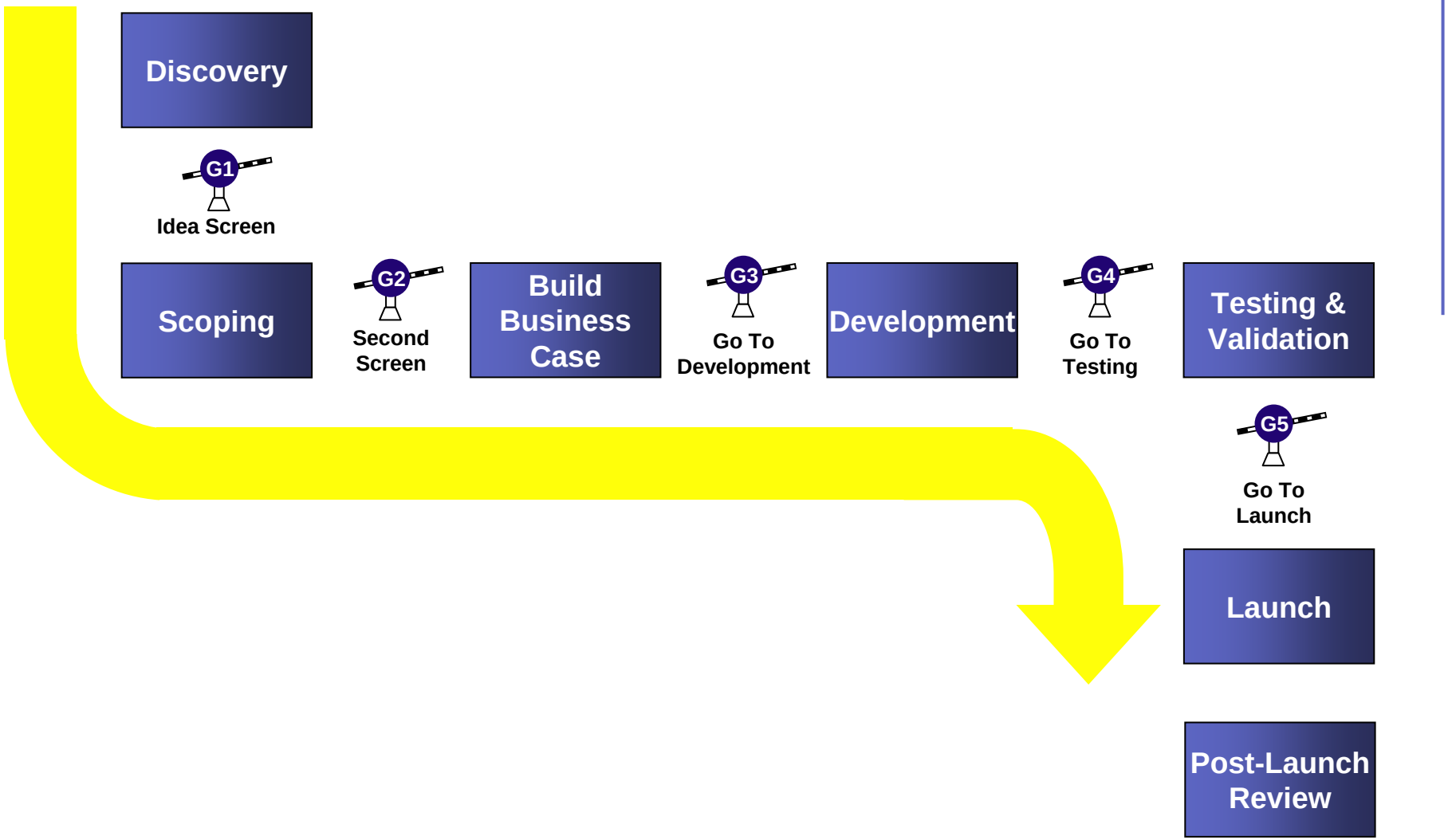
Generic Stage-Gate® Process



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Stage-Gate® Process

- Conceptual and operational roadmap for moving a new-product project from idea to launch.
- Provides a framework for better management of product development projects
- Provides correct and relevant information for business decisions.
- Ensures that the line organization is actively involved in the project and that the project status is made visible for all project stakeholders.
- Based on the experiences, suggestions and observations of a large number of managers and firms in over 60 cases as observed by Robert Cooper.

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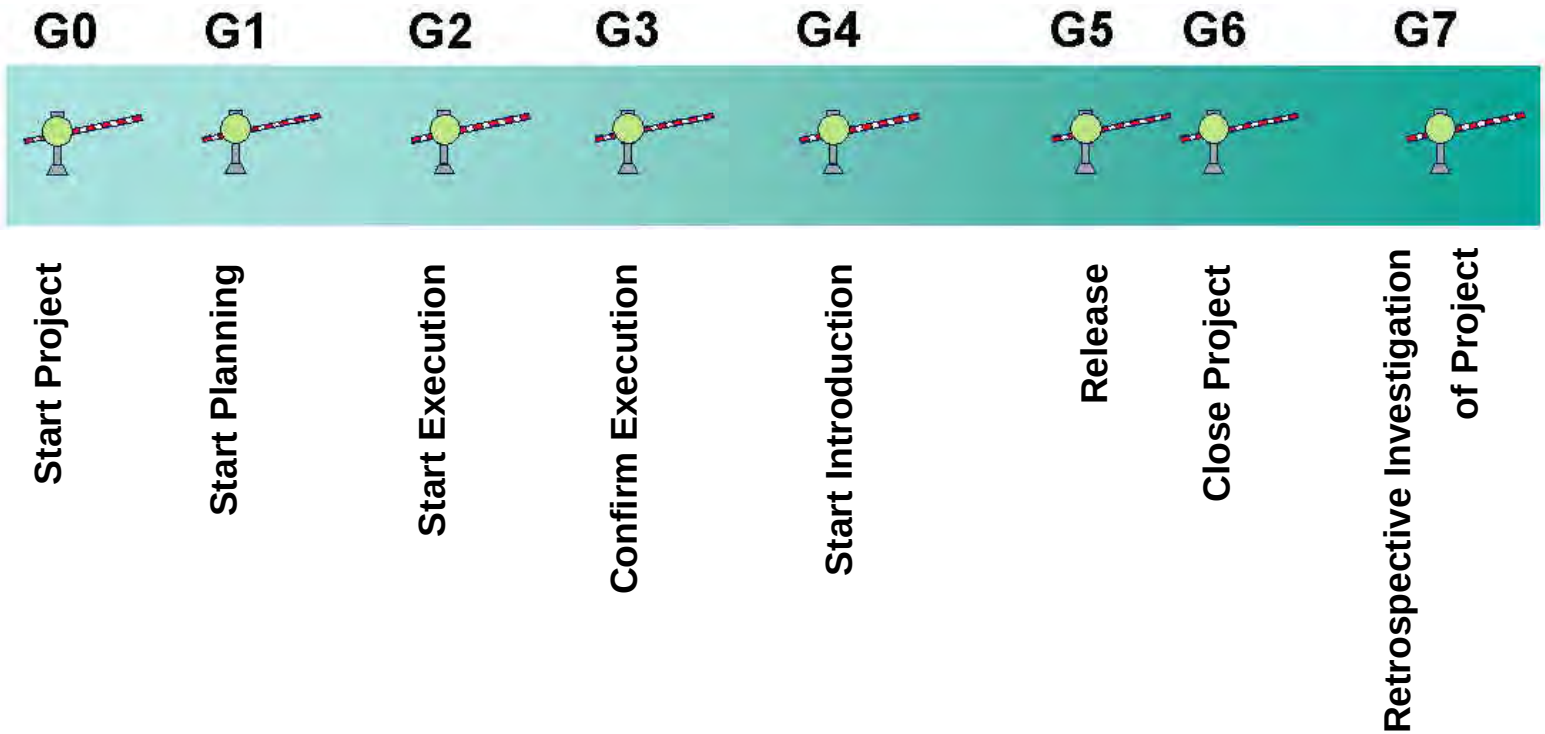
The ABB Gate Model

- The ABB Gate Model has eight defined gates for controlling a project from a business point of view, each with a certain purpose as shown below.



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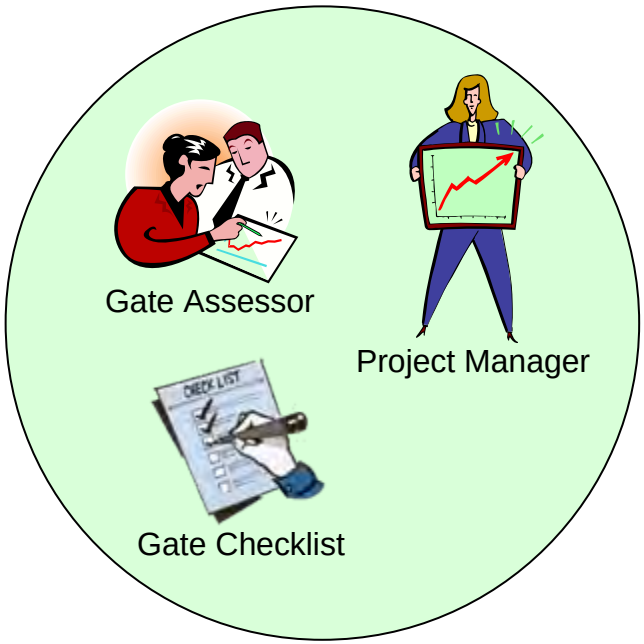
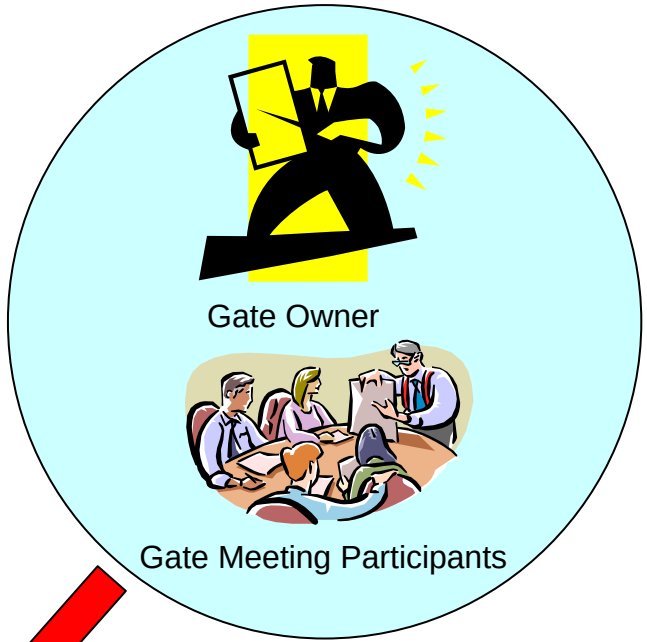
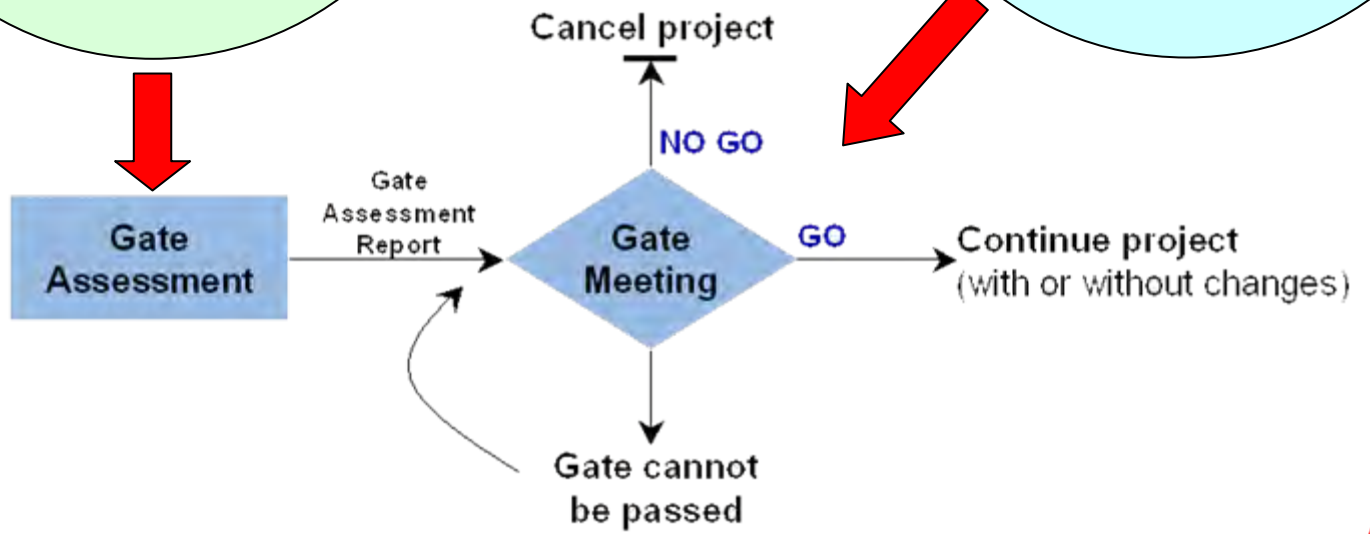
ABB's Gate Assessment Process







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Benefits of the Stage-Gate® Process

- Accelerates speed-to-market
- Increases likelihood of product success
- Introduces discipline into an ordinarily chaotic process
- Reduces re-work and other forms of waste
- Improves focus via gates where poor projects are killed
- Fosters promotion of innovative ideas
- Achieves efficient and effective allocation of scarce resources
- Ensures a complete process – no critical steps are omitted

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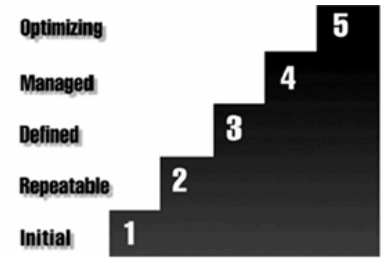
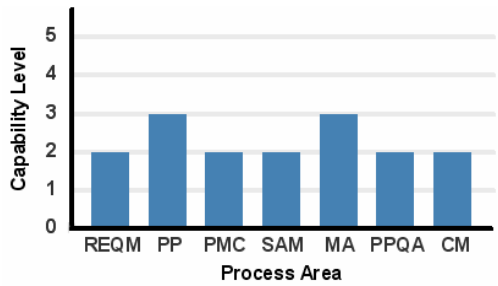
CMMI

- "Consists of best practices that address development and maintenance activities that cover the product lifecycle from conception through delivery and maintenance."
- Helps "organizations improve their development and maintenance processes for both products and services."
- CMMI can help:
  - set process improvement goals and priorities
  - provide guidance for quality processes
  - provide a yardstick for appraising current practices
- Provide a framework for benchmarking among and across organizations





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Benefits of CMMI

- Increases the likelihood of meeting cost, schedule, and performance goals
- Enhances collaboration with external stakeholders
- Helps organizations define common, integrated processes for system development
- Encourages proactive management techniques
- Establishes disciplined, repeatable processes rather than chaotic, ad-hoc product development cycles

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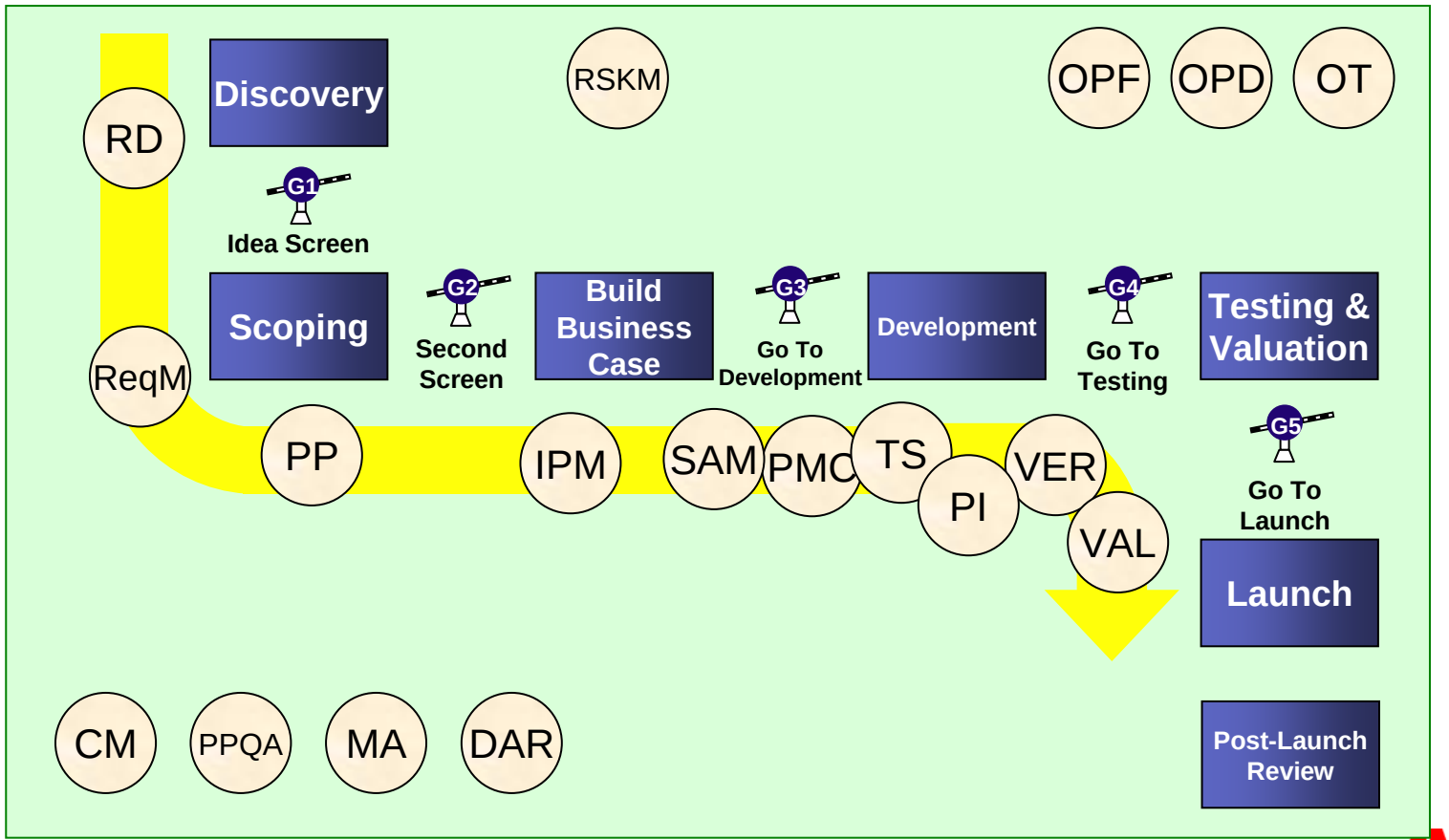
How CMMI and Stage-Gate® Complement Each Other

- CMMI best practices support the activities occurring during the stages



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How CMMI and Stage-Gate® Complement Each Other

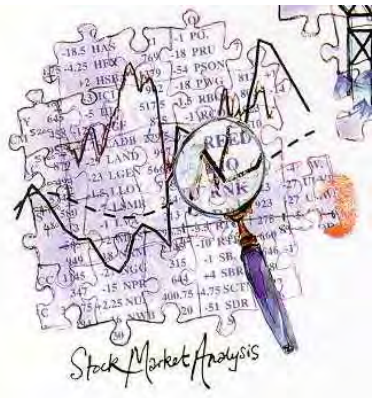
- Stage-Gate® provides a strong business decision and innovation focus not present in the CMMI

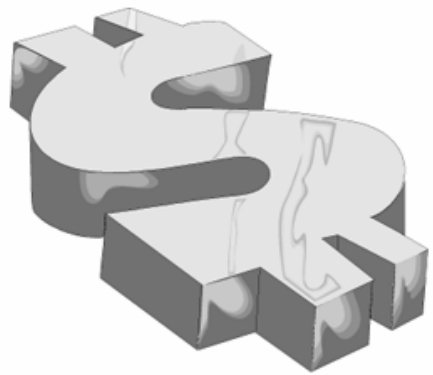
Market Analysis

Competitor Monitoring

Business Case Development

Intellectual Property Issues





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How CMMI and Stage-Gate® Complement Each Other

- CMMI provides more detail on best practices – especially within the Process Management and Support process area categories

Stage-Gate models tend to be checklist based – focused on ensuring that criteria have been met

CMMI provides guidance on specific practices that help organizations successfully achieve the criteria

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Summary

- Businesses combining the use of CMMI and Stage-Gate®
  - Products developed with repeatable, managed processes.
  - Products delivered on-time and within budget
  - Products meet market need
  - Products are profitable for the organization
  - Products represent the highest level of innovation

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Questions?

Power and productivity
for a better world™

NORTHROP GRUMMAN

DEFINING THE FUTURE

Risk Management Beyond CMMI Level 5

CMMI Technology Conference & User Group
13-16 November 2006

Warren Scheinin & Rick Hefner, Ph.D.
Northrop Grumman Corporation

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Background

- There are several straightforward ways to meet the practices of the Risk Management process area
- Beyond compliance, a Level 5 organization asks “Can the effectiveness and efficiency of the Risk Management process be improved?”
- This presentation examines some of the techniques and opportunities being used by Northrop Grumman to build on the CMMI Risk Management practices

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Agenda

- A Quick Review of Risk Management Practices in the CMMI
- Risk Management – What's Important to Improve?
- The Journey Ahead – More Opportunities for Process Improvement

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Review – Risk Management in the CMMI

SG 1 Prepare for Risk Management *Preparation for risk management is conducted.*
SP 1.1 Determine Risk Sources and Categories *Determine risk sources and categories.*
SP 1.2 Define Risk Parameters *Define the parameters used to analyze and categorize risks, and the parameters used to control the risk management effort.*
SP 1.3 Establish a Risk Management Strategy *Establish and maintain the strategy to be used for risk management.*

SG 2 Identify and Analyze Risks *Risks are identified and analyzed to determine their relative importance.*
SP 2.1 Identify Risks *Identify and document the risks.*
SP 2.2 Evaluate, Categorize, and Prioritize Risks *Evaluate and categorize each identified risk using the defined risk categories and parameters, and determine its relative priority.*

SG 3 Mitigate Risks *Risks are handled and mitigated, where appropriate, to reduce adverse impacts on achieving objectives.*
SP 3.1 Develop Risk Mitigation Plans *Develop a risk mitigation plan for the most important risks to the project as defined by the risk management strategy.*
SP 3.2 Implement Risk Mitigation Plans *Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate.*

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Process Compliance is Not Enough

- **A compliant process may not be efficient, nor effective, nor sufficient to meet the customers' needs**
- **A competitive environment requires a proactive approach to improving all processes**

What do we expect to happen in a Level 5 organization?

- **Institutionalization**
  - All projects implement Risk Management
- **A process improvement focus**
  - Every practitioner is looking for ways to make the risk management process better
- **A data-driven culture**
  - Data is gathered about the risk management process to identify ways it can be improved

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Risk Management is a Decision Management Tool

Decisions With Respect to Level of Knowledge

Uncertainty
(Probabilities)

More Uncertainty

Choosing between emerging technologies

Some Uncertainty

Selecting an architecture

Certainty / Near Certainty

Deciding on best COTS to meet requirements

Certainty
("Perfect" Information)

Many decisions fit somewhere in the middle where uncertainty can be "managed"

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Where Can We Look for Improvements?

Lean Six Sigma, applied to Risk Management

- **Voice of Customer**
  - Who are the customers of the risk management process?
  - What do they need? Desire? How do they judge success?
- **Voice of Process**
  - How efficient is our process? (e.g., risks identified/managed per resources spent)
  - How effective is our process? (e.g., identifying all risks)
  - Is there any unnecessary variation?
  - Are there any bottlenecks or time-wasters?
  - Can we reduce defects? (e.g., unidentified risks)
- **Voice of Business**
  - What best-practices exist in the community?
  - What will our future needs be?

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SIPOC Process Map – Project-Level Risk Management

Suppliers	Inputs	Process	Outputs	Customers
		Determine risk sources and categories	Risk sources, categories, parameters	Risk identifiers (project personnel)
Process Group	Historic risks Organizational guidance	Define risk parameters	Risk strategy Identified risks Prioritized risks	Project Risk Manager
External Customer	Areas of concern	Determine risk strategy	Risk mitigation plans	Project personnel
Project personnel	Areas of concern	Identify risks	Risk mitigation results	Project Risk Manager
Project Risk Manager	Expertise, experience	Evaluate, categorize, and prioritize risks	Lessons learned Metrics	Process Group
		Develop risk mitigation plans	Adherence to plans	Customer
		Implement risk mitigation plans		

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Risk Management Improvement Opportunities (1 of 2)

Goal/Practices	Improvement Opportunities
SG 1 Prepare for Risk Management Preparation for risk management is conducted.	
SP 1.1 Determine Risk Sources and Categories Determine risk sources and categories.	▪ More useful sources ▪ More useful categories
SP 1.2 Define Risk Parameters Define the parameters used to analyze and categorize risks, and the parameters used to control the risk management effort.	▪ More insightful parameters
SP 1.3 Establish a Risk Management Strategy Establish and maintain the strategy to be used for risk management.	▪ More effective strategies ▪ Tailorable strategies

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Risk Management Improvement Opportunities (2 of 2)

Goal/Practices	Improvement Opportunities
SG 2 Identify and Analyze Risks *Risks are identified and analyzed to determine their relative importance.*	
SP 2.1 Identify Risks Identify and document the risks.	▪ More efficient identification ▪ Few risks not identified
SP 2.2 Evaluate, Categorize, and Prioritize Risks Evaluate and categorize each identified risk using the defined risk categories and parameters, and determine its relative priority.	▪ More efficient evaluation, categorization, prioritization ▪ Fewer risks mis-evaluated, mis-categorized, mis-prioritized
SG 3 Mitigate Risks *Risks are handled and mitigated, where appropriate, to reduce adverse impacts on achieving objectives.*	
SP 3.1 Develop Risk Mitigation Plans *Develop a risk mitigation plan for the most important risks to the project as defined by the risk management strategy.*	▪ More efficient planning ▪ More effecting planning
SP 3.2 Implement Risk Mitigation Plans *Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate.*	▪ More efficient monitoring ▪ More effective monitoring

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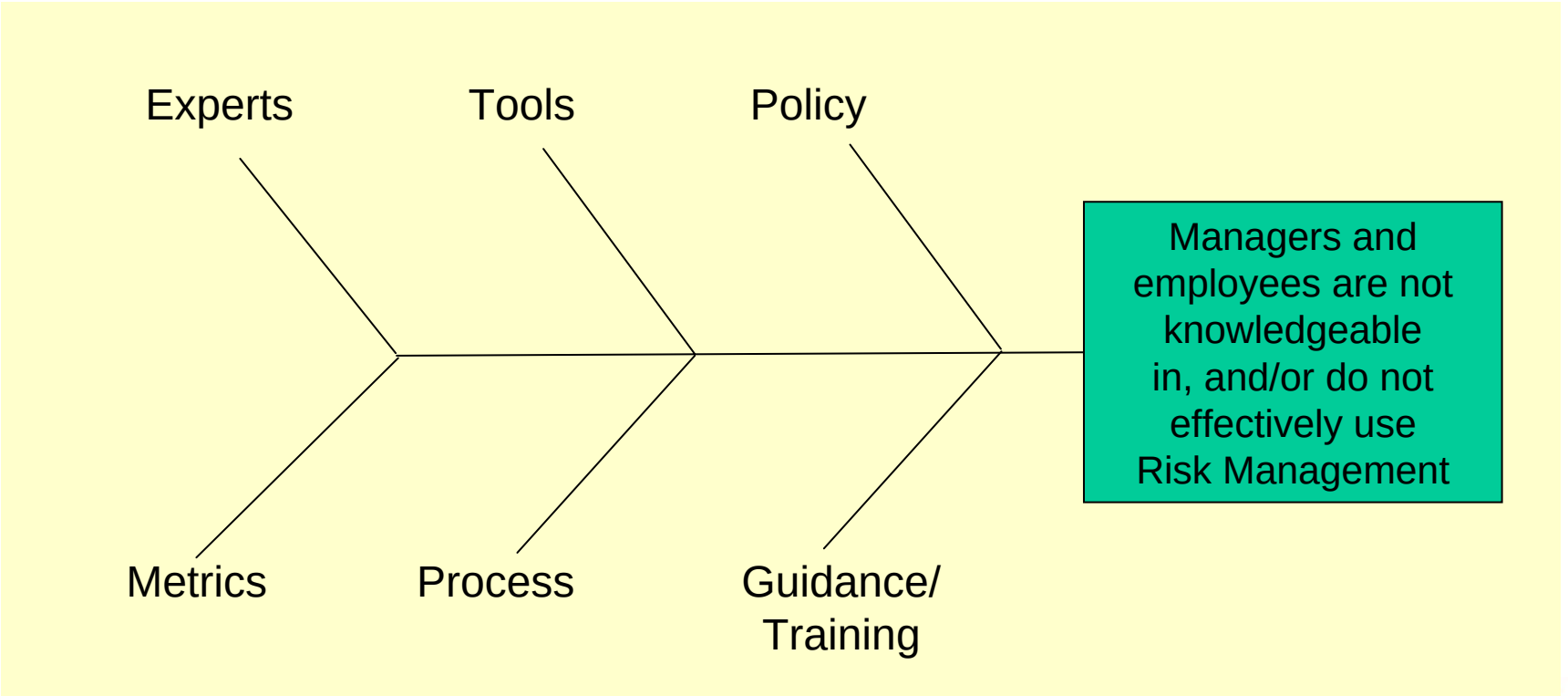
Voice of Customer – Project Managers' Top Concerns

- More consistent risk identification, to reduce the number of unidentified risks
- Better integration across teams and management levels
- Better process tailoring to fit project size and risk level



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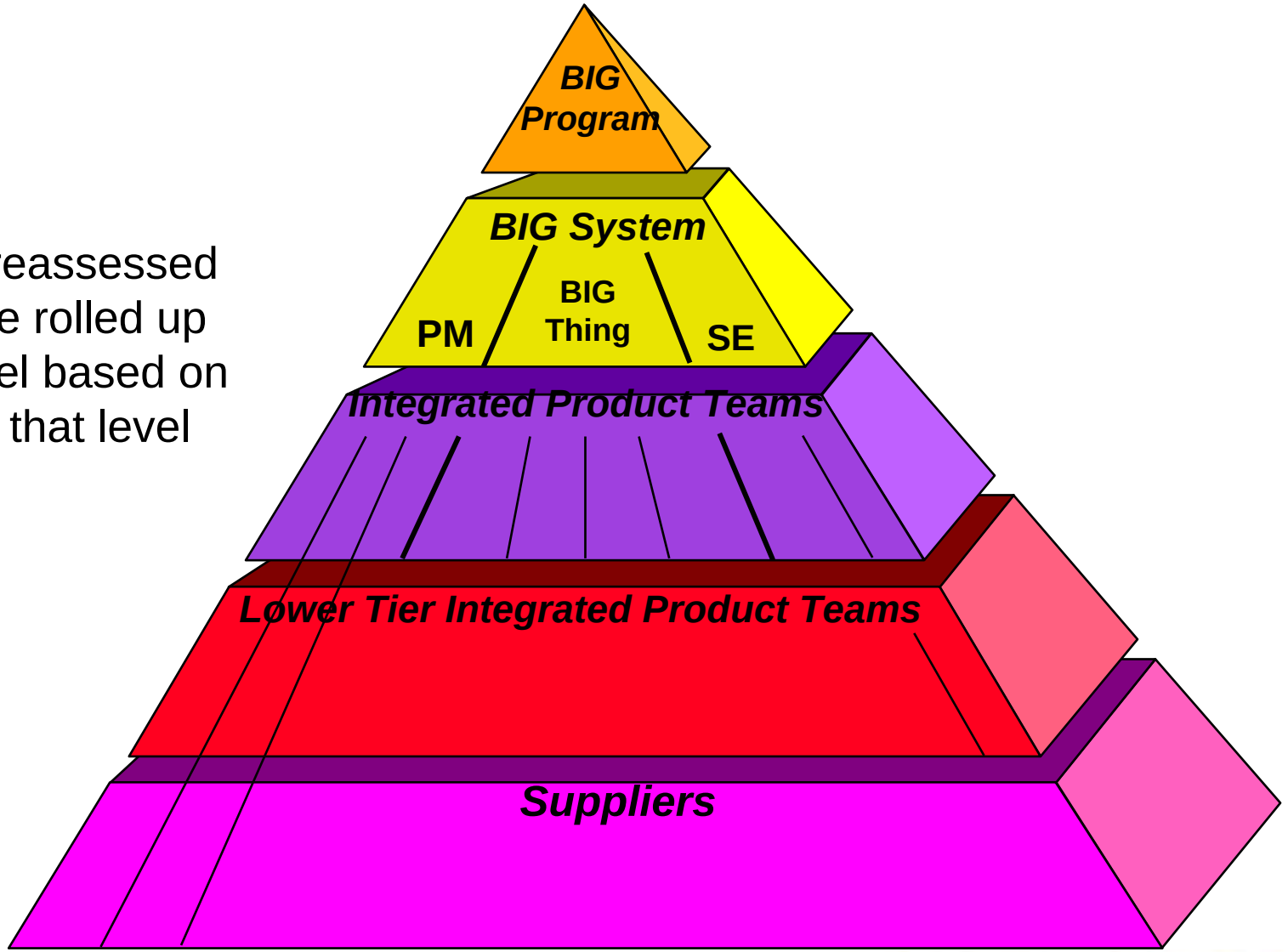
Risks Must be Rolled Up Throughout the Entire Stakeholder Pyramid Vertically

Risks are reassessed as they are rolled up to each level based on impact at that level



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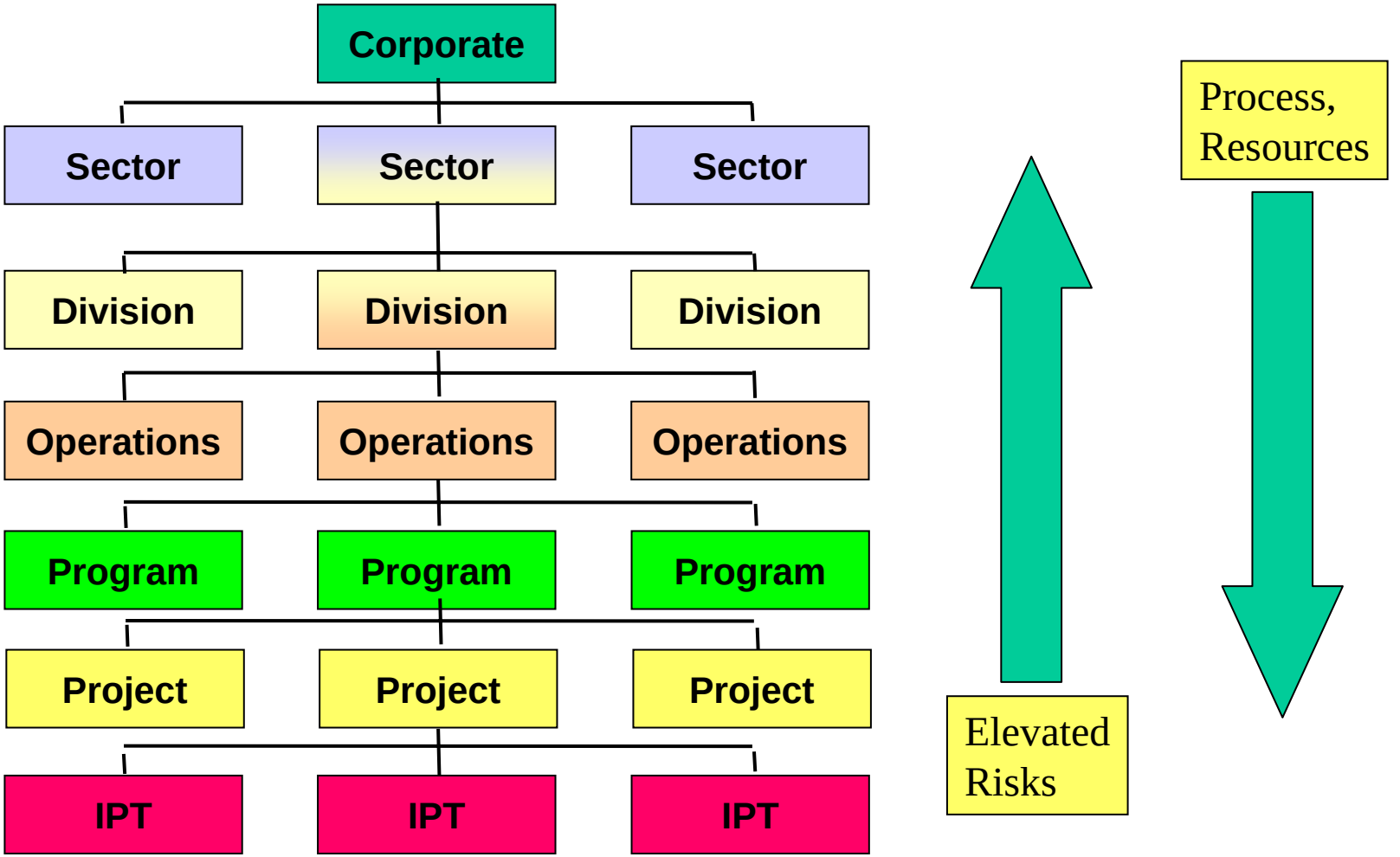
Better Integration Across Teams And Management Levels



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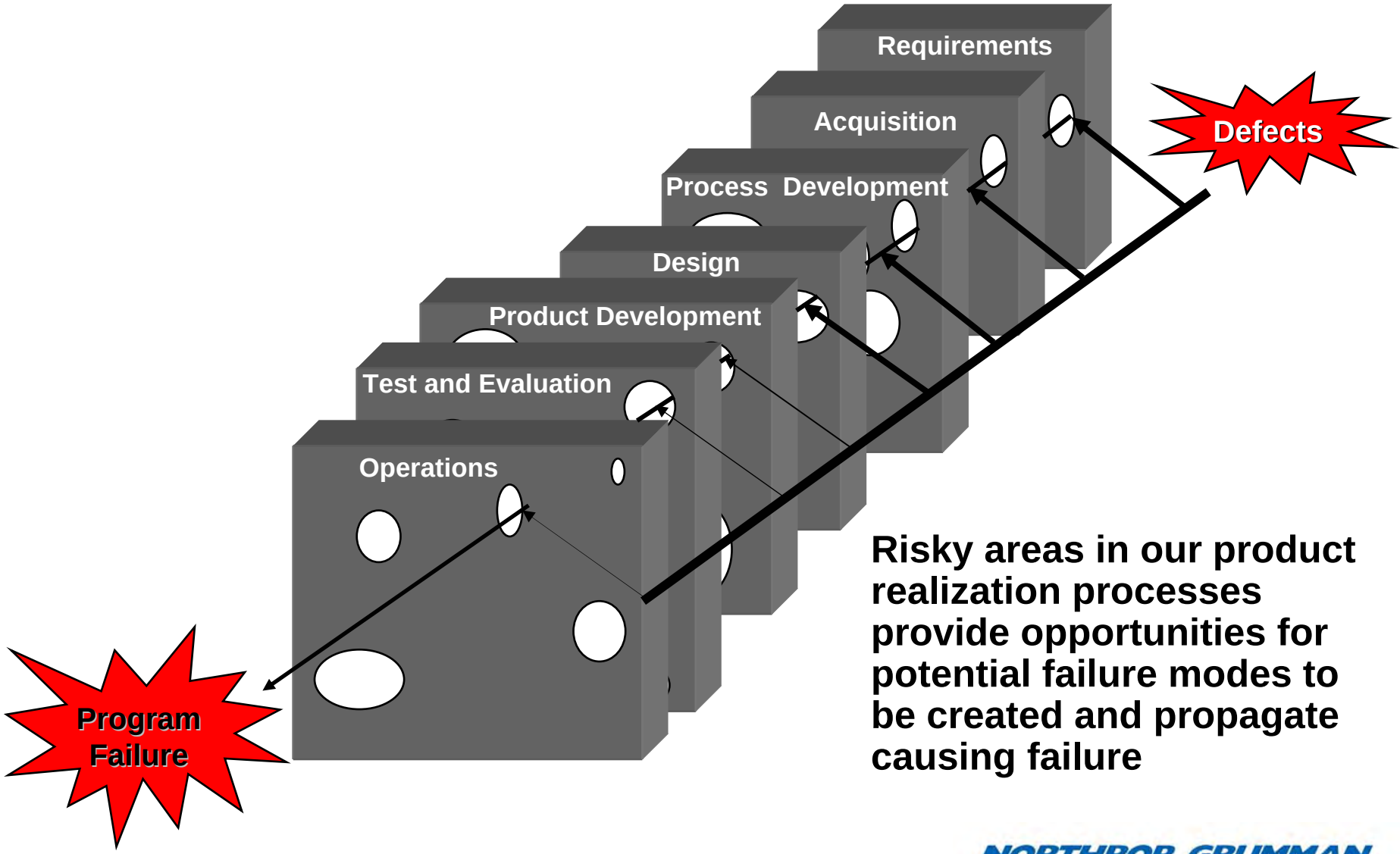
“Small Risks” Can Lead to Program Failure



Risky areas in our product realization processes provide opportunities for potential failure modes to be created and propagate causing failure

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Mission Success Requires Multiple Approaches

Risk Management

Systems Engineering

Independent Reviews

Training, Tools, & Templates

Dashboards for Enterprise-Wide Measurement

Communications & Best-Practice Sharing

Robust Governance Model (Policies, Processes, Procedures)

CMMI Level 5 for Software, Systems, and Services

ISO 9001 and AS-9100 Certification

Six Sigma

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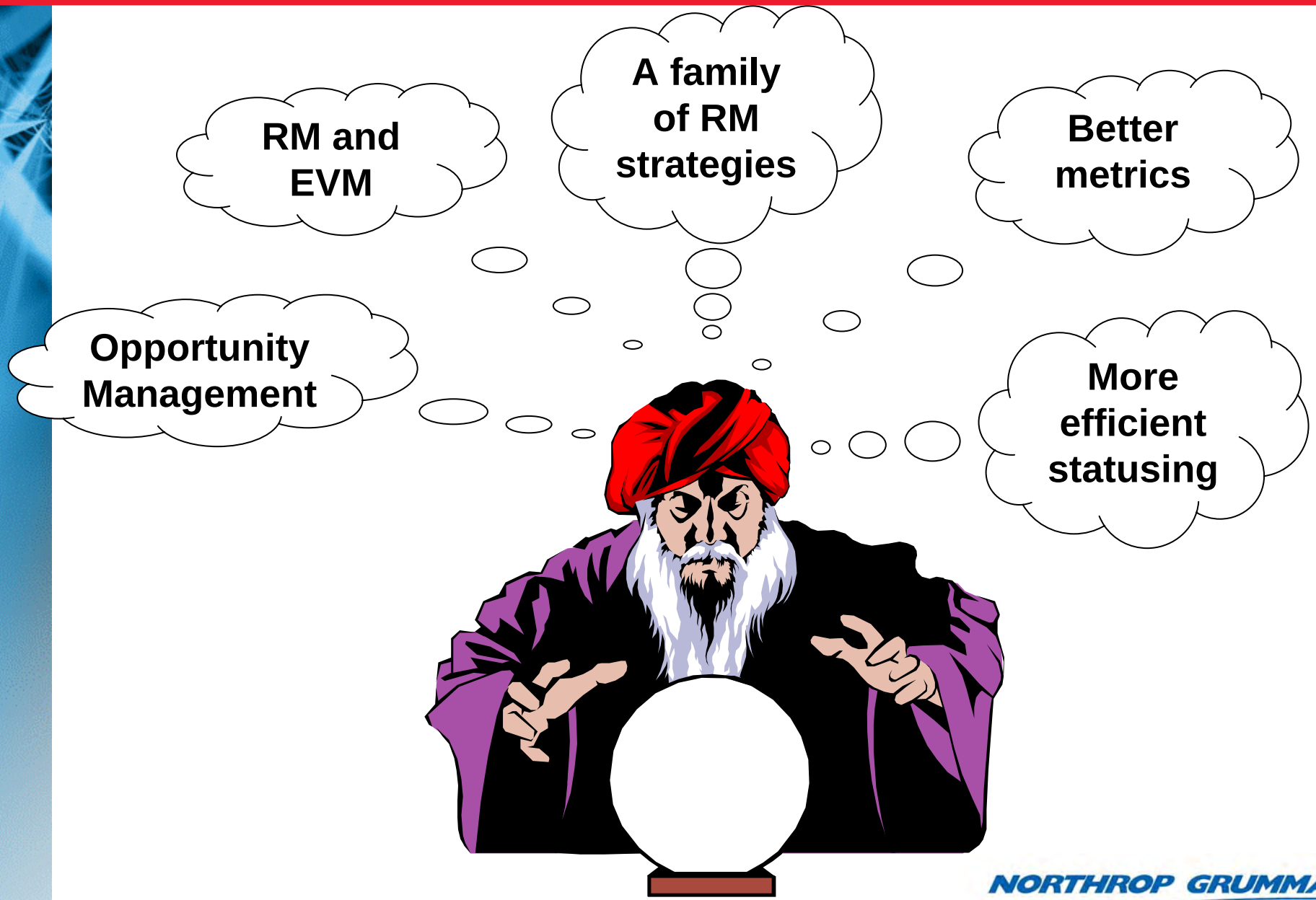
A Level 5 Organization is Never Satisfied….



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Imagine living an agile lifestyle with CMMI as your mother-in-law.

Hillel Glazer | Entinex, Inc.
agile@entinex.com |+01. 410. 369. 2062

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What the Abstract Said

Imagine living an agile lifestyle with CMMI as your mother-in-law.

What, with the constant pestering for improving yourself and providing better quality for her grandchildren. Not to mention always on your back about how much you spend on wasteful endeavors.

Is she really a pest or does she just not understand you?

Doesn't she see that you are improving yourself? That your quality does improve? That your cost variances and efficiency of resources are tighter than any of your friends? Or *her* friends' children for that matter?

"Oh! Look at how so-and-so's son-in-law bought his wife a big diamond! I bet *he* doesn't lead an agile lifestyle!"

Yeah, so what! And exactly how does that big diamond contribute to improvement, quality or productivity? Huh? HUH?!

So, you figure, if your CMMI mother-in-law is going to be looking over your shoulder all the time, you might as well show her how you are addressing improvements, quality, efficiency and productivity. It just might not be exactly as she's used to seeing it.

So, in this session, "My Agile Life with CMMI", we'll show you how Agile and CMMI can live together and gain the approval of your no-longer over-bearing mother-in-law.

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Topics

- How this session works.
- What are we looking at?
- What are we looking for?
- Generating a shared understanding.
- Exercising the shared understanding.
- The Take-Away.

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How this session works

- Few slides.
- A few words on each slide.
- Lots of discussion.
- **Session Purpose:**
  To generate dialogue and deeper appreciation as a user group for real-life implementation.

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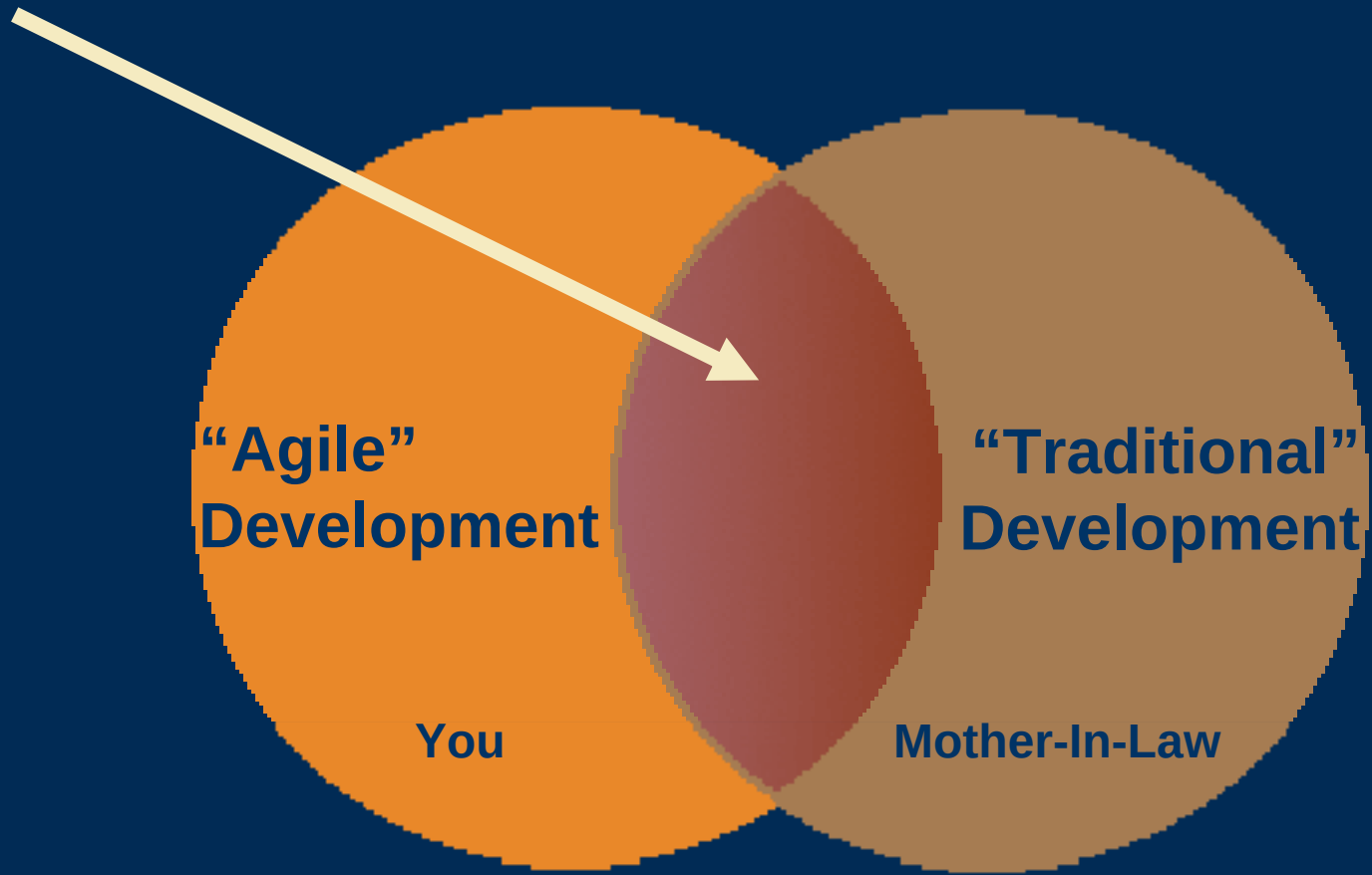
What are we looking at?



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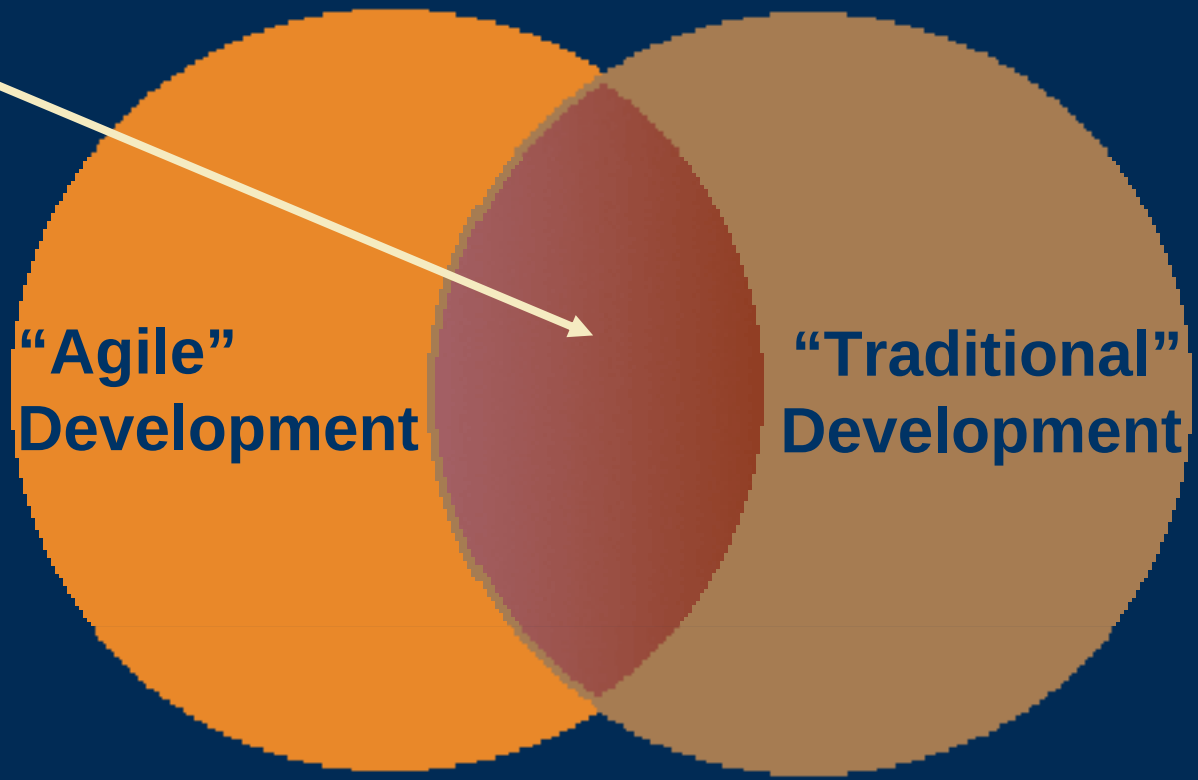
What are we looking For?

- Can this be possible?
- If so, how?
- If not, why not?
- What happens here?
- Conflicts…
- Synergies…
- Distinctions…



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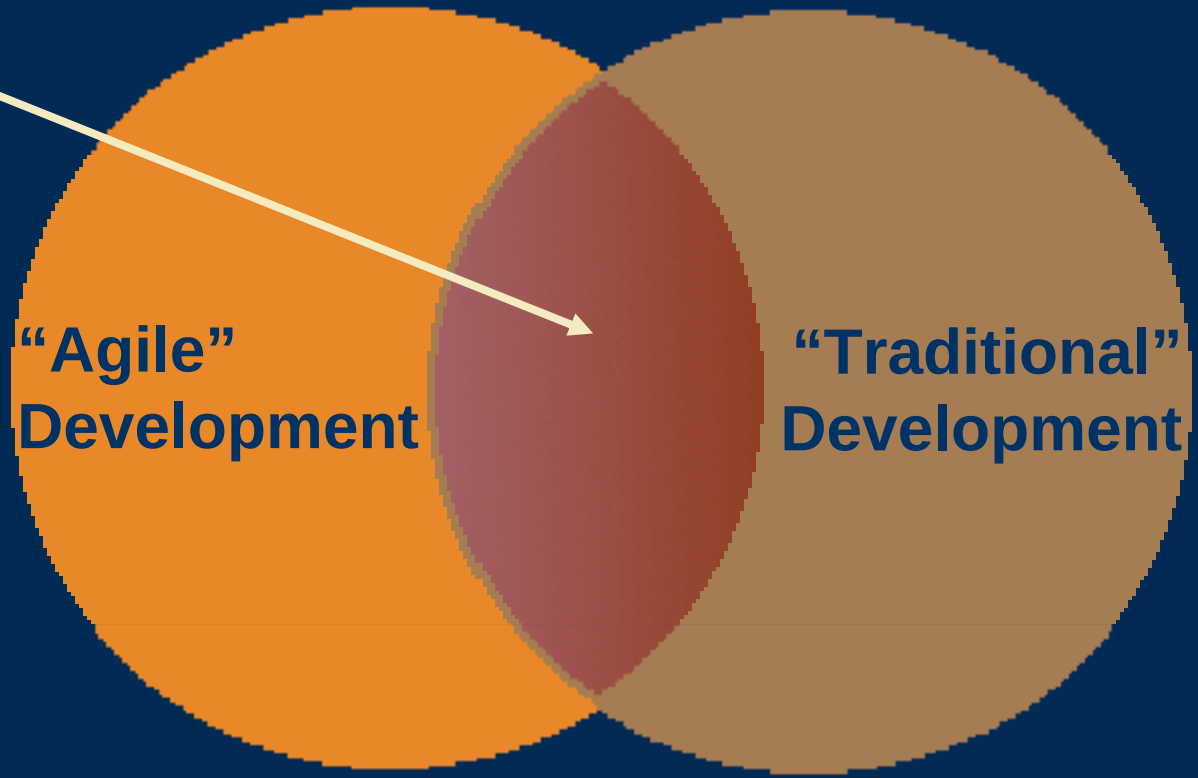
Quick Poll …

Can this be possible?



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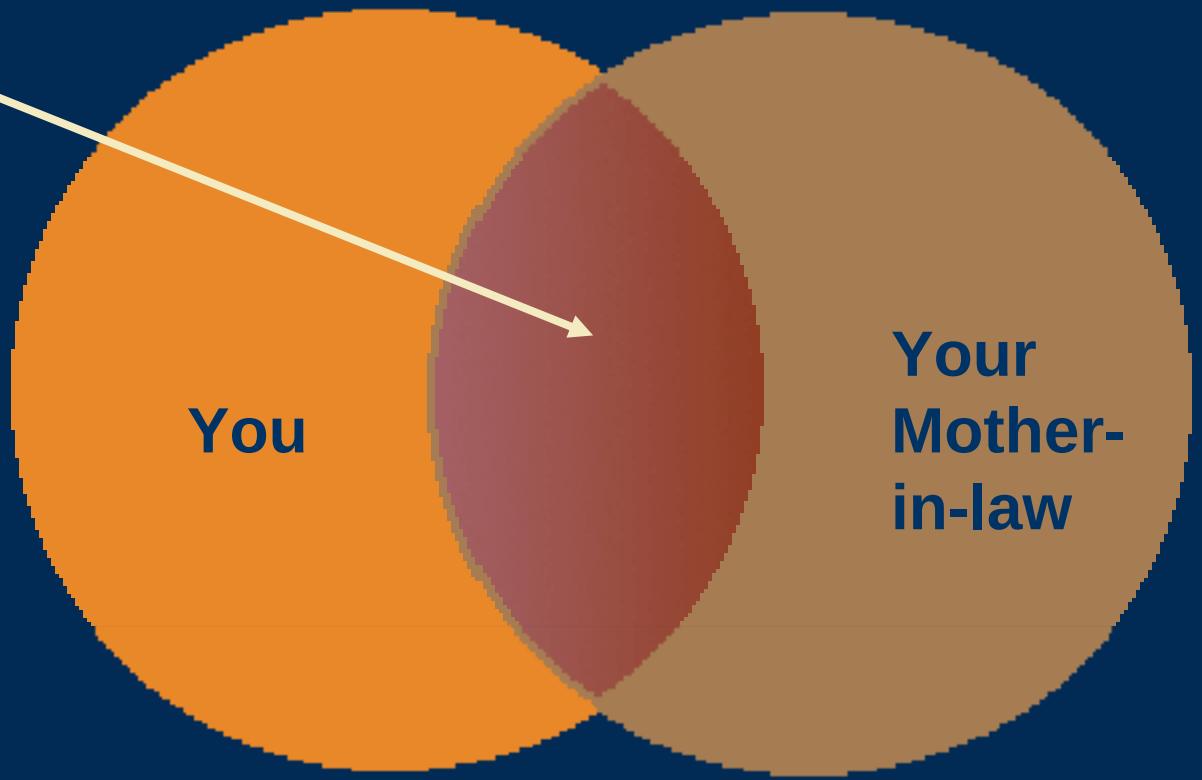
Quick Poll …

Can *THIS* be possible?



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What's that?

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Your Mother-in-Law's Way

- How your M-i-L wants you to live.
  -
  -
  -
  -
  -
- How you want to live.
  -
  -
  -
  -
  -
  -

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Share Goals?

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Shared Understanding

Ask critical questions:

- Does your M-i-L have any of *your* experience to base *her assumptions* about your approach?
- Does your M-i-L have any of *your* proof that what you're up to will work?

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Suppose…

- Your Mother-in-Law wasn't as fixated on ***path*** as much as she was on ***results***.

- Suppose you could ***demonstrate*** results and even ***account for the value*** in how you attainted them.
  - How would this change things?
  - (this is where you come in again)

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Generating a shared understanding

- How do we characterize “Traditional” and “Agile”?
  - (this is where ***you*** come in)

Traditional	Agile

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Share Goals?

-
-
-
-

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Shared Understanding

Ask critical questions:

▲ Does CMMI favor one over the other?

▲ Can we separate CMMI from development?

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Suppose…

- CMMI was about ***process management***, not ***development processes.***
- Agile could account for ***non-development*** activities.
  - How would this change things?
  - (this is where you come in again)

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Understanding Your M-I-L

- Keys to understanding (or communicating, or getting along with) your mother-in-law:
  - You both want the same thing.
  - Your approaches might be different.
  - Acknowledging that your contexts are different.
  - You can't always/only do things "her" way, or the way "others" do things.
  - You have more in common that not.

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shared understanding (you)

- What do we get at the intersection of Agile & CMMI?
-
-
-
-

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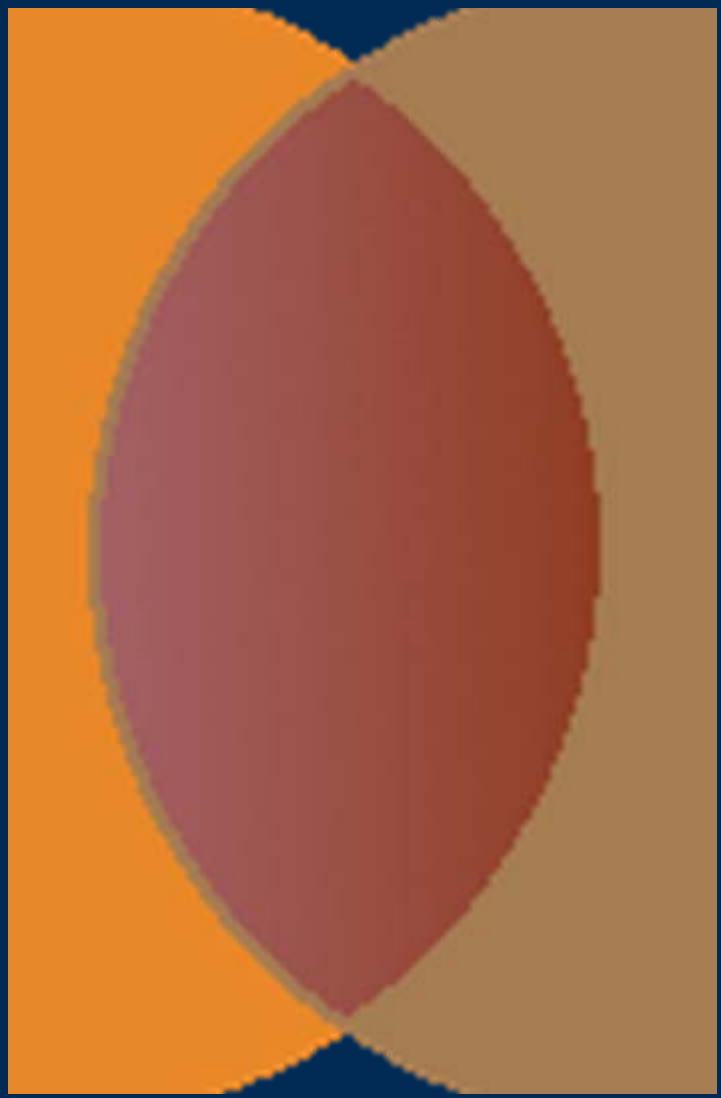
shared understanding (me)



- Empowered development teams.
- Account for everything that takes time.
- Manage the processes, not the people.
- Bureaucracy doesn't work:
  - Are they incompetent?
  - Do they lack discipline?
  - Does Agile work w/either?

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- **CMMI with Scrum**
- **Keys to Making CMMI *Agile***

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Scrum Components

- Product Backlog and Planning
- Sprint Backlog and Planning
- Resource Allocation
- WBS
- Daily Team Meetings
- Peer Reviews and Inspection
- Sprint Review

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Product Backlog and Planning

- The product backlog is defined by the **product owner** and managed by the Scrum master.
- Defines High Level Requirements and sets priorities.
- Defines high level work break down structure.
- May define high level release schedule.

- REQM
- PP
- PMC
- CM
- RD
- TS
- PI
- IPM
- RSKM
- DAR
- GP 2.2, 2.3, 2.4, 2.7

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Sprint Backlog and Planning

- Breaks the product goals down into demonstrable goals. This is usually at the use case level.
- Tasks are broken down into hour-based estimates, anything over 16 hours was broken down into smaller pieces.
- The team creates tasks, estimates and determines who is going to do what, everyone commits to the feasibility of the plan.
  - What can be done in 30 days with the resources we have at our disposal?

- REQM
- PP
- PMC
- CM
- RD
- TS
- PI
- VAL
- VER
- IPM
- RSKM
- DAR
- GP 2.2, 2.3, 2.4, 2.6, 2.7

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Resource Allocation

- Managed by the team, as members commit to getting the work done.
- Members **can play many roles at the same time:**
  - Developer, Architect and DBA
  - Developer, Tester and Requirements Analyst
- Member are committed to the project and external noise is minimized.
- The Scrum Master helps alleviate resource contention and noise.

- REQM
- PP
- PMC
- MA
- CM
- RD
- TS
- PI
- IPM
- RSKM
- DAR
- GP 2.2, 2.3, 2.4, 2.7

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Work Breakdown Structure

- A Product Goal can be broken down into many **use cases**
  - "The application needs to contain a shopping cart"
- A Sprint Goal satisfies a use case
  - "Allow a registered use to put items into their shopping cart"
  - "Allow a user to update the quantities in the shopping cart"
- Each sprint goal is demonstrable, releasable functionality.
  - Show that this use case works, and has been tested and could be released as functionality

- REQM
- PP
- PMC
- CM
- RD
- TS
- PI
- IPM
- RSKM
- DAR
- GP 2.2, 2.3, 2.4, 2.7

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Daily Team Meetings

- Quick 15-30 Minute Stand up Meetings.
- Answer 3 Questions:
  - What have you done since the last meeting ?
  - What are you going to do before our next meeting ?
  - What issues are you having that are impeding progress ?
- Daily Inspection and Visibility into team progress.
- Daily Issues Management and Resolution.
- Daily Project Command and Control within the self managing team.

- REQM
- PP
- PMC
- MA
- PPQA
- CM
- RD
- TS
- PI
- IPM
- RISK
- DAR
- GP 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 2.9, 2.10

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Peer Review and Inspection

- Peer reviews keeps the team members honest.
- Peer reviews are about **mentoring, not policing**.
- Complete **checkpoints and tollgates** along the project road map that can be done iteratively and kept **non-invasive.**

- REQM
- PMC
- MA
- PPQA
- CM
- RD
- TS
- PI
- VAL
- VER
- IPM
- RSKM
- DAR
- GP 2.6, 2.7, 2.9, 2.10, 3.2

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Sprint Review

- The Sprint review is a form of validity check-it is determined that the right product is being built.
- Covers whether the product was built right because a working version of the product is giving a viewing to the product owner.
- Product Owner (s) decides if functionally and quality are sufficient to be released

- REQM
- PMC
- MA
- PPQA
- CM
- RD
- TS
- PI
- VAL
- VER
- IPM
- RISK
- DAR
- GP 2.6, 2.7, 2.9, 2.10, 3.2

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Keys to Making CMMI "Agile"

- Reality-Based Process Descriptions and Life Cycles
- Non-Sequential Process Flows
- Non-Prescriptive Process Management
- Getting "the right people on the bus."*
- Use "*risk-avoidance-speak*" not "*model-speak*"
- Focus on Customer/Productivity/Profit/ROI (**NOT** process!)

*Jim Collins, *Good to Great*

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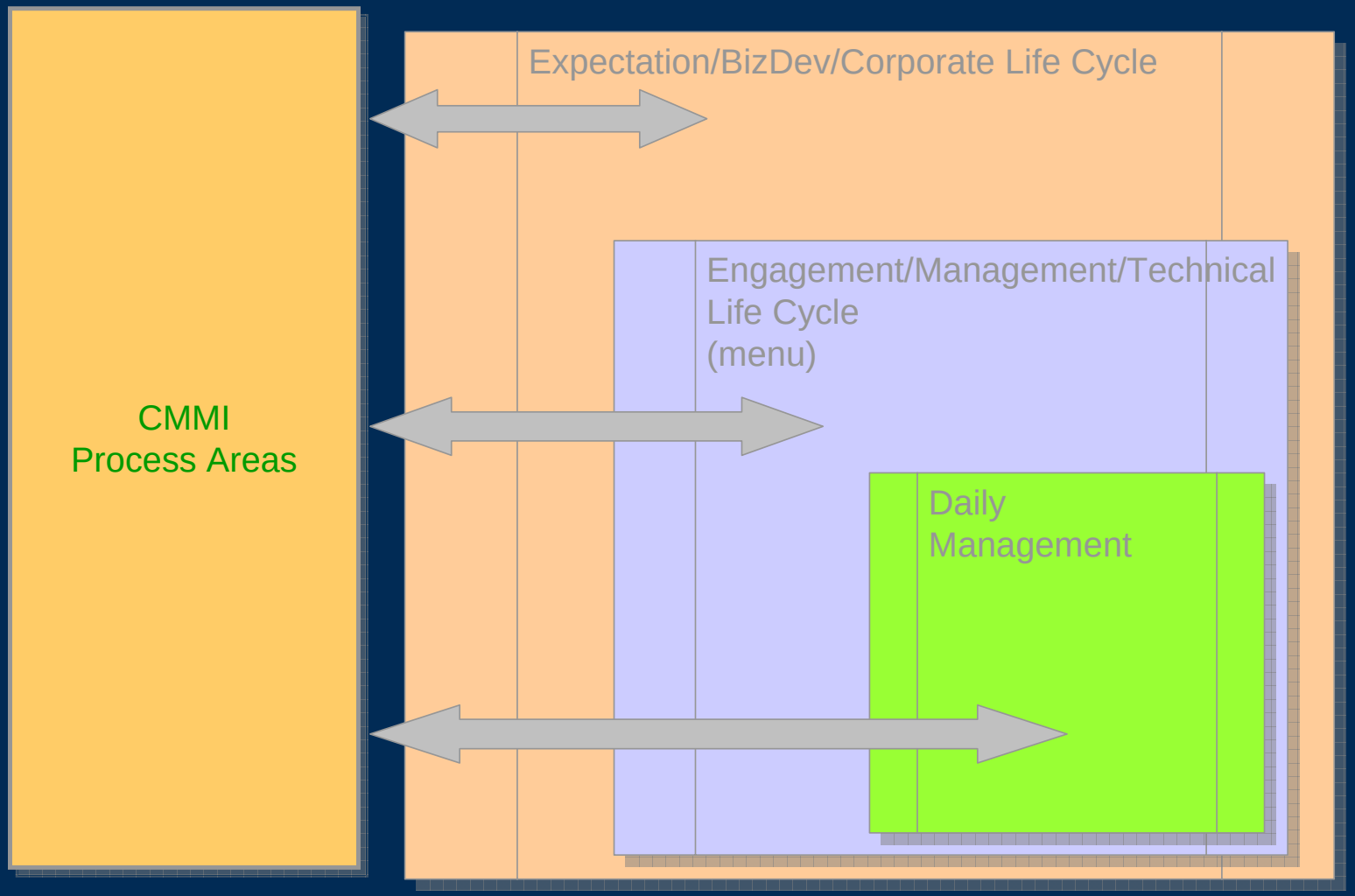
How We Made it Work



Translating technology dollars into business sense.℠

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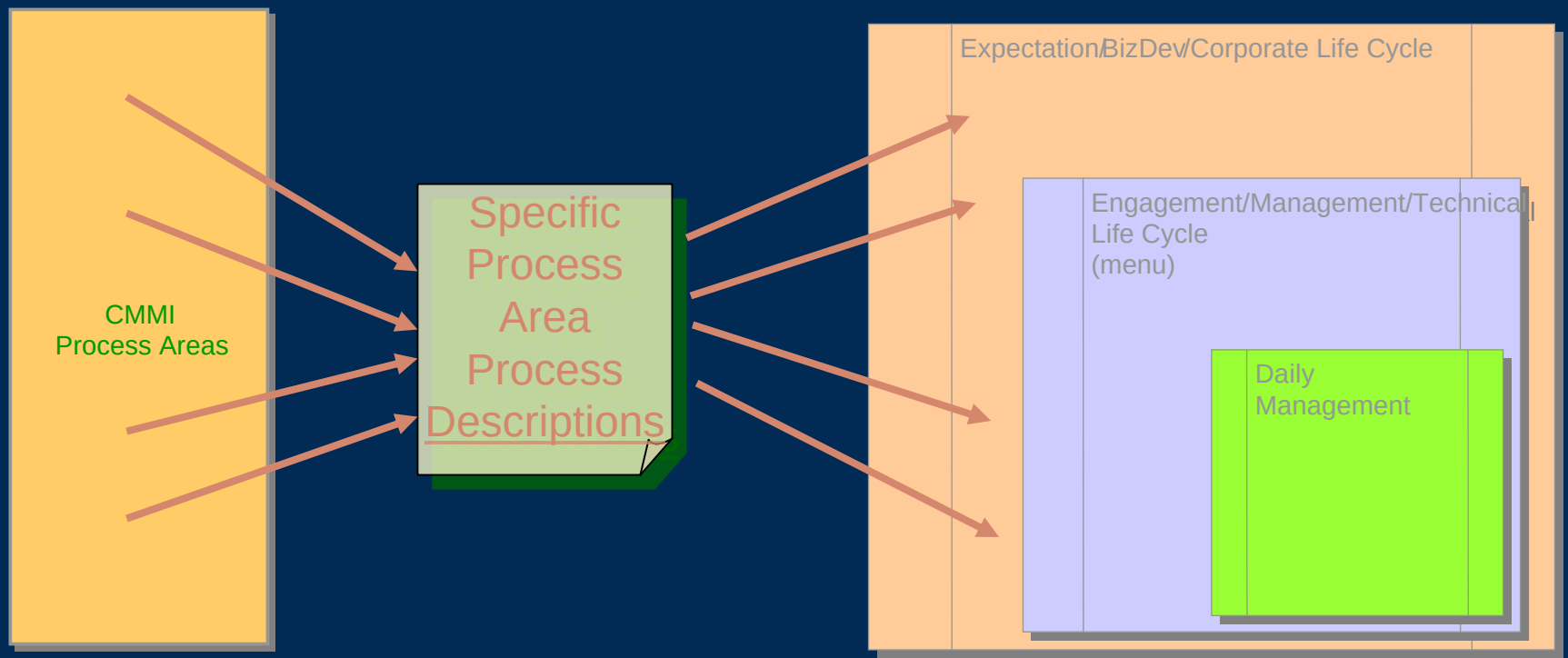
How We Made It Work (…)

- Process definition/description documents define where in YOUR reality practices take place.



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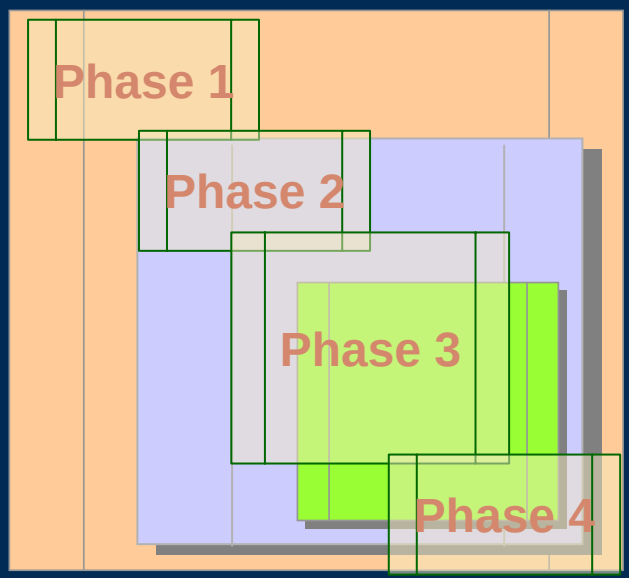
Real Work *Happens* in Real Work Products



Templates

Engineering Life Cycle

Backlogs & Peer Reviews

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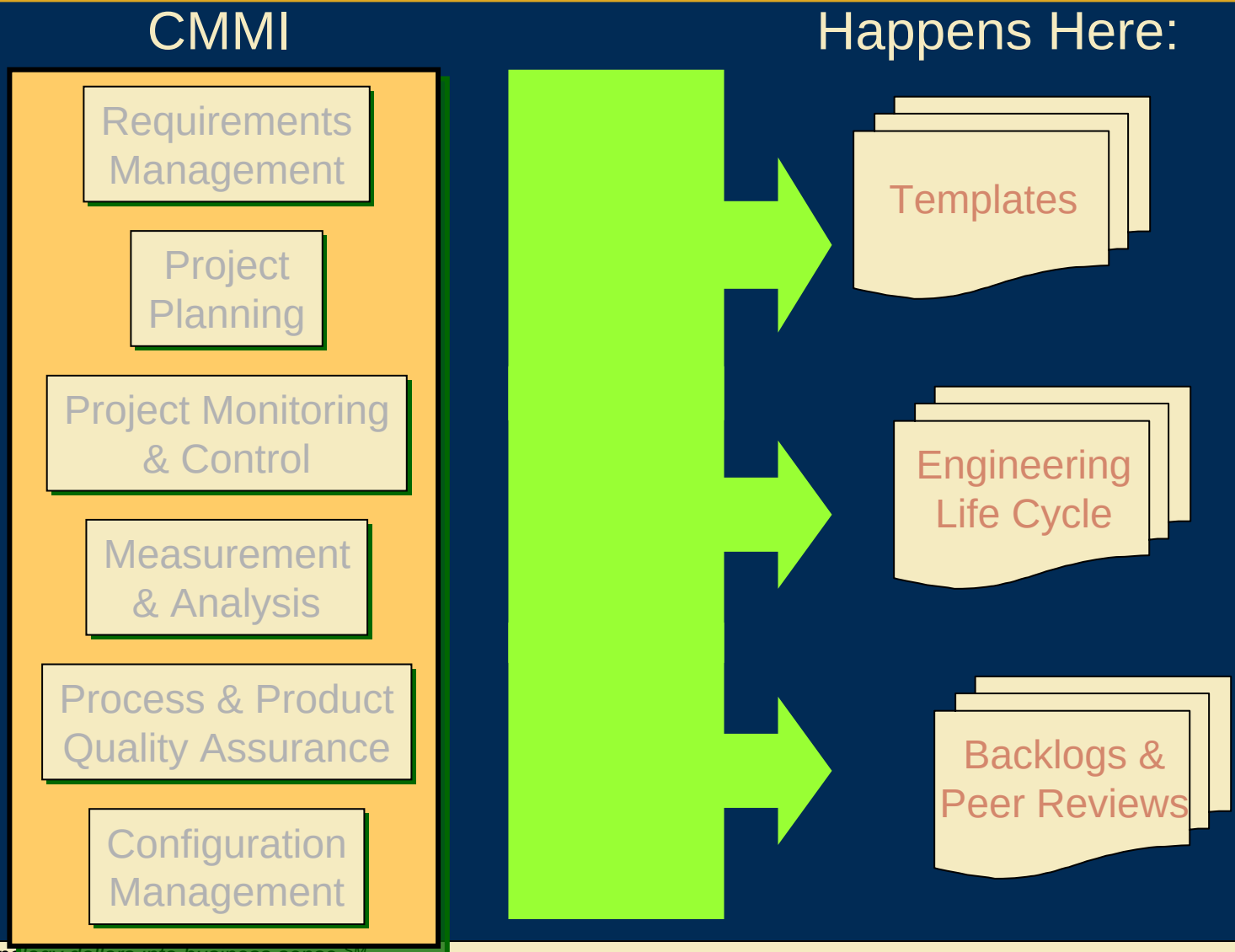
If A=B and B=C…



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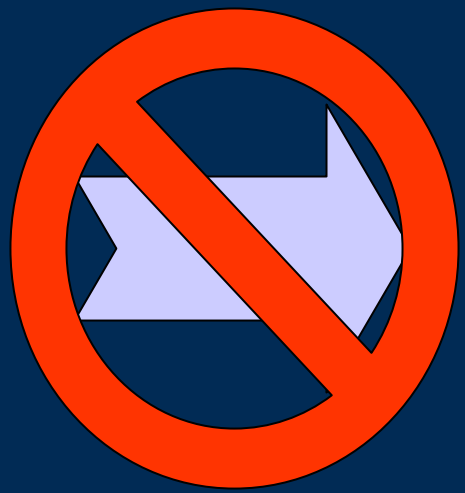
What DOESN'T Work

Specific Process Area Process Descriptions



Templates

Engineering Life Cycle

Backlogs & Peer Reviews

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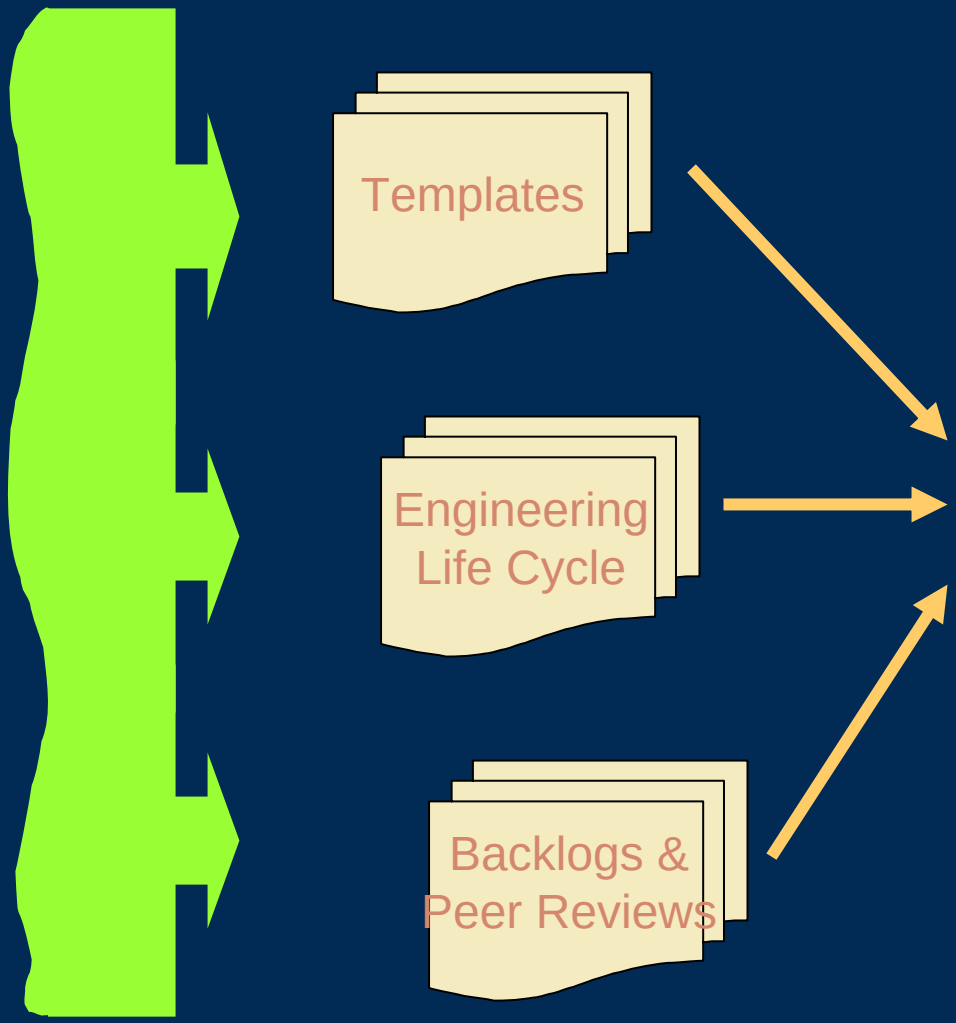
the All-Important SCAMPI



Process Implementation Indicator Descriptions come from here:

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Conflicts & Synergies (You)

- Conflicts
- Synergies

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Conflicts & Synergies (me)

- Conflicts
  - Traditional Auditing is inherently non-Agile™, can it be made to be agile?
  - FAR are inherently neither Agile™ nor agile.
  - Not all development teams are/can be disciplined.
  - Tenacious persistence of paradigm perceptions.
- Synergies
  - Both want the SAME THING.
  - Disciplined teams lead to successful implementation.
  - Institutionalization is natural.
  - Customer-focused is a GOOD thing.
  - Profit/ROI-focused is a GREAT thing!

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Distinctions (you)

-
-
-
-
-

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Distinctions (me)

- Neither CMMI nor Agile work in every situation and shouldn't be forced to.
- Narrowing-down each OU's reality takes work & time.
- CMMI can't be done ***to*** projects, it's done ***by*** projects and projects are done by ***people***.
- People are the critical commonality…

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Take-Away

- Agile and CMMI are after the same thing.
- How each OU pursues that is unique and people-based.
- If CMMI sticks to managing processes and Agile incorporates practices as tasks, they get along.
- Reality trumps authority and bureaucracy EVERY TIME.

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Questions?

It's **QUESTION TIME!!**

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Read our Agile CMMI Blog @ www.agilecmmi.com

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Use of SCAMPI^{SM} C for Agile Methodology

Lockheed Martin Integrated Systems & Solutions (LM IS&S)

Dorna Witkowski

Mary Lynn Penn

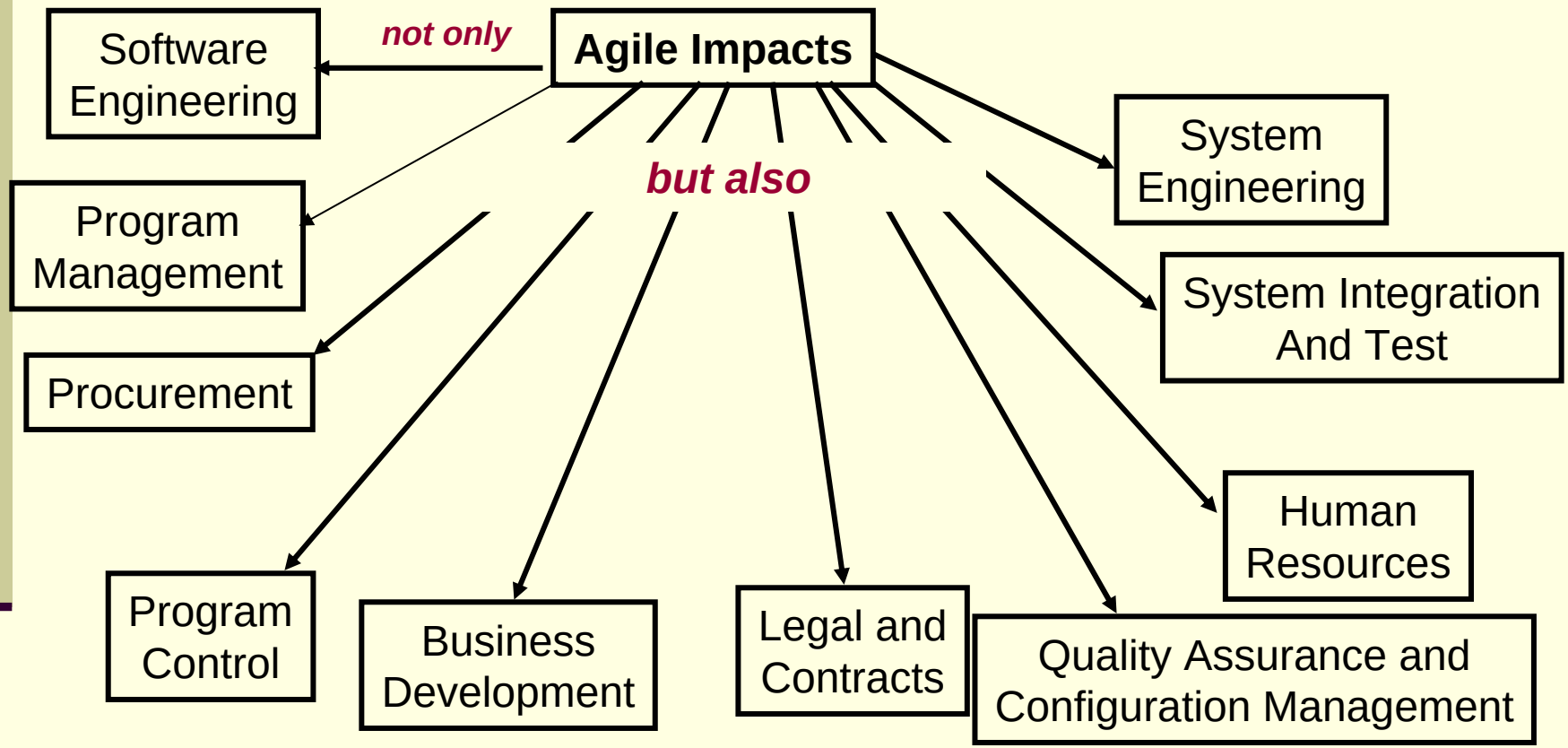
Approach to Agile at LM IS&S - Background

- LM IS&S CMMI® Maturity Level 5
  - SE/SW/SS/IPPD
- Agile perceived as a way to do things faster, cheaper, better
  - “We don’t need no stinking process.”
- LM IS&S starting to see RFPs “requiring” Agile and current Customers asking for Agile
  - But there were different perceptions of Agile both within IS&S and by customers

Approach to Agile at LM IS&S

- Therefore, IS&S saw the need:
  - To provide a clear definition of Agile for IS&S and communicate that definition
  - To understand the strengths and weaknesses of Agile and adopt it in the right way, for the right reasons, for our business
  - To define the blend of Agile and plan-driven methodologies that will provide best value for our programs and customers while still ensuring a disciplined approach

IS&S Agility – It's Not Just for Software



Agile methodologies drive changes across the organization, yet none of the industry Agile methods address the full scope of issues that impact IS&S

IS&S Multi-Staged Effort

- Establish an Agile Core Team (ACT)
  - Gather and share information and lessons learned about Agile across IS&S. Support proposals and customer “education”
  - Generate an "Agile Reference Model" (ARM) which describes a Systems and Software Engineering Agile life cycle
  - Use the ARM to identify and resolve Agile impacts to other organizations
  - Define agile program/project selection criteria:
    - Means to identify risks if Agile were to be used.
  - Validate the IS&S Agile life cycle through use on pilot programs.
  - Communicate to the organization.
    - Training materials, business development materials, engineering tool recommendations, etc.

Take incremental, high-value steps toward defining the IS&S Agile processes

Use of SCAMPI^{SM} Cs for Intent

- Agile Reference Model (ARM)
  - By February 2006, the Agile Core Team had established a draft Reference Model
  - Focused on Engineering portions of process (Software and Systems)
- Organization wanted to ensure that the results of ARM were compatible with CMMI®
  - Use of SCAMPI^{SM} C for *Intent* was an ideal fit
  - Plan to use a series of SCAMPI^{SM} Cs for intent as the Agile Reference Model gets refined for other process areas

Agile SCAMPI^{SM} C Process and Scope

- Used SCAMPI^{SM} Class C Method for Intent
  - Limited scope to Specific Practices of Engineering Process Areas
  - Obtained Senior Management sponsorship
  - Worked with Agile Core Team to get access to documentation and identify interviewees
    - Agile Reference Model was objective evidence for *intent*
    - *No implementation evidence available*
  - Used Practice Implementation Indicators (PIIs) to record findings
    - From documentation review and interview
    - SCAMPI^{SM} C requires at least one item of objective evidence (direct, indirect, affirmation) for each practice
  - Results reported to Agile Core Team and Sponsor

Agile SCAMPI^{SM} C Participants

- Experienced Team Members

Name	Introduction to CMMI (date attended)	Engineering Experience (# years)	Management Experience (# years)	Life Cycle Experience (# years)	Reporting Relationships
Team Lead	October, 2003	15 years	5 years	20 years	Direct Report to Sponsor
Team Member 1	February, 2005	22 years	5 years	20 years	Direct Report to Sponsor
Team Member 2	October, 2003	15 years	5 years	10 years	Direct Report to Sponsor
Team Totals		***52 years***	***15 years***	***50 years***	

- 2 Interviewees from Agile Core Team
  - About 1/3 of Agile Core Team

Summary of Results

- Very high correlation of *intent* of ARM to CMMI® Specific Engineering Process Area
  - 41 “Green” Specific Practices
    - Intent adequately addressed
  - 4 “Yellow”
    - Intent partially addressed (RD SP3.1, TS SP3.2, VER SP2.1, VER SP2.2)
  - 1 “Red”
    - Intent absent or poorly addressed (VER SP2.3)
- Recommended that documentation be enhanced to make sure intent is explicit
  - Document how the method handles interfaces, reviews, recording decisions, and constraints
- Recommended method be updated to include:
    - Measurements, Operations Concepts, End User Documentation, Peer Reviews

Actions Since SCAMPI^{SM} C

- Measurement section generated for ARM and is in the review process
- “Product Vision” defined in ARM is consistent with Concept of Operations
- Pair Programming being viewed as one form of “Peer Reviews”
  - Other reviews being defined in ARM

Next SCAMPI^{SM} C for *Intent* being planned 1Q07

Summary

- Agile Reference Model (ARM) being defined by IS&S to ensure consistent, best-value approach
  - Customers are driving the need to address
  - Organization is driving the need to maintain CMMI compliance
  - Goal is to define the blend of Agile and plan-driven methodologies that will provide best value for our programs and customers while still ensuring a disciplined approach
- SCAMPI^{SM} Cs for *Intent* are an effective tool to ensure ARM is consistent and compatible with CMMI

Organizational Synthesis - CMMI®, The Glue That Binds

Synthesizing:

- Business Process Model,
- ISO Standards,
- Life Cycle Management,
- Program Direction and
- CMMI®

into a Business Process Management System

Eileen Arnold, Patrick Waddick, Helen Addie, Christine Hulse and the ASD Engineering Team

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ASD' S Concurrent Initiatives

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BAE Systems Concurrent Initiatives

The major concurrent initiatives and business drivers used for illustration of our organizational system synthesis as presented here include:

- ASD's Business Process Model
- ISO Standards
- BAE Systems Operational Framework and Life Cycle Management Process
- CMMI®

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Change Is Inevitable

The pace at which change transpires and the complexity of that change is dependent upon the:

1) Number of concurrent change drivers
2) Degree to which the drivers are instituted
3) Cultural acceptance of the drivers
4) Capacity (Resources) to implement the change, and
5) Application of system synthesis

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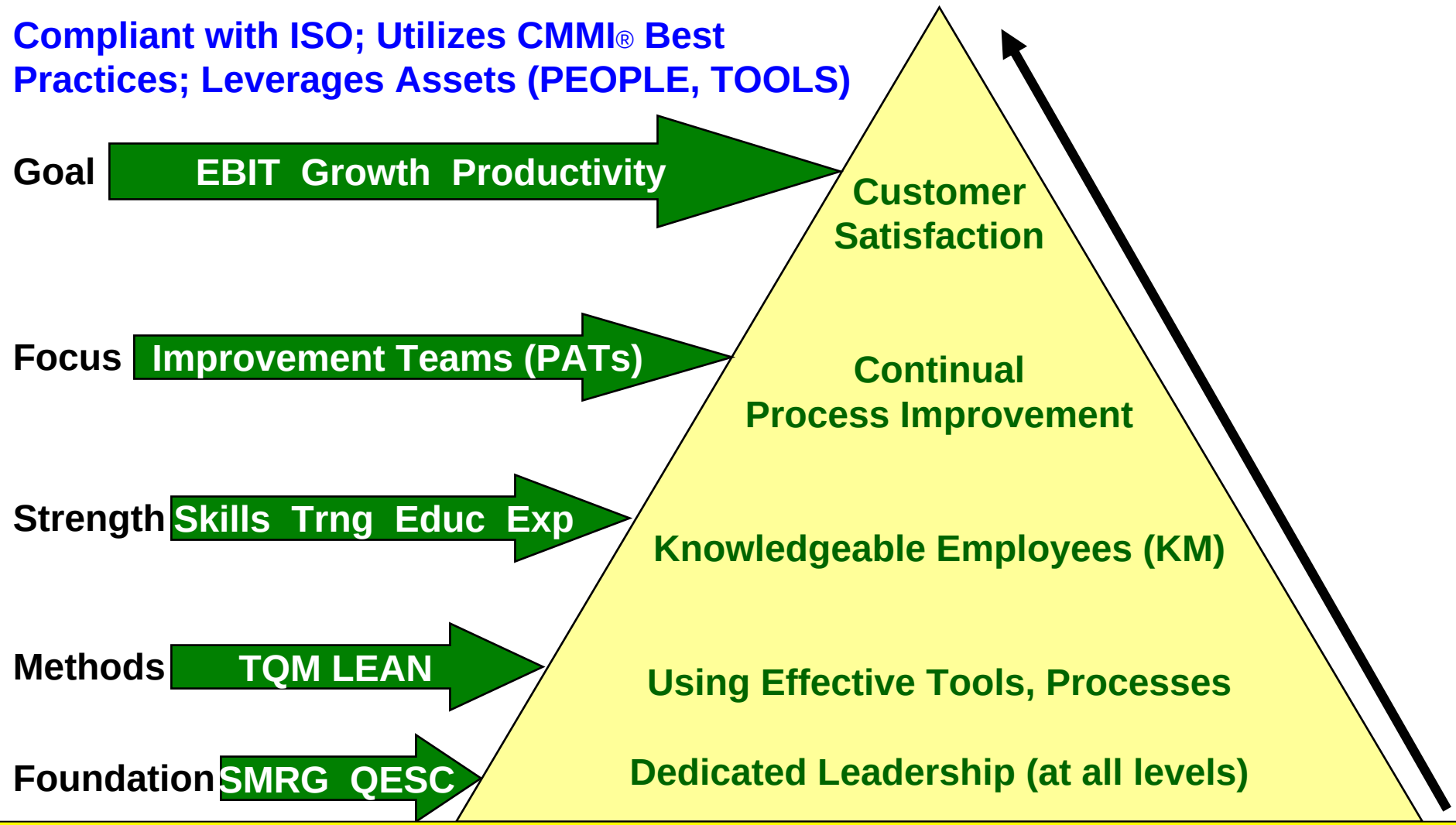
Our Business Approach

Compliant with ISO; Utilizes CMMI® Best Practices; Leverages Assets (PEOPLE, TOOLS)



CMMI® provided the suite of best practices applicable to software and systems engineering

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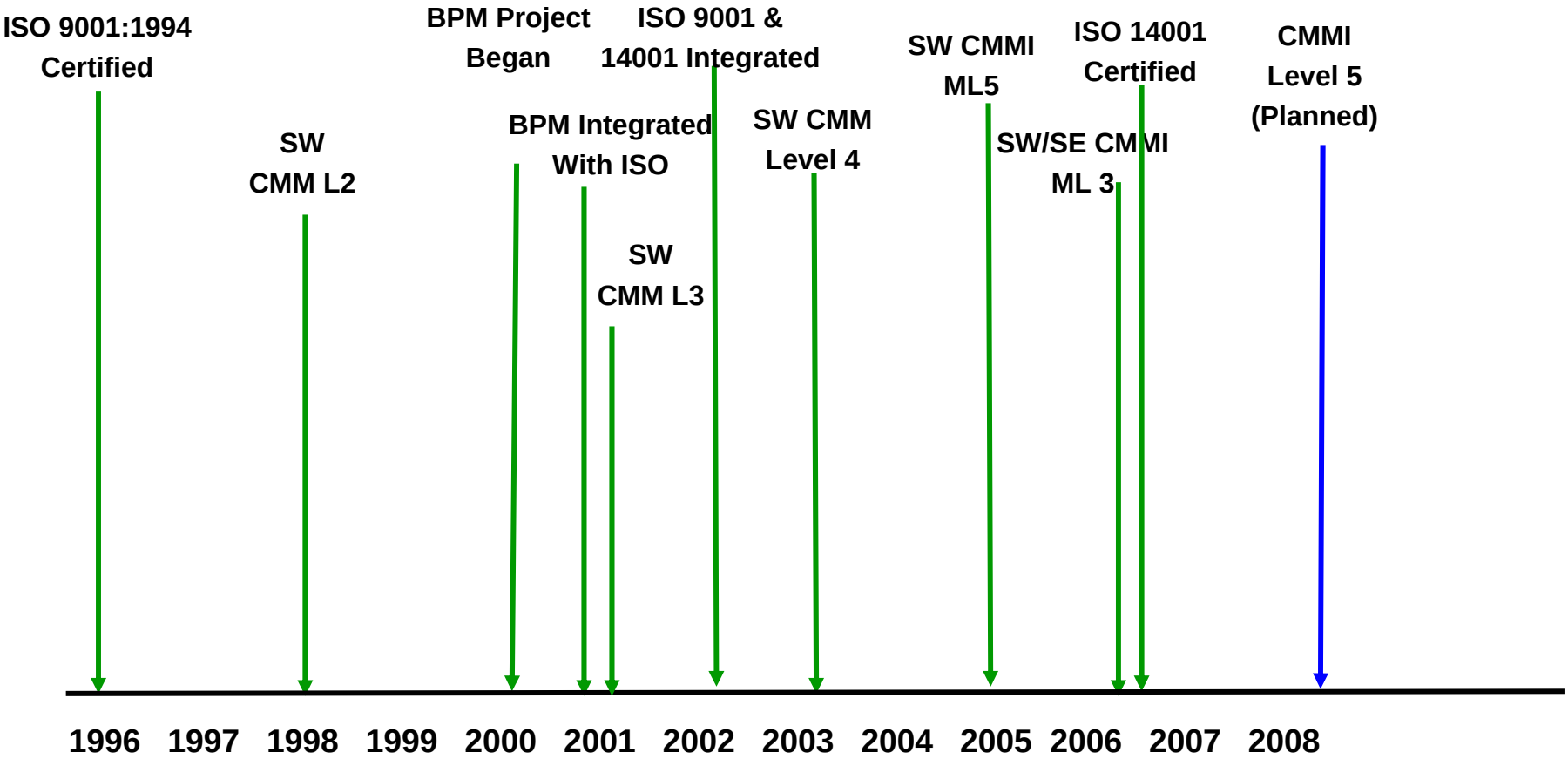
ASD Process Improvement & History Milestones



Business and Product Development Process Improvement

Movement from CMM to CMMI® triggers the start of synthesis –The “glue process” begins

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ASD' S Business Process Model Initiative

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ASD's Business Process Model Architecture

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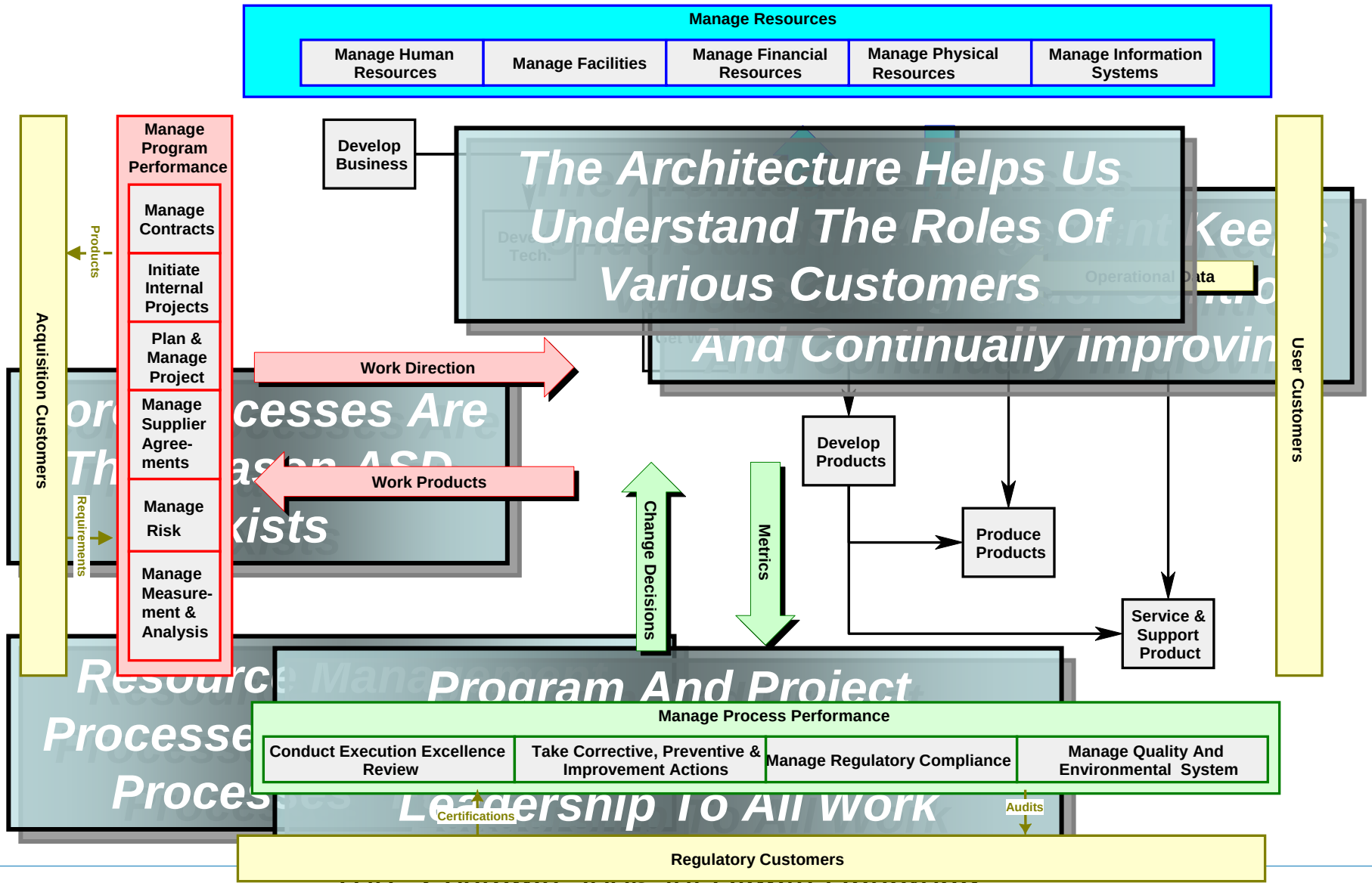

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0.0, Rev 09, 27 June 2005 Refer to BP00064 for Change History

ASD Business Process Model

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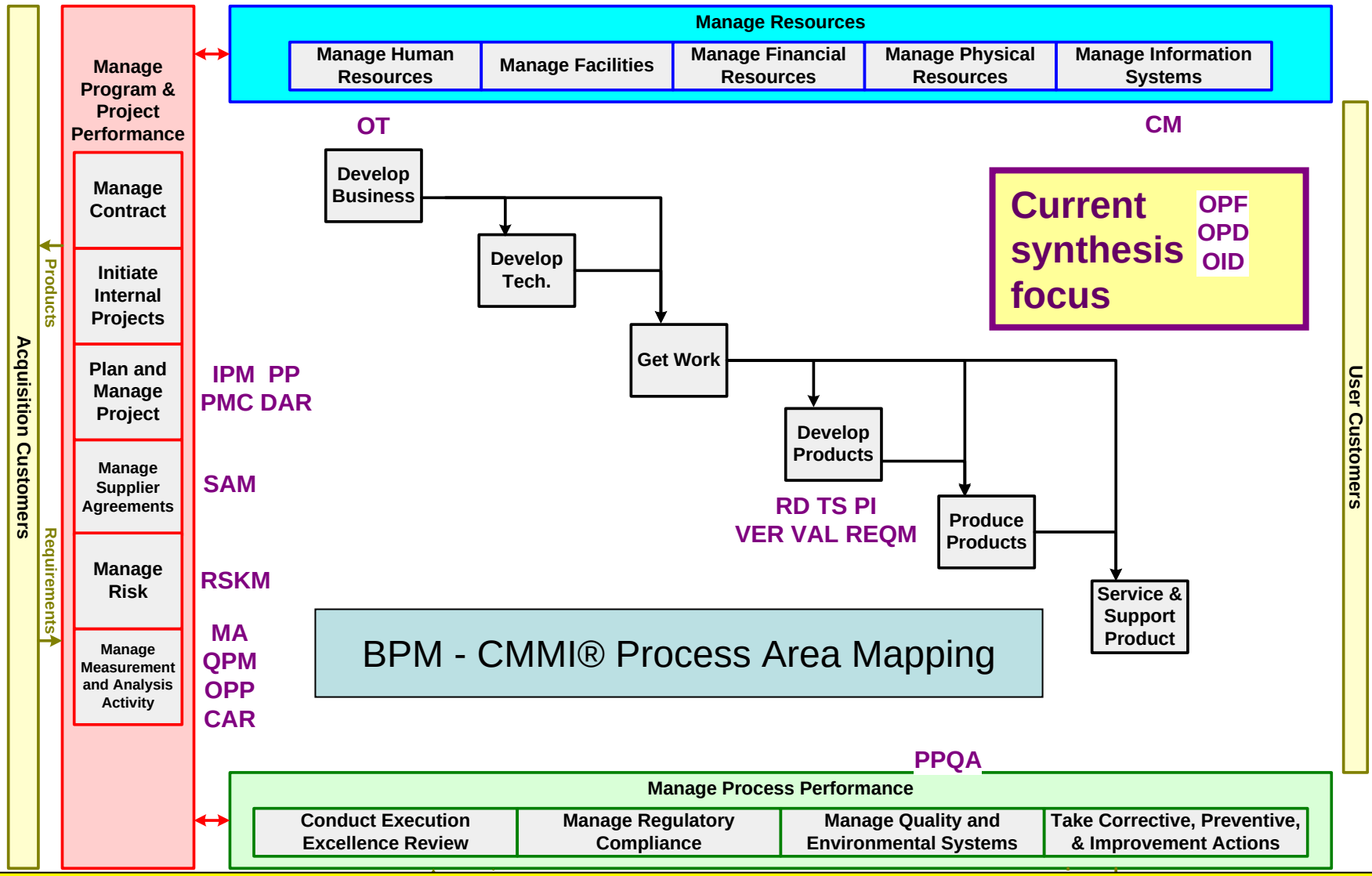

CMMI® institutionalization - the glue to cement the initiatives together under the BPM

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ISO Standards Initiatives

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ISO 9001 and ISO 14001

ISO 9001 standard emphasized

- Defining sequence and interaction of processes
- Customer requirements and customer satisfaction, for both external and internal customers
- Process measurement and/or monitoring; data-driven decision making
- Continual improvement
- Increased emphasis on management responsibility

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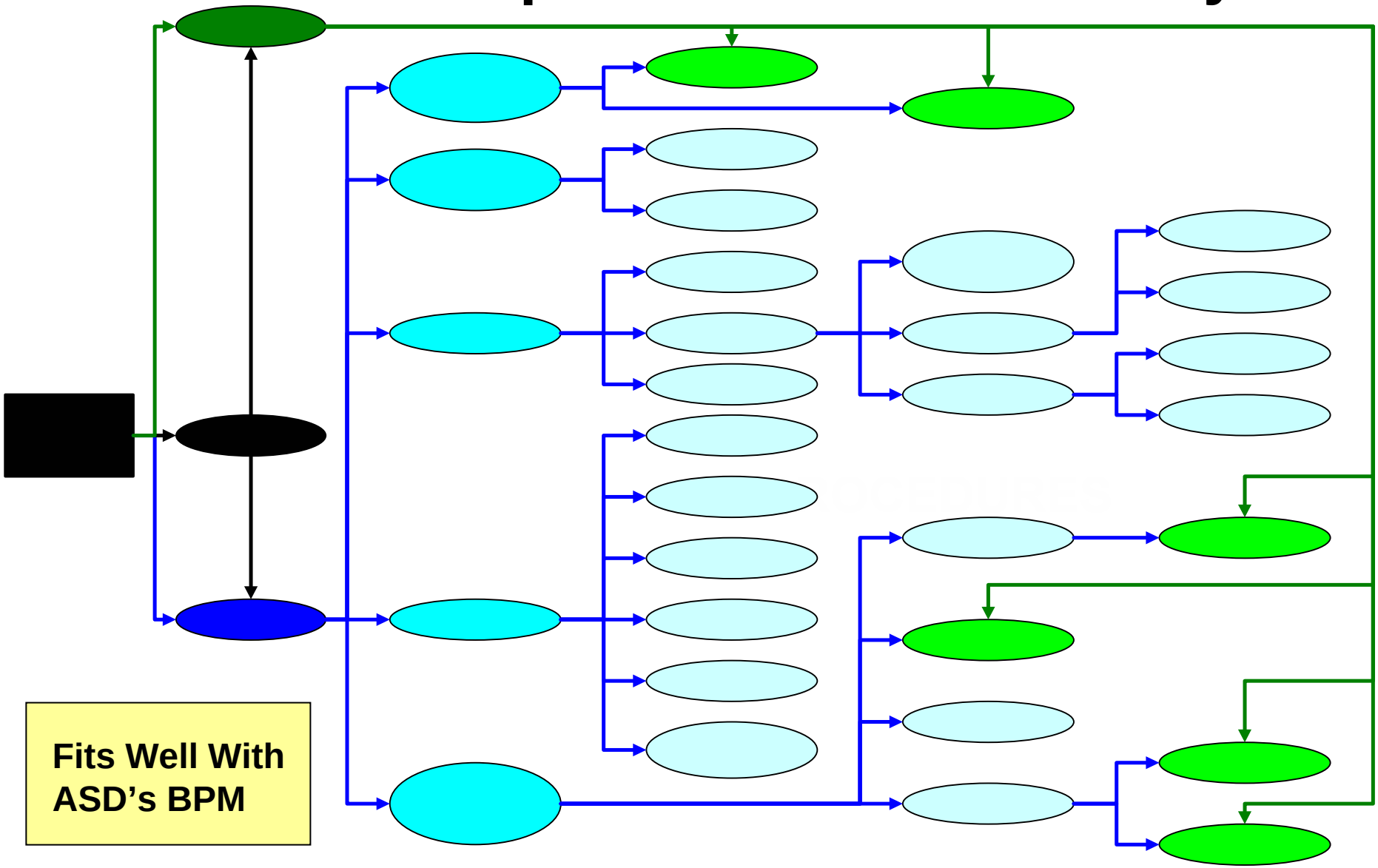
ISO 9001: Implied Process Hierarchy



Fits Well With ASD's BPM

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CMMI® and ISO are looked upon as people and process enablers to accomplish performance sharing, lean initiatives, safety, and other critical business support initiatives

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BAE Systems Operational Framework (OF) Life Cycle Management (LCM) Business Process

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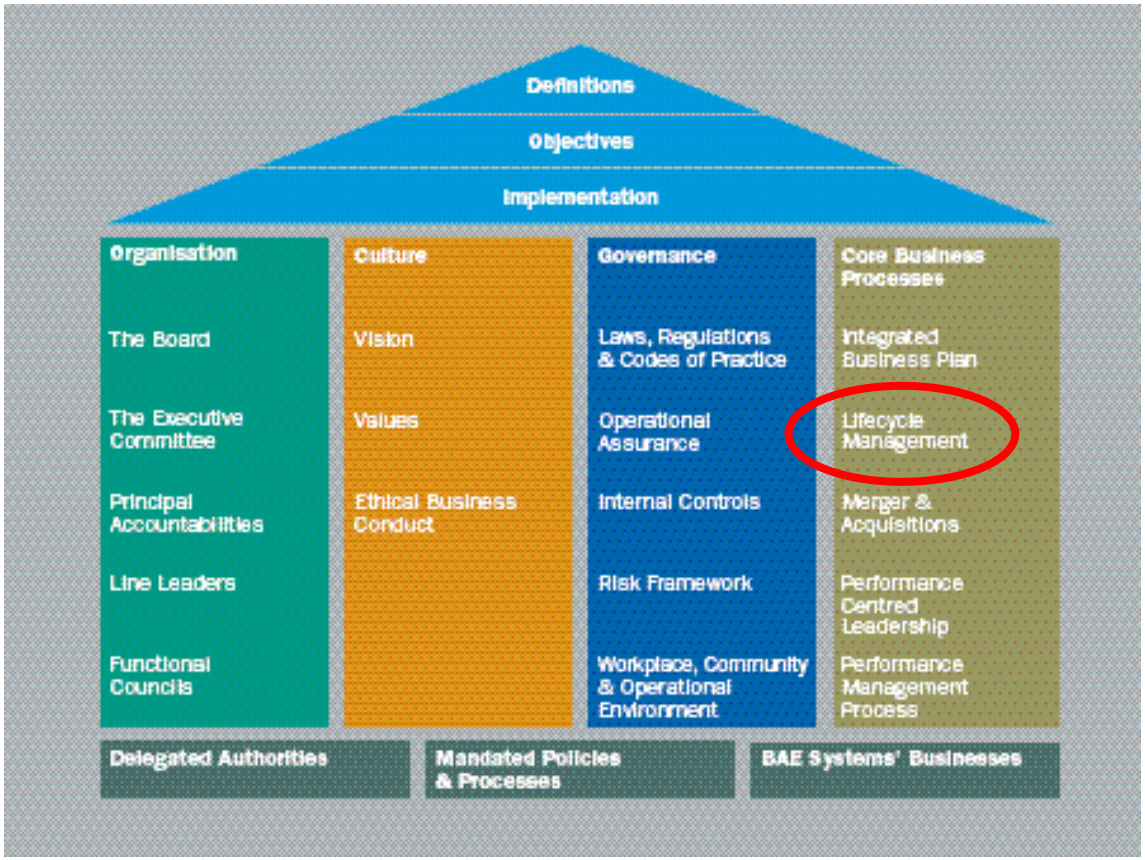
Acquisition by BAE Systems

BAE Systems Operational Framework (OF) (governance framework for all Business Units)



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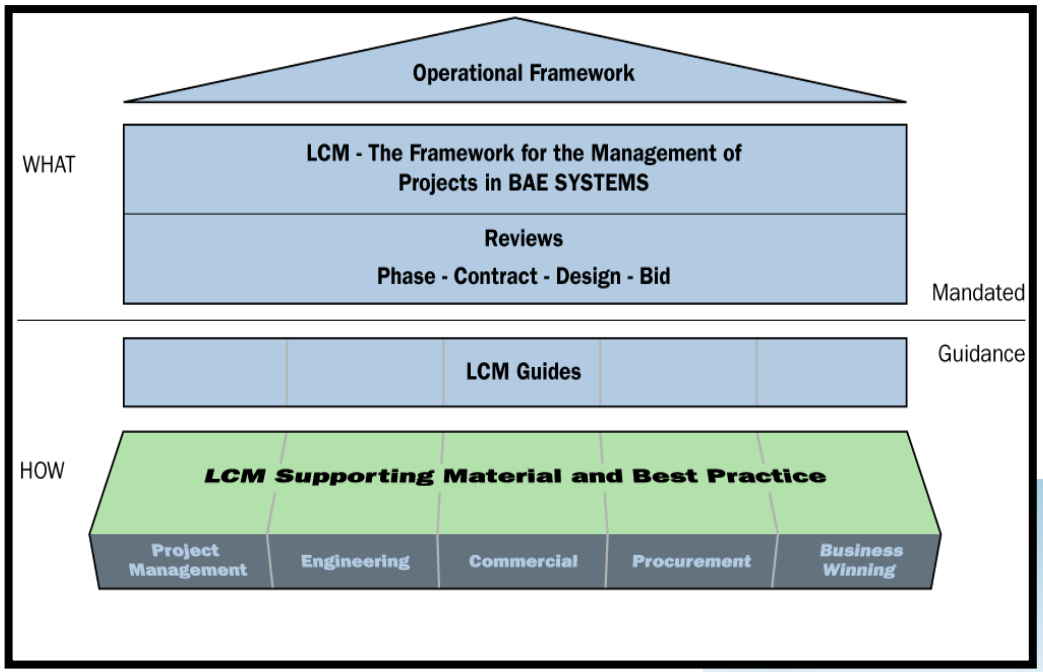
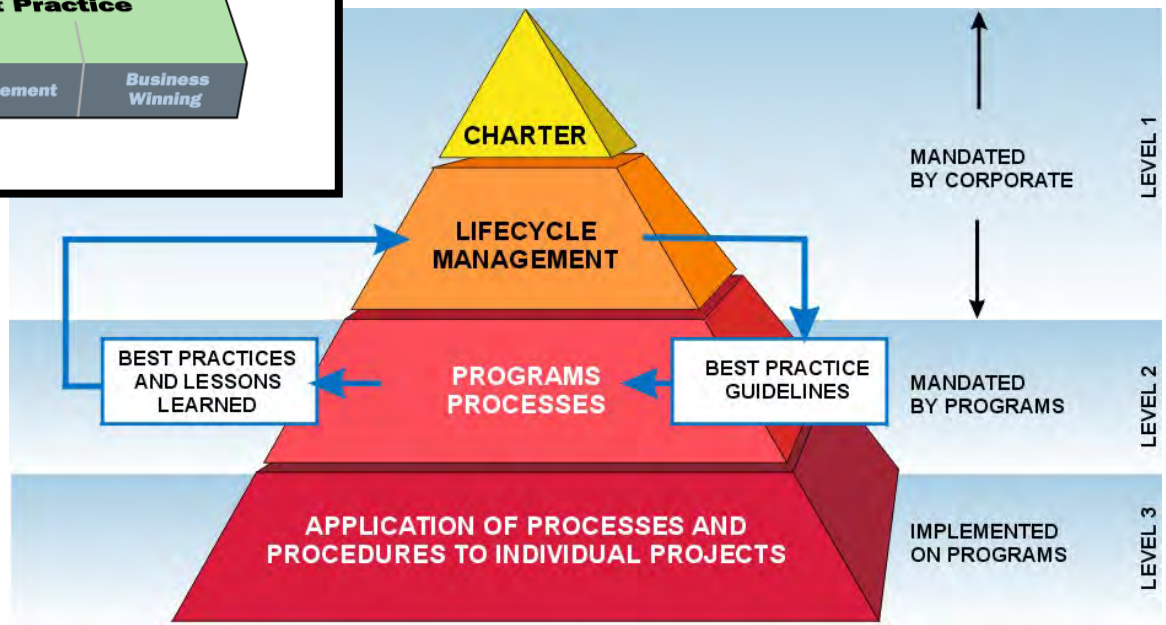
Life Cycle Management (LCM)





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Another Synthesis Opportunity - OF

1) All employees have an awareness of the Operational Framework
2) Local policies and processes are in place to implement the requirements of the Operational Framework and all mandated policies and processes
3) Appropriate training and monitoring processes are put in place to ensure proper implementation of the Operational Framework

CMMI® institutionalization provides a common language basis and processes in place

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Synthesizing Activities

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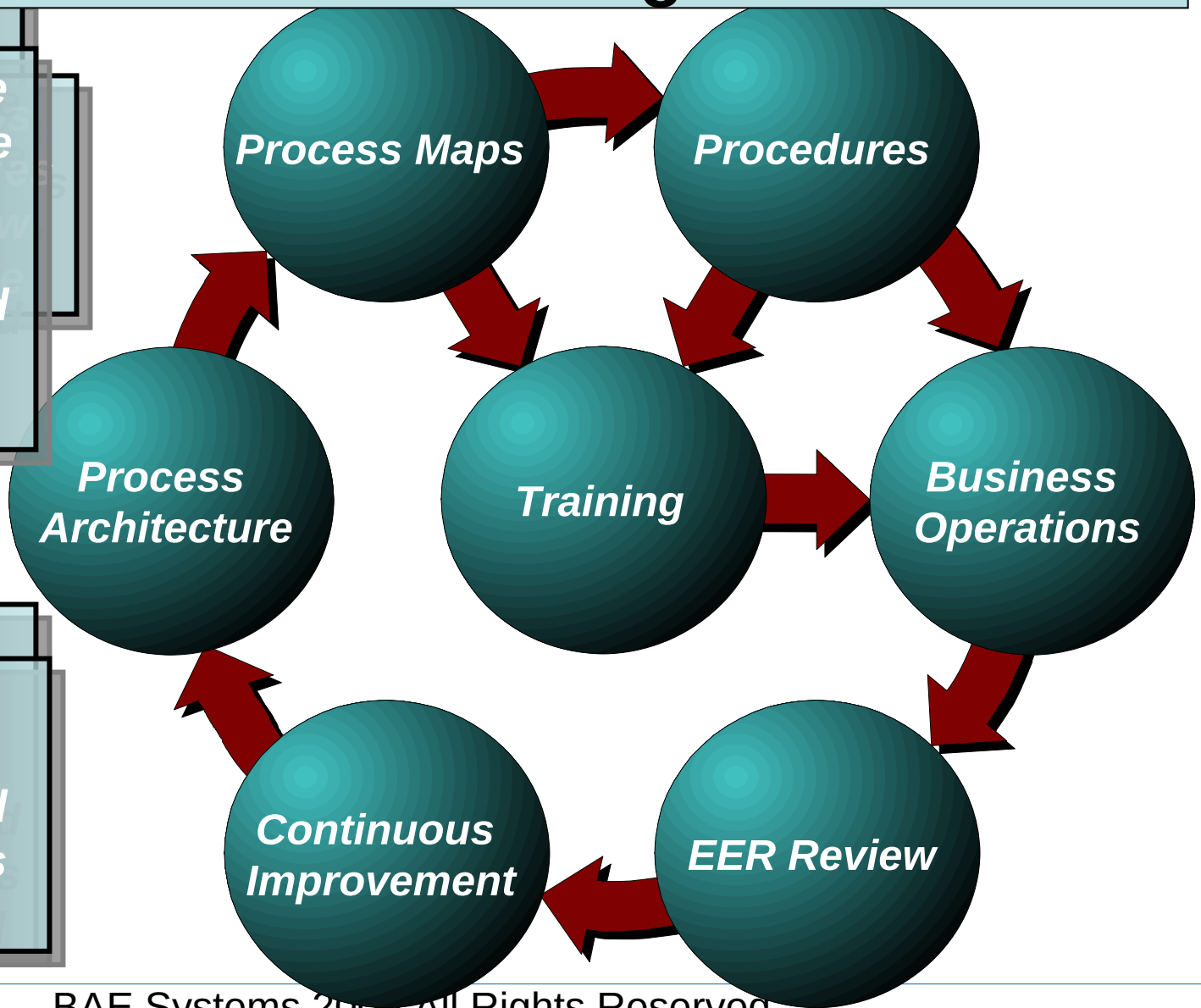
ASD's Process Based Management Vision

The Workforce Procedures Are Executed In The Conduct Of Business Operations And Results Are Measured



The Business Results Are Reviewed And Improvements Implemented

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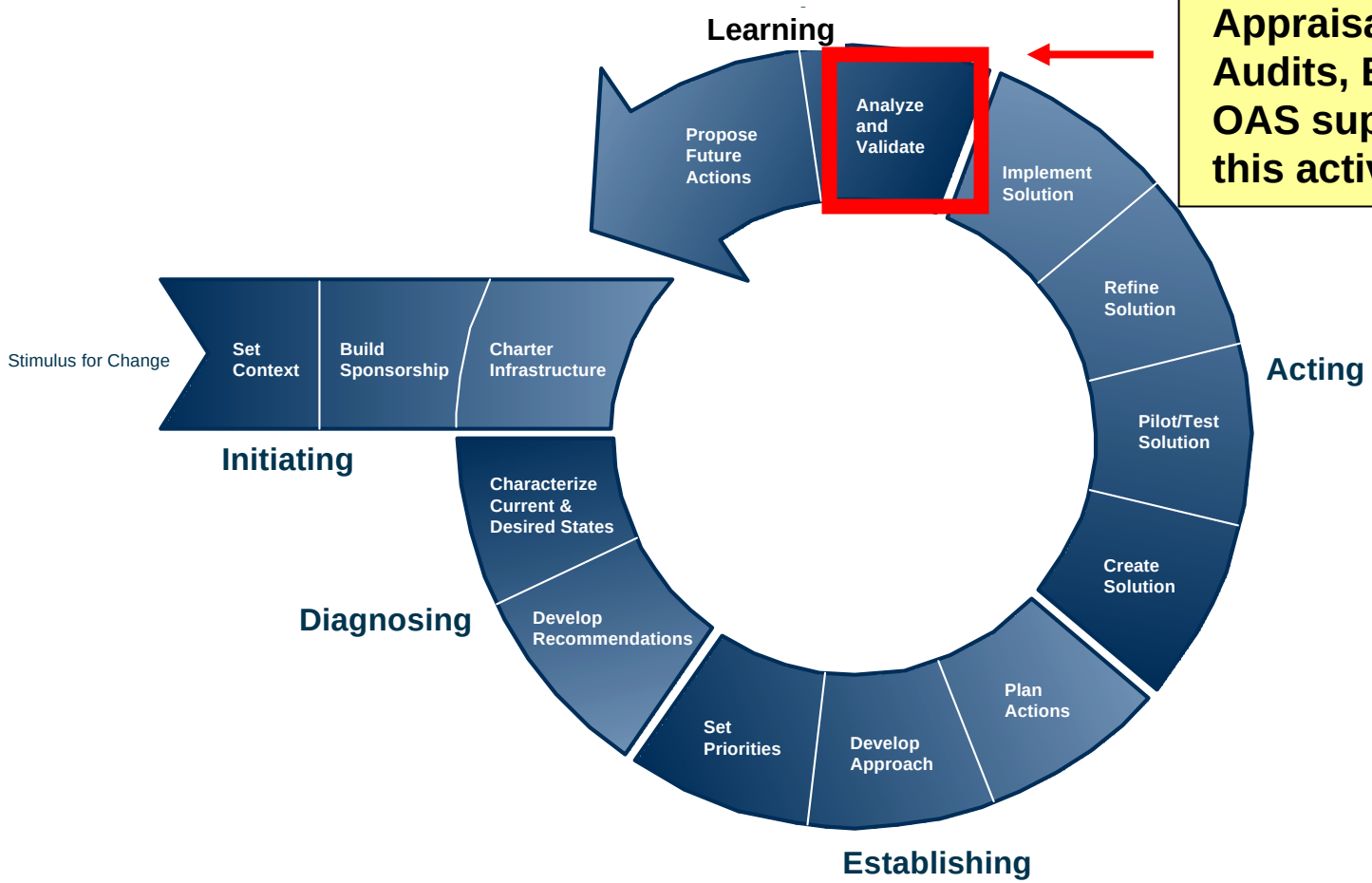
SEI's IDEAL™ Approach to Process Improvement

CMMI® Appraisals, ISO Audits, BAE OAS support this activity



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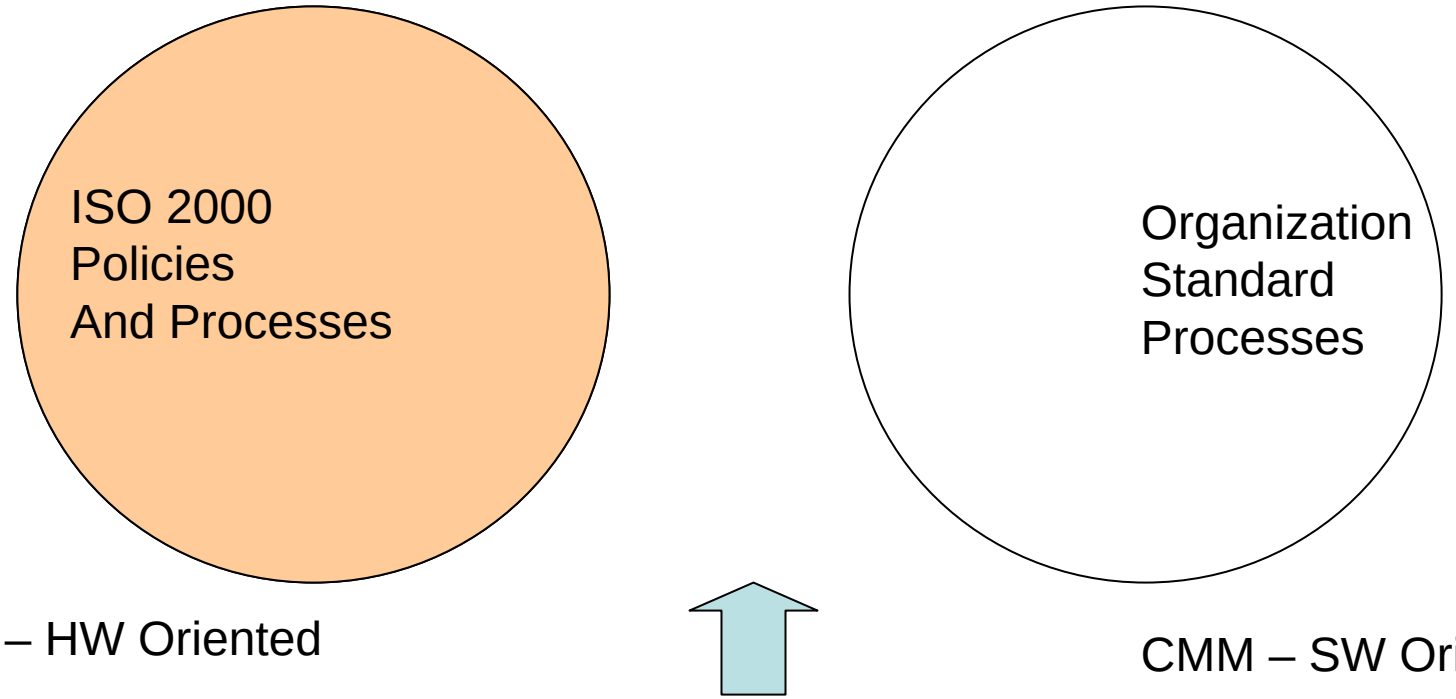
Legacy Documentation (Stove Pipe Initiatives)

Business Process Model



ISO – HW Oriented

CMM – SW Oriented

CMMI® for Systems Engineering and Software Engineering v1.1
And CMMI® for Development v 1.2 reduces overlap

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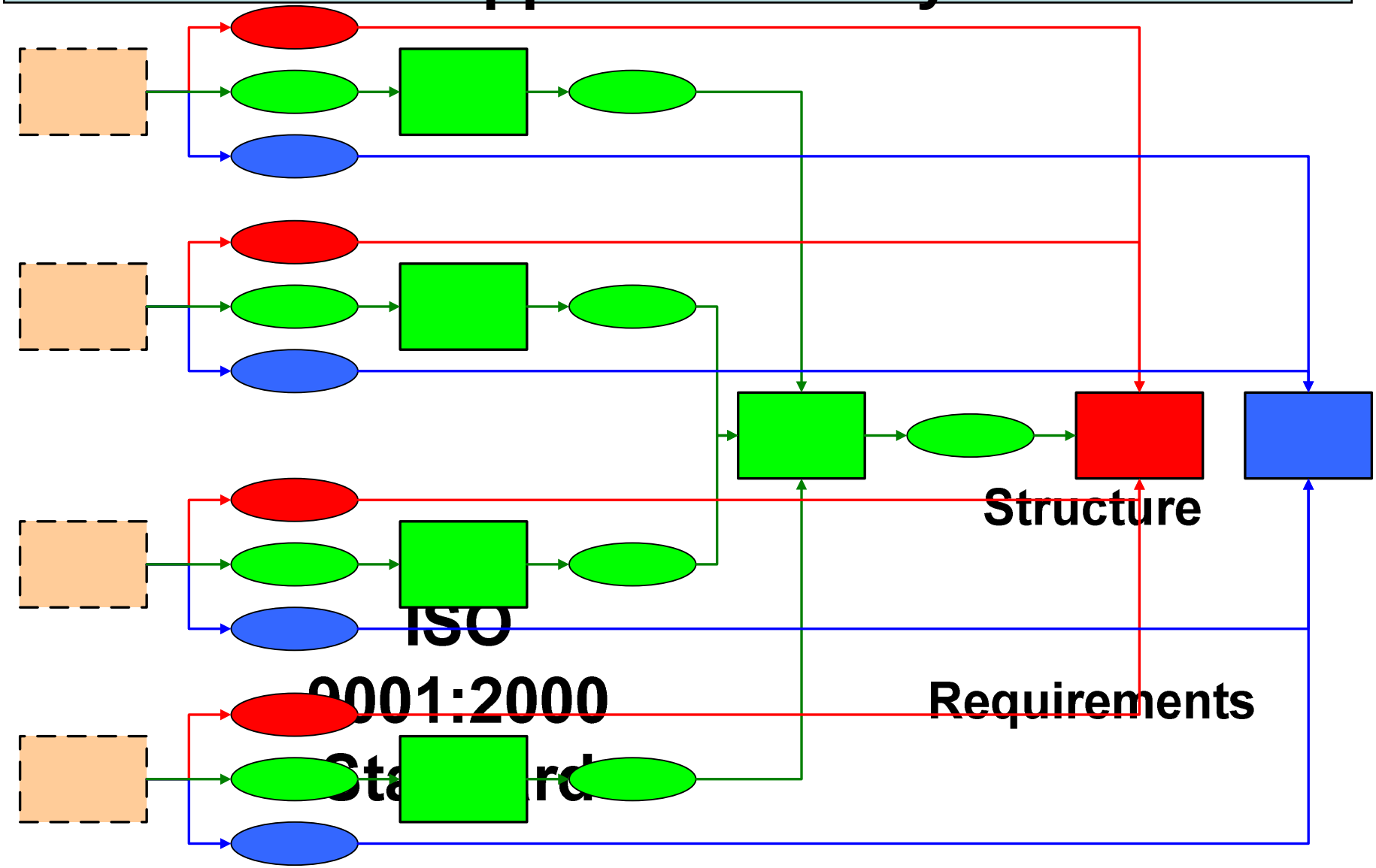
General Approach For Synthesis



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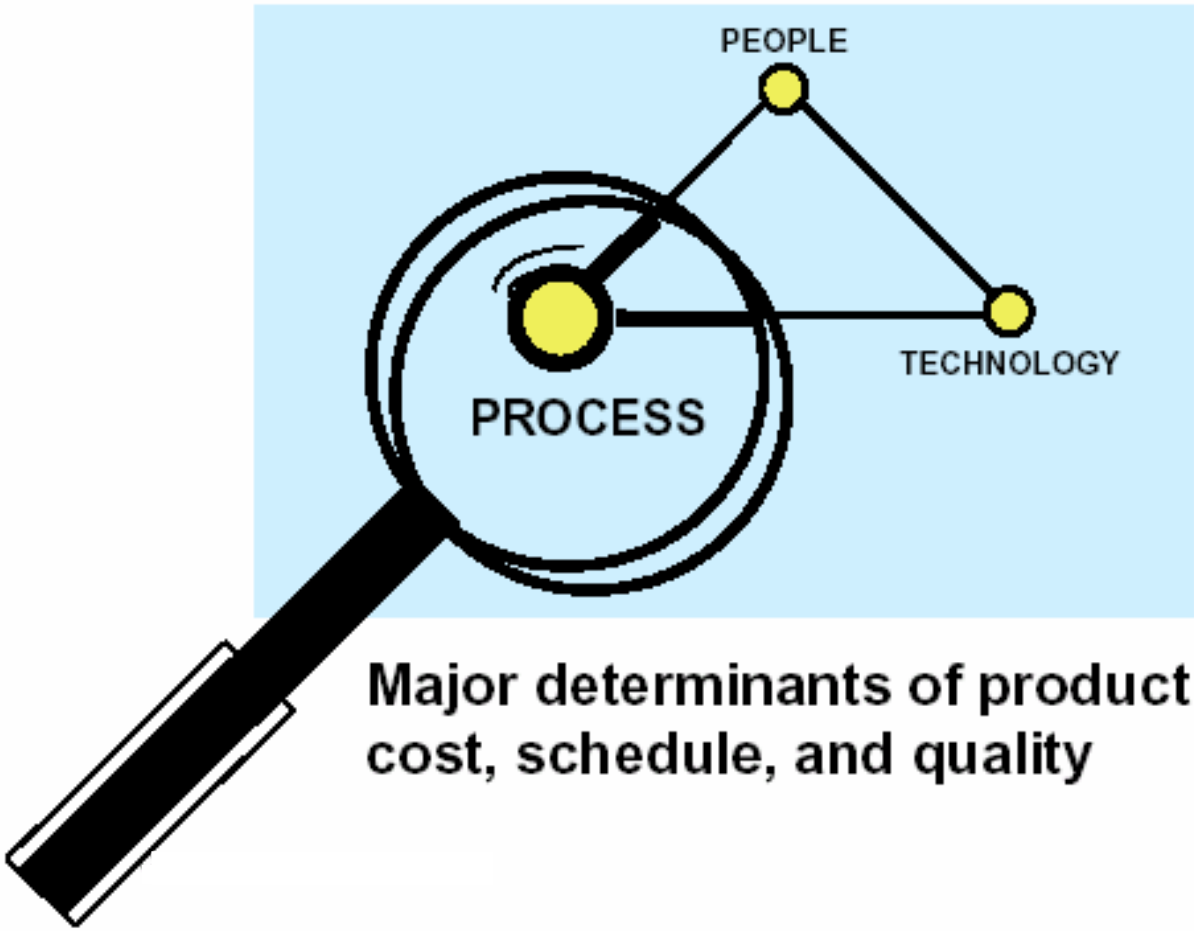
Why Focus on Processes?



Major determinants of product cost, schedule, and quality

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Process Institutionalization

Process institutionalization has been achieved when:

- A policy relating to the process exists
- The process is defined and documented
- Training exists and has been delivered
- Required resources are allocated
- The majority of the process is or has been exercised frequently (as appropriate to the project lifecycle)
- The execution of the process is measured, managed, and verified, and corrective actions are taken
- It is clear that the staff understand their processes, can discuss related artifacts, and believe in the effects

Institutionalization: The ingrained way of doing business that an organization follows routinely as part of its corporate culture.

Source CMMI Version 1.2

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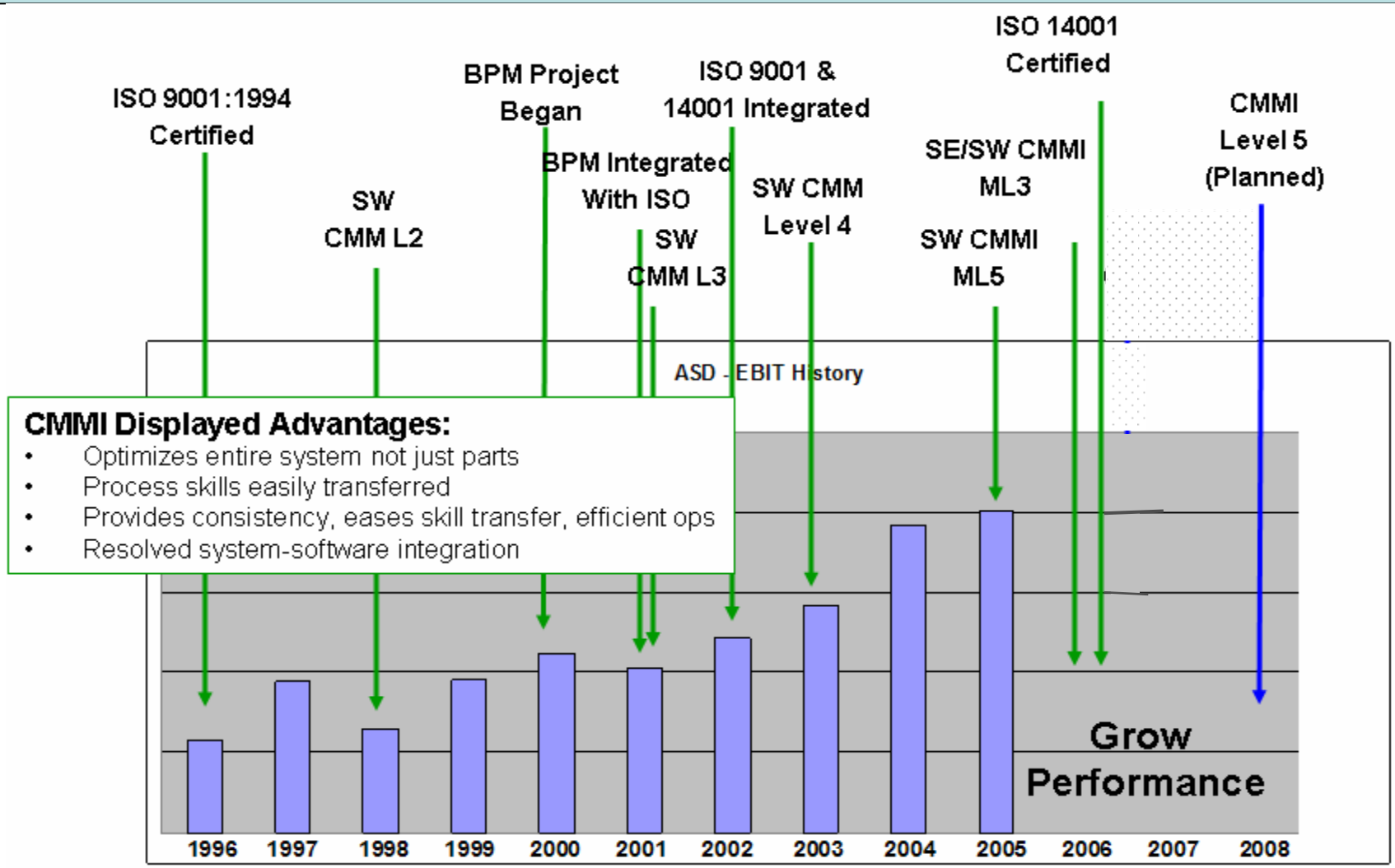
Process Influence on EBIT



Business and Product Development Process Improvement Correlates with financial performance

Business Advantages of Organizational Synthesis

- More efficient use of resources in developing, documenting, deploying, maintaining, and knowledge management
- Consistency in understanding, less confusion – unified process alignment
- Improved communication due to common language, processes

CMMI® Glue: Efficient resources, unified process alignment, improved communication

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Summary

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In Summary

1) Synthesis of the Organizational System presents an opportunity to operate in an effective business manner, improving coordination by reducing redundancy
2) For ASD, CMMI® and the need for institutionalization provided the glue to bind the organizational initiatives into a synthesized operation
3) Change happens – embrace the opportunity

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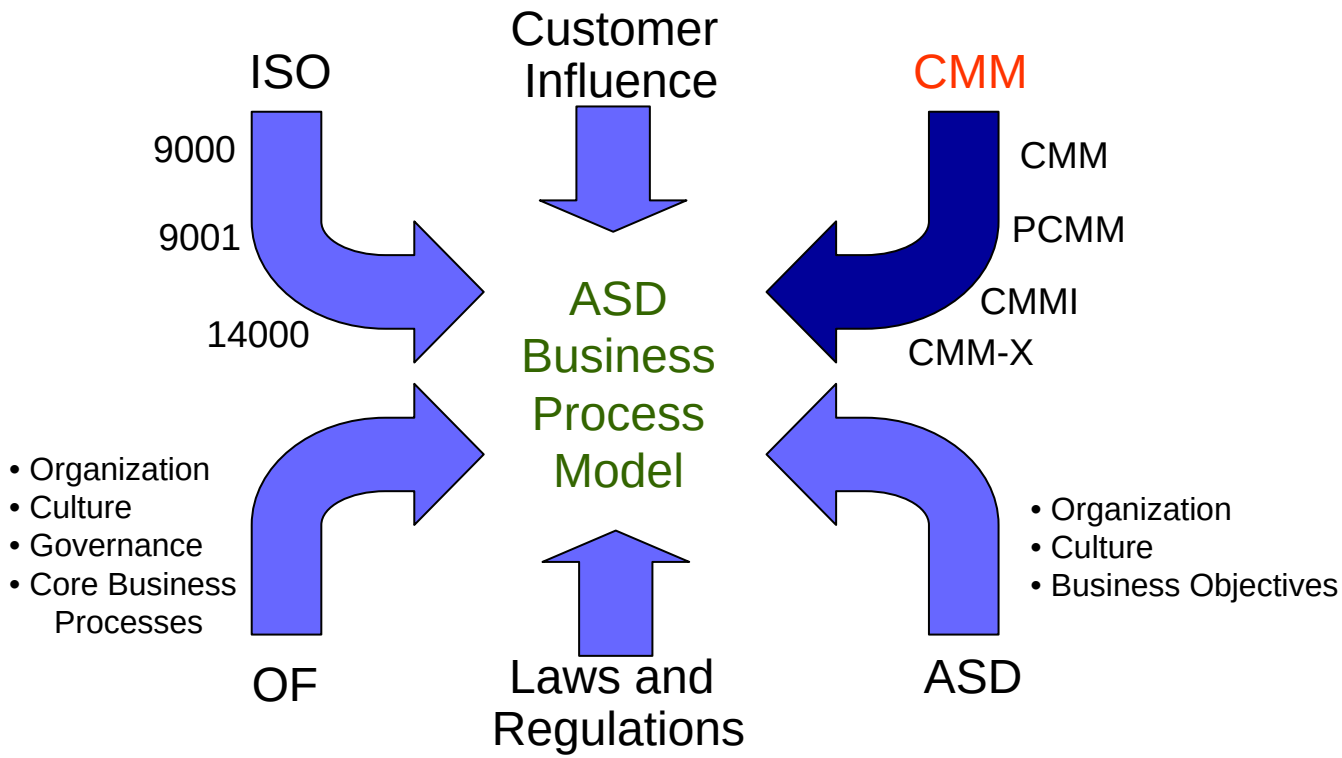
Key Enabler – CMM Practices



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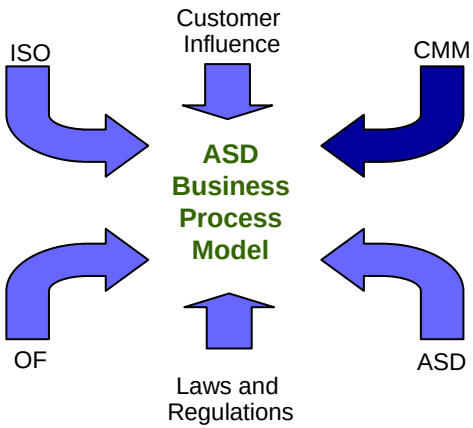
The Glue Results In …



Synthesis of Initiatives

Stronger Business Process Model OF Standard Processes

Increased Success of Business Goals

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Organizational synthesis is a journey, not a destination.

Integrating the organizational system is an evolutionary activity even if the company maintains its current initiatives, driven by the business need to change and improve.

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Operations and Maintenance – Not Just a Scaling Issue

Laurence Gill

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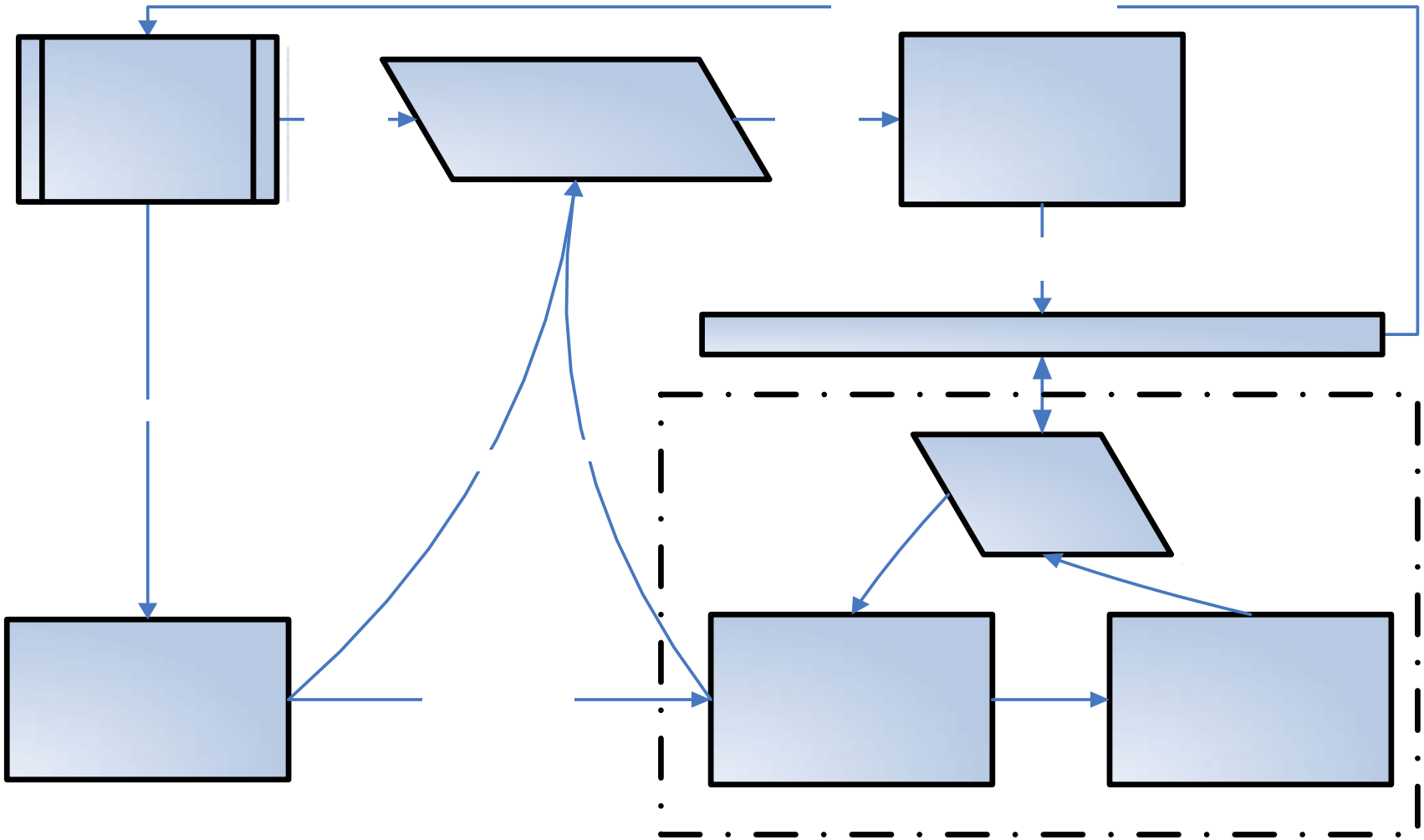
Operations and Maintenance Environment



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Challenges Facing O&M Projects - 1

- Supported applications are already developed and fielded
- Real time environment
  - Releases are typically added to a live system
- Typically part of multi-contractor team
  - May need to acquire some of the original developers
- 24-7 operation (actual or virtual)
- Responsible for overall system performance via Service Level Agreements
- High variability in workload
  - Help Desk Functions
  - Preventative Maintenance
  - Testing
  - Development
  - Release Management

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Challenges Facing O&M Projects - 2

- There are few, if any, recognizable development activities that the organization controls that map to all of the engineering practices in the CMMI model
- Customer owns process
  - Contractors may be able to influence the process
  - Customer controls changes to the process
  - Customer owns tools that support the process

Breakthroughs

- Classic engineering is not a prime focus
  - Tier 1 help desk tickets are often administrative or training
  - System problems get fixed immediately
  - Content of releases is less critical than implementation into live environment
- Most O&M contracts are Level of Effort (LOE)
  - Changes to the customer system operate differently
  - Work force is pre-determined; requirements are based on size of team
  - Schedule needs to adjust to the world of the application or network
- Many processes are performed at two levels
  - Project management exists for the O&M contract and the specific customer application
  - Support processes support the contract artifacts and the application environment
- Two projects exist – ours and the one we perform for the customer

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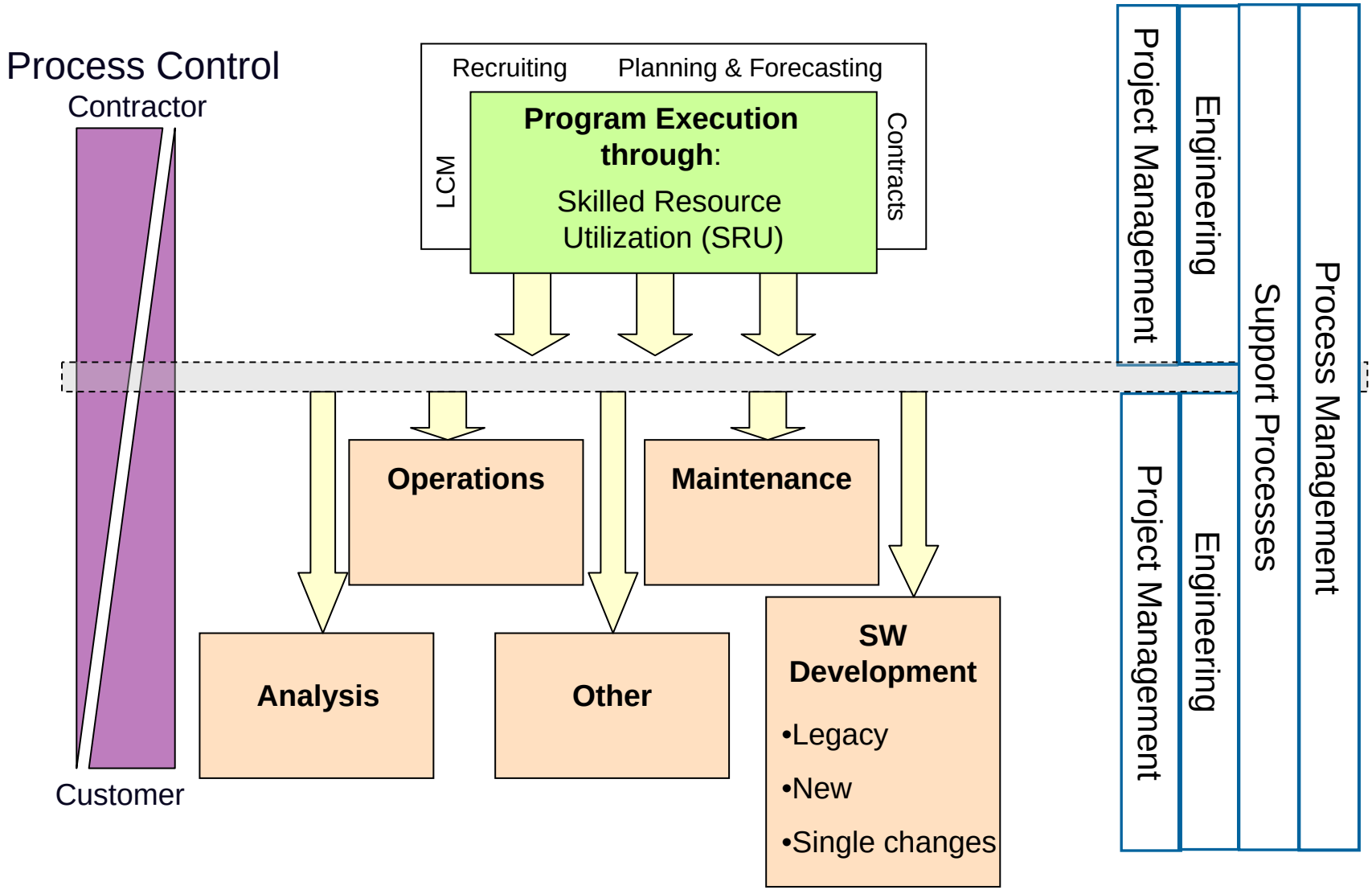
Framework for Implementing CMMI



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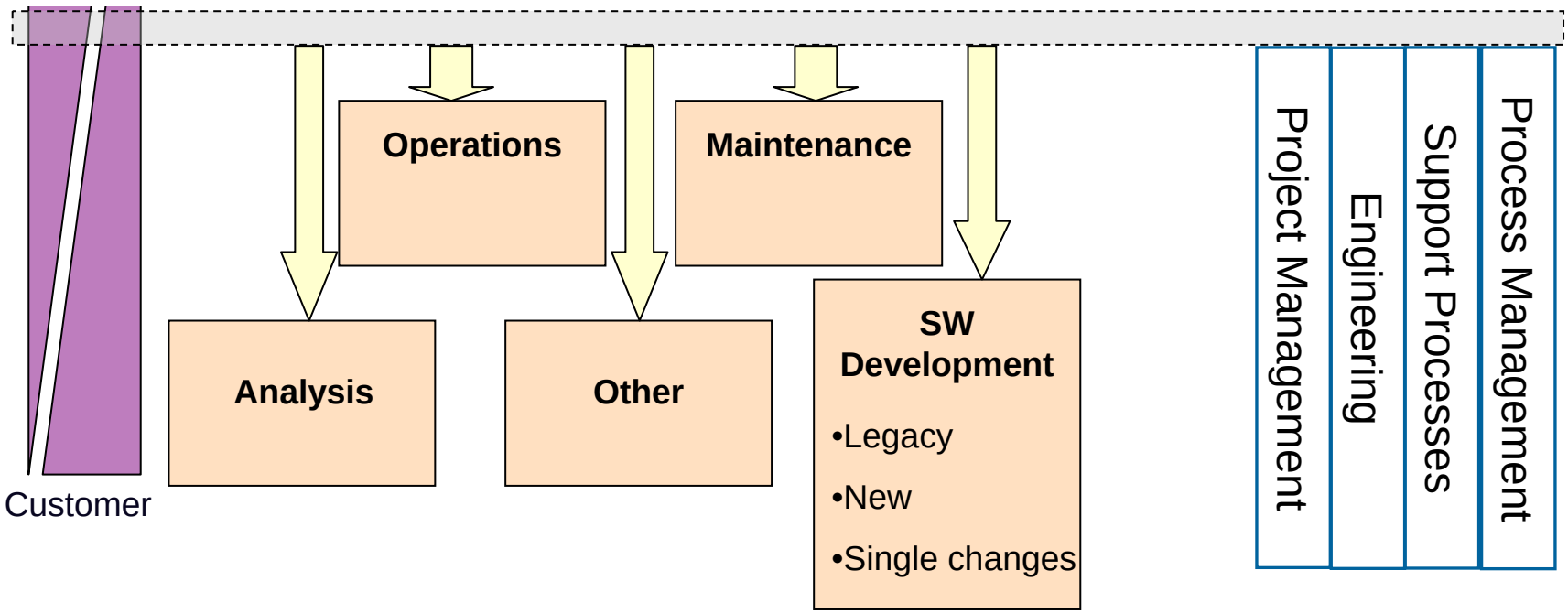
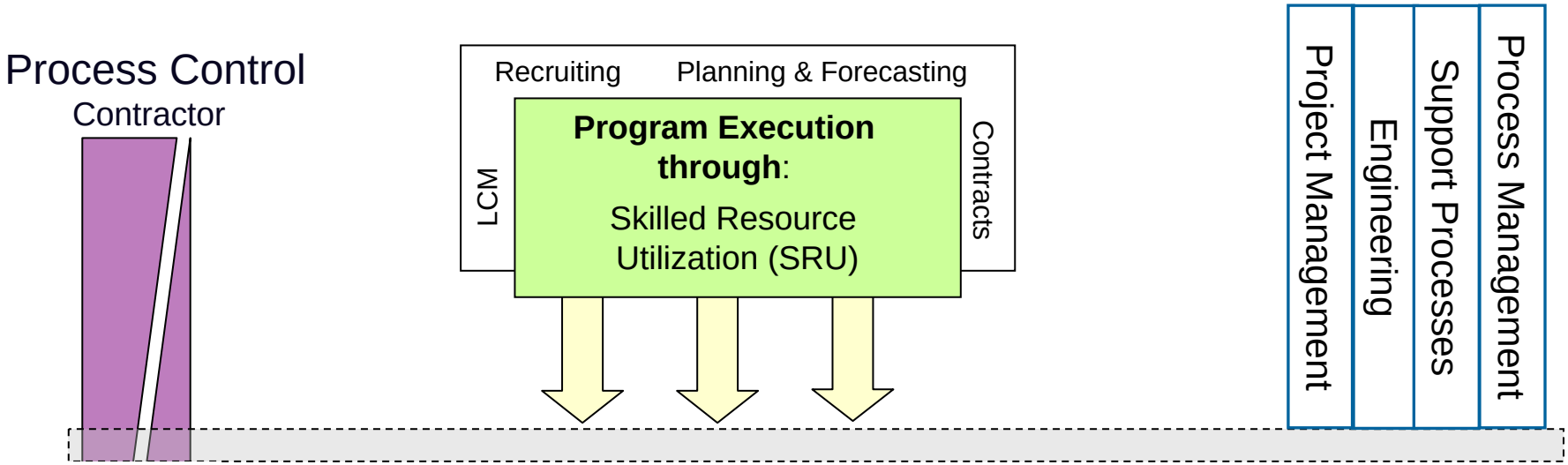
Framework for Implementing CMMI - Below the Line

- Operations and Maintenance activities occur below the line
- Work performed at customer direction performs similar processes but for different purposes
- Validation determines whether the work we perform below the line meets customer expectations



Framework for Implementing CMMI - Above the Line



- The products being provided are resources capable of performing the work below the line
- All of the CMMI Process Areas are applicable above the line
  - People are products; Systems are the resources we provide (staff and supporting non-staff)
  - Verification is against the requirements of the contract – not the verification activities performed for the customer
- Processes above the lines are under our control

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Above the Line Processes

SRU Process	Process Description
Define the Work (DTW)	Identify customer needs and expectations and define project requirements.
Design the Staffing (DTS)	Develop a resource solution that will address the requirements of the contract and the expectations of the customer – with an understanding of a real-time variable-workload environment using LOE resources.
Define Project Approach (DPA)	Develop plans and processes to be used to manage the resources provided to the customer.
Fill the Position (FTP)	Acquire the staff and non-staff supporting resources to perform the services.
Monitor the Project (MP)	Manage the requirements of the project.

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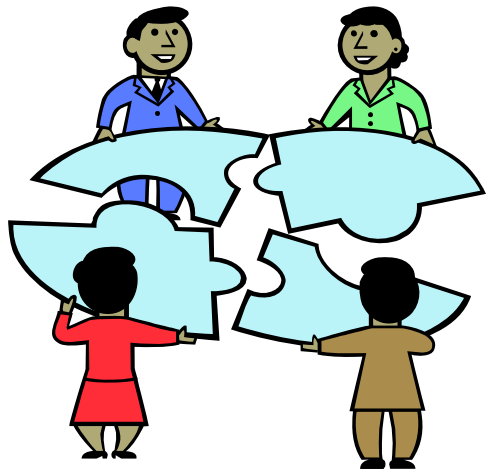
Implications to the Business

- Create breadth versus depth in staffing solution – virtual workforce
- Have to know best practices for below the line – influence
- Leading indicators to performance
  - Key performance indicators for staffing
  - Cannot ignore leading indicators for SLAs
- Develop multiple alternatives to provide services and select the one that best addresses the contract and environment
- Understanding what is required below the line is key to success above the line



Summary

- With our business-tailored interpretation of the CMMI we were able to apply best practices to the entire project, not just small bundled releases
- We were able to identify the O&M environmental challenges and develop a business solution that can be applied to our entire enterprise
  - Organizational standardization of processes
  - Project's defined process
- By separating the tasks we control from those that we don't, we were able to develop a better framework for implementing the best practices using the CMMI
- The processes developed mirror our business
- For more information about the implementation of the engineering process areas, join Kathy King tomorrow for the Engineering in a Non-Development Environment presentation

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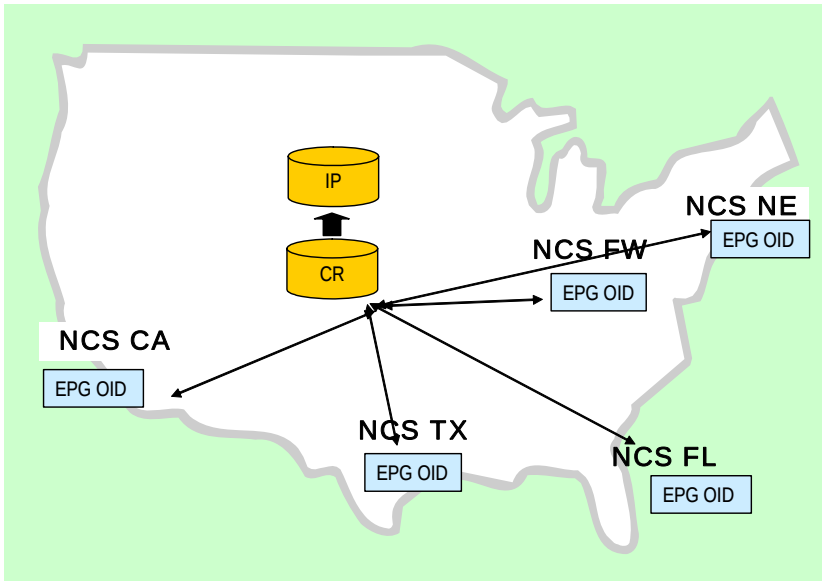
Raytheon

Customer Success Is Our Mission

When OID Crosses Time Zones, Disciplines and Customer Base

Network Centric Systems
Engineering
Laurie Haack
Michele Wall

November 15, 2006



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Introduction

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Network Centric Systems

- NCS has transformed from five sites with separate sets of processes to a common set of processes shared across NCS by all engineering disciplines.
- As part of that transformation, regionally independent improvements activities were replaced with an NCS-wide organizational level improvement activity.

- This has enormous implications for the ‘org’ in Organizational Innovation and Deployment.

- This presentation will
  - present the components of the NCS organizational improvement infrastructure
  - discuss how the organization improvement transformation occurred
  - Include a summary of key lessons learned

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Raytheon

Customer Success Is Our Mission

Overview

Solution

Journey

Lessons Learned

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Network Centric Systems

Raytheon
Network Centric Systems

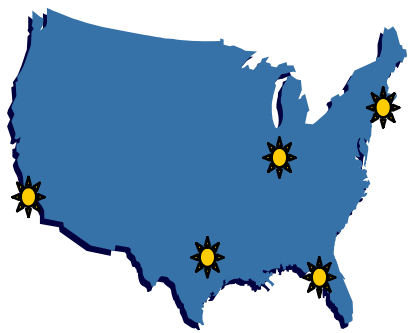
NCS develops and produces mission solutions for networking, command and control, situational awareness and air traffic management

Major programs include civilian applications, command and control systems, integrated communications systems and netted sensor systems as well as components to create these systems

President: Colin Schottlaender
Headquarters: McKinney, Texas

Five Primary Engineering Locations with 4000 Engineers:

- Marlborough, MA
- Ft Wayne, IN
- St. Petersburg, FL
- Mc Kinney, TX
- Fullerton, CA



CMMI Maturity Levels

- Starting point – Three level 5s, Two level 3s
- Goal – NCS-wide level 5 for SW, SE and HW

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Why Take on the Big Org Challenge

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Network Centric Systems

- General business direction to have one customer voice and to execute seamlessly across regions
- Invest $ where the overall impact is greatest
- Would enable CMMI L5 OID

- The big org has so many businesses, products, and customers – prioritization is hard
- Team building cross region and cross discipline is complicated
- Communication infrastructure demands are greater
- The big org doesn't have a personal face and a single authority below the executive level

- There was minimal sharing of improvements assets or improvement project results across sites.
- Redundancies existed – several sites doing improvements projects on similar topics.
- Limited resources were split across the sites.

Each business must do their own analysis of benefit.

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Raytheon

Customer Success Is Our Mission

Overview

Solution

Journey

Lessons Learned

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NCS Organization Improvement Process

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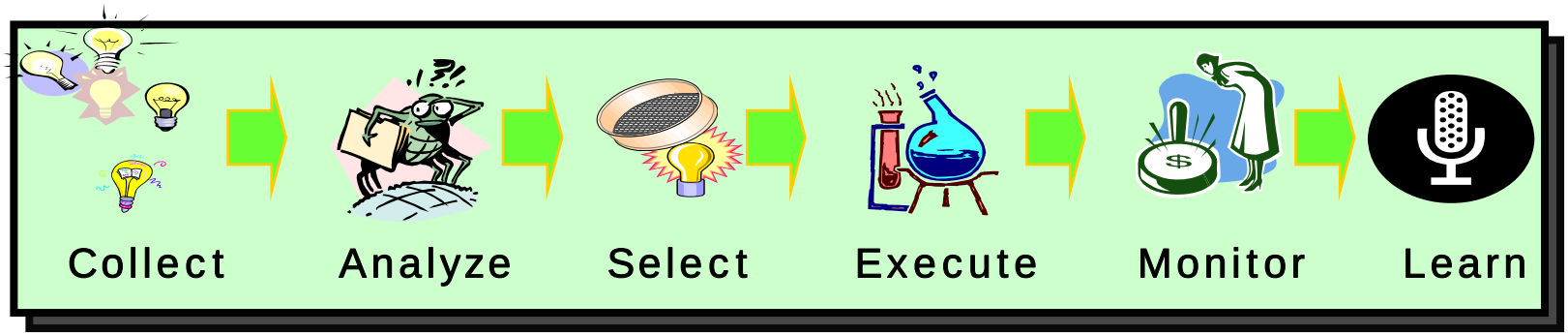

	Collect	Analyze	Select	Execute	Monitor	Learn
What	Proposal Advisory	Proposal Advisory	Project	Project	Project	Project
Stage	Submit Screen	Evaluate	Evaluate Rank	Execute	Execute Complete	All
Tool	IPPDB	IPPDB	IPPDB	IPPDB R6σ DB	iMetrics	Various
Who	All	Engineers OIC Council EPST	Council EPST NCS ETQ LT	Engineers	EPST Council Metrics Council	All
When	24x7	Monthly & Weekly	Annually & Quarterly	24x7	Monthly	24x7

Six Step Process that leverages R6σ and Existing Org Structure

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NCS Organization Improvement Process Guidance & Support

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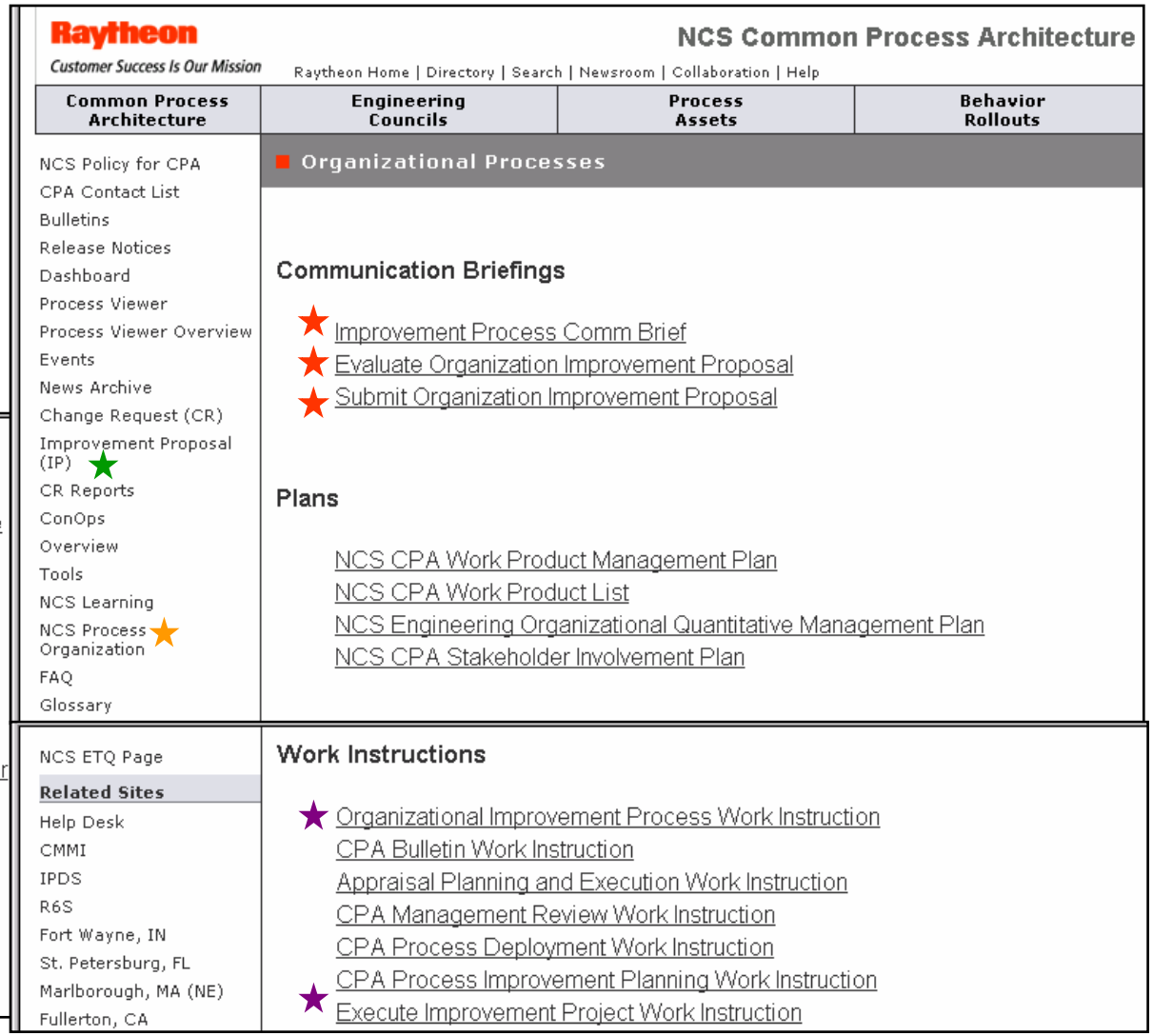
- Work Instructions
- Enablers
- Tools
- People
- Communication
- R6σ

Enablers

- CPA Bulletin Template
- CPA Process Senior Management Review Template
- ★ Improvement Project Plan and Report Template
- Organizational QM Plan Template
- iPlan Import Just-in-Time Training
- ★ Improvement Project Quad Chart Template
- ★ ETQ IP EVMS Enabler
- ★ ETQ Focus Area EVMS Consolidation Tool Enabler
- ★ ETQ Focus Area Status Report Enabler
- ★ ETQ IP Inchstones for Behavior Development Enabler
- ★ ETQ IP Inchstones for Pilot Project Enabler
- ★ ETQ IP Gate4 or Gate5 Enabler
- ★ ETQ IP Gate5 Checklist Enabler
- ★ ETQ Focus Area Project Status Report Enabler
- ★ ETQ IP ROI Tool Enabler
- ★ Pilot Plan and Results Report Enabler
- ★ Pilot Plan Checklist Enabler



IP Infrastructure includes direction, people, tooling and enablers.

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Work Instructions

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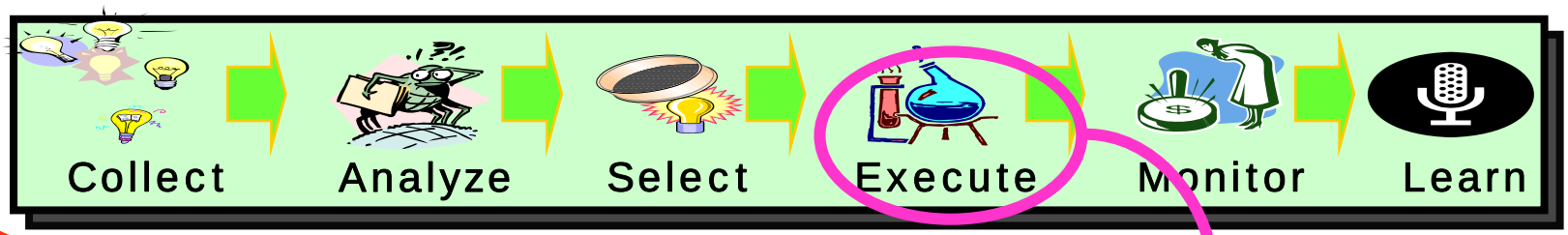

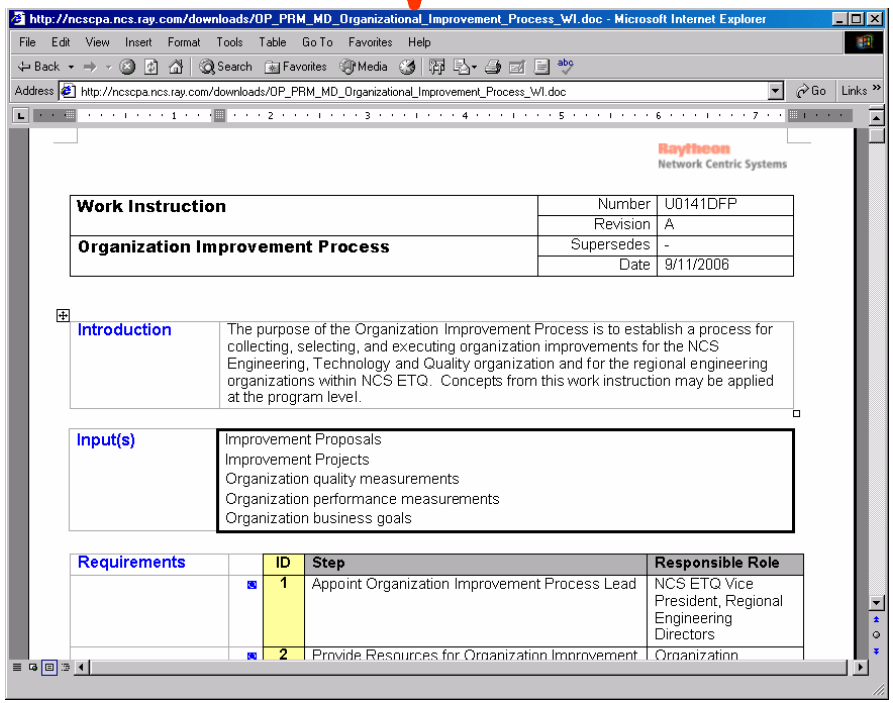

http://ncscpa.ncs.ray.com/downloads/OP_PRM_MD_Organizational_Improvement_Process_WI.doc - Microsoft Internet Explorer

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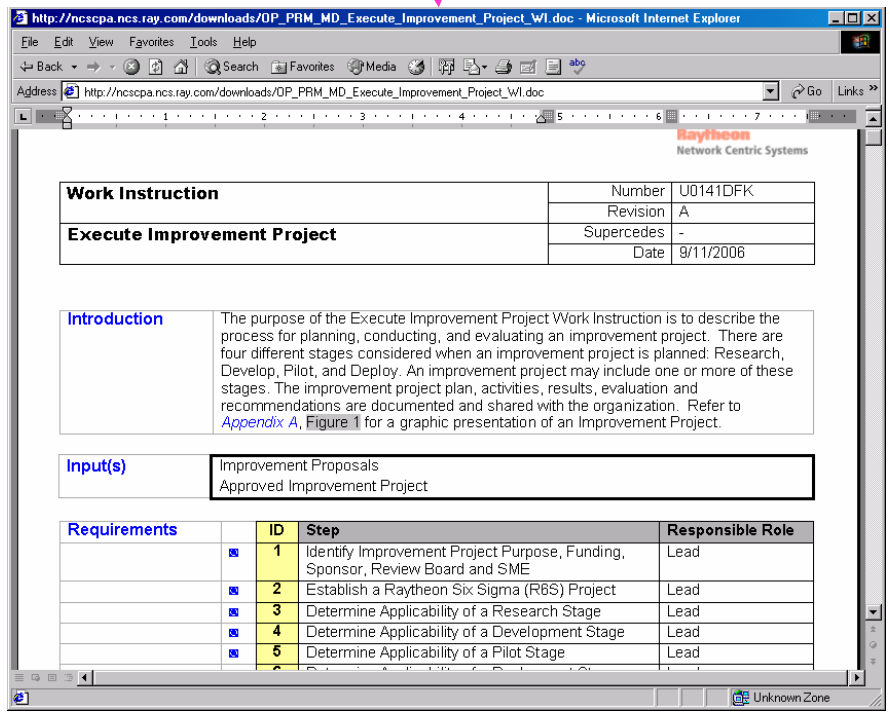
Work Instruction	Number	U0141DFP
	Revision	A
Organization Improvement Process	Supersedes	-
	Date	9/11/2006

Introduction	The purpose of the Organization Improvement Process is to establish a process for collecting, selecting, and executing organization improvements for the NCS Engineering, Technology and Quality organization and for the regional engineering organizations within NCS ETQ. Concepts from this work instruction may be applied at the program level.
Input(s)	Improvement Proposals Improvement Projects Organization quality measurements Organization performance measurements Organization business goals

Requirements	ID	Step	Responsible Role
	1	Appoint Organization Improvement Process Lead	NCS ETQ Vice President, Regional Engineering Directors
	2	Provide Resources for Organization Improvement	Organization



http://ncscpa.ncs.ray.com/downloads/OP_PRM_MD_Execute_Improvement_Project_WI.doc - Microsoft Internet Explorer

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Work Instruction	Number	U0141DFK
	Revision	A
Execute Improvement Project	Supercedes	-
	Date	9/11/2006

Introduction	The purpose of the Execute Improvement Project Work Instruction is to describe the process for planning, conducting, and evaluating an improvement project. There are four different stages considered when an improvement project is planned: Research, Develop, Pilot, and Deploy. An improvement project may include one or more of these stages. The improvement project plan, activities, results, evaluation and recommendations are documented and shared with the organization. Refer to *Appendix A*, Figure 1 for a graphic presentation of an Improvement Project.
Input(s)	Improvement Proposals Approved Improvement Project

Requirements	ID	Step	Responsible Role
	1	Identify Improvement Project Purpose, Funding, Sponsor, Review Board and SME	Lead
	2	Establish a Raytheon Six Sigma (R6S) Project	Lead
	3	Determine Applicability of a Research Stage	Lead
	4	Determine Applicability of a Development Stage	Lead
	5	Determine Applicability of a Pilot Stage	Lead

Unknown Zone

Organizational Improvement Process WI Describes the Process Steps

Execute Improvement Project WI focus is on a single project

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Tools (1 of 3)
Improvement Proposal and Project Database

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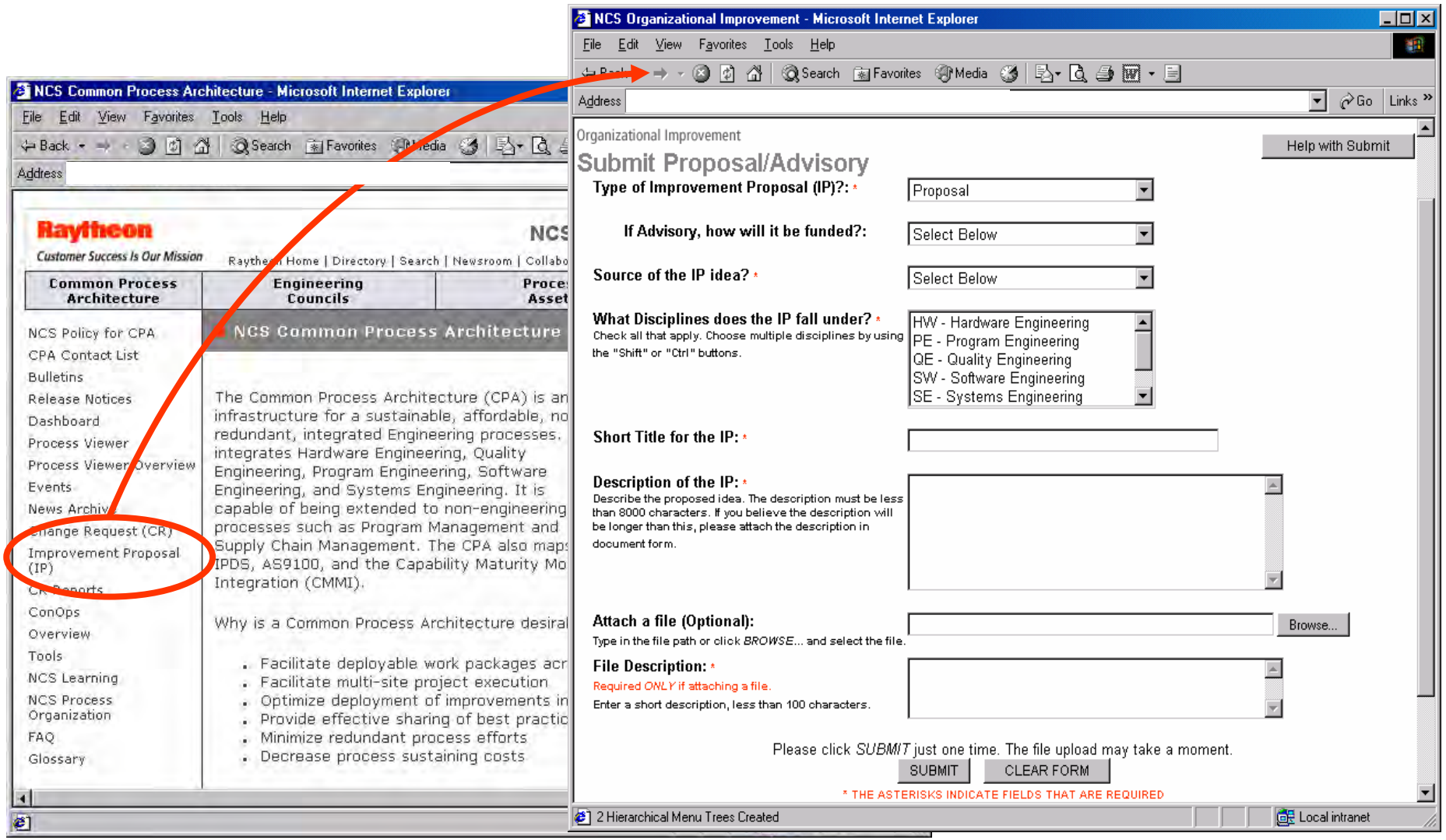

Link is easily Available

Proposal Submission Form is Simple

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Tools (2 of 3)
IPPDB MetaData Available to All

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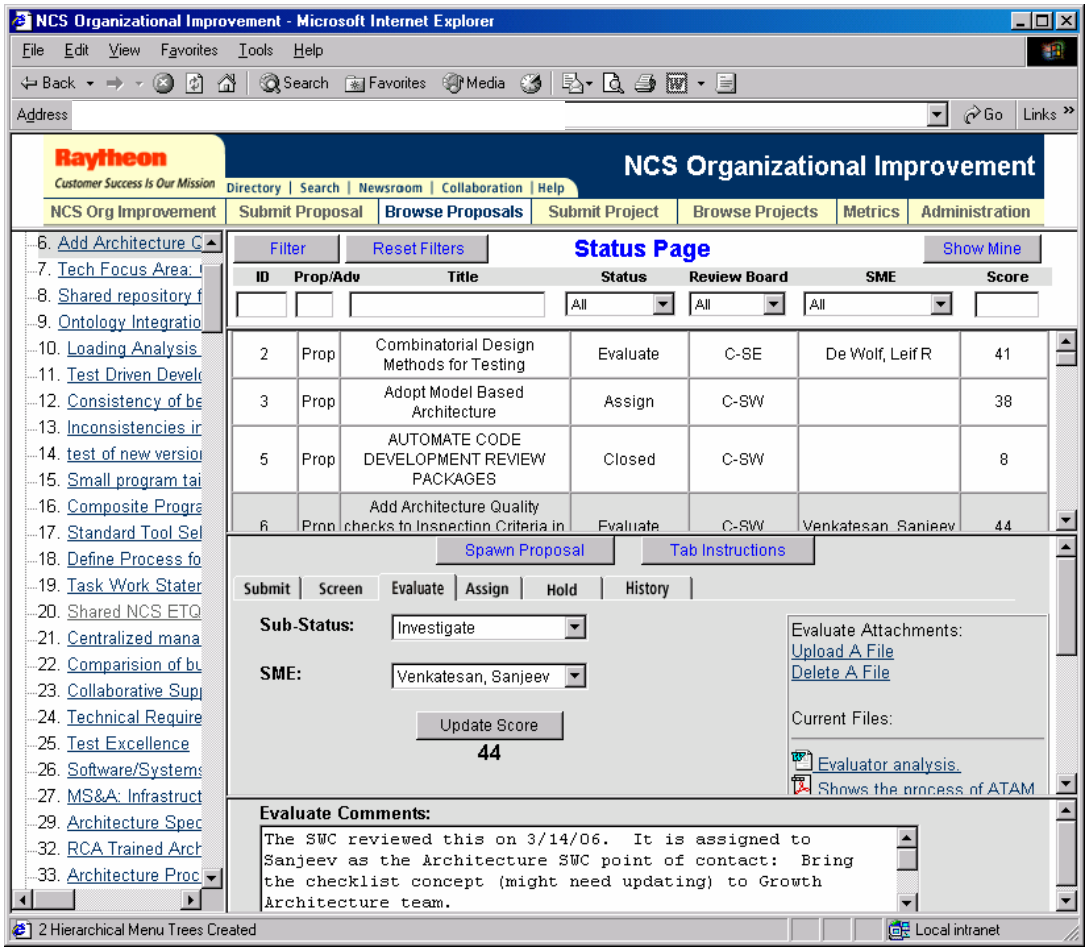

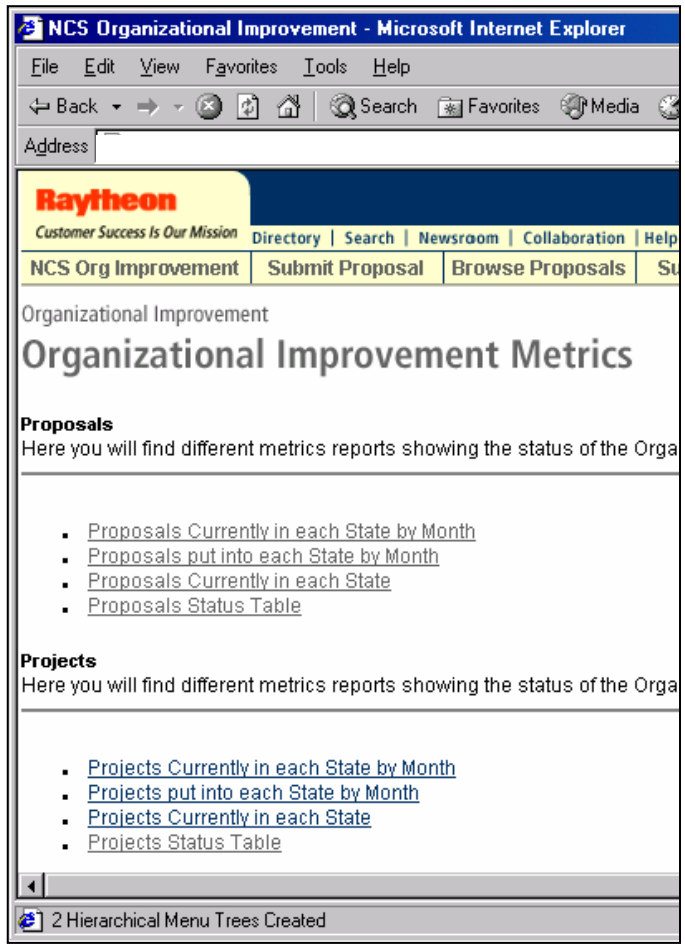

Proposal and Project Frames list all content, support filtering of summary information and allow access to detailed information about a proposal

Metrics to monitor process execution that also include an export to Microsoft Excel

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Tools (3 of 3)
R6σ – Raytheon Six Sigma

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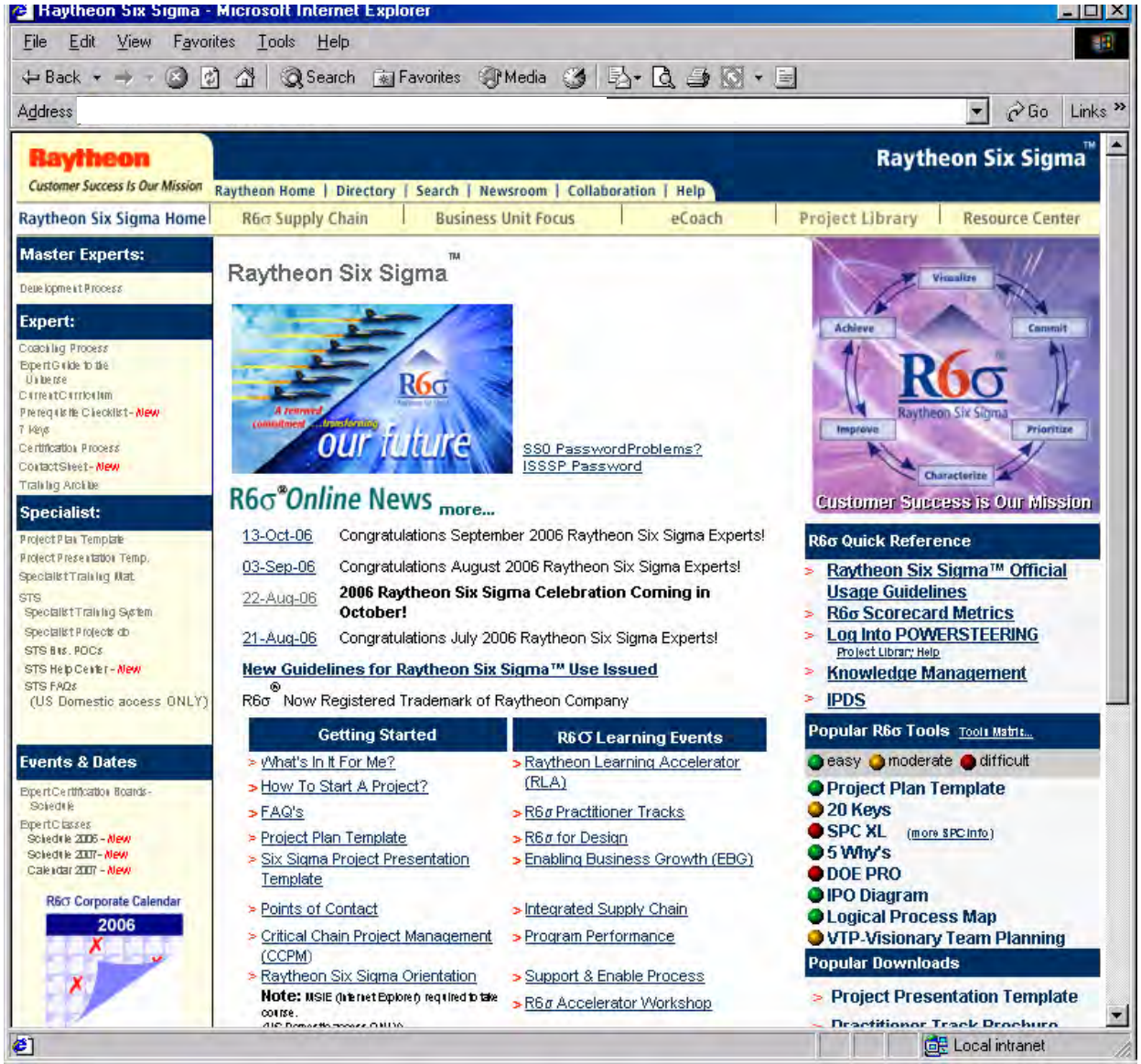
- R6σ is company culture – spans business units
- EVERYONE is trained and qualified as a specialist
- Raytheon Six Sigma is part of the DNA
- There is a robust set of tools and trained experts to facilitate their use



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Communication Briefings

- All have a common format
- They are targeted to be self led
- They are posted to the web site for easy down load on demand

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Common Process Architecture

Agenda

- What?
- Why?
- Who?
- Tools used
- Behaviors used
- Process
- Available Help
- Summary
- Expectations

Improve It!

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Common Process Architecture

Organization Improvement Process

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Common Process Architecture

Organization Feedback

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Common Process Architecture

How to Submit an Organization Improvement Proposal

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Common Process Architecture

How to Evaluate an Organization Improvement Proposal

It is impossible to over communicate

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People

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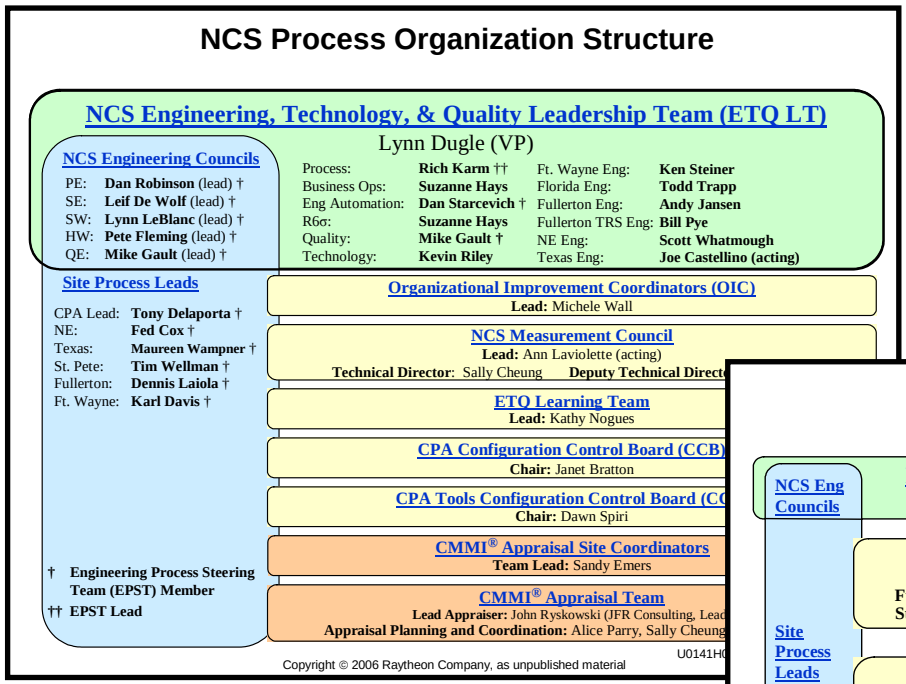
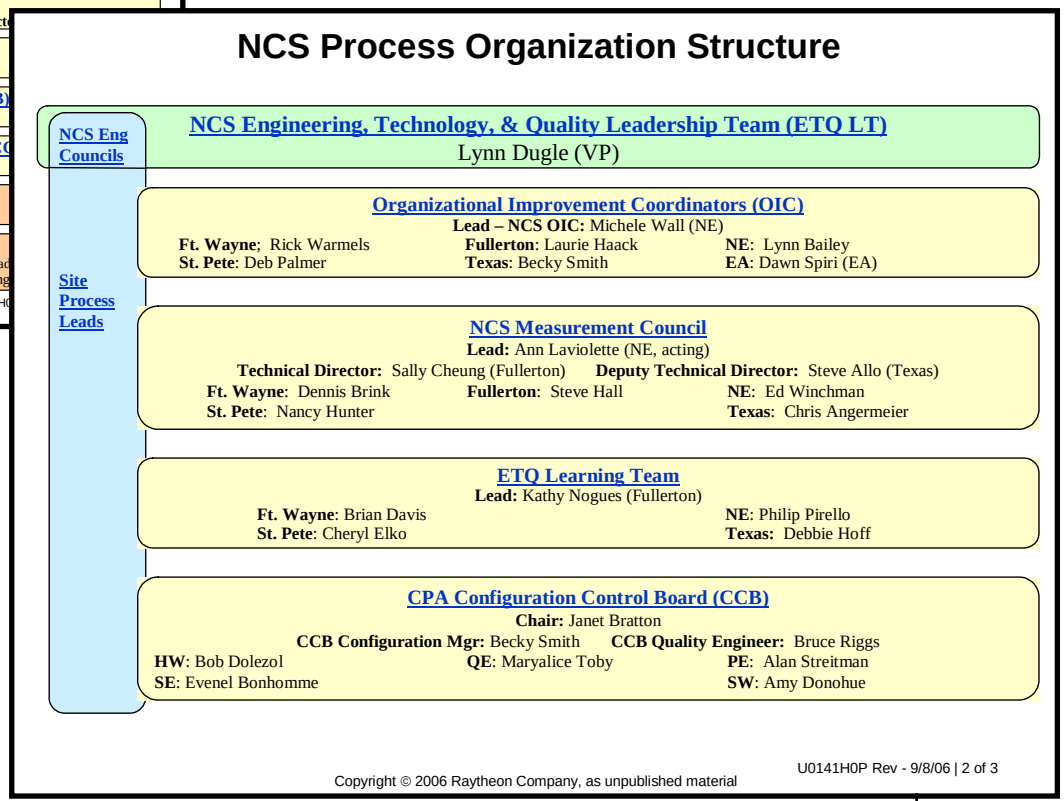


Every leader has organizational improvement responsibility. There is no separate improvement organization.



The OIC Role is the only improvement process addition.

- The OIC lead is a R6σ Expert.
- The OIC Team includes a representative from each major site. All OIC members review proposals.

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Org Improvement Annual Planning

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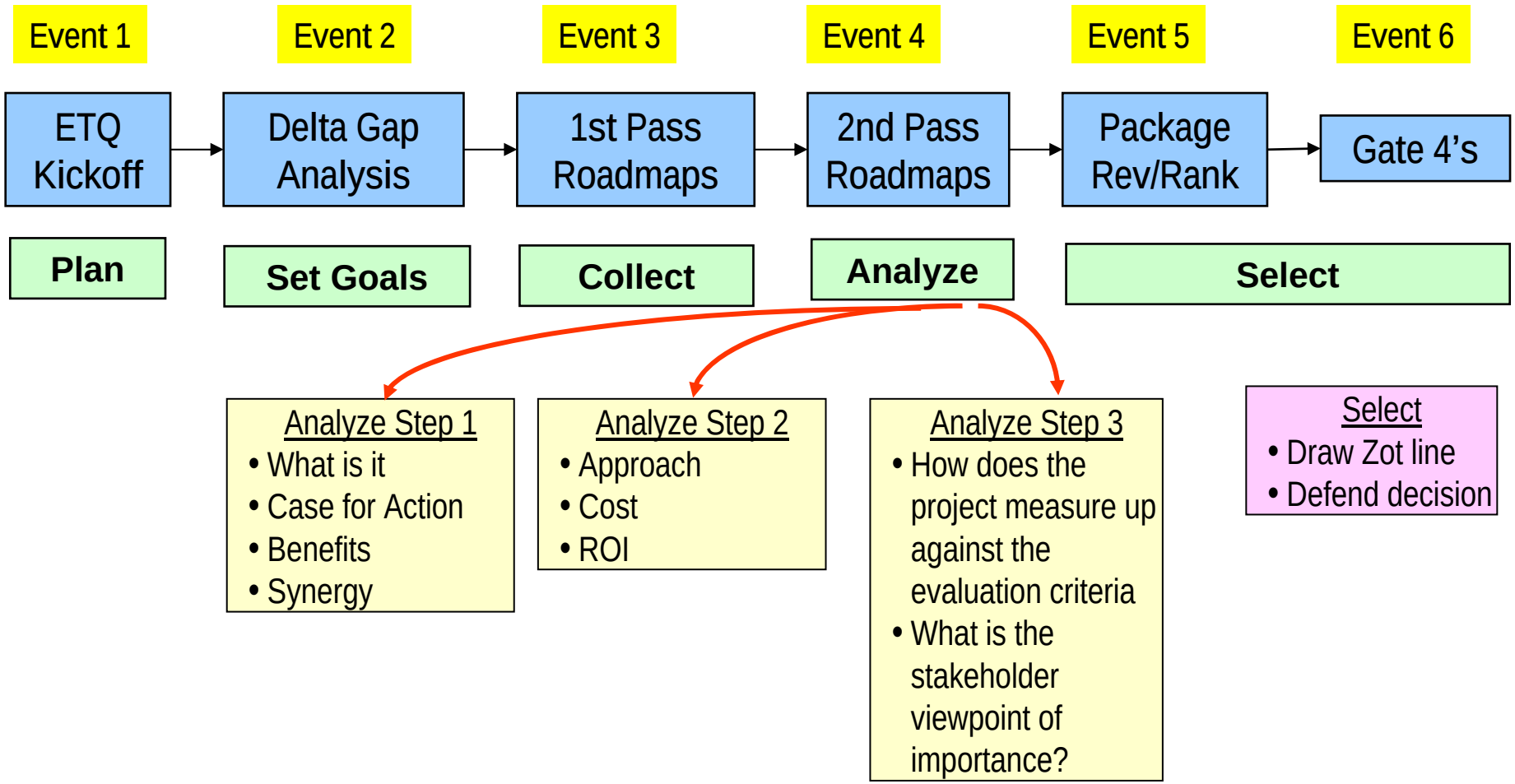

We have a strong Annual Planning Process

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Results to Date

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Notional project names

ID	TYPE	TITLE	STAGE	LEAD	Review Board	Rank	Focus Area	Eval Score
1	Appr	Adopt revolutionary development technology	Execute	Pochahantas	C-SW	4	Process	13
2	Appr	Streamline Supply Chain Interface						
3	Appr	Improve Requirements Handoff						
4	Appr	Improv Defect Containment						
5	Appr	prove Test						
6	Appr	se Customer isfaction						
8	App	w Method						

41 Executing Projects

- There are over 40 projects currently executing and over 200 proposals submitted.
- Data in the form of business, quality and process performance metrics trigger a variety of projects
  - Projects that address handshaking between functional organizations
  - Projects that target defect containment in key development stages
  - Projects that address insertion of technology and methods that require challenging paradigm shifts
  - Projects that are not gap closure - but opportunity grabbing

Projects are Executing in all disciplines and focus areas

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Raytheon

Customer Success Is Our Mission

Overview

Solution

Journey

Lessons Learned

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Where did we want to go?

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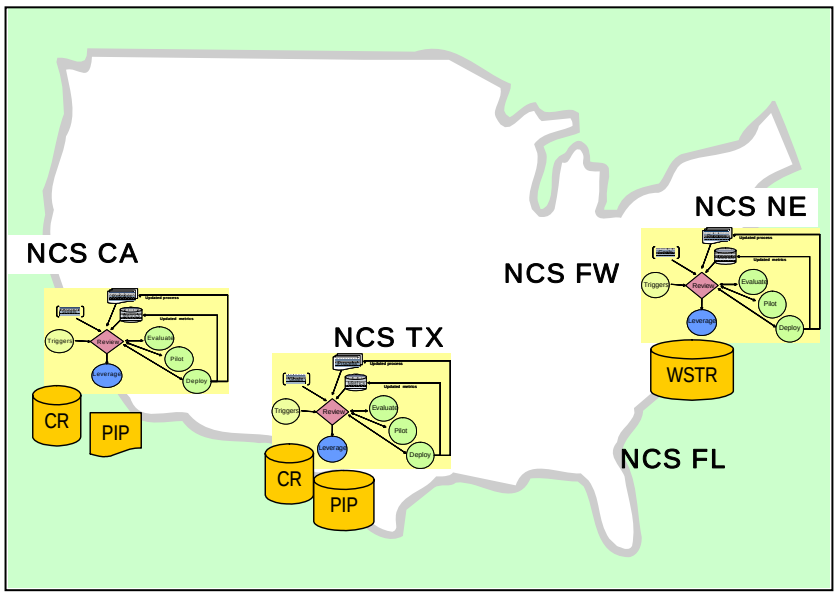
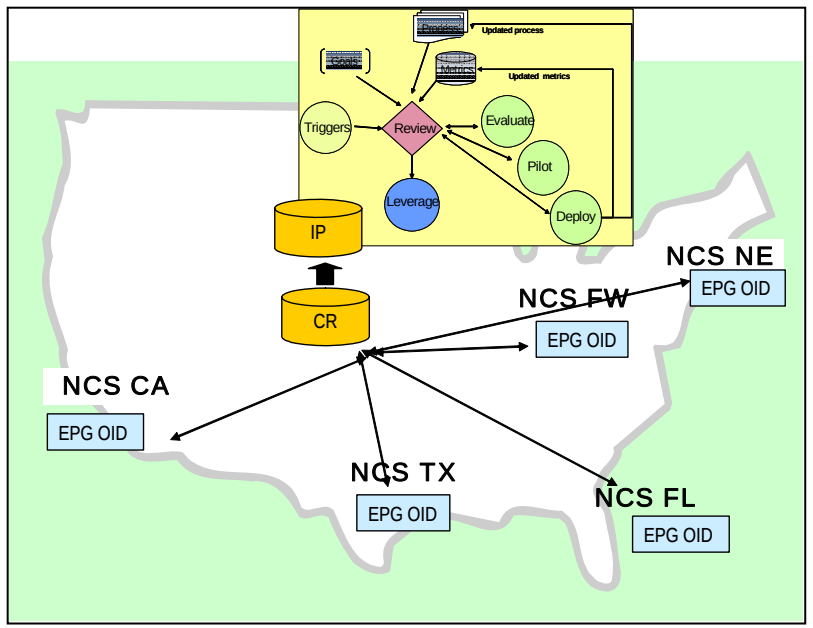
- Move from separate improvement processes across sites, various disciplines to integrated improvement
- To get improvements in engineering performance that are reflected in the business bottom line



Scope is local. Goals are local.
Process is local. Metrics are local.



Scope is NCS. Goals are NCS.
Process is NCS. Metrics are NCS.

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Challenges/Barriers
Hold on Sherlock…it's not so easy

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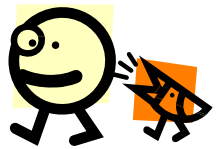
~4000 engineers, 5 sites, multiple time zones … and 5 disciplines at each site!!!

- What - no face to face – will never work
- That's not what we do and we're level 5

- SW,HW,SE,PE, program needs are different…functions versus programs



- I need you for this and I am here now…that IP lead isn't
- Improvements aren't urgent

- Who will be in charge – they can't know my needs
- Execs are not going to review my proposal
- Single point of decision at so high a level that details of improvements are difficult to assess

- It can't cost more
- The process, infrastructure and tools may not scale well

The challenge of the org
The challenge of the tools
The challenge of the process

This is a BHAG "Big Hairy Audacious Goal"

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The Journey

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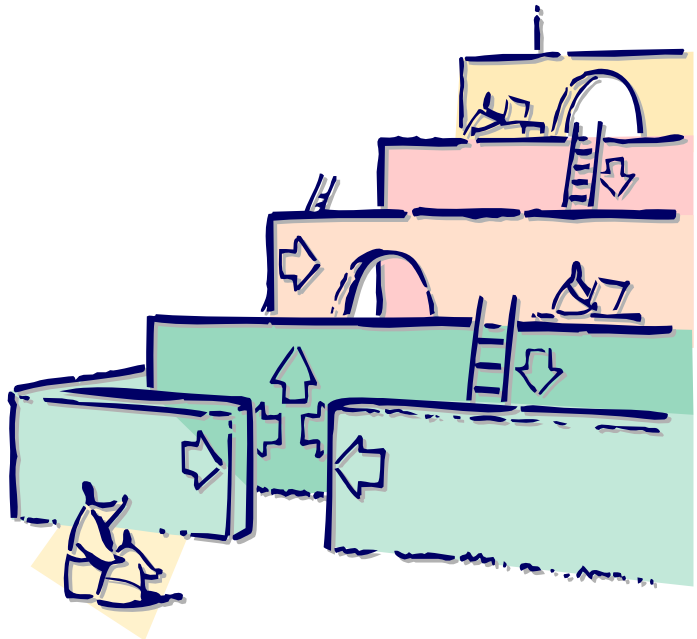
- Build a team and identify stakeholders
- **Align the team on a common vision**
- Ensure team commitment
- **Take stock of regional assets**
- **Take stock of company assets**
- **Identify common components and use a DAR type process to look at alternative solutions – address difficult questions first**
- Develop and Deliver a Concept Brief
- Iterate until concept is approved
- Develop artifacts
- Peer review artifacts with team
- Submit artifacts for stakeholder review
- Release
- DEPLOY



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Align the Team on a Common Vision

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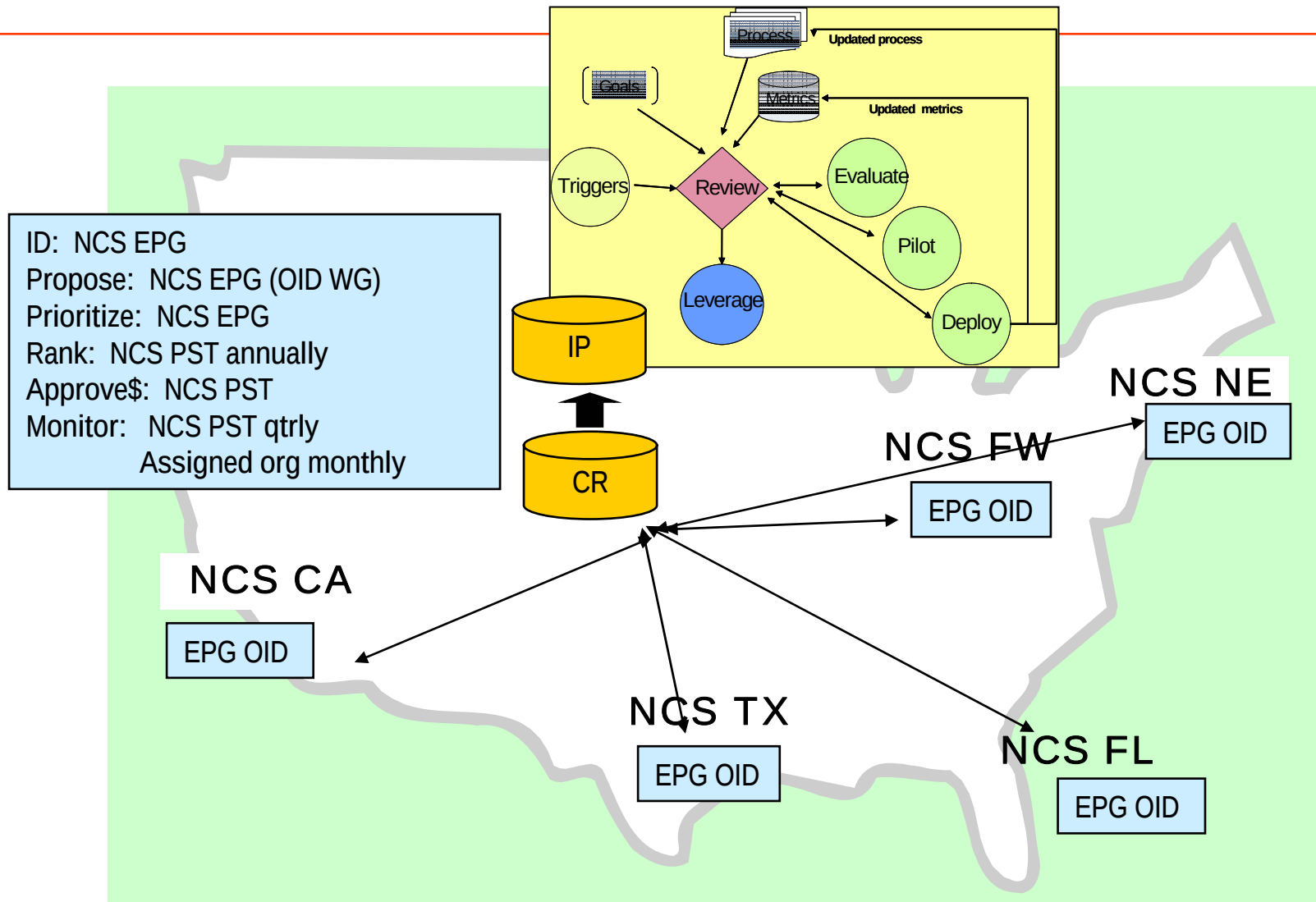

Scope is NCS. Goals are NCS. Gaps are NCS ETQ. Process is NCS. Metrics are NCS.

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Take Stock of Regional Assets

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- Solution Components
  - Work Instruction
  - Templates
  - Tools
  - Training
  - Review Boards
  - Approval Boards
  - Documentation

	SW						SE	HW	PM	QE
	Work Instructions	Templates	Tools	Review Boards	Approval Bodies	Training				
NE	-Blue Book -SEPG-020 -SEPG-002 -Roles/Resp	-R6S Template -Eval Template -Pilot Template -Deploy Template	-R6S Toolkit -Web Status -Web PAL -web submit -WSTR DB	-SEPG CCB -PTIC	-LT Steering Committee -Project Lead	not OID specific				
FU	-RFO 5-2 -Bulletin 5,13-15 -RFO 5-2-4 -RFO 5-2-5 -RFO 5-2-6 -RFO 5-2-7 -RFO 5-2-7-201 -RFO 5-2-8 -RFO 5-2-13 -RFO 5-2-4-103 -RFO 5-2-4-104 -RFO 5-2-4-105 -RFO 5-2-4-204	-Form 21832 -RFO 5-2-4-404	-R6S Toolkit -Website -Excel Log	-ECCB	-Appropriate leader -R6S ENG Baseline	-Piloting -Chng Mng -PI 101	same as SW			
TX	-SW Dir-000 -800P105 -800P020 -800P019	-Plan and Report Template	-R6S Toolkit -web status -web submit -PI DB	-OIB	-SEPG -SWEC LT -Tech Team	not OID specific				
FL										
IN										

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Analyze Regional Assets for Commonality and Potential Reuse

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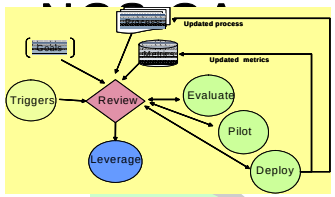
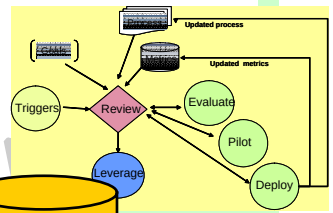
In common
Use EPG & LT & project Leads
Event driven new projects
Continual review of new idea
Ideas from anywhere
Continual monitoring of projects
Key person or WG for coordination

Differences
Annual strategic project planning
Tooling

NCS NE

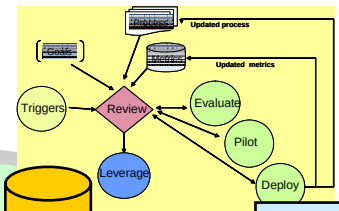


NCS FW



WSTR

NCS TX



CR PIP

CR PIP

NCS FL

ID: EPG CCB
Propose: EPG OID
Rank: Baseline Assessment
Approve$: LT + Technology
Monitor: EPG OID, LT

ID: SEPG OID Coordinator
Propose: Theme Lead
Rank: LT + Technology
Approve$: LT
Monitor: OIB

ID: SEPG CCB
Propose: PTIC
(Process Technology Insertion Committee)
Rank: PTIC constant
Approve$: SWEC LT
Monitor: PTIC + LT

Sites all had mechanisms to submit ideas, approval boards, and coordination POC. Differed in tooling and selection cycles.

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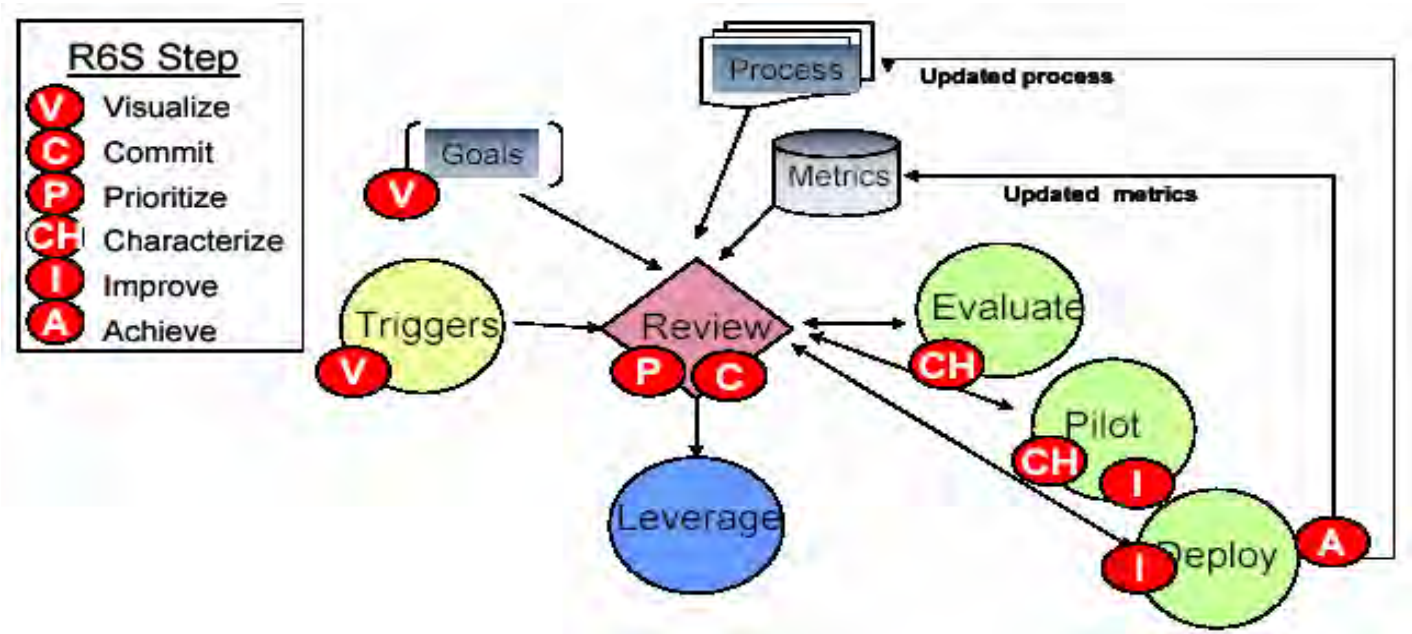
Take Stock of Company Assets

- FU, TX and NE all leverage Raytheon Six Sigma which include basic steps below
- Leveraging happens within site organization and cross sites through papers or symposiums – but after the Evaluate, Pilot and Deploy steps
- R6σ provided a common look at feel to separate regional processes



Everybody utilizes R6σ – TREMENDOUS lever and common communication vehicle

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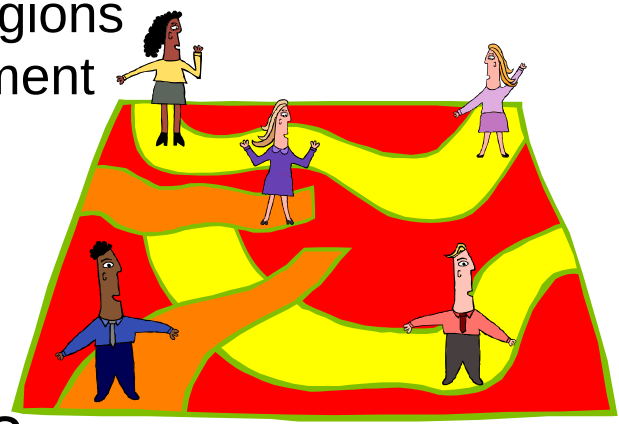
Which way to go?

- Lift, Modify or New Improvement Approach?
  - Should one of the regional approach's be adopted, is a blended approach needed, or a new concept entirely?
- "Distributed" versus "centralized" organization improvement?
  - Distributed - Regional level improvement activities with added communication mechanism between regions
  - Centralized - NCS-level organization improvement activities
  - Hybrid of both?
  - Discipline based? (HW, SW, SE, etc.)
  - Focus area or theme based?
- Who should be part of the organization improvement decision making/leadership?
  - EPG
  - Regional or NCS level Improvement Boards
  - Engineering Leadership



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Formulate alternatives and analyze them

- How to decide?
  - Used decision analysis techniques and considered:
    - ROI
    - Natural organization structures
    - Alignment with organization goals
    - Cost effective

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Option 1 – Regional Improvement Boards

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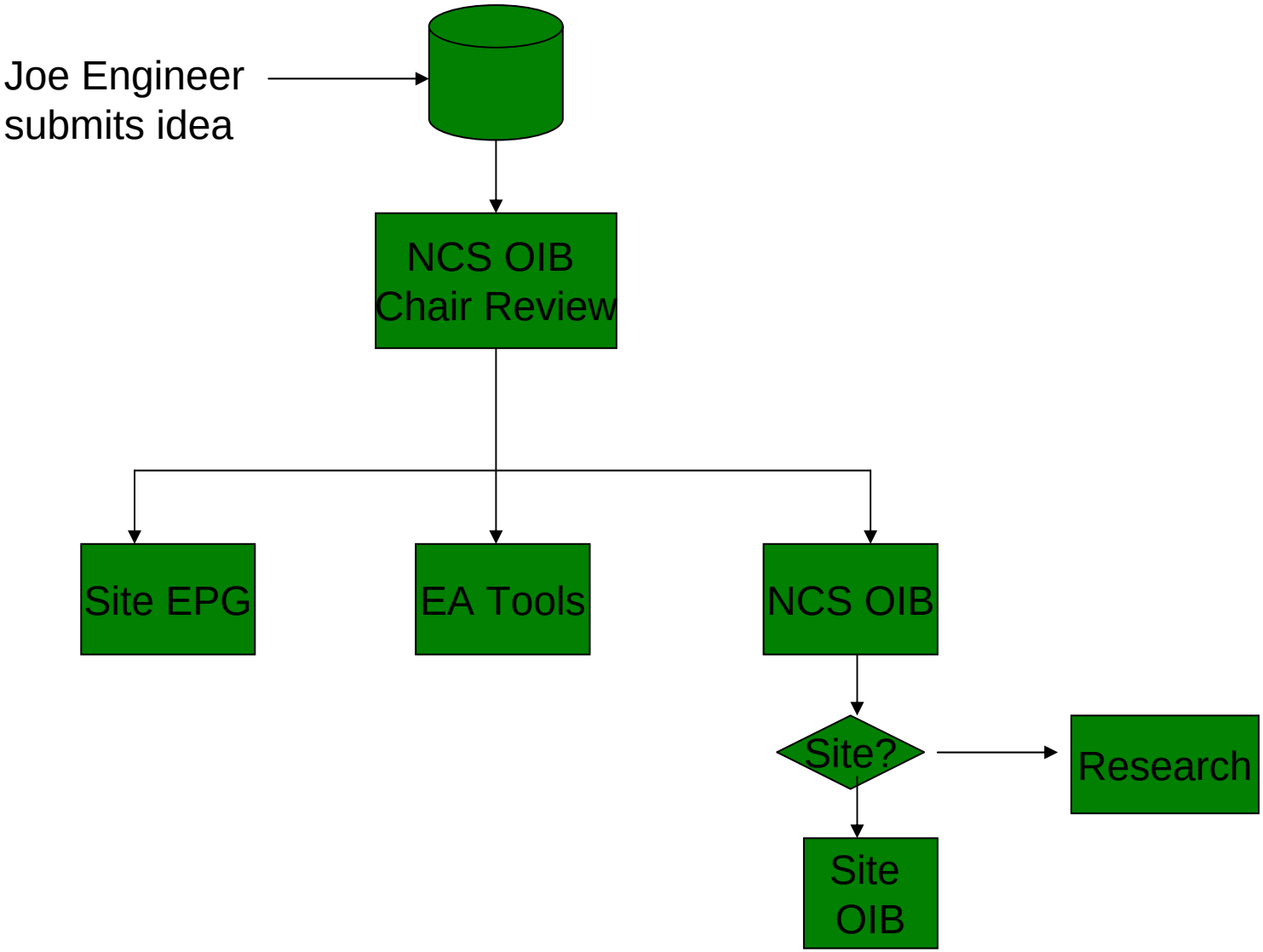

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Option 2 – Discipline Improvement Boards

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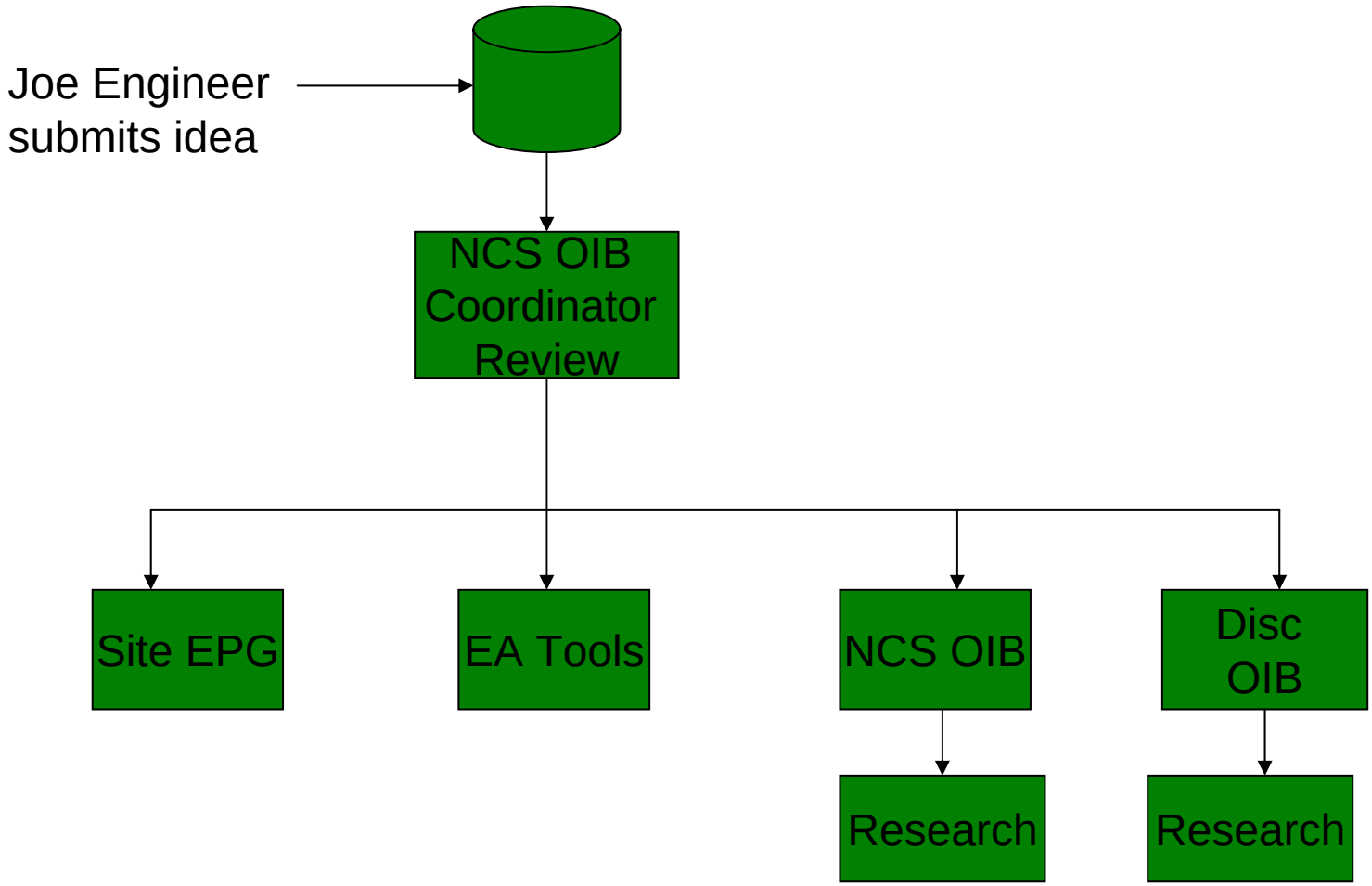

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Option 3 – Theme Improvement Boards

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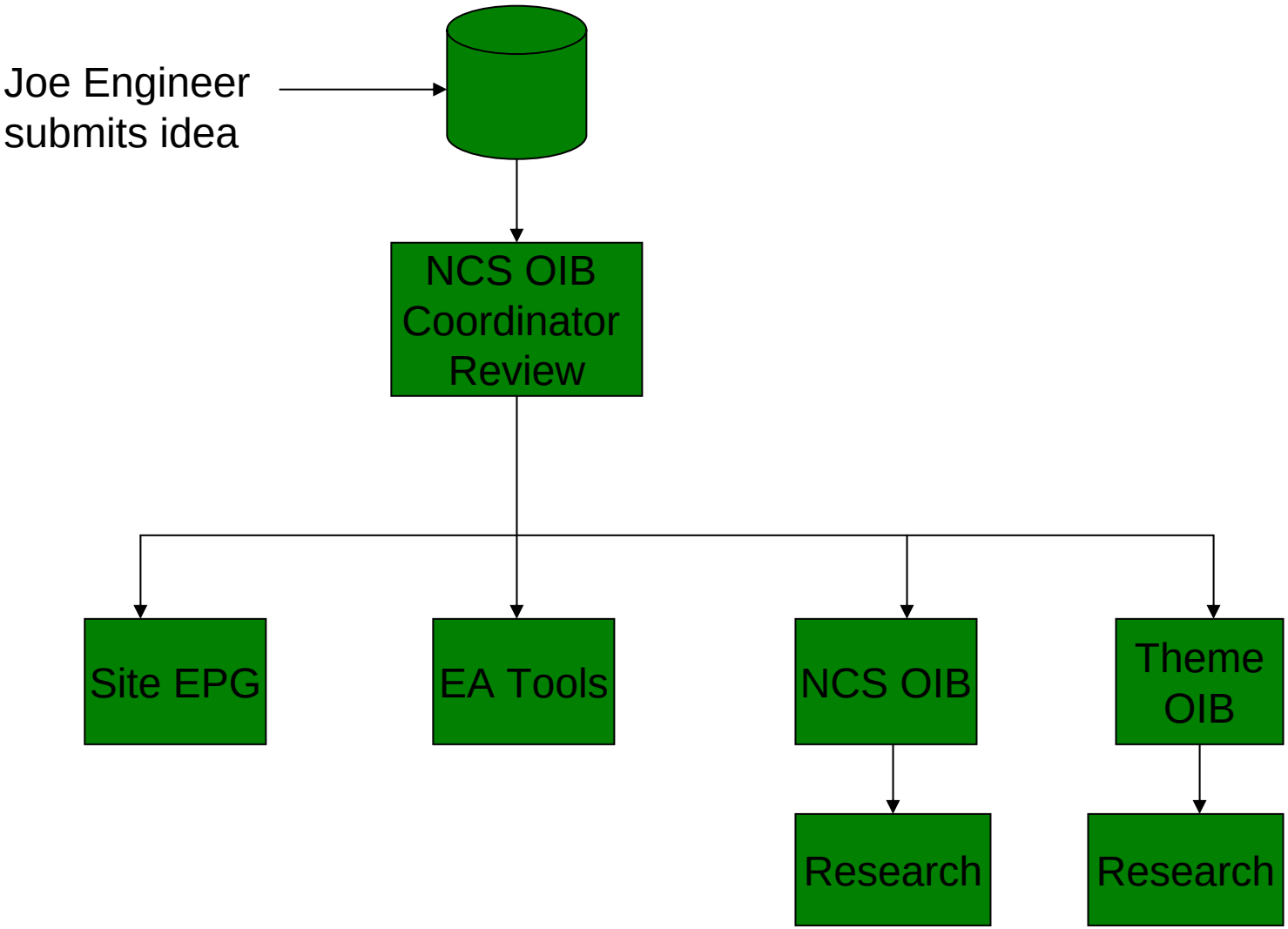

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Identify the Stakeholders

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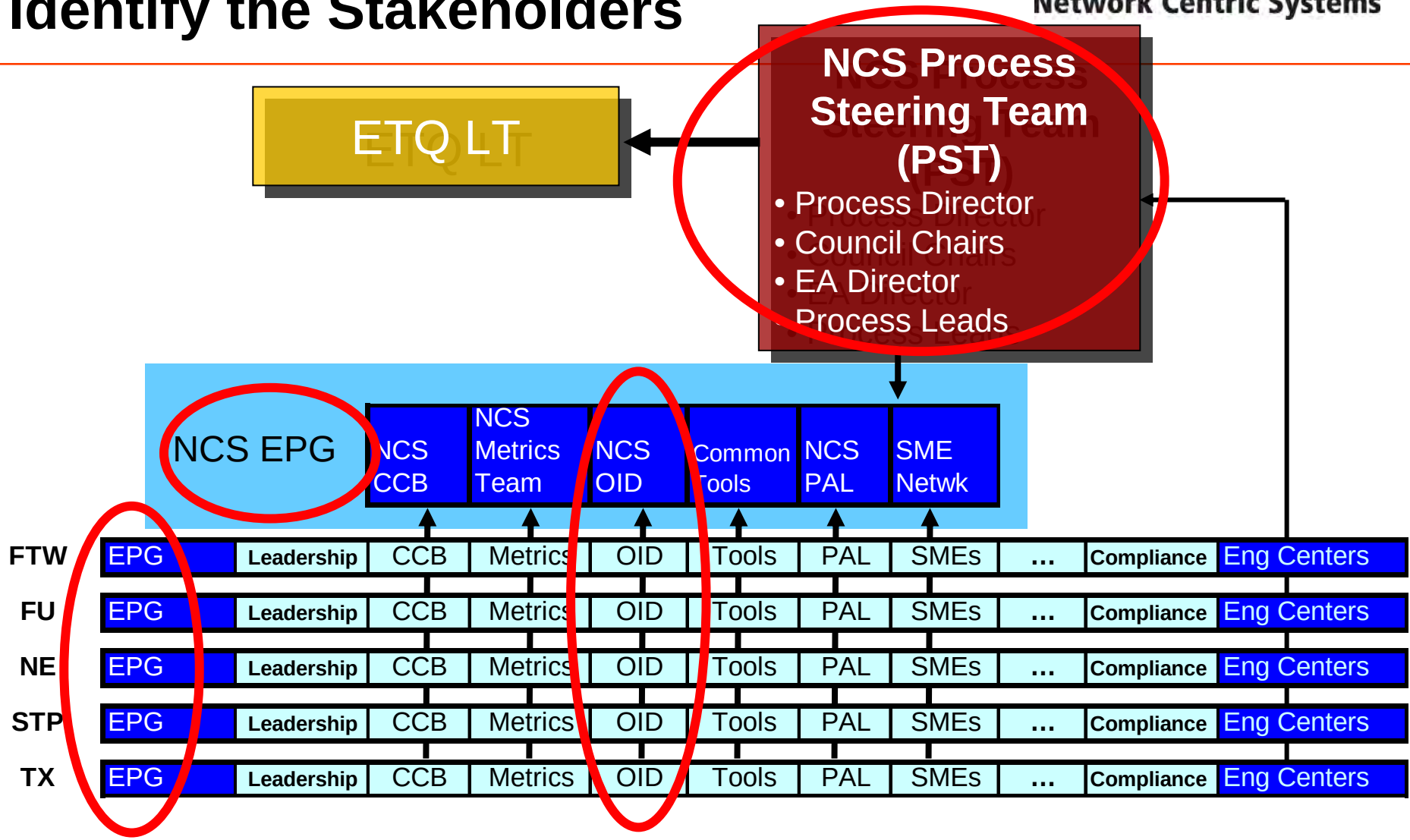

Use existing organizations

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Paradigm Shift

- Move improvement activities out of the jurisdiction of the regional EPGs and into the jurisdiction of the organization leadership.
  - Better alignment with org level objectives
  - Stronger sponsorship
  - Less redundancy
  - Better communication across regions
  - Better ROI

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Raytheon

Customer Success Is Our Mission

Overview

Solution

Journey

Lessons Learned

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Lessons Learned

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- Use the CMMI as a common language to facilitate understanding one another's solutions
- Use OID concepts to create and deploy org improvement
- The metrics are key – at the beginning, in the middle and at the end.
- Build on what you have
  - Wherever annual planning goes on – and everybody has annual planning, - that is collecting and selecting improvements
  - Improvements need sponsorship so make it the responsibility of leadership to review and select projects. It's where the money and resources are.
- You need a collection tool and it might as well be a communication tool too. It should be public.
- Cannot talk about OID as just the project collection, selection and execution piece, it is the loop between 4 and 5 that is key and all those processes work together.
- Get some things straight right away: Will every project that improves anything be part of this – what is the scope of an improvement? What is the relationship to CAR? What is the relationship to Technology?
- There is significant impact to appraisal preparation

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Words from our leader….

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"Our approach to process commonality is already reducing the process maintenance and appraisal costs, and we have invested those savings in new engineering capabilities and growth opportunities. Consistent processes and better tooling/ automation enable us to respond faster with lower costs, increasing our competitive edge."

Lynn Dugle, Vice President of Engineering, Technology and Quality, NCS Fullerton

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Q & A

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Acronyms

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Acronym	Definition
CPA	Common Process Architecture
DAR	Decision Analysis and Resolution
EA	Engineering Automation
EPG	Engineering Process Group
EPST	Engineering Process Steering Team
ETQ	Engineering Technology and Quality
FW	Fort Wayne, Indiana
HW	Hardware
IPPDB	Improvement Proposal/Project Database
LT	Leadership Team
MSI	Mission Systems Integration
NCS	Network Centric Systems
NE	North East
OIB	Organization Improvement Board
OIC	Organization Improvement Coordinator
OID	Organizational Innovation and Deployment
PST	Process Steering Team
R6s	Raytheon Six Sigma
ROI	Return on Investment
SE	Systems Engineering
STP	St. Petersburg, Florida
SW	Software
WG	Working Group
WI	Work Instruction

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References

1. Chrissis, Mary Beth, Konrad, Mike and Shrum, Sandy. “CMMI-Guidelines for Process Integration and Product Improvement” Addision-Wesley, 2003

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DEFINING THE FUTURE

Making OID Effective

CMMI Technology Conference and User Group
November 13 - 16, 2006
Abstract #3825

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Northrop Grumman Corporation

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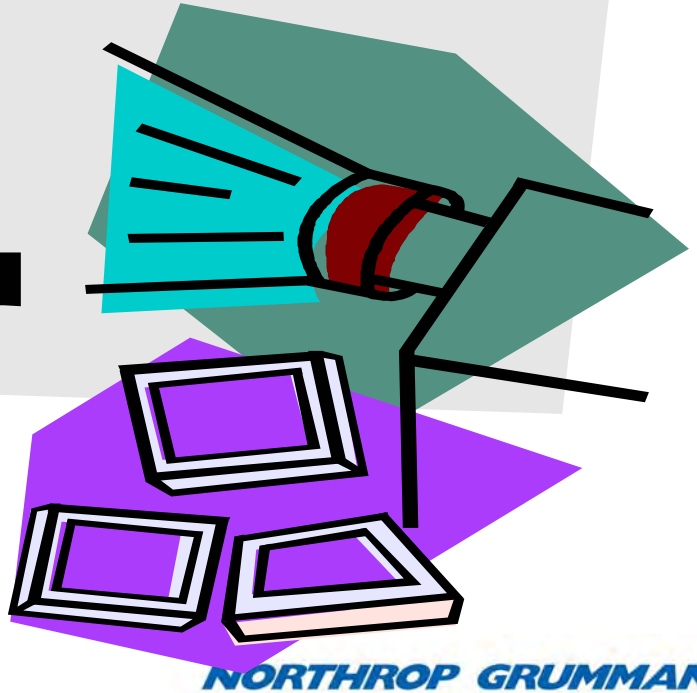
Agenda

- What is “Effective”
- Where We Struggled
- What Had to Change
- Measures of Change



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Northrop Grumman Mission Systems

- **Mission Systems Sector has 23,000 employees in 9 divisions**
- **Received first CMMI Level 5 SCAMPI A rating in April 2003**
- **By the end of 2006:**
  - **25 externally-led CMMI Level 5 SCAMPI As**
  - **99 projects through CMMI Level 5 SCAMPI As**
  - **Hundreds of CMMI Level 5 SCAMPI Bs and Cs**

Joint National Integration Center

Intercontinental Ballistic Missile Program

Satellite Command & Control

Level 5 is great, but… now the real journey begins!

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How Can We Better Institutionalize OID Behavior?

SCAMPI As

OID Practice	2003						2004						2005							
	04/17/03	05/01/03	10/02/03	10/29/03	11/14/03	12/11/03	10/08/04	11/11/04	11/12/04	12/03/04	12/10/04	12/10/04	02/24/05	05/20/05	06/09/05	10/13/05	11/04/05	11/09/05	11/14/05	12/14/05
SP 1.1 Collect Proposals	FI	FI	FI	FI	FI	FI	FI	LI	FI	FI	FI	LI	FI	FI	FI	FI	FI	LI	FI	FI
SP 1.2 Identify Innovation	FI	FI	FI	FI	FI	LI	FI	LI	FI	FI	FI	LI	FI	FI	FI	FI	FI	FI	FI	FI
SP 1.3 Pilot	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
SP 1.4 Select for Deployment	FI	FI	FI	FI	FI	FI	FI	FI	FI	LI	LI	LI	FI	FI	FI	FI	FI	FI	FI	FI
SP 2.1 Plan Deployment	FI	FI	FI	FI	FI	FI	FI	FI	LI	LI	LI	LI	FI	FI	FI	FI	FI	LI	FI	FI
SP 2.2 Manage Deployment	FI	FI	FI	FI	FI	FI	FI	FI	LI	FI	FI	LI	FI	FI	FI	FI	FI	LI	FI	FI
SP 2.3 Measure Effects	FI	FI	FI	FI	FI	FI	FI	FI	LI	LI	LI	LI	FI	LI	FI	FI	FI	LI	FI	FI
GP 2.1 Policy	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
GP 2.2 Planning	FI	FI	FI	FI	FI	FI	FI	LI	FI	FI	FI	LI	FI	LI	FI	FI	FI	LI	FI	FI
GP 2.3 Resources	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	LI	LI	LI	FI	FI	FI	LI	FI	FI
GP 2.4 Responsibility	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
GP 2.5 Training	FI	FI	FI	FI	FI	FI	FI	LI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
GP 2.6 Configurations	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
GP 2.7 Stakeholders	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
GP 2.8 Monitor and Control	FI	FI	FI	FI	FI	FI	FI	FI	LI	FI	FI	LI	FI	FI	FI	FI	FI	LI	LI	FI
GP 2.9 Evaluate Adherence	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
GP 2.10 Higher Level Mgmt	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	LI	FI	FI
GP [illegible] cess	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI	FI
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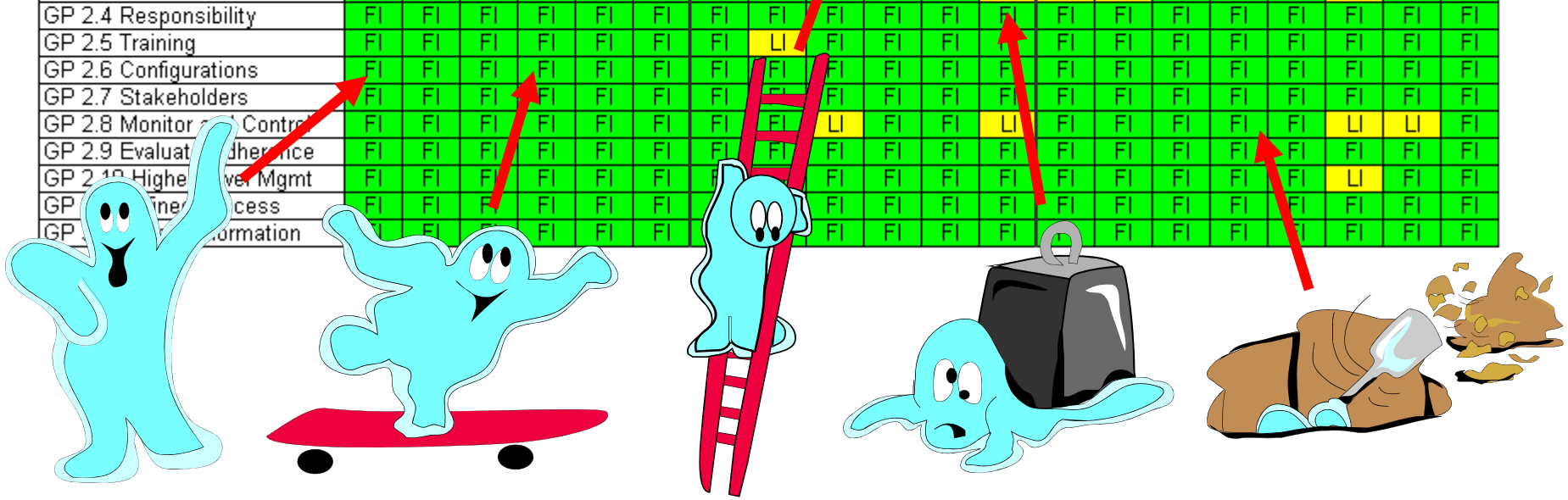

Elation **Skating** **Backsliding** **BOOM** **Recovery**

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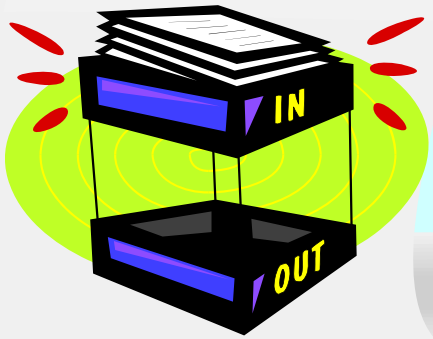
How Do We Know OID Isn't Institutionalized? It Doesn't Feel Right

1. SCAMPI A means it's time to worry, and it shouldn't

2. Not many improvements are submitted each year, which is only "ok"



3. Not many projects are finished each year, which is again, only "ok"

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What Did We Do?

- Overhauled the OID process
- In February 2006, completed an OID project called: "OID Revamp, i.e., **OID of OID**"

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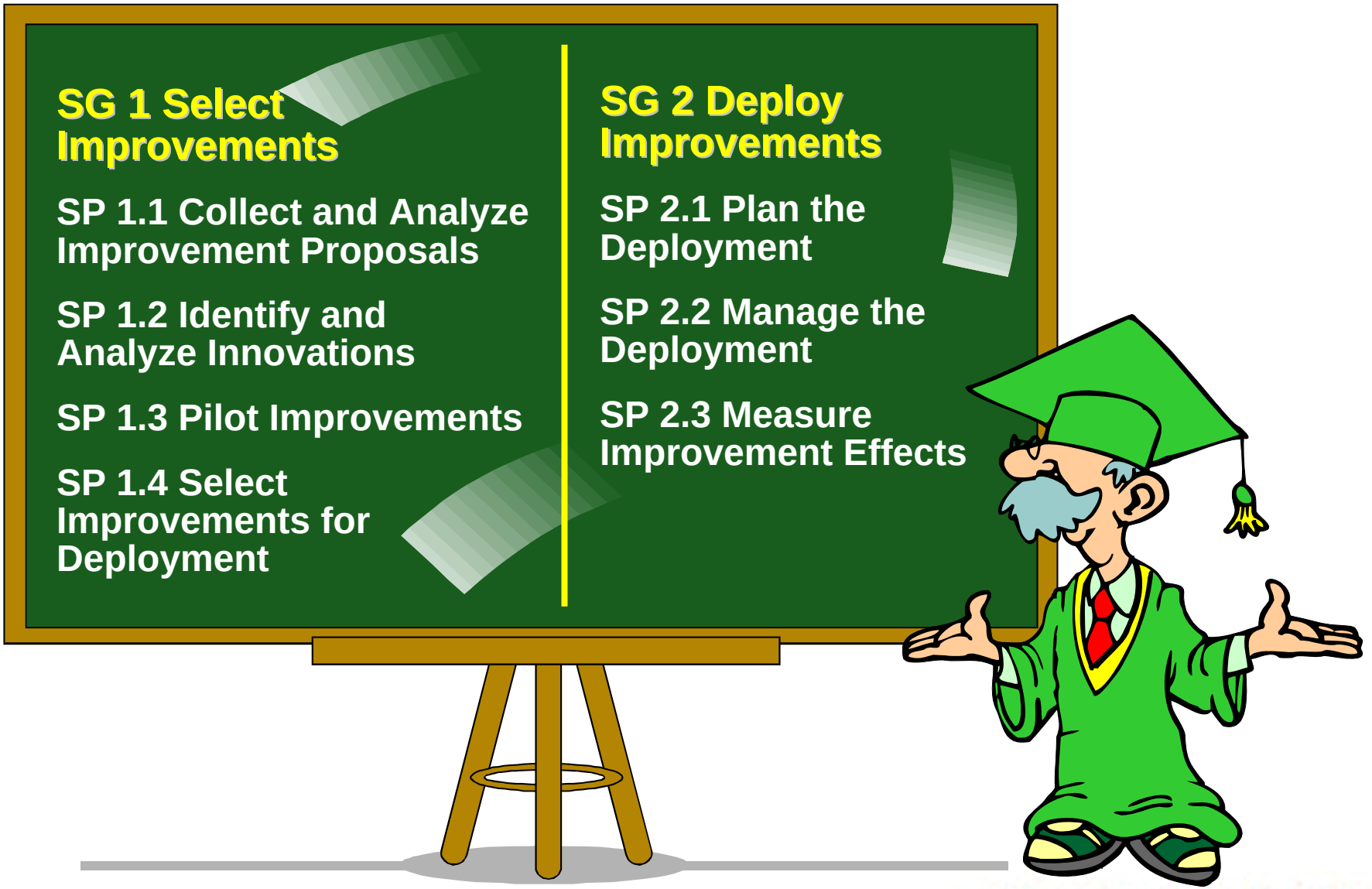
OID Refresher



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Level 3 OPF versus Level 5 OID

OPF

- Goals are qualitative (e.g., get better)
- Effects of improvements are not estimated or measured

OID

- Goals are quantitative (e.g., reduce variation by X% and/or mean by Y%)
- Improvements cause a shift in process capability, i.e., performance and/or quality
- Potential improvements are analyzed to estimate costs and benefits
- Improvements are piloted to ensure success
- Improvements are measured in terms of variation and/or mean

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Number of OID Projects is Only “Ok”

IN = 5

OUT = 4

2003

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

e.g., Project Plan Templates

IN = 3

OUT = 2

2004

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

e.g., Tests for Training Courses

IN = 6

OUT = 3

2005

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

e.g., Electronic Evidence Tool

The number of OID projects submitted (IN) and completed (OUT) pass CMMI Level 5, but we weren’t satisfied.

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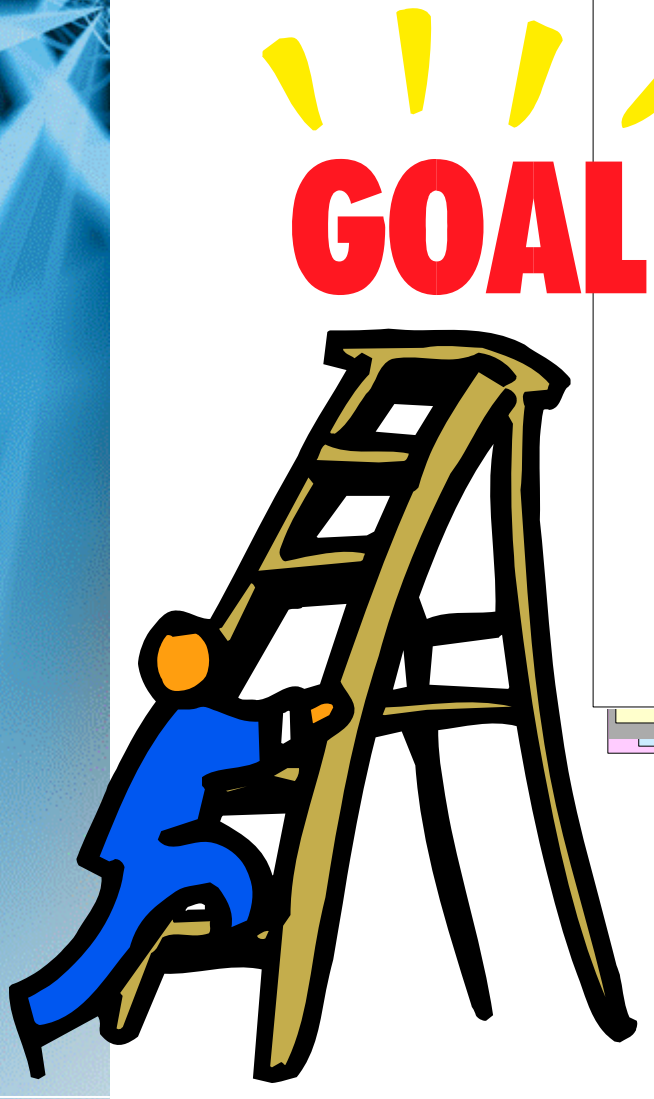
Actual Goal of the "OID of OID" Project



The previous OID process was not effective and resulted in very few completed improvements per year. To be effective, approximately **5 to 10 improvements should be completed per year**. The measure of improvement will be the number of suggestions provided per year and the number of improvements completed per year.

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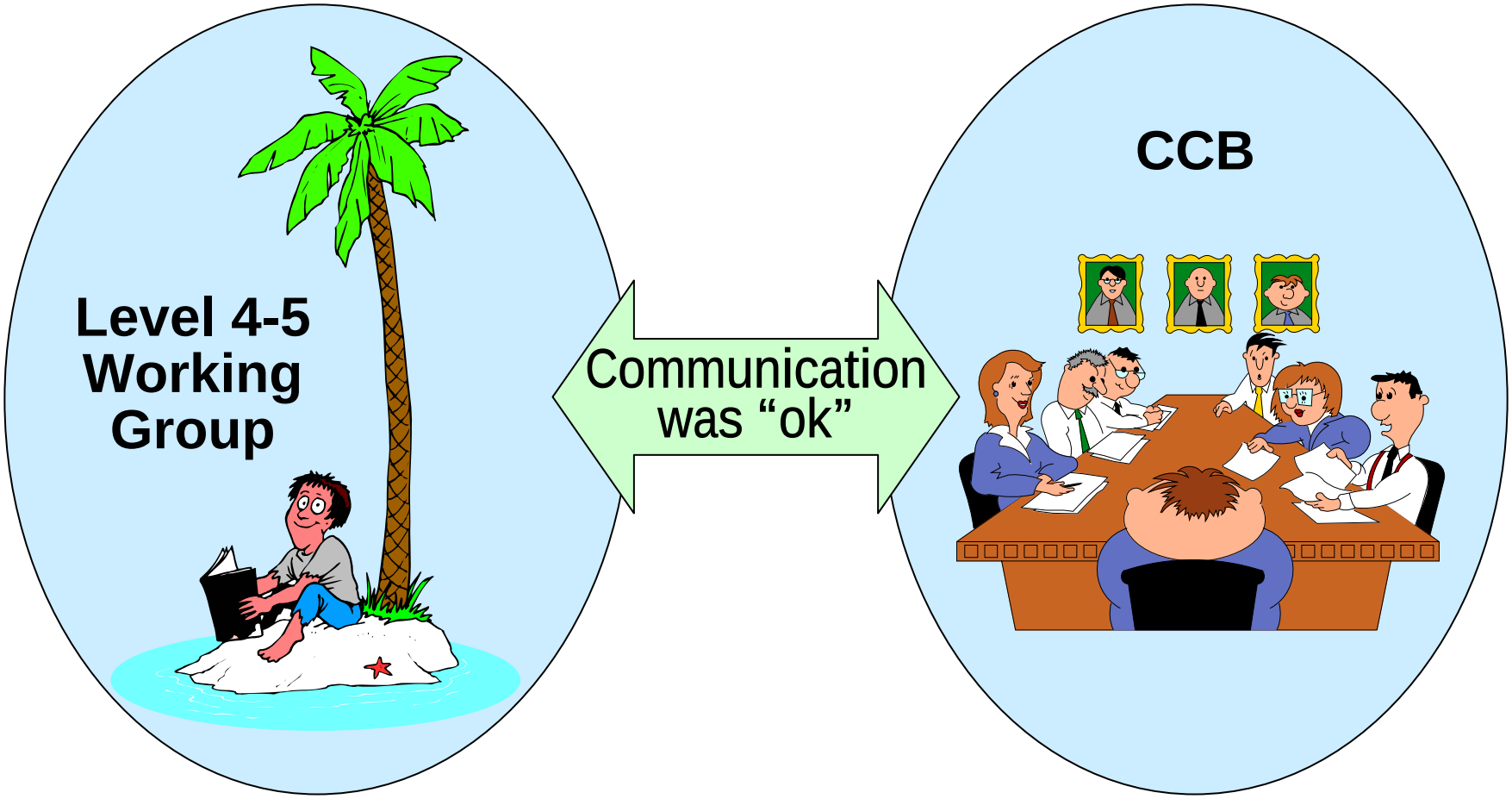
Change 1:
Changed the Organizational Structure



Ensure OID is managed at the right level of visibility and authority. It’s easy to have too many working groups.

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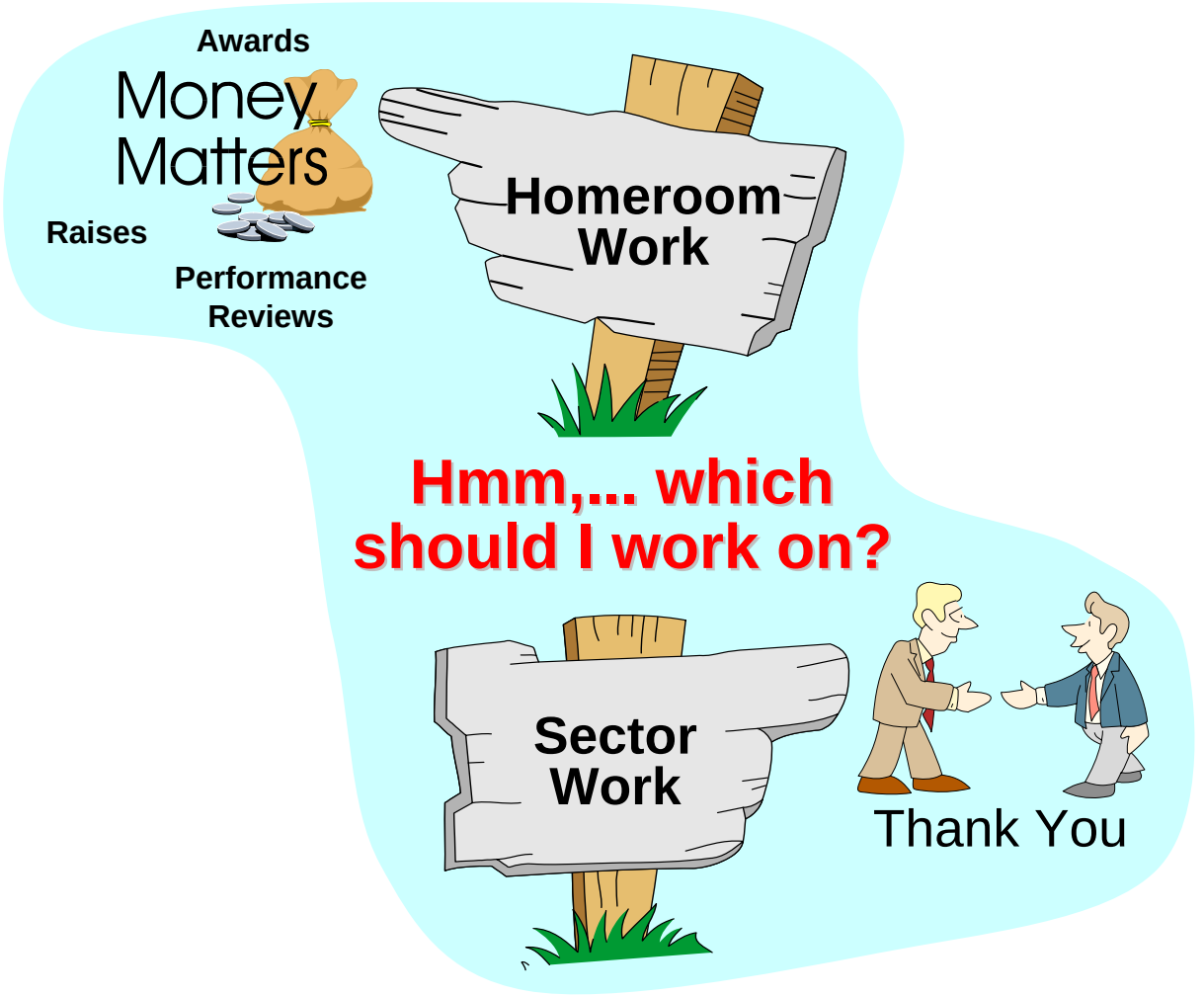
Change 2:
Assigned Clear Responsibility



Ensure the OID Lead does not have competing priorities, where the homeroom organization frequently wins.

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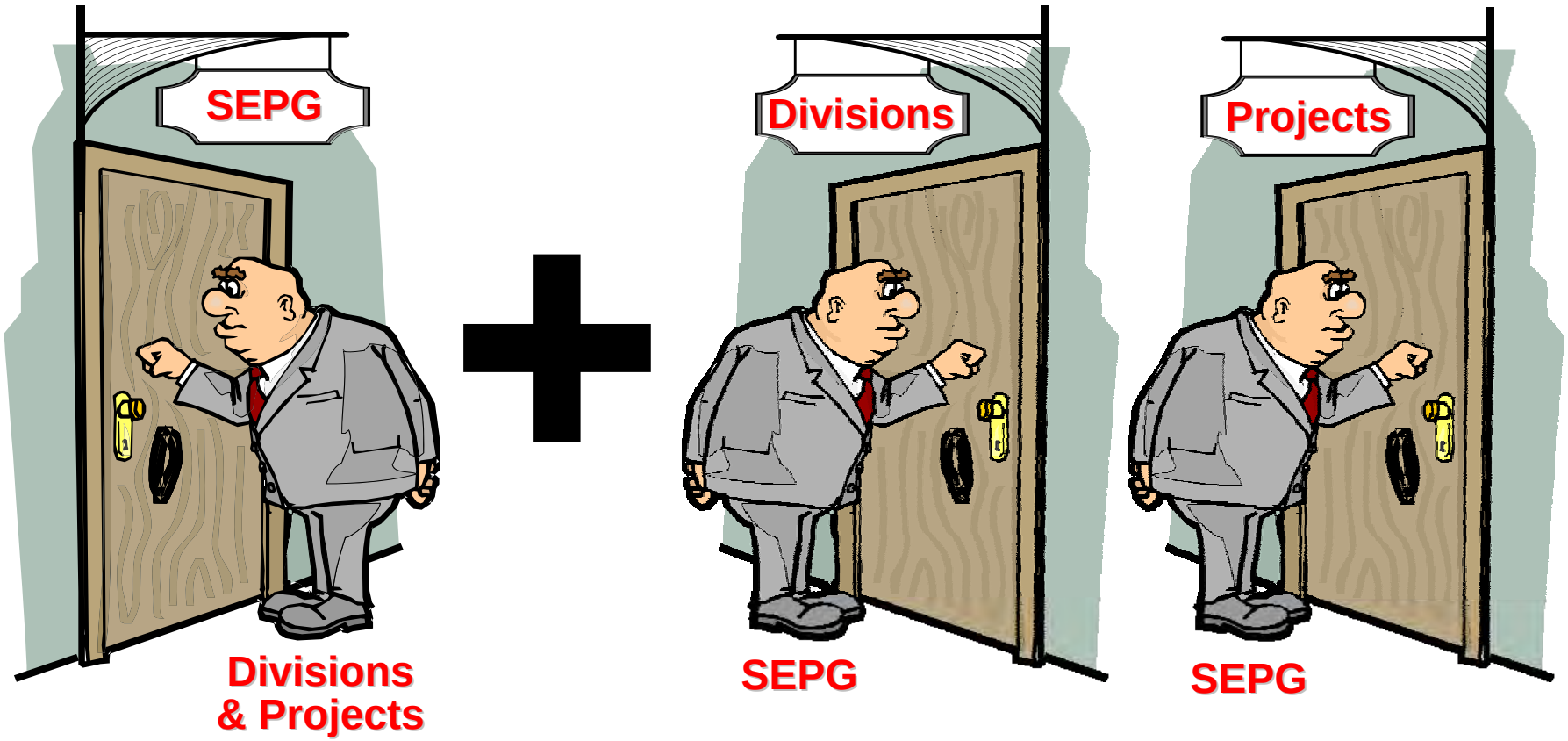
Change 3:
Became More Proactive

Reactive
(Wait for Suggestions)

Proactive
(Search for Suggestions)



Conduct a Voice of the Customer at least annually.
Don't wait for people to submit proposals.

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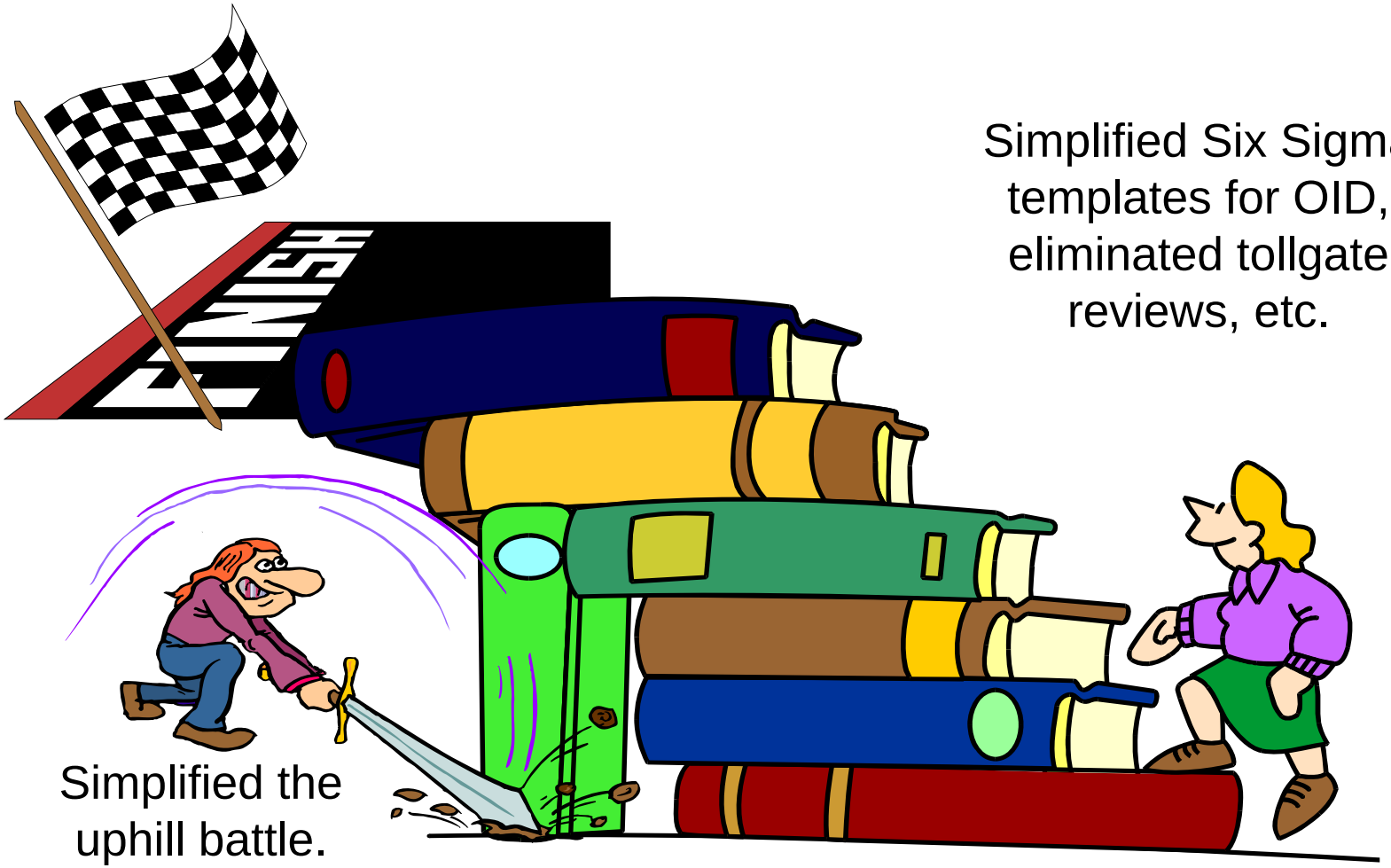
Change 4:
Eliminated the Bureaucracy



Simplified Six Sigma templates for OID, eliminated tollgate reviews, etc.

Simplified the uphill battle.

Keep it simple.

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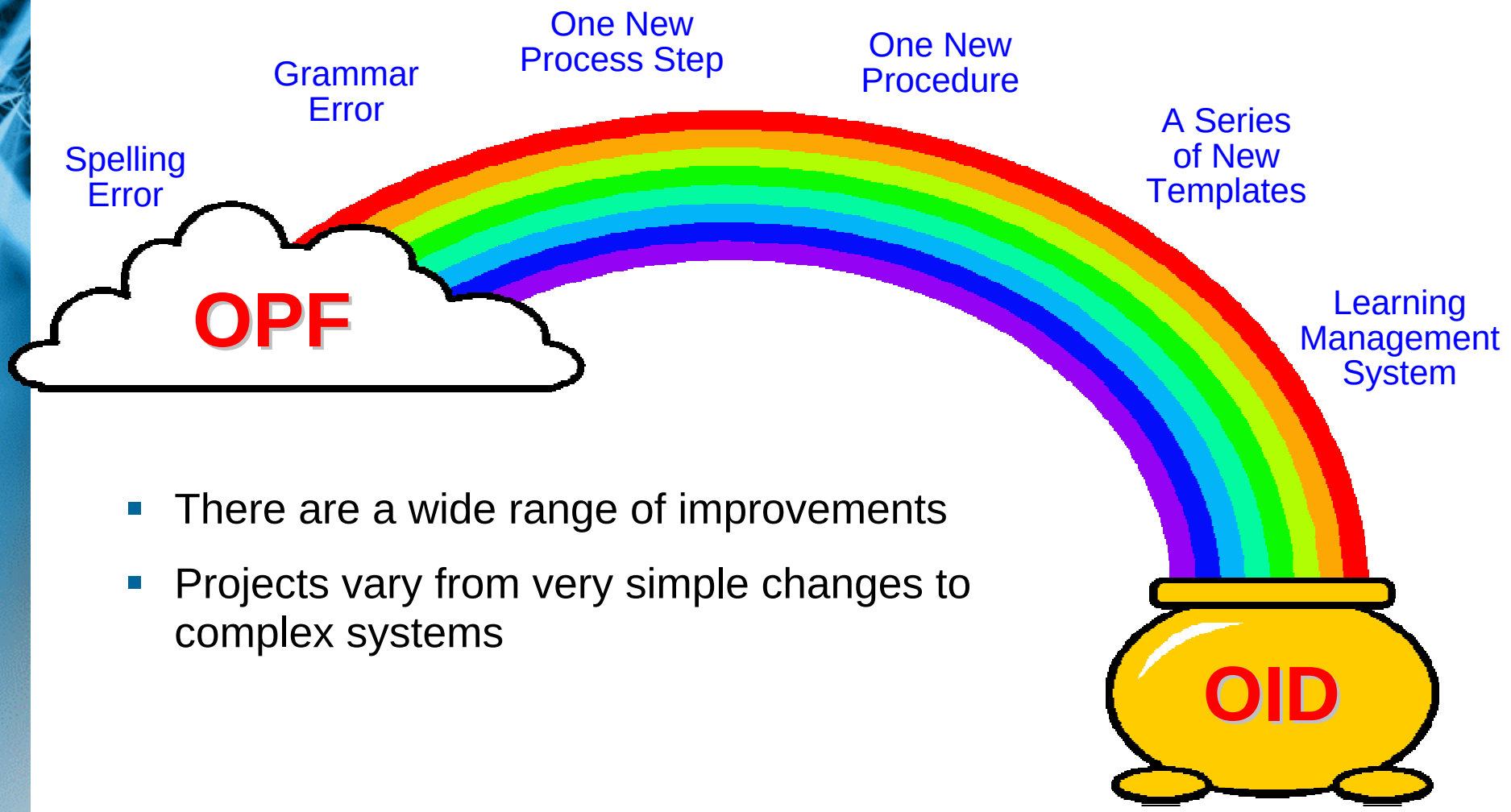
Change 5:
Avoided the Term "Innovative"



- There are a wide range of improvements
- Projects vary from very simple changes to complex systems

Pondering whether something is "innovative" scares people away. Focus on measuring and piloting improvements, as appropriate.

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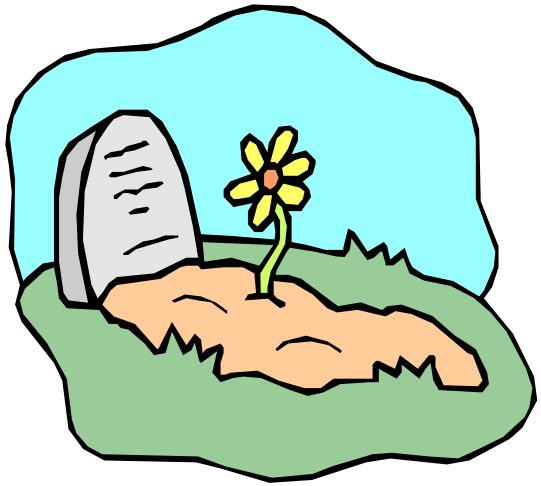
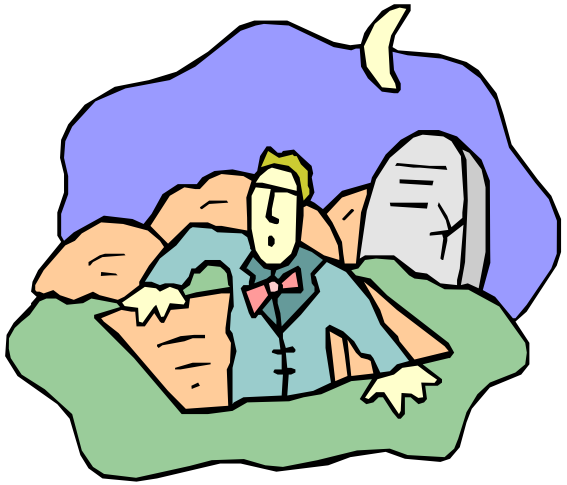
Change 6:
Resurrected the Watch List (1 of 2)



Watch List was not used frequently



Resurrected the Watch List

Let the Watch List loose for visibility

The Watch List is needed for both planning and monitoring and control.

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Change 6:
Resurrected the Watch List (2 of 2)

Watch List Fields

- Id
- Title
- Date submitted
- Requester
- Source, e.g., project, CCB
- Describe the improvement and why it is needed
- Will quality be improved?
- Will performance be improved?
- Cost analysis
- CCB disposition
- CCB comments
- CCB date
- Status
- Measure?
- Pilot?
- Assignee
- Priority
- Start quarter
- Post quarter
- Hours
- Date closed

The Watch List is statused monthly at the CCB and to higher-level management.

Status high priority improvements regularly, which helps push people to complete their projects.

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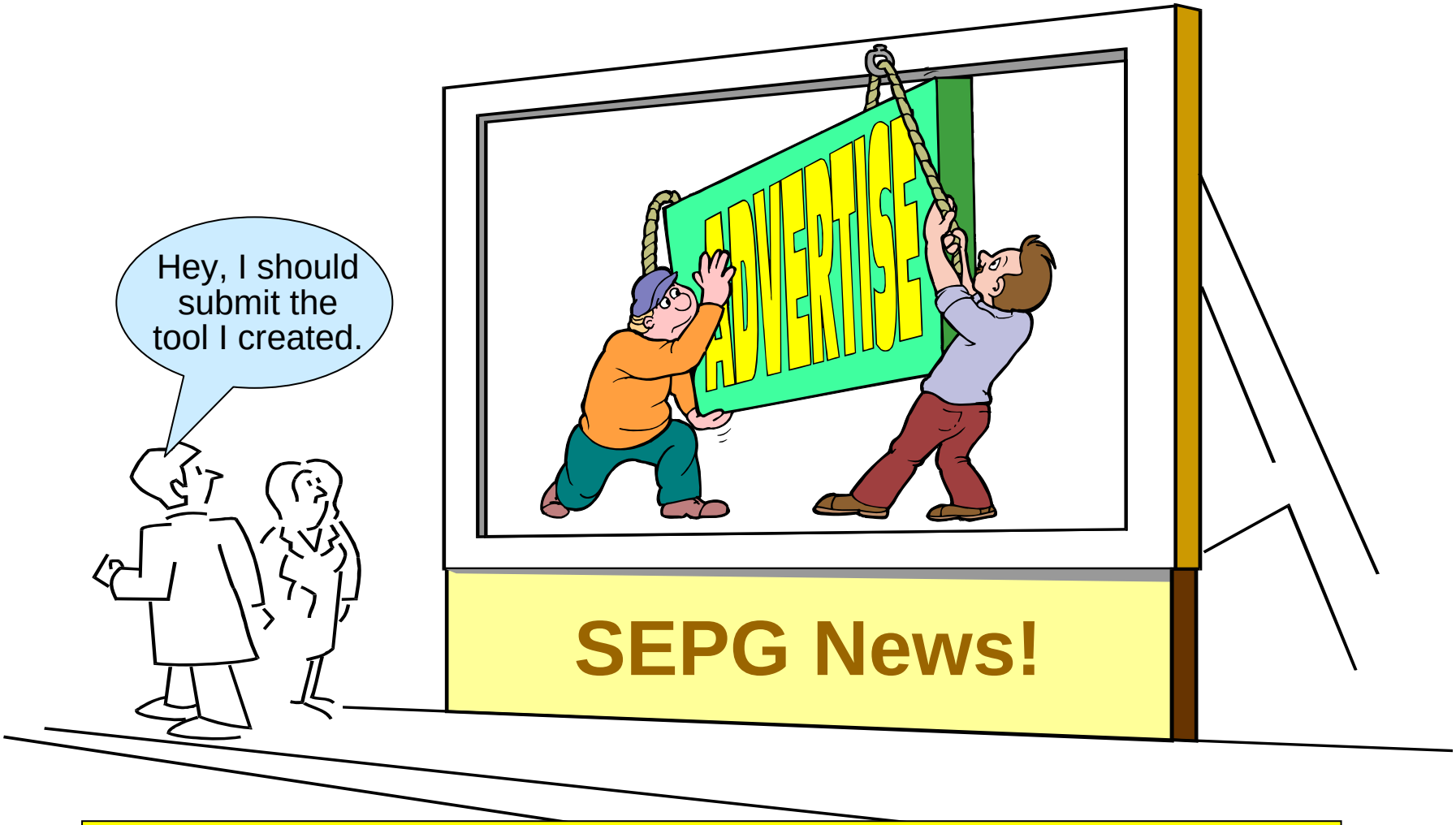
Change 7:
Made Successes More Visible



If people think their improvement suggestions end up in a "black hole", they will never submit anymore suggestions.

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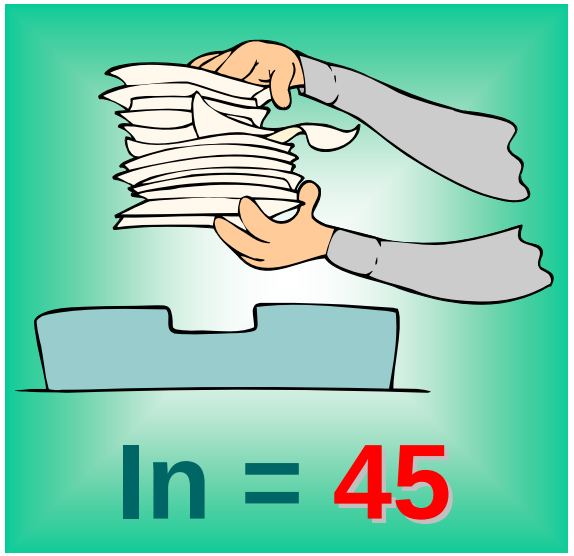
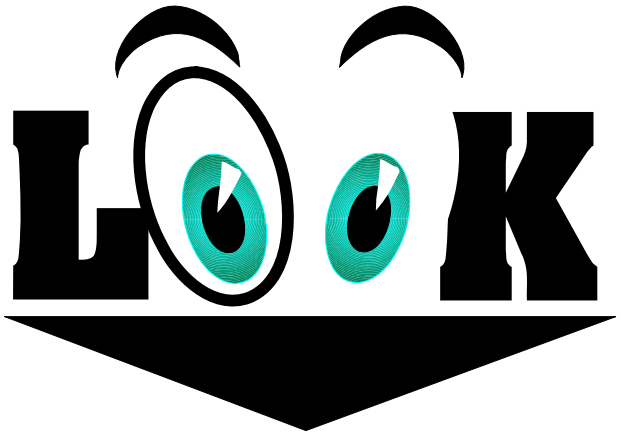
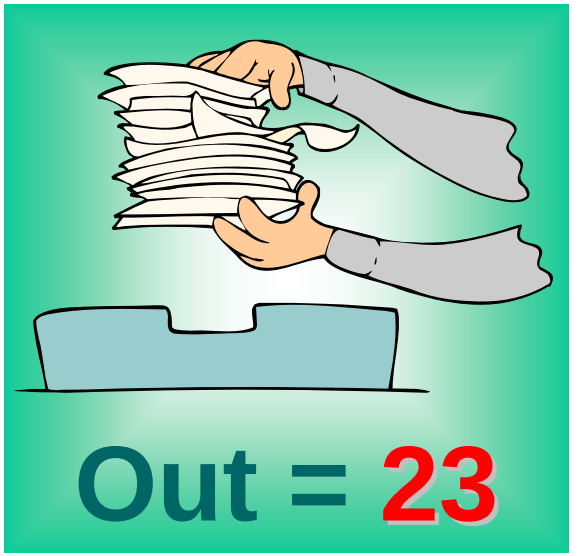
Look at Measures NOW



2003 In = 5
2004 In = 3
2005 In = 6



at the measures for 2006



2003 Out = 4
2004 Out = 2
2005 Out = 3

e.g., Software Product Lines

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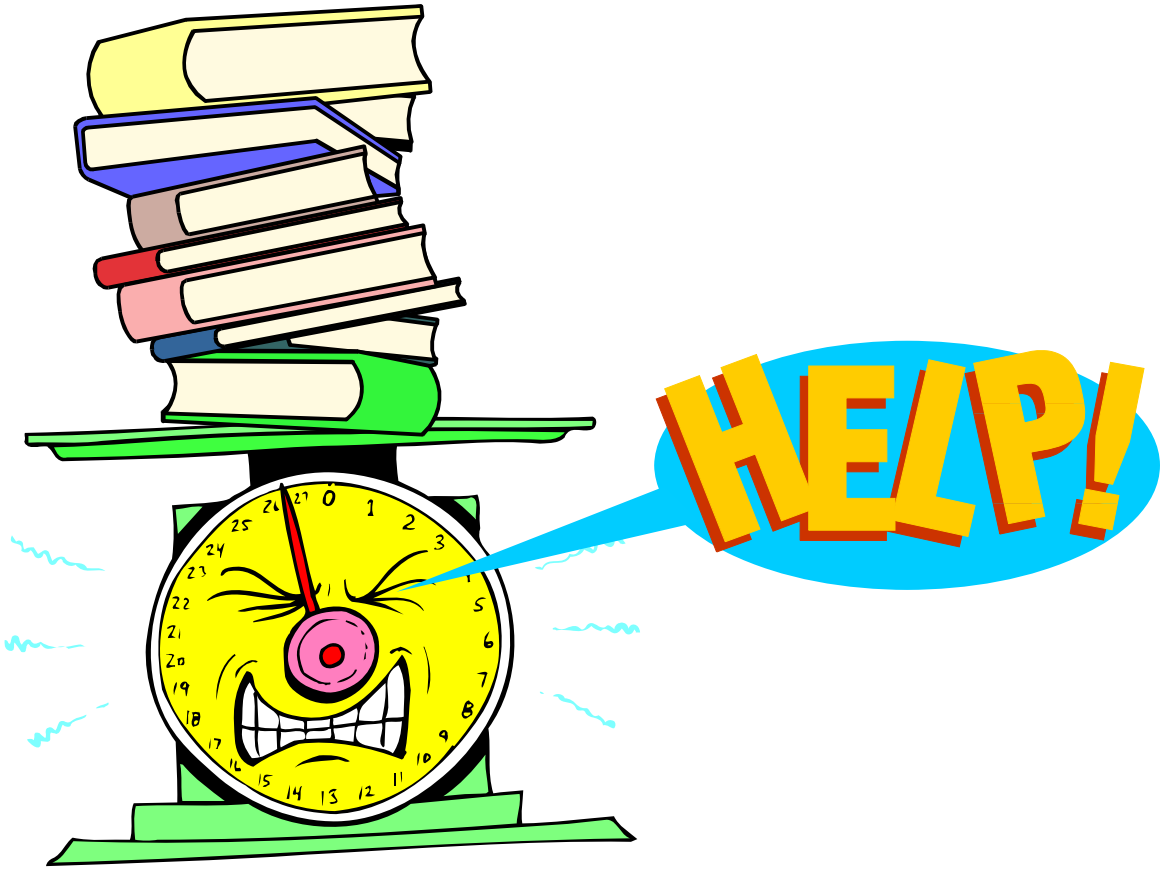
What Still Needs to be Fixed



The one remaining project to do is "OID of OID Lead". There's a LOT more planning and managing involved with the substantial increase in OID projects.

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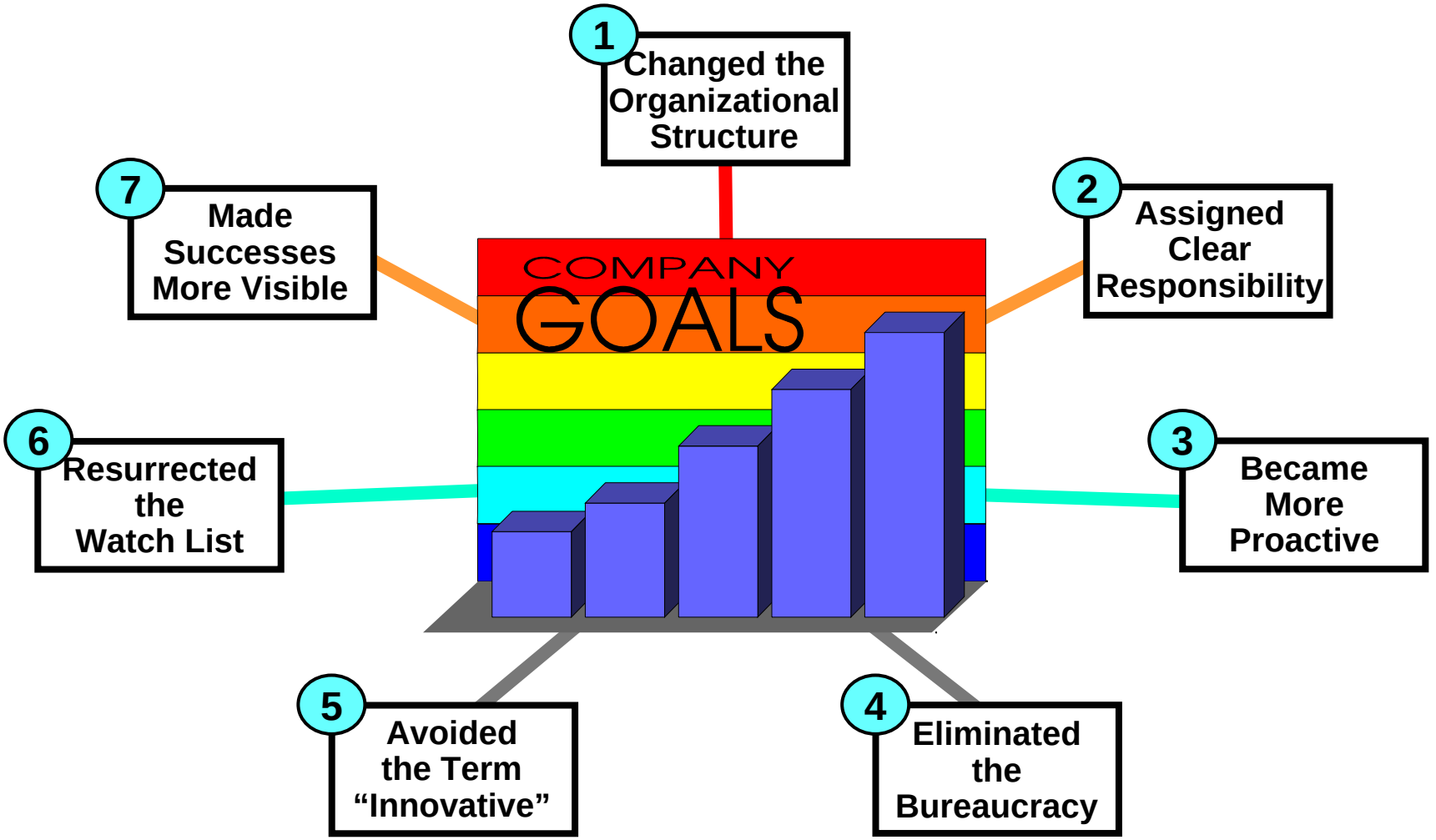
Summary



Through "**OID of OID**", we went from **4.7** to **45** improvements submitted and **3.0** to **23** projects completed.

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INITIAL LESSONS LEARNED FROM CONDUCTING SCAMPI-B APPRAISALS

ITZHAK LAVI

SARIT ASSARAF

ISRAEL AIRCRAFT INDUSTRIES LTD.

CMMI Conference –Denver Nov. 2006

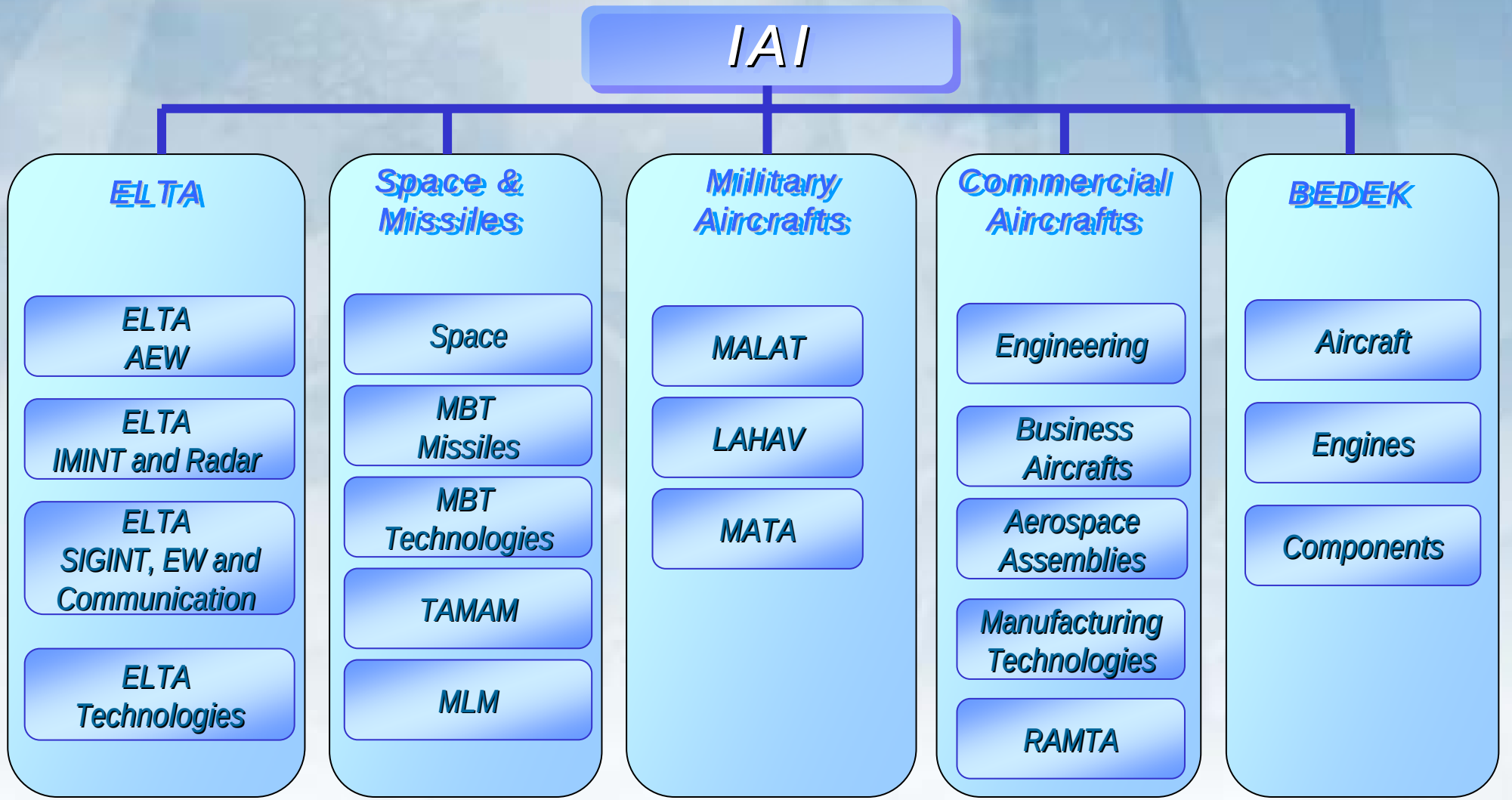
Topics

- Background
  - IAI Process Improvement Path
  - CMMI Implementation in IAI
- SCAMPI B&C Appraisals
- Performing SCAMPI-B Appraisals in IAI
- Lessons Learned and Recommendations

Israel Aircraft Industries (IAI)

- Largest industrial company in Israel
  - 15000 employees, 2.3 $B annual sales
- Involved in Development, Production, Maintenance and Service of Aerospace Systems
- IAI divisions are ISO9000 and AS9100 certified
- Started SW-CMM based Software development process improvement efforts in 1992
- Started CMMI based process improvement efforts in 2002

Israel Aircraft Industries Groups and Divisions



Corporate Initiatives for Process Improvement

Competitiveness Ability Improvement (CAI)
- Production Process Improvement
- Acquisition Process Improvement

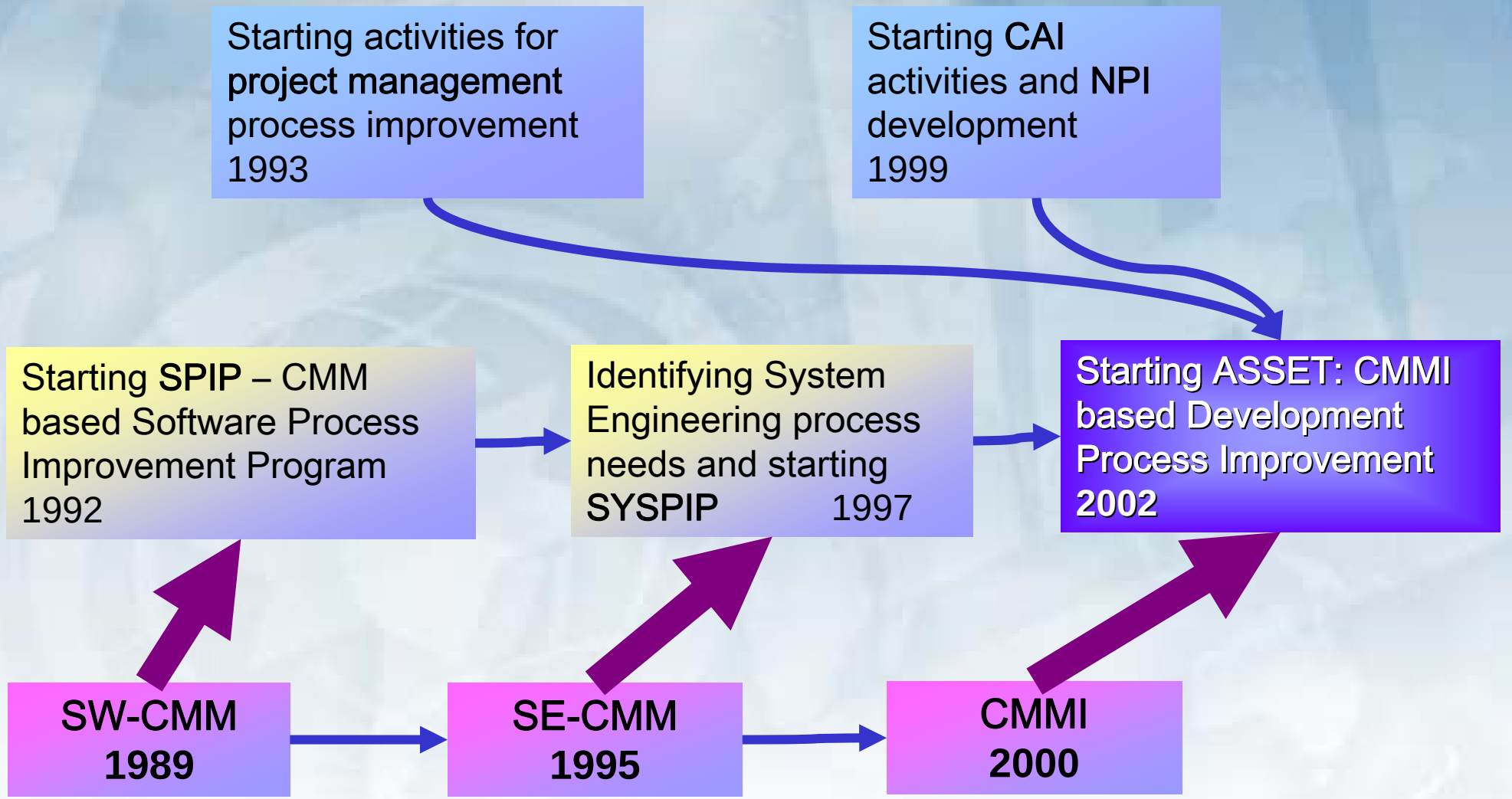
Project Management Process Improvement
- Project Planning and Control
- Risk Management

New Product Introduction (NPI)
IAI Uniform Project Process Framework

System & Software Engineering Development Processes and Methodologies

- Increase Quality
- Increase Sales
- Increase Profit

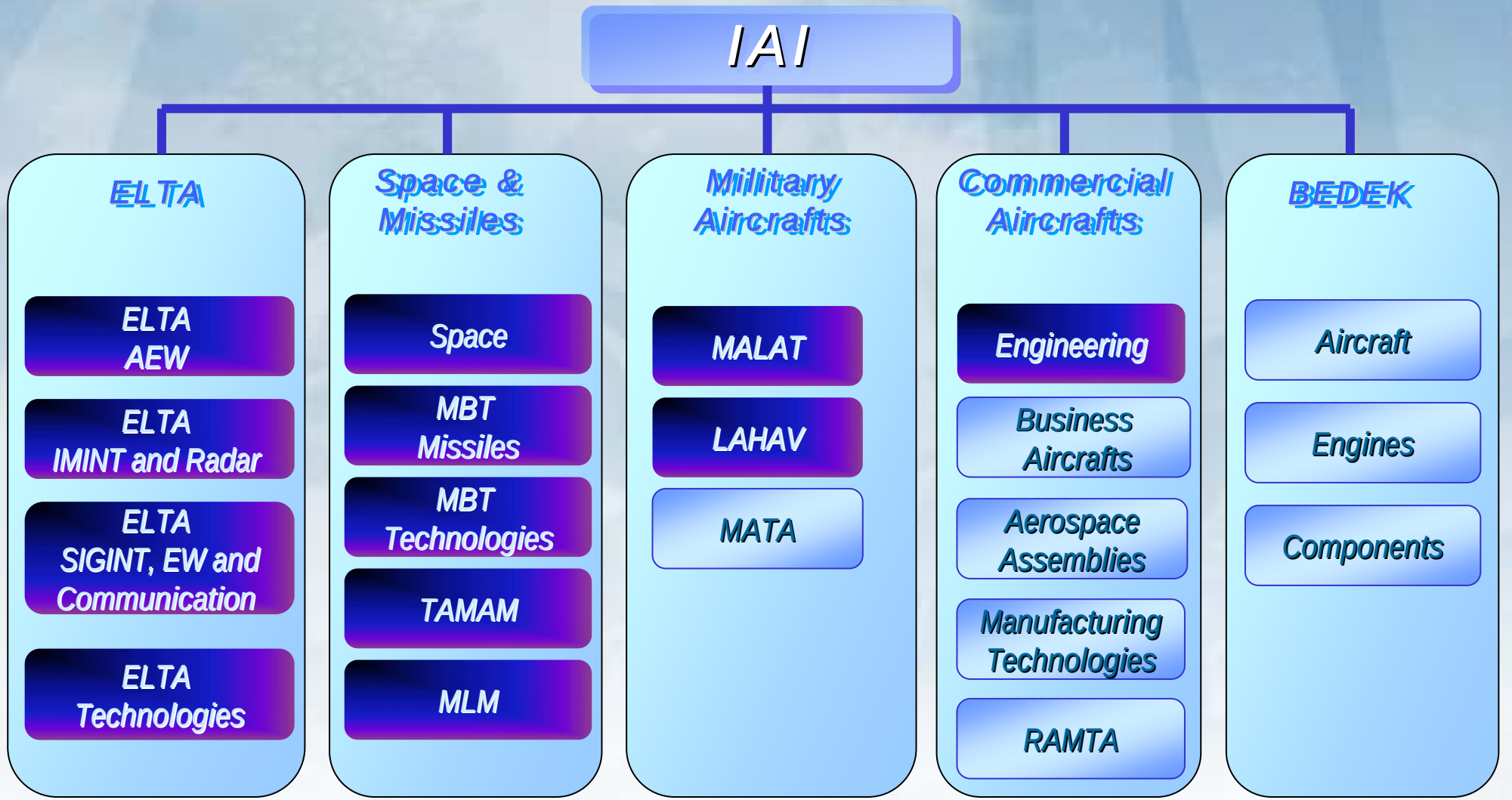
Israel Aircraft Industries Process Improvement Path -1



Israel Aircraft Industries process improvement path -2

- Process improvement efforts are coordinated at the corporate level and sponsored by the company VP of Operations
- Many infrastructure assets are developed at the corporate level and are adapted by the groups and divisions. Other assets are developed within the groups and divisions
- Process improvement implementation is conducted at the group and division level and sponsored by the group or division management

Israel Aircraft Industries Groups and Divisions



CMMI Based Process Improvement Activities

Appraisals in IAI

- Since the beginning of the CMMI implementation program in 2002, there have been many formal and informal process reviews and appraisals in IAI groups and divisions, with the CMMI as the reference model with the following objectives:
  - Identify strengths and weaknesses in the defined processes
  - Identify strengths and weaknesses in the way processes are actually performed
  - Provide the basis for process improvement activities
  - Determine CMMI maturity level

The need for a formal non SCAMPI-A appraisal

- While SCAMPI-A appraisals provide a reliable way to determine the CMMI maturity or capability levels, they are not as good for identifying strengths and weaknesses during the process improvement effort
- We needed a method that will be:
  - Well defined and documented
    - Can be applied consistently
  - Flexible and tailorable
    - Can be applied in many different situations
  - Less effort than SCAMPI-A
    - Can be applied more frequently
  - Will not provide rating
    - Will not create the stress usually associated with SCAMPI-A

SCAMPI-B Appraisal method

- Defined at the SEI in 2005 as ARC-B compliant appraisals method
- Purpose: To appraise a sample of the processes defined and implemented in the organization, and identify strengths and weaknesses, WITHOUT assigning maturity or capability level ratings
- Provides a higher level of flexibility than SCAMPI-A

SCAMPI-B Appraisals Concepts

- Define appraisal scope:
  - The organization parts to be appraised
  - The CMMI model scope to be considered
- Prepare formal Input and Plan documents
- Collect information from both direct artifacts and affirmations.
  - Indirect artifacts are usually not used in data sufficiency rules of SCAMPI-B
- Use data sufficiency rules and Draft Findings to verify and validate results
- Characterize practice implementation level as **Red**, **Yellow** or **Green** to provide easy understanding of the organization process status
- Appraisal team must consist of at least 2 members, in addition to the team leader
- Non Attribution

SCAMPI-C Appraisal method

- Defined at the SEI in 2005 as ARC-C compliant appraisals method
- Purpose: To appraise a sample of the processes defined or planned in the organization, and identify strengths and weaknesses, WITHOUT assigning maturity or capability level ratings
- Provides a higher level of flexibility than SCAMPI-B

SCAMPI-C Appraisals Concepts

- Define appraisal scope:
  - The organization parts to be appraised
  - The CMMI model scope to be considered
- Prepare formal Input and Plan documents
- Collect information from direct artifacts, indirect artifacts and/or affirmations
- Data sufficiency rules are less firm than in SCAMPI-B
- Non Attribution

IAI Goals in using SCAMPI-B

- Use a well defined, repeatable and flexible method for process appraisal
  - Obtain information about current processes
  - Identify good practices that should be repeated
  - Identify weaknesses as early as possible
  - Obtain information about the level of readiness for a SCAMPI-A appraisal
- Avoid the stress associated with SCAMPI-A
  - No rating

SCAMPI-B Appraisals Performed in IAI

- Two formal SCAMPI-B appraisals were conducted in IAI:
  - 1st SCAMPI-B appraisal performed in IAI LAHAV division in September 2005
  - 2nd SCAMPI-B appraisal performed in IAI ELTA group in December 2005
- In addition, three informal SCAMPI-B like appraisals were conducted in the same two organizations in 2006

Initial Lessons Learned -1

- Scope must be defined very carefully, especially when the time is very limited (5 to 7 days at the most)
  - Usually: 2-3 projects, 4-5 process areas
- Preparations for SCAMPI-B are similar to those for SCAMPI-A, e.g.:
  - PIIDs preparation
  - Appraisal team selection and training
  - Plan, Logistics, Schedule
  - Interview Scripts
- Draft Findings sessions may be less important than in SCAMPI-A
- For frequent PIIDs review SCAMPI-C may be more appropriate
- SCAMPI-B appraisals helped in focusing management attention and raising awareness of important process issues

Initial Lessons Learned -2

- Best results are obtained when the team consists of people from both the appraised organization and from outside
- SCAMPI-B may not be appropriate for initial process appraisal, because of the need to consider direct artifacts. SCAMPI-C may be better for this purpose
- SCAMPI-B may not provide enough information about readiness for SCAMPI-A because Indirect Artifacts might not be examined in a SCAMPI-B
- In some cases, SCAMPI-B method does not provide enough flexibility
  - Draft Findings Presentation contents
  - Combinations of project and CMMI scope

Combinations of Projects and CMMI Scope-1

	PP	PMC	REQM	CM
Project 1	DA	DA	DA	AF
Project 2	DA	DA	DA	AF
Project 3	AF	AF	DA	AF
Project 4	AF		DA	AF

DA = Direct Artifacts

AF=Affirmations

Sufficient Data

Insufficient Data

Data Sufficiency rules require:

- At least one direct artifact or one affirmation for each instantiation in scope
- Both a direct artifact and an affirmation when considering all instantiations in scope

Combinations of Projects and CMMI Scope-2

Not considered in SCAMPI-B

	PP				PMC				REQM			CM			
Project 1															
Project 2															
Project 3															
Project 4															

In scope Out of scope

Some process areas may intentionally not be covered in some projects to make better use of appraisal preparation and on-site time

Combinations of Projects and CMMI Scope-3

Not considered in SCAMPI-B

	PP				PMC				REQM			CM			
Project 1															
Project 2															
Project 3															
Project 4															

In scope Out of scope

Some practices may intentionally not be covered in some projects to make better use of appraisal preparation and on-site time

Recommendations regarding usage of SCAMPI B&C

- Use SCAMPI-B appraisals systematically as one of the tools on the process improvement path
  - Perform once a year to check process status between SCAMPI-A appraisals
  - Limit the scope to one process area category (e.g.: Project Management PAs, Engineering PAs)
  - Plan SCAMPI-B appraisals in conjunction with other appraisals (such as SCAMPI-C) so that maximum information is obtained with a minimal effort
- Use SCAMPI-C appraisals for more frequent process and PIIDs preparation status review
- Make sure that the team consists of people both from the appraised organization and from outside
- Make sure that expectations from SCAMPI B & C are aligned with the methods' capabilities
  - SCAMPI B or C are not a cheap replacement for SCAMPI-A

Sample plan involving SCAMPI-B appraisals

	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Periodic Formal Appraisals to determine **Maturity or Capability Levels**	▲												▲
Periodic Appraisals to identify **Strengths and Weaknesses** in Processes					▲				▲				
Interim **evaluation of progress** in process improvement and readiness for appraisals			▲				▲				▲	▲	

▲ SCAMPI-A ▲ SCAMPI-B ▲ SCAMPI-C

Recommendations regarding the SCAMPI-B Method

- Modify the SCAMPI-B method to enable more flexibility
  - Scope definition
  - Draft Findings presentation
- Find a way to consider indirect artifacts in SCAMPI-B data sufficiency rules, in addition to direct artifacts and affirmations

Thank You

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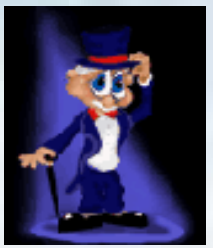

Practical Advice on Picking the Right Projects for an Appraisal

Bob Moore, Business Transformation Institute, Inc.
Will Hayes, Software Engineering Institute

You may recall . . .

- At the 2005 NDIA CMMI and SEPG 2006, we presented "Building a Credible SCAMPI Appraisal Representative Sample".
- This presentation demonstrated how to apply Design of Experiment (DOE) techniques in choosing a "good" SCAMPI appraisal representative sample.
- Today's presentation builds on our previous work to:
  - Provide advice on how to select projects for a SCAMPI appraisal while following the rules of SCAMPI Method Description Document version 1.2.
  - Demonstrate applying the more mathematical of the project selection techniques using Microsoft Excel.

Why Should We Care About Picking the Right Projects for an Appraisal?

- Choosing the right projects is the foundation of an appraisal that:
  - Is credible to anyone who was not part of the appraisal team or even part of the organization being appraised and
  - Maximizes the organization's understanding of its processes' strengths and weaknesses.
- These two benefits of choosing the right projects are mutually supportive because:
  - Choosing the right projects provides the most information gained per appraisal resource invested.
  - Other sets of projects could be examined, but would be inferior with respect to insights gained on process institutionalization.
  - Choosing a less-than-right set of projects invites suspicion that the appraisal results may reflect projects that are atypical of the processes used in the organization.
    - Atypical because only "good" projects were included or
    - Atypical because "bad" project were excluded.
- Bottom Line: picking the right projects maximizes the return on investment in the appraisal!

What Does SCAMPI MDD 1.2 Say About Picking the Right Projects? (1)

- Section 1.1.3, "Determine Appraisal Scope":
  - The organizational scope of **the appraisal must include sample projects and support groups that are representative of the implemented processes and functional areas** being investigated within the organizational unit and that operate within a coherent process context. The **rationale for selecting** these sample projects and support groups as representative of the organizational unit **must be documented**.

What Does SCAMPI MDD 1.2 Say About Picking the Right Projects? (2)

- Section 1.1.3, "Determine Appraisal Scope":
  - **Organizational unit size** (i.e., number of people and number of projects) and **sizes of projects and support groups** (i.e., number of people) in the organizational scope **must be documented** as well as the **percentage ratio of these two measures**:
    - **Population %**: the number of people in the organizational scope divided by the number of people in the organizational unit (x100)
    - **Project %**: the number of projects in the organizational scope divided by the number of projects in the organizational unit (x100)
  - **Critical factors that influence implementation of practices** in projects and functions within the organizational unit **must also be understood and identified**.

What Does SCAMPI MDD 1.2 Say About Picking the Right Projects? (3)

- Section 1.1.3, "Determine Appraisal Scope":
  - **Sample projects and support groups** selected to form the organizational scope (i.e., the combination of focus and non-focus projects and support functions) **must represent all critical factors identified for the organizational unit** to which the results will be attributed. The **coverage of the organizational critical factors** provided by these sample projects and support groups in the organizational scope in relation to the organizational unit **must be documented, in quantitative terms, in the appraisal input and ADS**.

What Does SCAMPI MDD 1.2 Say About Picking the Right Projects? (4)

- Section 1.1.3, "Determine Appraisal Scope":
  - Each sample project or support group in the planned organizational scope of the appraisal must be one of the three types listed below:
    - Focus projects must provide objective evidence for every PA within the model scope of the appraisal which addresses model practices applicable to those projects.
    - Non-focus projects must provide objective evidence for one or more PAs within the model scope of the appraisal which address practices performed on projects.
  - In appraisals where the reference model scope includes any project-related PA, the organizational scope must include at least one focus project.

What Does SCAMPI MDD 1.2 Say About Picking the Right Projects? (5)

- Section 1.1.3, "Determine Appraisal Scope":
  - **Information about the organizational unit should be documented in a way that allows future appraisal sponsors to replicate (to the extent possible) the organizational unit appraised**. This information should be in the appraisal plan, and used (in summary form if needed) in briefing the appraisal team and appraisal participants. **Other examples of critical factors include**:
    - application domains (or lines of business)
    - geographical breadth
    - disciplines (e.g., systems engineering, software engineering, or hardware engineering)
    - effort types (e.g., development, maintenance, or services)
    - project types (e.g., legacy or new development)
    - customer types (e.g., commercial or government agency)
    - lifecycle models in use within the organization (e.g., spiral, evolutionary, waterfall, or incremental)

Key Points of SCAMPI MDD 1.2, "Determine Appraisal Scope"

- The MDD does not advise us on how to pick projects, but it does provide conditions that our selected projects must fulfill to be acceptable:
  1. You must document the *percentage of the organization's people and projects* covered by the appraised projects and functions.
  2. The appraisal must use *representative* sample projects.
  3. Representative means that all *critical* (process implementation-influencing) *factors are covered* in the sample projects.
  4. The *relationship between the critical factors and the sample projects must be documented* in the ADS so that future appraisal sponsors.

Paths to Picking the Right Projects

- There are two alternative paths to be considered before picking the right project in planning an appraisal:
  - **Alternative 1**: Define the organizational unit to be appraised. The choice of the organizational unit will influence the choice of projects.
  - **Alternative 2**: Pick the projects to be appraised. The choice of projects will define the organizational unit to which appraisal results apply.

Advice on Picking The Right Projects

- The advice applies when following path 1.
- We'll discuss "reverse engineering" the organizational unit from the selected projects later (path 2).

Categories of Advice

- Project Life Cycle Advice
- Project Visibility Advice
- Project Critical Factors Advice
- Project Size Advice

Project Life Cycle Advice

1. Project Milestones and Appraisal Events:
   - Avoid choosing a project for an appraisal if the date for any appraisal event that requires the project's active participation would occur before a major product release or milestone.
   - Advice Rationale: The reason the project exists is to deliver its product(s). The project's progress towards delivering the product(s) is measured by reaching its milestones. Anything that interferes with releasing product(s) or meeting milestones will either:
     - decrease the project's likelihood of success or
     - be ignored by the project.

Project Life Cycle Advice (2)

2. Projects Early in Their Life Cycle:
   - Avoid appraising a project if the project is early in its life cycle.
   - Advice Rationale: Projects that are early in their life cycle are likely to have:
     - Immature artifacts,
     - Sparse artifacts,
     - Staff that, as whole, may be uncomfortable with the project, the processes, or each other.

Project Life Cycle Advice (3)

3. Projects Late in Their Life Cycle:
   - Avoid appraising a project if the project will end before or soon after the appraisal(s) is complete.
   - Advice Rationale: Any weaknesses discovered in a project that is late in its life cycle will give the project limited or no opportunities to fix the weaknesses. Consequently:
     - Future appraisals (e.g., a SCAMPI A following a SCAMPI B) using this project will find the same weaknesses as the current appraisal.
     - The project itself won't benefit from the appraisal's findings because the project may not be able to change or have too much invested in its existing process implementation to warrant changes (other projects may benefit, of course).

Project Visibility Advice

1. Important Projects:
   - Avoid appraising projects that are highly visible or important.
   - Advice rationale: An important or highly visible project may have too many distractions or pressures that will limit its ability to cooperate in preparing for an appraisal or limit the benefits it receives from appraisal results.
2. Trivial Projects:
   - Avoid appraising projects that are of trivial or marginal importance to the organization.
   - Advice rationale:
     - A trivial project may be cancelled, terminating its participation in an appraisal.
     - A trivial project may be viewed by the organization as not providing relevant process insights for other, more significant projects.

Project Size Advice

- Projects with Large Staff Sizes:
  - If project staff size is not a factor that influences processes in the organization, then select at least one large staff-sized project for the appraisal.
  - Advice Rationale: SCAMPI 1.2 requires that the appraisal population and project percentage must be documented. Larger projects will make the appraisal population percentage increase rapidly. Larger projects are also better able to accommodate the work required to prepare for an appraisal.
    - Hint: the SEI is looking for higher population and project percentages!

Project Critical Factors Advice Before We Get Started: A Little Necessary Math (1)

- Balanced designs are selections of projects for appraisals where there are an equal number of projects selected for each combination of critical factors.
- Orthogonal designs are selections of projects for an appraisal so that the critical factors balance out across the projects being appraised.

Project Critical Factors Advice Before We Get Started: A Little Necessary Math (2)

- Experimental resolution helps us to understand the degree of our "known unknowns" in an appraisal.
  - Resolution I = we gain no insight from an appraisal
  - Resolution II = we cannot tell the difference between the influence of main critical factor effects (why bother?)
  - Resolution III = Main factor effects can't be distinguished from two-factor interactions.
    - e.g., If the customer type, project size, and project type are all thought to influence process institutionalization, then a resolution III experiment can't tell the difference between the influence of customer type vs. project size and type combined.
  - Resolution IV = No main factor effects get confused with two-factor interactions, but two-factor interactions can't be distinguished from each other.
  - Resolution V = No main effect or two-factor interaction is confused with any other main effect or two-factor interaction, but two-factor interactions can't be distinguished from three-factor interactions.

Constructing A Project Factors Table: Step 1

- We will use this technique several times in the subsequent discussion.
- Create a table in Microsoft Excel.
  - The column headings will be the names of the factors that influence process institutionalization in the organization being appraised.
  - The row headings will be the names of the projects that are participating in the appraisal.

Table Construction Example Setup

- Factors that influence processes in the projects:
  - Project customer: commercial or government
  - Project location: domestic or international
  - Project type: development or maintenance
- Projects being considered:
  - Project 1: government, domestic, maintenance
  - Project 2: government, domestic, development
  - Project 3: commercial, international, development
  - Project 4: commercial, domestic, development

Table Construction Example: Step 1

	Customer	Location	Type
Project 1			
Project 2			
Project 3			
Project 4			

Constructing A Project Factors Table: Step 2

- Fill in the table with the factor levels for each project
  - Consistently convert factor levels to values of “1”and “-1”.
  - For each project row, fill in a “1” or “-1” depending on how the project is characterized against the corresponding factor column.

Table Construction Example: Step 2

	Customer	Location	Type
Project 1	1	1	-1
Project 2	1	1	1
Project 3	-1	-1	1
Project 4	-1	1	1

Constructing A Project Factors Table: Step 3

- Add additional columns to the table representing all possible combinations of factors
  - Examples:
    - If there are two factors (F1 and F2), add a column to the table and label it "F1*F2".
    - If there are three factors (F1, F2, and F3), add columns to the table labeled "F1*F2", "F1*F3", "F2*F3", "F1*F2*F3".
  - Compute the values for the cells in the additional columns by multiplying the values of the rows together according to the column headings.

Table Construction Example: Step 3

	Customer	Location	Type	Customer* Location	Customer* Type	Location* Type	Customer* Location* Type
Project 1	1	1	-1	1	-1	-1	-1
Project 2	1	1	1	1	1	1	1
Project 3	-1	-1	1	1	-1	-1	1
Project 4	-1	1	1	-1	-1	1	-1

Project Critical Factors Advice (1)

1. Higher Resolution Appraisals:
   - Select projects for the appraisal in sufficient numbers and diversity to get a resolution III or better appraisal.
   - Advice Rationale: Resolution I and II appraisals can't distinguish between the effect of main factors on process institutionalization. Resolution I and II appraisals yield no information.

Project Critical Factors Example

- The organization being appraised has two factors that are thought to influence process institutionalization:
  - project location (California or India) and
  - project customer (US Navy or insurance companies.)
- The appraisal looks at two projects:
  - Project #1 is in California that has the US Navy as a customer and
  - Project #2 is in India that has Mega Big Insurance as a customer
- Project #1 has some weaknesses in requirements management and some strengths in technical solution.
- Project #2 has some weaknesses in technical solution and some strengths in requirements management.
- What is the right conclusion about this organization's requirements management and technical solution process implementations?
- Answer: we can't draw any fact-based conclusions!

Determining Minimum Number of Projects from Resolution and Number of Factors

		Resolution							
		1	2	3	4	5	6	7	8
Factors (all with 2 levels)	1								
	2								
	3			4					
	4				8				
	5			8		16			
	6			8	16		32		
	7			8	16			64	
	8			16	16	64			128

Project Critical Factors Advice (2)

2. Critical factors versus number of projects :
   - Choose projects that maximize the number of factor settings in the fewest number of projects.
   - Advice Rationale: One of the principal appraisal cost drivers is the number of projects involved in the appraisal. Maximizing the number of factor settings covered in the fewest number of projects will maximize the information gained from the projects, and hence the coverage of the organizational unit, while minimizing cost.

Constructing A Project Factors Table (Continued from Earlier Discussion)

- Look for patterns or "unbalanced-ness" or "non-orthogonality" in the table that indicates potential problems:
  - One factor never varies or only varies when all other factors are set to particular values.
  - Two factors are always "low" or "high" in tandem with each other across the projects.
    - Indicated by one of the product columns always being the same sign
  - One of the main columns (with a single factor heading) is the same as one of the multiple column columns

Example 1: Factors Patterns

	F1	F2	F3	F1*F2	F1*F3	F2*F3	F1*F2*F3
P1	1	-1	1	-1	1	-1	-1
P2	-1	-1	1	1	-1	-1	1
P3	1	1	-1	1	-1	-1	-1
P4	-1	1	-1	-1	1	-1	1

Factor 2 and 3 are always the opposite of each other. We never learn anything about when they are both “high” or “low” at the same time.

Example 2: Factors Patterns

	F1	F2	F3	F1*F2	F1*F3	F2*F3	F1*F2*F3
P1	1	1	1	1	1	1	1
P2	-1	1	1	-1	-1	1	-1
P3	1	-1	-1	-1	-1	1	1
P4	-1	-1	-1	1	1	1	-1

Factors 2 and 3 are is always the same high or low setting, so we learn nothing about their separate influences on the processes.

Project Critical Factors Advice (3)

3. Critical factors and organizational unit scope:
   - If none of the appraised sample projects includes a particular setting for a particular factor, then the appraisal can't have any findings with respect to that factor setting.
     - Corollary: If your organization includes projects with a factor set to a particular value, then one of the sample projects must also include that factor with that value.
   - Advice Rationale: As an example, if an organizational unit includes commercial and government projects, then this factor influences process implementation. An appraisal that includes only government projects could not apply to the organization's commercial projects.

Example 3: Factors Patterns

	F1	F2	F3	F1*F2	F1*F3	F2*F3	F1*F2*F3
P1	1	1	1	1	1	1	1
P2	-1	1	1	-1	-1	1	-1
P3	1	-1	1	-1	1	-1	-1
P4	-1	-1	1	1	-1	-1	1

Factor 3 never varies—none of the appraised projects is telling us anything about the influence of factor 3 on process institutionalization. (This pattern is non-orthogonal!)

Project Critical Factors Advice (4)

4. Critical factors and multiple appraisals:
   - If the appraisal is considering three or more factors, perform "factor screening" SCAMPI B or C appraisal(s) before the SCAMPI A in order to discover and discard unimportant factors.
   - Use blocking techniques to divide one large appraisal into several smaller appraisals.
   - Advice Rationale: A full-factor appraisal that includes three factors each with only 2 settings each would need to examine 8 projects. (More factors would require even more projects.) The number of projects to be appraised in a single appraisal could be reduced by conducting lower-cost SCAMPI B or C appraisals to determine if some of the factors are inconsequential with respect to process implementation. (Alternately, use blocking techniques.)
   - Example: Suppose an organization includes commercial and government projects. A SCAMPI C appraisal that considered government and commercial projects (with the other factors allowed to vary) and found that the customer type yielded the same process strengths and weaknesses could be used to conclude that the "customer type" factor may be eliminated from consideration for future appraisals.

Reverse Engineering the Organizational Unit from the Appraisal

- Obeying all of the rules of the SCAMPI MDD 1.2 may be challenging.
  - Note: in designing experiments for engineering, science, medicine, social sciences, etc. , the rest of the world does everything described in the MDD and more to reach acceptable results.
- One way of reducing the challenge of the MDD is to pick the projects to be appraised and then compute out the organizational unit to which the appraisal would apply.

Reverse Engineering the Organization from the Appraisal

- Three SCAMPI MDD 1.2 rules drive the reverse engineering:
  - We must document the number of people in the appraisal's organizational scope divided by the number of people in the organizational unit (x100)
  - We must document the number of projects in the appraisal's organizational scope divided by the number of projects in the organizational unit (x100)
  - We must understand and identify critical factors that influence implementation of practices in projects and functions within the organizational unit.

Reverse Engineering Assumptions

- In documenting the appraisal, we assume that:
  - Higher population and project percentages are desirable versus lower percentages.
  - Any factor setting that is NOT covered in the appraisal cannot be attributed to the organization.

Reverse Engineering: Step 1

a. Write down a critical factors table, as discussed earlier, for the projects in the appraisal.
b. Select the "maximum desired organizational unit" to be represented with the appraisal.
c. Prune the "maximum desired" OU down to a "maximum possible" OU by checking the critical factors table for combinations of factor settings that are never examined—projects that contain these factor setting combinations must be excluded from the organizational unit.
   - For instance, if "customer type" could be "state government", "federal government", or "commercial", but the critical factors table includes only settings of "state government" or "federal government" then the maximum possible organizational unit CANNOT include "commercial" projects.
   - Note: there is a procedure to compute the organization from the factor settings. However, the procedure involves solving a set of linear equations modulo the number of factors and is too involved to discuss here.

Reverse Engineering: Step 2

a. Determine the population and project percentages that you believe are acceptable for a SCAMPI A appraisal.

b. Given the maximum organization determined by the factors coverage from step 1, compute the population and project percentages for the actual appraised projects compared to this maximum organization.
   - If the computed population and project percentages from step 2b are greater or equal to the limits in step 2a, then the organizational unit may be set to the maximum organization for the appraisal.
   - If the computed population and project percentages from step 2b are less than the limits in step 2a, then reduce the scope of the maximum organization until the actual population and project percentages are greater than or equal to the limits set in 2a. The organizational unit for the appraisal is this reduced maximum organization.

Summary

- We want to pick the right projects for an appraisal in order to:
  - Maximize the information gained about an organization's process implementation,
  - Minimize the cost and risk of the appraisal, and
  - Produce results that are credible to the larger process improvement community.
- We've discussed a number of approaches for achieving these goals based on our appraisal experiences and using mathematical techniques such as design of experiments.
  - The methods we've discussed require tools no more complex than MS Excel.

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Dr. Richard D. Stutzke

Richard D. Stutzke, Ph.D. was Vice-President, Science Applications International Corp. (SAIC), and has more than 40 years experience with software development and project management in the military and industry, including scientific, embedded real-time, and commercial systems. He has authored over fifty papers and articles on software estimation and management, and the book "Estimating Software-Intensive Systems: Projects, Products, and Processes" published by Addison-Wesley in 2005.

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DEFINING THE FUTURE

Extracting Strategic Value from CMMI

CMMI Technology Conference & User Group
13-16 November 2006

Rick Hefner, Ph.D.
Director, Process Initiatives
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Background

- **Many organizations have implemented the Capability Maturity Model Integrated (CMMI)**
- **Although they have achieved their desired maturity level and improvement goals, some organizations have seen little or no financial benefits**

What are the underlying principles of CMMI as they relate to productivity, predictability, and speed?

What is the return on investment?

What are the timelines for realizing these benefits?

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Agenda

- How Do Mature Processes Help?
- Knox Cost of Quality model
- Industry ROI data for CMMI
- Why ROI data doesn't always help
- Extracting strategic value from CMMI

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Projects Have Historically Suffered from Mistakes

People-Related Mistakes

1. Undermined motivation
2. Weak personnel
3. Uncontrolled problem employees
4. Heroics
5. Adding people to a late project
6. Noisy, crowded offices
7. Friction between developers and customers
8. Unrealistic expectations
9. Lack of effective project sponsorship
10. Lack of stakeholder buy-in
11. Lack of user input
12. Politics placed over substance
13. Wishful thinking

Process-Related Mistakes

14. Overly optimistic schedules
15. Insufficient Risk Management
16. Contractor failure Insufficient planning
17. Abandonment of planning under pressure
18. Wasted time during the fuzzy front end
19. Shortchanged upstream activities
20. Inadequate design
21. Shortchanged quality assurance
22. Insufficient management controls
23. Premature or too frequent convergence
25. Omitting necessary tasks from estimates
26. Planning to catch up later
27. Code-like-hell programming

Product-Related Mistakes

28. Requirements gold-plating
29. Feature creep
30. Developer gold-plating
31. Push me, pull me negotiation
32. Research-oriented development

Technology-Related Mistakes

33. Silver-bullet syndrome
34. Overestimated savings from new tools or methods
35. Switching tools in the middle of a project
36. Lack of automated source-code control

Standish Group, 2003
survey of 13,000 projects

- 34% successes
- 15% failures
- 51% overruns

Reference: Steve McConnell, Rapid Development

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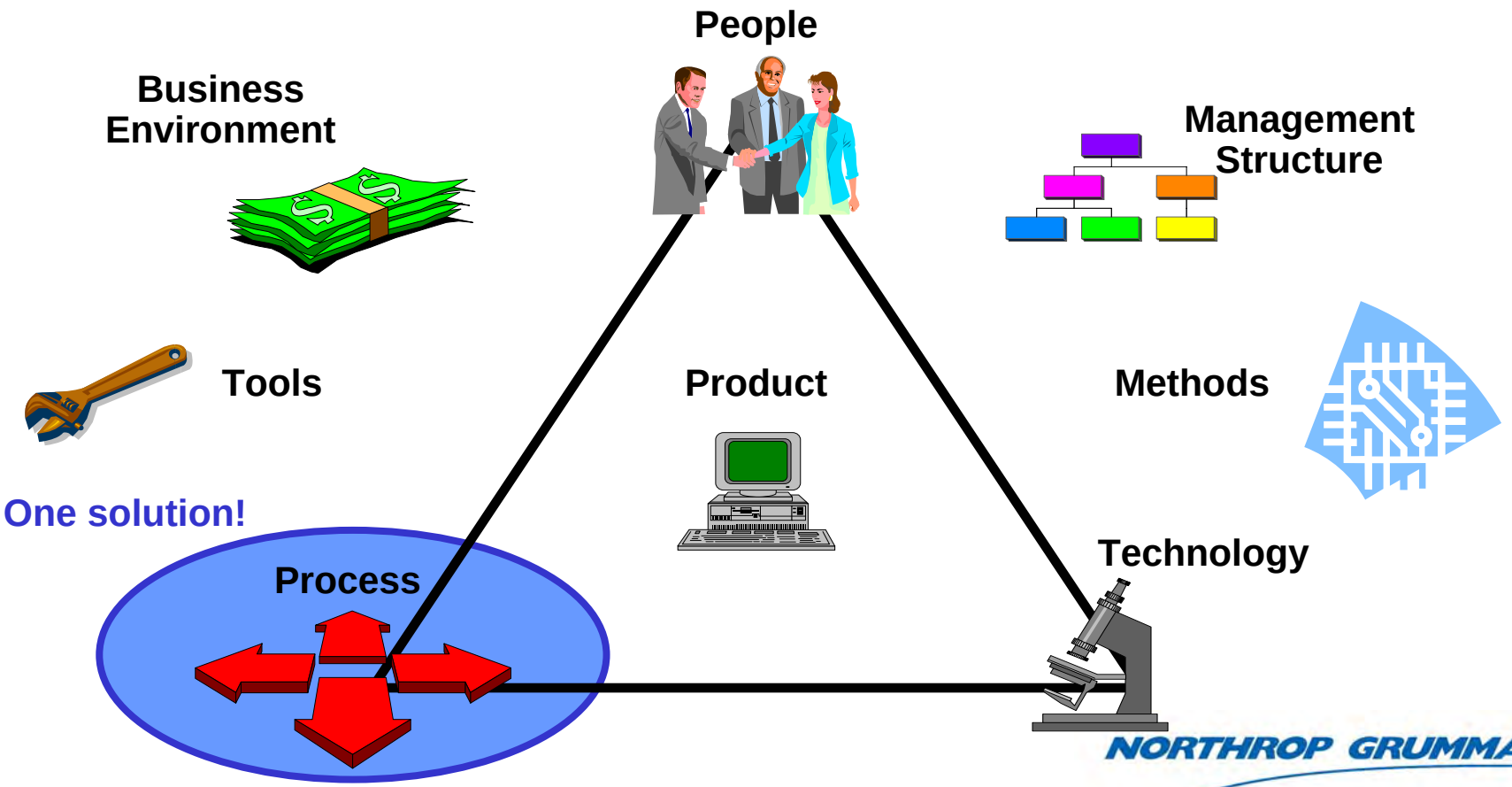
Many Approaches to Solving the Problem

- Which weaknesses are causing my problems?
- Which strengths may mitigate my problems?
- Which improvement investments offer the best return?



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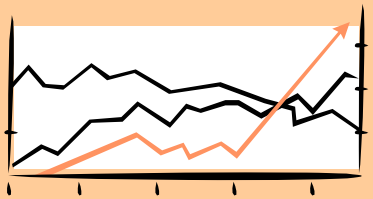
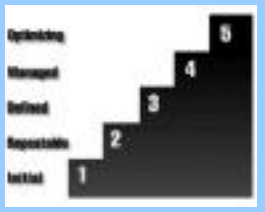
Approaches to Process Improvement

Data-Driven (e.g., Six Sigma, Lean)



- **Clarify what your customer wants (Voice of Customer)**
  - Critical to Quality (CTQs)
- **Determine what your processes can do (Voice of Process)**
  - Statistical Process Control
- **Identify and prioritize improvement opportunities**
  - Causal analysis of data
- **Determine where your customers/competitors are going (Voice of Business)**
  - Design for Six Sigma

Model-Driven (e.g., CMM, CMMI)



- **Determine the industry best practice**
  - Benchmarking, models
- **Compare your current practices to the model**
  - Appraisal, education
- **Identify and prioritize improvement opportunities**
  - Implementation
  - Institutionalization
- **Look for ways to optimize the processes**

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How Do Mature Processes Help?

- **Process maturity gets at one source of the problem, e.g.,**
  - Are we using proven industry practices?
  - Does the staff have the resources needed to execute the process?
  - Is the organization providing effective project support?
- **The main benefits typically seen are:**
  - Improved predictability of project budgets and schedules
  - Improved management awareness of problems
  - Reduced re-work, which improves predictability, cost, and schedule

J. Herbsleb and D. Zubrow, "Software Process Improvement: An Analysis of Assessment Data and Outcomes"

- 13 organizations
- ROI of 4:1 to 9:1
- Improved quality, error rates, time to market, productivity

R. Dion, "Process Improvement and the Corporate Balance Sheet"

- ROI of 7.7:1: Reduced re-work, improved quality
- Two-fold increase in productivity

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The Knox Cost of Quality Model

- **Extension of the Cost of Quality model used in manufacturing**

Cost	Category	Definition	Typical Costs for Software
Conformance	Appraisal	Discovering the condition of the product	Testing and associated activities, product quality audits
	Prevention	Efforts to ensure product quality	SQA administration, inspections, process improvements, metrics collection and analysis
Non-conformance	Internal failures	Quality failures detected prior to product shipment	Defect management, rework, retesting
	External failures	Quality failures detected after product shipment	Technical support, complaint investigation, defect notification

"Knox's Theoretical Model for Cost of Software Quality," Digital Technical Journal, vol.5, No. 4., Fall 1993, Stephen T. Knox.

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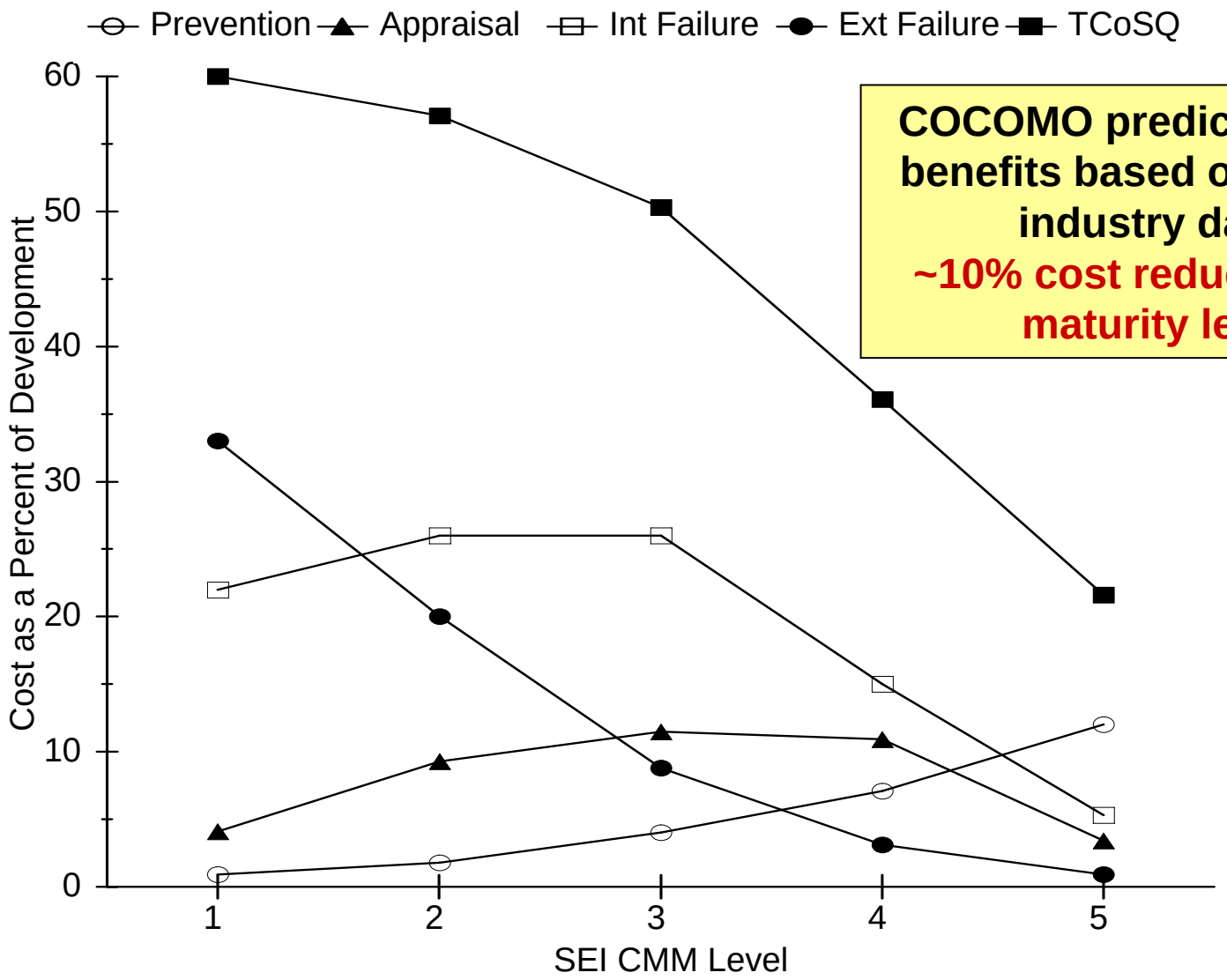
Knox Model – Theoretical Benefits



COCOMO predicts similar benefits based on current industry data:
~10% cost reduction per maturity level

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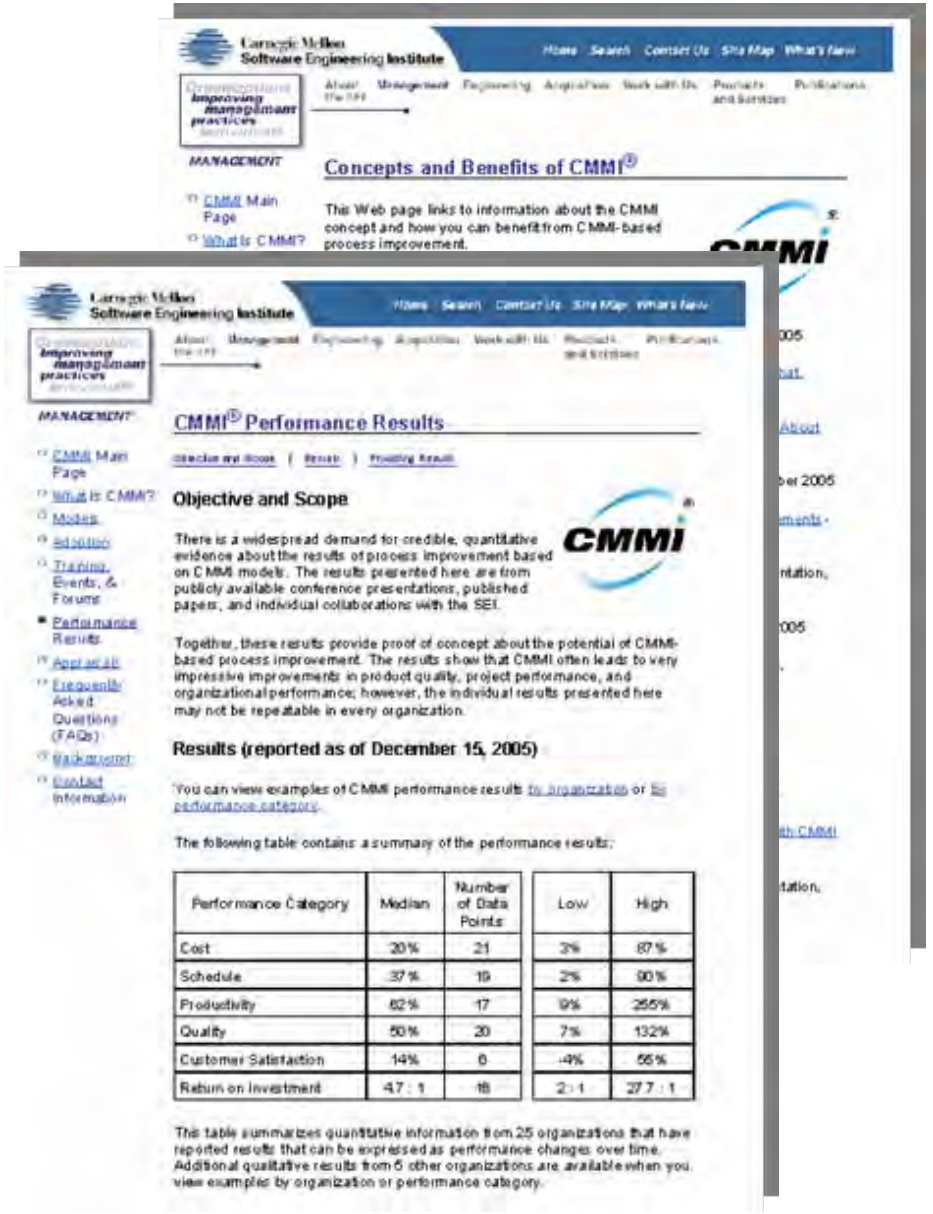
Benefits



- **Numerous studies have been published on the benefits of CMMI**
- ***Performance Results of CMMI-Based Process Improvement (CMU/SEI-2006-TR-004)***
- **CMMI Performance Results website: http://www.sei.cmu.edu/cmmi/results.html.**

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Typical CMMI Benefits Cited in Literature

- **Reduced Costs**
  - 33% decrease in the average cost to fix a defect (Boeing)
  - 20% reduction in unit software costs (Lockheed Martin)
  - Reduced cost of poor quality from over 45 percent to under 30 percent over a three year period (Siemens)
  - 10% decrease in overall cost per maturity level (Northrop Grumman)
- **Faster Schedules**
  - 50% reduction in release turnaround time (Boeing)
  - 60% reduction in re-work following test (Boeing)
  - Increase from 50% to 95% the number of milestones met (General Motors)
- **Greater Productivity**
  - 25-30% increase in productivity within 3 years (Lockheed Martin, Harris, Siemens)
- **Higher Quality**
  - 50% reduction of software defects (Lockheed Martin)
- **Customer Satisfaction**
  - 55% increase in award fees (Lockheed Martin)

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Why Do We Need ROI Data?

- **Management wants to invest overhead resources wisely**
  - Similar investment decisions are often based on “gut feel”, not hard data – does anything else seem more likely to yield results?
  - Investment decisions may be more driven by balance of short-term performance tactics and long-term marketing strategy
  - The key question is whether you could make similar progress with less resources (or more/faster progress with the same resources doing something else)
- **Projects want to justify the investment to their customers**
  - Difficult to convince process skeptics
  - People view the problem from their own experiences and skills

Beware of ROI as a smokescreen for process skepticism

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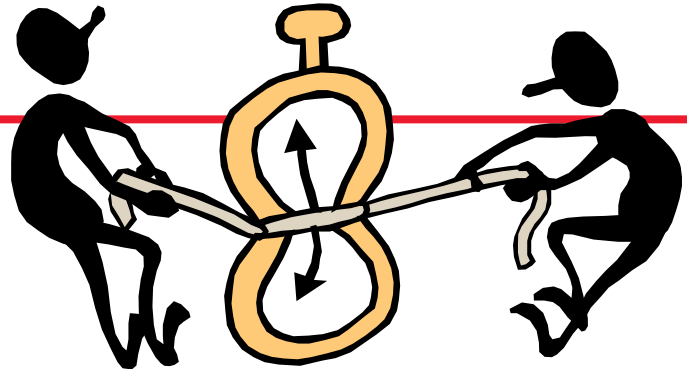
Establishing ROI



- **It is difficult to quantify the value of an improvement initiative**
- **How do you measure the change?**
  - Multiple levels – organizational, management, engineering, support
  - Multiple causes – awareness, knowledge, infrastructure
  - Short-term vs. long-term – Hawthorne effect
- **How do you measure the investment?**
  - What would we have done instead?
- **How do you determine the value of the measured change?**
  - Increased predictability – what's the value?
  - Increased productivity – who gets the benefit?
  - Better competitive position – how measured?
  - Time-frame

See also: S. Sheard and C.L. Miller , "The Shangri-La of ROI," Software Productivity Consortium, 2000

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Where the Problem Sometimes Arises

- Some organizations are driven to achieve a maturity level only for it's marketing value

Improvement goals are not set realistically ("Level 5 in '05")	No one takes the improvement effort seriously
Only some of the projects participate in the improvement effort	Personnel perceive CMMI as more expensive
Only some of the projects get appraised	Others don't implement; perceived as "done for show"
Insufficient resources (e.g., training, QA, metrics, consultants)	People don't learn the new behaviors or become proficient
Management doesn't enforce the process	Perceived as "done for show"; benefits are not realized

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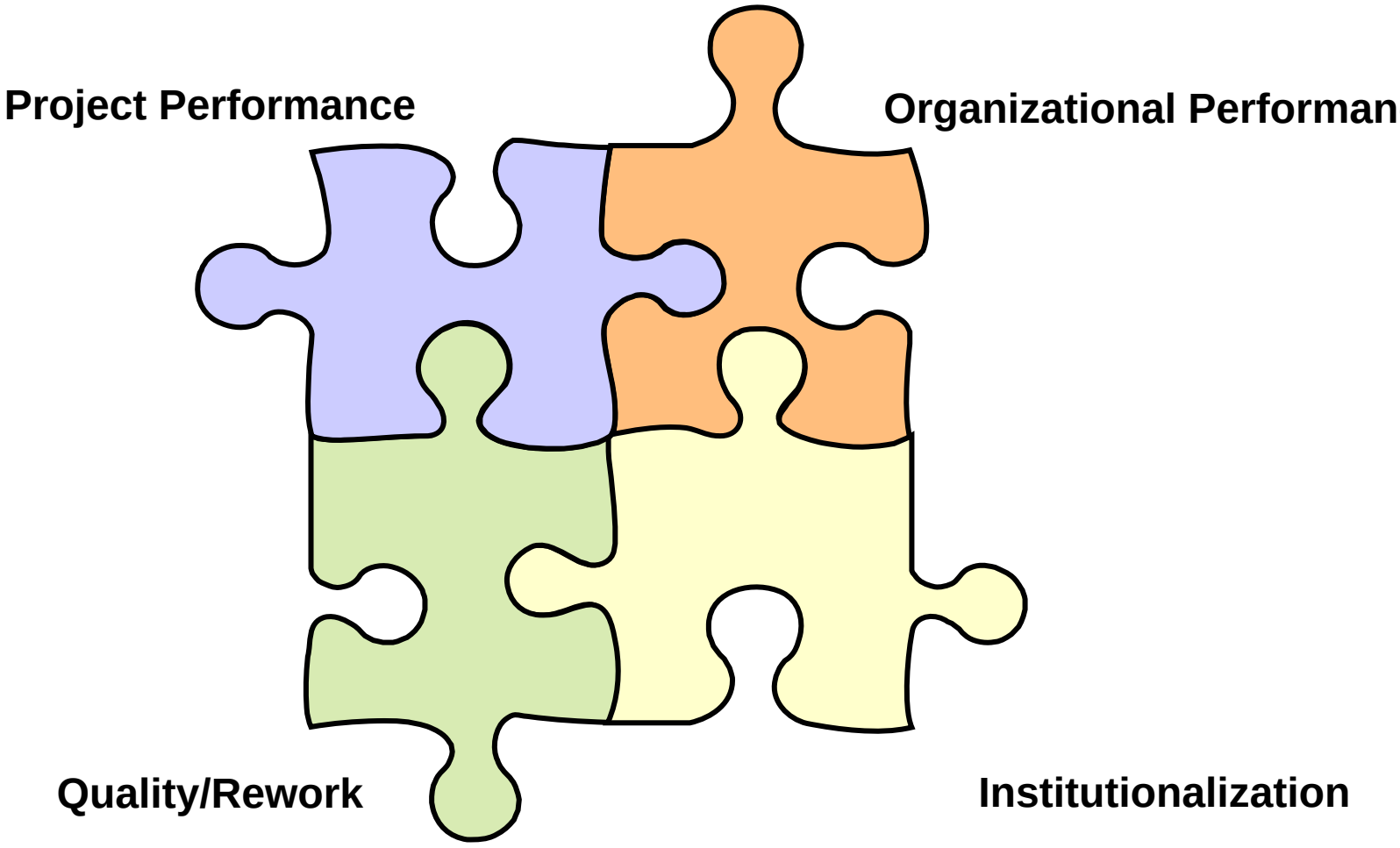
Extracting Strategic Value from CMMI



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Project Performance

- **Project performance problems often arise because of incomplete or unrealistic planning**
  - Forgotten activities
  - Unconscious decisions
  - Overly-optimistic estimates
- **When cost/schedule pressure arises, people abandon the plans, leading to more problems**
  - Individual judgment versus best use of resources

CMMI

- **Identifies the elements of good planning**
  - Proven engineering processes
  - Estimates based on historical data, using these processes
- **When cost/schedule pressure arises, CMMI practices track and correct**
  - Reactive (L2)
  - Proactive, risk management (L3)
  - Quantitative management (L4)
- **QA, management ensures processes/plans are followed**

- ***Train project managers on how to use the tools (estimation, earned value, risk management)***
- ***Project managers (not organizational staff) must be responsible for implementing the improved processes***
- ***Demand realistic, data-driven estimates***

"Project Implementation Strategies in the CMMI," R. Hefner, Wednesday, 3:30

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Organizational Performance

- **Each project's processes are unique**
  - Personnel must re-learn with each project
  - Difficulty moving people from project to project
  - Historical data of little use in estimation
- **No way to compare project-to-project**
  - Which process was best?
  - What did we learn?

CMMI

- **Standard organizational process, tailored to fit each project**
  - Can be documented, trained, supported by templates
  - Over time, people learn the process
- **Common processes/measures allow better use of historical data**
  - Calibrate cost estimation models
  - Project to project comparisons
  - Over time, the organization can optimize the process

- ***Develop an organizational process(es) which fits the full range of your projects (small/large, all life cycles and project types)***
- ***Capture and use historical data (measurement repository)***
- ***Capture and share project documents (process asset library)***

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Rework / Quality

- **Focus on "faster and cheaper" leads to skipping of essential steps**
  - Key steps are not obvious, often counter intuitive
- **Fixing latent defects often accounts for 30-40% of project cost**
  - The cost of defects (rework) is seldom measured

CMMI

- **A disciplined engineering and management process**
  - Do it right the first time
  - CMMI identifies the essential steps
- **Peer reviews find defects early, where it is cost effective to fix them**
  - Requirements, designs, code, plans, etc.
  - Often more efficient and effective than testing
  - Many types (Fagan inspections, walkthroughs, desk checks, etc.)

- ***Focus on eliminating defects, not on faster and cheaper***
- ***Measure the cost of finding and fixing defects***
- ***Invest time in learning different methods of peer review and when each is effective***

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Institutionalization

- **Some improvement efforts focus on quick fixes**
  - Driven by yearly budget cycles
  - Expectation that results will be immediate
- **It is tempting to reduce overhead to reduce cost**
  - Training
  - Staff support to projects
  - Use of outside process experts

CMMI

- **Short-term investment for long-term gain**
  - Initial investment in the cost of change, learning curve, new overhead structures
  - Long-term benefits in increased productivity
- **Organizational infrastructure exists to support the policies and process**
  - Measurement repositories

- ***Expect 18-24 months before benefits begin to be realized***
- ***Senior management must demand that <u>everyone</u> follow the new processes***
- ***QA can be the organization's strongest tool – if they are focused!***

"Sustaining CMMI Compliance," R. Hefner, Thursday, 10:15

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Lessons Learned

- **Process improvement means changing the process**
  - More important to learn the new behaviors than to “go through the motions”
- **Resistance often comes from fear of failure**
  - Walk the talk -- management at all levels must communicate the need for continuous improvement
  - Focus on learning from your mistakes and getting better
  - Training and assistance helps people in trying new processes
- **Six Sigma is a strong enabler for process improvement**
  - Focus on data, measurement systems, process improvement
  - Tying improvements to business goals
  - Allows the projects and organization to optimize the CMMI practices for maximum customer benefit

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Practical Earned Value Management Integrated with CMMI®-Compliant Processes

CMMI Technology Conference and User Group
November 13-16, 2006

Dr. Donn Milton
pragma Systems Corporation

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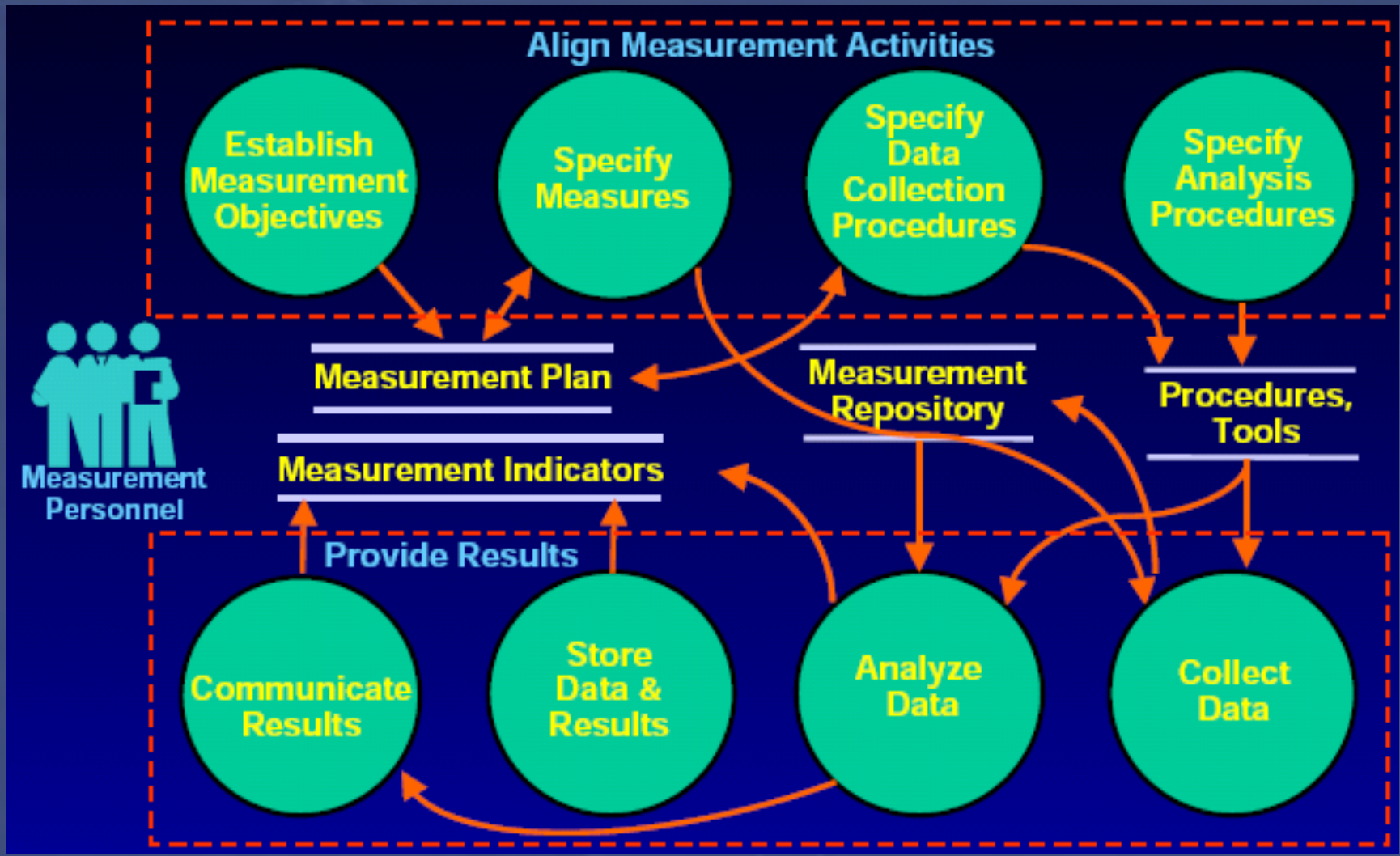
The Traditional View of Measurement & Analysis



Zubrow, David. *Measurement in a Process Framework*. Process and Methodology Seminar, Toronto, Canada, 2003. http://www.sei.cmu.edu/sema/pdf/zubrow_framework.pdf

Problems with the Traditional View

- Too many complex activities must be completed before any measurement and analysis can be performed
- Data collection is not integrated with process performance
- Concept of “measurement personnel with clipboards” is inefficient and ineffective

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Measurement Challenges

- Eliminate onerous and error-prone data collection procedures
- Deal with the large number of measures required by the CMMI in a consistent manner
- Enable customization of measure definition and reporting
- Integrate data collection with day-to-day work
- Enable real-time, fact-based management insight

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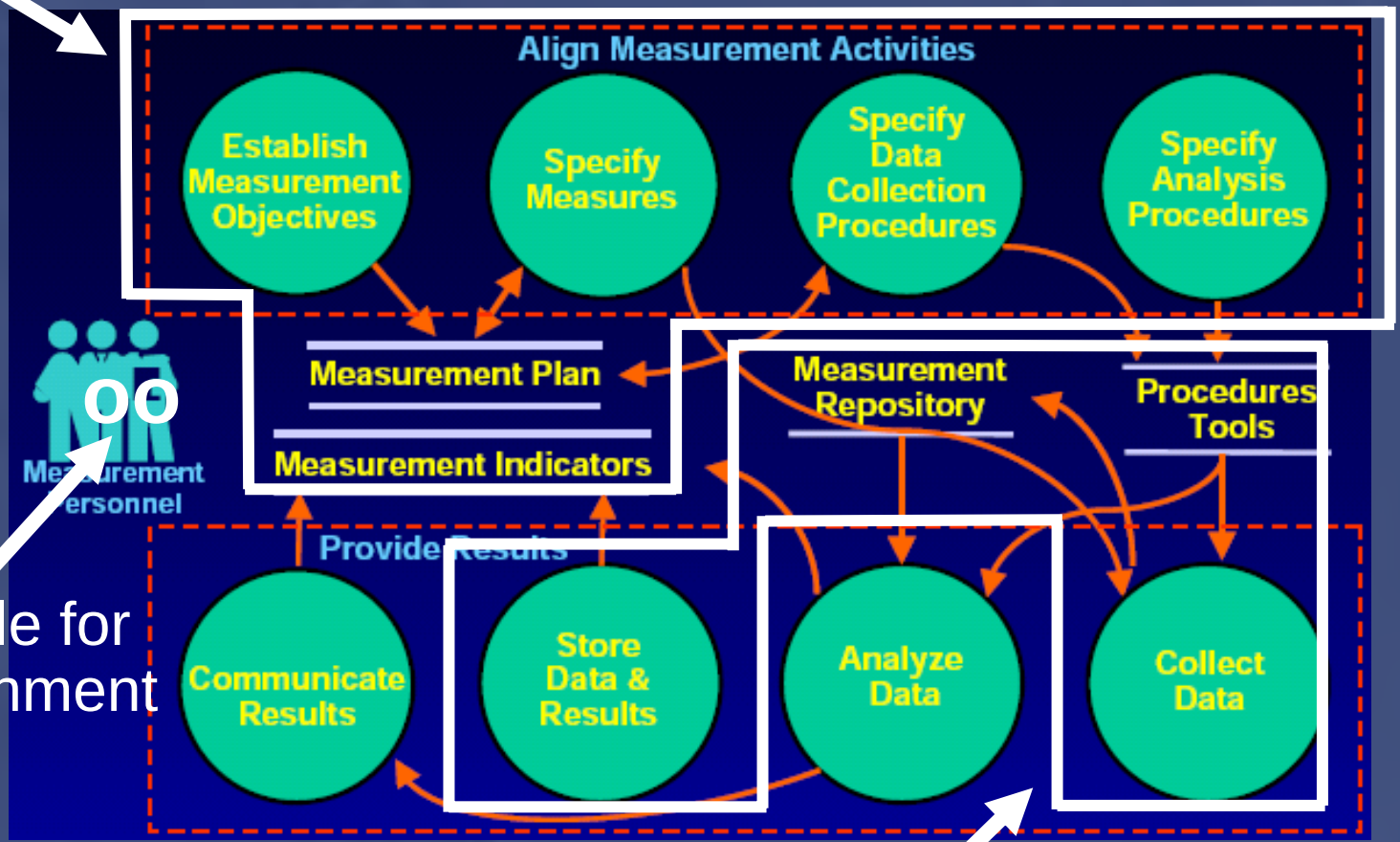
The processMax View of Measurement & Analysis

Pre-performed by processMax



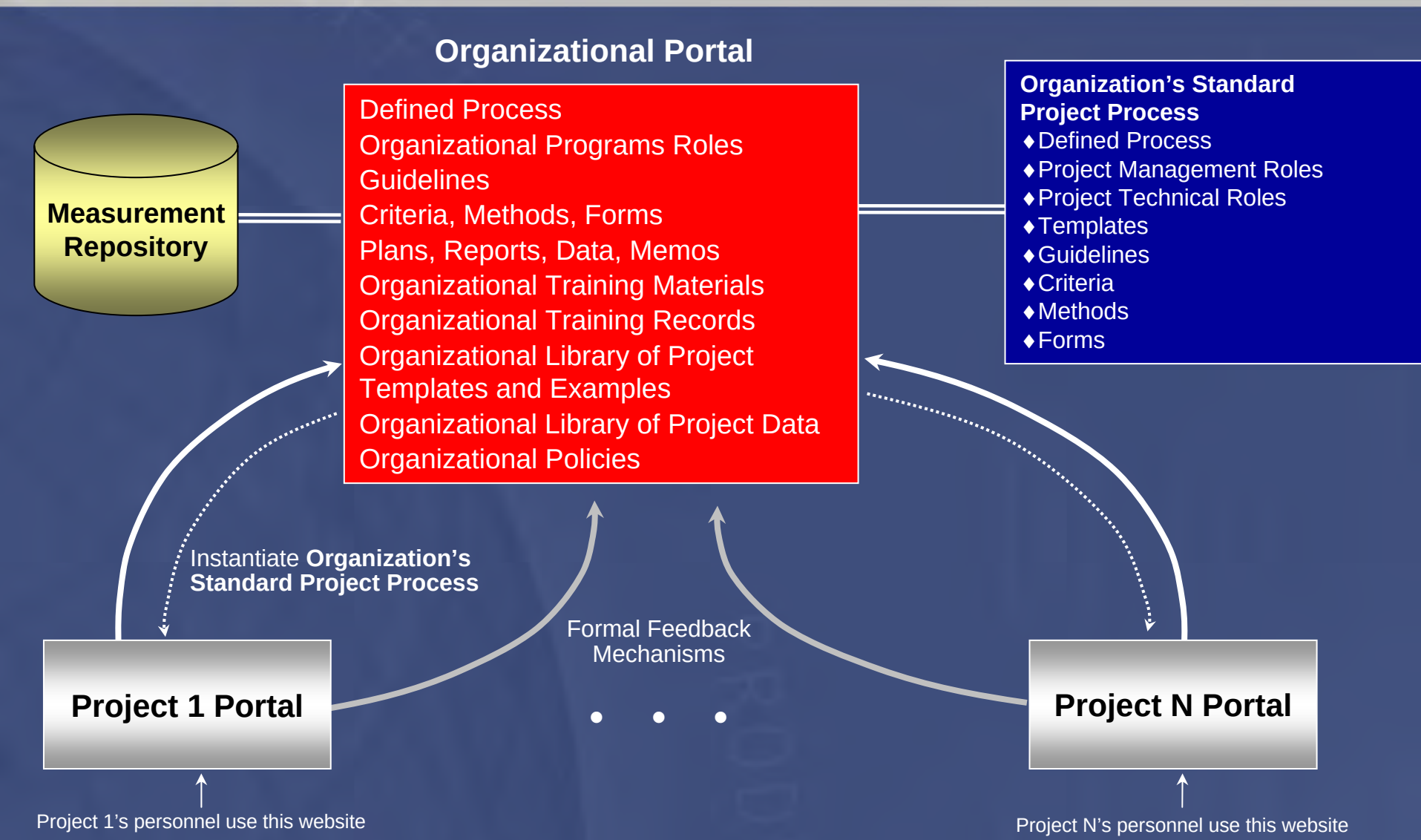
Available for Reassignment

Automated by processMax

processMax Measurement Approach

- Data is automatically captured at the source as user follows process steps
  - Timely
  - Accurate
  - Not subject to “revision”
  - No burden on users or measurement personnel
- As required or on a scheduled basis, a user initiates report generation
- Report generation accesses the Measurement Repository to retrieve relevant base measure data, generates and stores the report in the project repository
- Any other user can browse the stored report, with drill-down

processMax
Organization–Project Structure



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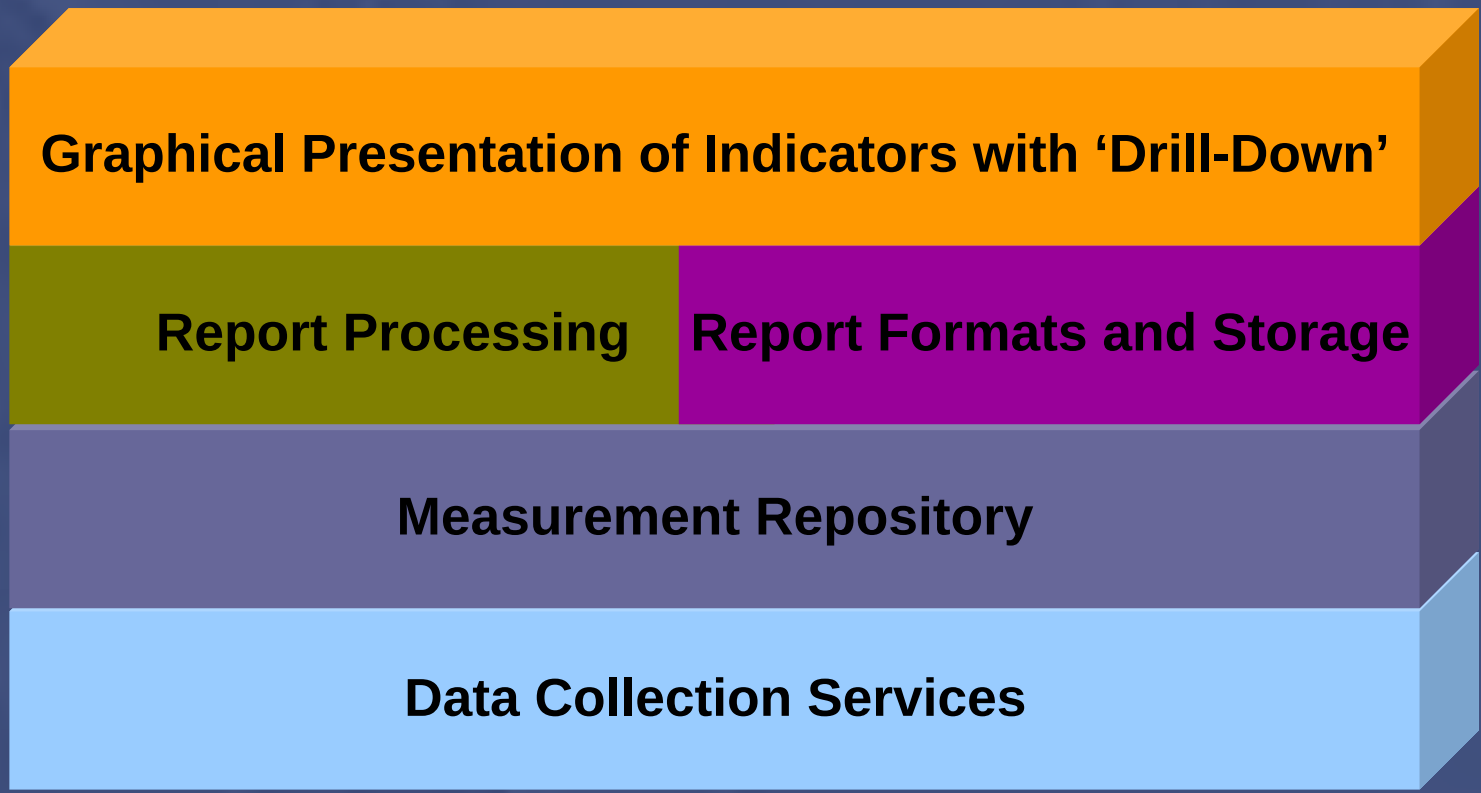
Automated Measurement & Reporting System



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Standards-Based Measurement

ISO/IEC 15939,

Software Engineering — Software Measurement Process

- Robust measurement process standard consistent with CMMI requirements
- ISO/IEC Measurement Information Model (MIM) provides structure that links information needs to relevant entities and their attributes

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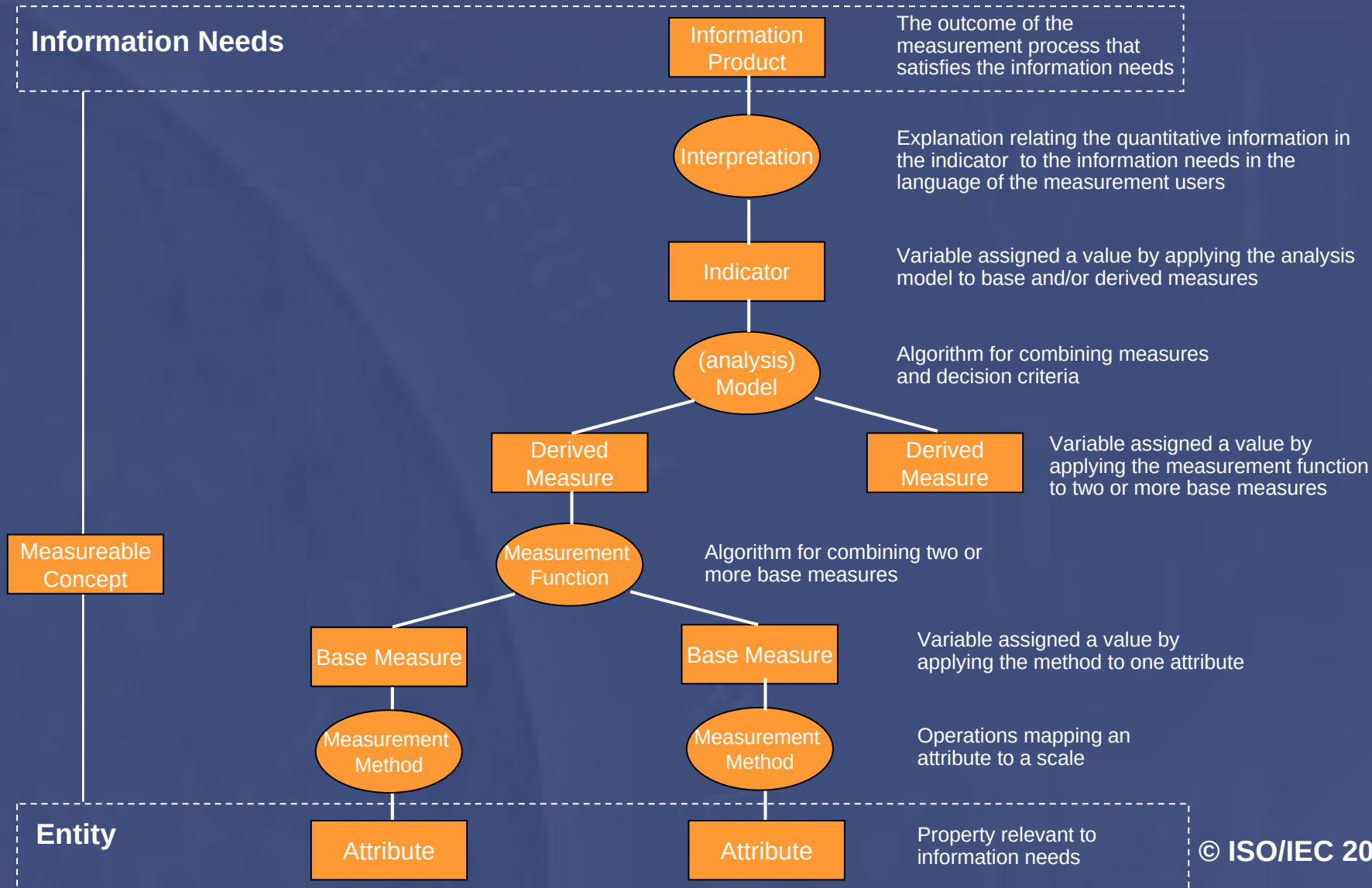
Key Relationships in ISO/IEC MIM



© ISO/IEC 2002

CMMI Level 3 for Software and Systems Engineering

- Measurement Objectives – 19
  - Approximately equivalent to the Purpose section of each Process Area (answers the question “Why are we measuring these particular items?”); associated with one or more Information Needs
- Information Needs – 24
  - Correspond approximately to PMC SP 1.1 and GP 2.8 of each Process Area; associated with one or more Indicators
- Indicators – 83
  - Trends or snapshots relying on Derived Measures and/or Base Measures
- Derived Measures – 115
  - Values that are functions of Base Measures and/or other Derived Measures
- Base Measures – 156
  - Information derived from a single attribute, independent of other Base Measures

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Why Earned Value Management?

Enables determination of schedule variance

Enables determination of “true cost variance”, not distorted by schedule performance

Not possible with traditional budget vs. actual cost tracking

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Basic Concepts of Earned Value Management

- Plan all work for the program
- Integrate work scope, schedule, and cost objectives into a baseline plan
- Objectively assess accomplishments
- Analyze significant variance from the plan and forecast impacts
- Provide data for higher level management decision making and implementation

Earned Value Management Systems, ANSI/EIA-748-A-1998.

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Look familiar?

Project Planning

SG 1 Establish Estimates

Estimates of project planning parameters are established and maintained.

SG 2 Develop a Project Plan

A project plan is established and maintained as the basis for managing the project.

Project Monitoring and Control

SG 1 Monitor Project Against Plan

Actual performance and progress of the project are monitored against the plan.

SG 2 Manage Corrective Action to Closure

Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan.

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Strong CMMI-EVMS Relationships

CMMI Process Area	EVMS Guideline from EIA-748-A, Earned Value Management Systems, Jan. 2002) [Earned Value Management Maturity Model® Goal]
Project Planning	2.1a Work Breakdown Structure (WBS) [L2, Organizational, Goal 1] 2.1b Organization structure [L2, Organizational, Goal 2] 2.2a Schedule of authorized work [L3, Planning, Goal 1] 2.2b Progress indicators [L3, Planning, Goal 2] 2.2c,d Control account budget baseline [L2, Planning, Goals 1; L3, Planning, Goal 3] 2.2e Work packages [L2, Planning, Goal 2]
Project Monitoring and Control	2.4a,b Schedule/cost variance analysis [L2, Analysis, Goal 1] 2.4c Indirect cost variance [Level 3, Analysis, Goal 3] 2.4d Element summary [Level 3, Analysis, Goal 4] 2.4e Managerial actions [Level 2, Analysis, Goal 3] 2.4f Estimate at completion [Level 3, Analysis, Goal 5]
Integrated Project Management	2.1c Integration of plan, schedule, budget [L3, Organizational, Goal 1] 2.1e Integrate WBS and org structure [L3, Organizational, Goal 3] 2.2a Identification of task dependencies [L3, Planning, Goal 1] 2.2d Budgets for authorized work [L3, Planning, Goal 3] 2.4 a-f (see Project Monitoring and Control) 2.5a Incorporation of changes into budget and schedule [L2, Revisions, Goal 1] 2.5e Changes to performance measurement baseline [L2, Revisions, Goal 4]
Measurement and Analysis	2.2b Progress indicators [L3, Planning, Goal 2]

Solomon, Paul. *Using CMMI to Improve Earned Value Management*, CMU/SEI-2002-TN016

Essence of Earned Value Management

- Assign a target value to each scheduled work element (at an appropriate level of detail)
- As work elements are completed, their target values are “earned”
- Work progress is quantified by earned value, against which we can measure:
  - What was spent to perform the work
  - What was scheduled to have been accomplished

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Why Do CMMI and EVM Together?

- Ensure that processes are integrated
- Eliminate process conflicts and redundancies
- Reduce rework that is inevitable from sequential implementation
- Enable a common startup approach

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Bringing It All Together for Earned Value

- Measurement Objective
  - Ensure the project is being performed within its planning parameters (PMC)
- Information Need
  - Monitor schedule, effort, costs, resources, and estimates for work product and task attributes (PMC SP 1.1)
- Indicator
  - Trend of Cumulative Earned Value (PMC SP 1.1, Subpractices 1 & 2)
- Derived Measures (top-level)
  - Planned Value, Earned Value, Actual Cost, Cost Variance, Cost Variance Percentage, Cost Performance Index, Schedule Variance, Schedule Variance Percentage, Schedule Performance Index, Estimated Cost at Completion

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Earned Value

sum (Planned Cost to Date per Task where Task is Level of Effort,
Earned Value per Task Where Task is not Level of Effort)

Earned Value per Task Where Task is not Level of Effort

multiply (Percent Complete per Task where Task is not Level of Effort,
Planned Cost per Task where Task is not Level of Effort and
Actual Start Date is less than Date of Report)

Planned Cost per Task where Task is not Level of Effort and Actual Start Date is less than Date of Report

sum (Planned Other Direct Costs per Task,
Planned Labor Cost per Task where Task is not Level of Effort and
Actual Start Date is less than Date of Report)

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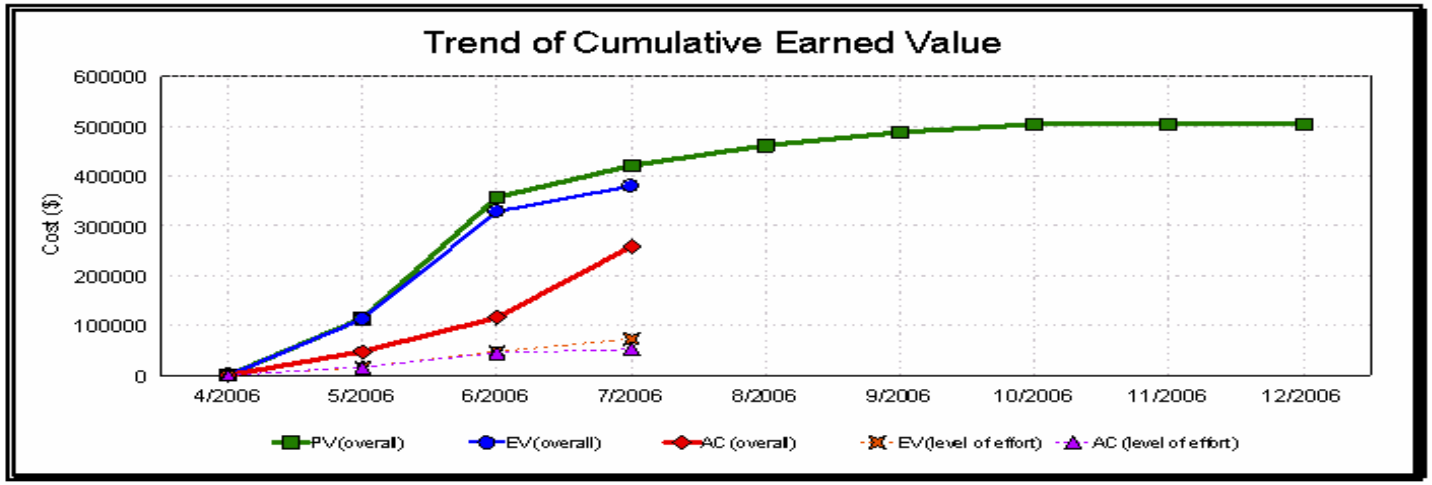
Trend of Cumulative Earned Value Report

N Progress And Performance Indicator - Microsoft Internet Explorer

Trend of Cumulative Earned Value

Portal Name: Project Andromeda (1.p.10000.10000) Analysis Method

Display Date: 07/12/2006 Page 1 of 2



Date	PV	EV	AC	Cost Variance	Schedule Variance	Performance Index		EAC
May 2006	$114,542.93	$112,630.74	$47,510.00	$65,120.74	($1,912.19)	Cost	2.37	$212,312.00
				57.82%	(1.67%)	Schedule	0.98	
June 2006	$357,001.27	$328,628.54	$115,310.00	$213,318.54	($28,372.74)	Cost	2.85	$176,607.09
				64.91%	(7.95%)	Schedule	0.92	
July 2006	$420,622.61	$380,152.64	$258,190.00	$121,962.64	($40,469.97)	Cost	1.47	$341,843.91
				32.08%	(9.62%)	Schedule	0.90	
August 2006	$461,142.61					Cost		

Summary & Benefits

- CMMI measurement and reporting is automated and centralized
- Robust and flexible measurement definition is based on ISO/IEC Measurement Information Model
- Measurement data is collected at the source, with no burden on users or measurement personnel
- A standard set of measures is instantiated for each project
- Full integration of Earned Value Management with procedures fully compliant with CMMI
- Real-time, fact-based management insight through web-enabled graphical reporting

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BLUE FORCE

SCAMPI-Bs for Contract Monitoring—A Case Study of the Mission Planning Enterprise Contractors

Lorraine Adams, SEI
Kathy Bastien, BlueForce LLC

November 15, 2006

Sponsored by the U.S. Department of Defense

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Agenda

- Background
- What is a PIER
- How PIER was Employed for MPEC
- How has PIER and the results change how the Program Office does business?
- Lessons Learned
- Way Ahead
- Summary

DOD Weapon Systems Acquisition Continues To Be High Risk Area

While DOD's acquisition process has produced the best weapons in the world, it also yields undesirable consequences in weapon system programs – cost increases, schedule delays, and performance shortfalls

Problems occur because weapon programs do not capture early on the requisite knowledge that is needed to effectively manage risks

Programs move forward with unrealistic cost and schedules estimates, lack clearly defined and stable requirements, use immature technologies, and fail to solidify design and manufacturing processes at appropriate junctures in development

As a result, programs require more resources than planned, the buying power of the defense dollar is reduced, and funds are not available for other competing needs

Paul Francis, Director
Acquisition and Sourcing Management
U.S. Government Accountability Office
May 18, 2004

GAO
Accountability * Integrity * Reliability

Problem Statement

A statement of organizational process maturity or capability level does not guarantee performance to that same level of proficiency on an individual project

Most DoD contractors claim high maturity/capability levels, yet from the perspective of the acquirer, systems engineering and program management practices are severely lacking

Teaming arrangements further cloud the issue of process execution and proficiency

Associated problems may not be evident until significant cost, schedule, or performance objectives have been missed at a late point in the program where corrective actions are very costly

How can the acquirer gain the necessary insight into process execution and proficiency as well as reinforce desired behaviors?

Agenda

Background

What is a PIER

How PIER was Employed for MPEC

How has PIER and the results change how the Program Office does business?

Lessons Learned

Way Ahead

Summary

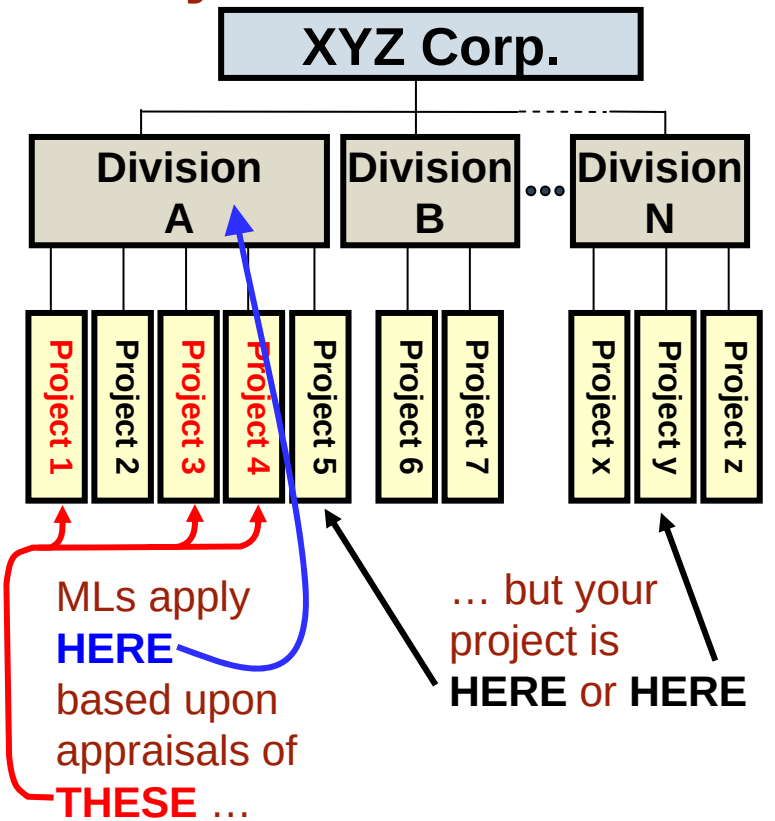
High Maturity Organizations

High Maturity Projects

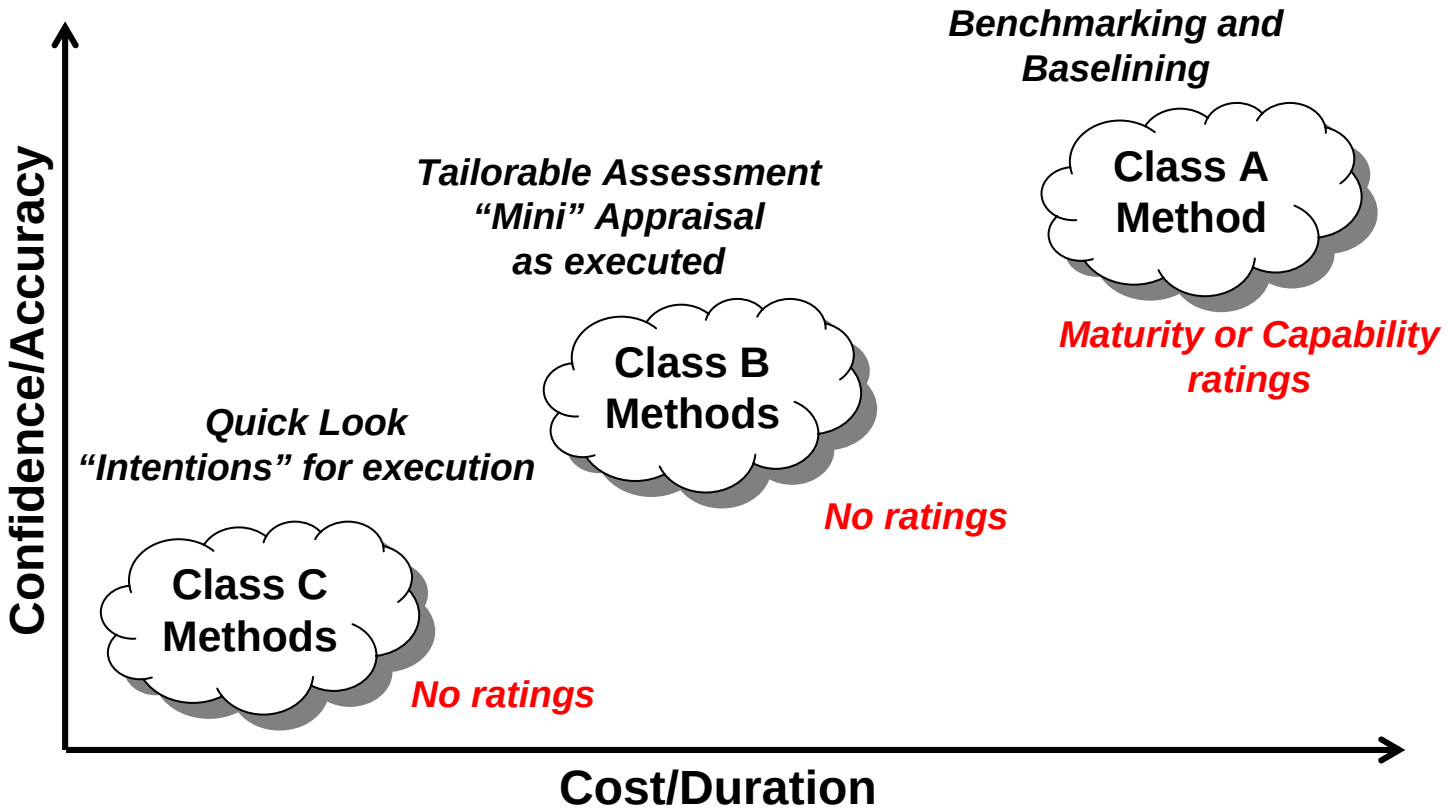
Maturity Levels are indicators of organizational *potential performance*.

They describe how the next project may *perform* based on a sampling of existing projects.

Maturity Levels reside at the organizational level and are not an indication of how an individual project *is performing*.



Standard CMMI Appraisal Method for Process Improvement (SCAMPI)



PIER Ground Rules

- **Use the process model – CMMI**
  - Interview questions based on model
- **Appraisal of process performance and adherence**
- **Focus on risk assessment – risks associated with process performance, adherence, and capability**
- **Observe strict confidentiality**
  - Results not attributable to individuals or interview groups
- **Approach SCAMPI collaboratively**
- **Results in actionable findings by Program Office and/or Contractor**

Agenda

Background

What is a PIER

→ How PIER was Employed for MPEC

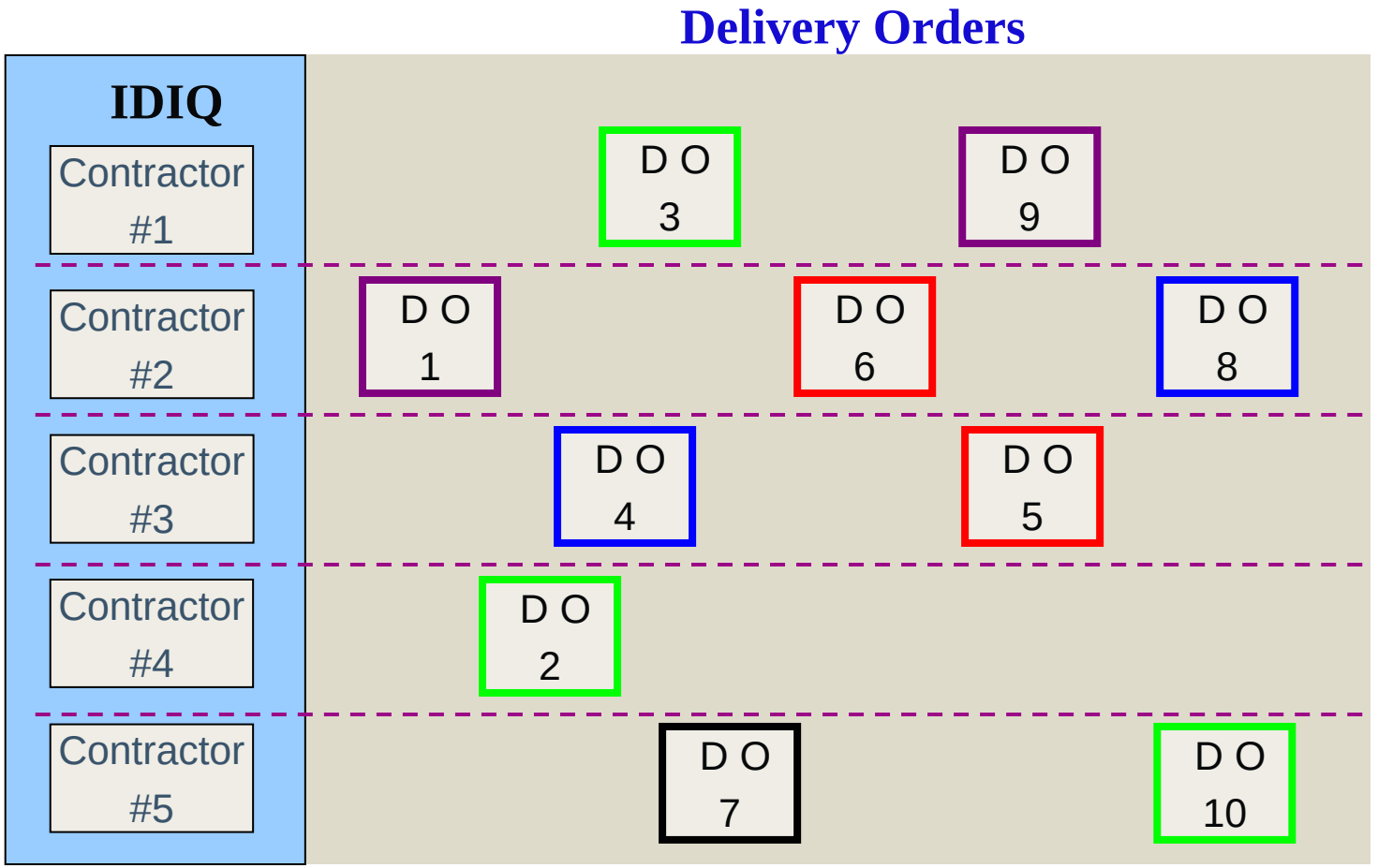
How has PIER and the results change how the Program Office does business?

Lessons Learned

Way Ahead

Summary

Mission Planning Contracting Structure



How PIER was Employed for MPEC

- **Used appraisals to baseline compliance with CMMI requirement**
  - demonstrate capability *or*
  - develop findings which yield improvement opportunities
- **One project would be selected from each contractor as a 'representative' of all Mission Planning projects for that contractor**
- **Appraisal findings would be used to assess progress toward meeting this the 24 month CMMI requirement**
  - Results to be factored into future DO competitions
- **Appraisal finding to be used for contract monitoring to identify areas of risk in project execution**
- **Appraisal findings resulted in request for Process Improvement Plans from the contractors**
  - Way ahead to fix findings in representative project
  - Way ahead to fix similar known deficiencies in all Mission Planning work

Agenda

Background

What is a PIER

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→ How has PIER and the results change how the Program Office does business?

Lessons Learned

Way Ahead

Summary

PIER Results have changed the way the Program Office does business

- **Contractor Process Improvement Plans and status are tied to contractor award fee**
- **RFP language has been modified to better reflect the program office desire for CMMI compliance across development teams – including subcontractors**
- **Based on input from appraisals, the program office is reviewing/modifying the standard CDRL list to get best ROI**
- **Business and technical rules for MP developers have been modified**
- **Program Office is modifying internal processes to better take advantage of information provided through contractor's standard processes (e.g. metrics)**

"In light of significant personnel cuts, we need to provide a smart way to provide a laser-like focus to our key issues. PIER reviews and EVM analysis provide that focus for us."

Steven A. Cote, GS-15, DAF
Deputy Director, 951st Electronic Systems Group

Agenda

Background

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How has PIER and the results change how the Program Office does business?

Lessons Learned

Way Ahead

Summary

Lessons Learned

Positive lessons / Benefits

- **Overcoming common misperceptions program offices have about CMMI**
  - What does a maturity level mean – *how is it attained*
  - Need to *understand the scope* of previous appraisals and certifications
    - Organizational unit appraised
- **More savvy consumers**
  - *Monitoring* is more necessary than people think
  - CMMI compliance and appraisal finding resolution should be tied into program office business activities
    - Award Fee Criteria (powerful motivator)
    - Business and Technical Rules
    - Proposal Evaluation Criteria
- **Appraisal results can be used to assist program management**
  - PMRs can *focus on areas of concern* based on findings
- ***Uncovering program risks* is more important than specific maturity levels – *real time contract monitoring is key***

Lessons Learned

Hard lessons / Ongoing challenges

- **Spirit vs. letter of the model**
  - Assure *intent of the model* is met versus using "checklist" mentality
  - Determine consistent approach to dealing with corporate "process lawyers"
  - Shouldn't judge "goodness", but you should judge *"reasonableness"*

- **Variability in the process itself, within the allowable scope of the method, can itself modify results**
  - Teams take on personalities based on membership (team members and lead appraisers)
    - Different personalities can provide inconsistent results
  - Need to ensure that decision criteria are *consistently applied*
  - Having a core group as a subset of each appraisal team provided a *consistent methodology* and *interpretation of evidence*

Agenda

Background

What is a PIER

How PIER was Employed for MPEC

How has PIER and the results change how the Program Office does business?

Lessons Learned

Way Ahead

Summary

Way Ahead -1

- **Mission Planning is reviewing options for verification of the November 2006 CMMI Maturity Level 3 requirement**
  - **Accept results of contractor SCAMPI As?**
    - Review of detailed appraisal results
  - **Conduct Program Office sponsored SCAMPI As?**
    - Requires core team to re-appraise contractors
  - **Verify completion of all process improvement activities outlined in approved Process Improvement Plan**

Way Ahead -2

- **How do we "maintain" the process improvement/process maturity focus to ensure consistent levels of performance/execution?**
  - **The Program Office is working to develop a multi-year plan for continual assessment/monitoring**
    - Additional appraisal for all contractors (cost/benefit)
    - "Spot check" areas of known deficiency
    - Appraisals for projects with performance issues
    - Appraisals for projects that fall within another organizational unit than "representative" project
- **Beginning to analyze PIER results against product quality to determine if there are correlations**
  - Could impact risk management/corrective actions in the future

Agenda

Background

What is a PIER

How PIER was Employed for MPEC

How has PIER and the results change how the Program Office does business?

Lessons Learned

Way Ahead

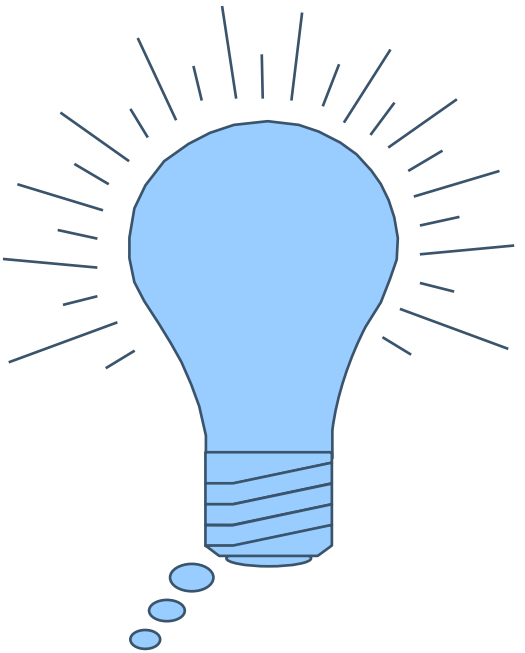
→ Summary

Summary

- **PIERs were very positive for Mission Planning**
  - Provided insight into contractor processes and potential program risks
- **Consistency is key**
- **Appraisal results have become a useful source of data to assist in program management activities**
  - PMs can focus attention on areas of the project that have highest risk due to inconsistent (or non-existent) standard processes
- **PIERs started as a way to do a "quick check" of contractor CMMI requirement compliance – and have now become a powerful management tool**

Savvy consumers can utilize PIERS as part of their management "tool box"

Questions



Carnegie Mellon
Software Engineering Institute

BLUE FORCE

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Applying CMMI
to the
DCMA Surveillance Strategy

Presented by:

John Eget
DCMA - Pittsfield

Nov 15, 2006

DCMA
Defense Contract Management Agency

Mission

DODD 5105.64, 9/27/2000: Mission – DCMA shall perform Contract Administration Services (CAS) for the DoD, other authorized federal agencies, foreign governments ….. and others as authorized. DCMA is a combat support agency of the DoD under the direction of USD (AT&L) performing CAS functions IAW the Federal Acquisition Regulation and DoD Federal Acquisition Regulation Supplement.

Topics to be Discussed

- **DCMA – Pittsfield Suppliers Time Line from CMMI Level 3 to CMMI Level 5**
- **Fundamentals of using CMMI Based Performance Management (CBPM) in a Performance Based Management (PBM) environment**
- **DCMA Pittsfield Method Description (CBPM methodology)**
- **Measurement Application using modified Practical Software Measurements (PSM) structure**
- **Surveillance Task/Action to CMMI Process Helper Guide**
- **DCMA Pittsfield Data Analysis and Use**

DCMA Pittsfield Suppliers Transition

- **CMM Level 3 - Prior to Nov 2003**
  - **Data recorded and analyzed using a CMM Based surveillance application**

- **CMMI Level 3 – Nov 2003 by contracted external assessment**
  - **Data recorded and analyzed using CMMI CBPM surveillance application**
- **CMMI Level 5 – Nov 2005 by contracted external assessment**
  - **Increased scope of PA coverage & Continued Data recording and analysis using CBPM surveillance application**

Institutionalization of a Process Change

- Initiate sponsorship and establish infrastructure
- Define Customer Outcomes (CO) and transfer to Memorandum of Agreement (MOA) elements
- Determine tasks/actions to be performed from MOA and select measurements to be collected/reported
- Establish priorities and develop measurement plan
- Initiate the measurement plan – start collecting and analyzing data
- Report DCMA surveillance analysis results to influence Customer Outcomes

CMMI Based - Surveillance Framework

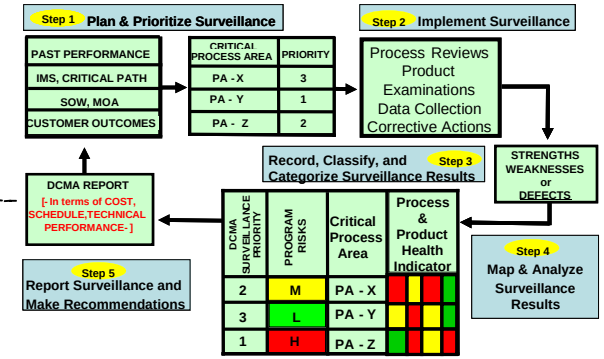
Step 1 Plan & Prioritize Surveillance

Step 2 Implement Surveillance

Record, Classify, and Categorize Surveillance Results **Step 3**

Step 4
Map & Analyze Surveillance Results

Step 5
Report Surveillance and Make Recommendations

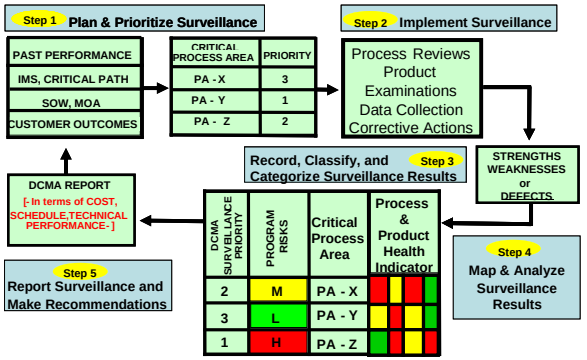


Plan and Prioritize Surveillance – Step 1

Customer Outcomes (CO) establishes Memorandum of Agreement (MOA) between Program Management Office (PMO) and DCMA

- **Analyze identified factors to determine and prioritize Critical Process Areas and Practices**
  - MOA specified tasks/actions
  - Past Performance
  - Integrated Master Schedule
  - Critical Path
  - Statement of Work

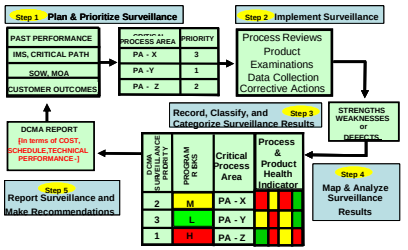
- **Develop DCMA Surveillance Plan**



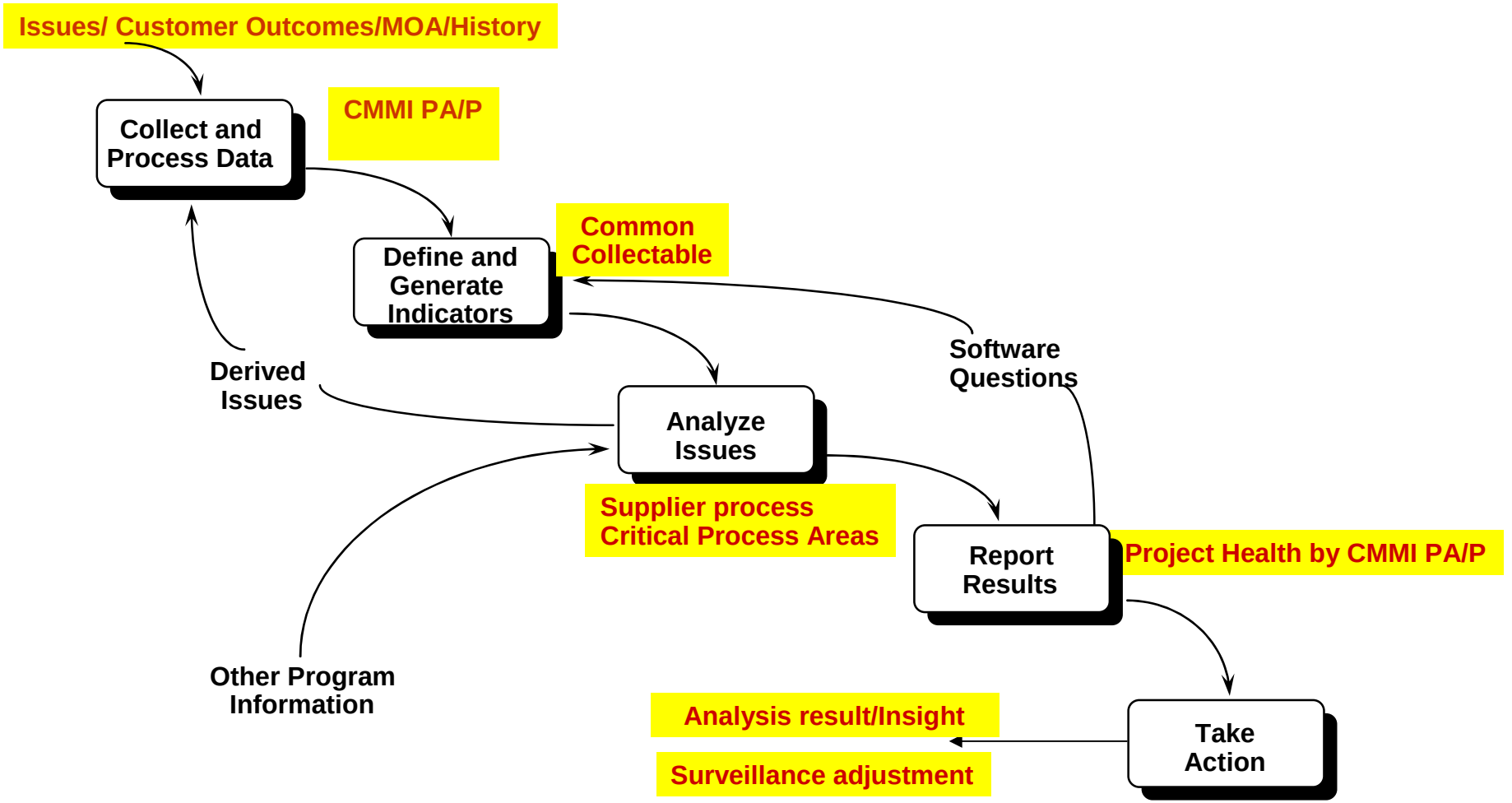
Implement Surveillance - Step 2

Perform Process Reviews, Product Examinations

- If necessary, issue Contractor Corrective Action (CAR) or Process Improvements (CIO)
- Tasks/actions for Process Reviews and Product Examinations determined in Planning and Prioritization
- Tailored PSM Measurement Application Process in Measurement Plan
- Practices observed determined By DCMA CMMI Helper Guide
- Record strengths as well as weaknesses



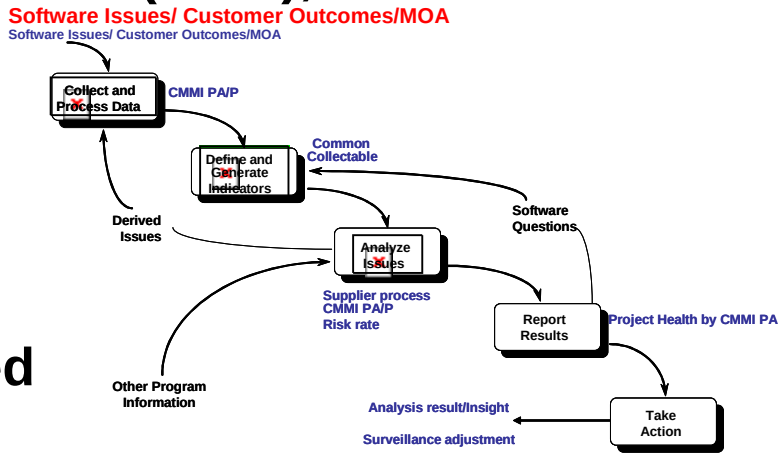
Tailored Measurement Application Process



Reference: www.psmsc.com

Tailoring the PSM Process

- **Memorandum of Agreement (MOA) is the primary driver for measurement requirements to satisfy Customer Outcomes (CO)**
- **The supplier's process defines how the software is to be measured throughout the life-cycle**
  - **Reconciliation of available metrics possible**
- **Collect, record, and analyze data to satisfy MOA derived tasks/actions, CMMI Process Areas/Practices (PA/P), and identified issues**
- **Apply independent analysis**
- **Use a structured approach to ensure analysis results are related to established Customer Outcomes**

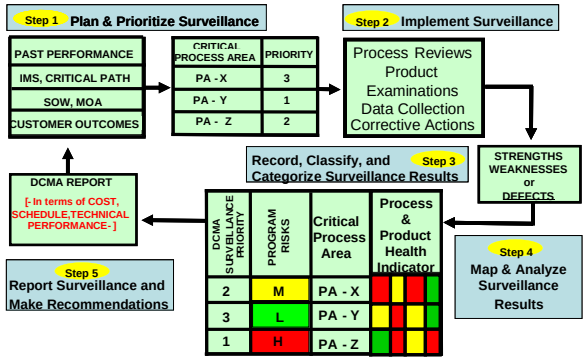


Record, Classify, and Categorize Surveillance Results – Step 3

Recording of surveillance in established CMMI Based - Performance Management database

- **Classification and weighting of surveillance results**

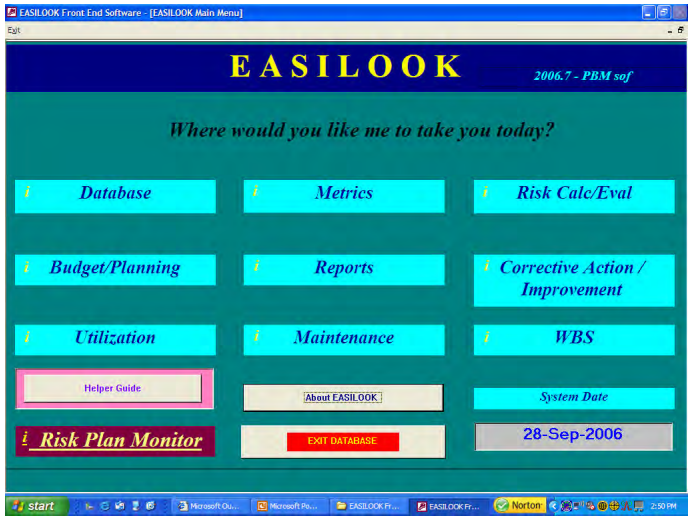
- **Categorize surveillance to related element**
  - **Customer Outcome (CO)**
  - **Memorandum of Agreement Task (MOA)**
  - **CMMI PA/P**
  - **Supplier Process**
  - **Process Risk**
  - **Development/Production Phase**
  - **Strength or Weakness**



CBPM database establishment

Each database record links the following:

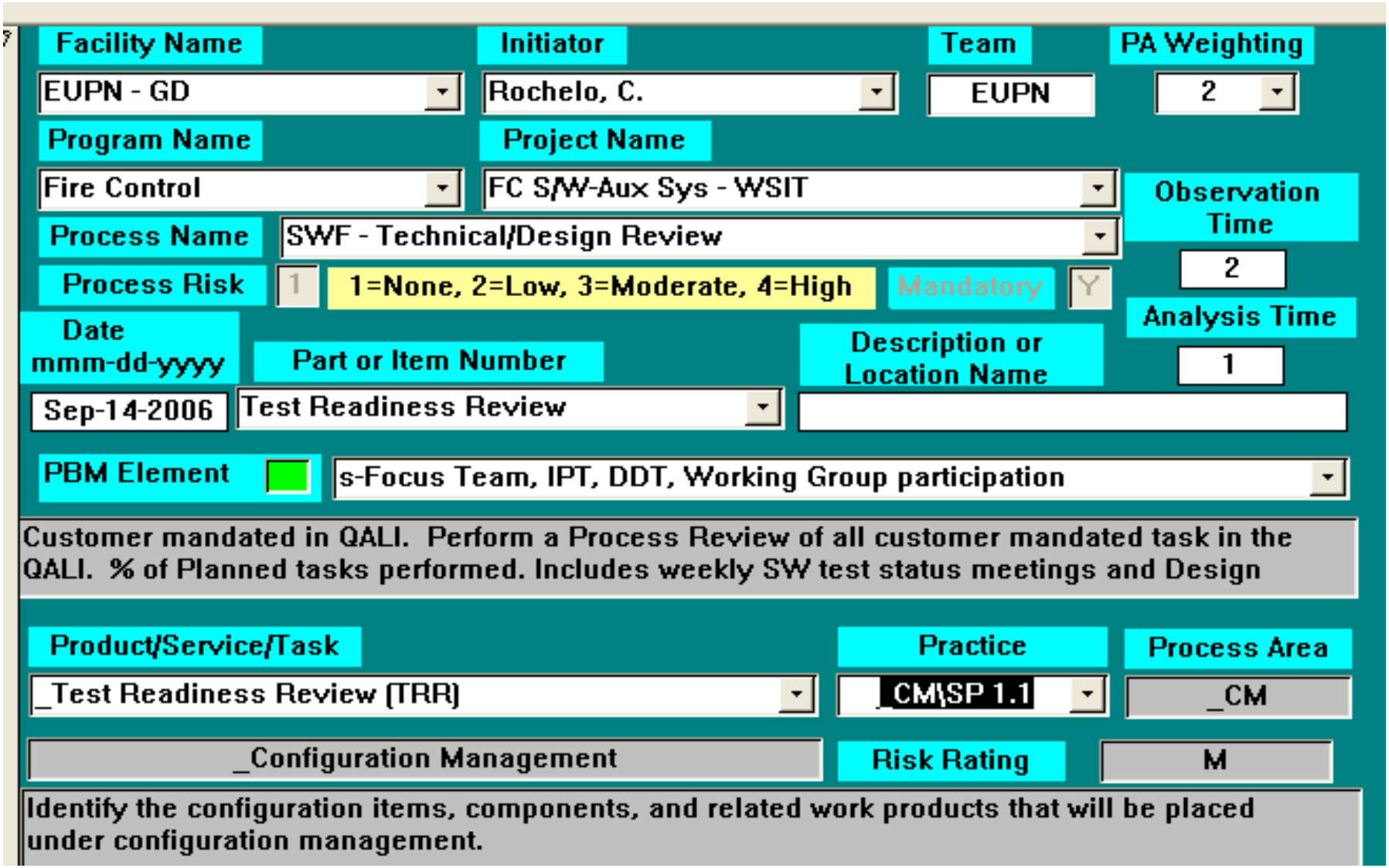
- **Date and individual**
- **Project**
- **Supplier Development/Production Process**
- **DCMA task/action**
- **Customer Outcome – Memorandum of Agreement element**
- **CMMI Process Areas/Practices**
- **Observations**
- **Defect with weight**
- **Root Cause with weight**
- **Corrective Action or Improvement Opportunity**



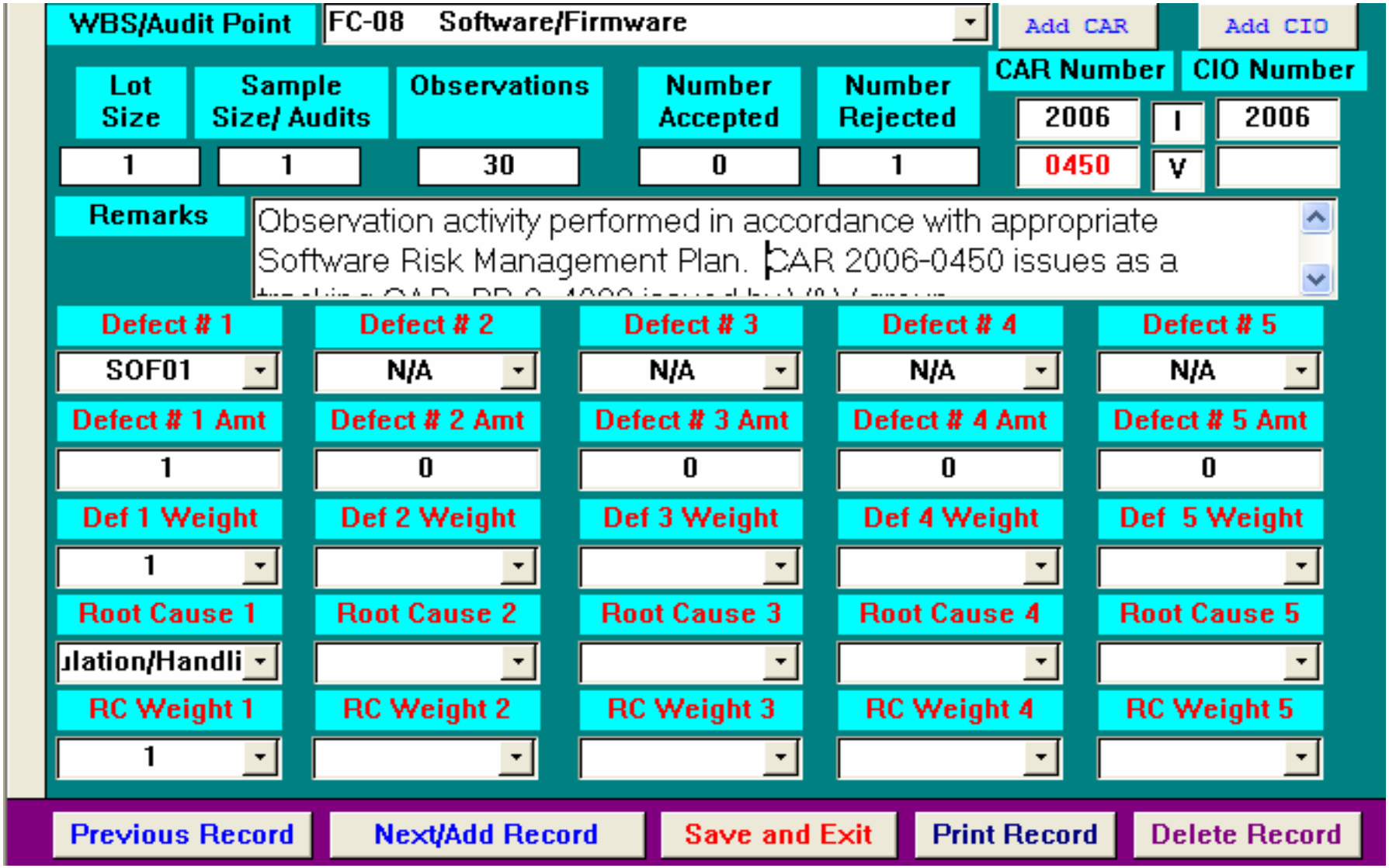
DCMA
Defense Contract Management Agency

CBPM database establishment

Capturing Surveillance Results

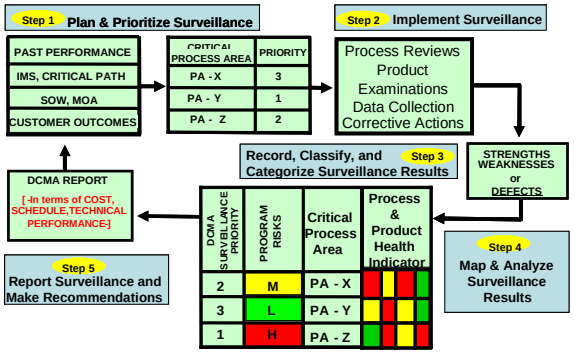


Capturing Surveillance Results



Map & Analyze Surveillance Results – Step 4

- **Results mapped to CMMI Process Area Practices**
- **Analyze Data**
- **Supplier Critical Process Areas evaluated**
  - Other linked elements analyzed
  - Appraise Applicable Critical Process Areas
  - Define Strengths or Weaknesses
- **Program Risks reassessed**

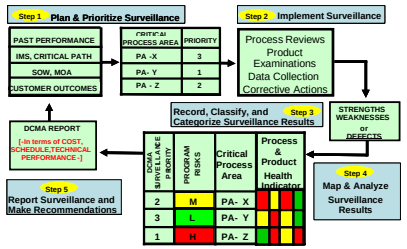


Report Surveillance & Make Recommendations – Step 5

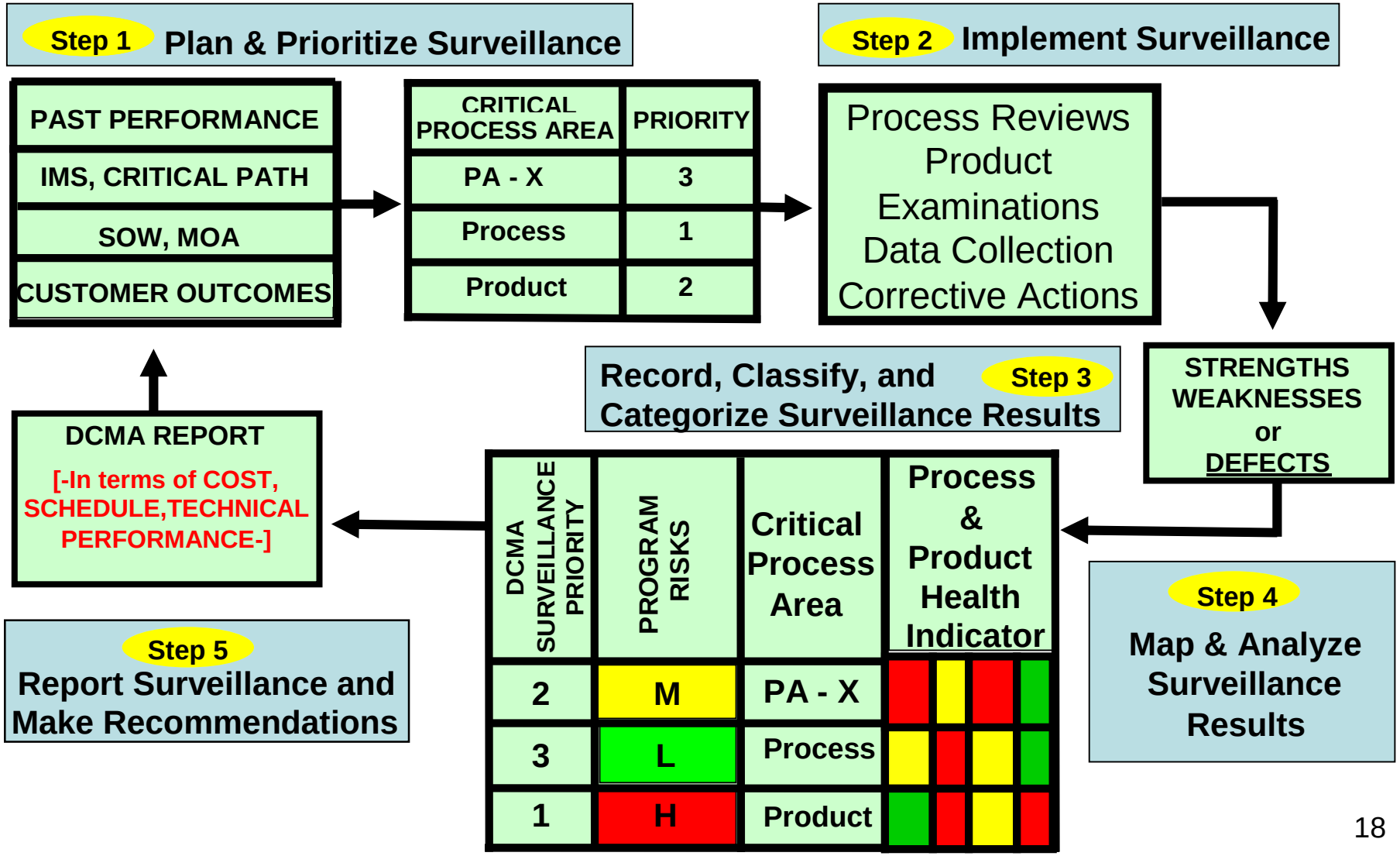
- **Generate Report**
  - Supplier processes that did/did not have an issue
  - CMMI Process Areas & Practices that did/did not had an issue (strengths and weakness)
  - Customer Outcomes observations performed
  - Memorandum of Agreement observations performed
  - DCMA Tasks performed
  - Observed issues and opportunities
  - Root Cause of issues

Defined by Customer

- **Recommend adjustments to Customer Outcomes**
- **Adjustments made to Surveillance**
  - Helper Guide CMMI PA/P to Task



CMMI Based - Surveillance Framework



Benefits of Strategy (Used)

- **CMMI Based – Performance Management (CBPM) developed as a structured surveillance method designed to promote program success via critical process area - based program insight. CBPM helps to:**
  - **Identify and prioritize** the critical processes of the program
  - **Objectively evaluate** those processes, relative to the CMMI
  - **Identify and assess** suppliers' process related risks along with other program measures
  - **Collect, analyze and report** process-related risk information and the impact to the program and its' products

- **Supplier's process capability, subsequent adherence and performance can be continuously evaluated and monitored**

DCMA
Defense Contract Management Agency

Another innovative DCMA approach for utilizing

CMMI for software surveillance

“Practical Use of DCMA’s CMMI based Risk Management”

By Gary Sigmund

Track 5, Wednesday at 1:30

Question ?

Or later

John.eget@dcma.mil
413 494 7533

Raytheon

Customer Success Is Our Mission

Mission Assurance of Software Suppliers – A Partnership Between Software Supplier Managers and Quality Engineering

Jill Brooks

Jack Lee

Network Centric Systems

Agenda

- Introduction
- Why Are We Here?
- CMMI Gap Analysis With MSI Focus
- Addressing The Gaps
- Integration Of SSM and QE
- Lessons Learned and Future Steps

**Mission Assurance of Software Suppliers –
A Partnership Between Software Supplier Managers and Quality Engineering**

Introduction – At a Glance

- A global technology leader in:
  - Defense, government and commercial electronics
  - Space
  - Information technology
  - Technical services
  - Business and special mission aircraft
- 2005 sales: $21.9 billion
- 80,000 employees worldwide
- Headquarters: Waltham, Massachusetts, USA
  - http://www.raytheon.com
  - Common stock ticker symbol: RTN

Partners in customer success

Introduction – Business Areas

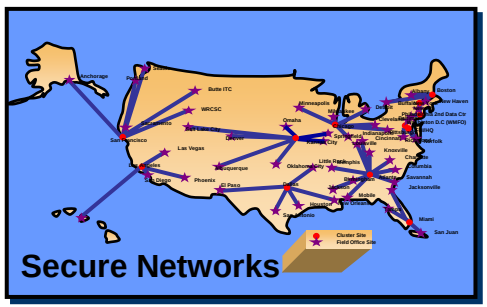
- Missile Defense
- Intelligence, Surveillance and Reconnaissance
- Precision Engagement
- Homeland Security

Network Centric Systems

Command & Control Systems

Missile Systems

Vision Systems



Combat Systems

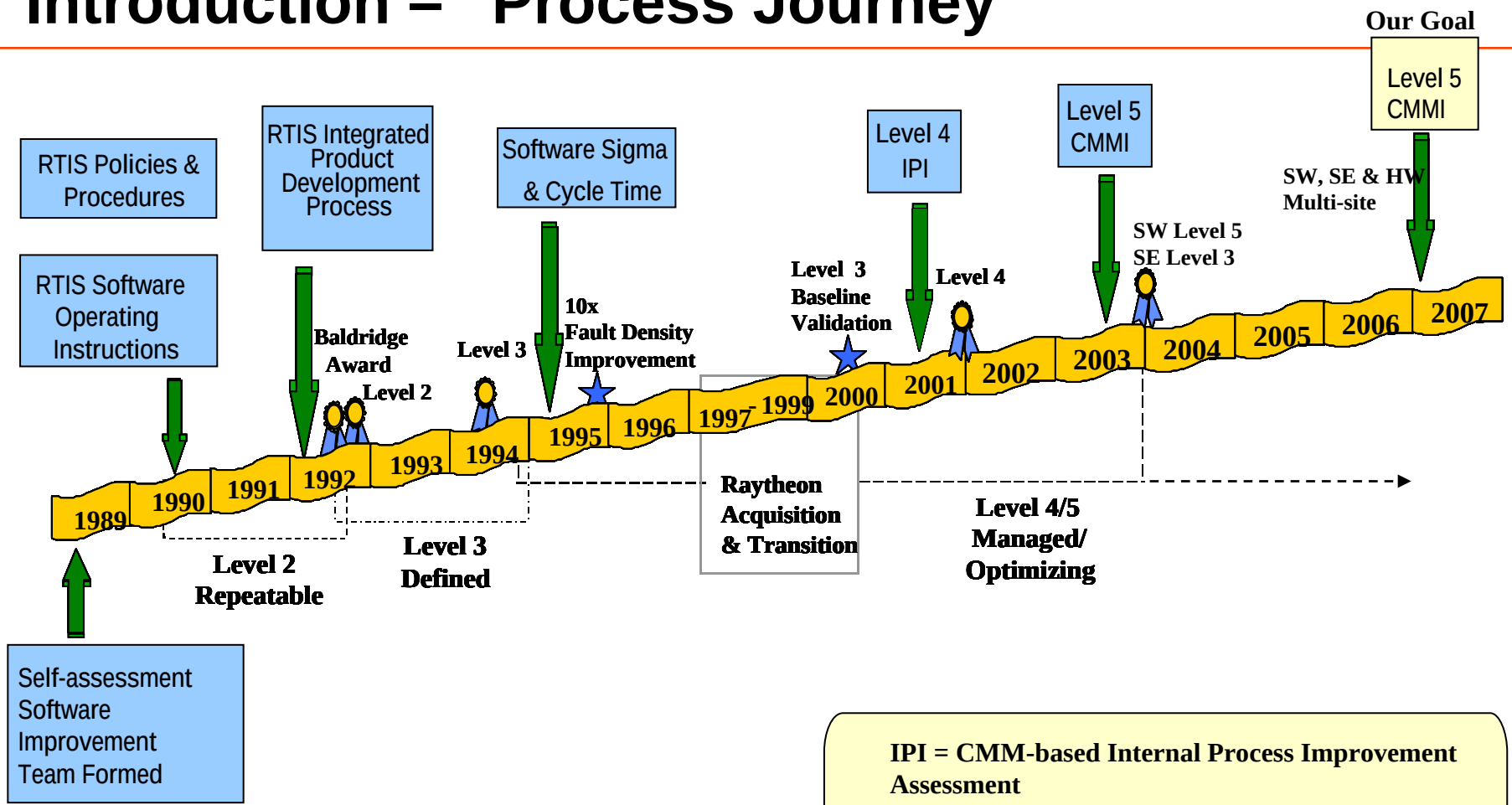
Integrated Communications

Superior mission integration for communication and information dominance

Raytheon's Global Presence
Serving Customers Around the World

- Raytheon International, Inc. business development offices
- Raytheon International, Inc. business development headquarters
- Raytheon Systems Limited
- Raytheon Australia
- Raytheon Canada
- Thales Raytheon Systems

Introduction – "Process Journey"



IPI = CMM-based Internal Process Improvement Assessment

RTIS = Raytheon/TI Systems

CMMI = CMM Integrated

A long history of process excellence

Why Are We Here? – The Burning Platform

Raytheon

- Our business is evolving from a system developer to a Mission Systems Integrator (MSI)
- > 70% of what we deliver comes from suppliers
- The role of supplier management must evolve
- In this presentation, Software Supplier Managers (SSMs) and Quality Engineers (QEs) are being highlighted to address this evolution

CMMI Behavior/Skills Analysis With MSI Focus

Raytheon

- CMMI-SE/SW/IPPD/SS V1.1 analysis of model used to identify behavior/skill gaps

Key Behavior/Skills	Noted in CMMI	Required for MSI Success	
		SSM role	QE role
Knowledge of regulations and practices associated with handling suppliers	Supplier Agreement Management	Major	Major
Acquisition planning and preparation	Supplier Agreement Management	Moderate	Minor
COTS products acquisition	Supplier Agreement Management	Major	Major
Supplier Evaluation and Selection	Supplier Agreement Management	Major	Minor
Negotiation and conflict resolution	Supplier Agreement Management	Major	Minor
Supplier Management	Supplier Agreement Management	Major	Major
Testing and Transition of acquired products	Supplier Agreement Management	Major	Major
Receiving, storing, using, and maintaining acquired products	Supplier Agreement Management	Moderate	Major

Legend: Major = Key Role
Moderate = Need knowledge
Minor = Support Role

MSI Success depends on trained skills & knowledge

CMMI Gap Analysis With MSI Focus

- CMMI-SE/SW/IPPD/SS V1.1 analysis of model used to identify behavior/skill gaps

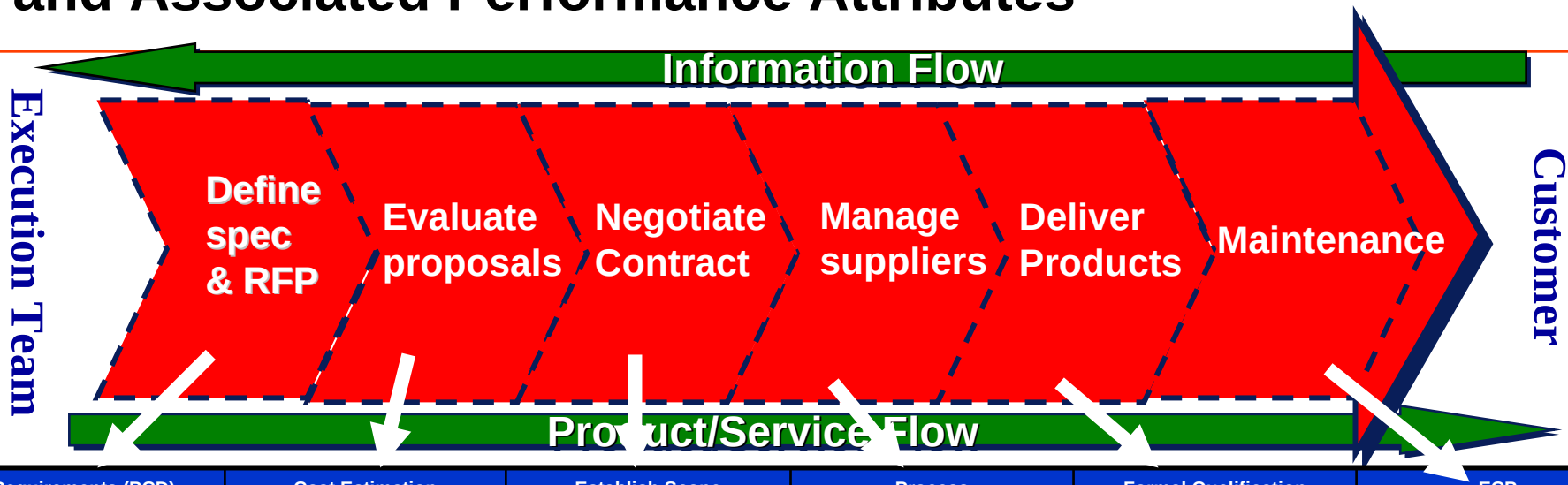
Key Behavior/Skills	Noted in CMMI	Required for MSI Success	
		SSM role	QE role
Application Domain	Process and Product Quality Assurance	Moderate	Major
Customer Relations	Process and Product Quality Assurance	Major	Major
Process descriptions, standards, procedures, and methods for the project	Process and Product Quality Assurance	Major	Major
Quality assurance objectives, process descriptions, standards, procedures, methods, and tools	Process and Product Quality Assurance	Moderate	Major
Identifying potential sources for candidate products to be acquired	Integrated Supplier Management	N/A	N/A
Acquisition feasibility and product life-cycle costs analysis	Integrated Supplier Management	Support	N/A
Evaluating supplier work products	Integrated Supplier Management	Major	Support
Monitoring supplier processes	Integrated Supplier Management	Major	Major

Gap Closure Process

- Develop SSM value stream and identify performance attributes
- Identify available training courses to supplement performance gaps
- Develop program specific training model to address needed skills
- On-the-job training with senior practitioners

Value Stream of SW Supplier Excellence and Associated Performance Attributes

Raytheon



Requirements (PCD)	Cost Estimation	Establish Scope	Process	Formal Qualification	ECP
SoS Architecture	Schedule Impact	Funding Constraints	Lifecycles	Transition	SCR
Process Capability	Risks/Opportunities (R&O)	Risks	Metrics	Receive and integrate role	Enhancement
SOW	Technical Evaluation	CAIV	Technical Reviews		Proposal & White paper Evaluation
Contract		Negotiation Strategy	R & O		P3I
			Supplier Performance		
			Knowledge Elicitation		
			Communication		
			SDRL Evaluation		
			Reqts Trade		
			Change Management		

Example of Value Stream Step One Performance Attributes

Performance Attributes	Standards of Excellence	Source of skills
Requirements (PCD)	Comprehend system requirements and integrate CONOPS strategy to capture applicable software performance requirements.	Domain experience OJT Mission Use Cases (SME) SE Class – Reqts Allocation
SoS Architecture	Understand the key customer/program quality factors to guide tradeoffs.	ATAM, JTA-A SEI Certified Architect training SE Class on Architecture
Process Capability	Understand parent process requirements.	OJT, OCD, FCS SDP DOORS Training
SOW	Comprehend the contents of statement of work	OJT
Contract	Comprehend the contents of the contract & establish evaluation criteria.	OJT

Specific standards of excellence associated with each performance attributes

Example of Program Training Model

Training Classes

Engineering Disciplines

	Source Selection			GS IPT			GS IPT (SW)				
IMS (Open Plan)	SSAC Training	SSET Training	NCS PL Cert. Training	DOORS	Cost Reimb. Contract Training	Ethics in the Procure. Process	Software Devl Plan Orientation	Configuration Mgmt.	Software Process Training	Intro to UML Modeling	Product Evaluations
O			NR	R	R	RC					
N/A			NR	R	R						
N/A			NR	R	R						
R		RC	R	R	R	RC					
N/A			NR	R	R						
N/A			NR	R	R						
N/A			NR	R	R		R	R	R		R
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N/A			NR	R	R						
R	RC	RC	R	R	RC	RC					
N/A			NR	R	R	RC	RC	R	RC		R
		R	NR	R	R	R					
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Specific training classes for those engineering disciplines to perform the tasks at hand.

Training courses to supplement performance gaps

Addressing The Gaps by On-The-Job-Training

Raytheon

- Mentor under a senior practitioner
- Shadow a senior SSM on different meetings and activities
- Familiarize the processes and procedures through self-learning
- Begin with lesser responsibility on a smaller supplier
- Increase responsibility with demonstrated performance

Mentoring and Hands-on experience to address gaps

Integration Of SSM and QE

- Advantages of a Integrated Team
  - Different perspectives of supplier activities
  - Review of critical metrics
  - Participation at reviews
  - Review of documents to ensure requirements compliance

- Performance Multiplier of an Integrated Team
  - SSM focus on cost, schedule, and technical performance
  - QE focus on process compliance through audits and surveillance checks

Integrated team provides the best combination of supplier management

Monitoring of Supplier activities

C	Green	Compliant	C
FO	Yellow	Open findings with acceptable plan	FO
FC	Yellow	Findings closed	FC
N	Red	Unacceptable resolution plan or 30 days past due	N
P	Purple	Planned audit	P
R	Blue	Rescheduled audit	R
U	Gray	Not audited	U
W	Orange	Process audit still in work	W

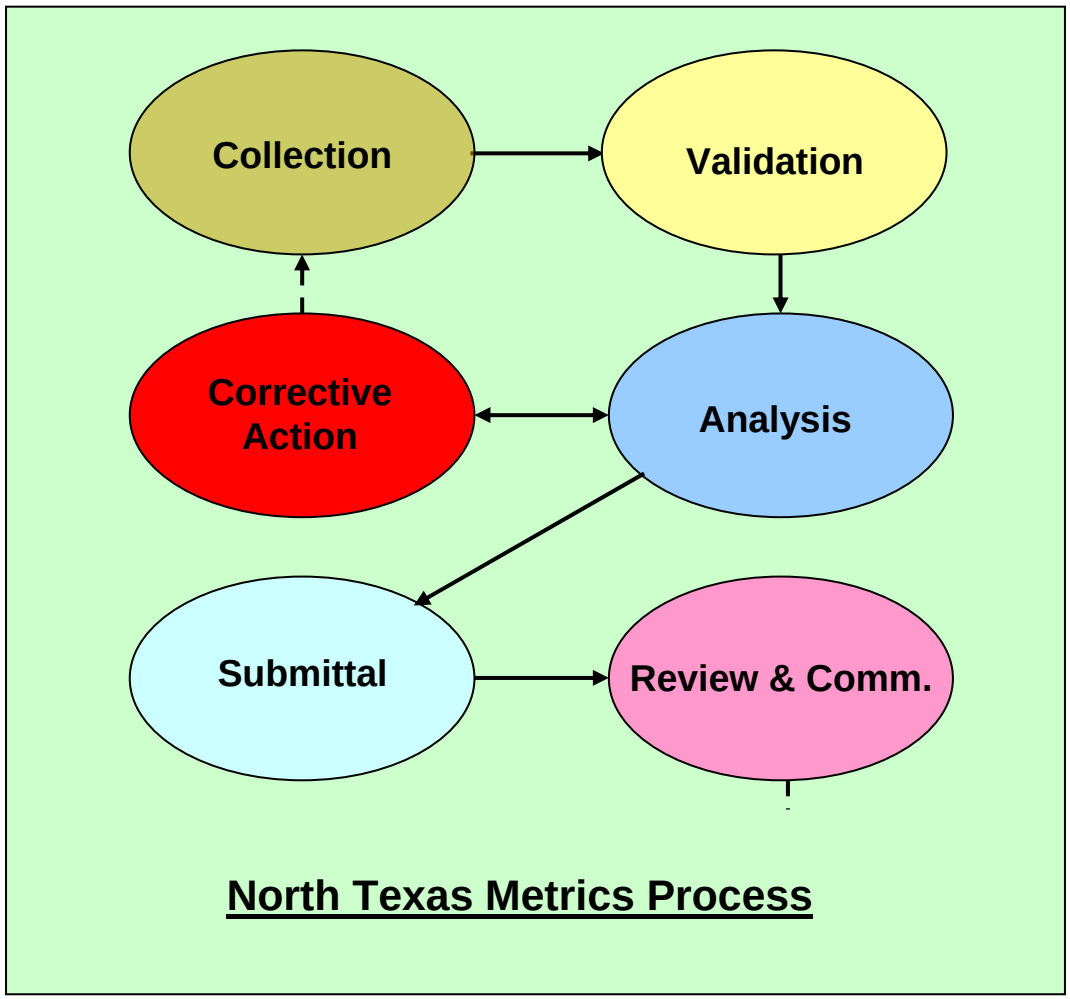
Data as of: 1/28/2006

Process Audit Area	Supplier/ LSI SDP	FCS SDP	Previous Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Latest Status
Software Project Management			2005													
-Recording rationale	4.8	4.8		U	U	U	U	U	U	U	U	U	U	U	U	U
-Access for Acquirer Review	4.9	4.9		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Cost & Schedule Estimation	5.1	5.1	FC	U	U	U	U	U	U	U	U	U	U	U	U	FC
-Software Measurements	5.2	5.2	FO	U	U	U	U	U	U	U	U	U	U	U	U	FO
-Group Coordination & Communication	5.3	5.3		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Training	5.4	5.4	FO	U	U	U	U	U	U	U	U	U	U	U	U	FO
-Software Risk Management	5.5	5.5	N	U	U	U	U	U	U	U	U	U	U	U	U	N
-Software Subcontractor Management	5.6	5.6		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Configuration Management	5.7	5.7		P	U	U	U	U	U	U	U	U	U	U	U	P
-Software Product Evaluation	5.8	5.8		U	P	U	U	U	U	U	U	U	U	U	U	P
-Software Quality Assurance	5.9	5.9		U	U	U	U	U	U	U	U	U	U	U	U	U
-Defect Management	5.10	5.10		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Development Environment	6.3	6.3		U	U	U	U	U	U	U	U	U	U	U	U	U
-Software Process Management	7	7		U	U	U	U	U	U	U	U	U	U	U	U	U

Example of an audit plan to ensure process compliance

Audit plan to ensure comprehensive coverage of process compliance

Software Metrics Analysis Process



Metrics Analysis to monitor and track performance

RaySMART™ Checklist

Raytheon

EXAMPLE

LCA Review Criteria

NEW

Review Criteria	4.0 System Requirements	5.0 Software Architecture	6.0 Views & Patterns	7.0 Life-Cycle Plan	8.0 Feasibility Rationale
0%	0%	0%	0%	0%	0%

6.0 Views & Patterns — SADD

6.1 Use Case View — TECHNICAL

		Score
6.1.1	Are the use cases in the use case view consistent with the logical view sequence diagrams?	
6.1.2	Does the use case view cover key behaviors?	
6.1.3	Is this view complete with respect to the suppliers completeness criteria as documented in the supplier tailoring of the GSS SADD Appendix C? (Use Case Diagrams and Use Case Text)	
6.1.4	Are the supplier use cases consistent with the GSI use cases as document in the GSS Operational Concept Document?	

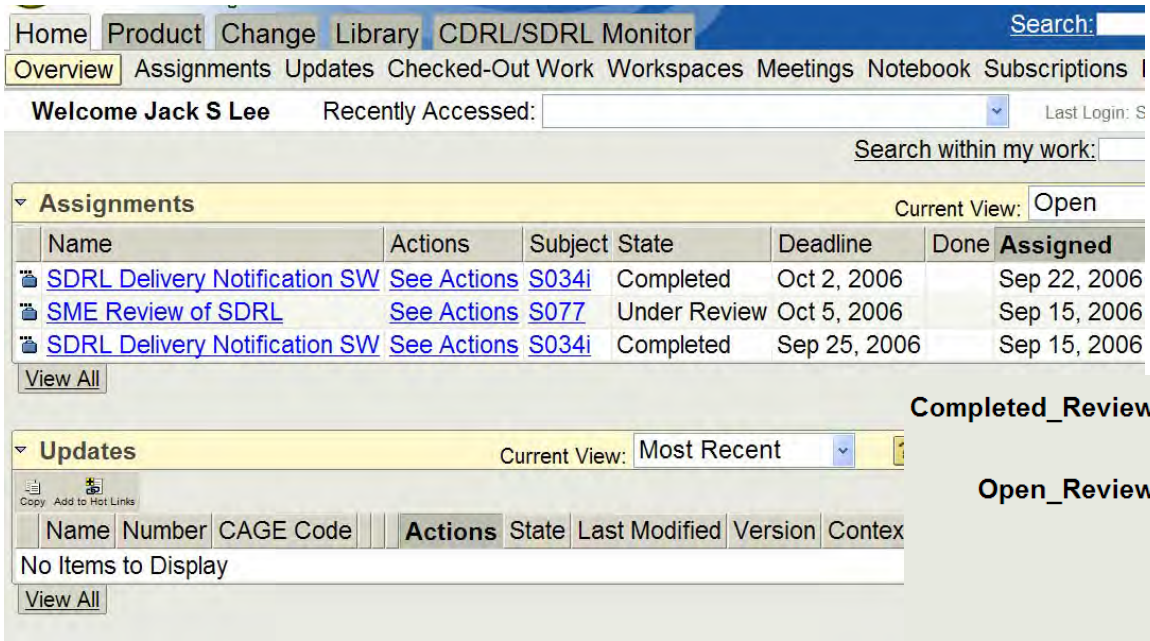
General Comments:

6.2 Logical View — TECHNICAL

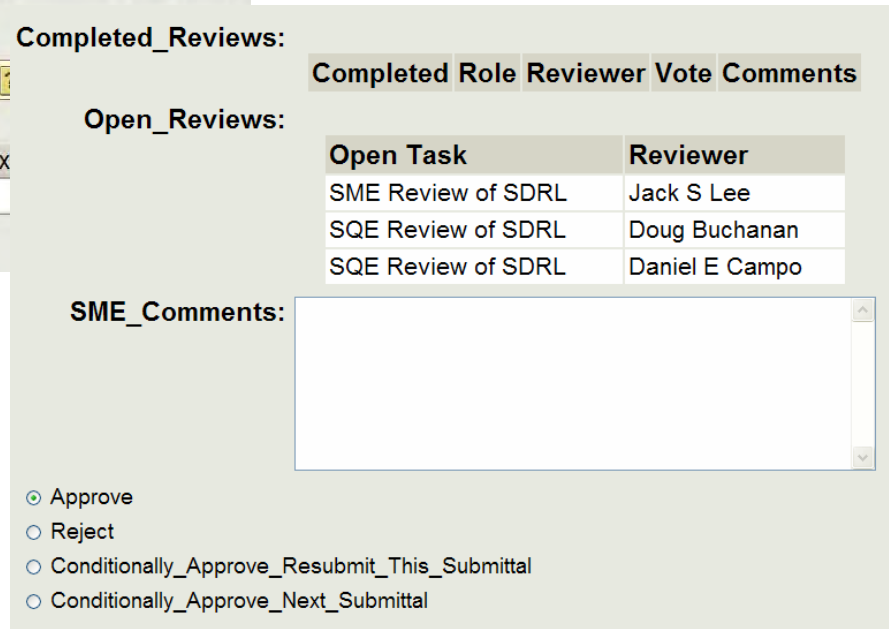
		Score
6.2.1	Are the top-level subsystems and classes defined?	
6.2.2	Are the relationships among the top-level subsystems and classes described?	
6.2.3	Is the control architecture captured (in terms of state machines for individual classes/objects, and via an Object Communication Model or the equivalent)?	
6.2.4	Are the internal interfaces, as captured in the interaction diagrams, described? e.g., this message contains Time of Day.	
6.2.5	Are the external interfaces on the Supplier Sequence Diagrams consistent with the CEEU/CREU IRS?	
6.2.6	Are the logical view diagrams internally consistent with one another?	
6.2.7	Are safety and mission critical classes clearly marked?	
6.2.8	Are the Supplier Sequence Diagrams (e.g., those presented at the Software Architecture Evaluation, and more) consistent with the GSS System Model Segment threads?	
6.2.9	Is the mapping between the GSS SADD Logical view elements (Aggregate Software Elements) and the Supplier Logical view elements clear (subsystems, classes)?	

Review Tool to consistently capture reviewers' feedback

Audits and Document Review



Document Review Tool



List of document reviewer

Electronic collaboration system to ensure timely completion of document reviews with the right reviewers

Lessons Learned

- There is a massive amount of information and data required to manage multiple suppliers and appropriate tools are critical
- Performing supplier management in an MSI role is not the same as simply scaling up the support roles of a “traditional” developer program
- Importance and cost of communication and coordination

Lessons Learned - Continued

- Lessons learned are captured by stages to enable continuous improvement
- Review Tools are mandatory to save time and be consistent
- Working with a diverse team with different culture and in different geographic locations is a challenge

Summary

- The roles of SSM and QE have evolved over time to better assess and address supplier management
- Evolution not as a “scale up” from a development program, but to include new activities and interactions
- In addition to SSM and QE, other disciplines contribute to supplier management such as supply chain, contracts, etc. to make up the full supplier management team
- Feedback SSM training needs to organization for gap closure
- Re-evaluate against the CMMI model to ensure that all elements are appropriately addressed

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Questions

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Systems Engineering Revitalization using CMMI®

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Director Engineering Operations, Code 09K
Chief Engineer Code 70E
Intelligence & Information Warfare Systems Department
SPAWAR Systems Center Charleston (SSC-C)

Sandee Guidry
SEI Authorized CMMI Lead Appraiser
SEI Authorized CMMI Trainer
TECHSOFT, Inc.
Engineering Process Office
SPAWAR Systems Center Charleston (SSC-C)

NDIA CMMI Technology Conference, November 15, 2006

SEI Partner
TECHSOFT
Technical Software Services, Inc.

SPAWAR
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Presentation Outline

- Introduction
- Revitalization Effort using CMMI®
- Training
- Summary

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Introduction to SSC-Charleston

- Where we fit
- What we do
- Who we are

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Where We Fit

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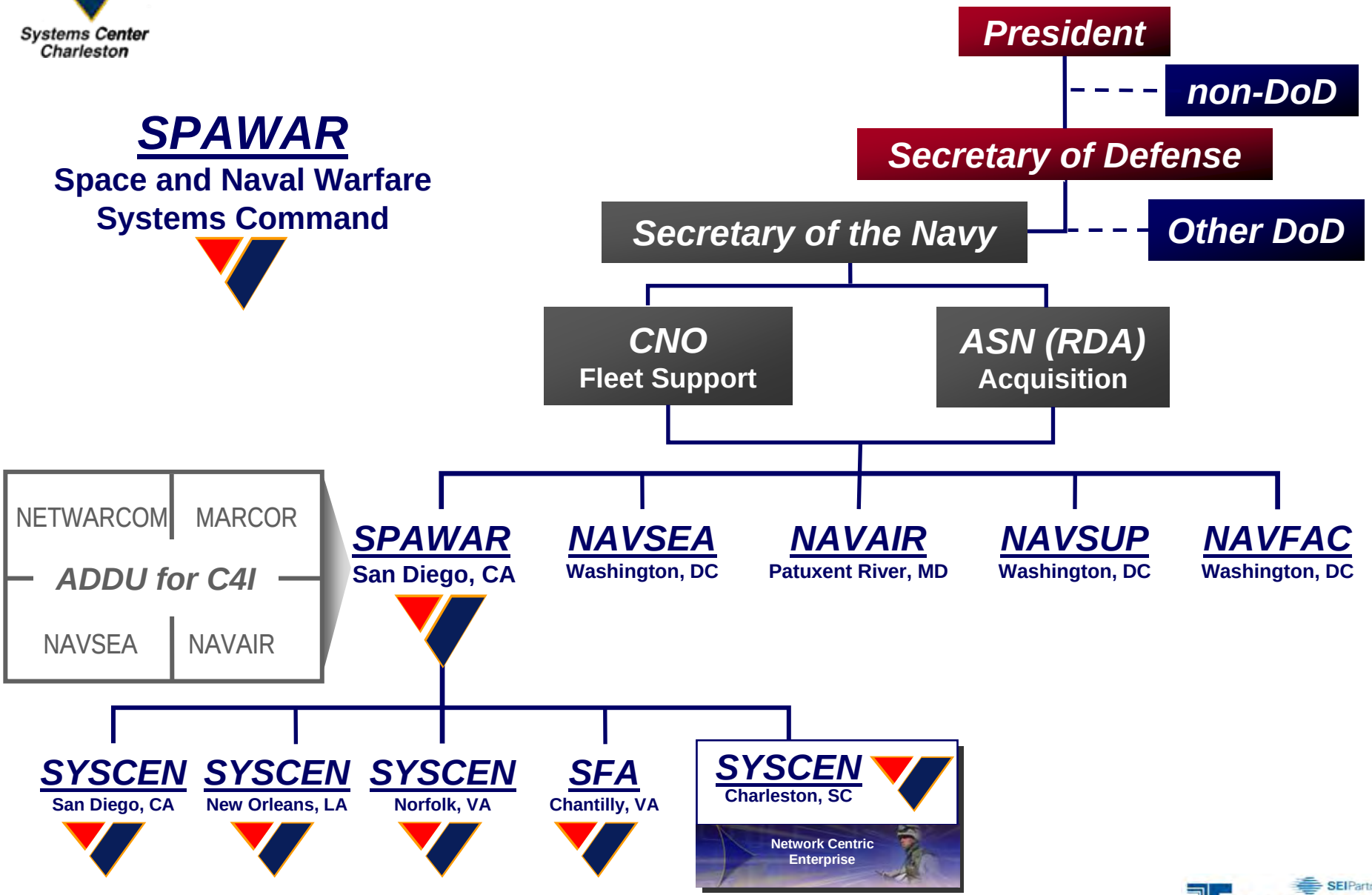
SPAWAR
Space and Naval Warfare Systems Command



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What We Do

Connecting the Warfighter

Mission- We enable knowledge superiority to Naval and Joint Warfighters through the development, acquisition, and life-cycle support of effective, integrated C4ISR Information Technology, and Space capabilities.

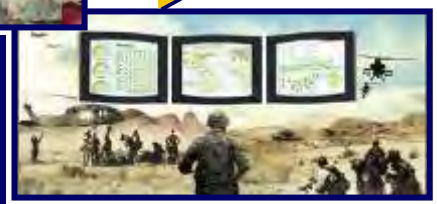
Vision-
Fully Netted in Three

We are the
Principal C4I Acquisition Engineering & Integration Center on the East Coast & Principal C4ISR ISEA for the Navy

MWR- MobileNet

Leveraging Technology

Body Worn Variant



NETCOP-Network Common Operating Picture

IR Pocketscope

Rapid Prototyping

Speed to Capability

Connecting the Warfighter to the resources needed to win GWOT

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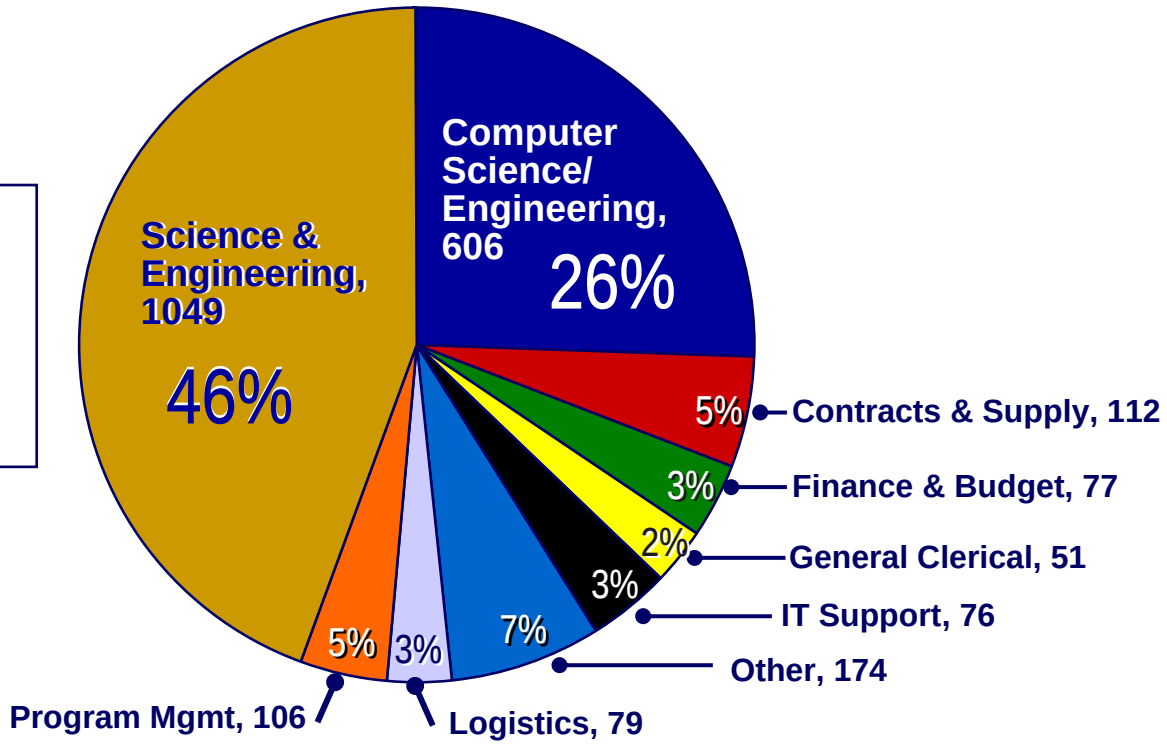
Who We Are

SPAWAR Systems Center Charleston

A Large Systems & Software Engineering Organization

Over 70% of workforce is in an engineering or computer-related discipline



- The solutions to the global war on terror developed by SPAWAR result from good systems and software engineering.
- Systems engineering is our core competency.
- Total workforce of ~ 2,300 employees.

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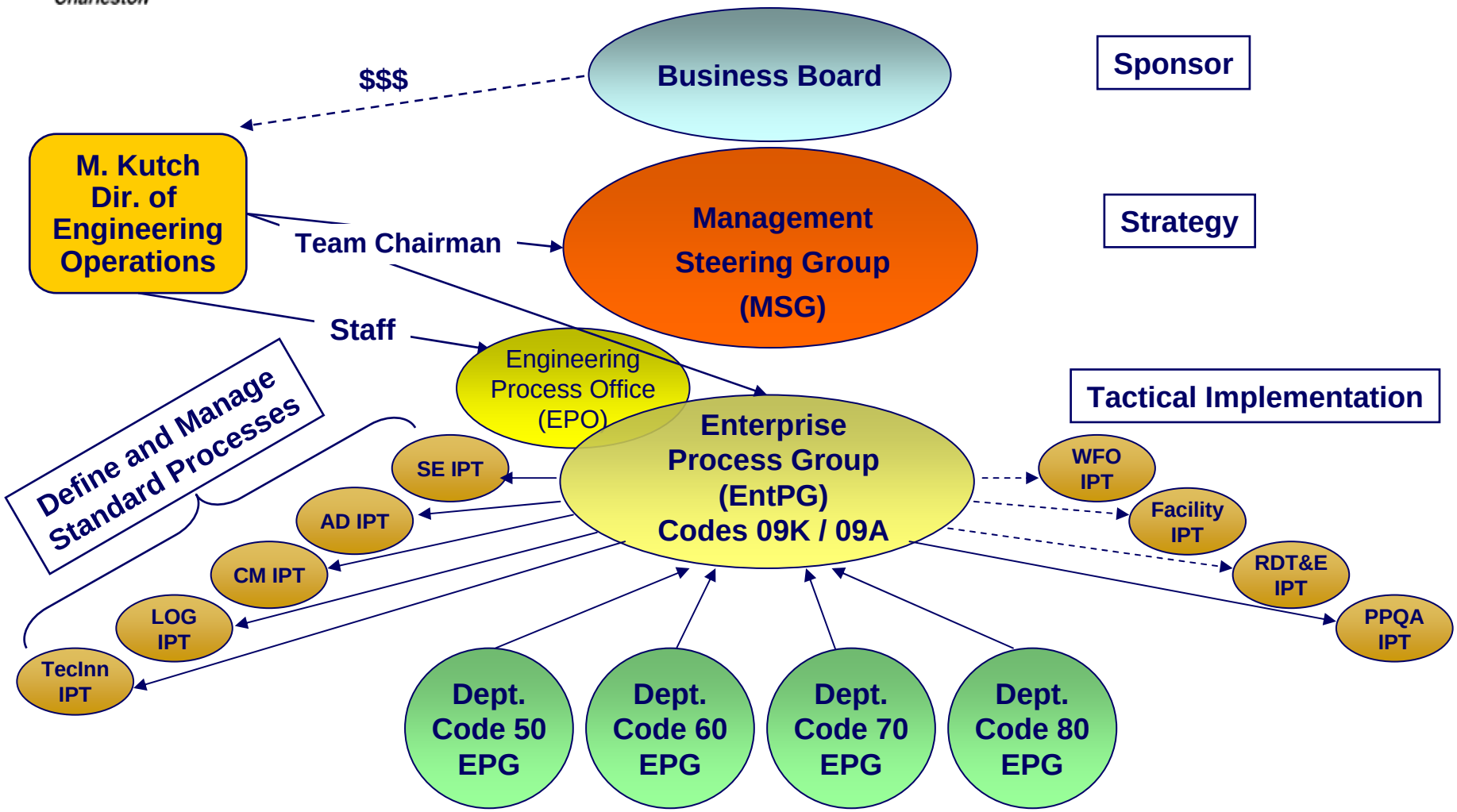
SE Revitalization Effort using CMMI®

- Vision
- Organization
- Plan
- Process
- Tools

Vision

- **Vision**
  - Develop and maintain a World Class Systems Engineering Organization
- **Approach**
  - Achieve Command-wide operational consistency
  - Based on ISO/IEC 15288 – systems engineering
  - Based on ISO/IEC 12207 – software engineering
  - Based on implementing CMMI® “Staged Respresentation”
  - Measure using best practices of CMMI® “Continuous Representation”
- **SSC-C commitment reaffirmed and formalized in Process Improvement Policy, 11 December 2003**

Organization for Implementation



SSC-C SE Revitalization Plan

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Elements of SSC-C SE Revitalization

Policy / Guidance
- SSC-C SE Instruction
- SSC-C SE Process Manual
- SSC-C SW-Dev Process Manual
- SSC-C SW-Maint Process Manual
- EPO Website
- ePlan Builder

Training / Education
- Intro to PI WBT
- SE 101 WBT
- SE Fundamentals
- SE for Managers
- Project & Process Workshop
- Intro to Software Engr.
- Architecture Dev. WBT
- Certification/Degrees

Assessment & Support
- CMMI® Level 2
- CMMI® Level 3
- Balanced Scorecard
- Lean Six Sigma
- Integrated Product Teams
- IT Tools

Underway

Completed/Ongoing

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SSC-C Engineering Process Guidance

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SPAWAR Instruction 54xx.1 (draft) SYSTEMS ENGINEERING POLICY

SPAWAR Policy

SSC-Charleston Engineering Processes Improvement Policy (Dec. 2003)

To be replaced with SSC-C SE/SW Instruction

Policies mandate the use of ISO/IEC life cycle processes and CMMI® best practices

ISO/IEC 15288
System Life Cycle Processes

ISO/IEC 12207
Software Life Cycle Processes

CMMI® for SE/SW

Industry Standards

Good Engineering

Top Level SSC-C Processes

SSC-C Systems Engineering Process

SSC-C Software Engineering Process

CMMI® Supporting Process Areas to SE/SW Processes

ML2	PP	PMC	CM	REQM	PPQA	MA	SAM
ML3	OPF	OPD	OT	IPM			
	RD	TS	PI	Ver	Val	RSKM	DAR

Use CMMI® to Measure & Assess Processes

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Classic System Engineering "Vee" Diagram Aligning SE with CMMI and Process Improvement

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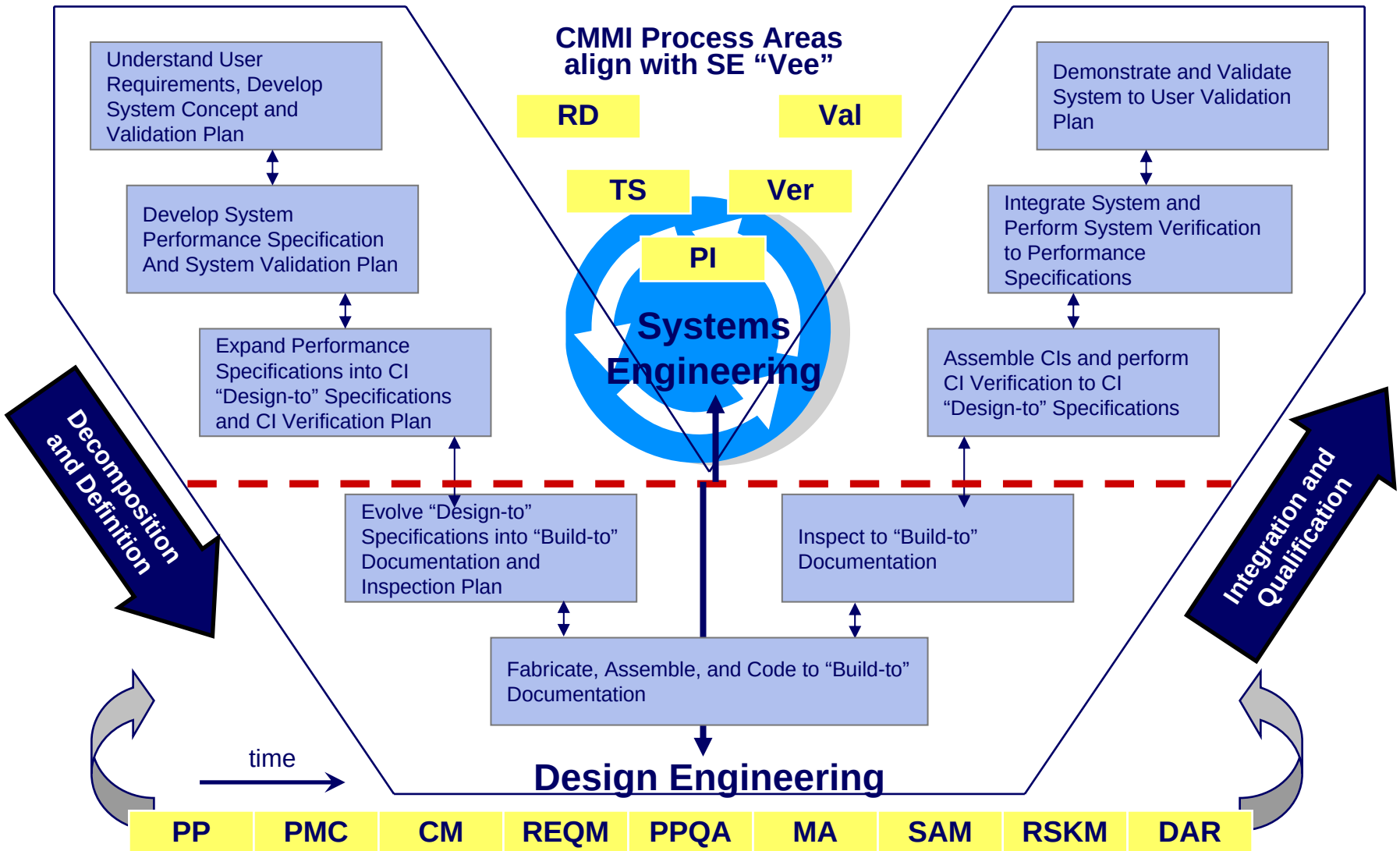

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Engineering Process Office Website

Systems Center Charleston

Address https://corpweb2.spawar.navy.mil/cmmi/standardprocesses/standardprocesses.aspx Go

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SSC-Charleston Engineering Process Office

EPO Home | ePlan Builder | WBT Courses | eWBS | Contact EPO | CorpWeb

Navigation

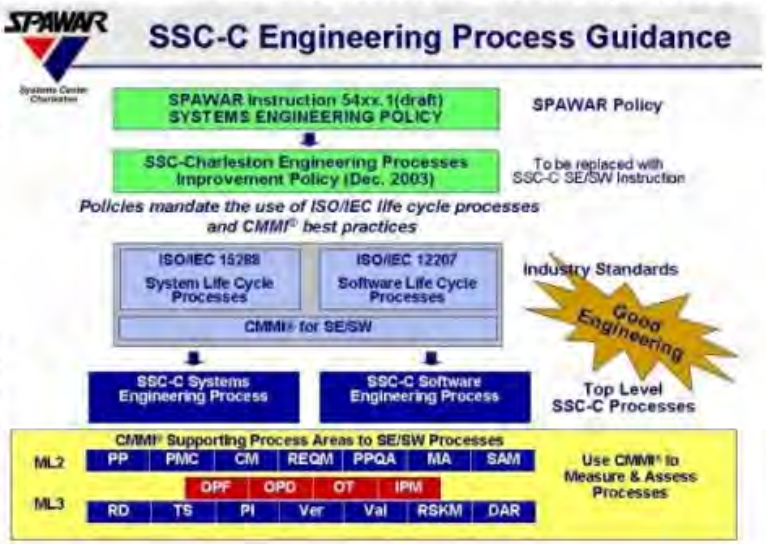
- Calendar
- SSC-C Standard Processes
  - Systems Engineering Process
  - Software Engineering Process
  - Life Cycles
  - Tailoring Criteria
- Process Areas
- Projects
- Process Improvement Teams
- Organizational Measurement Repository
- Training
- Innovation Program

SSC-C Standard Processes

Currently, the SSC-C Standard Processes contain policies, process manuals for CMMI®-SE/SW Level 2 and Level 3 process areas, and select SOPs. The standard processes for Systems Engineering and Software Engineering provide detailed procedures for accomplishing tasks within these respective disciplines. The 3 top-level standard engineering processes are:

- Systems Engineering
- Software Development
- Software Maintenance

These processes were derived from the ISO/IEC industry standards to address the typical engineering work performed by SSC-C. Additional SSC-C standard processes have been developed to further refine these top level engineering processes and to support the process areas of CMMI®. The graphic depicts the derivation of the SSC-C standard processes.



Related Links

- Process Improvement Communication Plan
- SSC-C Artifact Submittal Form

Internet

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ePlan Builder tool

- An interactive, web-based application that leads the user through a structured interview process (like TurboTax®) to generate a CMMI®-compliant plan
- Includes standard, consistent text
- Generates an initial project-specific document
  - Project Management Plan (with Work Breakdown Structure)
  - Configuration Management Plan
  - Process and Product Quality Assurance Plan
  - Requirements Management Plan
  - Measurement and Analysis Plan
  - Systems Engineering Plan (DoD SEP Format)

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Training

- SE Training Architecture
- Process Improvement and CMMI®
- Systems/Software Engineering Classroom
- Web Based Training (WBTs)

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What do we need to be world class?

- **All employees need a basic understanding of process improvement**
- **All project teams need to fully understand the CMMI® model (all processes, all levels)**
  - To understand all of the best practices and maturity levels
  - To comply/prepare for DoD and NAVY policy
- **All project team members and supporting personnel need to know how to perform the standard processes and best practices required**
  - How to do good SE, CM, QA, Planning, Measurement, Risk, …
- **To properly prepare for and complete an assessment or appraisal, key project team members need to map the project work products to the practices assessed.**

These needs can be depicted in a training architecture

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Training Architecture

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Foundation of PI and CMMI®

- PI WBT → SEI Intro to CMMI® 3-day

Core SSC-C project and engineering processes (Level 2 and 3)

- Engineering Project & Process Mgmt Workshop
- SE Fundamentals
- Intro to Software Engineering
- SE for Managers
- SEMP Workshop

Subject Matter Experts - Use commercially available on-site classes

- Quality Engineering
- Configuration Mgmt
- Requirements Analysis

Prepare Projects for BSC or SCAMPI

- Appraisal & Assessment Workshop 2-day

Existing
Existing - revise
New - develop
New - buy

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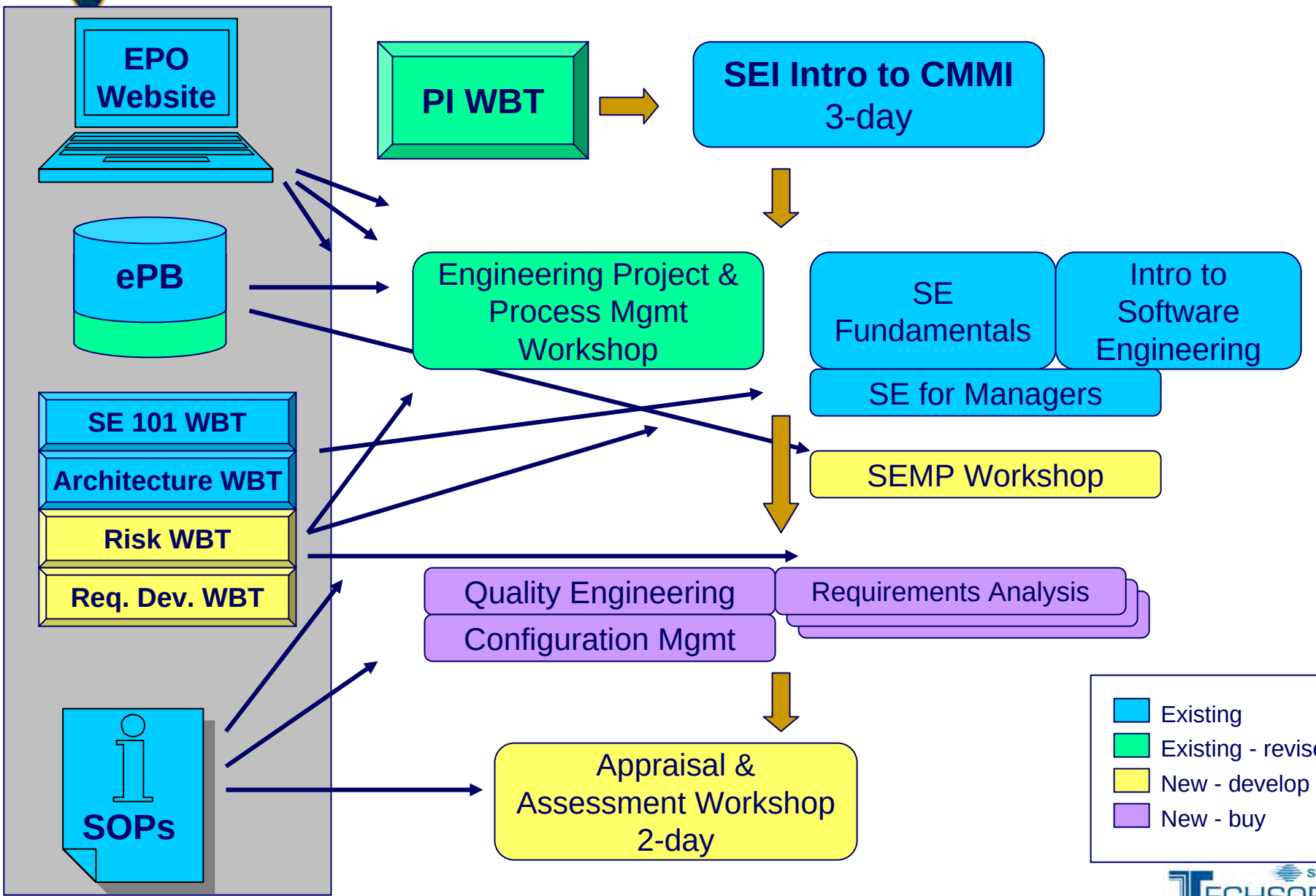
Supporting Tools



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Process Improvement Training

Intro to Process Improvement

- Over 950 people trained
- Provided via WBT
- Now Required for all employees

CMMI®

- SEI Intro to CMMI®
  - Over 300 attendees to date
- SSC-C Level 2 Processes overview

Project Management/Project Monitoring & Control

- 730 people trained

Process-specific Workshops (CM, QA, REQ, M&A)

- 450 people trained

This accounts for many employees attending more than one course

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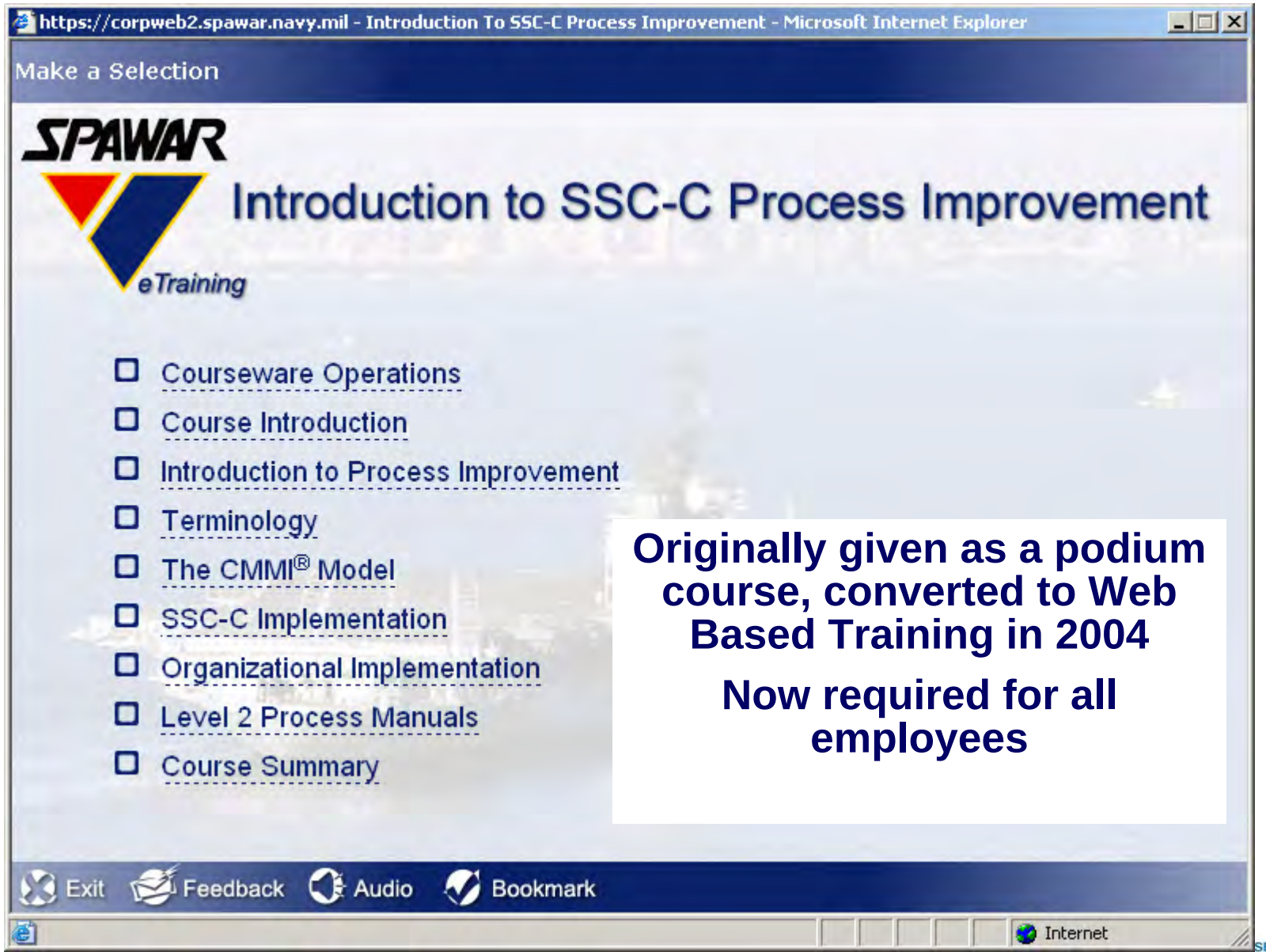
Intro to Process Improvement WBT

Systems Center Charleston



Originally given as a podium course, converted to Web Based Training in 2004

Now required for all employees

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SEI Intro to CMMI® for SSC-C

- **3-day *Introduction to CMMI®* course teaches the full CMMI® model**
  - Students learn how the best practices build and relate across process areas
  - Learn the terminology
- **SEI-Authorized instructors are well-versed in our implementation to augment material with SSC-C specific content**
  - Highlight SSC-C tools and resources
  - Actively involved in projects, teams, and infrastructure
- **Over 300 employees trained**
  - Want to build a cultural foundation within the engineering departments

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Systems Engineering Fundamentals Classes

- **Teach the Systems Engineering process**
- **3-day on-site, classroom course**
  - Based on SMU SE Masters course
  - Customized to incorporate SSC-C SE process
  - Over 300 SSC-C engineers trained
- **1-day SE for Managers course added**

"Thought provoking, motivating, and challenging. Learning basic SE caused me to brainstorm many different applications of organized system processes. It motivated me to want to begin organizing its application. It also challenged me to apply GOOD SE practices in order to successfully be more efficient in the process.."

"It was extremely beneficial to have a professor with extensive knowledge of the subject matter and one who could apply it to the SPAWAR methods."

Student Feedback

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Engineering Management Workshop

- **Multi-session workshop oriented "how to" class**
- **What is a good process? Is my process good?**
- **How to generate project plans**
  - What makes a good PMP, CM Plan, QA Plan…
  - How to use ePlan Builder
  - Hierarchy of plans (Based on level 2 or level 3 goals)
- **Configuration Mgmt**
  - Are my Configuration Items (CI's) and Change Control adequate?
- **PPQA**
  - How to execute a process review and work product review
- **Measurement and Analysis**
  - Are my measures measurable?
- **Requirements Management**
  - Traceability - simple to complex
- **Monitoring and Control using Reviews**

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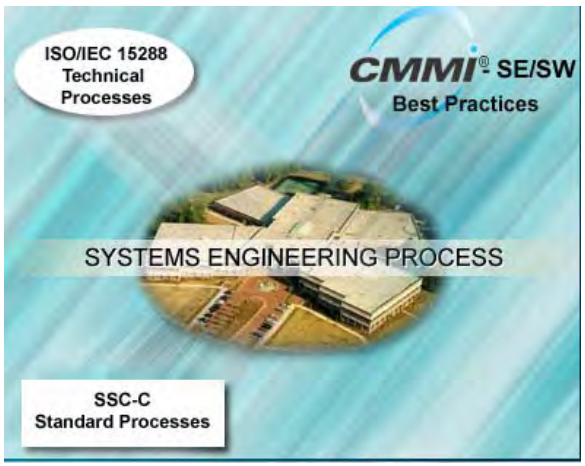
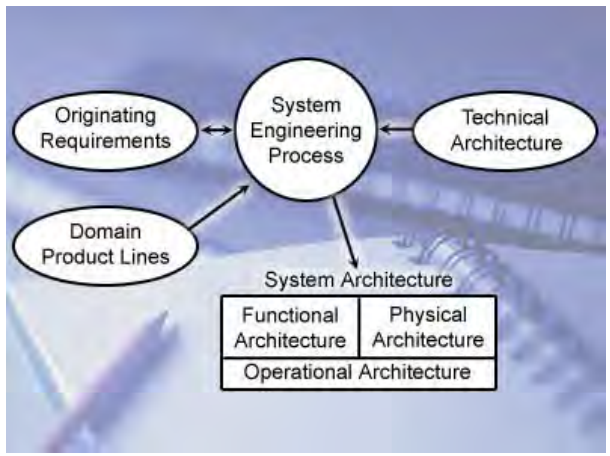
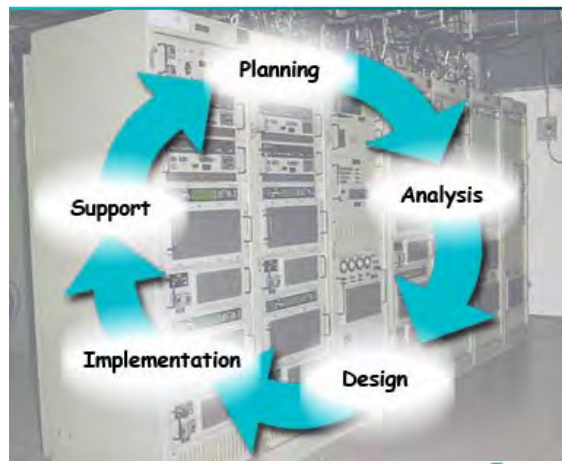
SE 101 Web Based Training

- **Introduction to Systems Engineering WBT**
  - 10-module web based training
  - Closely aligned to SSC-C SE Process, SE Fundamentals Course, and ISO/IEC 15288
  - Includes hotlinks to referenced documentation
    - SSC-C Process manuals, policies, standards
  - Extensive branching for more detail







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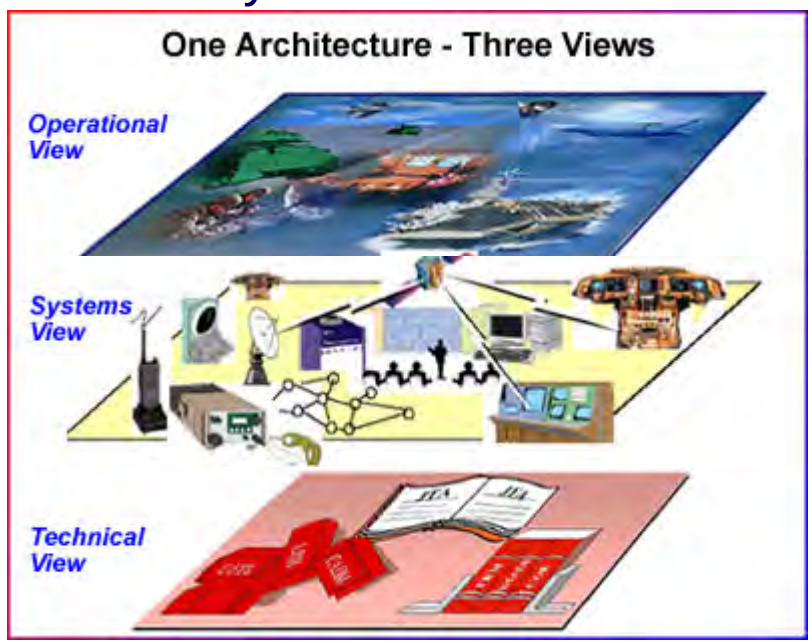
Topical WBTs

- **Developing web-based training courses in specific topics**
- **Architecture Development WBT - completed**
  - Introduction to Architecture Development and DoDAF
  - Designed to educate and promote value of system architecture to non-architects and new engineers
  - Tests for understanding
- **Risk Management**
  - Risk identification
  - Analysis tools and techniques
  - Mitigation planning
  - Risk monitoring
- **Requirements Development**



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Summary

- Accomplishments
- Results and Measures
- Lessons Learned
- Going Forward

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What We Have Accomplished

- **Process Focus**
  - Defined Policies and Processes
  - Aligned with DoD and SPAWAR guidance
  - Aligned with industry standards and CMMI® model
  - Built organization structured around processes and process improvement
- **Training is Critical**
  - Providing Fundamentals of Engineering for new and old professionals
  - Developed web-based training for “self-paced” and refresher training
  - Defining a structured technical career development path for engineers
- **Tools for the Engineers**
  - Developed *ePlan Builder* application to generate planning documents
  - Developed templates, checklists, and web-based document repositories to link standards and DoD guidance to day-to-day tasks and processes

Early and persistent Systems and Software Engineering applied to programs and projects

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Results and Measures

- **Selected pilot projects**
  - Training and Mentoring of project teams
- **Informal Appraisals, Process Reviews, and Document Reviews to measure progress and identify gaps**
  - Class B/C appraisals of selected projects
  - Define/review project-specific plans and procedures
- **Project-level Formal SCAMPI^{SM} Appraisals (Class A)**
  - Evaluated compliance with CMMI® Maturity Level 2 requirem
  - 8 projects appraised between June 2004 and February 2005
- **Command-wide ML2 appraisal in April, 2005**
- **Immediately began ML3 effort using similar approach**
- **4 Program/Project-level ML3 SCAMPI^{SM} Appraisals completed**
  - Mix of Maturity Level 3 and Capability Level 3 successes
  - Preparing for Command-wide ML3 appraisal in April, 2007
- **Continue to internally assess additional projects against Maturity Level 2 and 3 best practices for Balanced Scorecard**

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Is It Working?

- **Recognition of SE and CMMI effort**
  - 1st Systems Center to achieve Maturity Level 2
  - 1st Systems Center to have a program achieve Maturity Level 3 (AP)
  - Multiple presenter at NDIA SE and CMMI conferences
    - High interest in Tools, Training, and Implementation
- **Business**
  - LPD 17: “They see us as a model and want to increase our efforts.”
  - Automation Program: “We had hundreds of sites and there was a need for a structured organization to put a ‘wrapper’ around that and control it. CMMI became the wrapper.”
  - CICS: “CMMI was key to achieving the project goal.”
  - VIDS: “The VIDS failure (2000) motivated implementing CMMI because the team needed to change course or the customer would have no confidence in system development. It was a tremendous success…”
- **Innovation - Code 71 is receiving USMC/ONR $1M Intelligence Metadata Project due to “Quantum Leap” Innovation Initiative**
  - “I don’t think we would have even been considered if we hadn’t told them about this Innovation Project”

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Lessons Learned

- **Senior Management support is critical to success**
- **Training**
  - Everyone needs to be engaged – “train the masses”
  - Specific training for process owners/subject matter experts
- **Utilize Teams (IPTs) as champions of specific processes**
  - Multi-department representation
  - Change agent mentality
  - Process-focused charters
- **Resource Properly**
  - Implement with projects that want to improve, can benefit from efforts, and that recognize own weaknesses
  - EPO staff provided skilled coaching, resources, support, and tools
  - Project members learned by doing and maintaining
- **Goals and Publicity**
  - Keep goals to sizable bites (projects)
  - Publicize successes; Share best practices

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Implementation Plan - Future

- **2007**
  - Conduct interim Maturity Level 3 appraisals on projects
  - Correct findings and strengthen institutionalization
  - Conduct Command Maturity Level 3 appraisal in April, 2007
  - Incorporate new version of CMMI model (V1.2)
  - Incorporate IPPD (Integrated Product and Process Development)
  - Push Level 2 projects to Level 3
- **2008 - 2009**
  - Begin Maturity Level 4/5 implementation
  - Establish/Refine organizational and project measures
  - Increase collection of project, process, and organizational measurement data
  - Conduct interim Maturity Level 4 appraisals on projects

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Summary

SPAWAR Systems Center Charleston

- **Aggressive SE Program**
- **Industry Standards**
  - Systems Engineering
  - Software Engineering
- **Best Practices**

CMMI LEAN SIX SIGMA ISO 9001

corpweb2.spawar.navy.mil/cmmi/

- **Automated Tools**
  - ePlanBuilder
  - eWBS
- **Training – 1,600+**
  - SE Fundamentals - 305
  - Web-Based Training courses
    - SSC-C PI; Intro to SE; Arch. Dev.

- **Successes**
  - April 2005 Command Achieved CMMI® Maturity Level 2 as certified by Software Engineering Institute
  - June 2006 Common Information Centric Security (CICS) project achieved CMMI Level 3 in 16 of 18 Process areas
  - 1st SPAWAR Systems Center to achieve these levels
- **Goals**
  - World-Class SE Program
  - Support Command Balanced Scorecard
  - April 2007, Command to achieve CMMI® Level 3

Partner ECHSOFT Technical Software Services, Inc.

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Thank you !

Any Questions ?

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GENERAL DYNAMICS
Advanced Information Systems

Using Design for Six Sigma (DFSS) to improve the ease-of-use of a Process Asset Library (PAL)

Fred Roberts
November 15, 2006

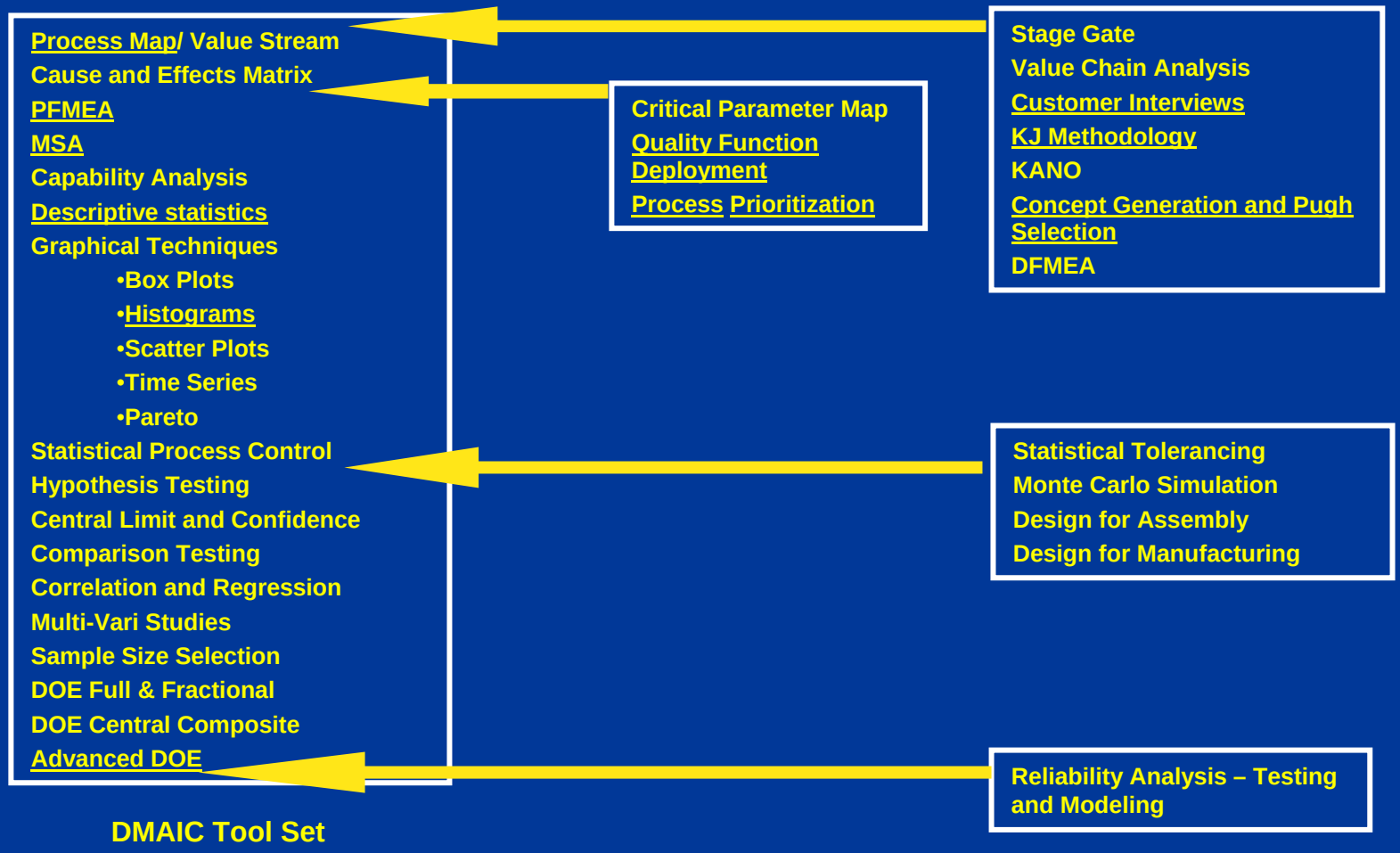
Agenda

- Design For Six Sigma (DFSS) Roadmap
- Six Sigma Tools – DMAIC & DFSS
- DFSS Phases
  - ↗ Concept
  - ↗ Design
  - ↗ Optimize
  - ↗ Verify
- Results
- Summary

DFSS Roadmap

Define	Concept	Design	Optimize	Verify
Define Scope	Understand Value	Map the Product or Process	Conduct Experiments	Create Roll out Plan
Define Objectives	Gather Voice/ Image of the Customer	Refine Design Concept	Analyze and Optimize redesign	Finalize FMEA
Assign Black Belt	Create/ Prioritize Requirements	Understand Variation	Simulate Performance	Document Control Plan
Develop Charter	Create/ Select Design Concepts	Minimize Complexity	Pilot Test	Implement Control Mechanisms
Form Team	Minimize Risk	Conduct Functional Analysis	Minimize Risk	Verify Long Term Process Capability
		Minimize Risk	Update Control Plan	

DMAIC & DFSS Tools



Design For Six Sigma: **Concept**

Gather Voice/Images of Customer

- The perception that the PAL was hard to use came from “hearsay.” Data on the nature and scope of the dissatisfaction did not exist.
- We used the Voice of the Customer (VoC) process and a Customer Selection Matrix to understand what causes dissatisfaction with using the PAL.

Image KJ: Good/Bad CPF

…65% sure people spend 1 hour/day lost in the CPF. #121

The CPF is easy to use

Users benefit from easy access to the CPF Architecture

- The structure is easy and self-explanatory#57
- •The CPF is a good reference for me#1
- •CPF is online! It's good!#89
- •The CPF is well organized hyperlinks and templates are useful.#4

The usability of the CPF continually improves

- The CPF has improved dramatically in the last year for Business Development#31
- •The CPF was difficult to use a while ago but now it is organized#5
- Because it is easy to use people will use the current document by pulling it off the network#133

The comprehensive CPF does not need improvement.

The CPF contains all necessary information

- •The CPF is comprehensive, everything you can imagine is in there, if you have enough time to find it. #22
- One-stop shopping! Provides everything I need to do my job in one place Easy to navigate to templates & guides used. Can focus on work in stead of the process#74
- •All in one place! Improvement over LotusNotes which had too many databases#83

The CPF is perceived as not needing changes

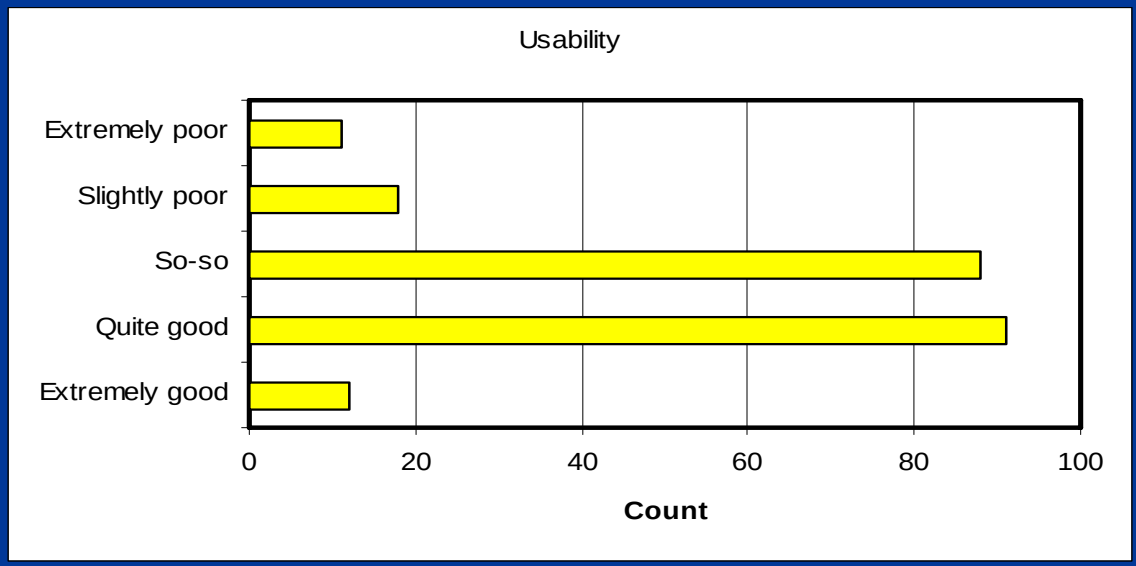
- I really don't have any frustrations with the CPF#32
- I don't know what I would change about the CPF#7
- •Can't think of any way to improve the CPF #25

The CPF needs improvement

- ..Not organized well Not defined by stages Doesn't spell out what is required, what isn't; Lacks summary of what to do; All over the place; Stove piped for the SBUs; Lacks flow #76
- •If you look at the CPF there is a process there but I don't think it is organized correctly. #100
- At the time it (CPF) was the right thing to do to get it going. No issue with the people. Going forward needs improvement#110

Survey of a random sample (7%) of the entire population

- Results of Ease Of Use Survey:



Extremely Poor	11	5.0%
Slightly Poor	18	8.1%
So-So	88	40.0%
Quite Good	91	41.4%
Extremely Good	12	5.5%

How we handled the So-So group.

The So-So or neutral group was viewed as not dissatisfied. This group does use the CPF and will have preferences on differing aspects of the CPF usability. They could be the "swing vote" if we adversely affect them.

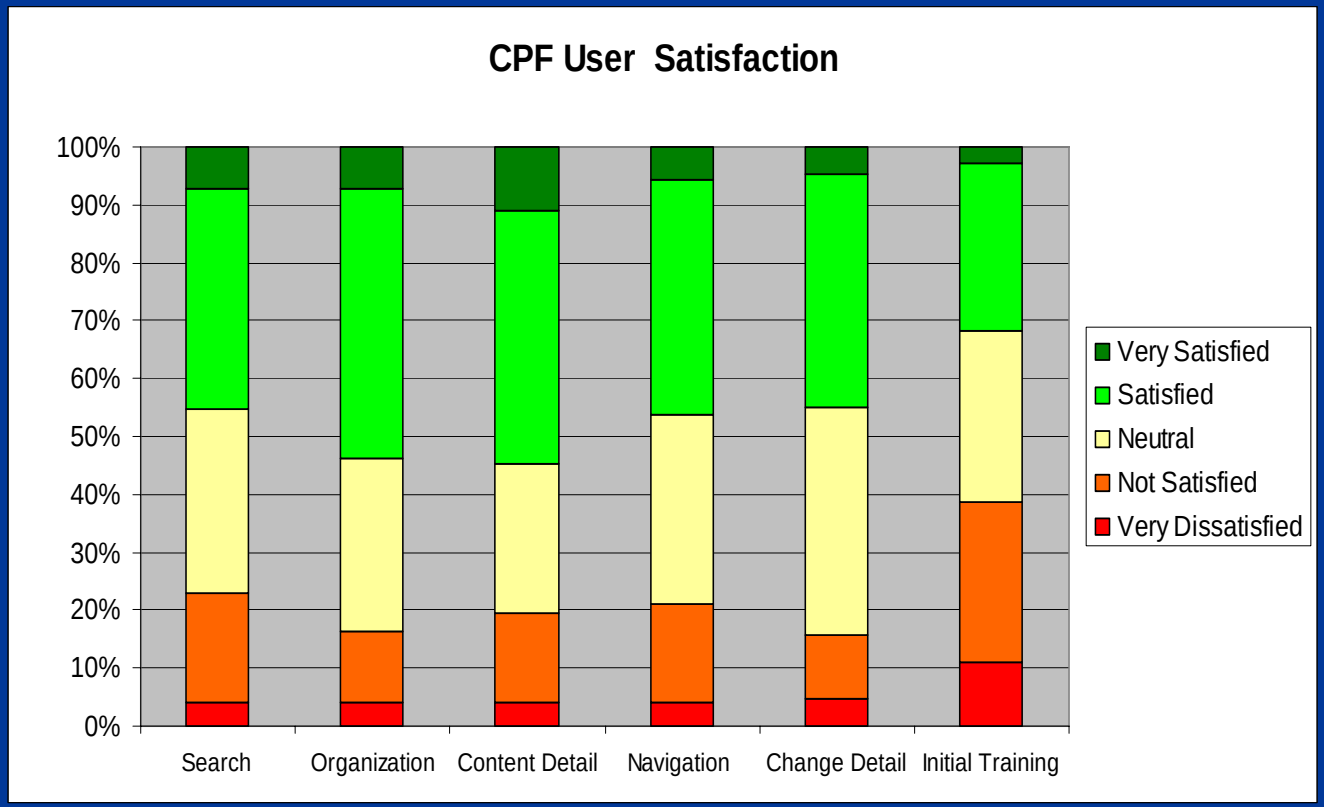
Design for Six Sigma: **Concept**

Survey Core Questions

How satisfied are you with the following components of Common Process Framework in providing you with what you need to do your job?

	Very Satisfied	Satisfied	Neutral	Not Satisfied	Very Dissatisfied
The current search capability	❑	❑	❑	❑	❑
The organization of materials	❑	❑	❑	❑	❑
The level of content detail	❑	❑	❑	❑	❑
The current navigation capabilities	❑	❑	❑	❑	❑
The level of detail regarding changes to documents	❑	❑	❑	❑	❑
The initial training you received	❑	❑	❑	❑	❑

Design for Six Sigma: **Concept**



Design for Six Sigma: **Concept**

Advanced DOE: Conjoint Analysis

Feature	Relative Importance	Level (Average Utility)		
Organization of the contents of the Common Process Framework should be …	2.6%	structured around the sequence of how work is performed	structured around functional areas	
		0.254	0.241	
As I go from Policy to Procedures to Instructions I prefer to see …	30.4%	the detail increase	minimal detail throughout	detail throughout
		0.355	0.131	0.253
I prefer to navigate the Common Process Framework using …	17.9%	pictures and diagrams with links	text and links	
		0.291	0.203	

Design for Six Sigma: **Concept**

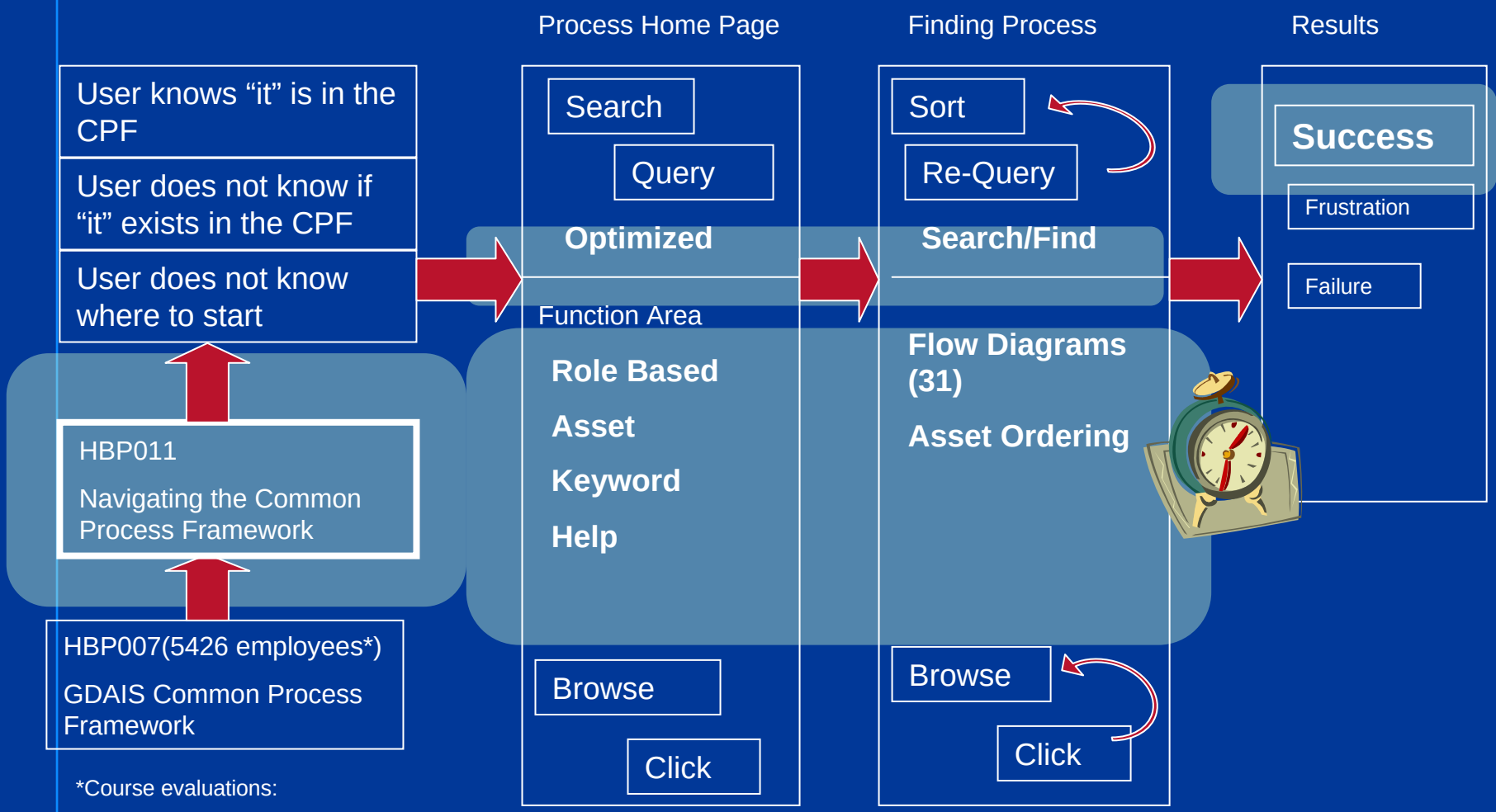
PUGH for Training Delivery

Requirements/Objectives	Current HBP007		HBP011				
	CBT	Instructor (Classroom)	CBT	Instructor (Classroom)	Mentoring	Instructor (WebEx)	Discovery
Measure Skill transfer	80%	100%	-	S	+	+	-
Personal Contact	no	yes	S	S	S	-	-
Measure Training Effectivness	no	no	S	+	+	+	S
JIT	yes	no	S	S	-	+	+
Efficient	yes	no	S	S	-	+	-
			1 '-'	1 '+'	S	3 '+	2 '-

S = Same as Current
"+'" = Positive wrt Current
"-" =Negative wrt Current

Design for Six Sigma: **Design**

Refine Design Concept (i.e., Can-Be)



*Course evaluations:

Instructor Led 57; CBT 87

GENERAL DYNAMICS
Advanced Information Systems

Design For Six Sigma: **Design**

Understand Variation

- The prioritized requirements were used as a basis for formulating the questions in our survey to confirm the relative importance of the individual requirements. The fact that we were dealing with perceptions and preferences made this a difficult process.
- The tool selected supported anonymity and large sampling(~7%) which allowed us to know who responded, which helped in segmenting the population.
- The Measurement System Analysis showed very little variability in responses.

Design For Six Sigma: **Optimize**

Analyze and Optimize Redesign

- The survey results clearly show that Initial Training was a source of dissatisfaction with the usability of the Process Framework, by nearly a factor of two.
- Concurrent with the DFSS EOU project the Process Owner continued to make improvements to five of the six categories by adding views, flow diagrams, and tweaking the search engine.
- Hence, we chose training since training had the highest dissatisfaction level for our users.

Design For Six Sigma: **Verify**

Finalize PFMEA/ Control Plan

- There were five process steps in deploying the training with the following RPN (Risk Prioritization Numbers)

Identify Trainees	**48**
Schedule training for employees	**210/24 (high risk)**
Conduct Training	**6**
Evaluate Training Results	**126/14 (high risk)**
Analyze and Report	**63/28 (easy fix)**

Design for Six Sigma: **Verify**

PFMEA

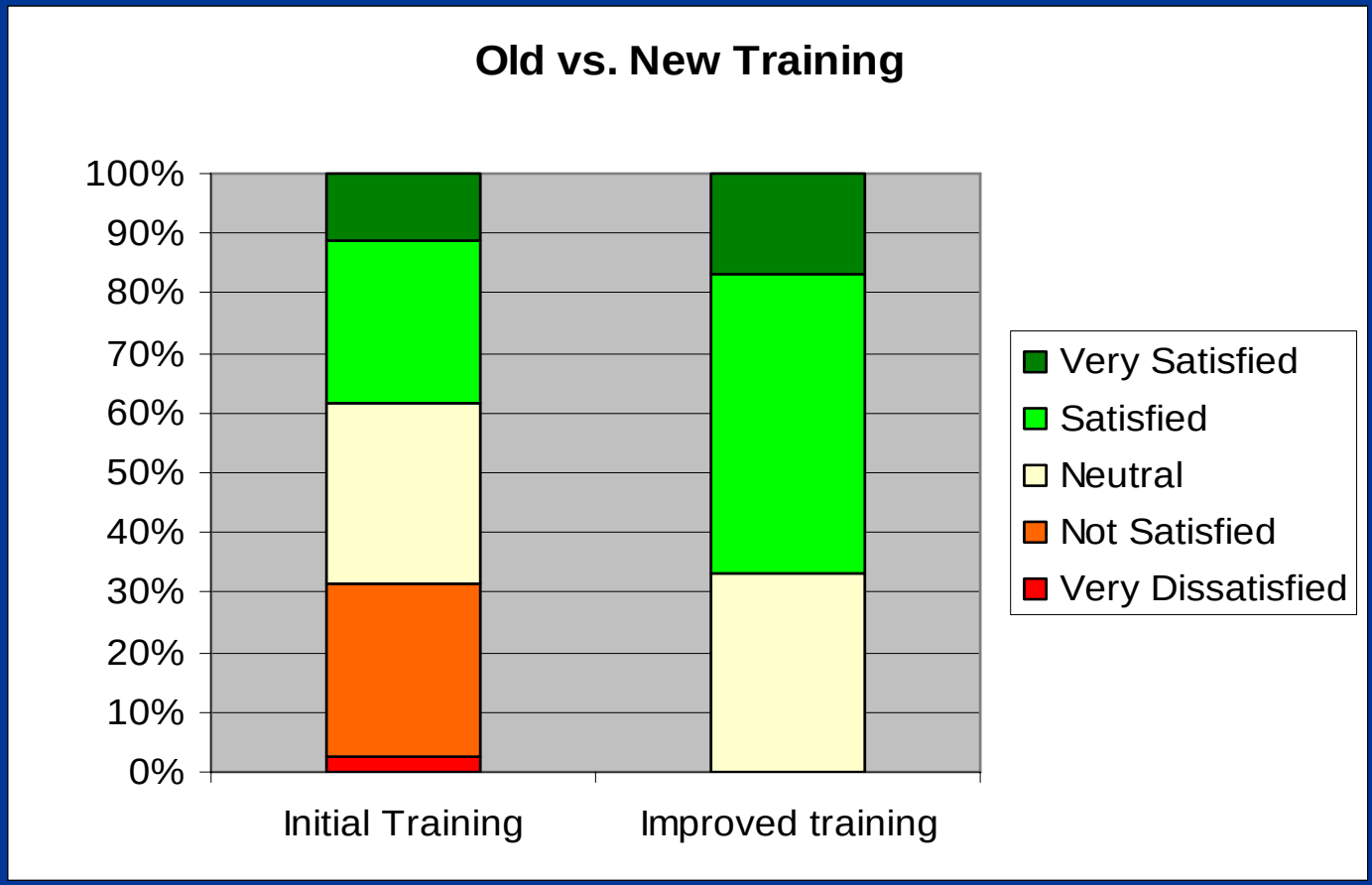
Process Step/Input	Potential Failure Mode	Potential Failure Effects	SEV	Potential Causes	OCC	Current Controls	DET	RPN	Actions Recommended	Resp.	Actions Taken	SEV	OCC	DET	RPN
Identify Trainees	Not notified of new hires	Employees not scheduled	8	Lack of automatic notification	2	Existing HR Onboarding Process	3	48							0
Schedule Training	Requirements for course not understood	Training not delivered	6	Managers don't recognize that this should be required	5	People Managers are required to take Onboarding training	7	210	Make System add this to ITP	Ralph/Fred		6	2	2	24
Conduct Training	Delevery Tool (i.e. Web EX not available)	Rescheduling increases cost, delays JIT requirements	3	IT Infrastructure problems and/or limitations	2	Helpdesk	1	6							0
Evaluate Training Results	Data not collected	No analysis	7	Evaluations not required	6	Do not Require Eval form	3	126	Require Evaluations as completion criteria	David/Cindy		7	2	1	14
Analyze and Report	No resources (available , budget,or assigned)	Inability to assess effectiveness and improve	7	Availability of instructors/ analysists	3	HR Policy on Instructors	3	63	EO Schedule/ Plan for instructors	Ralph		7	2	2	28

Design For Six Sigma: **Verify**

Control Plan

Process	Process Step	Output	Input	Process Specification (LSL, USL, Target)	Measurement Technique	Sample Size	Sample Frequency	Control Method	Reaction Plan
Training	Schedule Training	Scheduled	New Hire/ Re-training	100% new hire	Individual Plot	continuous	event driven	Report to Higher Level Management	
Training	Evaluate Training Results	Course Evaluation	Training has occurred	100% each student	histogram % completed	continuous	event driven	Report to Higher Level Management	Follow-up w/student
Training	Analyze and Report	Statistical Analysis	Course evaluations	Quarterly Reports	count/on time	event driven	event driven	Report to Higher Level Management	
Training	Training Materials	Revised Materials	PIR	na	Revisions	continuous	event driven	PIR Process	

Results


Old vs. New Training
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Initial Training
Improved training
Very Satisfied
Satisfied
Neutral
Not Satisfied
Very Dissatisfied

Summary

- **Process Design For Six Sigma tools:**
  - **Support the CMMI model by providing the "how" for many of the practices in the model**
  - **Support the design of effective and efficient processes**
  - **Improved the ease-of-use of our Process Asset Library**

Contact Information

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Questions?

GENERAL DYNAMICS

How to Sell CMMI to Your CEO in His Own Language

Lemis O. Altan

cognence inc
Improving Software Economics

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A Few Questions

- How many of you have tried to convince your “C” level executives on the merits of the CMMI Model and haven’t made any headway?
- How many of you keep thinking there is a communication problem, if only…. I can make myself heard?
- How many of you have approached your CEO regarding process improvement efforts from a technical perspective?

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Session Objectives

- Review the language of engineering and engineering processes
- Learn the language of the CEO
- Translate the engineering language to CEO's language
- Learn how process improvement efforts can be sold in business context – an example

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Language of Engineering

Life Cycle (waterfall, iterative, spiral, v-model)

Requirements development

Configuration management

Solution development

Integration

Interfaces

Testing (unit, component, system, …ability, performance, etc.)

Builds

Bug fixes

Release

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Language of CMMI Framework

Process institutilization

Project instantiation

Maturity level

Capability level

DAR process

Causal analysis

Monitor and control

Criteria

Relevant stakeholders

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Language of CEOs

- Revenue
- Expense – selling, administrative, engineering, etc.
- Gross margins
- Net income
- Earnings Before Interest, Taxes Depreciation and Amortization (EBITDA)
- Operating profit
- Cost reduction
- Revenue growth
- Return On Investment (ROI)
- Strategy
- Productivity
- Competition

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Typical Customer Survey/Feedback Results

- Quality of our products are very low
- They may be reconsidering purchasing another product from us
- They find numerous bugs
- They feel as if they are our testing group
- Our products are always late
- Our products are not meeting their needs

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State of Engineering Organization

- Long hours for engineers
- Fighting the same old battles again and again
- Attrition is high - Losing many talented people
- Too many bugs
- Cannot get a product released as expected
- Rework, rework, rework – not enough time to do it right, but plenty of time to do it over!
- Heroes, heroes, heroes

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Solution 1

We are going to adapt CMMI to create engineering processes; we are going to institutionalize them and mature the organization.

We will put everything under configuration management.

We will fix all bugs before we release a product.

It will take a long time; but it will be worth it at the end.

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What do you think the reaction of your CEO will be?

- What is this CMMI thing?
- How long did you say it will take?
- How much did you say it will cost?

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Solution 2

- We find out our SW engineering costs in real $s by conducting a **cost analysis against the industry benchmarks**, based on the results we work to reduce the biggest cost areas.

- We find out the state of our **engineering practices as compared to the industry best practices** (CMMI Model) and then adapt them to fix our problems based on where we can impact the highest costs.

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Strategy

A business approach to process improvement based on the language of the CEO:

Step 1: Financial Cost Analysis of engineering quality

Step 2: Gap Analysis of engineering practices against the industry best practices (CMMI)

Step 3: Correlation between steps 1 and 2

Step 4: Recommended Areas of Improvement for the best ROI.

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Example: Company A – Situation Analysis

- Company A, Engineering Organization is developing a Next Generation System (NGS) that incorporates hardware and software elements.
- Software defect rates in previous products were high.
- To develop and deliver a high quality product, Company A has engaged in several process improvements, including Design for Six Sigma (DFSS) House of Quality (HOQ).
- To meet the timing requirements, impact, and budget constraints, a "QuickLook" assessment was performed – to determine **highest value, engineering practice improvement opportunities** and setting baselines.
- Effort will focus on 3 key areas: Project management, engineering and support areas across 5 engineering subsystem teams over a 1-week timeframe and include a Cost of Quality analysis.

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Underlying Quality Premises

- The earlier quality can be driven into a product, the less costly it will be to deliver and support the product.
- Average software projects spend 50% or more of their budgets fixing quality problems introduced earlier in the software engineering life cycle.
- High cost of poor quality robs organizations of the ability to deliver more features and functionality to the market.
- The underlying premise of process improvement is:
  - *"The quality of a product is largely determined by the quality of the process that is used to develop and maintain it."*

  Based on TQM (Total Quality Management) principles as taught by Shewhart, Juran, Deming and Humphrey

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Step 1: Financial Cost Analysis of Engineering Quality

Cost of Quality Analysis

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Cost of Quality Analysis Objectives

- Quantify in “$”s poor quality costs
- Identify major opportunities for poor quality to reduce cost
- Identify opportunities for reducing customer dissatisfaction
- Identify threats to product salability
- Expand budgetary and cost controls
- Stimulate improvement through publication
- Improve ability to deliver more to the business/market
- Reduce the functionality gap versus the competition
- Provide executives with tangible reasons to invest in software engineering improvement

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Cost of Quality (CoQ) Concept

- Developed by J.M. Juran and applied successfully by companies like Toyota Motor Corporation to achieve competitive advantages through the development of better quality products
- CoQ represents *all costs associated with poor quality*

Source: Juran's Quality Handbook

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Example – Company A, Engineering Org. Cost of Quality Results Summary

• Total Organizational 3-Month Costs:	$3, 648,000	100%
• Software Development Costs	$1,060,000	29%
• Quality Costs	$2,588,000	71%
• Prevention Costs	$200,000	5%
• Appraisal Costs	$181,000	5%
• Internal Rework Costs	$725,000	20%
• External Rework Costs	$1,482,000	41%
Yearly Organizational Cost Savings Opportunity	$3,094,000	30%

Based on Company A SW Eng. budget of $10M/year reducing CoQ to 40%

- Company A, SW Development Quality of Data: Low/Average

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Example – Company A, Engineering Cost of Quality Results

Development Costs = 29%

Costs incurred to directly develop the product, or interim work products that lead to a product. Does not include any reviews, testing, or rework

Examples:

- Capturing/Documenting Requirements
- Architecting the system
- Designing the system
- Writing and unit testing code
- Managing the project
- Creating user documentation
- Creating installation guides

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Example – Company A, Engineering Cost of Quality Results

Prevention Costs = 5%

Costs incurred to keep failure and appraisal costs to a minimum

Examples:

- Quality planning
- Software quality assurance
- Software configuration management
- Supplier capability assessments
- Quality training
- Software reuse
- Requirements reviews
- Design reviews
- Code reviews
- SCM tools
- External process assessments
- Process improvement efforts

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Example – Company A, Engineering Cost of Quality Results

Appraisal Cost = 5%

Costs incurred to determine the degree of conformance to quality requirements

Examples:

- Purchased software testing
- Defect reporting/tracking
- Test automation software
- First iteration integration testing
- First iteration system testing
- User acceptance testing

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Example – Company A, Engineering Cost of Quality Results

Internal Failure costs = 20%

Costs associated with defects that are found prior to transfer of the software to the customer

Examples:

- Design corrective action
- Design re-reviews
- Purchased software corrective action
- Purchased software re-test
- Defect reporting/tracking
- Defect fixing
- 2nd and subsequent integration testing iterations
- 2nd and subsequent system testing iterations

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Example – Company A, Engineering Cost of Quality Results

External Failure Costs = 41%

Costs associated with defects that are found after the software is shipped to the customer

Examples:

- Next release defect rework (maintenance)
- "Re-engineering"
- Technical support personnel
- Software returns
- Lawsuits
- Contract penalties
- Lost customers
- Lower marketplace perception
- Loss of pricing power
- Lost sales

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CMMI Based Gap Assessment

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Engineering Process Improvement Premise

- Capability Maturity Model Integration (CMMI®) incorporates systems and software engineering industry best practices that are widely recognized to deliver quality systems.
- In performing the “QuickLook” Company A process assessment, the CMMI will be used as the reference model.

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Example – Company A, "QuickLook" Engineering Processes Assessment

Process Areas selected for "QuickLook":

- Engineering:
  - Requirements Development
  - Requirements Management
  - Product Integration
  - Verification
- Project Management:
  - Project Planning
  - Project Monitoring and Control
- Support:
  - Configuration Management
  - Measurement and Analysis

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Example – Company A, "QuickLook" Engineering Processes Assessment Results

Capability Level	Process Area
1	Requirements Development (9 practices satisfied out of 12; 3 not rated)
0	Project Planning (6 practices satisfied out of 14)
0	Project Monitoring & Control (4 practices satisfied out of 10)
0	Requirements Management (3 practices satisfied out of 5)
1	Product Integration (9 practices satisfied out of 9)
0	Verification (4 practices satisfied out of 8)
0	Configuration Management (5 practices satisfied out of 7)
0	Measurement and Analysis (0 practices satisfied out of 8)

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Example – Company A, "QuickLook" Engineering Processes Assessment Results

CMMI Generic Goals and Practices Summary

Rating	Generic Goal/Generic Practice Description
NS	GG 2 – Institutionalize a Managed Process
NS	GG 2.1 – Establish an Organizational Policy
NS	GG 2.2 – Plan the Process
NS	GG 2.3 – Provide Resources
S	GG 2.4 – Assign Responsibility
NS	GG 2.5 – Train People
NS	GG 2.6 – Manage Configurations
NS	GG 2.7 – Identify and Involve Relevant Stakeholders
S	GG 2.8 – Monitor and Control the Process
NS	GG 2.9 – Objectively Evaluate Adherence
NS	GG 2.10 – Review Status with Higher Level Management

■ S = Satisfied ■ NS = Not Satisfied

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Step 3: Correlation Between Cost of Quality and Gap Analysis of Engineering Practices Against CMMI

Correlation of Two Assessments

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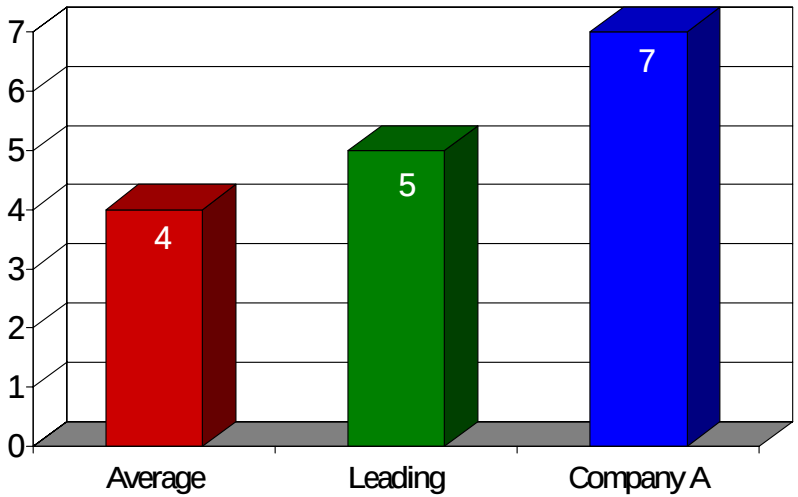
Example – Company A, Correction of Engineering Costs and Process Gaps

Requirements Effort % Benchmarks



"Quick Look" Engineering Process Assessment Results

Capability Level	Process Area
1	Requirements Development (9 out of 12 practices satisfied; 3 not rated)
0	Requirements Management (3 out of 5 practices satisfied)

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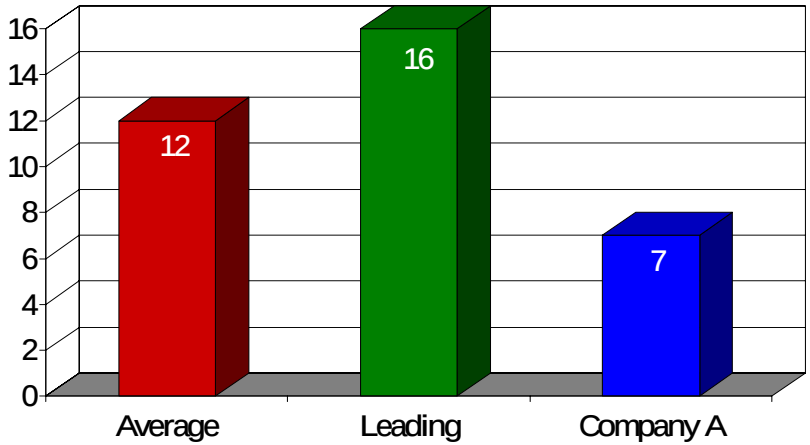
Example – Company A, Correction of Engineering Costs and Process Gaps

Design Effort % Benchmarks



"Quick Look" Engineering Process Assessment

Capability Level	Process Area
1	Product Integration (9 out of 9 practices satisfied)

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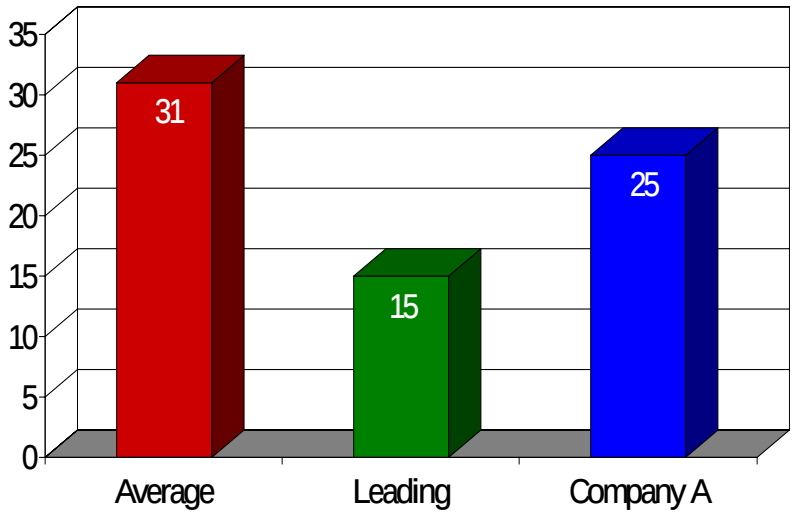
Example – Company A, Correction of Engineering Costs and Process Gaps

Testing Effort % Benchmarks



"Quick Look" Engineering Process Assessment Results

Capability Level	Process Area
0	Verification (4 out of 8 practices satisfied)

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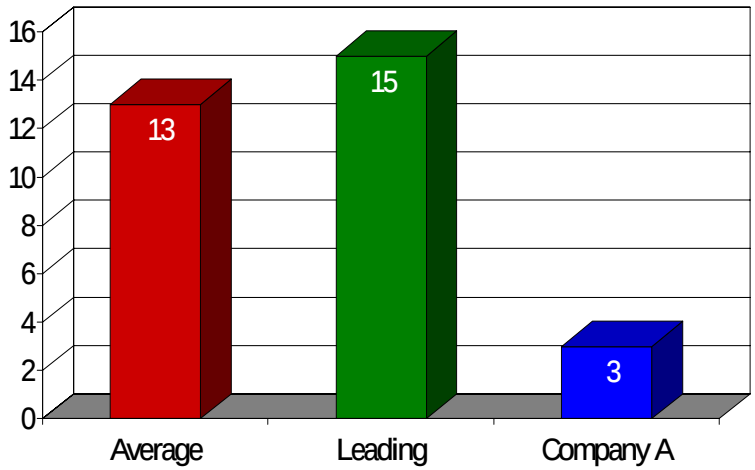
Example – Company A, Correction of Engineering Costs and Process Gaps

Project Management Effort % Benchmarks



"Quick Look" Engineering Process Assessment

Capability Level	Process Area
0	Project Planning (6 out of 14 practices satisfied)
0	Project Monitoring & Control (4 out of 10 practices satisfied)

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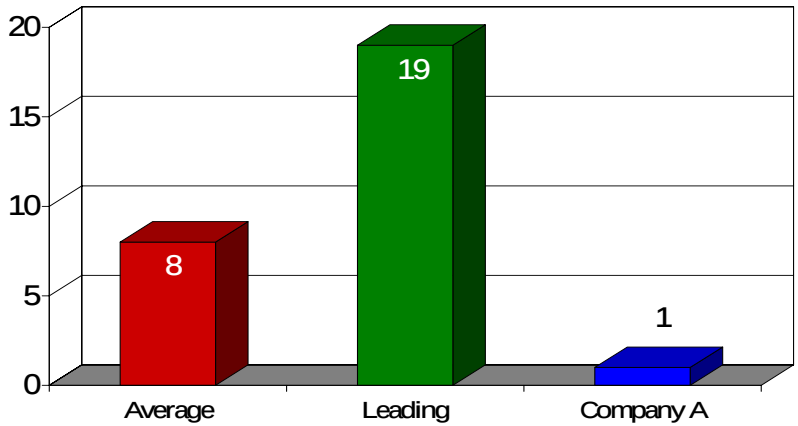
Example – Company A, Correction of Engineering Costs and Process Gaps

SQA % Benchmarks



"Quick Look" Engineering Process Assessment

Capability Level	Process Area
1	Configuration Management (5 practices out of 7)

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Step 4: Recommended Areas of Improvement for the Highest ROI

Risks and Recommendations

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Example – Company A, Recommended Areas of Improvement for the Highest ROI

Major Areas of Risk – 1:

- Most widely-recognized software experts view project management as a critical capability in delivering quality software. Project planning and project monitoring and control is weak in Company A SW organization. (CoQ PM cost allocation confirms this observation.)
- Effective measurement and analysis (M&A) is almost non-existent. Without M&A it is very difficult to gain insight into the software development processes, products, and projects, and take corrective actions when necessary.

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Example – Company A, Recommended Areas of Improvement for the Highest ROI

Major Areas of Risk – 2:

- Verification activities at the component and sub-assembly level need to be better planned and implemented. Unit and integration tests must be tied back to the requirements allocated to the software components.

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Example – Company A, Recommended Areas of Improvement for the Highest ROI

Overall Recommendations – 1:

- Take steps to apply a level of discipline and rigor to software engineering project management in-line with the DFSS and systems engineering improvements already installed
  - Thoroughly plan the software activities and deliverables as related to the system requirements allocated to software
  - Properly schedule the software projects – do not allow "un-tethered" activities to remain off schedules
  - Plan and implement a measurement and analysis capability that addresses process, product, and project dimensions

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Example – Company A, Recommended Areas of Improvement for the Highest ROI

Overall Recommendations – 2:

- Institute more formal software work product inspections and track results.
- Continue to apply the successful DFSS and systems engineering techniques to drive systems requirements to the software components where verification can take place against those requirements.

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Questions and/or Comments?

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Appendix

Supporting Details

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Characteristics of Average/Leading Benchmarks

Average (CMM/CMMI ML1)	Leading (CMM/CMMI ML 3)
Total CoQ of 55% - 70%	Total CoQ of 40% - 50%[1]
External Failure Costs > 50%	External Failure Costs 15%-25%[2]
Spend 31% on Testing	Spend 15% on Testing[3]
Spend 8% on SQA	Spend 19% on SQA[3]
	20% Decrease in Cost & Schedule[3]
	80% Decrease in Released Defects[3]
	65% Increase in Productivity[3]

Includes process improvement, work product reviews, and classical SQA activities

1: Dion, R., "Process Improvement and the Corporate Balance Sheet," *IEEE Software*, July 1993
2: Krasner, H., "Self-Assessment Experiences at Lockheed," *SEI/AIAA SPI Workshop*, Chantilly, VA 1990
3: Jones, C., "Measuring Software Process Improvement," *Software Process Improvement*, IEEE, 2001

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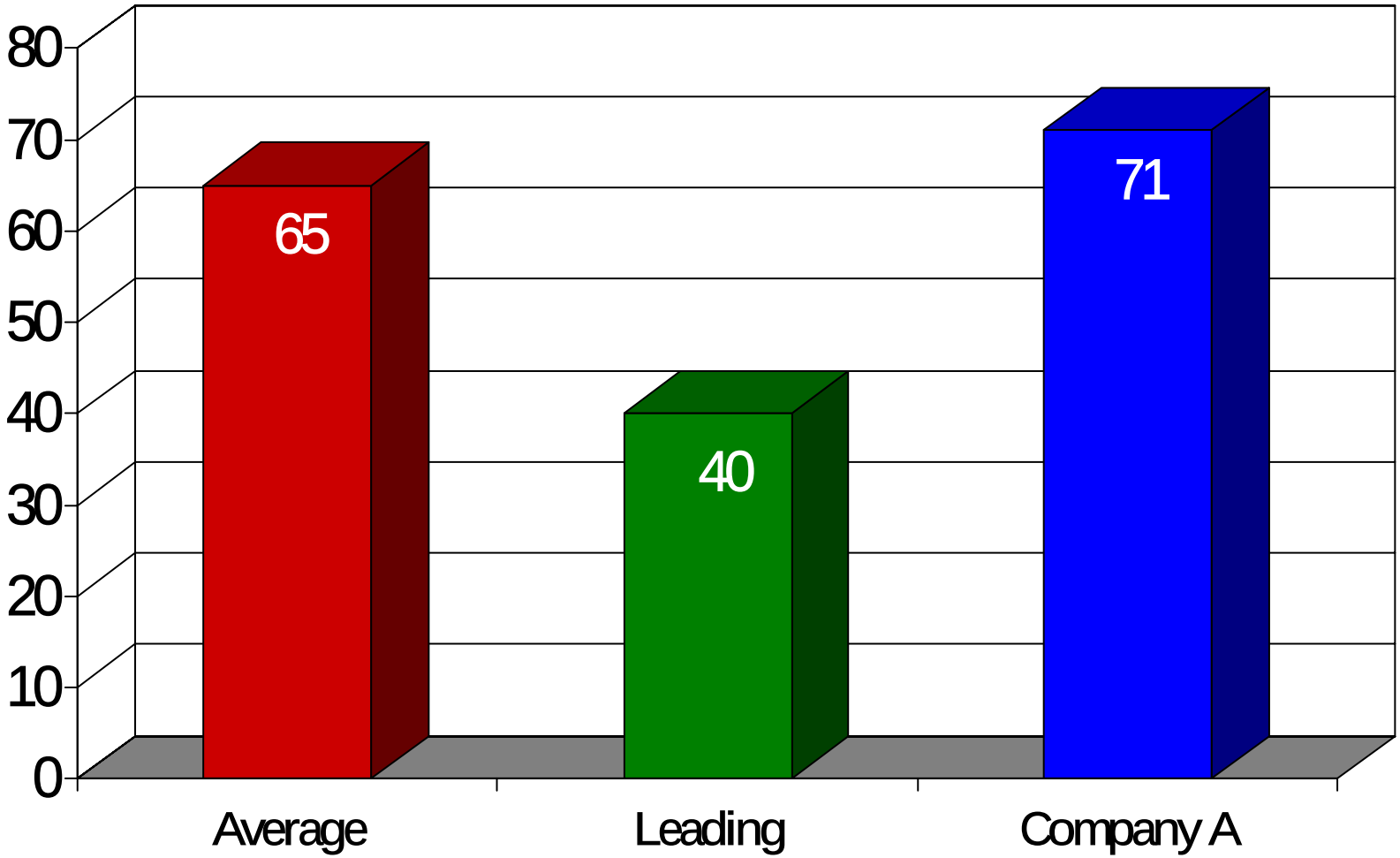
Company A - Cost of Quality % Compared to Benchmarks



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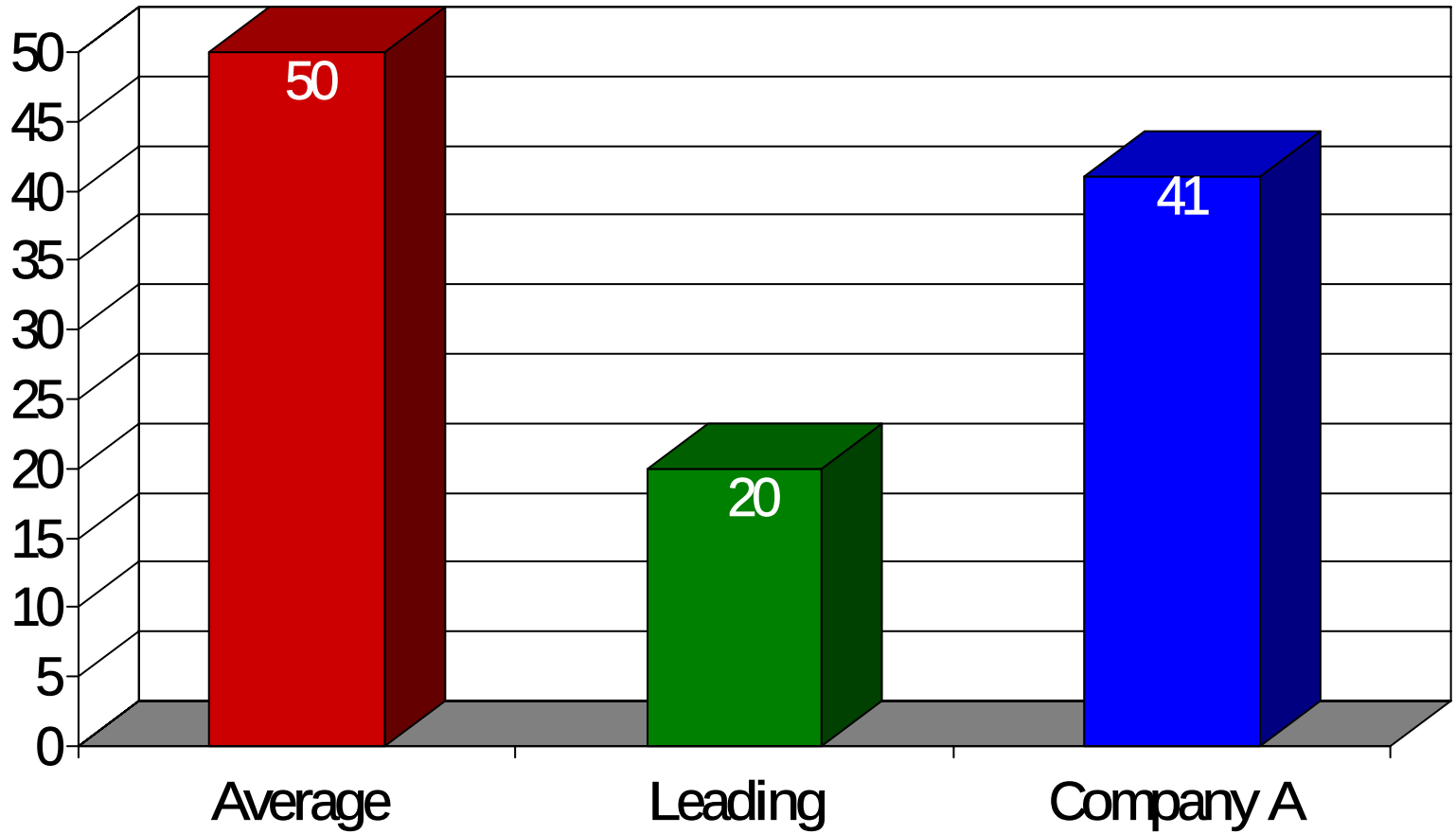
Company A - External Failure % Compared to Benchmarks



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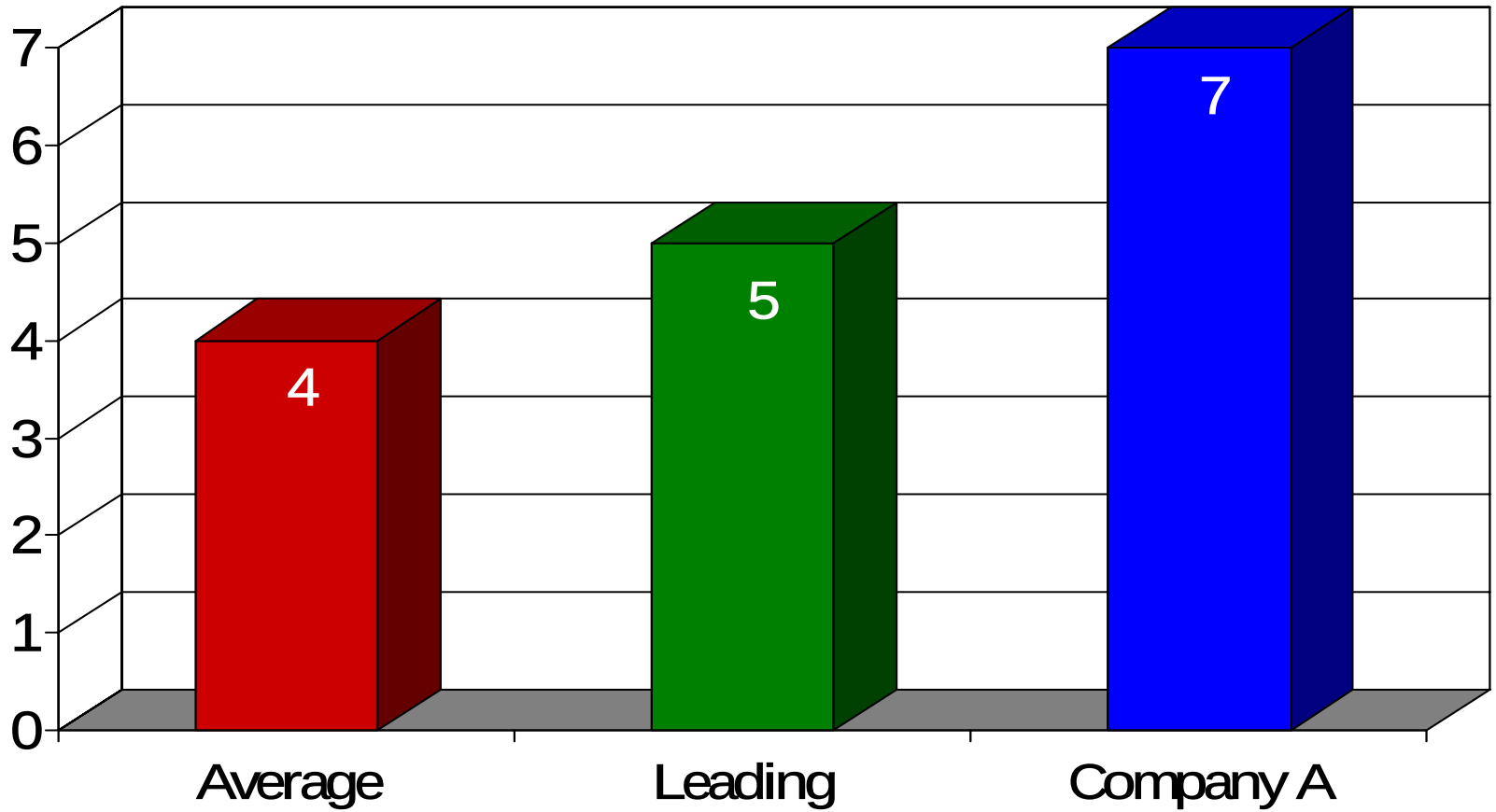
Company A - Requirements Effort % Benchmarks



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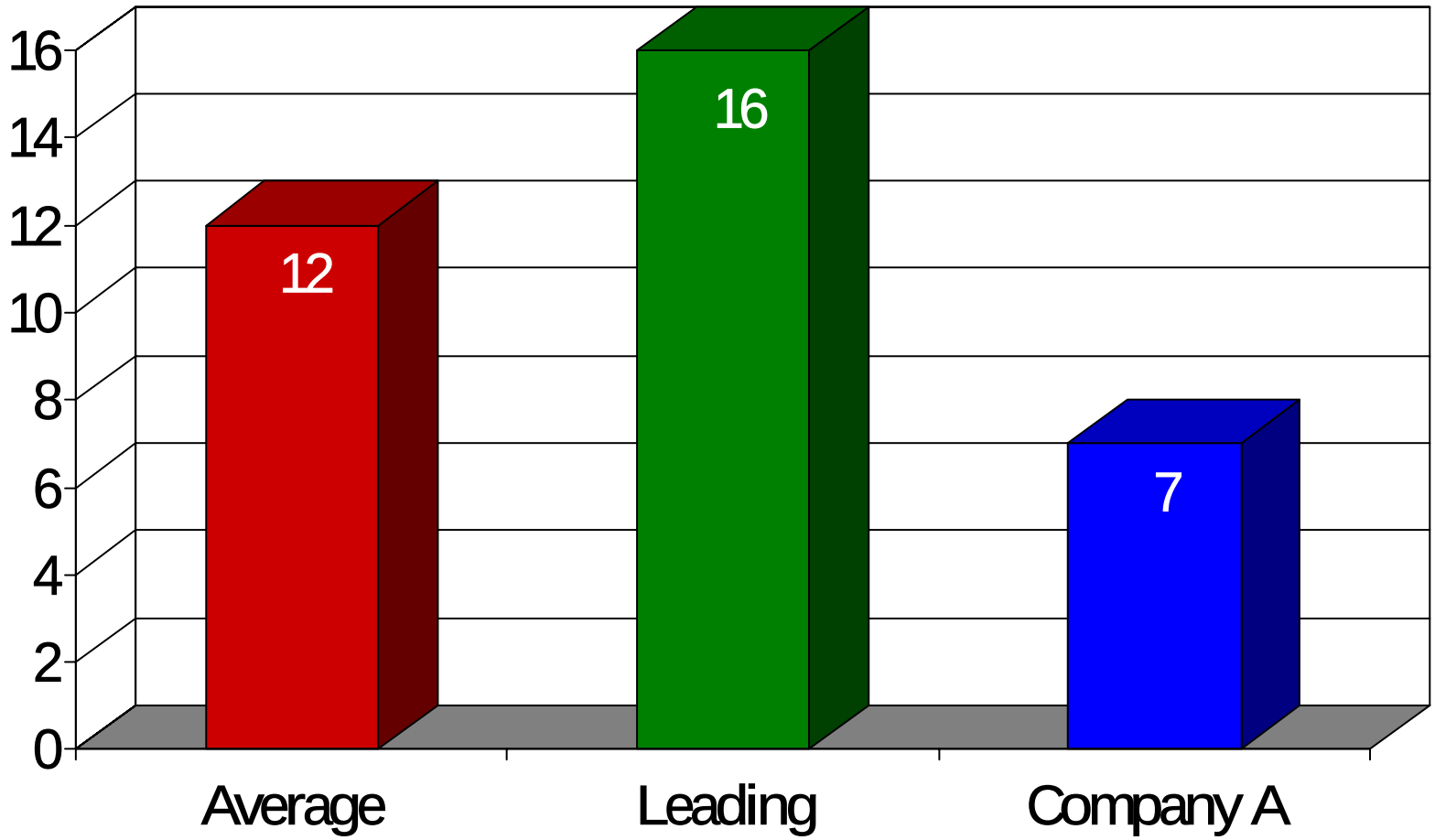
Company A - Design Effort % Compared to Benchmarks



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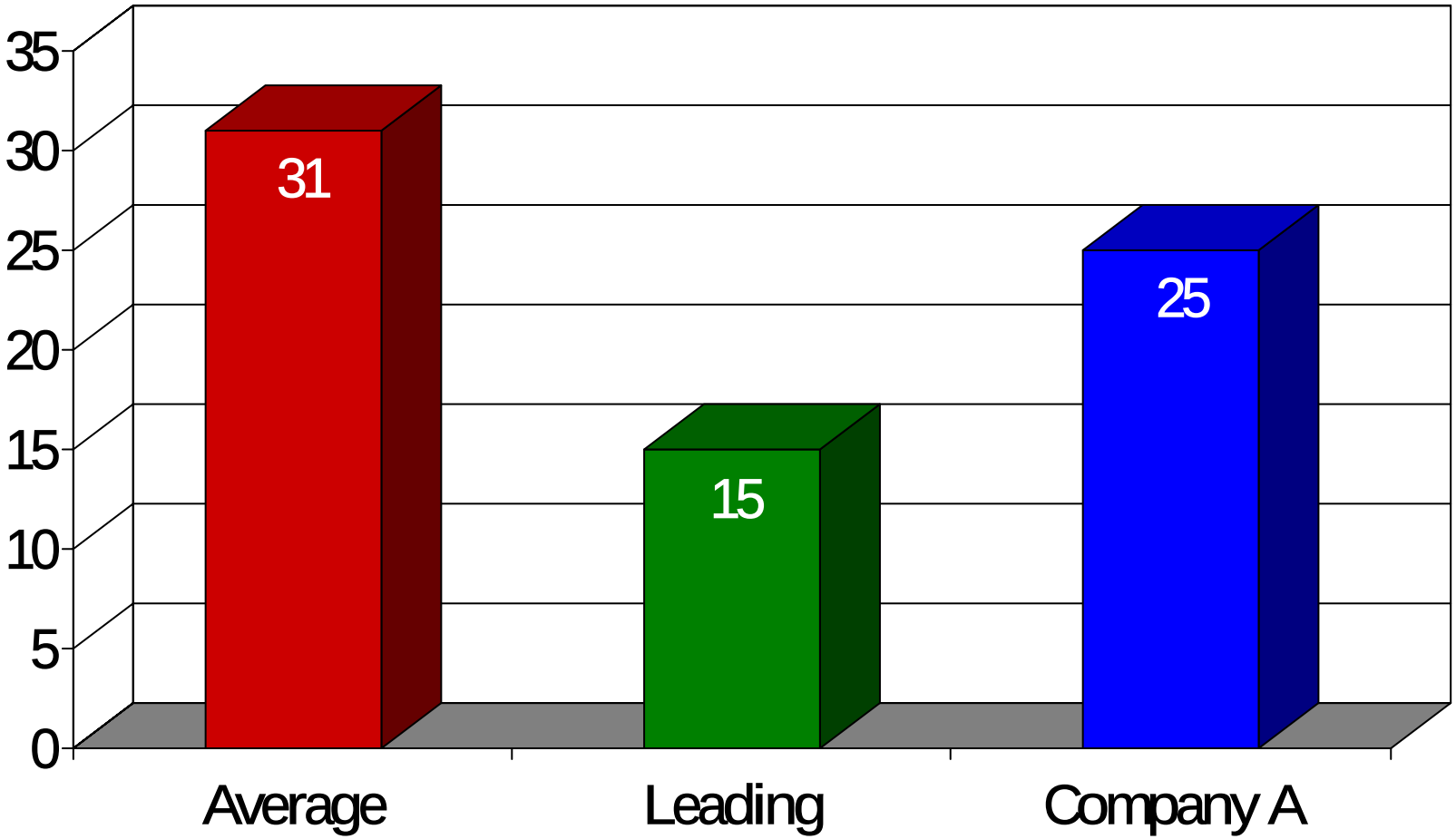
Company A - Testing Effort % Compared to Benchmarks



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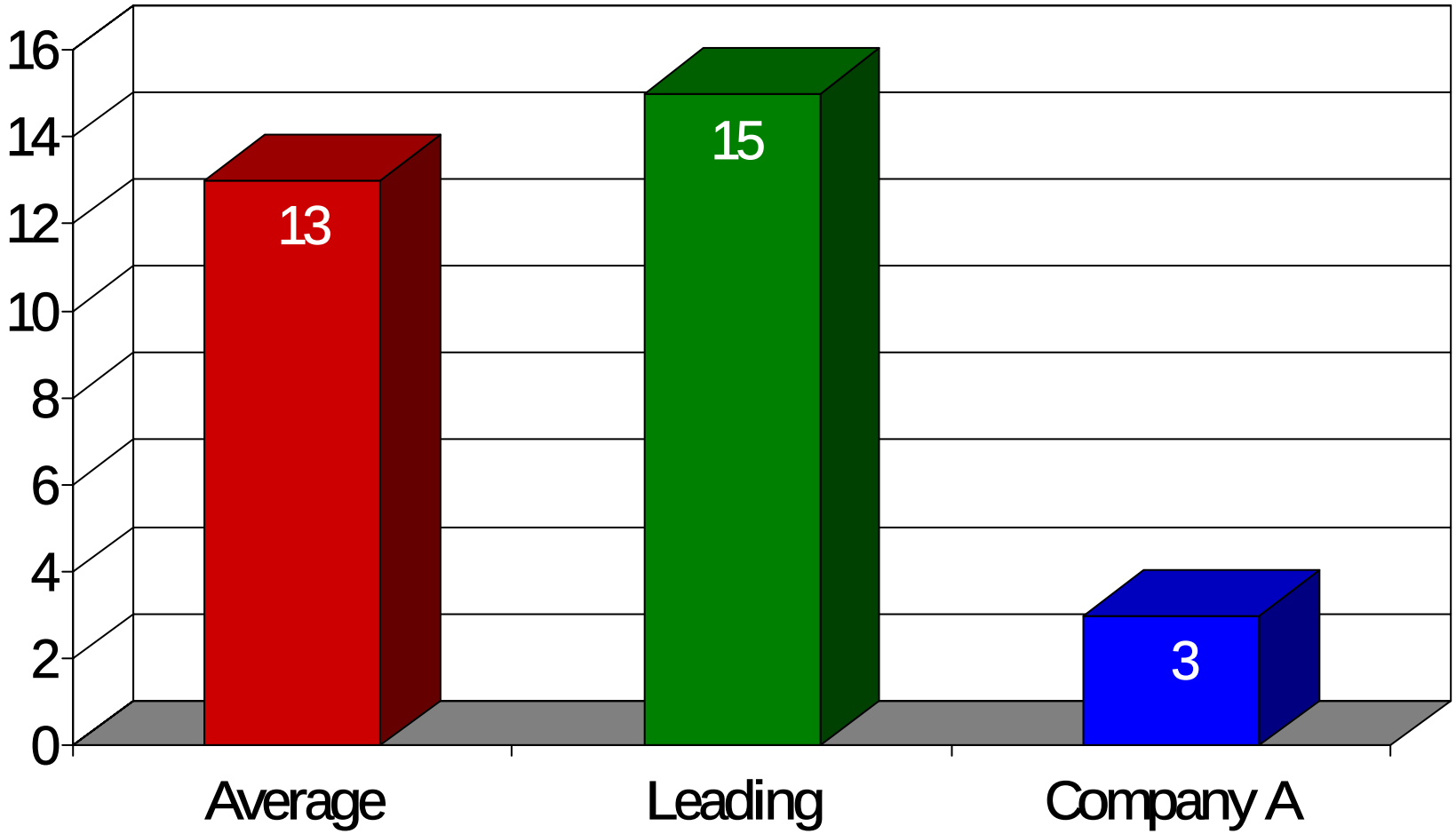
Company A – Project Management Effort % Compared to Benchmarks



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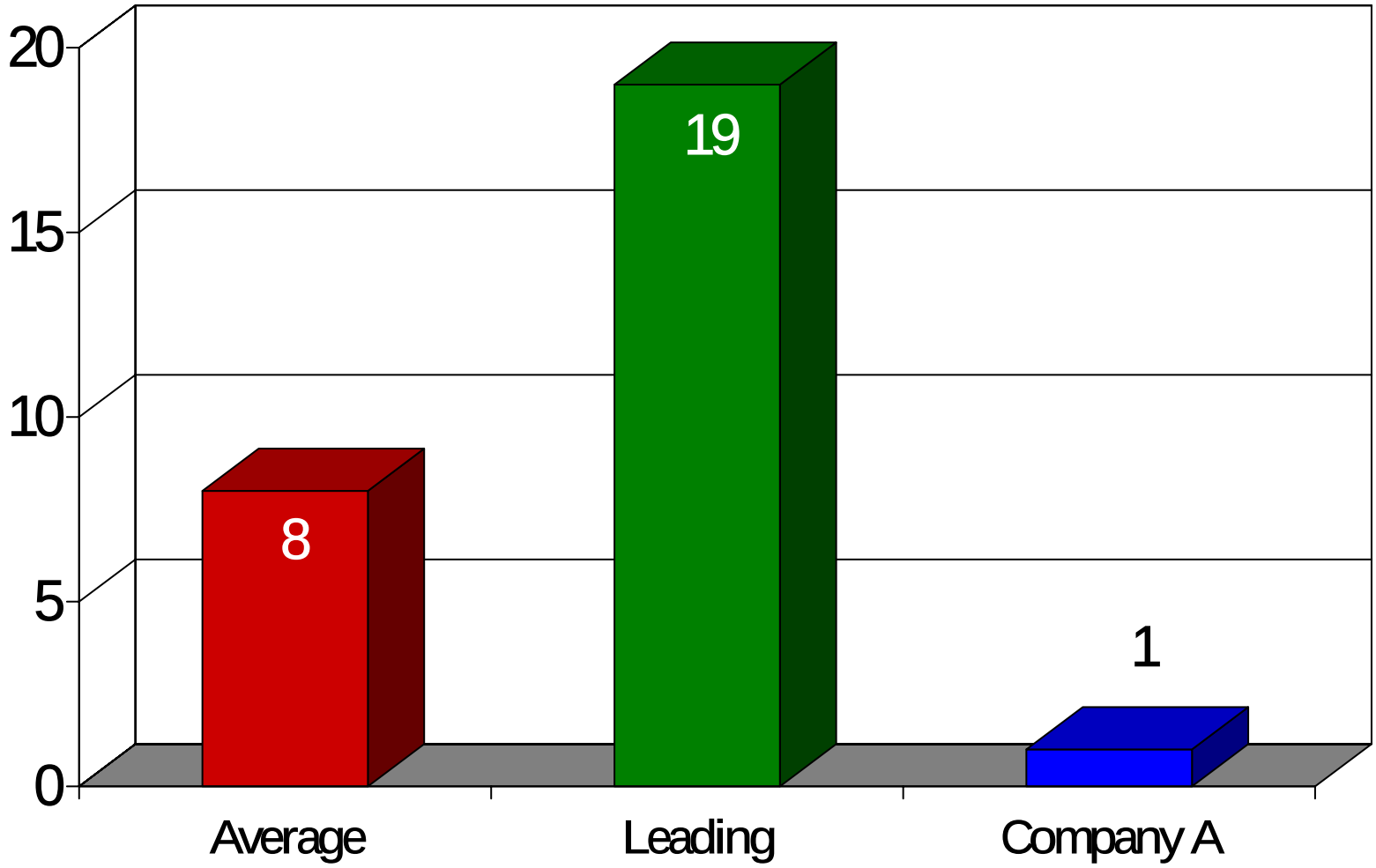
Company A SQA % Compared to Benchmarks



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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Requirements Development Strengths:

- NGS System Engineering process appears to be performing extremely well for the identification and gathering of NGS requirements.
- It was consistently conveyed that the to-date NGS product development process is resulting in a much better defined product than previous efforts.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Requirements Development Weaknesses:

- Descriptions of the subsystem-to-subsystem interface identified in the requirements have not yet been detailed.
- The subsystem teams do not have a documented operational scenario (free of design), or a documented operational concept (design dependent).

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Requirements Management Strengths:

- The understanding of requirements at the current phase of NGS is much better than the understanding of requirements on prior product requirements phases.
- The system engineers and subsystem teams commit to their subsystem requirements through the frequent subsystem team meetings.
- Changes to requirements have been documented in the different HOQ levels.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Requirements Management Weaknesses:

- The requirements are documented in numerous spreadsheets and diagrams. Bi-directional traceability was not discovered.
- Subsystem teams have not yet driven the requirements into the project plans and schedules, nor are they allocated to the work product level.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Strengths:

- Each subsystem team has a work breakdown structure (WBS) embedded in their current schedule.
- The subsystem teams work within the high level product development life cycle described by the NGS Systems Engineering group.
- The subsystem teams identify and analyze technical risks.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Weaknesses – 1:

- Subsystem teams do not have a process for estimating the effort and cost required for the work products.
- The current processes used by the subsystem teams do not address the budget aspect of the project.
- Schedules exist but do not appear to address all desired information.
- Subsystem teams do not identify and analyze all project, budget, resource, and schedule risks.
- Subsystem teams do not plan for the management of data used or data created during the project activities.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Weaknesses – 2:

- Subsystem teams do not explicitly plan for resources (other than personnel) such as facilities, tools, and equipment resources.
- Subsystem teams rely heavily on subject matter experts to perform project activities. Few subsystem teams plan for the future knowledge and skill needs.
- Stakeholders are involved in the process, however the schedules provided for review do not appear to provide adequate visibility into the involvement of the relevant stakeholders.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Weaknesses – 3:

- Subsystem teams have not adopted or created individual project development plans (at the subsystem team level) and processes on how they will operate.
- Subsystem team personnel does not review other subsystem development plans, or development plans of others that impact the commitments to the subsystem teams' NGS activities.
- Subsystem teams do not all reconcile their requirements, activities, work products, development plans and commitments with available resources.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Planning Weaknesses – 4:

- Commitments and other important decisions agreed upon between subsystem and lower level teams are not documented in a consistent fashion.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Monitoring and Control Strengths:

- All subsystem teams track technical issues.
- The subsystem teams identify and monitor their technical risks.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Monitoring and Control Weaknesses – 1:

- Subsystem teams do not collect and monitor project data against the plan.
- Subsystem teams monitor commitments made or accepted with outside individuals and groups, however the monitoring activity is not performed in a planned manner.
- Subsystem teams do not always address risks other than technical risks such as schedule, budget, resource, and other project type risks.
- Subsystem teams do not monitor the subsystem team data management activities.
- Subsystem teams do not monitor stakeholder involvement in a planned manner.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Project Monitoring and Control Weaknesses – 2:

- Project monitoring and control does not appear to be as detailed as it should be.
- The subsystem teams track technical issues (typically via the DFMEA process). However, other project issues are not typically recorded.
- The subsystem teams appear to have limited capability to take corrective actions on issues as they are constrained by resource and schedule.
- Few subsystem teams track and manage action items for specific issues to closure.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Product Integration Strengths

- An established process exists that:
  - Validates sub-system components independently
  - Requires CCB review prior to integration and delivery to DVT/EVT

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Product Integration Weaknesses:

- Past projects have performed differing levels of product integration.
- Some subsystem teams have procedures to perform build integration. These procedures do not appear to address integration sequencing activities or the integration of the hardware to the software at a planned time.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Verification Strengths:

- All subsystem teams plan for informal peer reviews of software work products.
- All subsystem teams perform informal peer reviews of the software work products.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Verification Weaknesses – 1:

- The subsystem teams have not defined the verification methods that will be used for each hardware and software requirement allocated to each lowest level component(s). Past projects have tested the component / subassemblies using a series of regression tests that do not appear to have been explicitly linked to the requirements allocated to software.
- Few subsystem teams have documented procedures for verifying the requirements allocated (NUD's, non-NUD's, interface and other requirements) to the components, subassemblies, or subsystems.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Verification Weaknesses – 2:

- The subsystem teams do not collect or analyze data on the results of peer reviews of their software work products.
- Few subsystem teams collect and analyze data on the verification activities performed on the software work products at the component, subassembly, or subsystem levels.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Configuration Management Strengths:

- In most cases, code for existing products cannot be modified without a Pinnacle tracking number.
- Release notes that detail the contents of builds are always produced.
- Numerous documented procedures exist for creating code baselines and releases.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Configuration Management Weaknesses – 1:

- The subsystem teams have not identified categories or individual configuration items that must be controlled at the subsystem team level.
- The subsystem teams have multiple systems for use. In some cases, detail of the use of some of these systems is not documented.
- Baselines of other project documents and internal work products are not been identified.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Configuration Management Weaknesses – 2:

- The subsystem teams do not appear to track changes for non-deliverable project documentation, and other internal work products.
- The subsystem teams do not perform configuration audits (PCA's/FCA's) on configuration baselines.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Measurement and Analysis Strengths:

- Evidence was found that at least one subsystem team has identified measurements to collect, analyzes those measurements, and reports them to stakeholders.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Measurement and Analysis Weaknesses:

- Few subsystem teams have established measurement objectives, specified the measures to be collected, how the measures will be collected, or how they will be analyzed and reported.
- Few subsystem teams collect specified measurement data, analyze and interpret the data, manage and store the data, or report the data to relevant stakeholders.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Company A, Generic Goals/Practices Strengths:

- No generic practice strengths were identified.

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Example – Company A, "QuickLook" Engineering Processes Assessment Findings

Generic Goals/Practices Weaknesses – 1:

- Organizational policies for planning and performing the NGS product activities were not discovered.
- The plans and schedules reviewed do not address each of the activities expected in the process areas examined.
- Some subsystem teams do not appear to have adequate resources (staff, tools, facilities, licenses, etc.) for performing to the process and creating their project work products. The average staff work week is in excess of 45 hours per week.

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Example – Company A, "QuickLook" Engineering Processes Assessment Results

Generic Goals/Practices Weaknesses – 2:

- The organization has a heavy reliance on subject matter and domain experts to complete the work activities. Planning and scheduling of additional training required to increase the capability of the team does not appear to be typically considered.
- The subsystem teams have not planned and scheduled for appropriate levels of configuration management on the subsystem team work products.

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Example – Company A, "QuickLook" Engineering Processes Assessment Results

Generic Goals/Practices Weaknesses – 3:

- The subsystem teams have not planned and scheduled for the identification and involvement of the relevant stakeholders in the product development process.
- The subsystem teams have not planned and scheduled for an objective evaluation of the process and work products against the standards and procedures that define them.
- The subsystem teams have not planned and scheduled for process reviews that should occur with higher level management.

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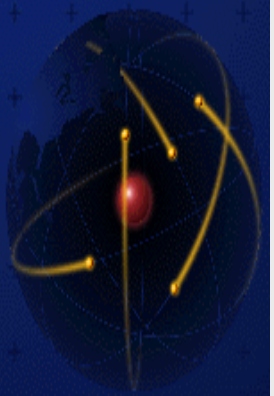
pmo *paving the road to optimized IT value: perspectives and a case study*



release 1.1

(updated)

Terry Jabali

Founding Principal

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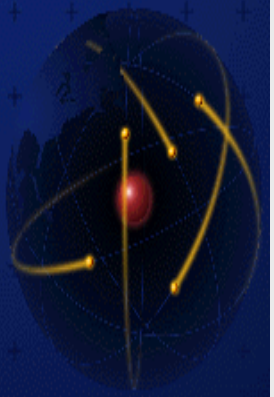
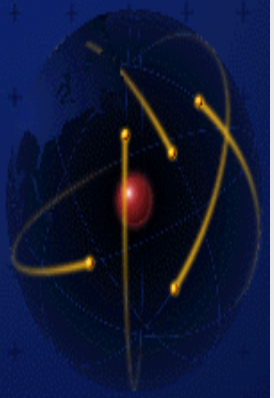
agenda



Session theme: lessons for successful **deployment / adoption:**

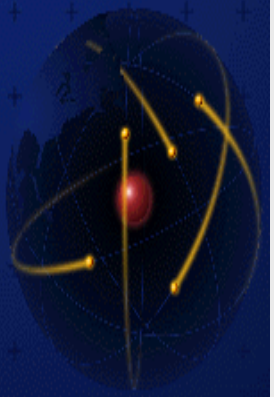
- Provide pmo practice insights
- Cite case studies using CMMi: *case study, challenges, reflection, lessons learned*
- Discuss successful pmo premises

Open forum for discussion



about pmo

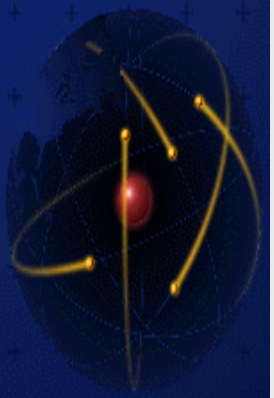
definition of PMO by PMI®



"The Program Management Office is an organizational body or entity assigned various responsibilities related to the centralized or coordinated management of those projects under its domain. The responsibilities of PMO can range from providing project management support functions to actually being responsible for the direct management of a project"

PMBOK 3rd Ed

pmo value creation

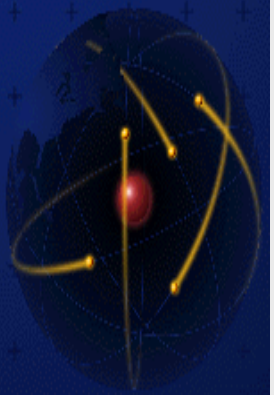


- PMO (Program Management Office) by design builds on a series of best practices including PMI® standards. In NA, the majority of Fortune companies have already or in the process of establishing IT PMO office.

- Structure may vary; PMO is either part of the business or the IT organization; regardless, its mission focuses on delivering business value with accountability for results

example of an actual pmo charter

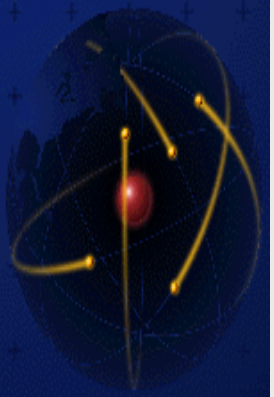
(education institution)



"The Program Management Office will provide:

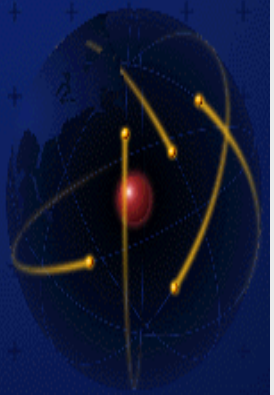
- state-of-the-art project management software which will include automated project scheduling, project interdependency tracking, issue management, resource management and other tools;
- assistance in managing risks and addressing quality considerations;
- skills training for project managers;
- consistent and effective project management methodologies; and
- proactive communication of project and task status.

The benefits are straightforward and include higher probability of success, more consistent and simplified management, and accountability for all results. This should ultimately lead to higher client satisfaction and a better place to work and learn."

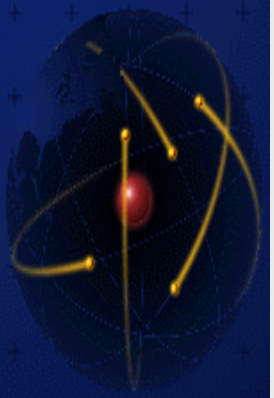


cmmi® role

cmmi® role

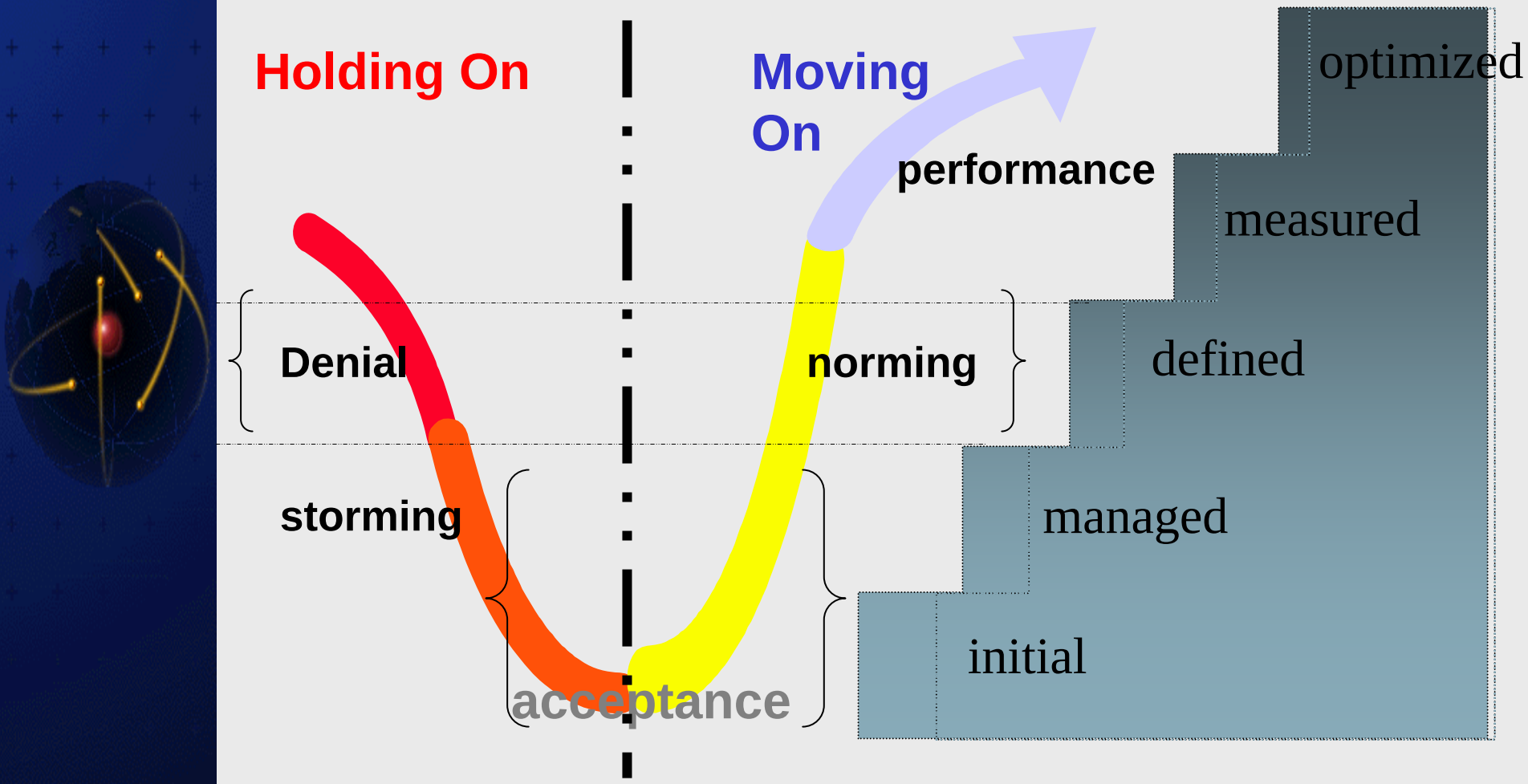


- Establishes an organization framework for successful project management practices
- Provides a roadmap for continuous process improvements across program and project portfolios
- Provides consistent measurements across the life cycles, e.g., SDLC, PLM… while providing a gauge for evolving the organization's maturity
- Iterative roadmap for adoption



Adoption and cmmi®

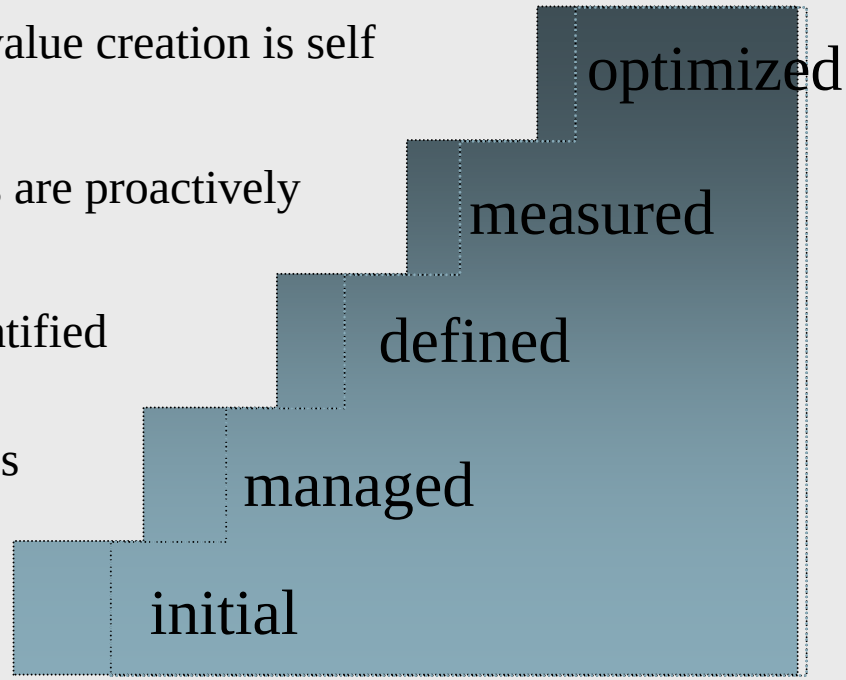
adoption cycle correlation



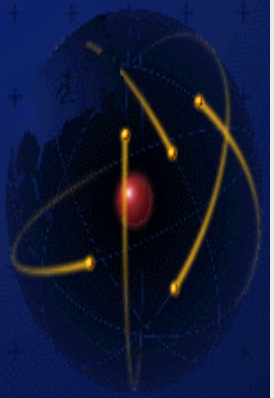
CMMi

organization adoption correlation

- User-adoption is synergistic – value creation is self renewing
- User-adoption / success metrics are proactively gauged
- Audience needs are clearly identified
- Inconsistent deployment success
- Poor product/service adoption



CMMi-L3



pmo case studies

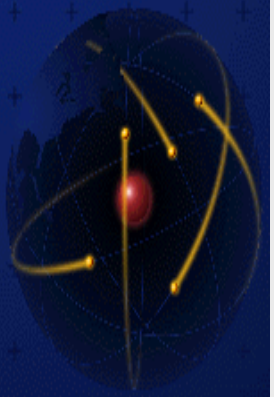
CMMi-L3

case study 1: “major telco”

(~$40 billion in revenues)

- Established a Program Management Office
- PMO SEPG formed with local legs at the unit level
- Governance/Audit team (post deployment)
- Super Users at the local level
- Retained a major consulting team
- Introduced a series of templates to support SDLC, targeting level 3:
  - REQM, CM, PPQA (Proc and prod quality ass), MA; OPF (Org Proc), OT (train)
  - Project complexity-based requirements: High and Low
  - RTM: Requirements Traceability Matrix
  - Peer Reviews
  - Change Management process
  - Document management application
  - Project management software with resource allocation and time tracking

case study 1: what went well?

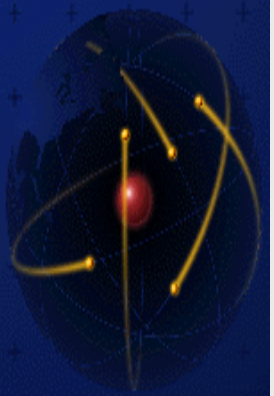


- Engagement model was clear with the customer—introduced “Application Front Gate” to the IT organization
- Consistency of templates: for example, requirements documents were no longer called different names: BRD, RD…
- SEPG ensured consistent application across a matrix IT organization—process exceptions had to go through a review committee
- Paving the road toward meaningful measurement at the PPM level became within reach

CMMi-L3

case study 1: challenges

- Target: Level 3
- Given the culture, introduced a very aggressive rollout timeline:
  - Project complexity-based requirements
  - RTM: Requirements Traceability Matrix
  - Peer Reviews
  - Change Management process
  - Master directory of process assets / document management tool
  - Project management application (eVista Artemis)
  - Audits



Once understood, adopted; still confusion persisted between high and low complexity project requirements

Poor adoption: Perceived as additional work

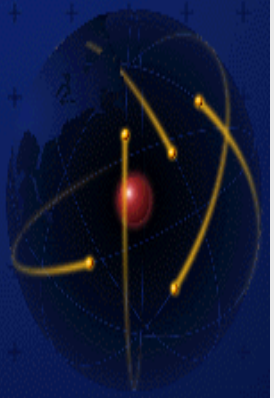
Basic adoption: perceived as unnecessary work; most completed the basic requirements

Well received by IT; not well by the business

Saved $$$ on space needed for attachments; links didn't always work!

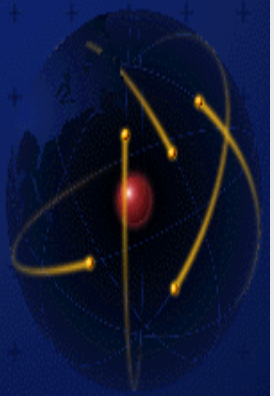
Poor adoption due to slow performance; cumbersome—lowered productivity

Too Much Resistance—impacted productivity



audience reflection

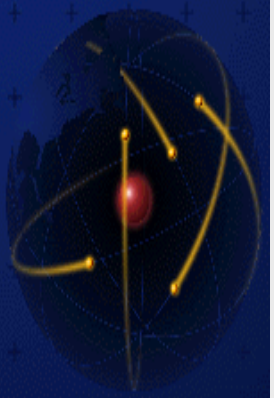
case study 1: lessons learned



- Big bang introduction of people, process, and corresponding tools does not work all at once—*cultural adoption rate must be taken in account*
- CMMi champions were re-aligned elsewhere in the organization
- Process improvement is not defined by consultants—rather, it is defined by front line doers—engage cross team members across cycle (not only “smart” people)
- Tools’ capability and maturity must be mapped for productivity flow not just features
- Culture must be taken in account for an adoption rate and the subsequent roll-out success
- Closely evaluate capability to deliver (e.g. resources, training…)

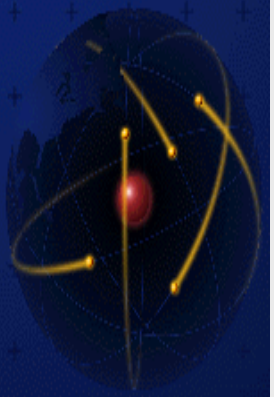
case study 2: “global shipping co.”

($5 billion in revenues)



- Established a pmo practice
- Defined balanced scorecard (BSC) which defined the PPM objectives
- Adopted ad-hoc CMMi
- Instituted PMI standards
- Enabled standard SDLC template in project management software
- Instituted an end-to-end project governance
- Piloted a project case study for the entire PMO team
- Debated PMO approaches of “process and tools”
- Promoted PMI certifications for consistent practices

case study 2: what went well?



- EPS (SEPG like)
- PMO Balanced scorecard directly linked to corporate initiatives “upfront” while providing a tracking mechanism across project portfolios (PPM)
- Paving the road toward meaningful measurement at the PPM level became within reach provided the SDLC template is widely adopted

case study 2: challenges

- Established a pmo practice
- Defined balanced scorecard (BSC) measurements
- Adopted PMI standards
- Enabled standard SDLC template in project management software
- Instituted an end-to-end project governance
- Piloted a project case study for the entire PMO team
- Debated PMO approaches of “process and tools”
- Promoted PMI certifications

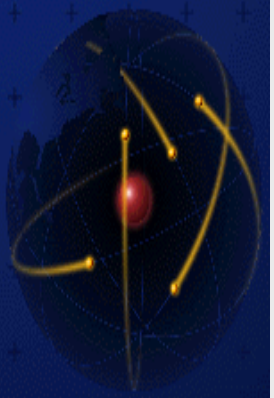
PMs had to come-up to speed on PMI leading practices

Vendor provide template 12207 was not relevant to internally, driven IT department—much customizations were needed

Many resisted the straight jacket

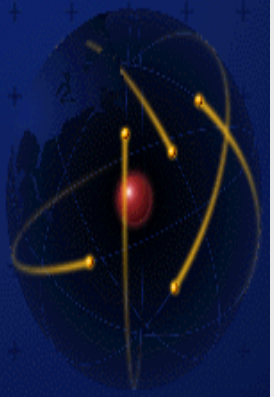
management had already made its decision regardless—PMs already knew

CMMi was not adopted; as a result, missing a critical document such as RTM left the organization vulnerable to re-occuring project risks

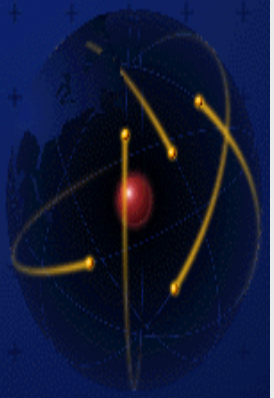


audience reflection

case study 2: lessons learned



- Deploying BSC and encouraging standardization by adopting standards enabled greater PMO value creation; however, not considering critical components of CMMi such as OPF, RTM… left PMO more vulnerable to frequent project over-runs

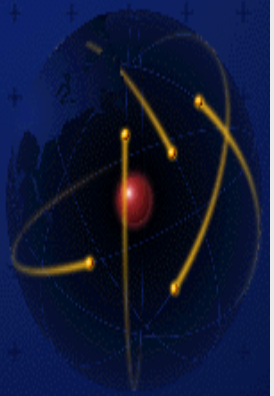


pmo success drivers
top 3 premises

“Say not I have found the truth—rather, I have found a truth for the truth walks upon all paths”

Gibran K Gibran

pmo and enterprise effectiveness is one

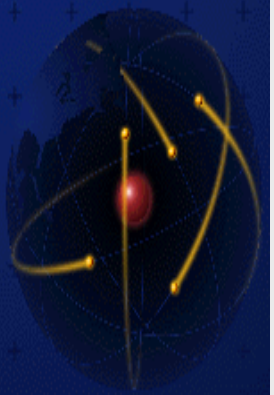


- The marriage between people, process and technology can be happy or a troubled one. How well we understand and sanction these performance drivers, positive and/or negative, determines the effectiveness of PMO and the subsequent level of customer value creation

Frameworks provide a roadmap—deployment is a science as much as it is an art

pmo
Premise 2

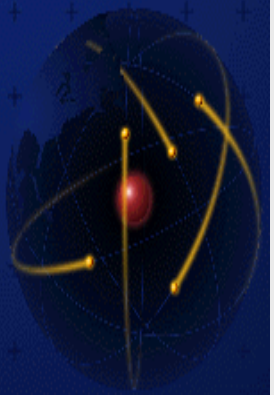
capability & maturity modeling can advance PMO performance if,



1. PMs subscribes to a process of productivity
2. PMs use intuitive tool--process and tools are aligned
3. PMs competency is promoted and rewarded
4. Vertical process and process inter-relations are complimentary
5. Team members recognize that it is an evolution to higher maturity (don't jump steps)

pmo
Premise 3

begin with understanding adoption drivers first



1. Begin with user-adoption drivers as a layered foundation: Motivated adopters lead first
2. Focus on value at the lowest denominator in order to drive adoption
3. Reward a culture of ownership—motivate for execution

about presenter

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Belmont, CA 94002;
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650.218-2588

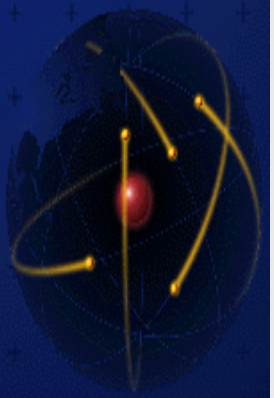
Terry Jabali

- Terry has over 16 years of consulting expertise for creating high performance organizations encompassing performance management frameworks, enterprise applications, and business intelligence. He is the Chief Architect of Applied Enterprise Dynamics, Inc. (AED). He advises CxOs and managers on turnkey solutions encompassing program and project management, service delivery modeling for IT organizations, customer-centric business process reengineering, performance management and business intelligence with key emphasis on analytics, scorecards, and actionable dashboards leveraging best practices frameworks such as the Capability and Maturity Model (CMMi®).

  Terry serves as a Director on the board of Project Management Institute, Program Management Office (PMO) SIG. He is also a program certification panelist, impacting 200,000 worldwide members.

  Prior roles: CRM Practice Head for North America, Clarify, Nortel Networks Principal, Computer Sciences Corporation (CSC) CRM Practice Head, Cedars (Peoplesoft) Leadership Development Director, American Society for Training and Development (ASTD-RMC) Founder, Fifth Generation Consultants Terry earned his B.A. degree in Applied Behavioral Sciences and completed graduate work in System Dynamics at MIT and Organization leadership at Stanford. Terry holds several industry certifications including CPM, Six Sigma Green Belt (ip), CPC, and others.

For related whitepapers, please goto: www.pmoiq.net



questions

BAE SYSTEMS

NDIA CMMI Technology Conference

Looking Beyond Quantitative Defect Management

Anil Midha
BAE Systems, NES
Wayne, NJ

Presentation Agenda

- Background
- Issues involved
- Where do we need to look and why
- Recommendation – “The Three-Prong Approach“
- Defect insertion vs. detection analysis
- An integrated approach to defect analysis
- A robust causal system
- Summary
- In closing

Background

- Organizations aspiring to be (or operating at) high CMMI maturity levels generally focus on defects
- Typically they collect defects from work product inspections or reviews in development phases
- For CMMI Maturity Levels 4 and 5, it is required to quantitatively manage and statistically analyze the defects to:
  - Understand the impact of common as well as special causes of variations
  - Perform root cause analysis of high impact defects

Issue is …

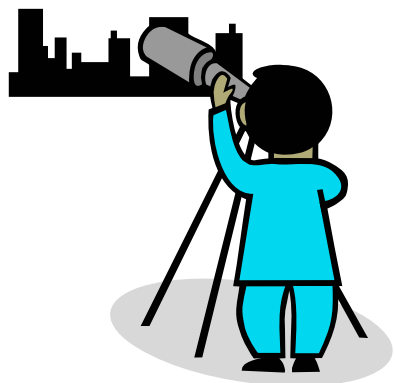
Quantitative defect analysis most often focuses on “quantity” of defects, not other aspects of defect analysis, such as:

- Defect prevention throughout the development lifecycle
- How early are the defects detected after getting inserted?
- What is the “chasm” between defect insertion and defect detection?
- How do we reduce this “chasm” and thus cause left-shift in phase detection of defects?
- What is the cost-effective approach to impact both quantity of defects and early detection of defects?

Looking Beyond … Where?

Need to:

- Have a defect management approach that complements quantitative analysis
- Analyze defect insertion, detection, and correction process
- Consider other significant defects beyond the software and systems defects detected through peer reviews and inspections
- Review defects from more of an integrated engineering view rather than a single functional discipline view
- Examine the effectiveness of the causal system and apply it to a broader range of anomalies and opportunities than just defects

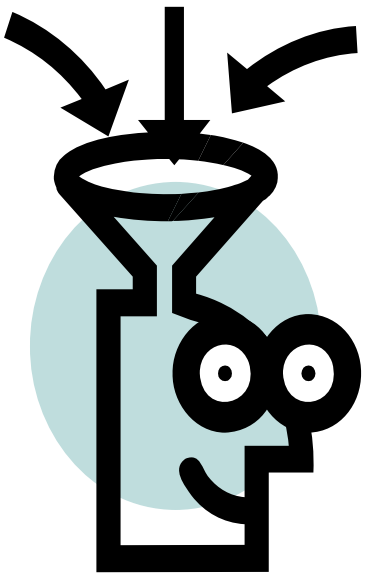


Why is it important?

- Quantitative management and application of statistical control techniques for defect analysis is “necessary” but not “sufficient”
- Defects getting detected at later development lifecycle phases do not receive the scrutiny of the quantitative management

- A non-integrated approach of defect management misses out on some of the key opportunities of addressing defect prevention and early detection in the most cost-effective manner
- Lacking a robust causal system leads to treating the symptoms rather than addressing the causes of deeper issues

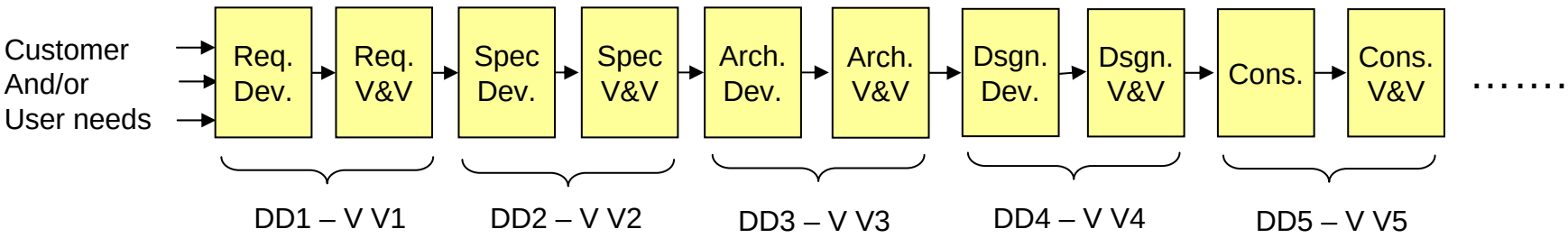
The Answer is …



A Three-Prong Approach:

- Reduce the gap between phase of defect insertion and defect detection
- Adopt an engineering integrated approach to defect analysis
- Apply a robust causal system

Engineering Development Lifecycle



- Engineering development lifecycle can be considered as a series of 1 to n Design-Development (DD) activities followed by a corresponding Verification and/or Validation (V & V) activities
- Assumptions:
  - One or more functional disciplines (Software, Systems, Electrical Hardware, Mechanical, etc.) are working in parallel in various phases
  - Every functional discipline may or may not be performing a corresponding V & V activity after its DD activity
  - Parts of the development lifecycle may be repeated incrementally and/or iteratively

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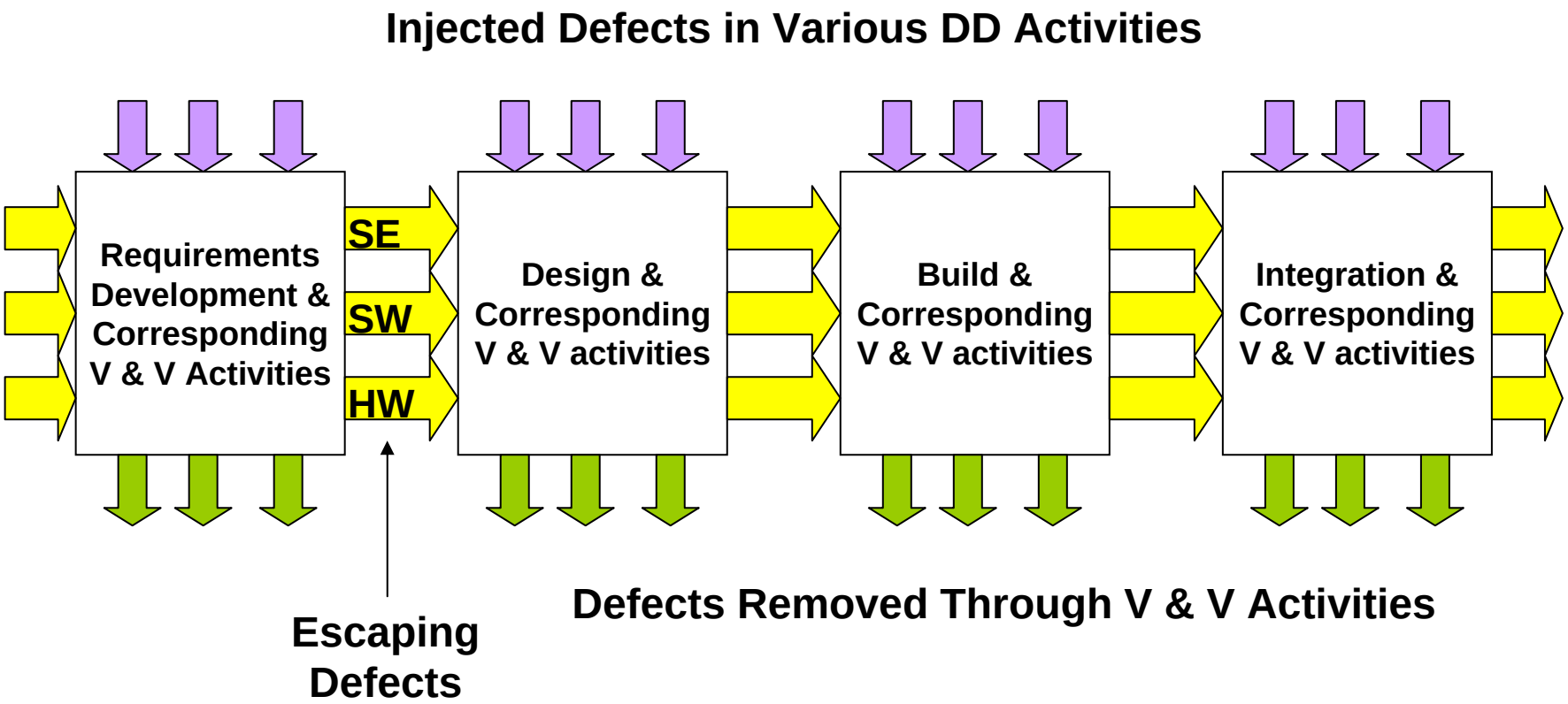
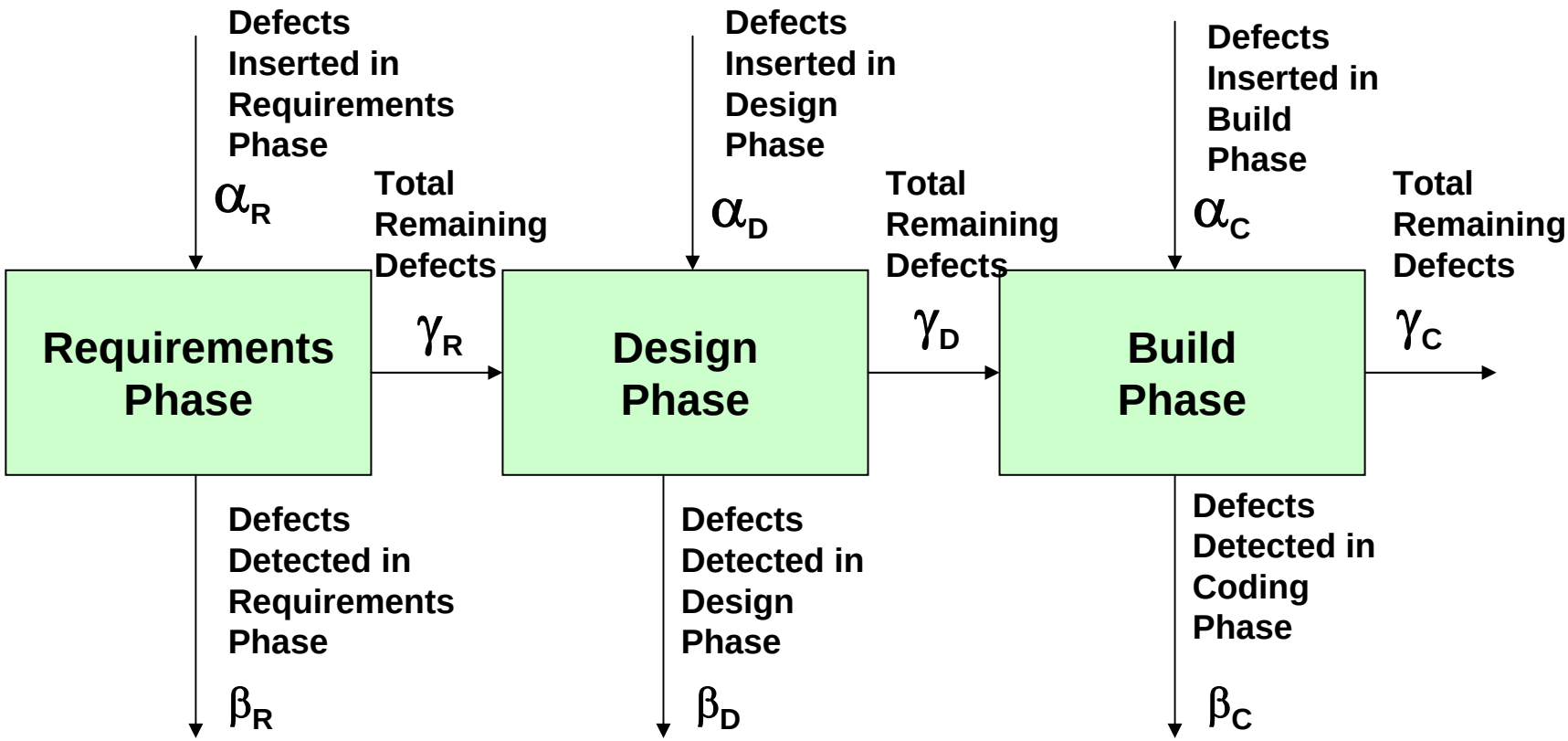
Engineering Development – Defects Injection & Removal



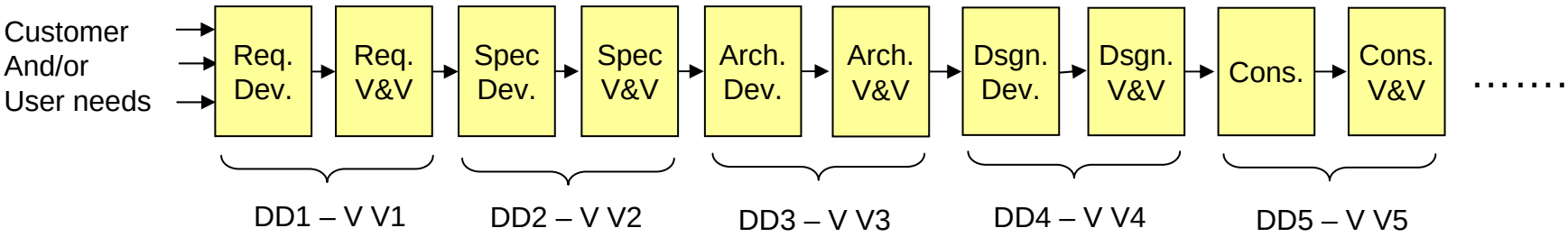
Conceptual Defect Insertion/Detection Model



$\alpha_R >= \beta_R$ Total Defects in Design Phase, $T = \gamma_R + \alpha_D$ and so on …

$\beta_D < T$

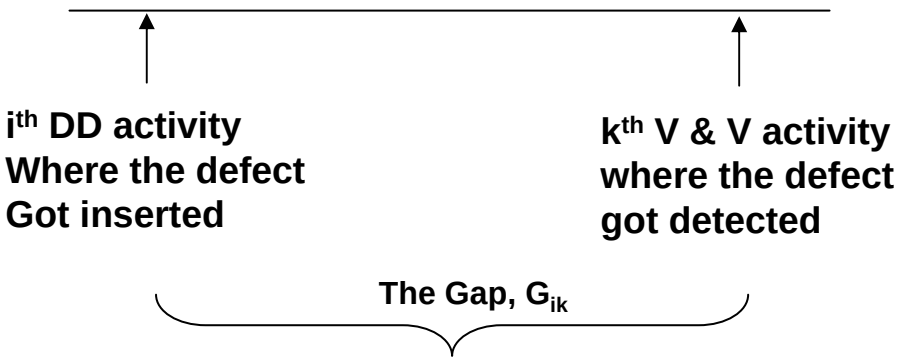
Defect Insertion vs. Detection (1)



- A defect detected in k^{th} V & V activity might not have been inserted in the corresponding preceding kth DD activity
- Usually it is an earlier DD activity of the same or a different functional discipline in which the defect got inserted
- In some extreme cases, the defect might have been inserted in an earlier DD activity of a different spiral/iteration

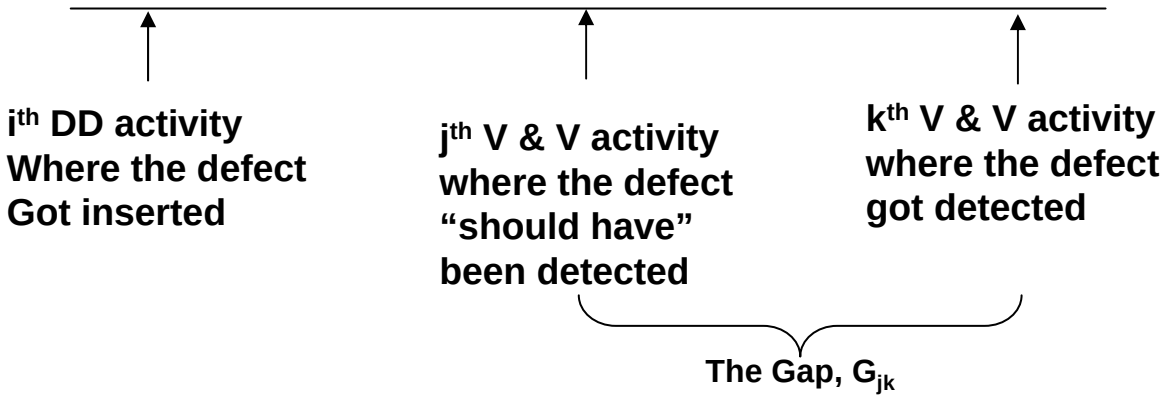
Defect Insertion vs. Detection (2)

- Ideal Case: A defect inserted in the k^{th} DD activity gets detected in the k^{th} V & V activity
- Typical Case: A defect inserted in the k^{th} DD activity gets detected in the i^{th} V & V activity, where i^{th} activity is an earlier DD activity in the time sequence
- The gap, G_{ik} is the number of intervening V & V activities between the i^{th} and the k^{th} V & V activities
- One would like the gap, G_{ik} to be zero



Defect Insertion vs. Detection (3)

- Practically, it may not be possible to get this ideal state because it may be one of the intervening V & V activities (like a simulation) that might have been the only practical first V & V activity to detect the defect
- Analyze which V & V activity "should have" detected the defect; let us assume it is jth V & V activity



- It is this real gap, G_{jk} – let us call "***Opportunity Gap"***, that must be reduced

Defect Insertion vs. Detection Analysis (1)

- For each significant defect in each V & V activity, we need to collect and analyze:
  a) Sequence number of the DD activity where the defect got inserted
  b) Sequence number of the V &V activity where the defect got detected
  c) Sequence number of the V &V activity where the defect should have been detected (by default, it should be same as for defect inserted)
- Calculate Opportunity Gap (OG) = difference of sequence numbers between (b) and (c)
- Best Case: OG being zero, i.e., no V &V activity missed detecting the defect
- Typical Case: OG being greater than zero; i.e., 1 or more V &V activities missed detecting the defect

Defect Insertion vs. Detection Analysis (2)

- Goal: Reduce OG for all significant defects
- Further analyze the data for:
  - Which V & V activities are able to detect more defects?
  - Which DD activities are more error prone in inserting defects
  - Which VV activities are more prone to missing defect detection?
- This analysis should lead to strengthening:
  - Those V & V activities that are missing defect detection
  - Those DD activities that are prone to defect insertion
- Over time – with appropriate process adjustments – OG should be reducing

Benefits of The Approach

- By paying close attention to defect insertion and detection, the process changes will be applied where it would be most needed
- Over time, most of the defects will tend to be detected in the earliest possible detection opportunity
- Over time, most of the defect detection will have a “left shift” effect
- This will lead to the most cost effective DD and V&V activities, also impacting product development cycle time and quality

Need for an Integrated Approach to Defect Analysis

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- Defects detected in the later development lifecycle phases are usually more complex – they impact most disciplines, are the most expensive to fix, and require broader & deeper scrutiny
- Often superficial analysis leads to categorizing the detected defect in one or the other discipline, while it may have been best addressed in a multi-discipline approach for the most optimal solution
- Addressing only a subset of root causes of the problem may lead to a partial or sub-optimal solution

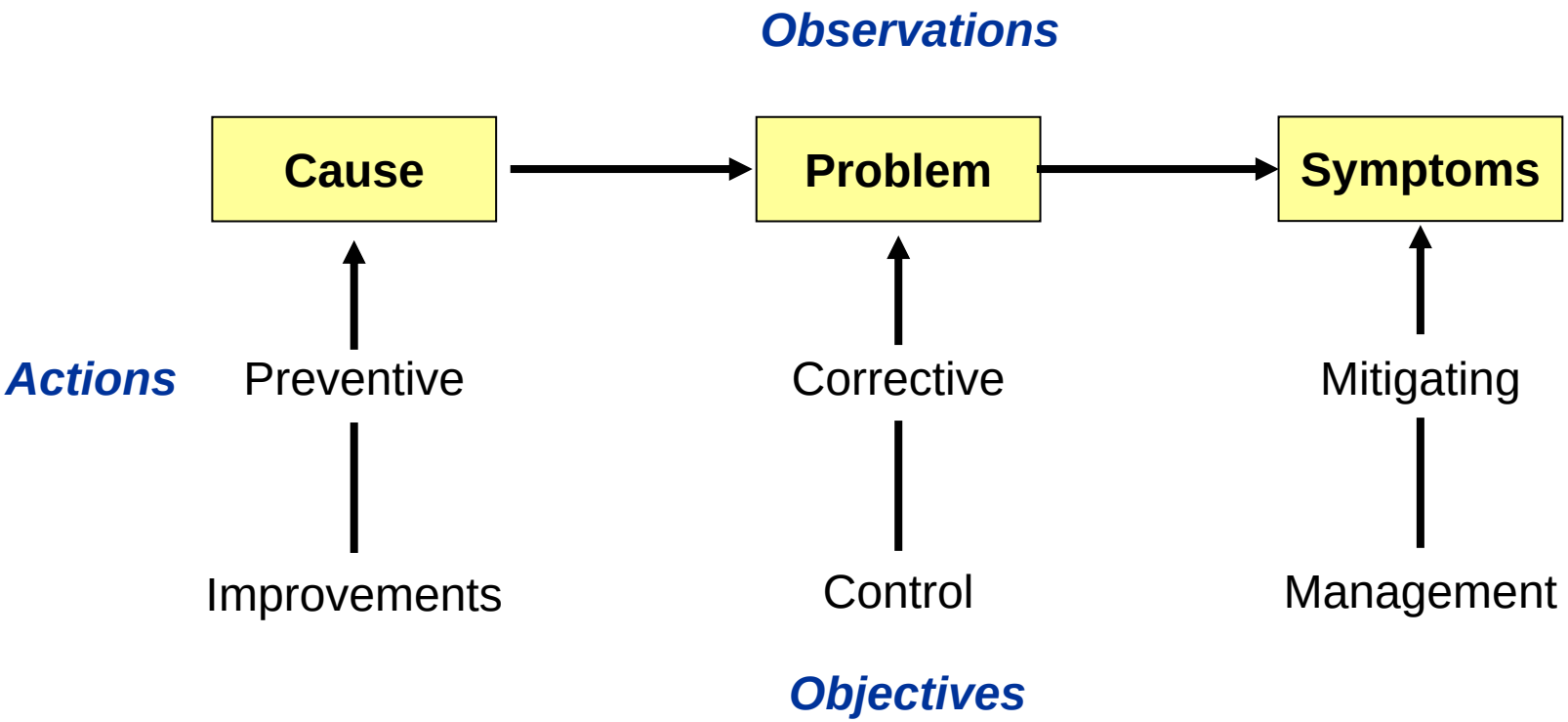
An Integrated Approach to Defect Analysis

- Record all integration and systems test defects in a cross-discipline engineering defect tracking system
- Review the detected defects in a multi-discipline team to:
  - Analyze all possible causes of the problem
  - Assess the impact in all subsystems/components in all functional disciplines
  - Identify an optimal near-term solution while simultaneously analyzing if there is a better longer-term solution for later implementation
- Implement the identified solution using a systems approach
- Address root causes of the defect to implement preventative actions for the future

Need for a Robust Causal System

- Inadequate root cause analysis may lead to:
  - Treating the symptoms rather than the problem
  - Addressing the wrong problem
- A robust causal system would help uncover real causes of the problems so that actions could be taken to avoid similar problems in the future
- Addressing root causes of the problems is one of the most effective defect prevention mechanisms

A Robust Causal System (1)



Elements of a Causal System

Reference: Card, David N. “Understanding Causal Systems” CrossTalk, October 2004

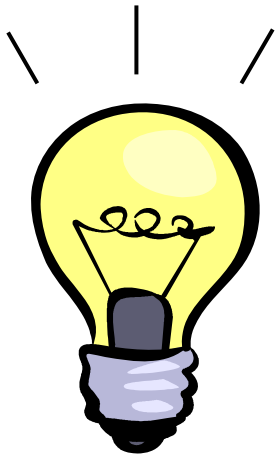
A Robust Causal System (2)

- For each significant defect:
  - Isolate and Identify symptoms and problem
  - Use Ishikawa diagram approach to identify all the root causes of the problem
  - Understand that it may produce multiple symptoms
  - Identify all possible causes that may have contributed to the problem
- Identify appropriate preventive, corrective, and mitigating actions to address causes, problem, and the symptoms

Summary

- The Three-Prong Approach needs to complement, not replace, quantitative defect management and statistical control
- Defects needs to be detected in the earliest possible V & V activity
- Adopt an integrated systems approach to address the significant problems identified in the later development lifecycle phases
- Use a robust causal system to analyze significant defects and their root causes

In closing …



Reducing the number of defects is as important as preventing them and detecting them at the earliest opportunity.

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Thank You!

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Indicators of Reliable SCAMPI® Appraisal Results

Bruce A. Boyd
Associate Technical Fellow
The Boeing Company
Integrated Defense Systems – St. Louis, MO

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The “Question”

Dear Lead Appraiser,

Your recent appraisal findings briefing said that you collected data on the number of artifacts reviewed, the number of appraisal team hours, the number of projects, the number of participants, and the number of additional evidence items requested.

Is there some kind of aggregate score that could be used to determine how effective the appraisal was?

Curious

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The Answer?

IT DEPENDS!

- Unfortunately, there is no “magic formula” for calculating the effectiveness or reliability of a given SCAMPI® appraisal.
- There are some minimums for artifacts reviewed and appraisal team hours, but it’s just not true that “bigger is better”.
- However, we’ve found that there are some key attributes that can serve as indicators of an effective appraisal…

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Appraisal Effectiveness Indicators

- The following attributes of appraisals may be used as indicators of the effectiveness of appraisals…
  - Planning
  - Organizational Unit – Projects
  - Duration/Effort
  - Team Size and Composition
  - Team Activities and Training
  - Project Participation
  - Evidence Review

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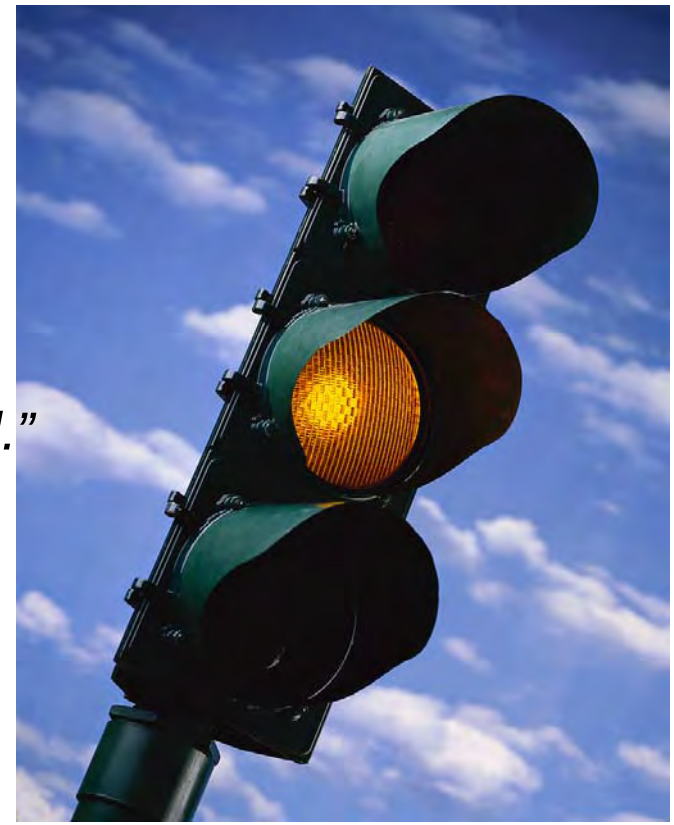
Caution!

- These indicators are derived from some actual lessons learned, some “horror stories” from other organizations, some conversations with lead appraisers, and some personal opinions.
- They are not hard and fast rules, nor do they pretend to support or replace the requirements of any published appraisal method description.
- *“Any resemblance to actual persons or events, living or dead, is purely coincidental.”*
- They are just something to think about…



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Appraisal Planning

- How thorough is the appraisal plan?
  - Planning should be done well in advance of the start date
  - The plan should reflect an understanding of the organization being appraised
  - The plan should not just be a “boilerplate” with names and dates inserted
  - The appraisal sponsor and other key members of the organization should have opportunities for significant input into and review of the plan
  - The lead appraiser should interact with the sponsor during planning, not just to get approval of the plan
  - Once the appraisal has begun, it should follow the approved plan

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Organizational Unit -- Projects

- How are the projects in the appraisal selected?
  - The lead appraiser should assess how well the projects represent the organization as a whole
  - Generally, the appraisal scope should not just include the projects offered by the organization
  - The lead appraiser should not offer a "site certification" – such certifications are not part of the SCAMPI® method
  - Projects should not be allowed to "drop out" once the appraisal has begun, nor should new projects "drop in"
  - Projects that have been previously appraised should not be granted a "free pass" – they must be appraised from a "clean sheet"

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Appraisal Duration and Effort

- Does the appraisal take a reasonable amount of time?
  - A Class A SCAMPI® SE/SW/IPPD/SS appraisal of 4-6 projects ought to take about 10 work-days to complete
  - Less than 5 days does not seem reasonable
  - Pre-onsite review of evidence is recommended
  - An appraisal should not stretch out over several weeks or months
  - Team work-days should not be excessively long
  - A planned Class B or C appraisal should not “morph” into a Class A appraisal
  - Projects should not “rework” evidence during the appraisal period

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Appraisal Team Size/Composition

- How many people are on the team?
  - A full SCAMPI® Class A Level 5 appraisal should probably have 8-12 people to keep the workload manageable
- What is the make-up of the team?
  - Team members from outside the appraised organization should be welcomed
  - A well-balanced team includes experienced practitioners representing the disciplines and functions being appraised
  - A mixture of experience levels and viewpoints provides for good consensus building
  - Domineering personalities should be avoided

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Appraisal Team Activities and Training

- What do the appraisal team members do?
  - All should be reviewing evidence, participating in interviews, writing requests for information, participating in characterization discussions, and developing findings
  - All should be operating somewhat autonomously, not as “gophers” for the lead appraiser
  - Team findings should be formed by consensus, not the dictate of the lead appraiser

- How was the appraisal team trained?
- All should have received required training in the model and the appraisal method – not necessarily by the lead appraiser
- The lead appraiser should verify training and other credentials of team members before the start of the appraisal

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Project Participation

- Who does the appraisal team talk to on the projects?
  - Project managers and practitioners should be interviewed directly
  - Process focals or other "surrogates" should not be primary sources of affirmations
  - "Hearsay" evidence should be followed-up with face-to-face interviews

  - Organizational EPG members should not need to participate in project-level interview sessions
  - Pre-appraisal briefings may address the conduct of the appraisal, but should not be "coaching" sessions used to provide the "right answers"

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Evidence Review - 1

- How is objective evidence used in the appraisal?
  - Documented evidence (Direct and Indirect) should be the primary driver of practice characterization
  - Most effective (and efficient) appraisals are done in verification mode, not discovery mode
  - Practice Implementation Indicators (PIIs) of some form should be used to organize and present evidence to the appraisal team

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Evidence Review - 2

- Intuition or “gut feel” should not be allowed to overrule the objective evidence
- Counter-affirmations should not be ignored – they may be a source of latent truth
- Artifacts should be used appropriately – for example, process documents are not direct evidence of performance
- Artifacts should not be created just for the appraisal – “wet ink” documents should be treated as suspect

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Summary

- When evaluating whether an appraisal (planned or past) is effective, the organization sponsor and EPG should consider the following questions…
  - *How thorough is the appraisal plan?*
  - *How are the projects in the appraisal selected?*
  - *Does the appraisal take a reasonable amount of time?*
  - *How many people are on the team?*
  - *What is the make-up of the team?*
  - *What do the appraisal team members do?*
  - *How was the appraisal team trained?*
  - *Who does the appraisal team talk to on the projects?*
  - *How is objective evidence used in the appraisal?*

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Conclusion

- What you do with these indicators is up to you.
- Our experience has been that you ignore these indicators at your own risk.
- When these indicators are considered, you can have confidence that the appraisal results represent an accurate assessment of your organization's CMMI maturity level and/or capability profile.
- Will the appraisal will indicate how good you are at passing appraisals?
- Or… how good you are at managing projects, developing products, and improving performance?

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Lockheed Martin
Integrated Systems & Solutions

A Large Appraisal ?

Dennis A. Ring
SEI Lead Appraiser

M. Lynn Penn
Director Quality Systems & Process Management

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IS&S Benchmarking Maintenance

Initial Benchmark
- SCAMPI C 6-9 months after ATP

One year after Initial Benchmark:

SCAMPI B
- All programs over $X contract value
- Some programs between $X and $X
  - FFP, numerous subs, not co-located team, high risk, corporate or IS&S visibility

SCAMPI C
- Non-SCAMPI B programs between $X and $X
- All programs (>$X) that are following the “primes” or “customers” processes
  - A PPS mapping is required and this is done for process risk determination

REVISITS depend on “Process Risks” identified in previous benchmark – ALL PROGRAMS VISITED EVERY TWO YEARS

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Appraisal Characteristics

Method:

- **SCAMPI V1.1 (ARC Class A)**

Disciplines:

- **Systems & Software Engineering, IPPD, SS**

Models & Representations:

- **CMMI V1.1 Staged Representation**

Dates:

- **October 2005**

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Overview of Appraisal

Appraisal Team Members

Gene Miluk (Lead Appraiser)	*SEI*
Charlie Ryan	*SEI*
Peter Capell	*SEI*
Joanne O'Leary	*SEI*
M. Lynn Penn	*LM IS&S*
Bill Pohle	*LM IS&S*
Dennis Ring	*LM IS&S*
Dorna Witkowski	*LM IS&S*

Site Coordinators (LM IS&S):

- *Dick Warren*
- *Connie Czaplicki*
- *Mike LaBarge*

The Challenge

COAST-TO-COAST LOCATIONS

200+ PROGRAMS

6 LINES OF BUSINESS

15,000 TECHNICAL EMPLOYEES

SEI CMMI APPRAISAL

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Sampling Technique

The scope of the SCAMPI was the entire IS&S organization. Three programs represent more than 20% of the work distributed across all of the IS&S regions.

- ***AEHF***
- ***IEC***
- ***SBIRS (ground segment)***

Through sampling, 27 other programs were offered into the appraisal to validate that the IS&S processes had been truly institutionalized. These programs will have full artifact libraries and completed binders available for the appraisal team's validation. Sampling from these programs will increase the coverage to 73% of the IS&S bottom line.

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Sampling Technique (continued)

Review of focus programs allowed team to become familiar with terms, tools, and standard processes

Allocated specific process areas to **mini-teams**

Included additional programs **to broaden** the programs investigated to include all Lines of Business and multiple program types

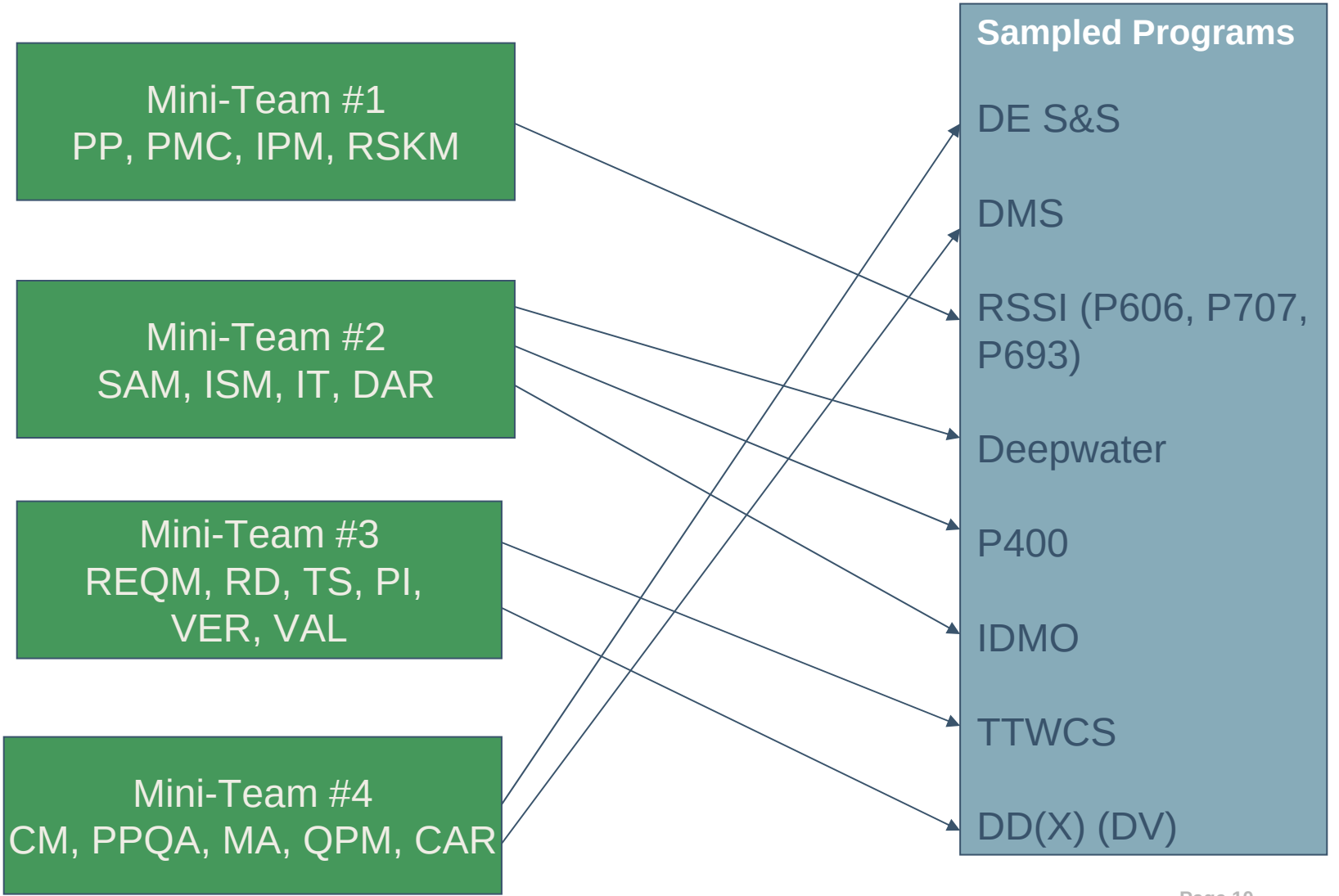
Reviewed program documentation (already provided in binders)

- Used familiarity from focus programs to craft questions confirming implementation and institutionalization

Conducted **additional interviews** with these programs

- 10 additional programs
- 42 additional people

Mini-teams presented findings to **full team for consolidation**


Mini-Team #1
PP, PMC, IPM, RSKM
Mini-Team #2
SAM, ISM, IT, DAR
Mini-Team #3
REQM, RD, TS, PI,
VER, VAL
Mini-Team #4
CM, PPQA, MA, QPM, CAR
Sampled Programs
DE S&S
DMS
RSSI (P606, P707, P693)
Deepwater
P400
IDMO
TTWCS
DD(X) (DV)

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Results of Broadening Coverage

- Found appropriate consistency of practices, tools, and processes across the additional programs
- No major weaknesses, issues, or concerns were found
- Increased team confidence in institutionalization across IS&S

Carnegie Mellon
Software Engineering Institute

List of Published SCAMPI Appraisal Results

ORGANIZATION NAME:	Lockheed Martin Corporation
SPONSOR NAME:	Walter Winkler
LEAD APPRAISER NAME:	Eugene Miluk
SEI PARTNER:	Software Engineering Institute
APPRAISAL END DATE:	10/14/2005
MATURITY LEVEL ASSIGNED:	5
APPRAISED ORGANIZATIONAL UNIT:	
Entity Name:	Integrated Systems & Solutions
Location(s):	King of Prussia, PA
CMMI MODEL USED:	CMMI-SE/SW/IPPD/SS, V1.1, Staged
APPRAISAL METHOD USED:	SCAMPI v1.1

MODEL SCOPE & CAPABILITY RATINGS ASSIGNED:

Process Management		Project Management		Engineering		Support	
OPF	Satisfied	PP	Satisfied	REQM	Satisfied	CM	Satisfied
OPD	Satisfied	PMC	Satisfied	RD	Satisfied	PPQA	Satisfied
OT	Satisfied	SAM	Satisfied	TS	Satisfied	MA	Satisfied
OPP	Satisfied	IPM	Satisfied	PI	Satisfied	DAR	Satisfied
OID	Satisfied	RSKM	Satisfied	VER	Satisfied	OEI	Satisfied
		IT	Satisfied	VAL	Satisfied	CAR	Satisfied
		ISM	Satisfied				
		QPM	Satisfied				

http://seir.sei.cmu.edu/pars/pars_display.asp?i=1049

LOCKHEED MARTIN

Questions ?

Performance Benchmarking Consortium

NDIA CMMI Technology and Users Conference

Mark Kasunic
November 15, 2006

Software Engineering Institute | Carnegie Mellon

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Presentation Topics

Introduction

- Overview – The Process Benchmarking Consortium
- Motivation & Benefits
- Ground covered

PBC Working Teams

- Concept of operations
- Voice of customer
- Specification

Next Steps

- Near-term goals
- How you can participate

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What is Benchmarking?

Term	Description
Benchmark	To take a measurement against a reference point.
Benchmarking	A process of comparing and measuring an organization with business leaders anywhere in the world to gain information which will help the organization take action to improve its performance.

The Benchmarking Management Guide
American Productivity and Quality Center

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Types of Process Benchmarking

Term	Description
Internal studies	Compare similar operations within different units of an organization.
Competitive studies	Target specific products, processes, or methods used by an organization's direct competitors.
Functional or industry studies	Compare similar functions within the same broad industry or compare organizational performance with that of industry leaders.
Generic benchmarking	Compares work practices or processes that are independent of industry.

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The Performance Benchmarking Consortium

During April 2006, SEI launched a vendor and industry collaboration on benchmarking software project performance.

Objectives

- Provide tools and credible data for goal-setting and performance improvement
- To combine benchmark data from multiple repository sources thereby creating a superset of information for benchmark and/or performance comparison

Value

- Establish specifications for the collection and comparison of benchmark data from different vendor sources
- Allow companies to leverage existing data to help them establish and achieve their business goals

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Current PBC Members as of October 2006

Consortium members are leaders in software measurement and benchmarking from consultancies, industry, and academia.

David Consulting Group	PRTM
Galorath Incorporated	QSM
ISBSG	Raytheon
Lockheed Martin	SEI
Motorola	SPR
Oracle	STTF
PRICE Systems	University of Ottawa

* International Software Benchmarking Standards Group (ISBSG)

** Software Technology Transfer Finland (STTF)

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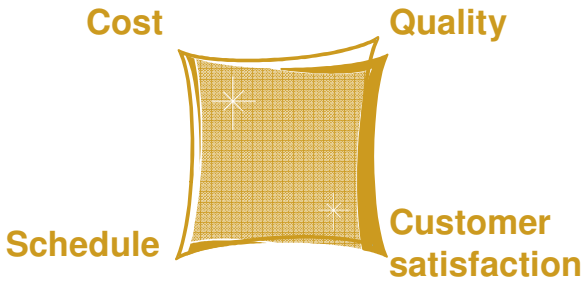
Motivation

Organizations want a way to gauge their performance and to compare their performance with others in their industry.

Data on project performance is needed to demonstrate the impact of process improvement.

Benchmarks

- provide a reference point for interpreting performance
- facilitate interpretation by setting specifications for how performance measurements are collected



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Is There Community Interest?

During June, 2006, the PBC conducted an initial survey to assess the voice of the customer.

can authorize sharing of organization's performance data

assigns a high degree of value to software project performance benchmarks

12 out of 14
or
85.7%

part of a team who can authorize sharing of organization's performance data

assigns a high degree of value to software project performance benchmarks

57 out of 63
or
90.5%

Results of 2006 PBC Survey
- Sample size = 800
- Response Outcome ≈ 25%

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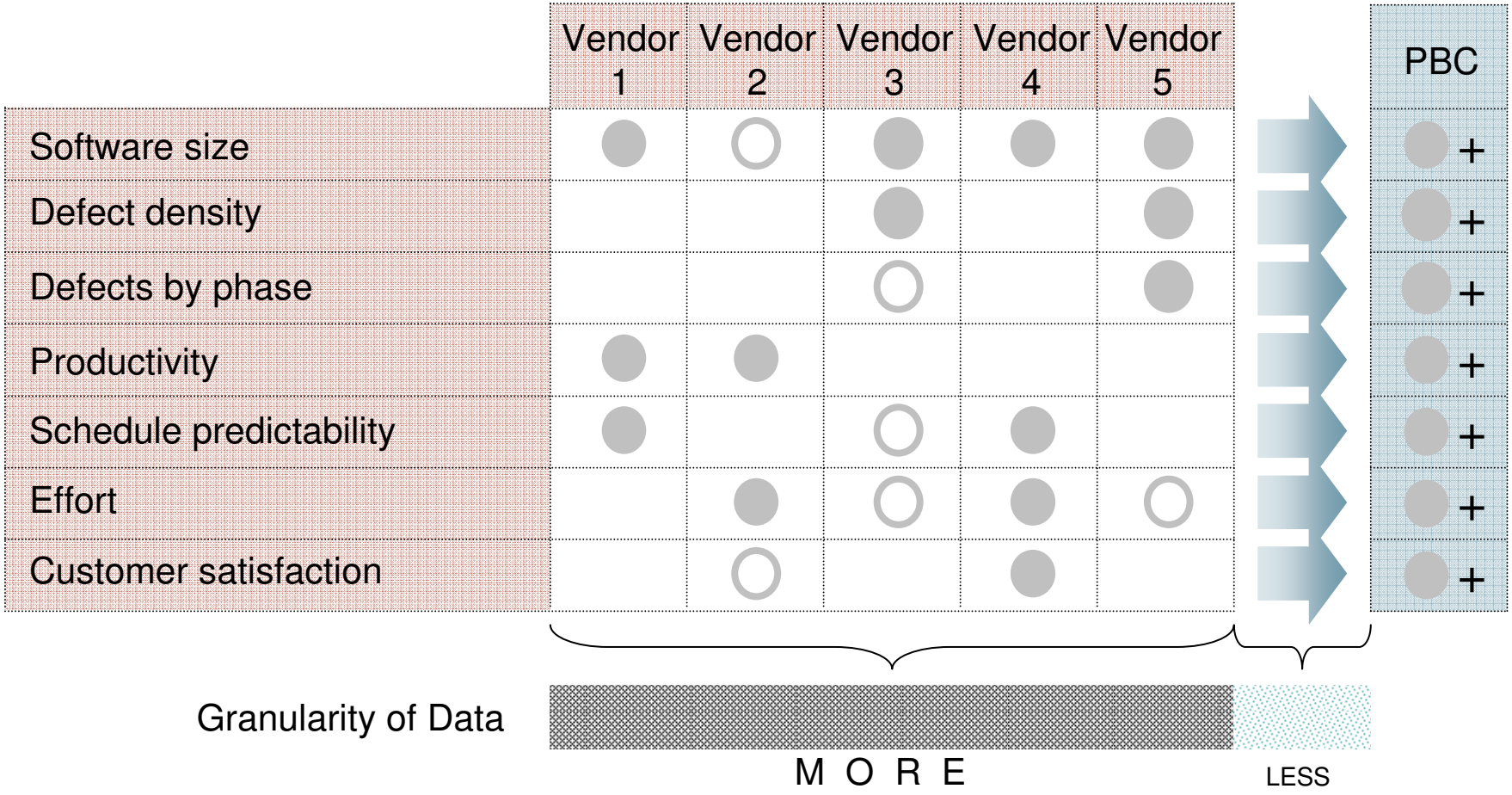
Broader Data Provided by PBC



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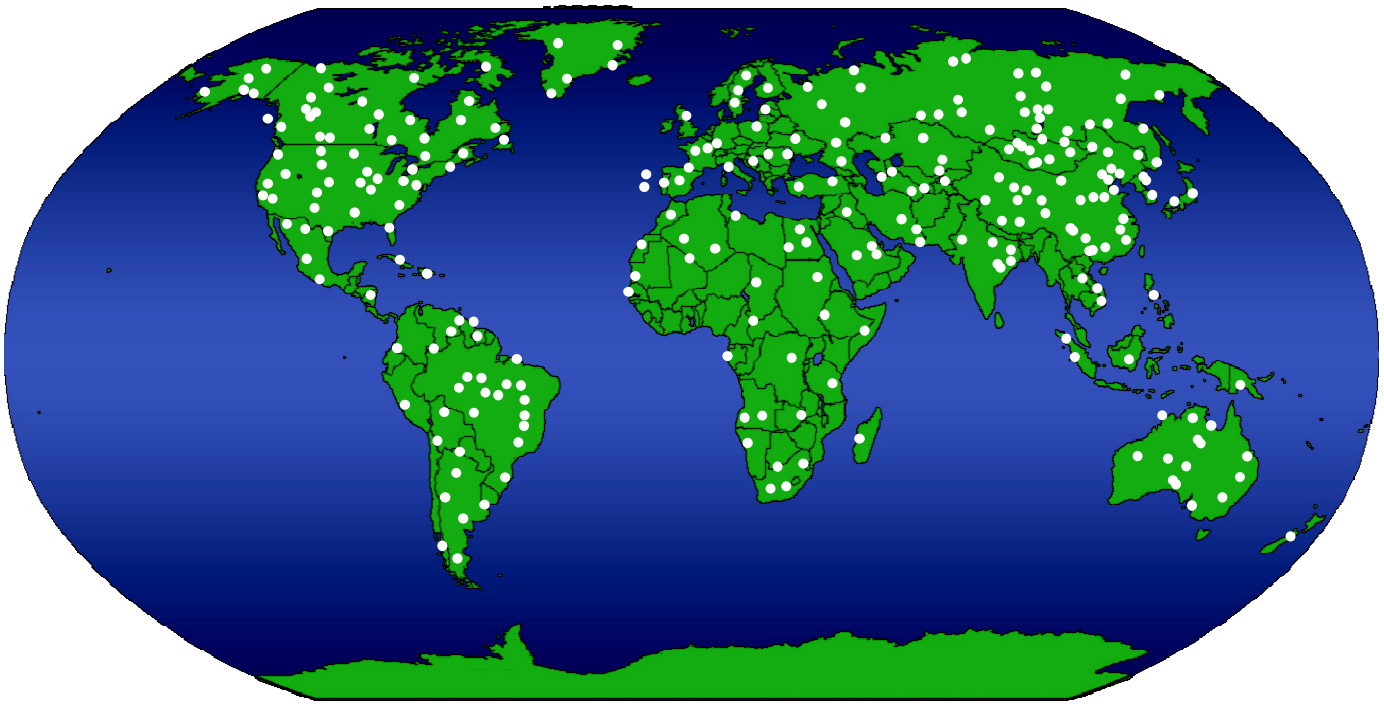
Broader Data Set Provided by PBC



PBC

- Member #1
- Member #2
- Member #3
- Member #4
- Member #5
- Member #6
- Member #7
- Member #*n*

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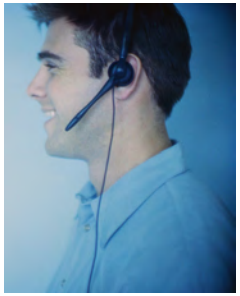
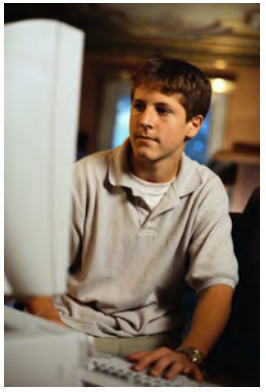
PBC Provides Broader Coverage of Application Domains

- Education
- Insurance
- Health and Medicine
- Military Systems
- Financial & Banking
- Manufacturing
- Electronics
- Communications





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Presentation Topics

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- → Ground covered

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Next Steps

- Near-term goals
- How you can participate

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Ground Covered - 1

Kick-Off Workshop at SEI [April 19-20, 2006]

- 14 presentations by workshop attendees; Discussion of current benchmarking issues and ways to address them.
- Brainstorming issues on how to proceed.
- Initiative to conduct survey to obtain community input on factors most likely to affect software project performance.
- Performance Benchmarking Consortium (PBC) is born.

What is performance measurement?

What makes a benchmark good and useful?

What constitutes valid data if you are interested in learning about your range of results in comparison to other benchmarking companies?

How should performance measurements be categorized?

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Ground Covered - 2

PBC Workshop [June 28-29, 2006]

- Initial survey addressing *performance factors* - results presented
- Planning and goal-setting
- Soliciting member input on the PBC business concept
- Initial concepts about PBC products and services
- Setting up work teams

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Ground Covered - 3

PBC Workshop [October 4-5, 2006]

- Work team status reports and planning
- Discussion of ConOps (Concept of Operations)
- Presentations by Member Companies
- Discussion of PBC Measurement Specification
- Selection of initial set of performance influence factors and performance indicators that will populate version 1 of the PBC repository.
- PBC 2006 planning and 2007 goal-setting

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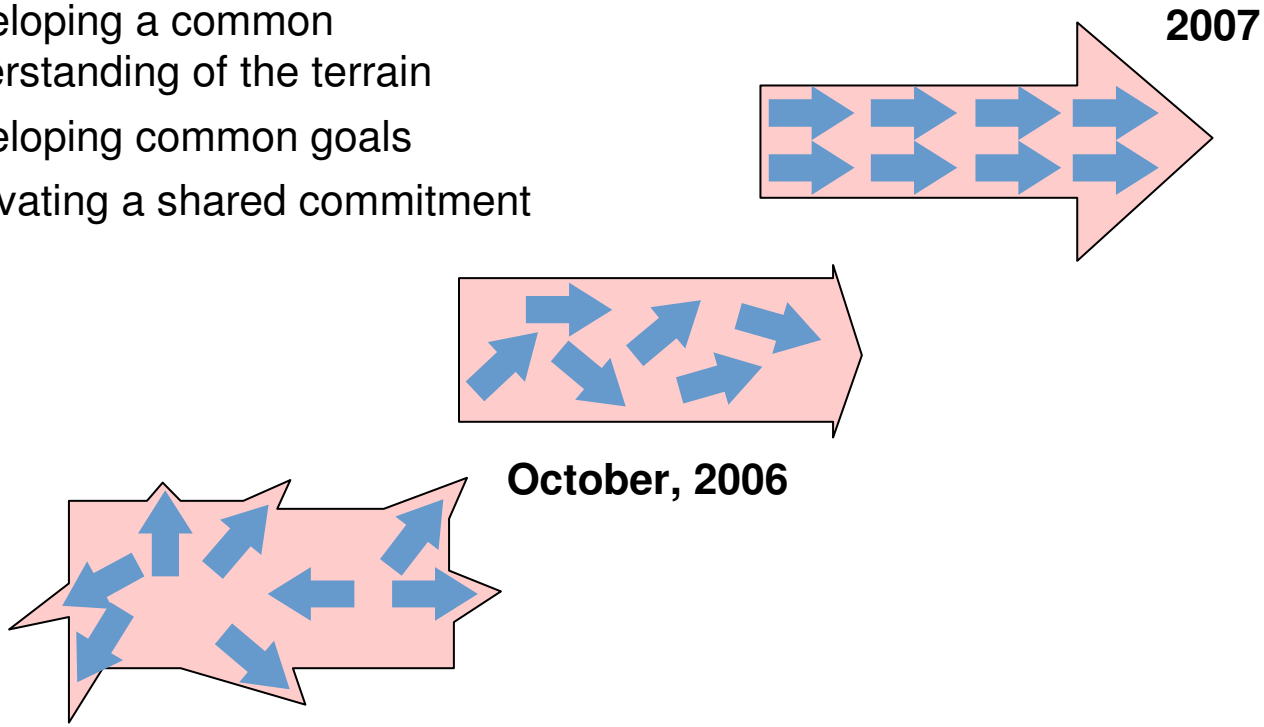
PBC Member Alignment is Happening

Work during 2006 as focused on

- Developing a common understanding of the terrain
- Developing common goals
- Cultivating a shared commitment



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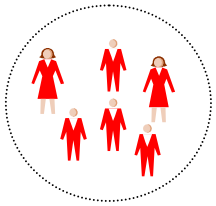
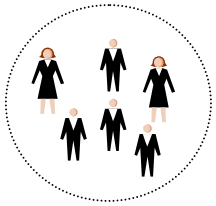
Current PBC Teams



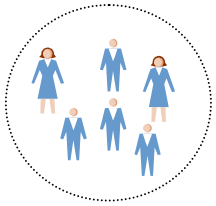
ConOps Team

- Business planning
- Communication planning
- Concept of operations



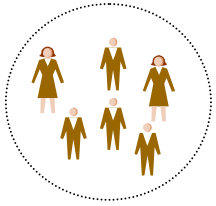
Voice of Customer Team

- Soliciting community input
- What do people need?



Specification Team

- Performance measurement definitions & guidance



Pilot Implementation Team

- Testing the solution components

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Next Steps

- Near-Term Goals
- How you can participate

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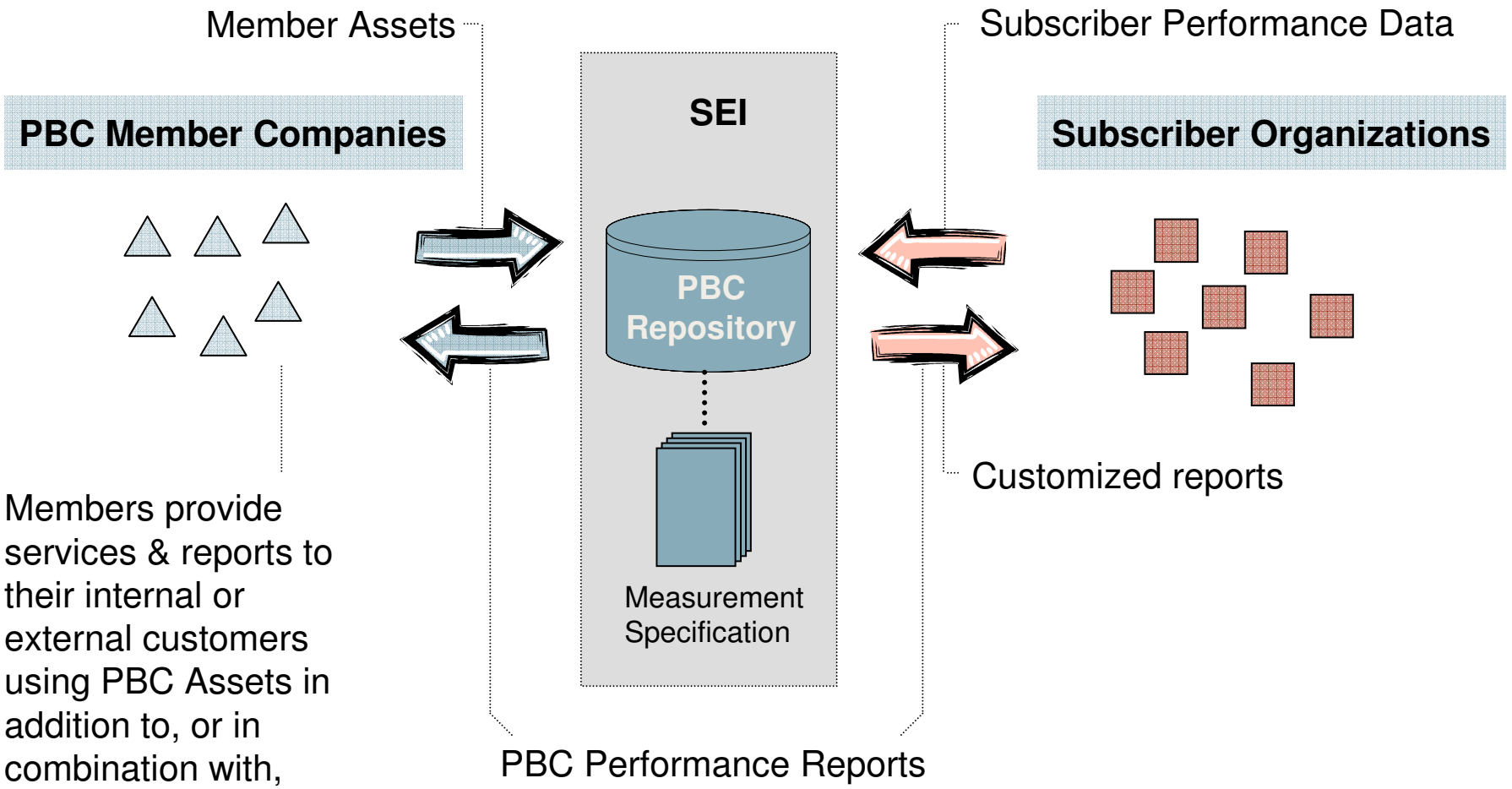
Concept of Operations - 1



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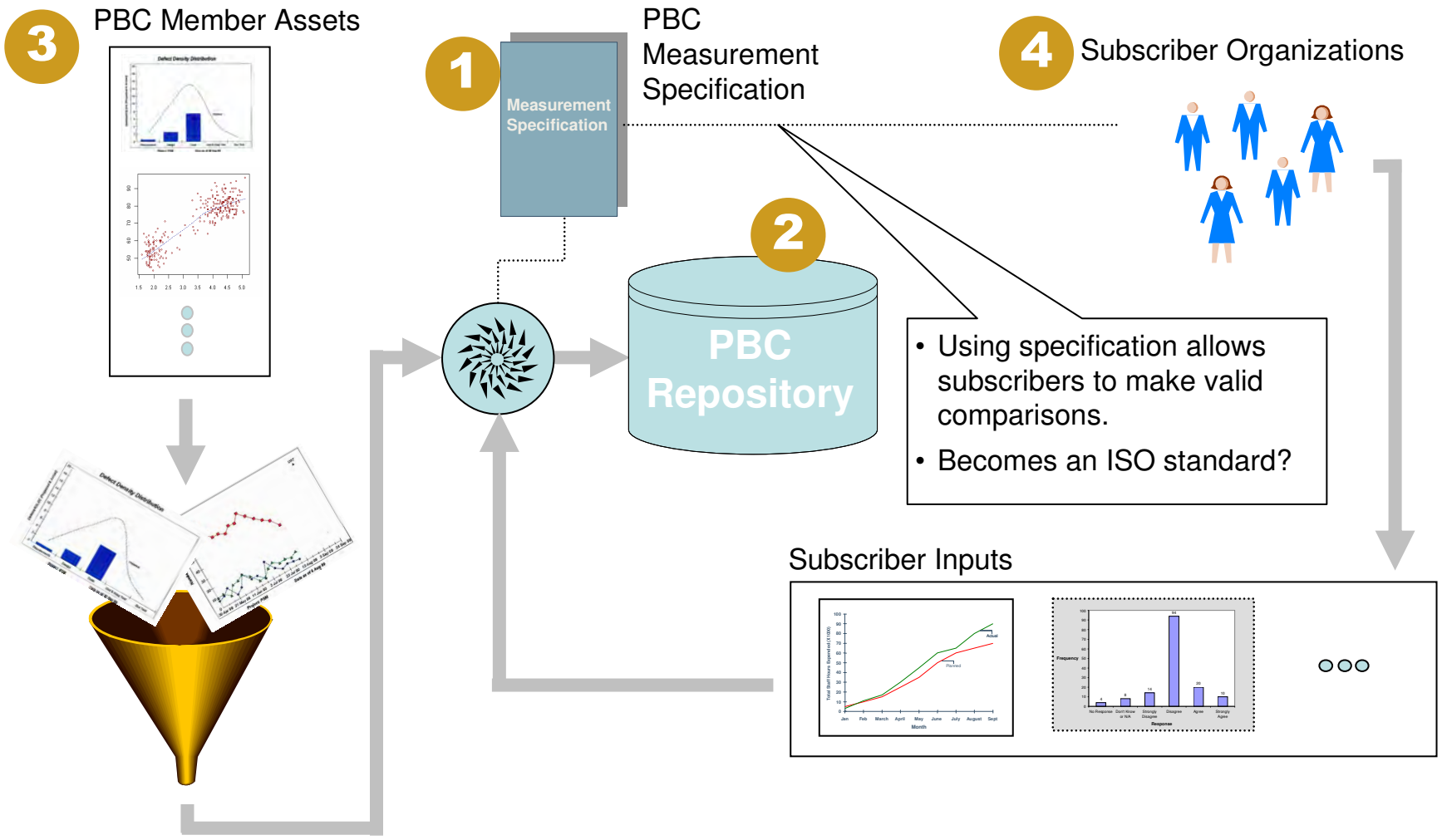
Concept of Operations - 2



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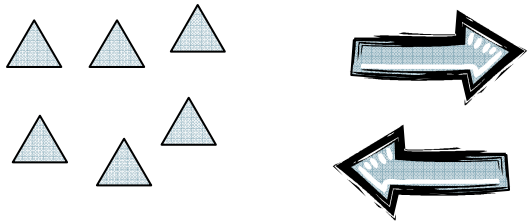
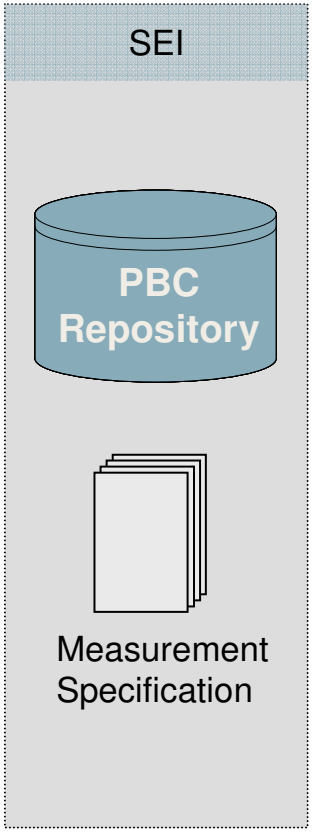
Concept of Operations - 3

The SEI:
- authors Meas. Spec.
- houses the repository
- provides website & admin
- authors PBC Reports
- provides communication support

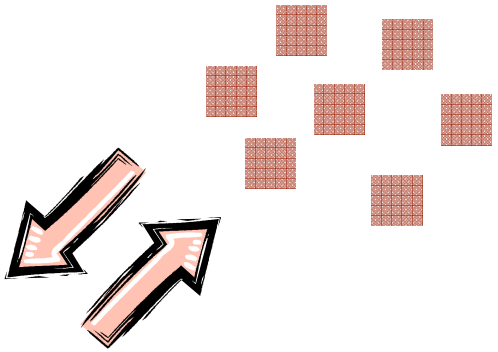
PBC Member Companies



Member companies:
- provide assets to stock the repository
- collaborate on Meas. Spec.
- pay fee to sustain operations
- provide training & consultation



Subscriber Organizations



Subscribers submit performance data that adheres to Meas. Spec.

They pay fee for:
- PBC Performance Reports
- Customized reports

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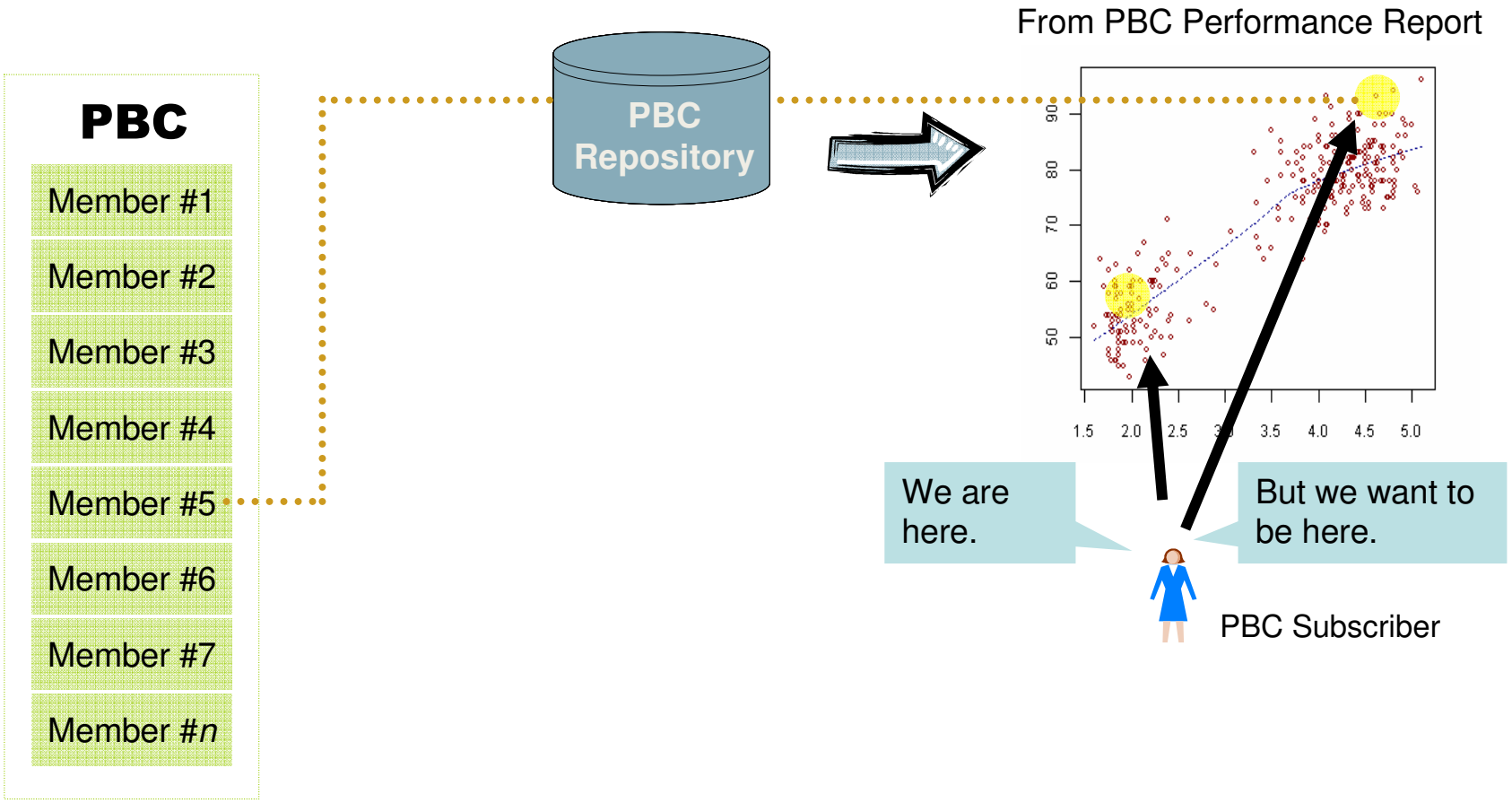
Concept of Operations - 3 Benchmarking



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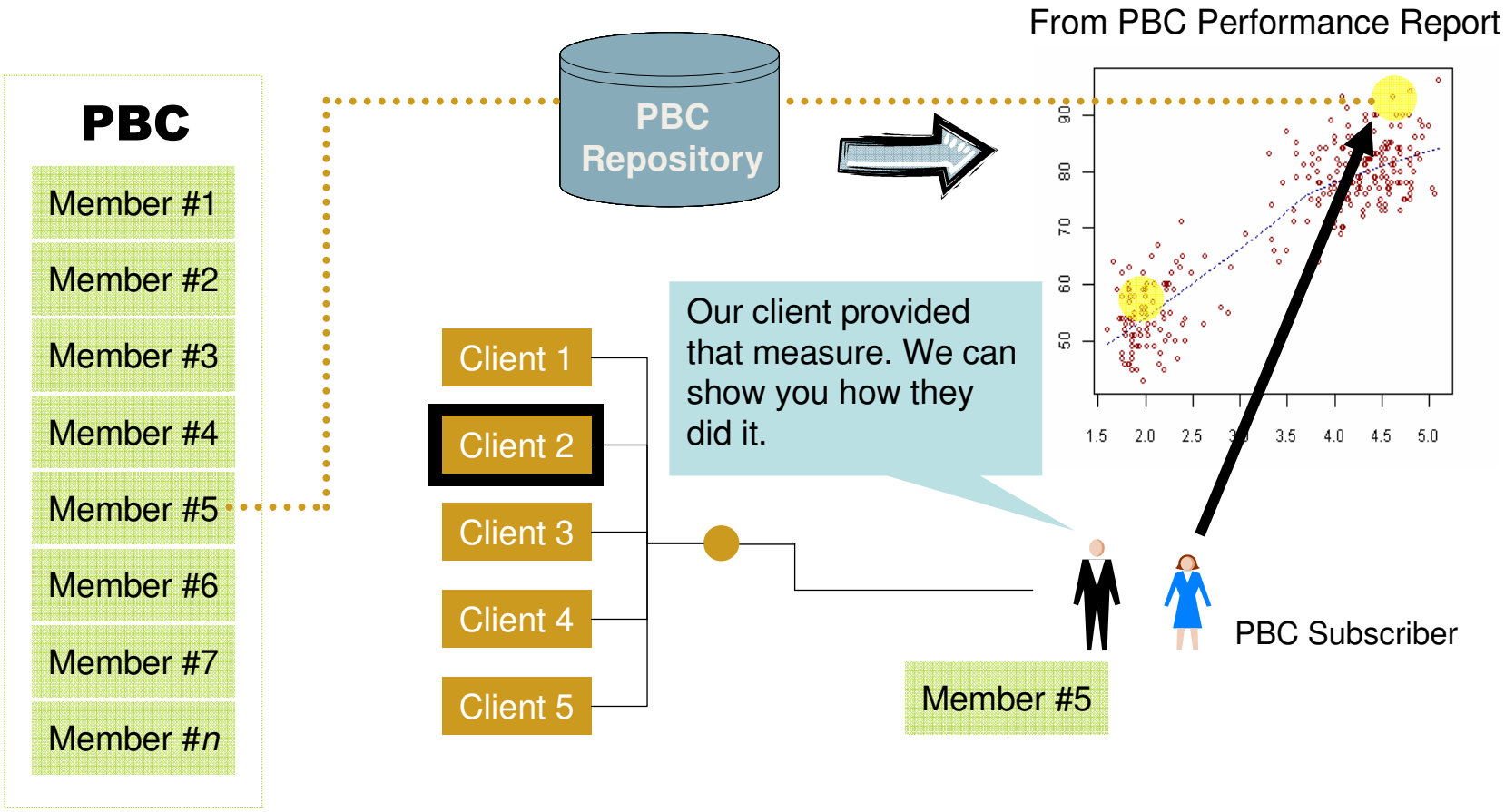
Concept of Operations - 4 Benchmarking



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Voice of Customer Team

This team is focused on ensuring that the voice of the customer is represented as PBC products are planned for development.

- Conducted a survey to obtain community input about factors that influence software project performance
- Planning a birds-of-feather session for next SEPG Conference to solicit community input to influence the development of PBC products and services

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Specification Team Work

The Spec Team is working to develop common definitions.

Performance Influence Factors

- Process maturity
- Application domain
- Stability of requirements
- Size
- Project type
- Team size
- Developers' functional knowledge

Performance Indicators

- Defect density
- Time-to-market
- Schedule predictability
- Productivity index
- Project delivery rate

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Specification Team – Building Common Definitions

Example: Time-to-market measure

S/W Project A
Meas. Definition A

S/W Project B
Meas. Definition B

S/W Project C
Meas. Definition C

S/W Project D
Meas. Definition D

How can you compare?

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Specification Team – Building Common Definitions

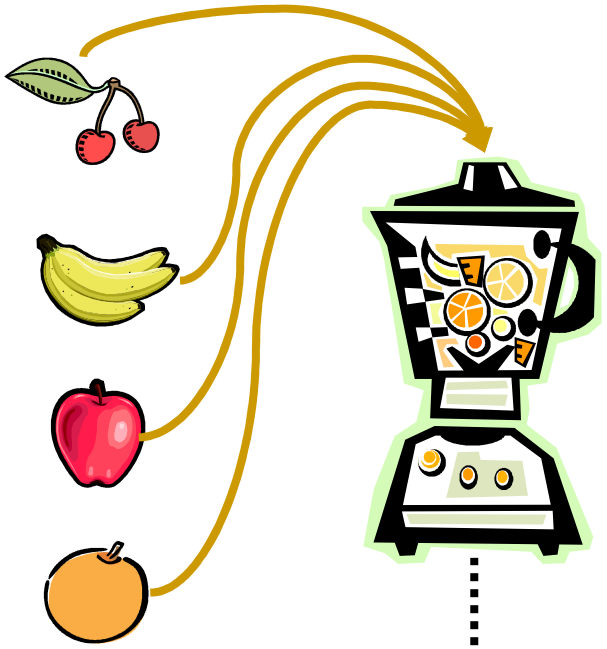
Example: Time-to-market measure

S/W Project A
Meas. Definition A

S/W Project B
Meas. Definition B

S/W Project C
Meas. Definition C

S/W Project D
Meas. Definition D



The Specification Team

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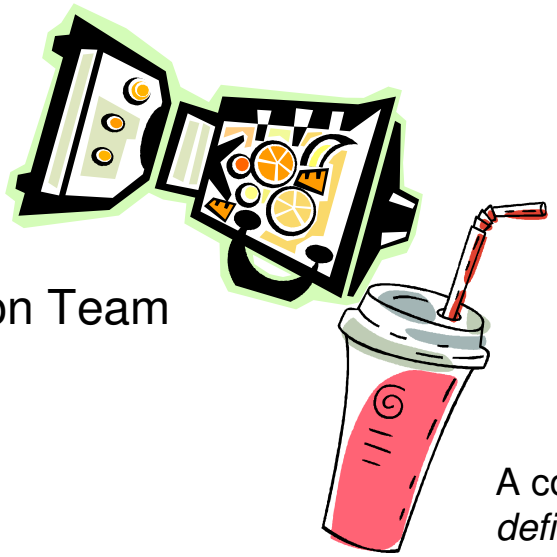
Specification Team – Building Common Definitions

Example: Time-to-market measure

The Specification Team



A cool, refreshing *common definition* for "time-to-market" that permits valid comparisons between software projects

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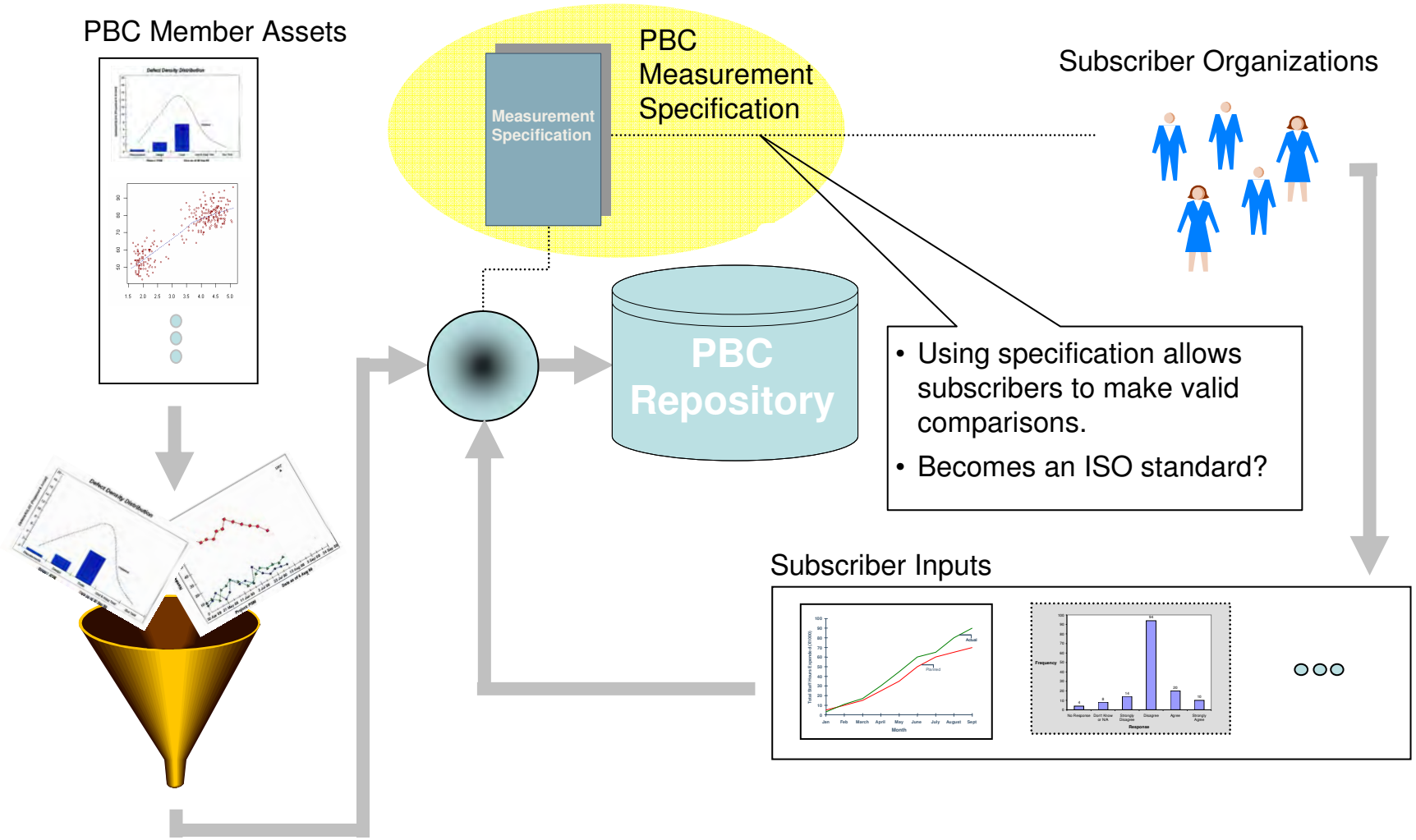
PBC Measurement Specification



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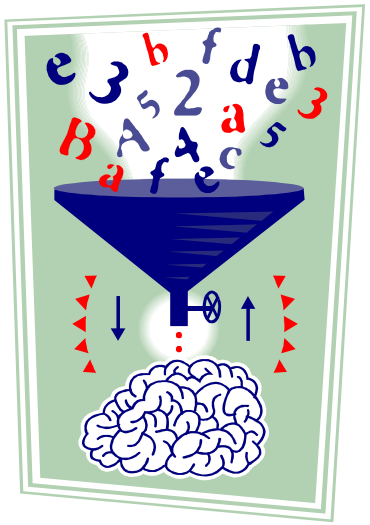
Near-Term Goals

The PBC will

- create a set of process specifications for the consistent and meaningful collection, analysis, and dissemination of comparative performance benchmarks for software projects
- develop a data model that will facilitate the aggregation and comparison of data from different sources
- pilot test solution components
- develop version 1.0 of the PBC data repository



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Are You Interested?

- The PBC will be expanding membership during 2007.
- Individuals who become members during 2007 will participate in proof-of-concept trials and provide feedback on the PBC Concept of Operations.
- If your organization is interested in sponsoring you as a member or if you are interested in becoming a subscriber of future PBC products and services, then please send email to Mark at mkasunic@sei.cmu.edu
- Individuals who contact us will be added to our database. We will periodically send email about progress and future plans for the PBC.

Thank-you

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Acknowledgements

Kate Armel	QSM
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Pekka Forselius	STTF
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Peter Hill	ISBSG
Tim Hohmann	Galorath, Incorporated
Thomas Lienhard	Raytheon
Larry McCarthy	Motorola
Arlene Minkiewicz	PRICE Systems
Kristal Ray	Oracle
Suresh Subramanian	PRTM
Bob Weiser	Lockheed Martin

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Anita Carleton
Robert Ferguson
Diane Gibson
Dennis Goldenson
Oksana Schubert
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Dave Zubrow

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Why Do You Need a Maturity Level 5 Supplier?

CMMI Conference
November 2006
Denver, Colorado

Welcome

WelKom

Huan Yín

Bienvenido

Bienvenue

Wilkommen

ΚΑΛΟΣΟΡΙΣΑΤΕ

Bienvenuto

Välkommen

Tervetuloa

Witamy

ברוכים הבאים

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Agenda

- Myths
- Characteristics of ML2 – ML5 Organizations
- Buyer's Responsibility for Defining the System Up Front
- Buyer's Responsibility for Managing the Supplier
- Supplier Relationship
- Supplier Selection Criteria
- Continuous Representation, Capability Levels and Supplier Capability Evaluation

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Myths

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Myths

- You must “trust” your supplier or you should not choose them
- You must never allow your supplier to suggest a change to the requirements or to the contract
- If you do not have so much expertise, it is quite OK to have your Supplier to define your requirements for you and the Acceptance Testing criteria
  - It is also acceptable for the Supplier to conduct the Acceptance Testing for you
- Using a Supplier is always cheaper than developing a product or product component in-house

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Myths - 2

- If you choose a Maturity Level 5 Supplier, it greatly reduces the work for the Project, because the Supplier will “manage itself”
- If you need multiple suppliers, ML 5 Suppliers will be more willing to cooperate to support your business objectives
- ML 5 Suppliers are able to demonstrate expected performance regardless of the application domain
- ML 5 Suppliers are able to support the culture of any Buyer they are supporting

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Characteristics of ML 2 – ML5 Organizations

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Maturity Level 2 Characteristics

- Projects of the organization have ensured that processes are planned and executed in accordance with policy
- Projects employ skilled people
- Adequate resources are made available to the project team members
- Controlled outputs are produced
- Relevant stakeholders are involved, monitored, controlled, and reviewed and are evaluated for adherence to their process descriptions
- Status of the work products and the delivery of services are visible to management at defined points
- Work products are appropriately controlled

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Maturity Level 3 Characteristics

- Processes are well characterized and understood, and are described in standards, procedures, tools, and methods
  - These standard processes are used to establish consistency across the organization
  - The standards, process descriptions, and procedures for a project are tailored from the organization's set of standard processes to suit a particular project or organizational unit and therefore are more consistent
- Processes are managed more proactively using an understanding of the interrelationships of the process activities and detailed measures of the process, its work products, and its services

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Maturity Level 4 Characteristics

- The organization and projects establish quantitative objectives for quality and process performance and use them as criteria in managing processes
- Quantitative objectives are based on the needs of the customer, end users, organization, and process implementers
- Quality and process performance is understood in statistical terms and is managed throughout the life of the processes

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Maturity Level 4 Characteristics - 2

- For selected subprocesses, detailed measures of process performance are collected and statistically analyzed
- Special causes of process variation are identified and, where appropriate, the sources of special causes are corrected to prevent future occurrences
- At maturity level 4, the performance of processes is controlled using statistical and other quantitative techniques, and is quantitatively predictable

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Maturity Level 5 Characteristics

- At maturity level 5, an organization continually improves its processes based on a quantitative understanding of the common causes of variation inherent in processes
- Quantitative process improvement objectives for the organization are established, continually revised to reflect changing business objectives, and used as criteria in managing process improvement
- Both the defined processes and the organization's set of standard processes are targets of measurable improvement activities

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Deciding To Use A Supplier

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Buyer's Responsibility for Defining the System Up Front

- Requirements
  - Business
  - Technical
  - Performance
  - Quality
  - Competition
  - Competence
  - Acceptance Criteria
- WBS → SOW
- Initial Planning
- Critical Path
- Initial Risk Identification

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Buyer's Responsibility for Defining the System Up Front - 2

- Initial Technical Solution
- Deliverables
- Supplier Relationship
- Selecting the Supplier
- Establishing the Supplier Agreement
- Performing a Kick-Off with the Supplier's Project Team
- Monitoring the Supplier's Performance
- Evaluating Selected Supplier Processes and Work Products
- Transferring the Product or Product Component from Supplier to Buyer environment

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Requirements

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Deciding to Use a Supplier Requirements

- Understand the “customer’s” requirements
  - Must be at a low enough level to be able to decide which of its customer requirements the Buyer wants the Supplier to be responsible to implement

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Deciding to Use a Supplier Requirements - 2

- Categories of questions for consideration
  - How are those requirements related to the Buyer's organizational business requirements?
  - What is the Buyer's relationship with the Supplier?
  - What technical ability must the Supplier have?
  - What technical performance is required and is the supplier capable?
    - What other projects can the Supplier discuss and show the actual performance delivered?
  - What quality factors is the Buyer seeking for the Supplier to deliver?
    - Reliability
    - Maintainability and Expandability
    - Interoperability
- See Template for Deciding to Use a Supplier
  →Template to Help Decide to Use a Supplier.doc

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Identify System Requirements

- Determine goal and scope of the effort
  - Review customer input
- Gather high-level Requirements
  - Identify the goals and requirements of project
  - Describe current state or system
  - Describe change to system or new system
  - Document justification for system change or new system
  - Identify security requirements
  - Identify computer resource requirements
  - Identify internal and external interfaces

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Review Customer Input

- Overview
- Objectives
- Assumptions and Constraints
- Requirements
  - Functional requirements
    - what the system should do, not how
  - Non-functional requirements
    - constraints on the system

Describe System Objectives

- Reason for the system
  - Why is it being built?
    - for Research and Development
    - for a specific customer
    - to meet existing/anticipated market needs/requirements
    - to upgrade an existing system to newer technology

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Describe System Objectives - 2

- Reason for the system
  - What is the problem it is trying to solve?
    - a known problem
    - an anticipated problem (e.g., loss of maintenance/production support for existing technology)

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Develop System Overview

- The overview describes the interactions between the system and its operational environment
  - Other systems with which it must interface
  - Protocols it must use to interface with them
  - Who the users are and in what manner they will use it
  - Expected change in its environment over its lifetime

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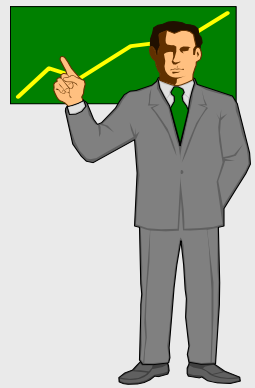
Document Your Assumptions

- All assumptions should be documented
  - Captures thinking at the time
  - Easier to find where wrong assumptions were made weeks and months later
  - Reduces the risk of finger pointing about who made the right or wrong assumption
  - Necessary for backup or someone who may take over the role of the person who worked on the decision to use a Supplier



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List System Constraints

Functional Constraints

- Performance
- Efficiency
- Response times
- Capacities
- Safety
- Security
- Quality issues
  - Maintainability
  - Portability
  - Reliability

Design Constraints

- Development standards
- Libraries
- Operating Environment:
  - System compatibility
  - Interaction with existing systems (hardware and/or software)
  - Hardware
  - Operating system

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Acceptance Criteria

- Acceptance Criteria (the criteria that a product or product component must satisfy to be accepted by a user, customer or authorized entity) should be part of the requirements capture and specification process
  - Who will perform the acceptance testing?
  - What environment or portion of the user's environment must be exercised to satisfy the acceptance criteria?
  - How much simulation will be allowed?
  - What process will be followed if errors are found?
    - What classification of errors must be fixed before the system will be accepted?
    - What classification of errors may allow the system to be accepted in the event that workarounds can be provided?

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Work Breakdown Structure

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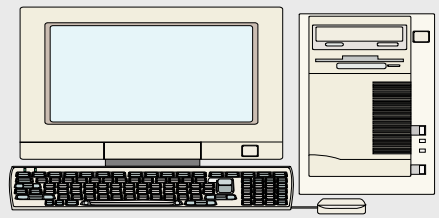
Determine Resources Needed

- Develop initial high-level work breakdown structure (WBS) PP-SAM-Starterkit-WBSExampleContentsv2.0.doc
- Make initial high-level rough estimates
  - Size & Complexity
  - Effort
  - Critical computer resources
- Identify all participant roles



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Determine Resources Needed - 2

- Develop high-level staffing profile including need for contracting support
- Determine training needs
- Identify the QA activities to be performed and the required support
- Determine CM activities and support
- Determine the Test activities and support
- Identify groups external to the project for inter-group coordination
- Develop preliminary schedule

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Initial Planning

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Initial Estimation

- Provide initial estimates for the following
  - Size
  - Effort
  - Cost
  - Schedule
  - Risks
  - Computer Resources
  - Facilities and Test Environment

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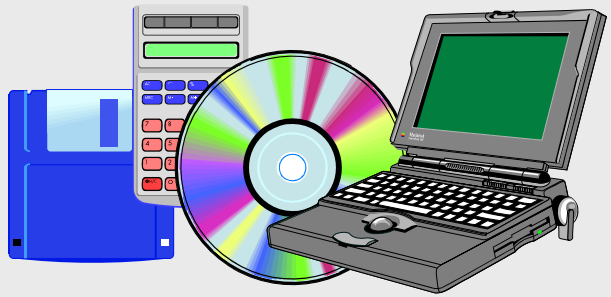
Resources Required

What must one have to get this project done?

- Staff
- Tools
  - Analysis
  - Design
  - Project Tracking
  - CM
  - Testing
- Facilities
- Systems
- Training



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Staff Requirements

- Project Manager
- Detailed definition of skills and experience needed
- Detailed definition of time-frame needed
- Staff Requirements for planning and implementation phases of the project

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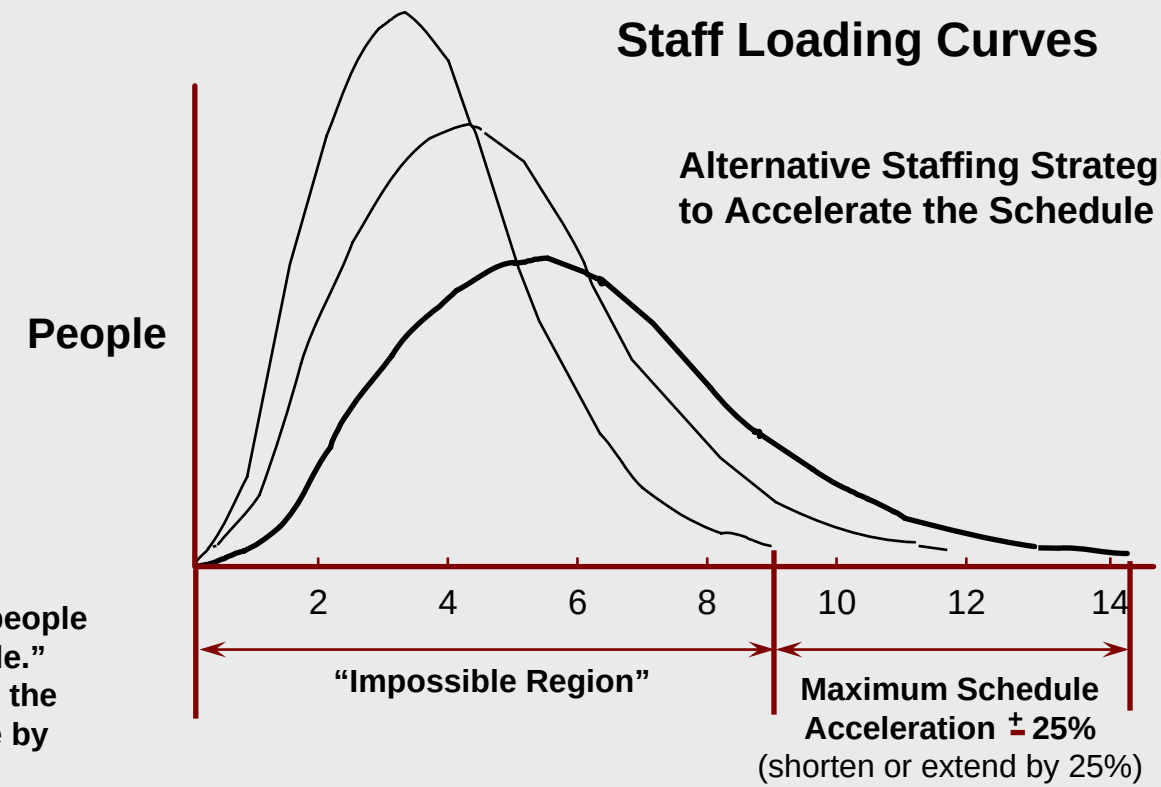
Resource Planning



"Person months and people are not interchangeable."
"You cannot complete the project in half the time by doubling the people."

Frederick Brooks
The Mythical Man-Month

Barry Boehm
Software Engineering Economics

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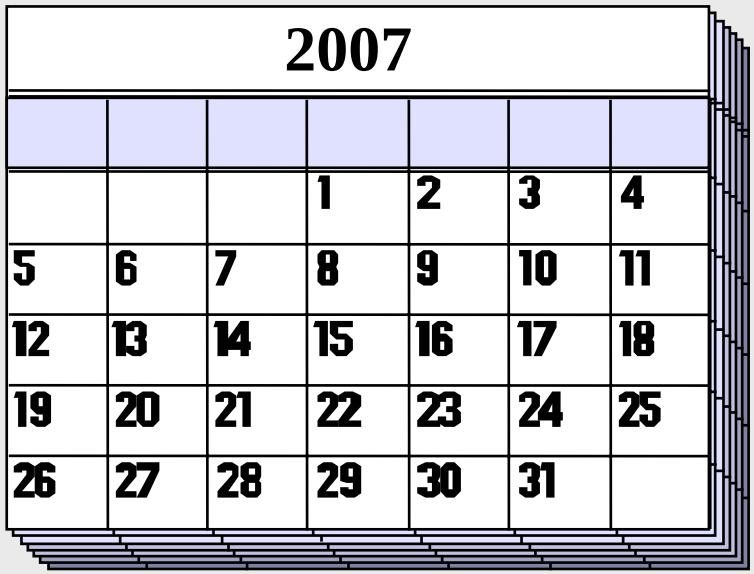
Critical Path

Create an Initial Schedule



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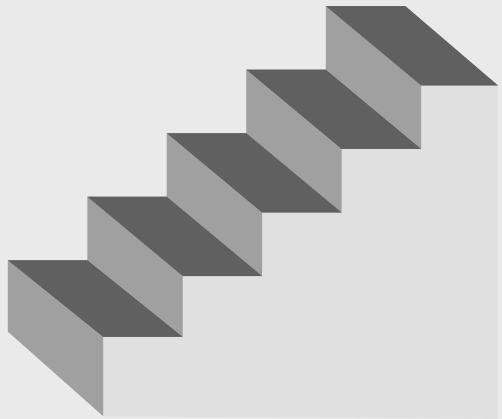
Critical Path

- Determine Tasks Dependencies
- Calculate the Critical Path (CPM) schedule
- Integrate Resources into schedule



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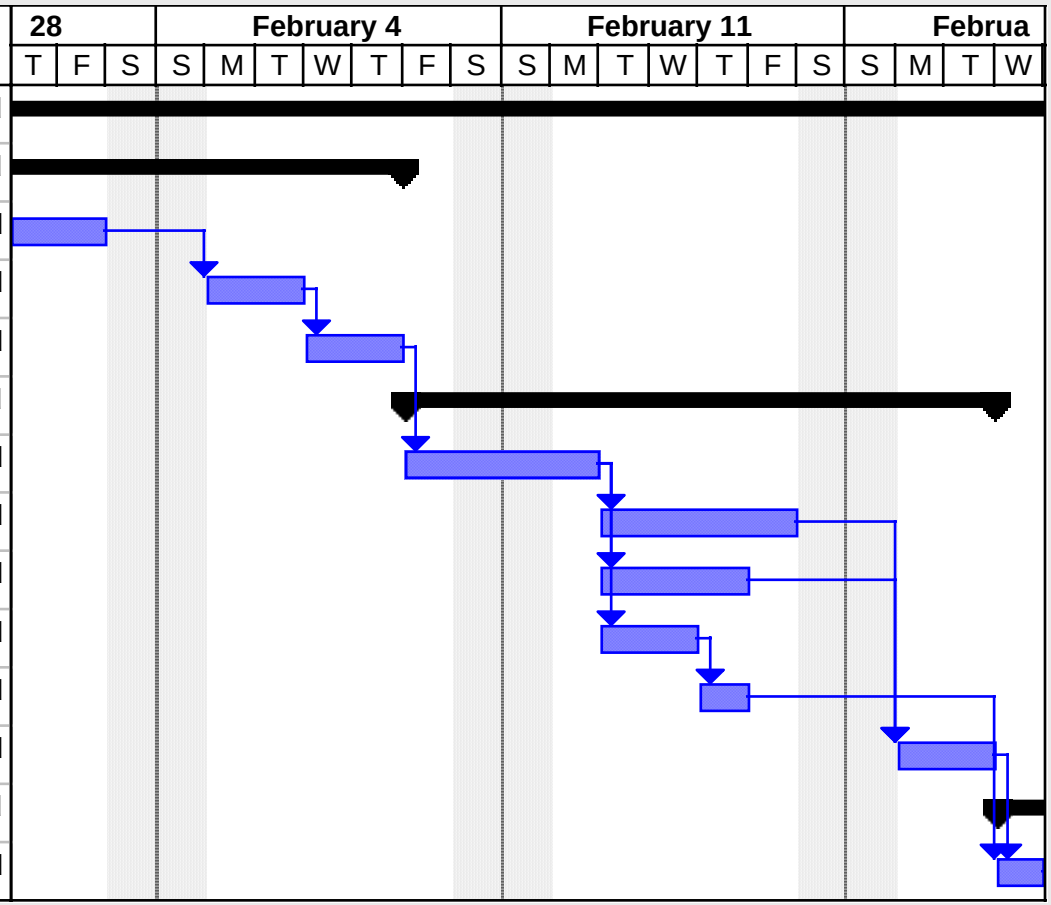
Microsoft Project Gantt Chart

ID	Task Name	Duration
1	**1 Develop Software System**	**17d**
2	**1.1 Design Phase**	**6d**
3	1.1.1 Develop Funct	2d
4	1.1.2 Complete Desi	2d
5	1.1.3 Develop Accep	2d
6	**1.2 Implementation Pha**	**8d**
7	1.2.1 Complete Deta	2d
8	1.2.2 Generate Code	4d
9	1.2.3 Document Sys	3d
10	1.2.4 Develop ATP	2d
11	1.2.5 Develop Site P	1d
12	1.2.6 Complete Test	2d
13	**1.3 Installation Phase**	**3d**
14	1.3.1 Install System	1d



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Risks

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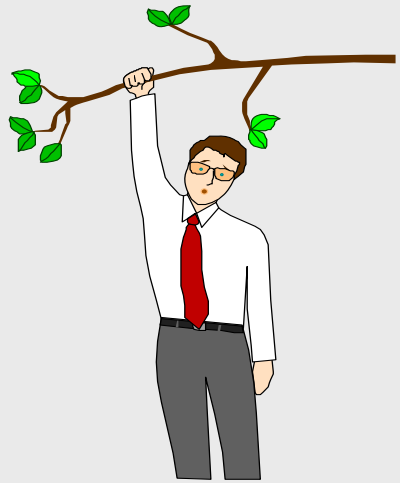
Risk Definition

- Any event that could impact project results
  - Effort and Cost
  - Schedule
  - Functionality
  - Performance
  - Quality



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Technical Solution

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Recommend Strategy Tasks

- Develop high-level development strategy
- Develop high-level system architecture
- Identify proposed language/development environment
  - Identify potential use of tools
  - Identify potential use of COTS

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Recommend Strategy Tasks - 2

- Describe potential alternative solutions
- Describe advantages and disadvantages of each potential solution in order to be in the best position to evaluate the Supplier's recommendations

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Deliverables

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Review Preliminary Project Plan

- Prepare preliminary project plan
- Ensure that all deliverables are clearly specified;
  - Product components in software and hardware integrated into a system
  - Architecture Specification
  - Design Specifications
  - Installation Manual
  - Operator's Manual
  - User's Manual
  - Functional Configuration Audit Report
  - Physical Configuration Audit Report
  - Version Description Document
  - ……

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Supplier Relationship

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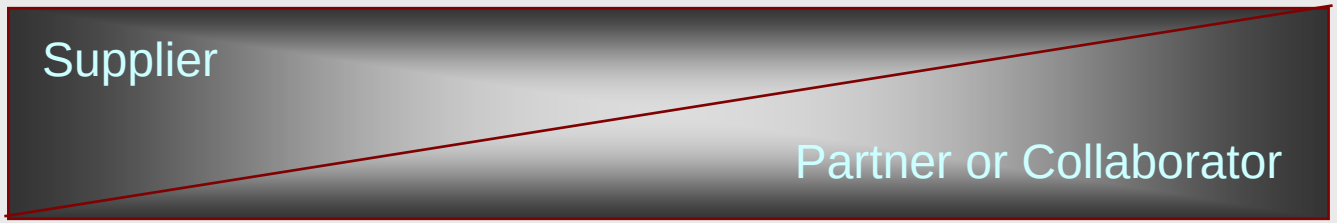
Supplier Relationship

Requirements **Trust**



Supplier is given a small set of requirements

Supplier has proven its ability to perform within the agreed upon time and budget

Supplier as proven performance track record and is willing to share the entrepreneurial risk

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Supplier Selection Criteria

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Supplier Evaluation Criteria

- Suppliers are selected based on their ability to perform the work according to predefined evaluation criteria
  - Prior documented performance in similar applications
  - Geographic location
  - System Engineering capabilities
  - Software Engineering capabilities
  - Knowledge, skills, and numbers of staff available to perform the work
  - Available resources (facilities, hardware, software, training)
  - Capability evaluation (Appraisal Results)
  - KI Supplier Evaluation Checklist →Consolidated Supplier Evaluation Criteria - v2.7 Categories.rtf

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Establish the Supplier Agreement

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Establish the Supplier Agreement

- Establishing and maintaining the supplier agreement provides the supplier with the project needs, expectations, and measures of effectiveness
- The supplier agreement typically includes:
  - Statement of work
  - Terms and conditions
  - List of deliverables, schedule, and budget
  - Defined acceptance process including acceptance criteria

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Establish the Supplier Agreement - 2

- Identification of project and supplier representatives responsible and authorized to agree to changes to the supplier agreement
- Identifying the process for handling requirements change requests from either side
- Identifying processes, procedures, guidelines, methods, templates, etc., that will be followed
- Identifying critical dependencies between the project and the supplier
- Identifying the form, frequency, and depth of project oversight the supplier can expect from the project
  - includes evaluation criteria to be used in monitoring the supplier's performance

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Establish the Supplier Agreement - 3

- Identifying the supplier's responsibilities for ongoing maintenance and support of the acquired products
- Identifying warranty, ownership, and usage rights for the acquired products

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Monitor the Supplier's Performance

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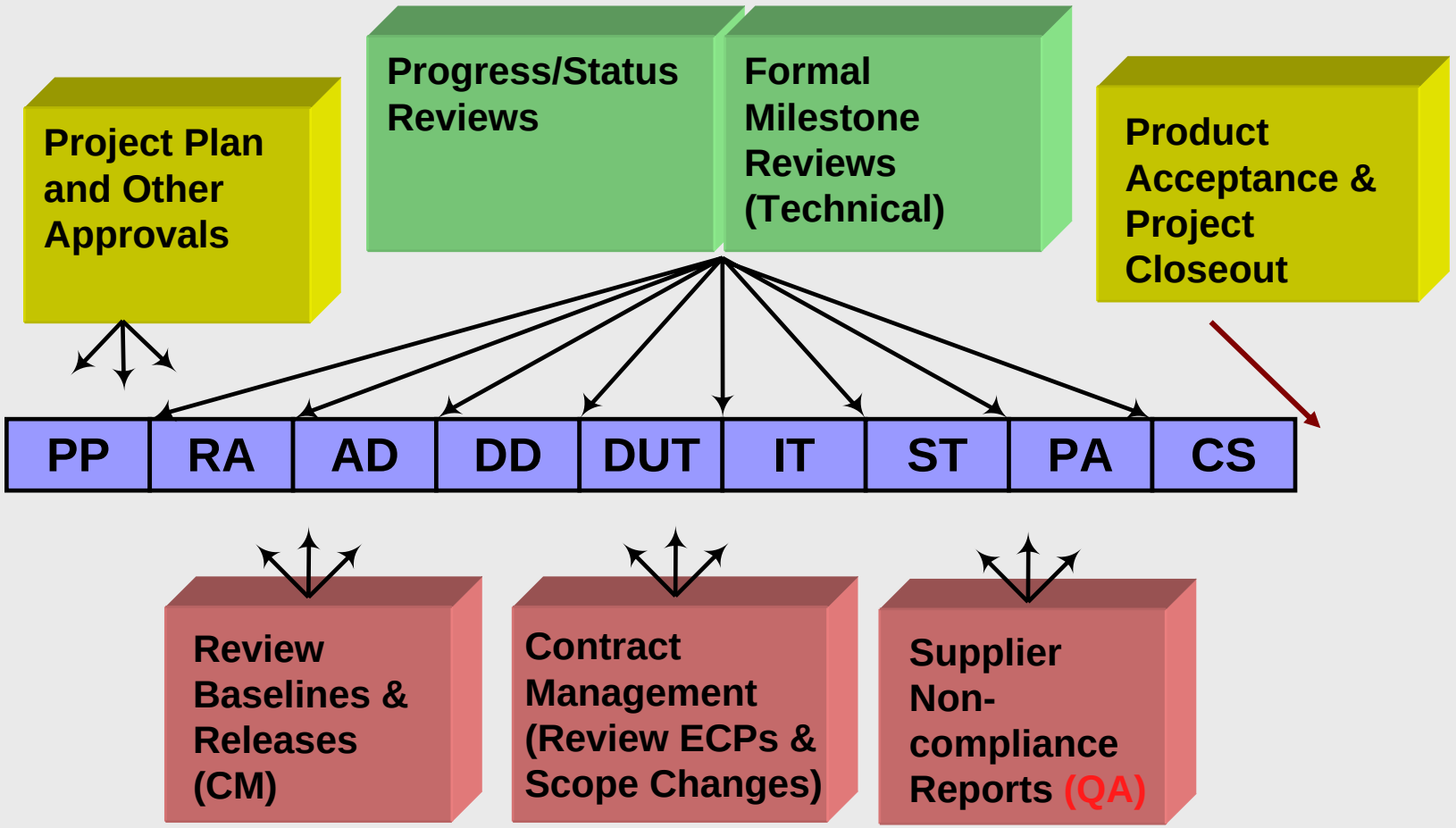
Monitoring Performance Activities



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Monitoring Concerns

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Supplier Quality Assurance Monitoring

- The project's Quality Assurance representative monitors the supplier's quality assurance activities
  - The supplier's plans, resources, procedures, and standards, for quality assurance are periodically reviewed to ensure they are adequate to monitor the supplier's own performance

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Supplier Configuration Management Monitoring

- The project's Configuration Management representatives monitor the supplier's configuration management activities
  - The project and the supplier coordinate their activities on matters relating to configuration management to ensure that the supplier's products can be readily integrated or incorporated into the project environment

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Monitoring Selected Processes and Evaluating Selected Work Products

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Monitor Selected Supplier Processes

- In situations where there must be tight alignment between some of the processes implemented by the supplier and those of the project, monitoring these processes will help prevent interface problems
- The selection must consider the impact of the supplier's processes on the project.
  - On larger projects with significant subcontracts for development of critical components, monitoring of key processes is expected
  - On smaller, less critical components, the selection process may determine that monitoring is not appropriate
  - The overall risk should be considered in selecting processes to be monitored between these extremes

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Monitor Selected Supplier Processes - 2

- The processes selected for monitoring should include:
  - Engineering
  - Project management
  - Support processes critical to successful project performance such as quality assurance and configuration management
- There should be sufficient monitoring to detect issues, as early as possible, that may affect the supplier's ability to satisfy the requirements of the supplier agreement
- Analyzing selected processes involves taking the data obtained from monitoring selected supplier processes and analyzing it to determine whether there are serious issues

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Measurement and Analysis Monitoring

- Measurement and analysis of the product components provided by suppliers is essential for effective management of the quality and costs of the project
- It is possible, with careful management of supplier agreements, to provide insight into the data that support supplier-performance analysis

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Evaluate Selected Supplier Work Products

- The scope of this specific practice is limited to suppliers providing the project with custom-made products
  - Custom-made products that present some risk to the program due to complexity or criticality should be examined as potential candidates
- Selected work products produced by the supplier should be evaluated to help detect issues as early as possible that may affect the supplier's ability to satisfy the requirements of the agreement
- The work products selected for evaluation should include critical products, product components, and work products that provide insight into quality issues as early as possible

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Evaluate Selected Supplier Work Products - 2

- Work products are evaluated to ensure the following:
  - Derived requirements are traceable to higher level requirements
  - The architecture is feasible and will satisfy future product growth and reuse needs
  - Documentation that will be used to operate and to support the product is adequate
  - Work products are consistent with one another
  - Products and product components (e.g., custom-made, off-the-shelf, and customer-supplied products) can be integrated

Transitioning from the Supplier's Environment to the Buyer's Environment

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Transitioning the Acquired Product From the Supplier to the Project

- Monitor the transition of the acquired products from the supplier to the project
  - Ensure that the appropriate facilities to receive, store, use, and maintain the acquired products are available
  - Ensure that the appropriate training is provided to assist in the transition
  - Ensure that the storing, distributing, and use of the acquired products is performed according to the terms and conditions specified in the supplier agreement
  - Transitioning from Supplier to Buyer
    → Transitioning from Supplier to Buyer v2.2.rtf

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Supplier Capability Evaluation

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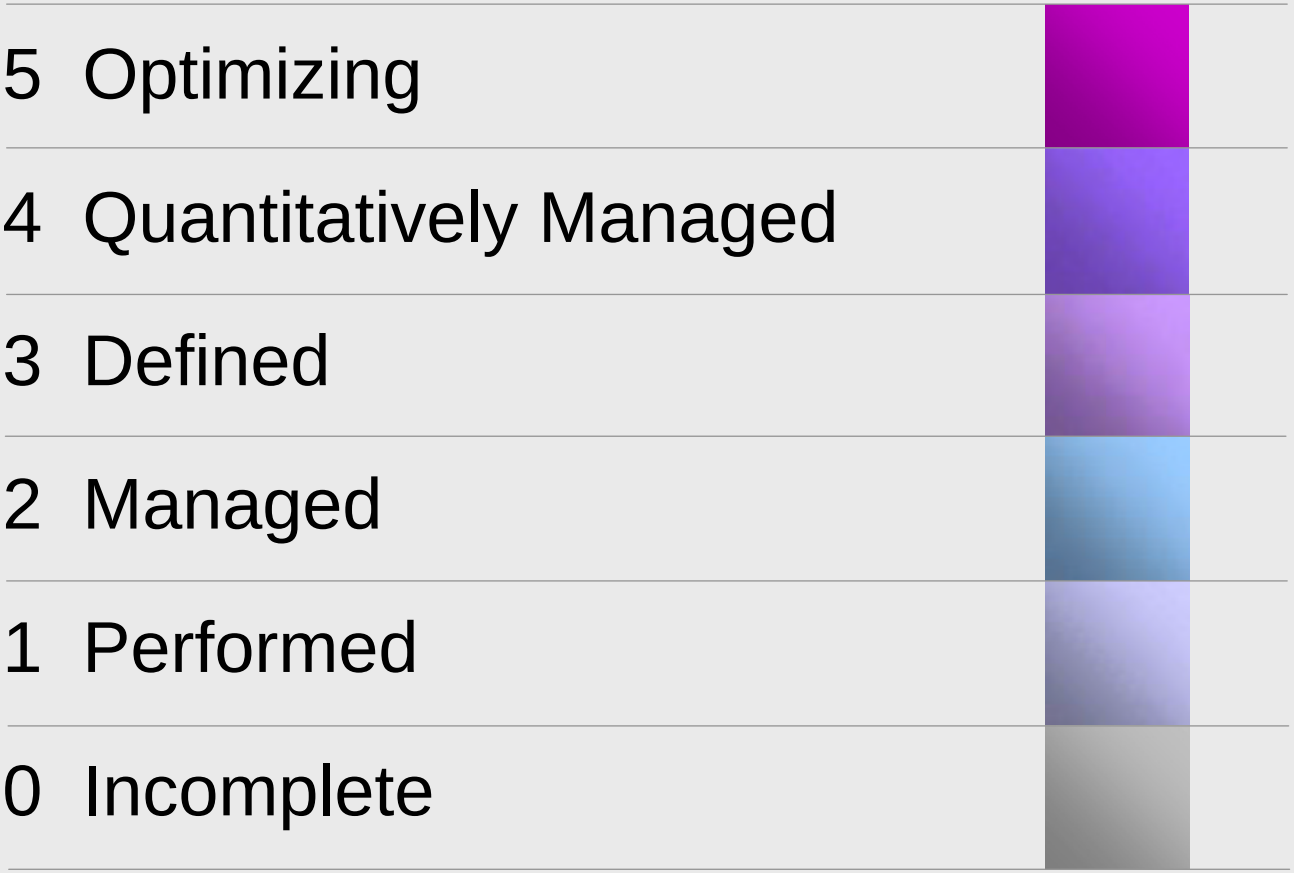
CMMI Overview

Level	Process Characteristics	Process Areas
5 Optimizing	Focus is on quantitative continuous process improvement	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	Process is measured and controlled	Quantitative Project Management Organizational Process Performance
3 Defined	Process is characterized for the organization and is proactive	Requirements Development Technical Solution Product Integration Verification Validation Decision Analysis & Resolution Organizational Process Focus Organization Process Definition Organizational Training Integrated Project Management Risk Management
2 Managed	Process is characterized for projects and is often reactive	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Product and Process Quality Assurance Configuration Management Measurement & Analysis
1 Initial	Process is unpredictable, poorly controlled, and reactive	

Capability Levels



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Supplier Capability Evaluation

- Capability Level 0 deals with Incomplete processes
- An incomplete process is a process that is either not performed or only performed partially
  - One or more ***Specific Goals*** of the process are not performed
- Capability Level 1 deals with Performed processes
- **A performed process is a process that accomplishes the work necessary to produce work products**

Supplier Capability Evaluation - 2

- Capability Level 2 deals with Managed processes
- A managed process is a performed (capability level 1) process that has the basic infrastructure in place to support the process with the following characteristics:
  - It is planned and executed in accordance with policy
  - Employs skilled people who have adequate resources to produce controlled outputs
  - Involves relevant stakeholders
  - Is monitored, controlled, and reviewed
  - Is evaluated for adherence to its process description

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Supplier Capability Evaluation - 3

- GP 2.1 Establish an Organizational Policy
- GP 2.2 Plan the Process
- GP 2.3 Provide Resources
- GP 2.4 Assign Responsibility
- GP 2.5 Train People
- GP 2.6 Manage Configurations
- GP 2.7 Identify and Involve Relevant Stakeholders
- GP 2.8 - Monitor and Control the Process
- GP 2.9 - Objectively Evaluate Adherence
- GP 2.10 Review Status with Higher-Level Management

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Supplier Capability Evaluation - 4

- GP 3.1 - Establish a Defined Process
- GP 3.2 Collect Improvement Information
- GP 4.1 Establish Quantitative Objectives for the Process
- GP 4.2 Stabilize Subprocess Performance
- GP 5.1 Ensure Process Improvement Objectives
- GP 5.2 Correct Root Causes of Problems

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Summary - Why Do You Need an ML5 Supplier?

- Deciding to use a supplier requires:
  - Understanding of the requirements to a low enough level
  - Developing the initial project planning
  - Defining the expectations, resources, and constraints for a project that will make use of one or more suppliers
  - Determining the relationship the Buyer wants with the Supplier
  - Developing the Statement of Work
  - Developing the RFP
  - Establishing the Evaluation Criteria

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Summary - Why Do You Need an ML5 Supplier? - 2

- Evaluating the supplier's organizational process capability against the requirements and constraints
- Evaluating the supplier's quality and configuration management process capability
- Evaluating the supplier's management and engineering capability for the desired tasks
- Validating the supplier's past project performance on projects of similar size, complexity, functionality, cost, schedule, quality, risk, and customer satisfaction

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Thank You

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CMMI Based Risk Management: Managing the Risk Attributed to Supplier Processes

Presented By:

Gary Sigmund, Program Integrator
Defense Contract Management Agency
Naval Sea Systems Operations

CMMI Technology Conference an User Group

15 November 2006

CMMI Based Risk Management

Presentation Goals & Objectives

- **Defense Contract Management Agency (DCMA) surveillance activities can be effectively planned and implemented within the context of :**
  - **the CMMI**
  - **the contractor's process capability and improvement strategy**
- **DCMA surveillance can be used to identify the Risks which can be attributed to process; and monitor the effectiveness of contractor Risk Handling methods**

Topics to be Discussed

The DCMA Risk Management and Surveillance Requirements
- o DOD 5000.2R
- o Risk Management Guide for DOD Acquisition - 6th Edition v1.0 August 2006
- o Federal Acquisition Regulations

The application of CMMI to DCMA Surveillance Activities
- o Monitoring of Supplier Risk Management Program
- o Contractor Process Improvement
- o Award Fee Decisions
- o Pre-Award Surveys

The DCMA CMMI Based Surveillance Framework

The transformation of CMMI Based Surveillance Data into customer desired Information

"Process" - A critical contributor to program risk

"To manage risk, the PMOs should focus on the critical areas that could affect the outcome of their programs. Work Breakdown Structure (WBS) product and** process **elements and engineering an manufacturing** processes **contain <u>most</u> of the significant risk events."

"Critical risk** processes **are the developer's engineering and production** processes **which historically have caused the most difficulty during the development and/or production phases of acquisition programs."

"These** processes **include, but are not limited to, design, test, production facilities, logistics and management."

Risk Management Guide for DOD Acquisition 6th Edition, v1.0 August 2006

<u>The components of the CMMI offer the ideal suite of best practices to assist DCMA with in-plant surveillance and risk monitoring.</u>

Two conflicting perspectives on Acquisition Risk

Government Risk: ***the probability/likelihood of acquiring a fully functional system on time, at the right price, with reasonable supportability and maintenance costs downstream.***

Contractor Risk: ***involves the inherent chance of making a profit or incurring a loss and acquiring future business.***

The Government PM and the Contractor may consequently have different views on specific Cost, Schedule, and Performance Risk levels ***and the amount of process which is necessary***

Risk Management and the CMMI

Why should DCMA align the CMMI to DOD's Supplier Risk Management and Surveillance Mission?

***DOD Agency Requirements**:*
DCMA is the DOD component which performs Contract Administration Services in-plant;
DCMA is required by Federal Law to administer contracts and perform Surveillance to assist the Government acquire systems which are developed, produced and managed from Contractor processes

***Contract Process Requirements**:*
The contactor processes are key contributors to the risk of acquiring a System

Contractor Process and Improvement Initiatives:
The Contractor typically is modeling their processes and improvement Efforts to the CMMI architecture

CMMI Based Risk Management

What are the investment returns?

Program-Process Risk Information to be used by DCMA, Contractor, and PMs

DOD POLICIES

FAR

MOA

CMMI based Risk Management

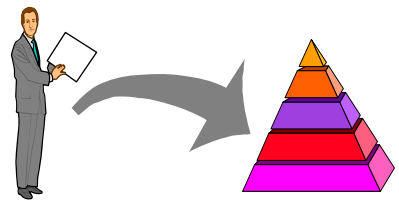
Process Capability & Performance Indicators for Award Fee Determination

Real-Time Contractor Process Improvement

CMMI Based Risk Management

What it is:

- **A framework for using the CMMI to perform Supplier Risk Management while performing surveillance required by the FAR.**
- **A tool for exposing and handling the acquisition risk which can be attributed to contractor processes.**
- **A 5 Step Method to capture surveillance results, which are organized and analyzed by the components of the CMMI**
- **A framework for linking and coordinating:**
  - Surveillance required by the FAR
  - DOD Risk Management Policy and Guidance in a Post Award Environment
  - DCMA Process Reviews, Product Examinations, and Corrective Actions within the context of the CMMI
  - DCMA activities within contractor's process improvement strategies



Why it's CMMI Based:

- **Defacto Standard and Common Language for Government & Industry**
- **Provides a suite of known "Best Practices" to focus surveillance efforts**

When it's applied:

- **Used Daily**

CMMI Process Areas Mapping to the FAR

Mapping the CMMI Process Areas to the DCMA Contract Administration Service surveillance requirements mandated by the FAR

FAR Subpart 42.3—Contract Administration Office Functions

42.302 Contract administration functions.
(a) The contracting officer normally delegates the following contract
Aministration functions to a CAO:

(40) Perform engineering surveillance to assess compliance with contractual terms for schedule, cost, and technical performance in the areas of design, development, and production. *PP, PMC, RD, RM, TS, PI, VER, VAL, IPM, RM, CM, PPQA, M&A, SAM*

CMMI Process Areas Mapping to the FAR

Mapping the CMMI Process Areas to the DCMA Contract Administration Service surveillance requirements mandated by the FAR

FAR Subpart 42.3—Contract Administration Office Functions

42.302 Contract administration functions.

(a) The contracting officer normally delegates the following contract Aministration functions to a CAO:

(38) Ensure contractor compliance with contractual quality assurance requirements. *PPQA*

CMMI Process Areas Mapping to the FAR

Mapping the CMMI Process Areas to the DCMA Contract Administration Service surveillance requirements mandated by the FAR

FAR Subpart 42.3—Contract Administration Office Functions

42.302 Contract administration functions.
(a) The contracting officer normally delegates the following contract Aministration functions to a CAO:

(41) Evaluate for adequacy and perform surveillance of contractor engineering efforts and management systems that relate to design, development, production, engineering changes, subcontractors, tests, management of engineering resources, reliability and maintainability, data control systems, configuration management, and independent research and development. PP, PMC,SAM, IPM, RSKM, REQM, RD, RM, TS, PI, VER, VAL

CMMI Based Risk Management

What are the Advantages of Using CMMI?

- **Validates Government expectations of Contractor to achieve/maintain appropriate levels of process capability and performance**
- **DCMA is on-site Govt. Rep – Utilizing knowledge and past experience with day-to-day process and product performance.**
- **DCMA surveillance is a continuous assessment of process performance - data always current – differs from snap-shot appraisal methods**

CMMI - Based Risk Management Framework

Step 1 Plan & Prioritize Surveillance

PAST PERFORMANCE
IMS, CRITICAL PATH
SOW, MOA
CUSTOMER OUTCOMES

CRITICAL PROCESS AREA	PRIORITY
PA - X	3
PA - Y	1
PA - Z	2

Step 2 Implement Surveillance

Process Reviews
Product Examinations
Data Collection
Corrective Actions

Step 3 Record, Classify, and Categorize Surveillance Results

STRENGTHS
WEAKNESSES
or
DEFECTS

DCMA SURVEILLANCE PRIORITY	PROGRAM RISKS	Critical Process Area	Process & Product Health Indicator
2	M	PA - X	
3	L	PA - Y	
1	H	PA - Z	

Step 4
Analyze & Map Surveillance Results

DCMA REPORT
[-In terms of COST, SCHEDULE,TECHNICAL PERFORMANCE-]

Step 5
Report Surveillance and Make Recommendations

CMMI - Based Risk Management Framework

Step 2 **Implement Surveillance**

Process Reviews
Product Examinations
Data Collection
Corrective Actions

Transformation of Data onsite

DCMA CMMI Based Observations

DCMA Surveillance Notes gathered during: Process Reviews,
Product Examinations, Data Analysis,
Corrective Actions

DCMA Findings – Issues - Concerns

CMMI - Based Risk Management Framework

Step 2 **Implement Surveillance**

Process Reviews
Product Examinations
Data Collection
Corrective Actions

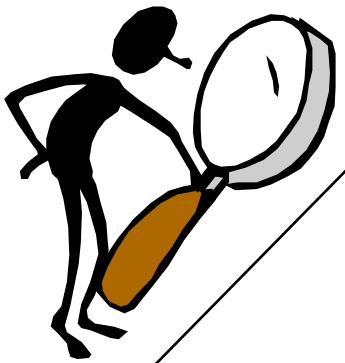
Surveillance Data Collection Technique –
Conversation & Discussion

CMMI based data is collected while attending meetings and through day to day discussions of process with the contractor

CMMI - Based Risk Management Framework

Step 2 **Implement Surveillance**

Process Reviews
Product Examinations
Data Collection
Corrective Actions



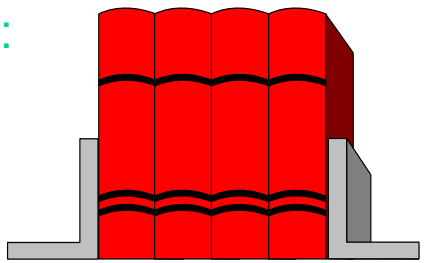
Surveillance Data Collection Technique –
Review of Documentation

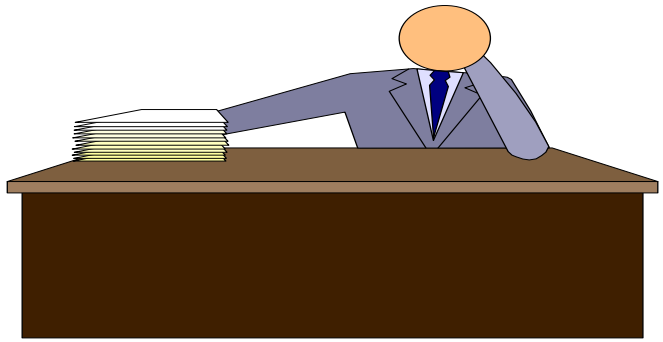
How is documentation used by KTR?

Define & Standardize process
Indicate a Commitment to Use a process
Provide evidence of process use
Collect data about process performance

Document Categories:

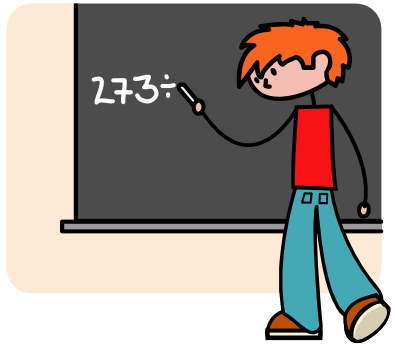
Organization Level
Project Level
Implementation Level





Translation of CMMI based Surveillance Data into Risk related Information

Findings – Issues – Concerns are Used to:



- *Identify* ***Strengths & Weaknesses to the customer and the supplier***
- *Adjust* ***surveillance activities to handle the risk by working with the supplier to improve processes***

CMMI - Based Risk Management Framework

Step 2 **Implement Surveillance**

Process Reviews
Product Examinations
Data Collection
Corrective Actions

Transformation of Data onsite

DCMA CMMI Based Observations

DCMA Surveillance Notes gathered during: Process Reviews,
Product Examinations, Data Analysis,
Corrective Actions

DCMA Findings – Issues - Concerns

CMMI - Based Risk Management Framework

Record, Classify, and Categorize Surveillance Results — **Step 3**

STRENGTHS
WEAKNESSES
or
DEFECTS

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

VE SG.2 Perform Peer Reviews

- **SDFs of TYZ_acad, and TYT_acad do not contain peer review records as required by project SSPM**
- **SQA and Project manager inputs to cost proposal did not include hours for SQA activities and /or Engineering activity to support peer reviews of design objects on three CSCIs.**

CMMI - Based Risk Management Framework

Record, Classify, and Categorize Surveillance Results — **Step 3**

STRENGTHS
WEAKNESSES
or
DEFECTS

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

VE SG.2 Perform Peer Reviews

- **Design reviews are not being held on the fgU-PN4 program**
- **Software Development Plan, IMS, and Software Development Files do not reflect the planning for reviews of fgU-PN4 design objects**
- **DCMA review of SDFs reflect the absence of design review records as prescribed by XYZ's mandated process IDR_006A.**

CMMI - Based Risk Management Framework

Record, Classify, and Categorize Surveillance Results — **Step 3**

STRENGTHS
WEAKNESSES
or
DEFECTS

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

VERIFICATION (VER)

- ***Defects are not being identified on three CSCIs within the Audio Conference Upgrade Project (VE SG 3)***
- ***Peer Reviews of Design Objects are not planned for three software configuration items on the Audio Conference Upgrade Project. (VE SG 2)***

CMMI - Based Risk Management Framework

Step 4

Analyze & Map Surveillance Results

Analysis Step 1 ***summarize CMMI based Observations into Finding statements within each Process Area when applicable***

Analysis Step 2 **generate a Risk related Issue or Concern which would be sent to the Customer and also warrant a DCMA action to handle the risk.**

Analysis Step 3 **generate** *Consequence / Impact Statements*

Analysis Step 4 **generate a DCMA** *Risk Monitoring Strategy*

CMMI - Based Risk Management Framework

Step 5
Report Surveillance and Make Recommendations

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

DCMA Monthly Report to Customer

Issue/Concern: ***XYZ Corporation's failure to conduct design peer reviews on three CSCI development efforts may result in defects going undetected until the test phase.***

Consequences / Impact:

The test effort will likely be extended.

An increase in development cost and a slippage in schedule should be expected if the developers are to rework and retest the fixes associated with the defects uncovered in the test phases.

CMMI - Based Risk Management Framework

Step 5
Report Surveillance and Make Recommendations

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

DCMA Monthly Report to Customer

Finding/Issue/Concern: ***XYZ Corporation's failure to conduct design peer reviews on three CSCI development efforts may result in defects going undetected until the test phase.***

Consequences / Impact:

The test effort will likely be extended.

An increase in development cost and a slippage in schedule should be expected if the developers are to rework and retest the fixes associated with the defects uncovered in the test phases.

CMMI - Based Risk Management Framework

Step 5
Report Surveillance and Make Recommendations

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

DCMA Monthly Report to Customer

DCMA Risk Handling and Monitoring Plan for next 30 days

- **Increase independent DCMA inspection of design products using contractor defined standards and conventions and/or tool set**
- **Increase activity in planning efforts of follow-on efforts to ensure proposals include estimates for design peer reviews**
- **Work with contractor SEPG to ensure absence of design peer reviews are reported by contractor's SQA oversight function**

CMMI - Based Risk Management Framework

DCMA
Defense Contract Management Agency

Step 1 Plan & Prioritize Surveillance

PAST PERFORMANCE
IMS, CRITICAL PATH
SOW, MOA
CUSTOMER OUTCOMES

CRITICAL PROCESS AREA	PRIORITY
PA - X	3
PA - Y	1
PA - Z	2

Step 2 Implement Surveillance

Process Reviews
Product
Examinations
Data Collection
Corrective Actions

STRENGTHS
WEAKNESSES
or
DEFECTS

Step 3 Record, Classify, and Categorize Surveillance Results

DCMA SURVEILLANCE PRIORITY	PROGRAM RISKS	Critical Process Area	Process & Product Health Indicator
2	M	PA - X	
3	L	PA - Y	
1	H	PA - Z	

Step 4
Analyze & Map Surveillance Results

DCMA REPORT
[-In terms of COST, SCHEDULE,TECHNICAL PERFORMANCE-]

Step 5
Report Surveillance and Make Recommendations

CMMI - Based Risk Management Framework

Record, Classify, and Categorize Surveillance Results — **Step 3**

STRENGTHS
WEAKNESSES
or
DEFECTS

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

CM SG.3 Establish Integrity; SG.2 Track and Control Changes: SG.1 Establish Baselines

- **Audio Conference Enhancement Project SCM Plan was prepared during the proposal and updated 30 days after contract award --plan continues to be dynamic while under control of SCCB**
- **SCCB Software/Documentation Change Requests identified in audit of the S/DCR database reflect activity against SCM Plan**
- **Review of the SCM Plan's revision history against S/DCRs reflect routine use and control of management plan**

CMMI - Based Risk Management Framework

Record, Classify, and Categorize Surveillance Results — **Step 3**

STRENGTHS
WEAKNESSES
or
DEFECTS

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

CM SG.3 Establish Integrity; SG.2 Track and Control Changes: SG.1 Establish Baselines

- Audio Conference Enhancement Project SCM Plan Appendix IV includes a detailed list of software work products to be placed under formal configuration control;

- list includes components of software development and support environment

CMMI - Based Risk Management Framework

Record, Classify, and Categorize Surveillance Results — **Step 3**

STRENGTHS
WEAKNESSES
or
DEFECTS

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

Project Planning (PP) SG.3 Develop a Project Plan

- **Audio Conference Enhancement Project SCM Plan Appendix IV includes a detailed list of software work products to be placed under formal configuration control (PP SP2.3);**
- **List includes components of software development and support environment (PP SP2.3, CM SP1.1)**

CMMI - Based Risk Management Framework

Record, Classify, and Categorize Surveillance Results — **Step 3**

STRENGTHS
WEAKNESSES
or
DEFECTS

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

CM SG.3 Establish Integrity; SG.2 Track and Control Changes: SG.1 Establish Baselines

-Customer approved changes initiated within Requirements Traceability Management (RTM) tool are directly linked to change control function of development documentation CM SP1.3-1, SP1.2-1; REQM SP1.3-1

-Impact of change requests on development/test documentation and code is readily identified in computer generated reports CM SP1.2-1

CMMI - Based Risk Management Framework

Record, Classify, and Categorize Surveillance Results — **Step 3**

STRENGTHS
WEAKNESSES
or
DEFECTS

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

CONFIGURATION MANAGEMENT (CM)

- ***Audio Conference Upgrade Project planning activities include strong emphasis on the establishment of and compliance with a Software Configuration Management Plan (PP SP2.3);***
- ***Management controls ensure regular use of activities outlined in the plan and the accuracy of the plan itself (PMC SP1.4)***

CMMI - Based Risk Management Framework

Step 4

Analyze & Map Surveillance Results

Analysis Step 1 **summarize CMMI based *O*bservations** *into Finding* **statements within each Process Area when applicable**

Analysis Step 2 **generate a Risk related** Finding**,** Issue **or** Concern **which would be sent to the Customer and also warrant a DCMA action to handle the risk.**

Analysis Step 3 **generate** *Consequence / Impact Statements*

Analysis Step 4 **generate a DCMA** *Risk Monitoring Strategy*

CMMI - Based Risk Management Framework

Step 4

Analyze & Map Surveillance Results

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

CONFIGURATION MANAGEMENT (CM)

- ***Audio Conference Upgrade Project SCM function provides routine access and rigorous identification and control over software work products throughout development life cycle***

CMMI - Based Risk Management Framework

Step 5
Report Surveillance and Make Recommendations

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

DCMA Monthly Report to Customer

Finding/Issues/Concern: ***XYZ Corporation's strong emphasis into the identification, status, and change control over work product configurations will likely enhance the customer/user's ability to maintain integrity and traceability of system configuration throughout system life cycle.***

CMMI - Based Risk Management Framework

Step 5
Report Surveillance and Make Recommendations

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

DCMA Monthly Report to Customer

Consequences / Impact:
Inconsistencies among work products caused by inadvertent or unauthorized changes will likely be uncovered and corrected throughout development life cycle.

Increased visibility into product functionality and development progress will likely occur.

The likelihood of cost overruns or schedule slippages occurring as a result of inconsistencies among work products should be reduced.

CMMI - Based Risk Management Framework

Step 5
Report Surveillance and Make Recommendations

DCMA Data Sources: Proposal Evaluations, Process Reviews, Product Examinations, Corrective Action Requests

DCMA Monthly Report to Customer

DCMA Risk Handling and Monitoring Plan for next 30 days

Reduce DCM independent auditing/oversight of project SCM function. Establish periodic spot-check validation of SQA audit function of SCM activity.

Work with contractor SEPG and SQA to identify other opportunities for process improvement requiring DCM and contractor SQA insight.

CMMI - Based Risk Management Framework

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SCAMPI[SM] Version 1.2 Updates

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Purpose

The purpose of this talk is to describe the major changes to the SCAMPI A appraisal method for v1.2.

Revision Process

The CMMI Steering Group provided a long-term strategy and the upgrade criteria for v1.2.

The SCAMPI Upgrade Team (SUT) reviewed change requests to identify possible changes for the v1.2 appraisal method documents: Appraisal Requirements for CMMI (ARC) and Method Definition Document (MDD).

The CMMI Steering Group served as the configuration control board for v1.2 changes to the ARC and MDD.

The SUT developed a draft of the ARC and MDD for review by lead appraisers in May 2006.

The ARC and MDD were released as part of the v1.2 CMMI Product Suite.

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SCAMPI Upgrade Team Members

Mary Busby	Lockheed Martin (Co-chair)
Jack Ferguson	SEI (Co-chair)
Sandra Cepeda	RD&E Command, Software Engineering Directorate
Will Hayes	SEI
James Heil	U.S. Army (In Memoriam)
Denise Kirkham	Boeing
Steve Masters	SEI
Lisa Ming	BAE Systems
Charlie Ryan	SEI
Beth Sumpter	National Security Agency
Ron Ulrich	Northrop Grumman
Joe Wickless	SEI

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SCAMPI A V1.2 Major Themes

Reduce complexity and ambiguity

Provide additional guidance where needed

Strengthen appraisal planning and conduct

Strengthen appraisal reporting

Define appraisal validity period

Strengthen lead appraiser requirements

Reduce Complexity[1]

The requirement for instruments (e.g., questionnaires) was removed.

Only two types of objective evidence are now required:

- documents
- interviews

The following sections in MDD were revised:

- switched 2.2 Verify and Validate Objective Evidence and 2.3 Document Objective Evidence so that the order of tasks reflects the natural order of conducting an appraisal
- separated Verify Objective Evidence and Validate Preliminary Findings to better describe each process

Reduce Complexity²

The use of the term instantiation was changed:

- Instantiation is now defined as “the implementation of a model practice used in the appropriate context within the boundaries of an organizational unit.”
- The word “instantiation” for project and organizational-wide entities was replaced with “project” or “support group.”

Reduce Ambiguity

The rating Not Rated was clarified:

- Process areas outside of the model scope are rated as Out of Scope. For example, for a maturity level 3 appraisal, maturity level 4 and 5 process areas are rated as Out of Scope.
- For process areas that have insufficient data to be rated, the rating is Not Rated.
- Process areas in the model scope, but outside the organizational scope are rated as Not Applicable. The only CMMI-DEV process area that can be Not Applicable is SAM (as determined by the appraisal team).

The practice characterization tables were revised:

- clarified the use of virtual versus live interviews
- changed “face-to-face interviews” to “oral interviews”

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Provide Additional Guidance

Guidance for readiness reviews was revised to include team and logistical readiness.

Additional guidance was provided for using virtual methods (e.g., for interviews and briefings).

Additional guidance was provided for using alternative practices (Appendix C: Alternative Practice Identification and Characterization Guidance).

Strengthen Appraisal Planning and Conduct

Organizational unit sampling was revised to*

- strengthen parameters and limits for organizational sampling (e.g., identifying a minimum number of focus projects)
- include criteria for reporting sampling decisions

The Conduct Appraisal Phase must now be complete within 90 days.

Appraisal team members are now required to sign final findings.

*Changes to address sampling were extensive. Refer to the MDD for details.

Strengthen Appraisal Reporting

The Appraisal Disclosure Statement (ADS) now requires the following information.

Organizational sampling criteria and decisions (e.g., projects included, projects excluded, percentage of organization represented)

Basis for maturity/capability level 4 and 5 appraisal results
- subprocesses statistically managed
- mapping of these subprocesses to quality and process-performance objectives

Signatures of both the lead appraiser and sponsor
- The lead appraiser affirms that the appraisal scope is representative of the organizational unit.
- The sponsor affirms the accuracy of the ADS and authorizes the SEI to conduct any audits deemed necessary.

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Define Appraisal Validity Period

V1.2 appraisal results are valid for a maximum of 3 years from the date of the ADS.

V1.1 appraisals will expire on August 31, 2007 or 3 years after the date the appraisal was conducted, whichever is later.

Strengthen Lead Appraiser Requirements

Prior to conducting a v1.2 SCAMPI appraisal, the following must occur:

- Current candidate and authorized lead appraisers and team leaders must complete CMMI v1.2 Upgrade Training.
- Candidate and authorized lead appraisers must attend SCAMPI Face-to-Face Training.
- Those who want to conduct v1.2 SCAMPI level 4 or 5 appraisals must be certified. Certification requirements address the following:
  - education, training, and experience in level 4 and 5 concepts
  - completion of an oral exam

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Summary

The SCAMPI A appraisal method was revised based on change requests received to

- reduce complexity and ambiguity
- provide additional guidance where needed
- strengthen appraisal planning and conduct
- strengthen appraisal reporting
- define the appraisal validity period
- strengthen lead appraiser requirements

The changes are intended to make appraisals more accurate, reliable, and efficient.

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CMMI® Version 1.2 and Beyond

NDIA CMMI Technology Conference
November 13, 2006

Mike Phillips
Software Engineering Institute
Carnegie Mellon University

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Thanks to Gary Wolf and D'Ann Hunt from Raytheon, Denise Cattan of SPIRULA

CMMI Today

Selected CMMI® Data (FY06)

17,630 Trained in Introduction to CMMI

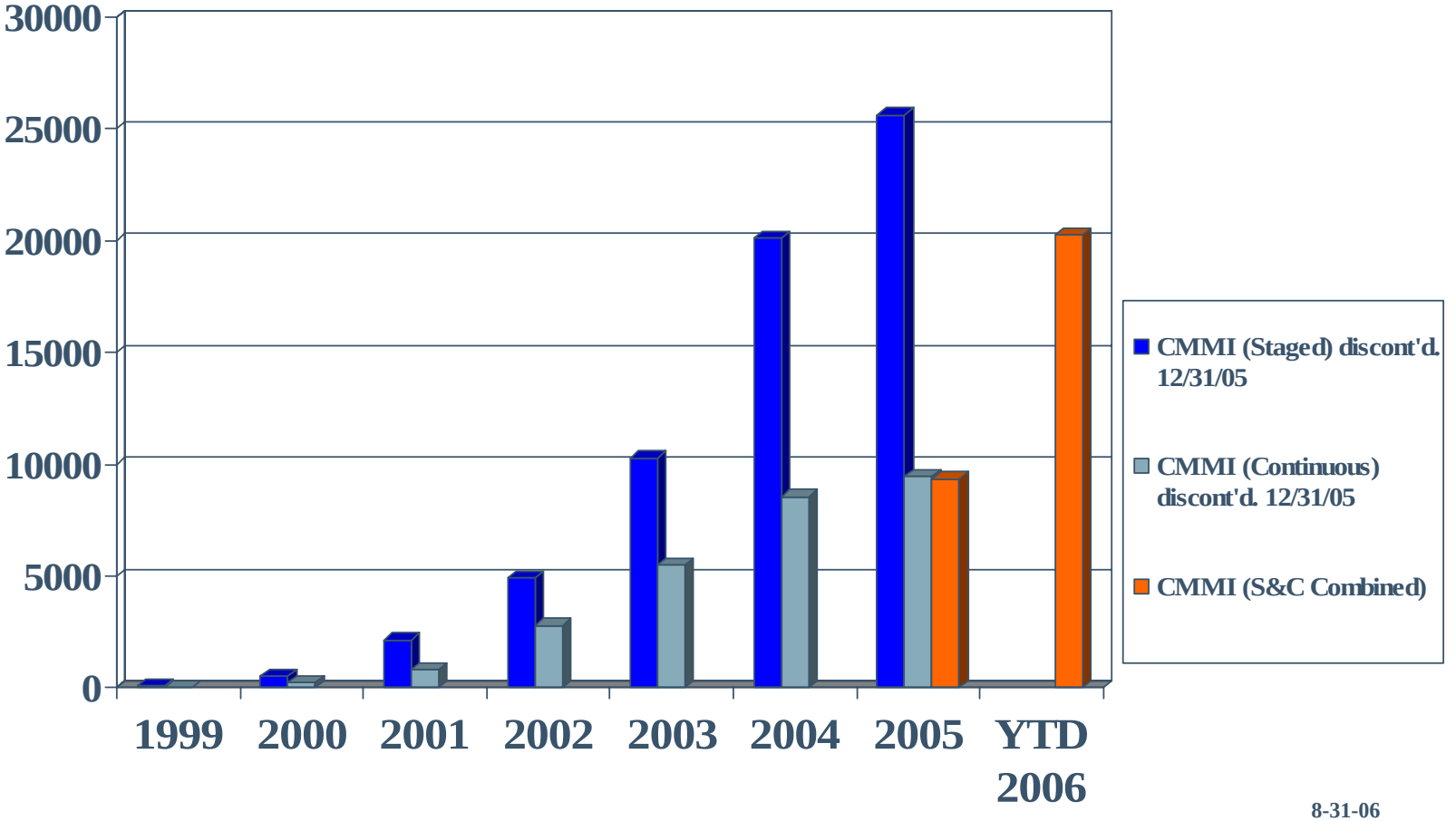
Net increase of:

- **-108 Authorized Introduction to CMMI Instructors**
- **45 Authorized SCAMPI Lead Appraisers**
- **84 Authorized SCAMPI B/C Team Leads**

744 SCAMPI V1.1 Class A Appraisals conducted and reported to the SEI

417 Publicly Reported SCAMPI V1.1 Class A Appraisals on the SEI Web Site

Number of CMMI Students Trained (Cumulative)



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Transition from V1.1 to V1.2 Status - 10-12-06

Introduction to CMMI Students
- Registered for Upgrade Training – 464
- Upgrades Complete – 190

Lead Appraisers and Instructors
- Registered for Upgrade Training – 561
- Upgrade Training Complete – 256
- Exams
  - Passed – 159
  - Failed (and not yet retaken) – 7

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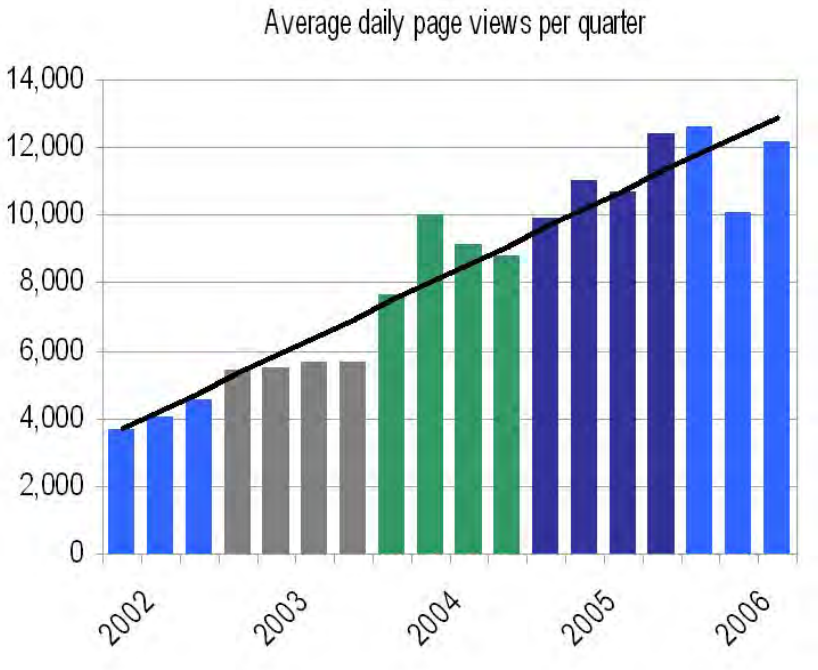
CMMI Adoption Trends

CMMI Web pages views in September 2006

- 360K/month
- Exceeded 24K/day

The following were the most downloaded files on the SEI Web site in September 2006:

- CMMI-DEV, V1.2 (PDF Version)
- CMMI V1.1 Overview Presentation
- CMMI V1.2 Overview Presentation
- CMMI-DEV, V1.2 (Word Version)
- CMMI V1.2 Model Changes Presentation



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CMMI Transition Status – 10/31/06

Training

- Introduction to CMMI – 58,178 trained
- Intermediate CMMI – 2,280 trained
- Introduction to CMMI Instructors – 449
- SCAMPI Lead Appraisers – 630 trained
- SCAMPI B&C-Only Team Lead -- 33

Authorized

- Introduction to CMMI V1.1 Instructors – 404
- SCAMPI V1.1 Lead Appraisers – 451
- SCAMPI B&C Team Leads -- 432

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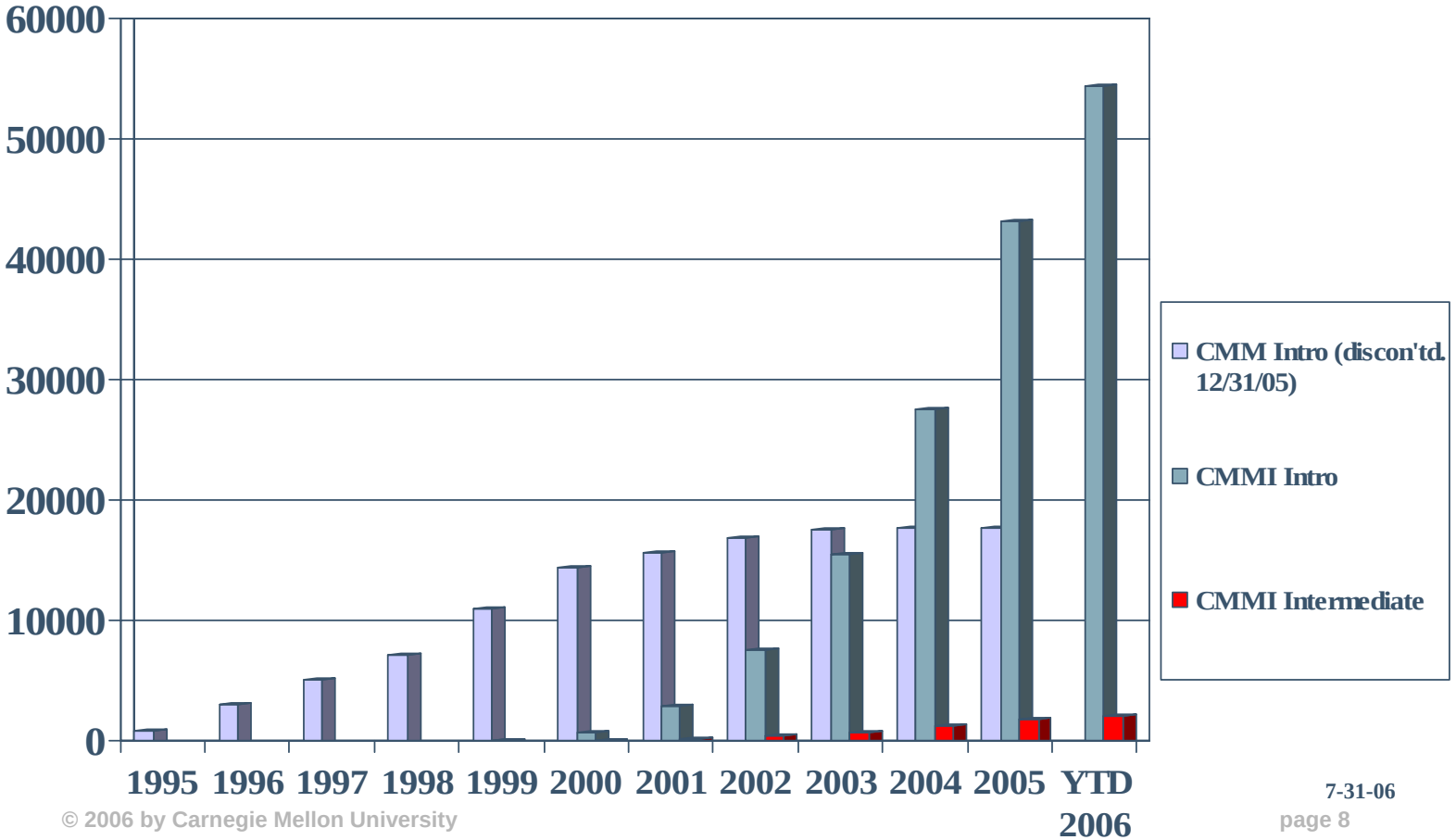
Intro to the CMM and CMMI Attendees (Cumulative)



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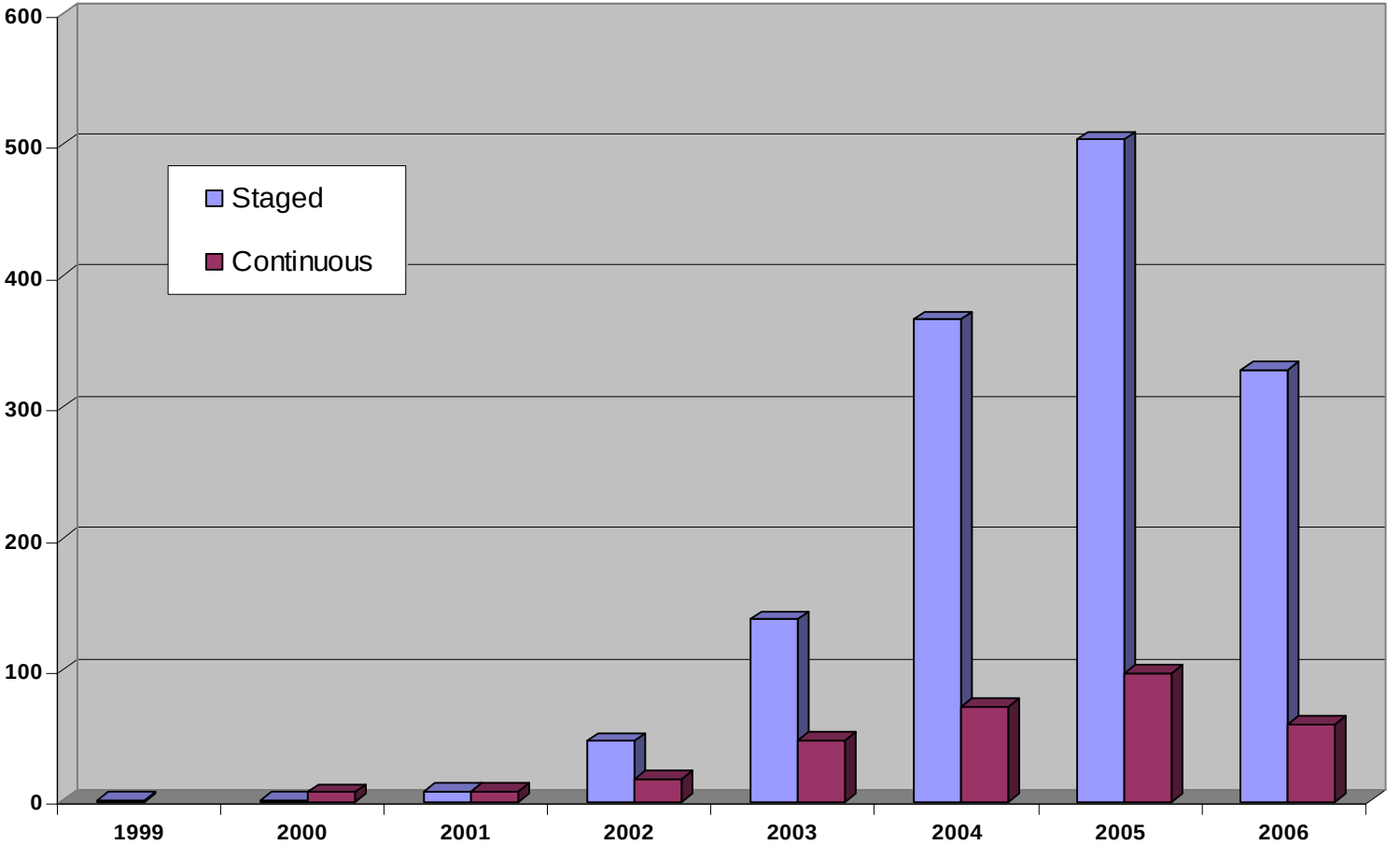
Number of SCAMPI vX Class A Appraisals Conducted by Year by Model Representation*
Reported as of 31 August 2006
*Where Representation is reported



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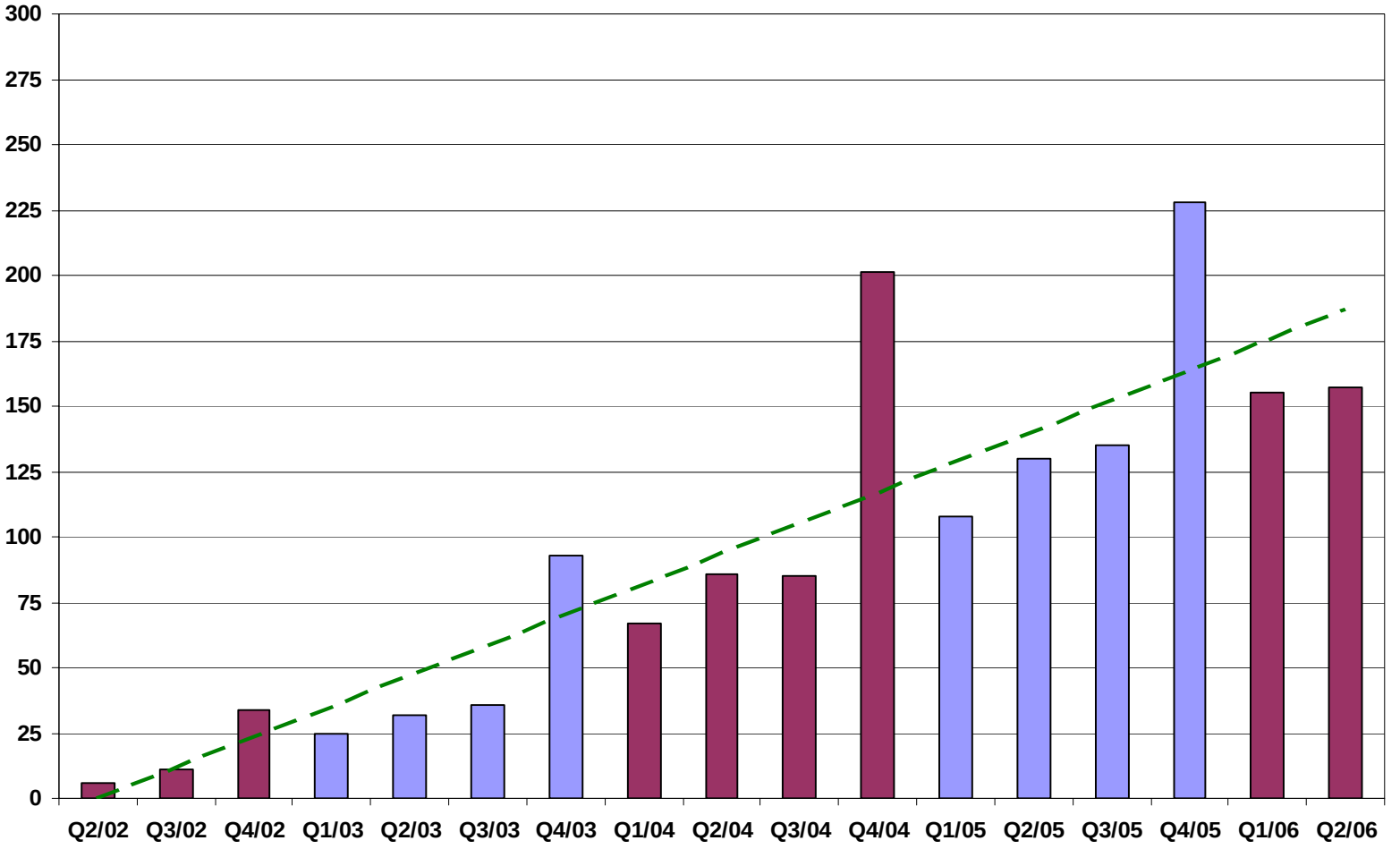
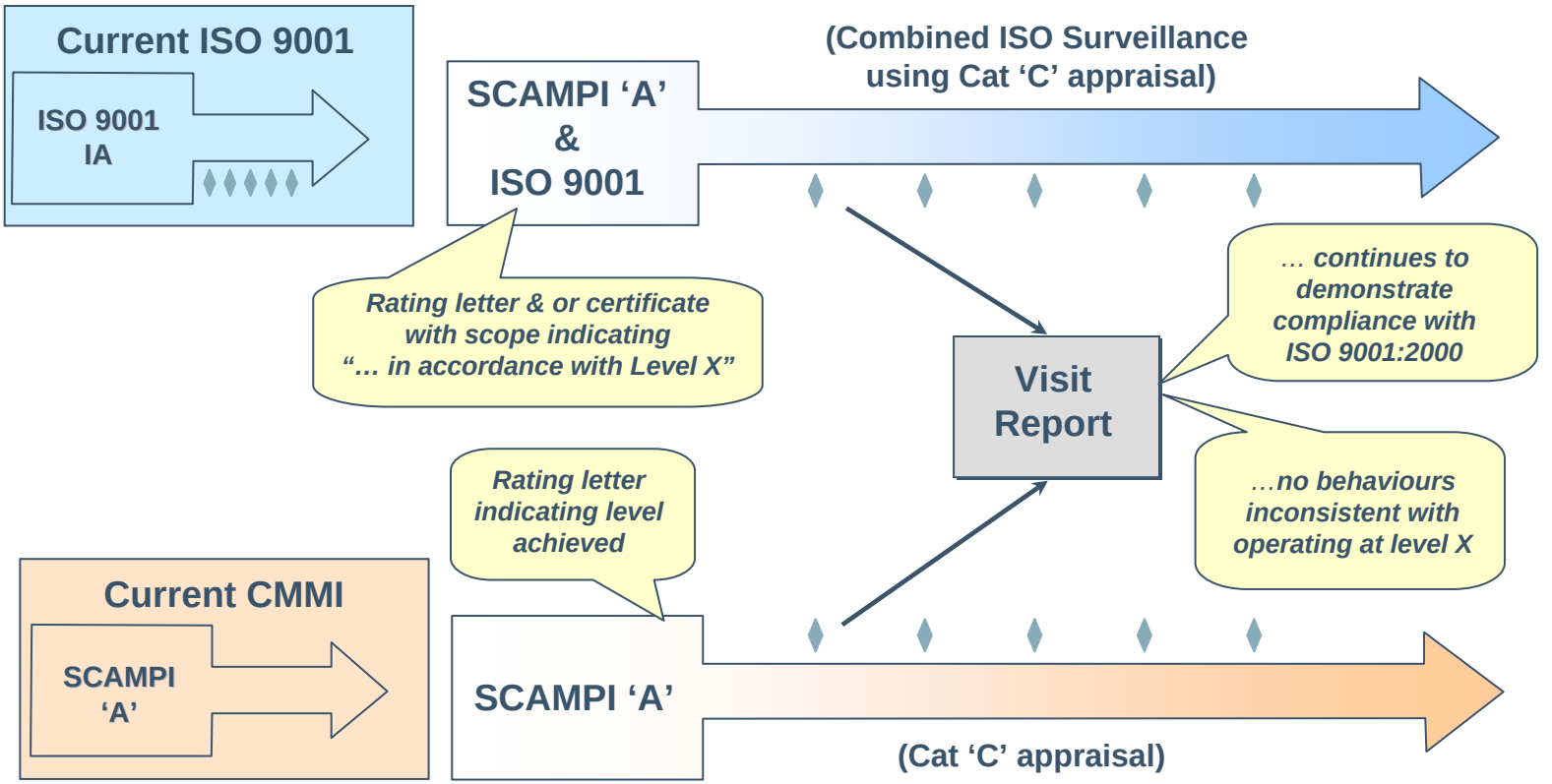
Number of SCAMPI v1.1 Class A Appraisals Conducted by Quarter
Reported as of 31 August 2006



Combined Appraisal Opportunities



The possible options for assessment and surveillance

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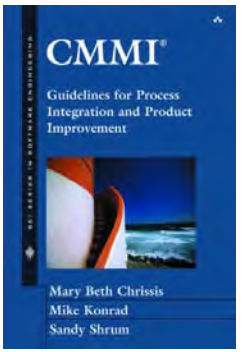
Adoption: What Else Is Happening?

The Addison-Wesley SEI Series Book and:



- A Guide to the CMMI
- CMMI: A Framework…
- CMMI Assessments
- CMMI Distilled: Second Edition
- CMMI SCAMPI Distilled
- CMMI: Un Itinéraire Fléché
- De kleine CMMI
- Interpreting the CMMI
- Making Process Improvement Work
- Practical Insight into CMMI
- Real Process Improvement Using the CMMI
- CMMI Survival Guide
- Systematic Process Improvement Using ISO 9001:2000 and CMMI
- Balancing Agility and Discipline

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How about SEI Publications?

Technical notes and special reports:

- Interpreting CMMI:
  - for Operational Organizations
  - for COTS Based Systems
  - for Service Organizations
  - for Marketing (in progress)
- Using CMMI with:
  - Earned Value Management
  - Product Line Practices
  - Six Sigma
- Supplementing CMMI for Safety Critical Development (in progress)
- Demonstrating the Impact and Benefits of CMMI (and web pages – www.sei.cmu.edu/cmmi/results)

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CMMI Today

Version 1.1 CMMI Product Suite was released January 2002.

- **CMMI Web site visits average over 12,000/day**
- **Over 58,000 people have been trained**
- **Almost 1600 “class A” appraisals have been reported to the SEI**

Now we want to continuously improve…

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CMMI V1.2…and Beyond

Major Themes

Reduce complexity & size

Increase coverage

Increase confidence in appraisal results

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Reduced Model Complexity & Size

Eliminated the concepts of advanced practices and common features

Incorporated ISM into SAM; eliminated Supplier Sourcing (SS) addition

Consolidated and simplified the IPPD material

All definitions consolidated in the glossary

Adopted a single book approach (i.e., will no longer provide separate development models)

Report size reduced 15% from either predecessor; PAs reduced 12%

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Supplier Agreement Management

Specific Goal	Specific Practice
Establish Supplier Agreements	**1.1 – Determine Acquisition Type** **1.2 – Select Suppliers** **1.3 – Establish Supplier Agreements**
Satisfy Supplier Agreements	**2.1 – Execute the Supplier Agreement** **2.2 – Monitor Selected Supplier Processes** **2.3 – Evaluate Selected Supplier Work Products** **2.4 – Accept the Acquired Product** **2.5 – Transition Products**

v1.1 SP2.1 “Review COTS Products,” was eliminated. “Identify candidate COTS products that satisfy requirements” is a new subpractice under the Technical Solutions Process Area SP1.1, “Develop Alternative Solutions and Selection Criteria.”

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Integrated Product and Process Development (IPPD) Changes

IPPD material is being revised significantly.

- Organization Environment for Integration PA removed and material moved to Organizational Process Definition (OPD) PA.
- Integrated Teaming PA removed and material moved to Integrated Project Management (IPM) PA.
- IPPD goals have been consolidated.
  - "Enable IPPD Management" in OPD
  - "Apply IPPD Principles" in IPM
- Overall material condensed and revised to be more consistent with other PAs.

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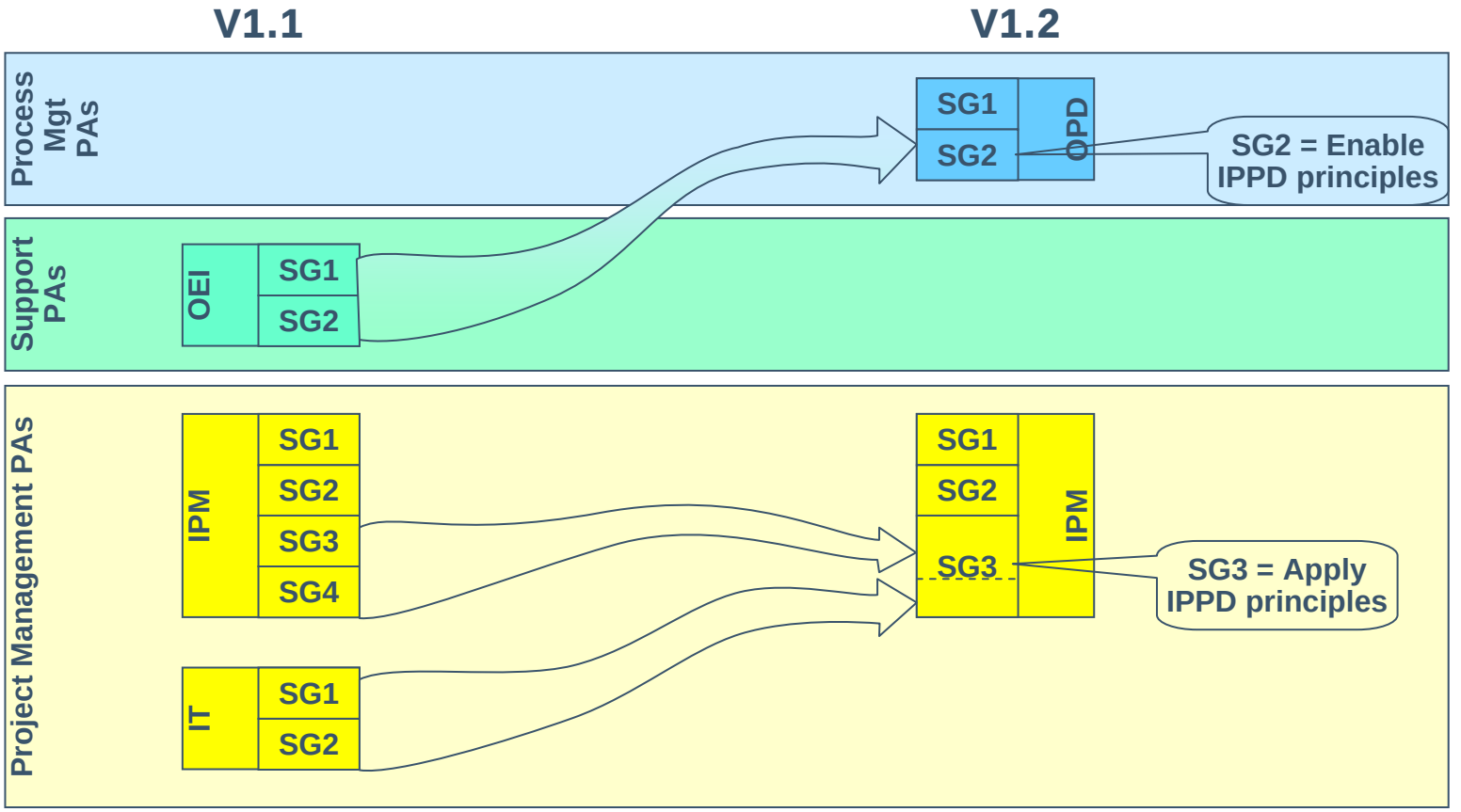
IPPD Changes



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Increased Model Coverage

Added hardware amplifications

Added two work environment practices (i.e., one in OPD and one in IPM)

Added goal and two practices in OPF to emphasize importance of project startup

Updated notes (including examples) where appropriate so that they also address service development and acquisition of critical elements

Updated name to CMMI for Development (CMMI-DEV) to reflect the expanded coverage

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Added Hardware Amplifications and Examples

Six hardware amplifications were created to add emphasis on hardware engineering. Here is an example from TS.

SP 2.1 Design the Product or Product Component

Develop a design for the product or product component.

For Hardware Engineering
Detailed design is focused on product development of electronic, mechanical, electro-optical, and other hardware products and their components. Electrical schematics and interconnection diagrams are developed, mechanical and optical assembly models are generated, and fabrication and assembly processes are developed.

Hardware examples were also added to emphasize hardware engineering.

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Added Work Environment Coverage

Work environment standards are established at the organizational level in OPD.

SP 1.6 Establish Work Environment Standards
Establish and maintain work environment standards.

The project's work environment is established at the project level in IPM.

SP 1.3 Establish the Project's Work Environment
Establish and maintain the project's work environment based on the organization's work environment standards.

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Organizational Process Focus

V1.1

SG1 – Determine Process Improvement Opportunities

1.1 – Establish Organizational Process Needs

1.2 – Appraise the Organization's Processes

1.3 – Identify the Organization's Process Improvements

SG2 – Plan and Implement Process Improvement Activities

2.1 – Establish Process Action Plans

2.2 – Implement Process Action Plans

2.3 – Deploy Organizational Process Assets

2.4 – Incorporate Process-Related Experiences into the Organizational Process Assets

V1.2

SG1 – Determine Process Improvement Opportunities

1.1 – Establish Organizational Process Needs

1.2 – Appraise the Organization's Processes

1.3 – Identify the Organization's Process Improvements

SG2 – Plan and Implement Process Improvement

2.1 – Establish Process Action Plans

2.2 – Implement Process Action Plans

New

SG3 – Deploy Organizational Process Assets and Incorporate Lessons Learned

3.1 – Deploy Organizational Process Assets

3.2 -- Deploy Standard Processes

3.3 -- Monitor Implementation

3.4 -- Incorporate Process Related Experiences into the Organizational Process Assets

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Model Changes - Other

Improved the Overview section (Part One)

Improved clarity of how GPs are used

- Moved generic goals and practices to Part Two
- Added explanation of how process areas support the implementation of GPs
- Added GP elaborations for GP 3.2

Improved the glossary (e.g., higher level management, bidirectional traceability, subprocess)

Limited the process areas that can be considered "not applicable" to SAM.

Clarified material throughout the model based on over 1000 change requests

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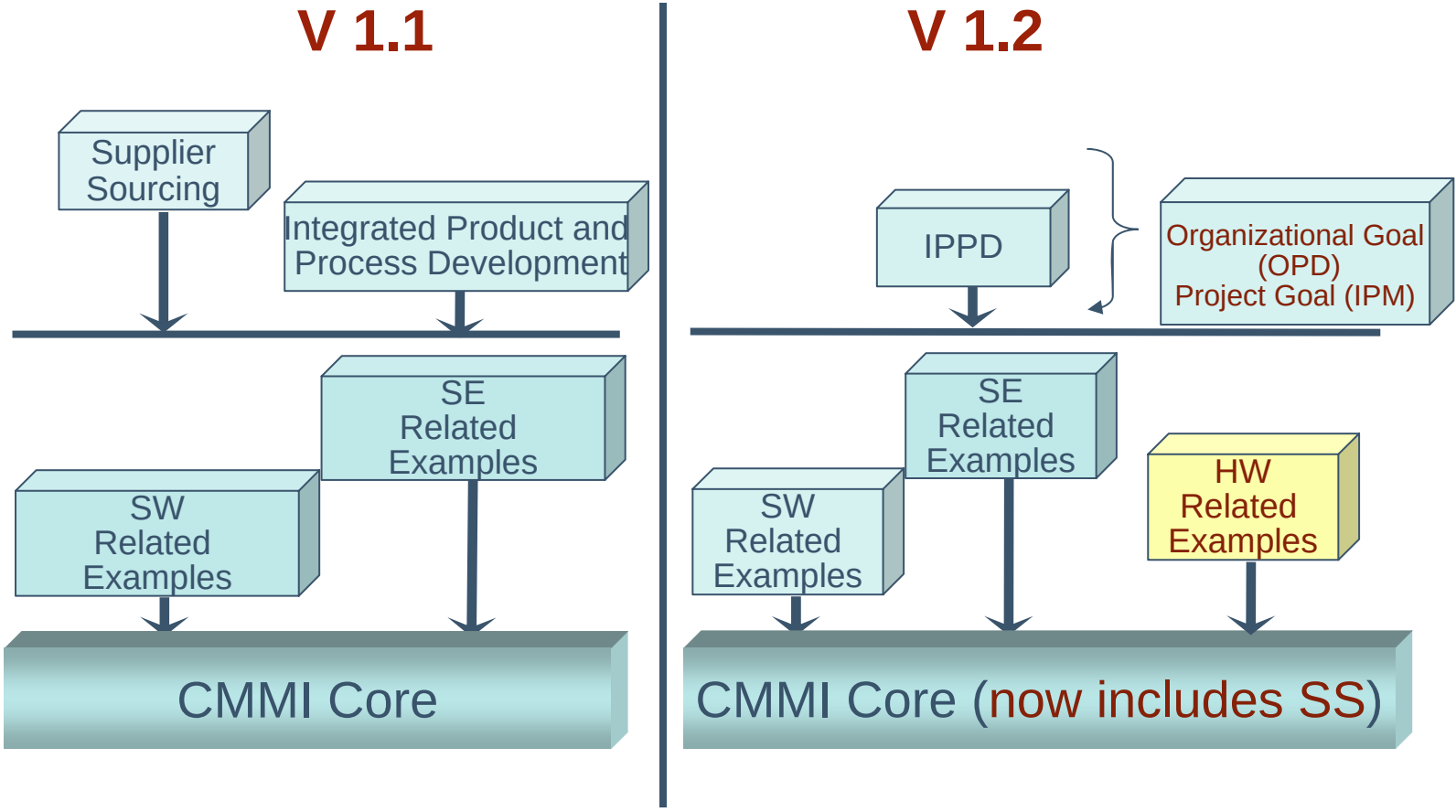
CMMI Model Combinations



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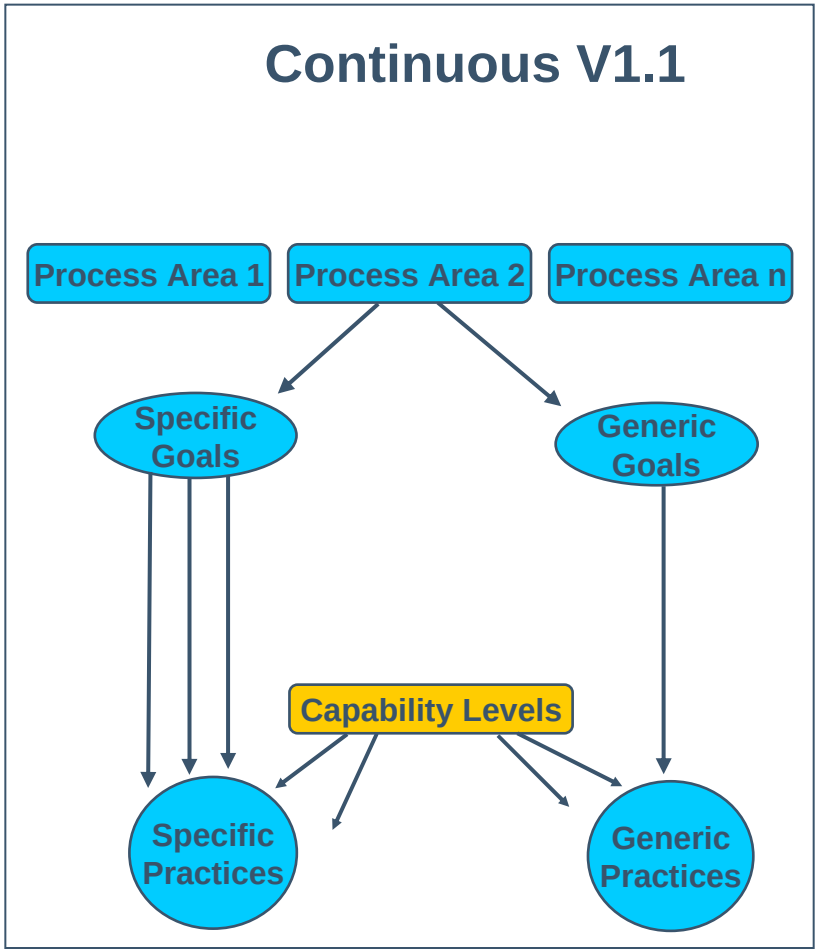
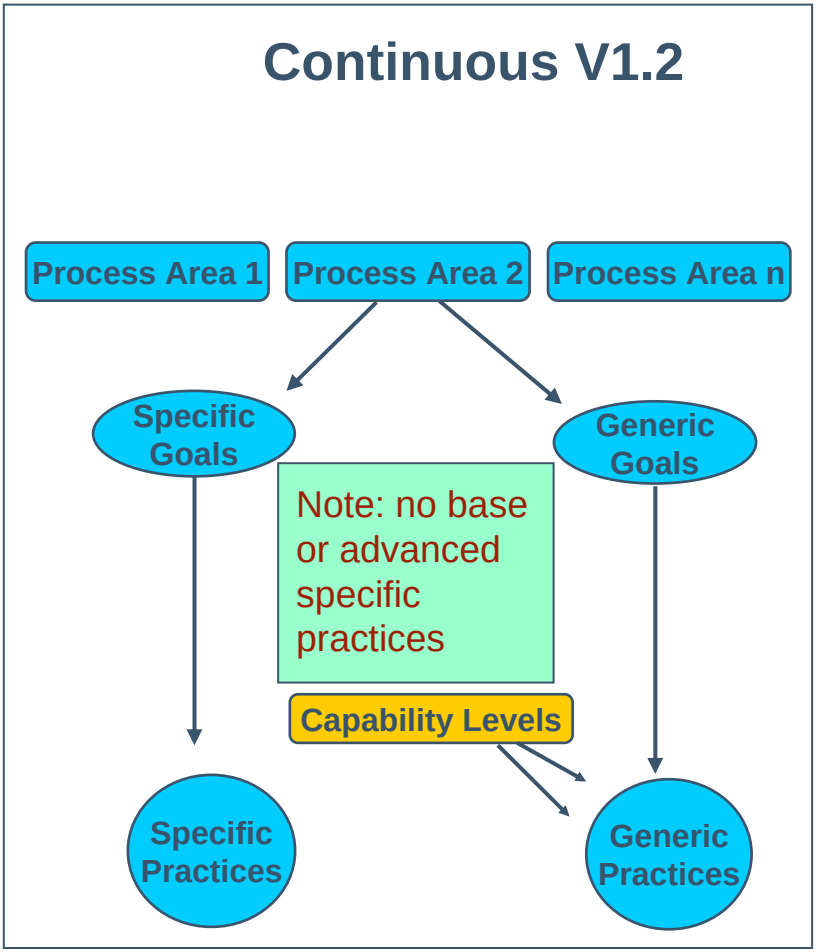
Model Structure[1]





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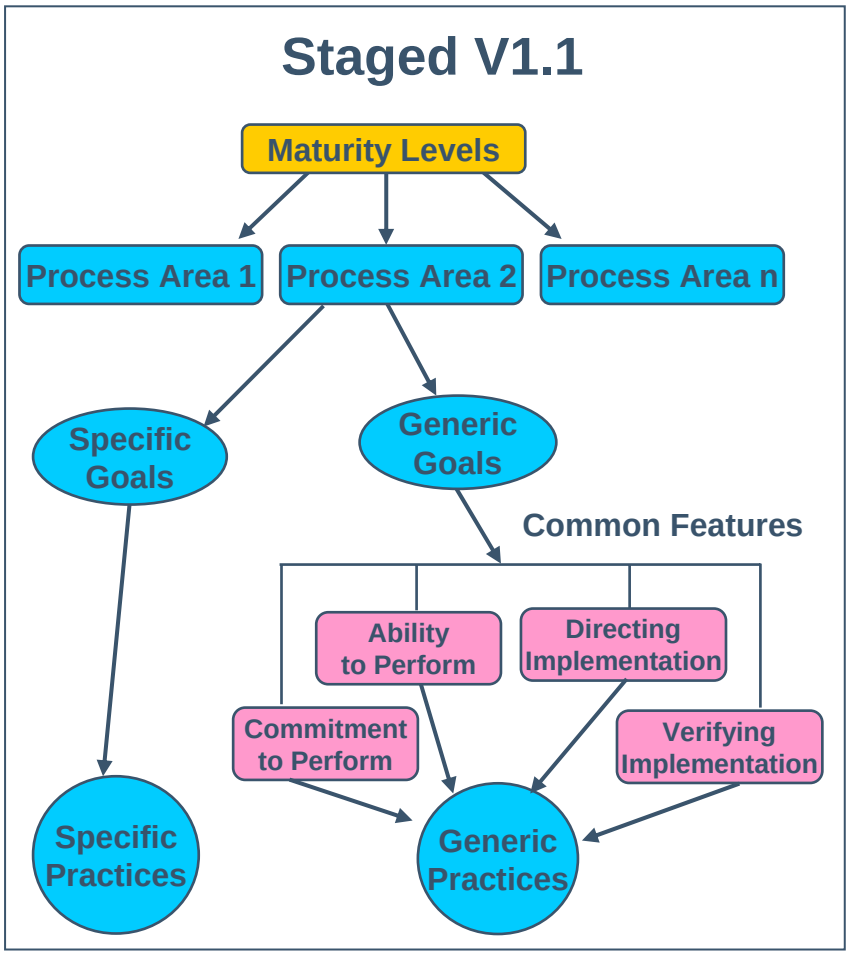
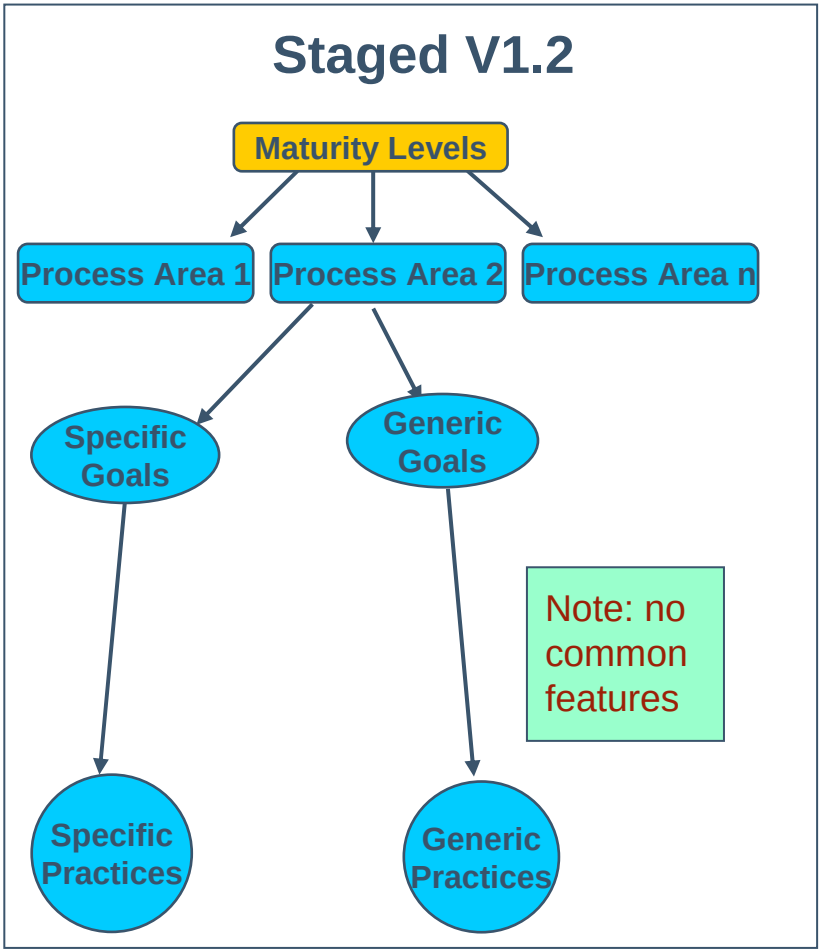
Model Structure[2]





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CMMI V1.2 Schedules

Version 1.2 CMMI Product Suite release	August 25, 2006
Update material available	August 25, 2006
Upgrade course available on-line	August 25, 2006
First Lead Appraiser “face to face”	October 16, 2006
V1.2 ADS required for all SCAMPIs	October, 2006
Last V1.1 Intro training	December, 2006
First expiration of V1.1 appraisals (3 year validity)	August 25, 2007
Last V1.1 appraisal	August 31, 2007

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Beyond V1.2$_1$

Improved architecture will allow post-V1.2 expansion.

- Extensions of the life cycle (Services, Outsourcing/Acquisition) could expand use of a common organizational framework:
  - allows coverage of more of the enterprise or potential partnering organizations
  - adapts model features to fit non-developmental efforts (e.g., CMMI Services, CMMI Acquisition)

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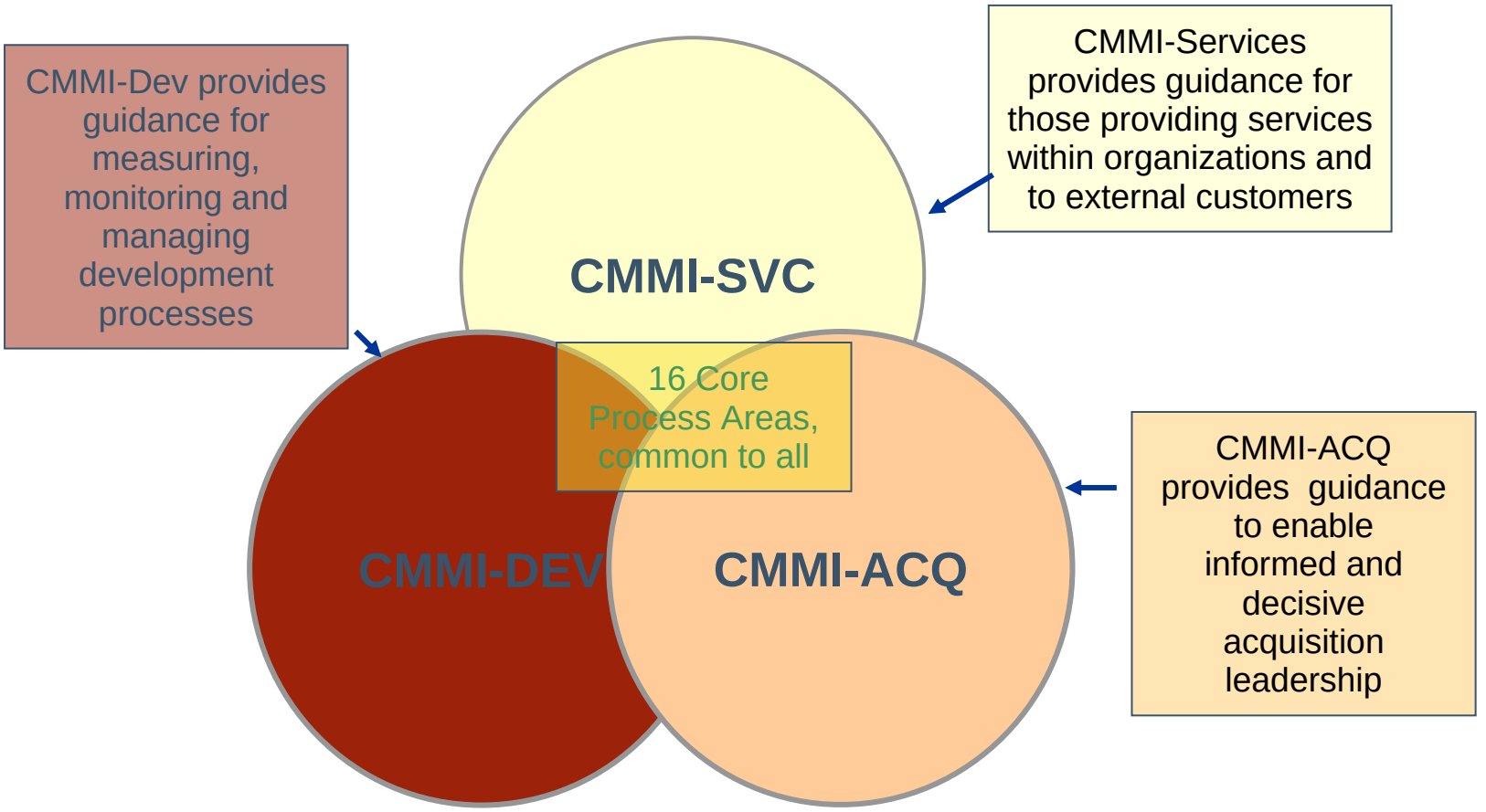
3 Complementary "Constellations"



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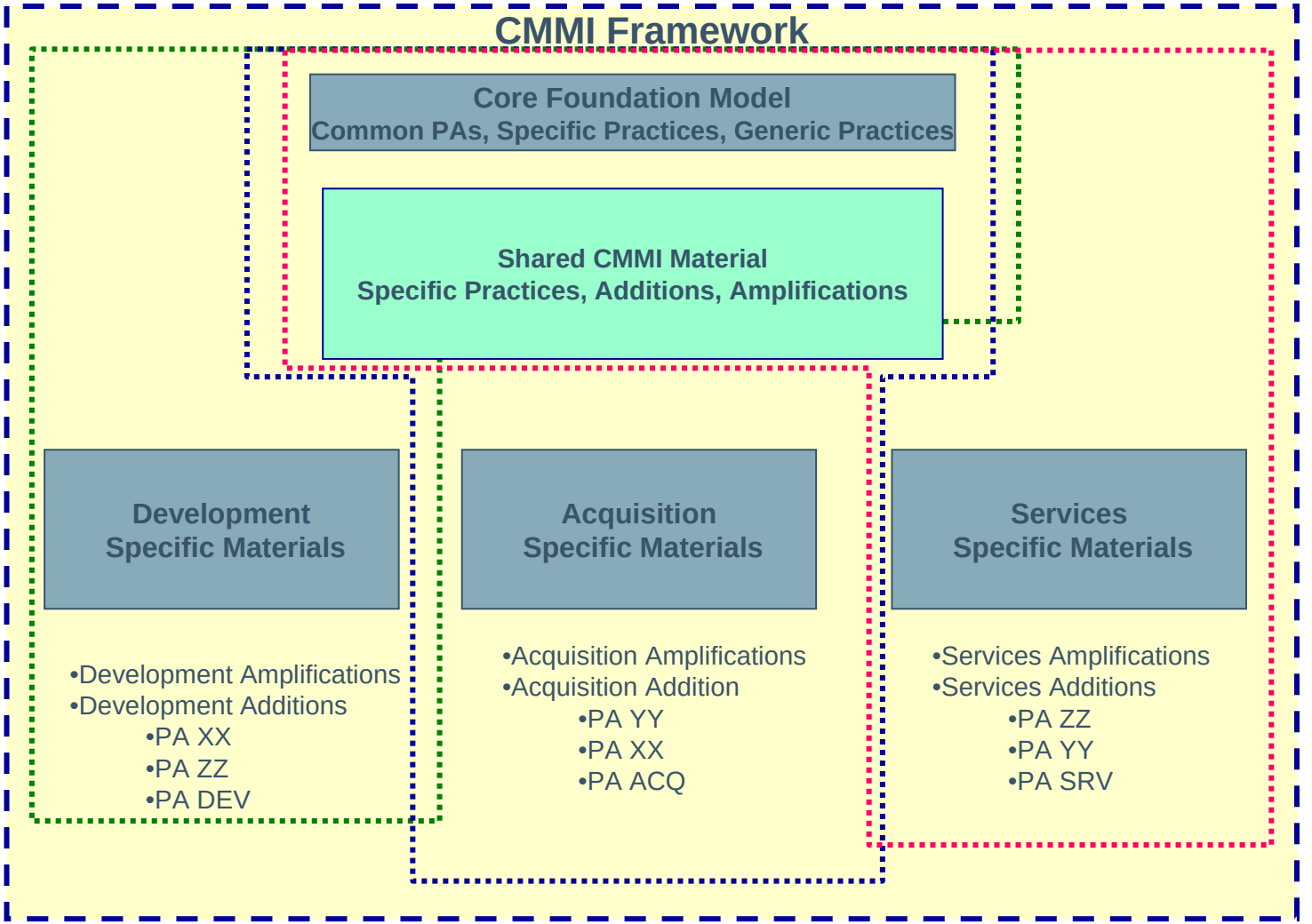
Architecture & Constellations



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Beyond V1.2$_2$

First two new “constellations,” CMMI for Services and CMMI for Acquisition, have been “commissioned” by CMMI Steering Group. Development will be in parallel with V1.2 effort; publication sequenced after V1.2 rollout.

Northrop-Grumman is leading industry group for CMMI Services.

- Initial focus will be for organizations providing “DoD services” as well as internal IT:
  - System maintenance
  - Network Management, IT Services
  - IV&V

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Beyond V1.2$_3$

SEI is coordinating development of CMMI-ACQ.

- Will build upon General Motors IT Sourcing expansion
- Will add government perspectives from both DoD and civil agencies

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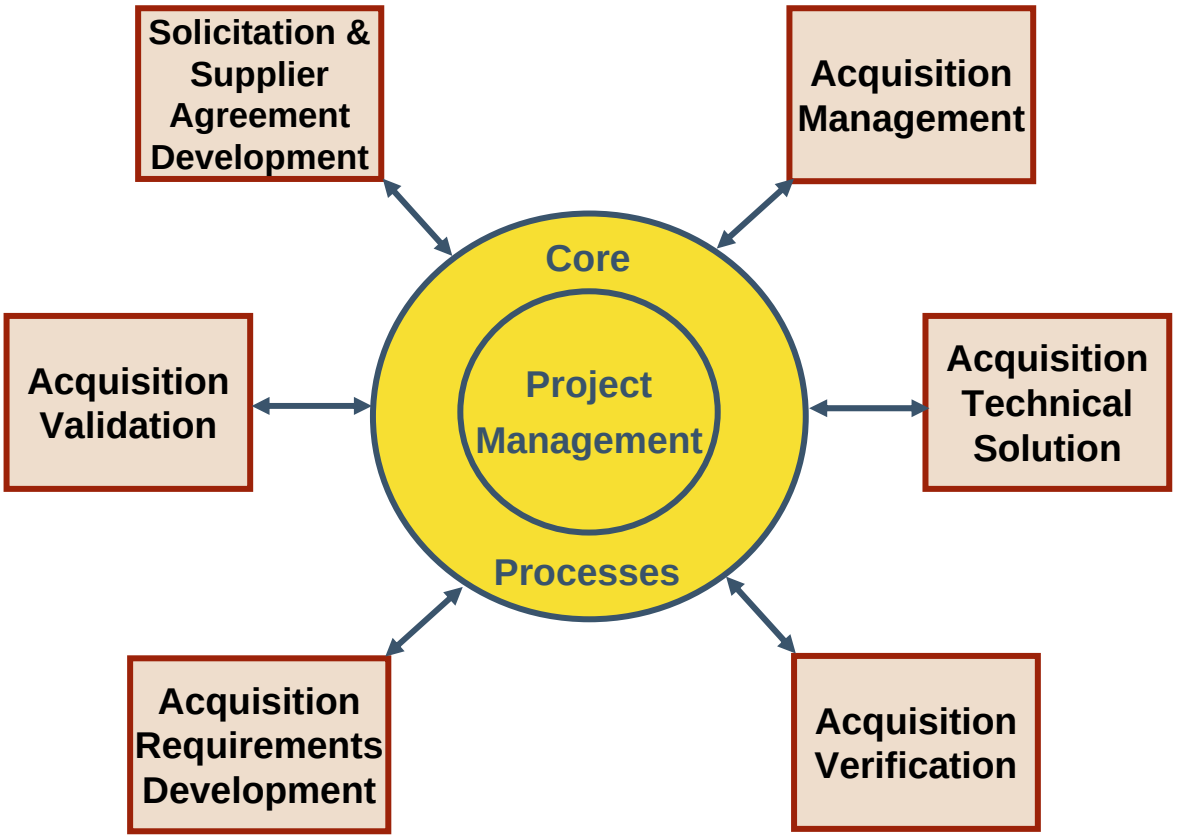
Initial CMMI-ACQ Key Acquisition Processes*



*based on initial CMMI-ACQ model developed by General Motors/SEI

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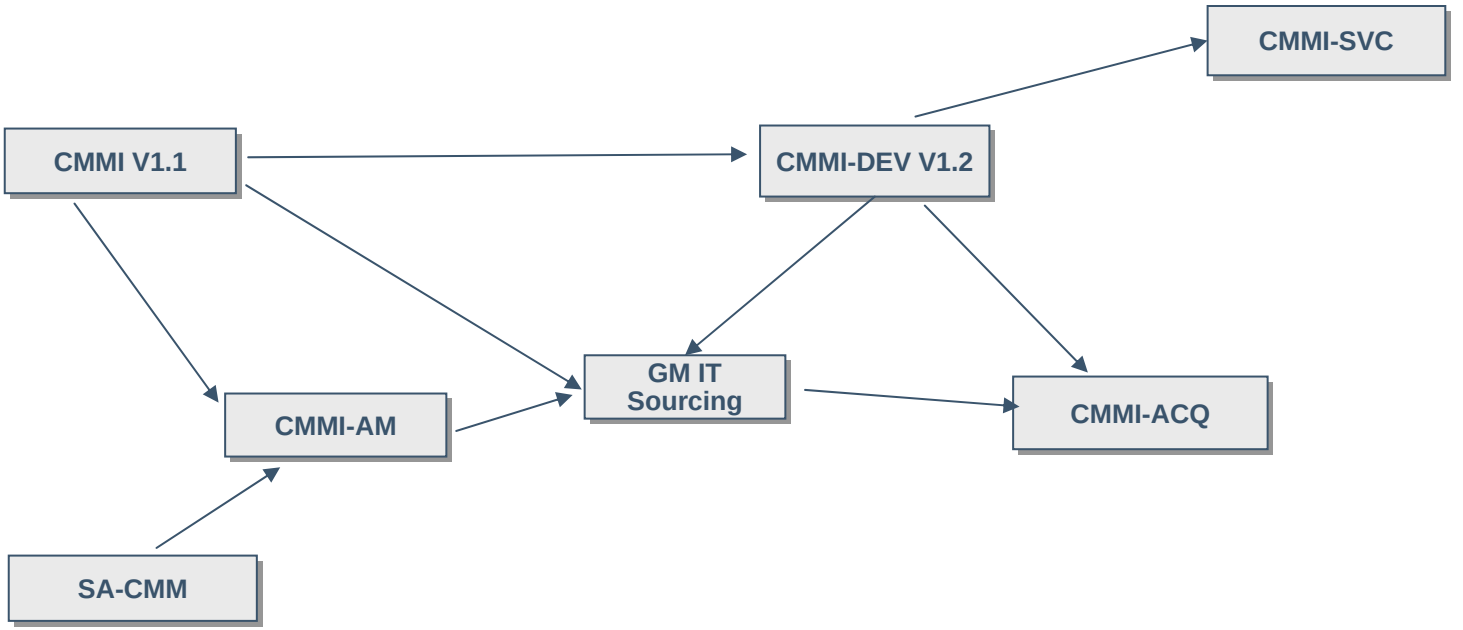
Planned Sequence of Models



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Q-Labs©

Shaping your Processes for Competitive Advantage

A DNV Company

Lean Process Design

A Concept of Process Quality

David N. Card

dca@q-labs.com

Agenda

- Background and Objectives
- Concepts of Lean
- Lean Process Design Process
- Summary

Background

- CMMI® requires the definition of processes that cover certain goals and practices
  - Requires “sufficiency”
  - Does not provide criteria for a “good” process – not an appraisal consideration
- Lean principles provide “goodness” criteria for processes
- Lean usually applied as a re-engineering technique, e.g., Kaizen

CMMI® is a registered trademark of Carnegie Mellon University

Objectives

- Identify the process “goodness” criteria implicit in Lean principles
- Explain how these can be applied during the design and initial definition of processes
- Minimize later rework and re-engineering

The Lean Misconception

- Lean is not about “light weight” processes
- “Lean” refers to reducing inventory and “work in progress”
- Lean is accomplished through robust processes
  - Simple
  - Reliable
  - Standardized
  - Enforced

Caveat: many flavors of Lean

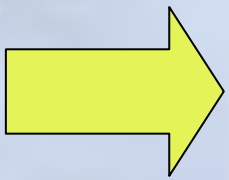
Five Lean Principles

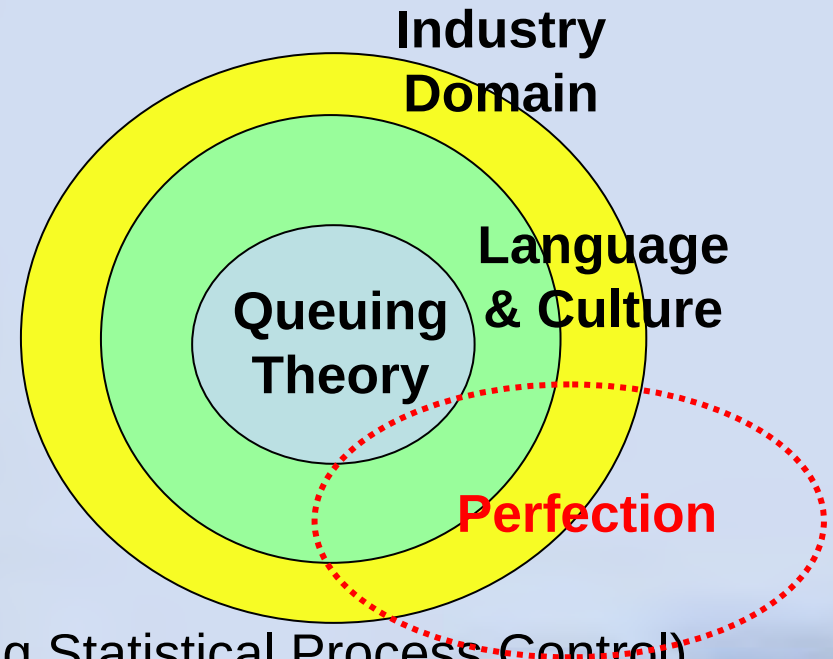
- *Value* – identify what is really important to the customer and focus on that
- *Value Stream* – ensure all activities are necessary and add value
- *Flow* – strive for continuous processing through the value stream
- *Pull* – drive production with demand
- *Perfection* – prevent defects and rework

Value Stream = Business Process

Views of Lean

- **Five Observed Principles**
  - Value
  - Value Stream
  - Flow
  - Pull
  - Perfection
- **Technical Practices**
  - Similar to Six Sigma (including Statistical Process Control)
  - Adds queuing theory perspective



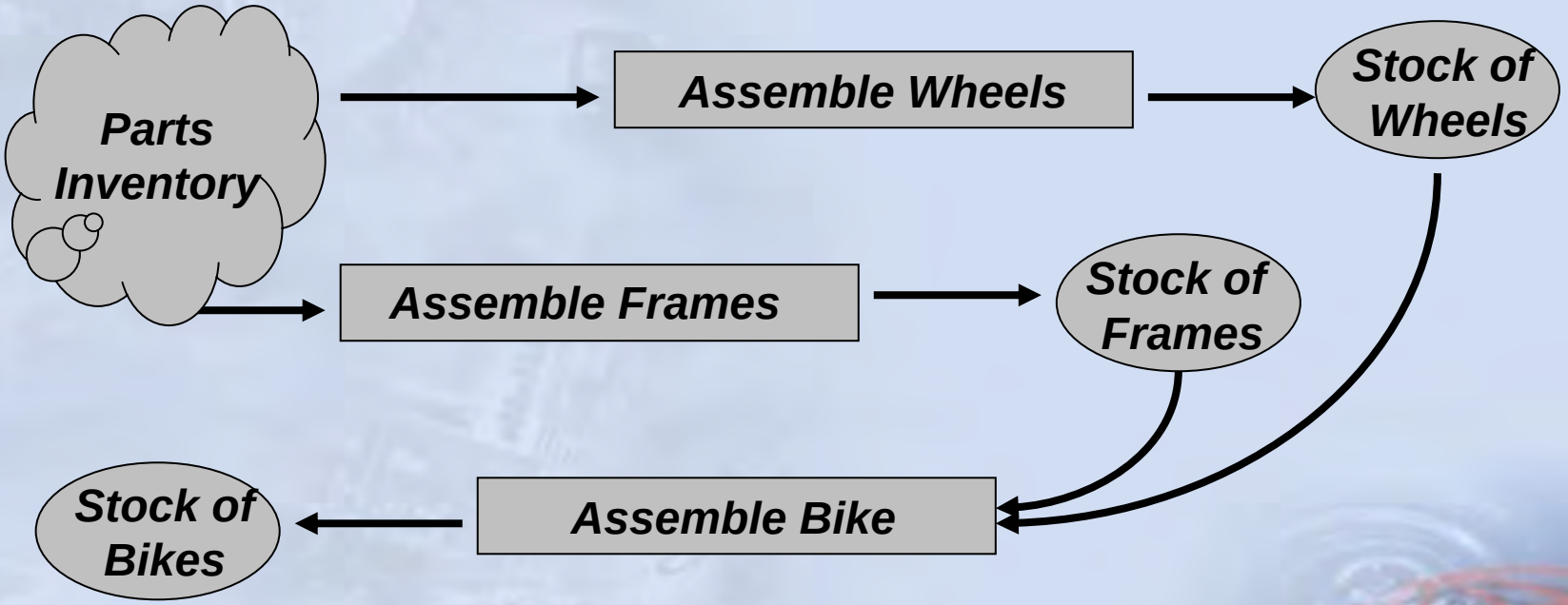


Lean Techniques

- Realize the principles of Lean
  - Methods and tools for defining, analyzing, and improving processes
  - Criteria for efficient and effective processes
  - Dimensions of process performance subject to control
- Based on queuing theory (a process may be viewed as a system of queues)

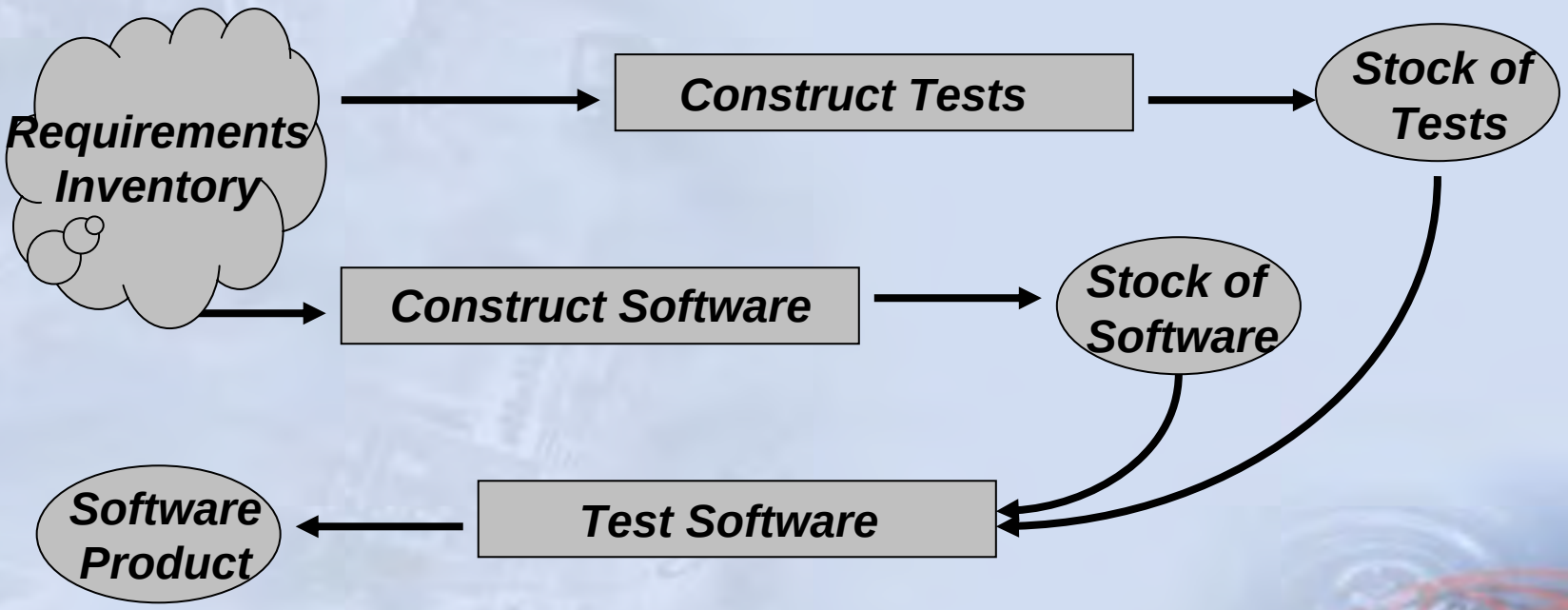
Lean is not just an attitude!

Example Manufacturing Process



Inventory and Work in Progress Enable Inefficient and Unreliable Processes!

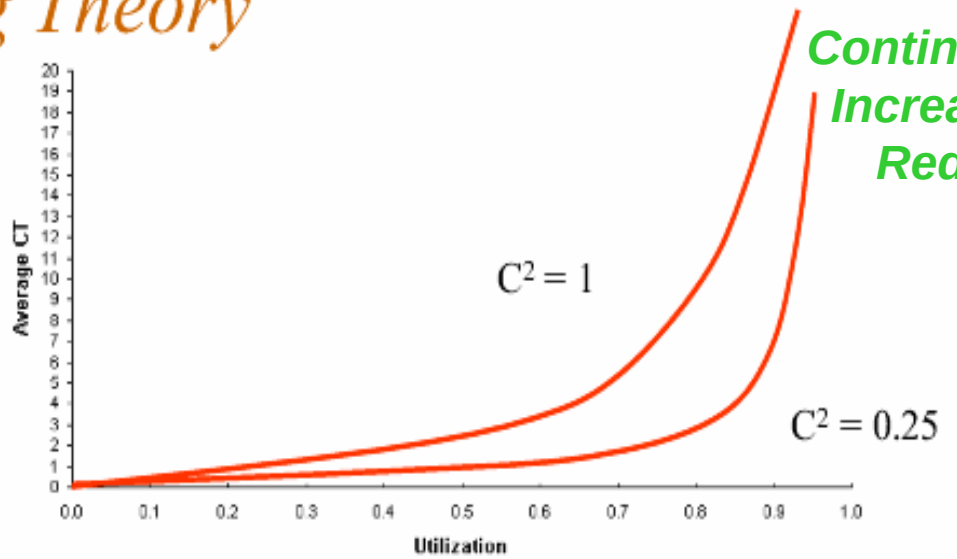
Example Software Process



Waterfall model implies large WIP;
Incremental and agile imply smaller WIP,
but are they "robust" enough?

Limits to Performance

Queuing Theory



Continuous Improvement Increases Capacity and Reduces Variability

Capacity Utilization and Variability

Variability

Capacity Utilization

$$CT_q = \left(\frac{Ca^2 + Ce^2}{2}\right)\left(\frac{u}{1-u}\right)te$$

High levels of variability further exacerbates the effects of capacity utilization

From P. Middleton, Lean Product Development, 2005

Implications of Queuing Theory

- Broadens concerns for managing the capacity of organizations
- Leads to design criteria for process definition
  - Queues with certain properties operate more efficiently
- Suggests candidate measures
  - Properties of queues are measurable

The Capacity Myth

- Most engineering organizations behave as if their system/software development capacity is elastic
  - Capacity expands to accommodate the need
  - Projects are planned in isolation
- Systems have limits to performance
  - Organizational performance must be managed to facilitate project success
  - Organizational performance is not simply an aggregation of individual projects

Lean Process Design

- Why – begin the process improvement journey with efficient and effective processes, not just compliant processes
- How – use Lean concepts to make decisions about the organization and composition of processes, more than human factors considerations
- When – during process design and initial definition, not just as later rework

Kaizen

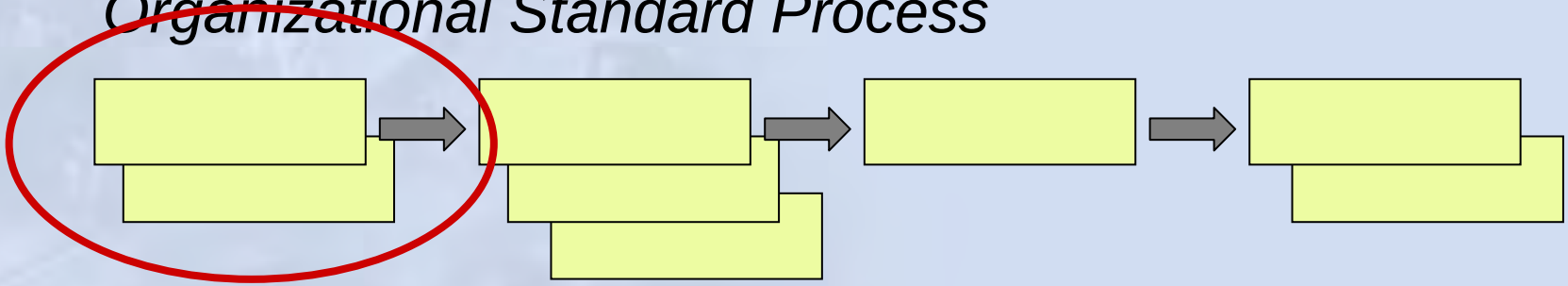
- A facilitated team activity
- Focused on improving an existing process or (more commonly) subprocess
- Applies Lean principles
- Typically involves tools such as
  - Quality Function Deployment
  - Process Mapping
  - Value Stream Analysis

Process Size as a False Trail

- Lean is not about the “size” or “volume” of the process definition
- Process definition includes
  - Organizational standard process
  - Organizationally-defined alternatives
  - Project-defined alternatives
- Volume of alternatives and variations often exceed the volume of the basic organizational process – focus on these!

Process Proliferation

Organizational Standard Process

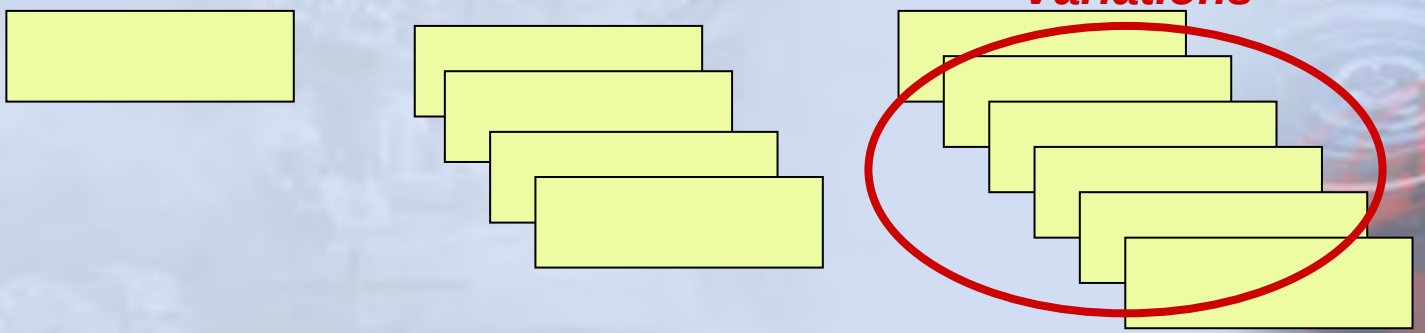


Eliminate OSP Element

Organizationally Defined Alternatives

Projects Defined Processes

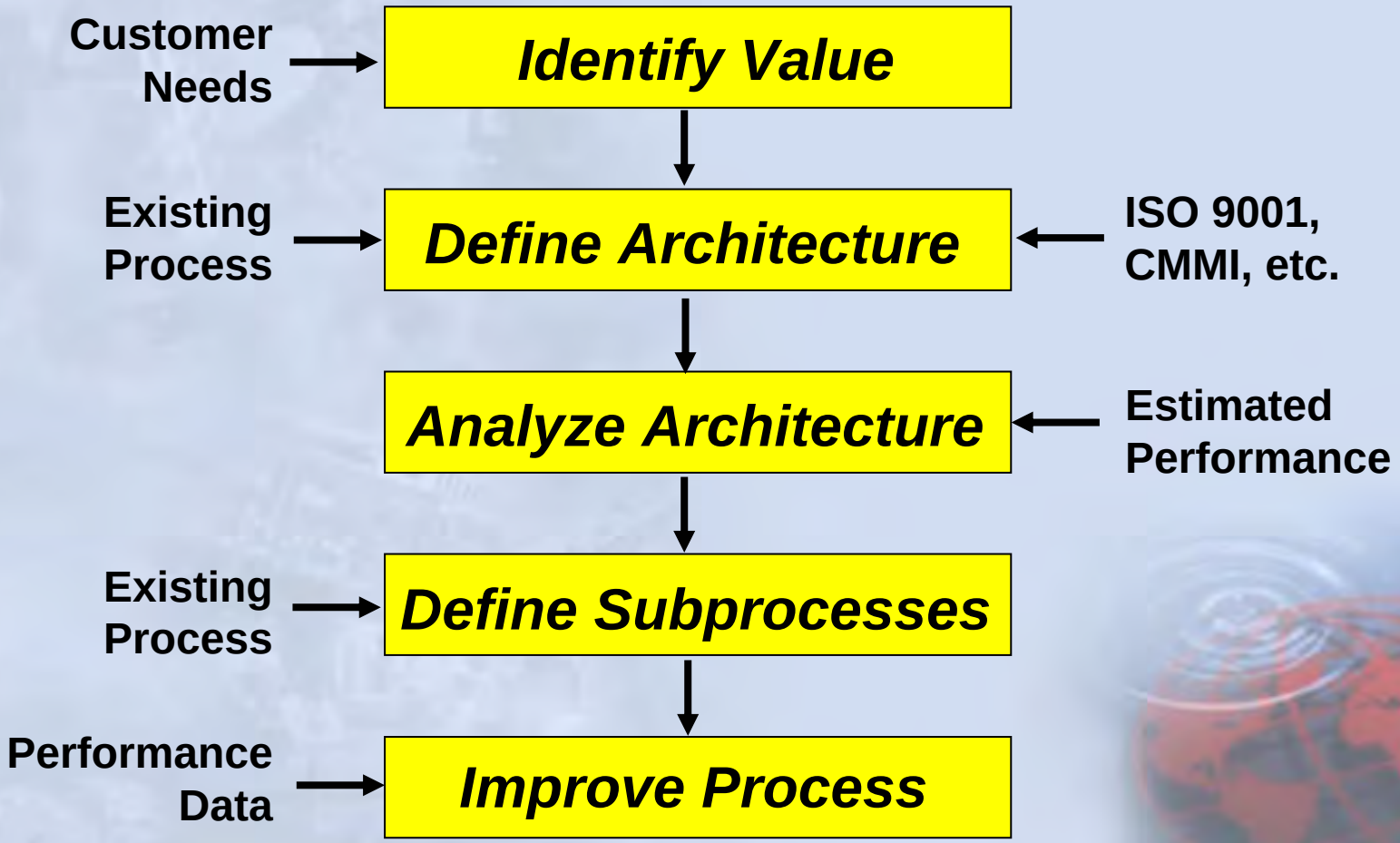
Eliminate Project Variations



Lean Process Design Process

- Requires a focus on the architecture or "system design", as well as the design of subprocesses
- Provides common and specific criteria for each level of design
- Use estimates of process performance to help make design decisions
- Incorporates traditional process definition conventions and notations

Lean Process Design Process



Lean Process Design Criteria

- Break work into “small” packages
- Process small packages of work continuously
- Distribute work evenly across subprocesses
- Minimize subprocess variations
- Minimize hand-offs between subprocesses
- Reuse subprocesses within the architecture
- Avoid redundant or duplicative tasks
- Eliminate “just in case” activities
- Minimize waiting and delays
- Identify and mitigate performance constraints
- Understand downstream demand

Lean Subprocess Design Criteria

- Use proven subprocesses
- Ensure subprocess are followed
- Keep subprocesses simple
- Plan for control of subprocess performance
- Build quality assurance into each subprocess
- *Avoid redundant or duplicative tasks*
- *Eliminate "just in case" activities*
- *Minimize waiting and delays*
- *Identify and mitigate performance constraints*

Human Factors Criteria

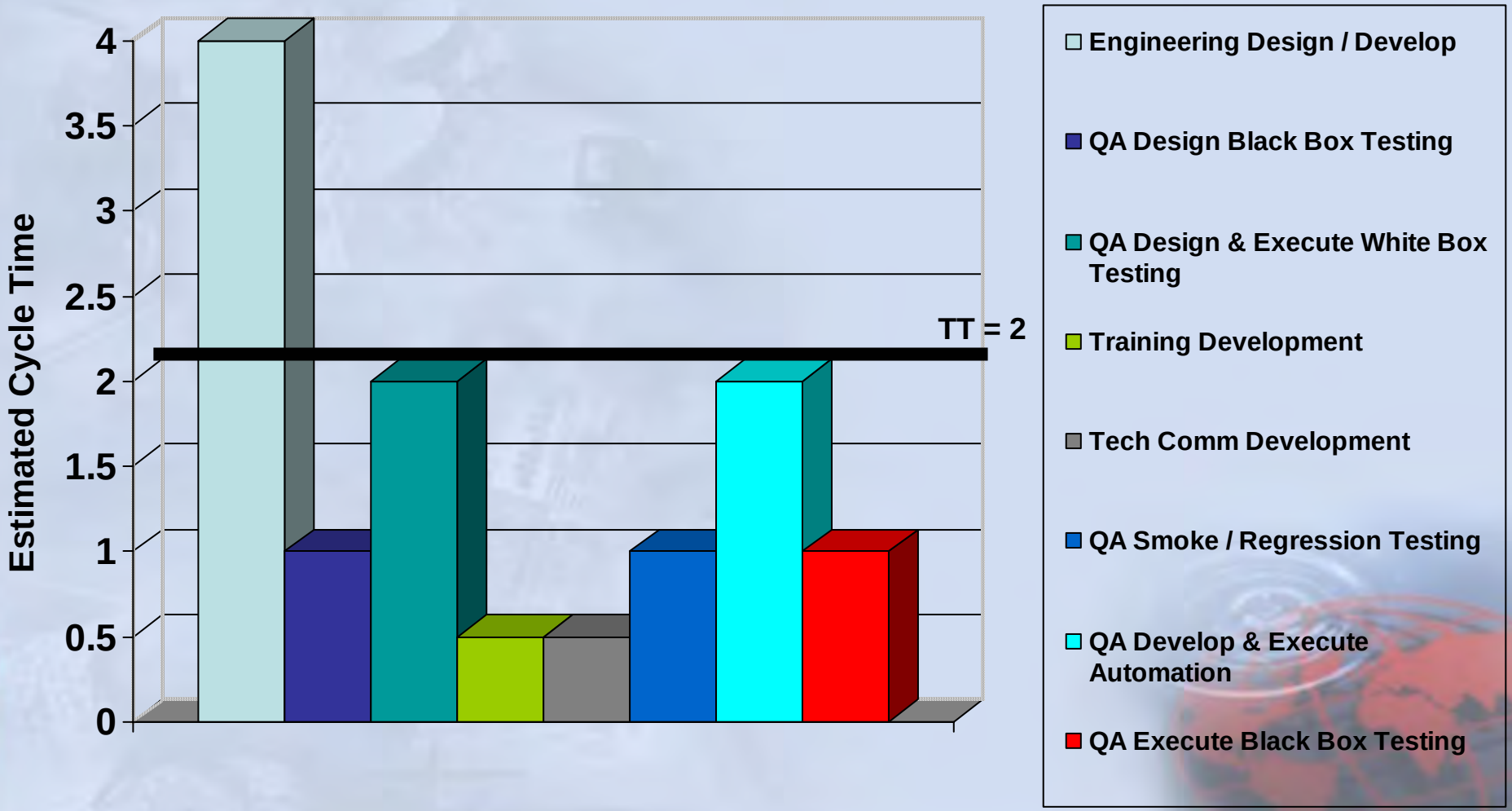
- Process definitions are intended for human users, must be
  - Understandable
  - Natural/Intuitive
  - Accessible
  - Effectively supported by tools
  - Etc.
- Process definitions are only one element of a process instantiation (also, people, tools, and input)

Lean Software Management Case Study: Timberline Inc

Peter Middleton
Amy Flaxel
Ammon Cookson

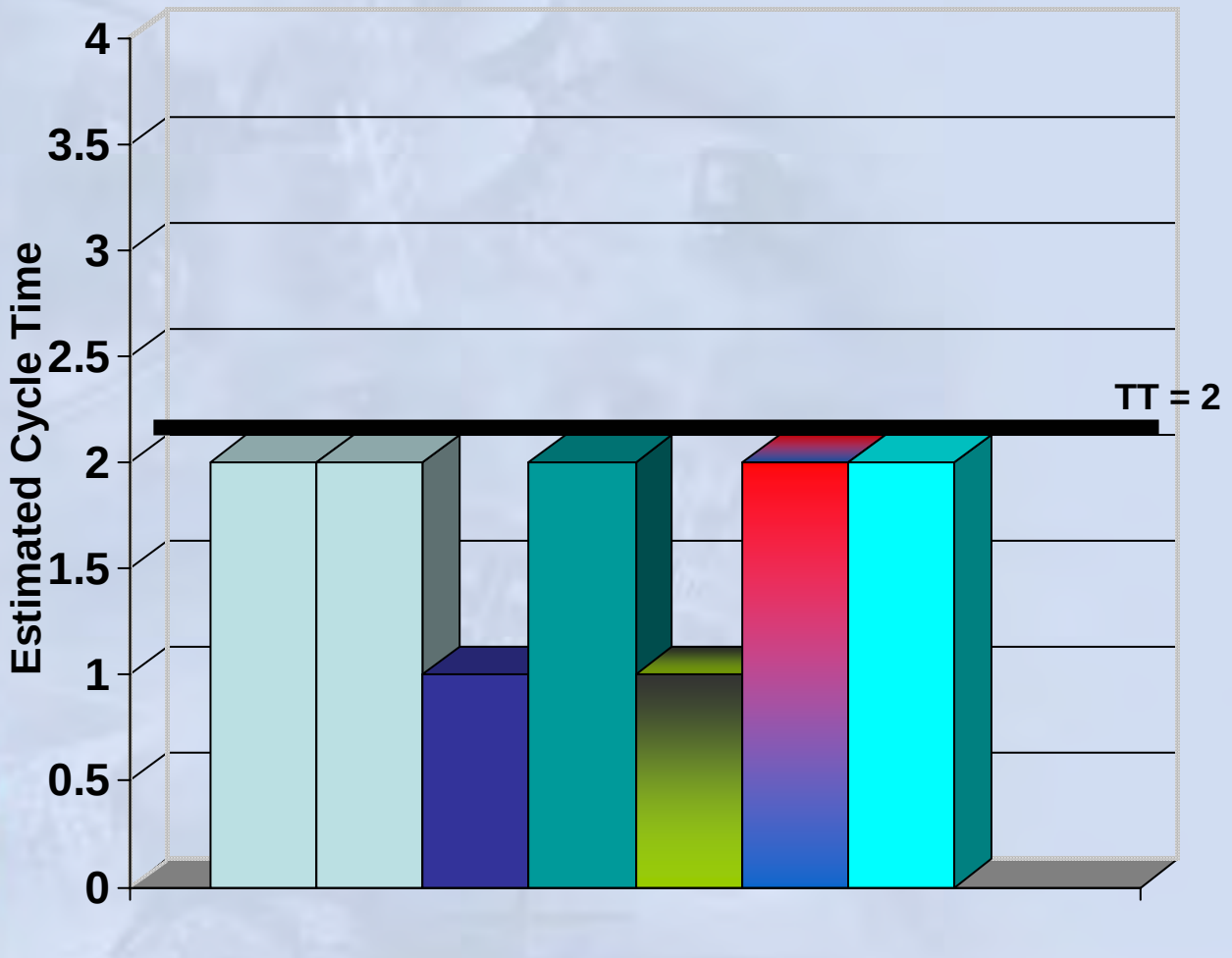
Used with Permission

Work Balance Chart - Initial



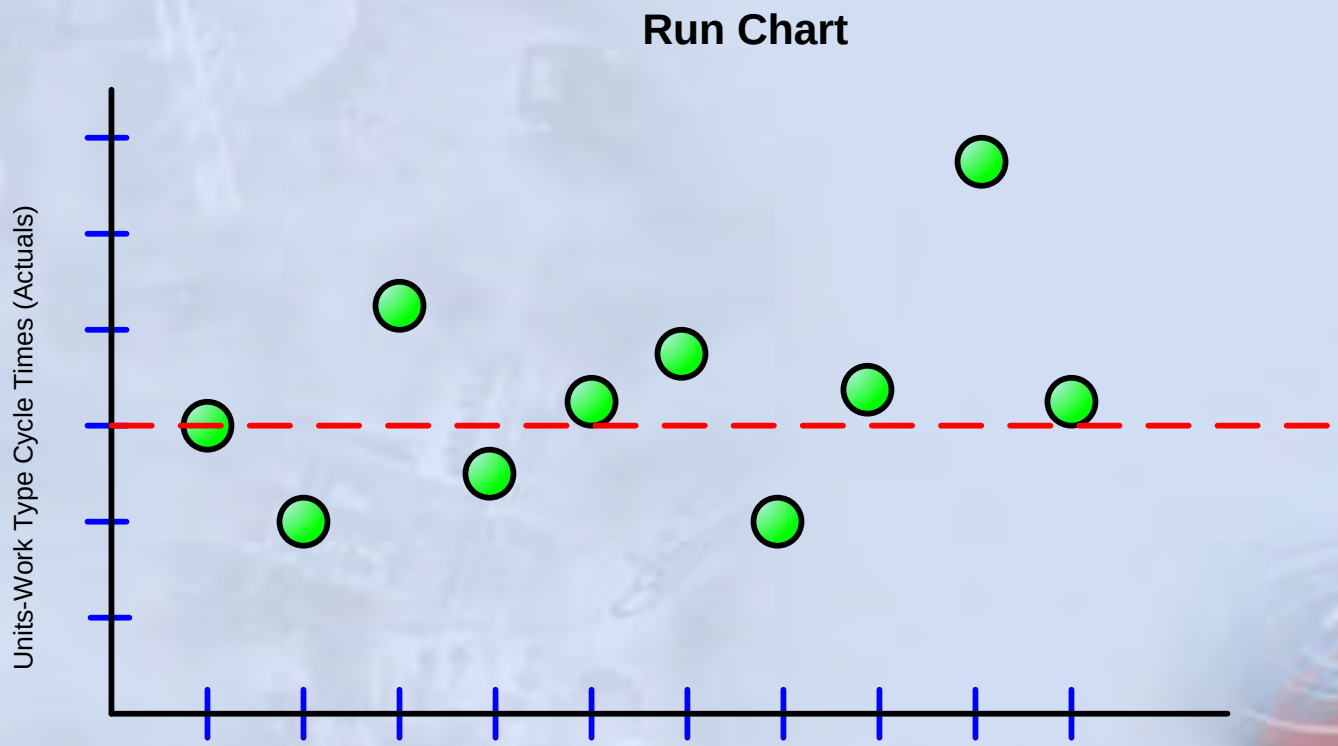
Middleton, Flaxel, Cookson

Work Balance Chart – Post Adjustment



Middleton, Flaxel, Cookson

Example: Cycle Time Analysis



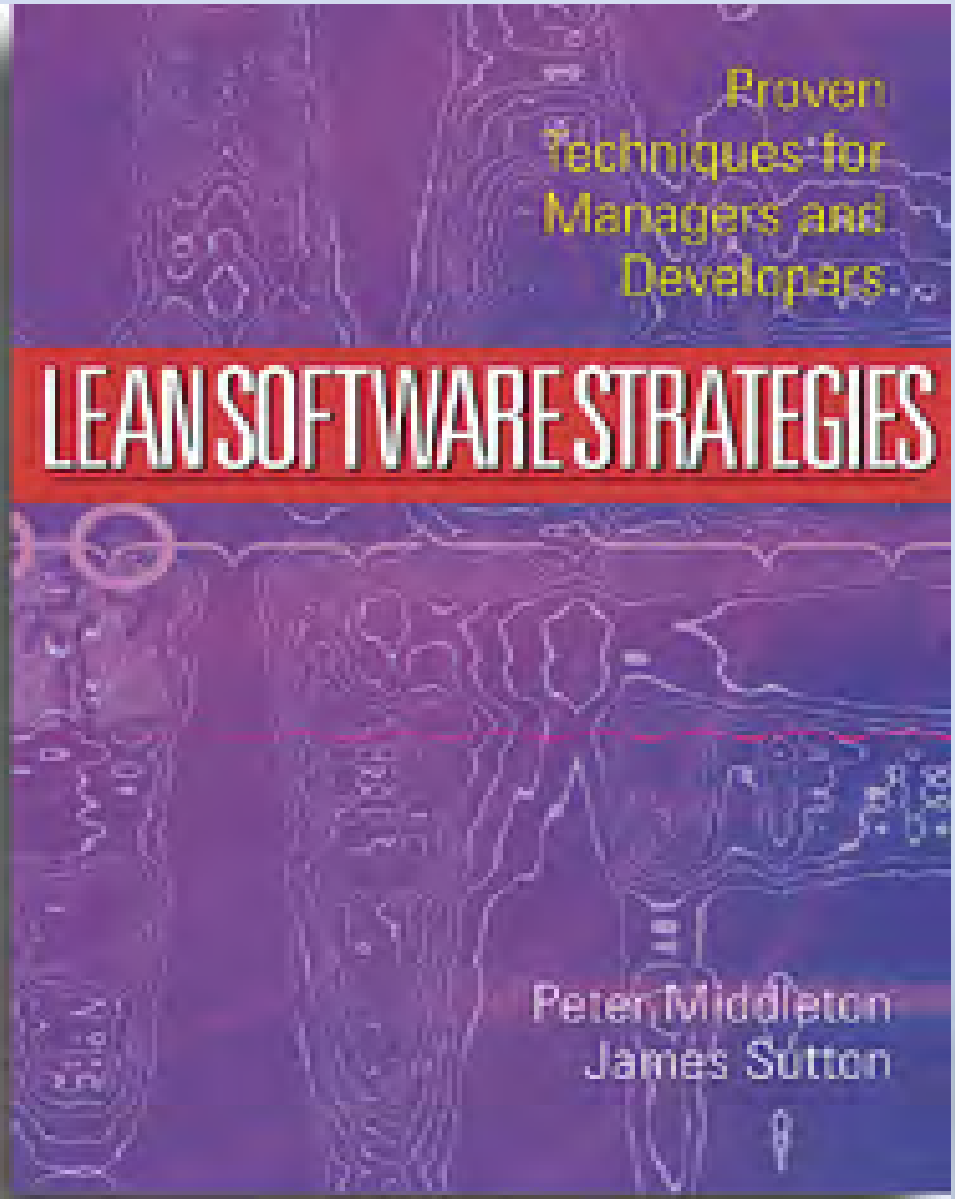
Middleton, Flaxel, Cookson

Performance Dimensions

- Task size
- Work arrival rate
- Cycle time
- Effort
- Delay/Waiting
- Defects
- Rework

Summary

- Lean is not about the volume of process definitions
- Processes can be designed, up front, to be more efficient and effective with Lean principles
- Good process design requires engineering at both the system (overall process) and subprocess levels
- Lean helps identify the critical measures of performance


Proven Techniques for Managers and Developers
LEAN SOFTWARE STRATEGIES
Peter Middleton
James Sutton

About Q-Labs

- Consulting, Training and Appraisals in:
  - Software Measurement
  - CMM/CMMI
  - Lean/Six Sigma
  - ISO 15504/SPICE
  - ISO (001
- 150 employees
- ISO 9001 Certified

- A broad international client base, e.g.
  - Alcatel, Bouygues Telecom, France Telecom, Orange
  - AXA, BNP Paribas, Banques Populaires
  - ABB, R. Bosch, EDF, IBM, Siemens, Schneider Electric, Thomson Detexis, Volvo, Sony
  - Atomic Energy Board of Canada, FAA, Norwegian Ministry of Justice, Swedish Civil Aviation Administration
  - Thales, Thomson, FMV, US Army TACOM

Make Middle Managers the Process Owners

CMMI Conference
November 2006
Denver, Colorado

Welcome

WelKom

Huan Yín

Bienvenido

Bienvenue

Wilkommen

ΚΑΛΟΣ ΟΡΙΣΑΤΕ

Bienvenuto

Välkommen

Tervetuloa

Witamy

ברוכים הבאים

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Agenda

- History of Assessment and Process Improvement
- Managing Process Change
  - Building Support for Change
  - A Sample Change Model
  - Attributes of Successful Changes
  - Sponsors
  - Middle Managers

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Agenda - 2

- Sample Process Improvement Infrastructure
  - Senior Management Advisory Board
  - Steering Committee
  - Process Group
  - Working Groups
- Middle Managers as Process Owners
- Summary
- Case Study (ING (Postbank))

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In the Beginning (Short History of Assessment and Process Improvement 1988 – 1991)

Quality Management Maturity Grid

Measurement Categories	Stage I: Uncertainty	Stage II: Awakening	Stage III: Enlightenment	Stage IV: Wisdom	Stage V: Certainty
Management understanding and attitude					
Quality Organization Status					
Problem Handling					
Cost of Quality as % of sales	20	18	12	8	2.5
Quality Improvement Actions					
Summation of company quality posture	We don't know why we have problems with quality				We know why we do not have problems with quality

From "Quality is Free" by Philip Crosby

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History of Assessment and Process Improvement

- Organizations were encouraged to conduct an assessment
  - Team was predominantly from the SEI
    - 5-6 SEI Assessment Team Members
    - 2-3 Organization Team Members
  - SEI Assessment Team Leader led the assessment, and was responsible for the Draft and Final Finding presentation
  - Final Report was written at the SEI based on the assessment results but only by SEI people
  - Recommendations were developed by SEI assessment team members – approved by Watts Humphrey

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History of Assessment and Process Improvement - 2

- Most of the organizations assessed in the early days of the SEI's development of the Software Process Assessment method were ML 1
  - Had problems with basic project management functions
  - Most had difficulties writing a decent Project Plan
  - The SEI's assessment recommendations almost inevitably suggested that the organization develop a process improvement or "Action Plan" and carry it out!!!!!
    - OK, we cannot plan therefore the SEI suggests we make an Action Plan which is like a Project Plan for process improvement and implement it – Sure!

Managing Process Change

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Managing Process Change

- There have been continuous advances in technology and process modeling:
- Technology
  - Hardware capability and performance advances
  - New user interfaces and application areas
  - New tools
  - New methods
  - Web-based

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Managing Process Change - 2

- Process Modeling:
  - ISO 9000:2000
  - Capability Maturity Model (CMM)
  - EIA – 731 – Systems Engineering CMM
  - Capability Maturity Model Integration (CMMI®)
  - BOOTSTRAP
  - ISO 15504 (SPICE)
  - EFQM (Quality Management Model)
- But even with of all of the process models and with our passion to incorporate technology to help us, we (the industry) seem to be getting worse, not better

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Managing Process Change - 3

- WHY? - Because we have not paid sufficient attention to process, people, and their reactions to change!

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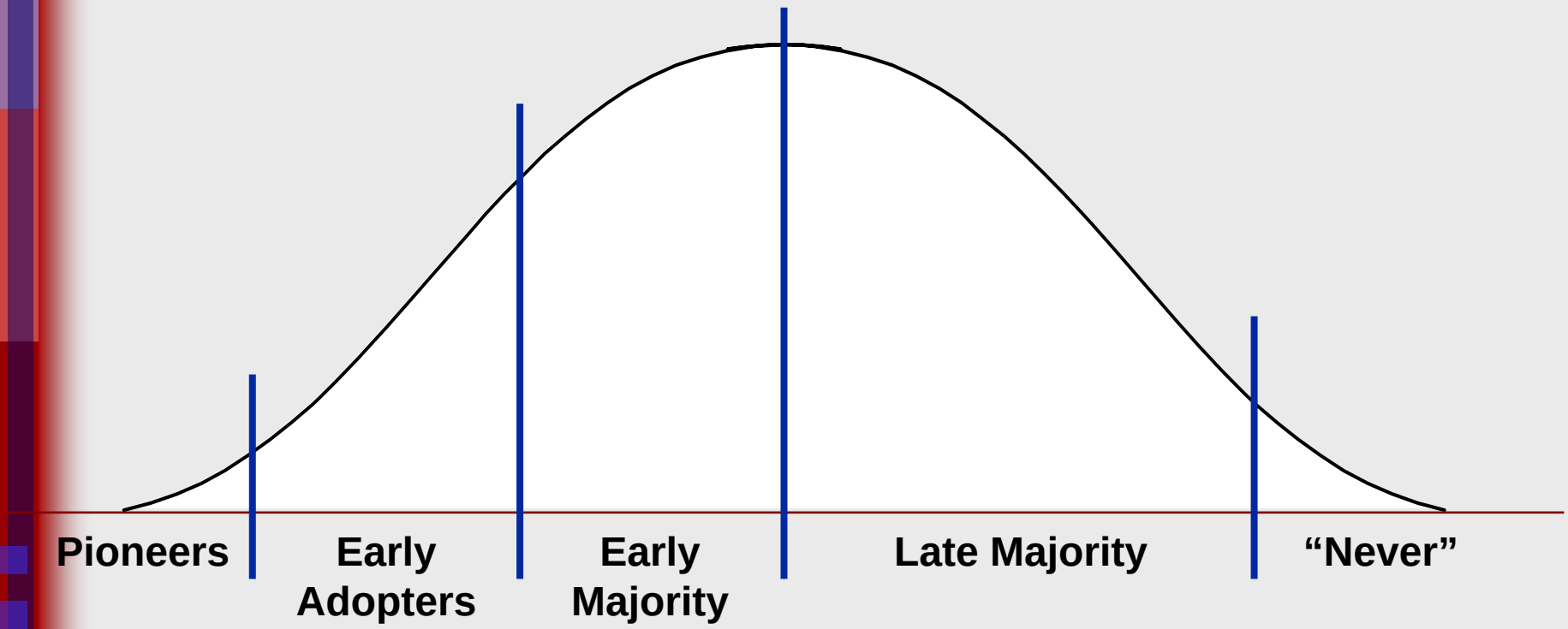
Change

- Change is a pervasive aspect of our lives and almost a necessity for economic survival.

Process Adoption Curve



Focus of Effort

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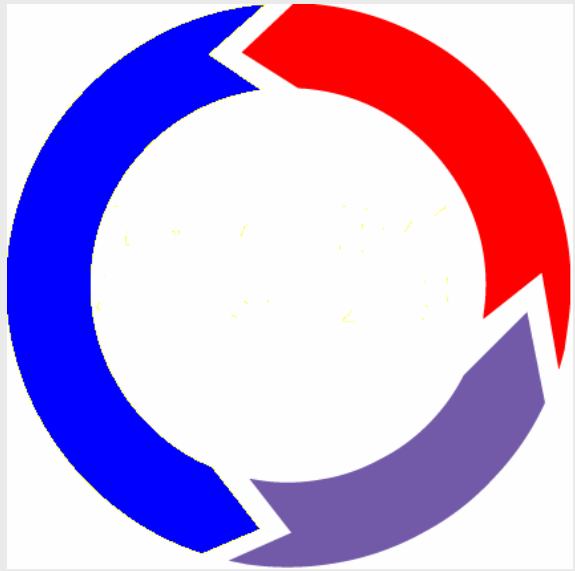
Principles of Process Change

- Major changes must be sponsored by Senior Management
- Focus on fixing the process, not assigning the blame
- Understand current process first
- Change is continuous
- Improvement requires investment
- Retaining improvement requires periodic reinforcement



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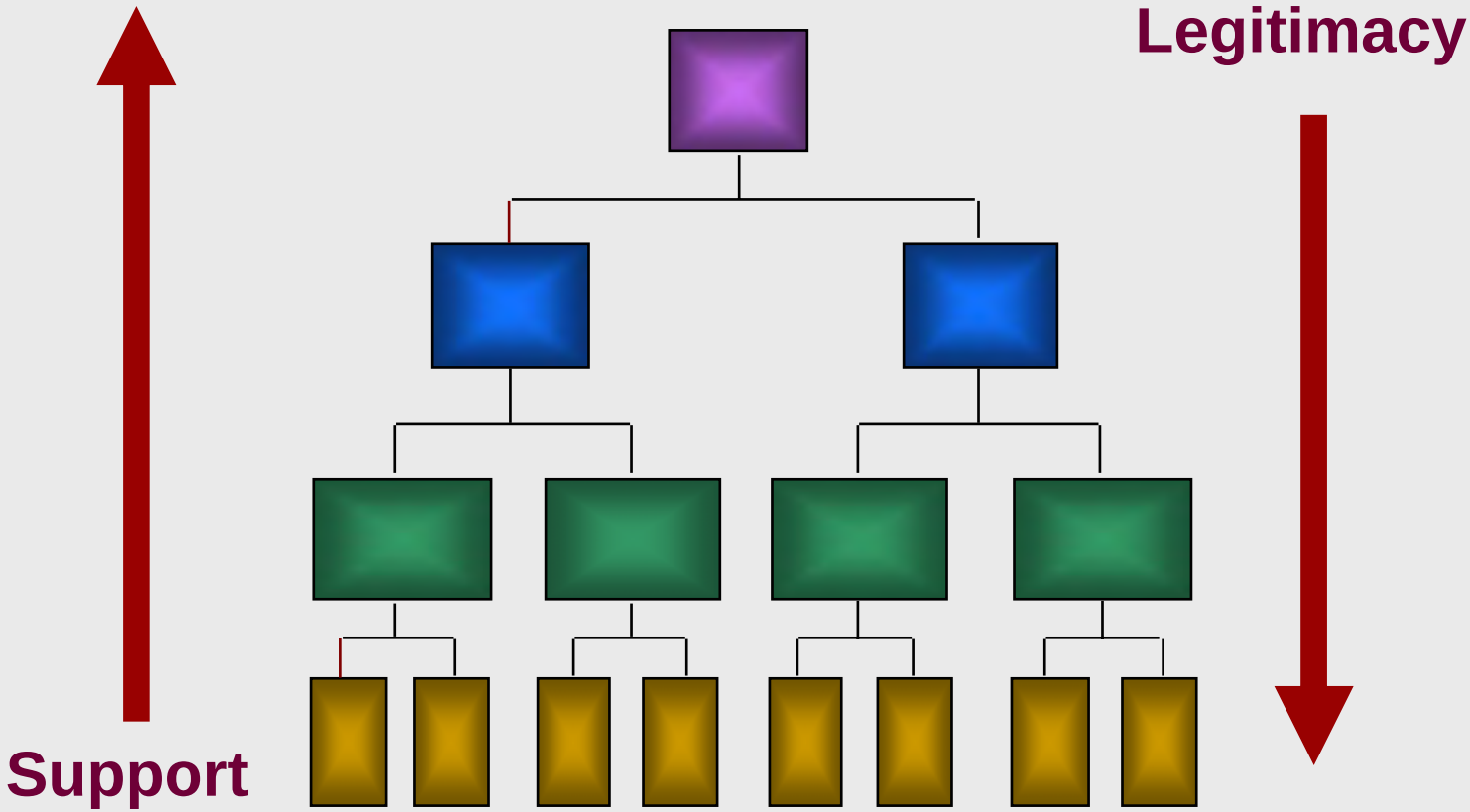
Building Support for Change



[courtesy JMaher]

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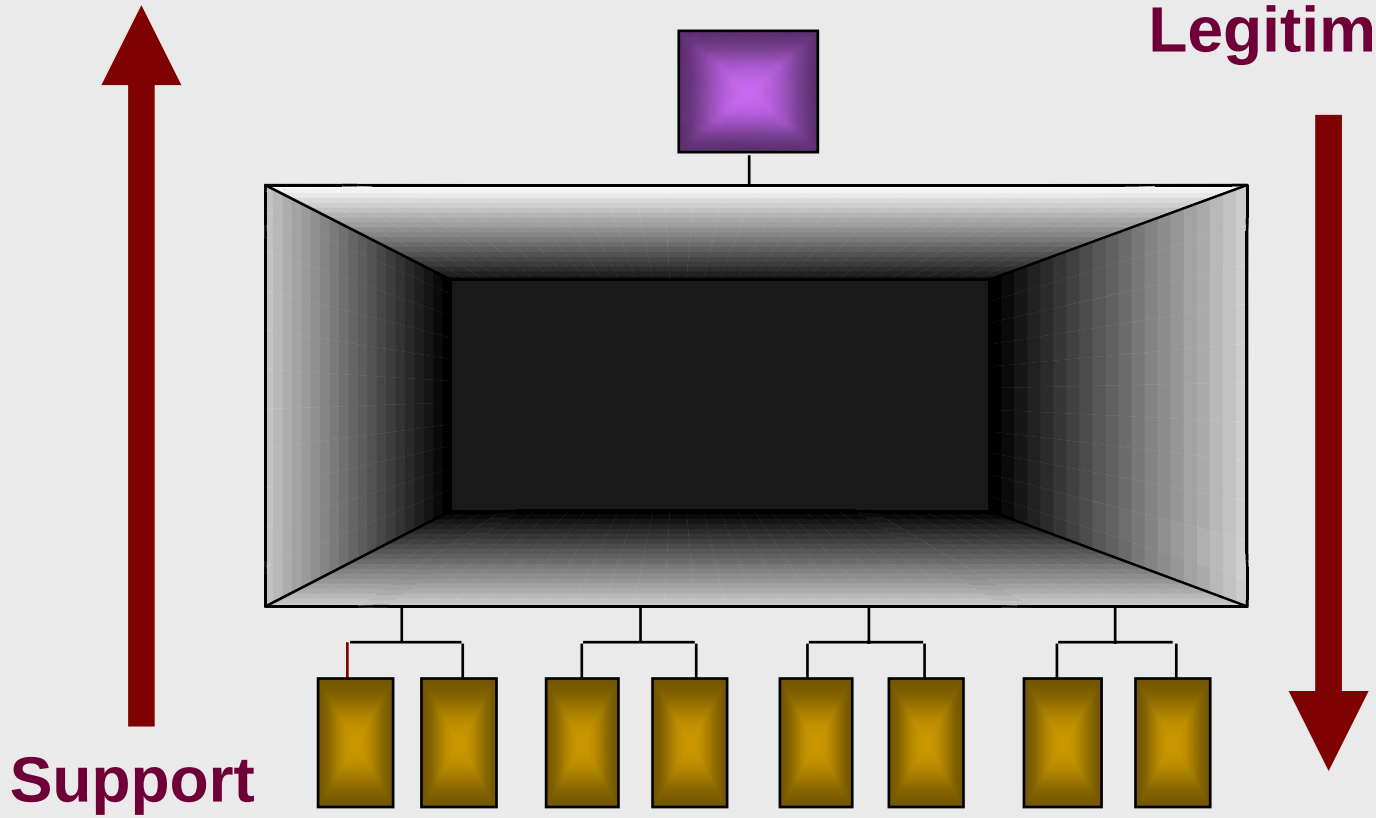
Building Support for Change - 2



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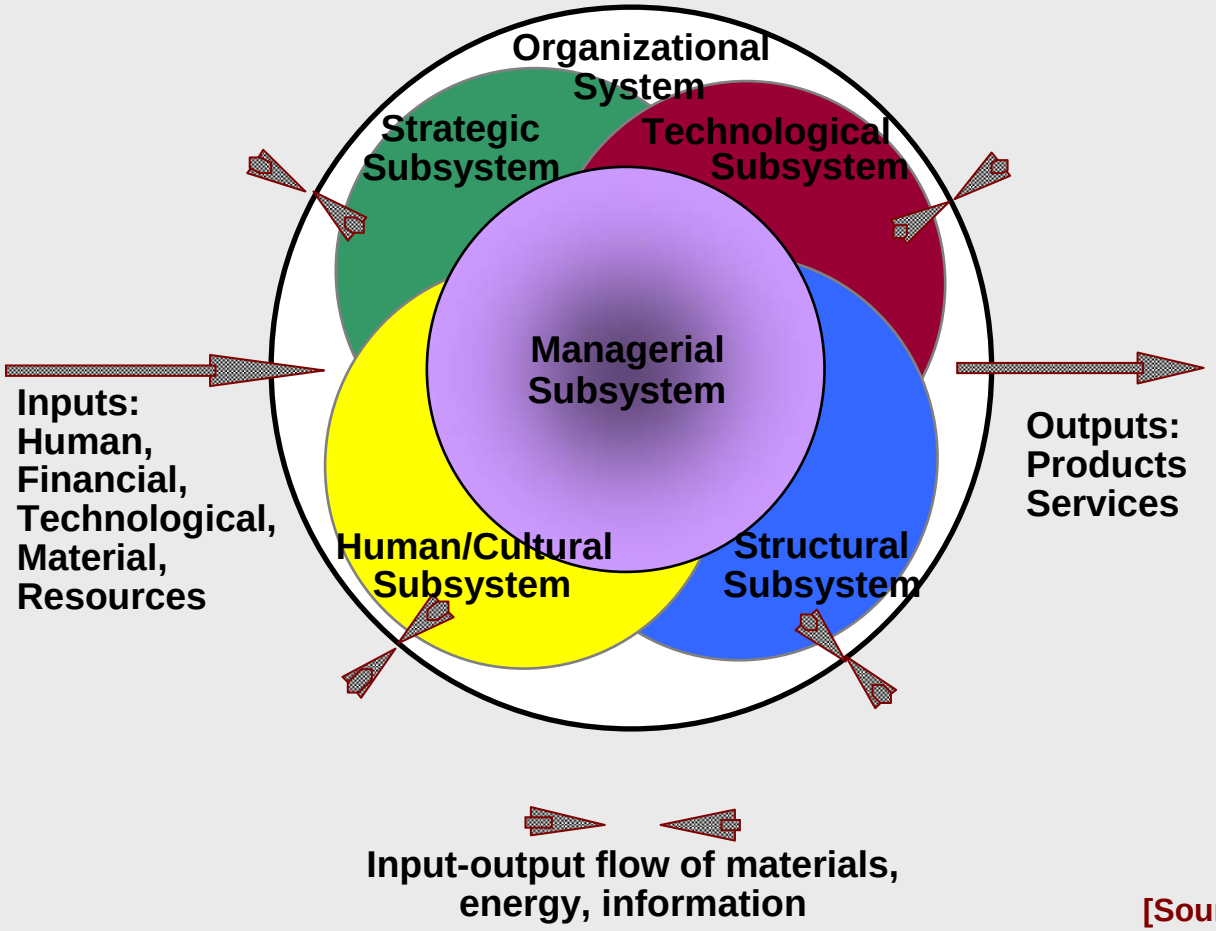
Organizations as Systems



[Source: Morgan, 1986]

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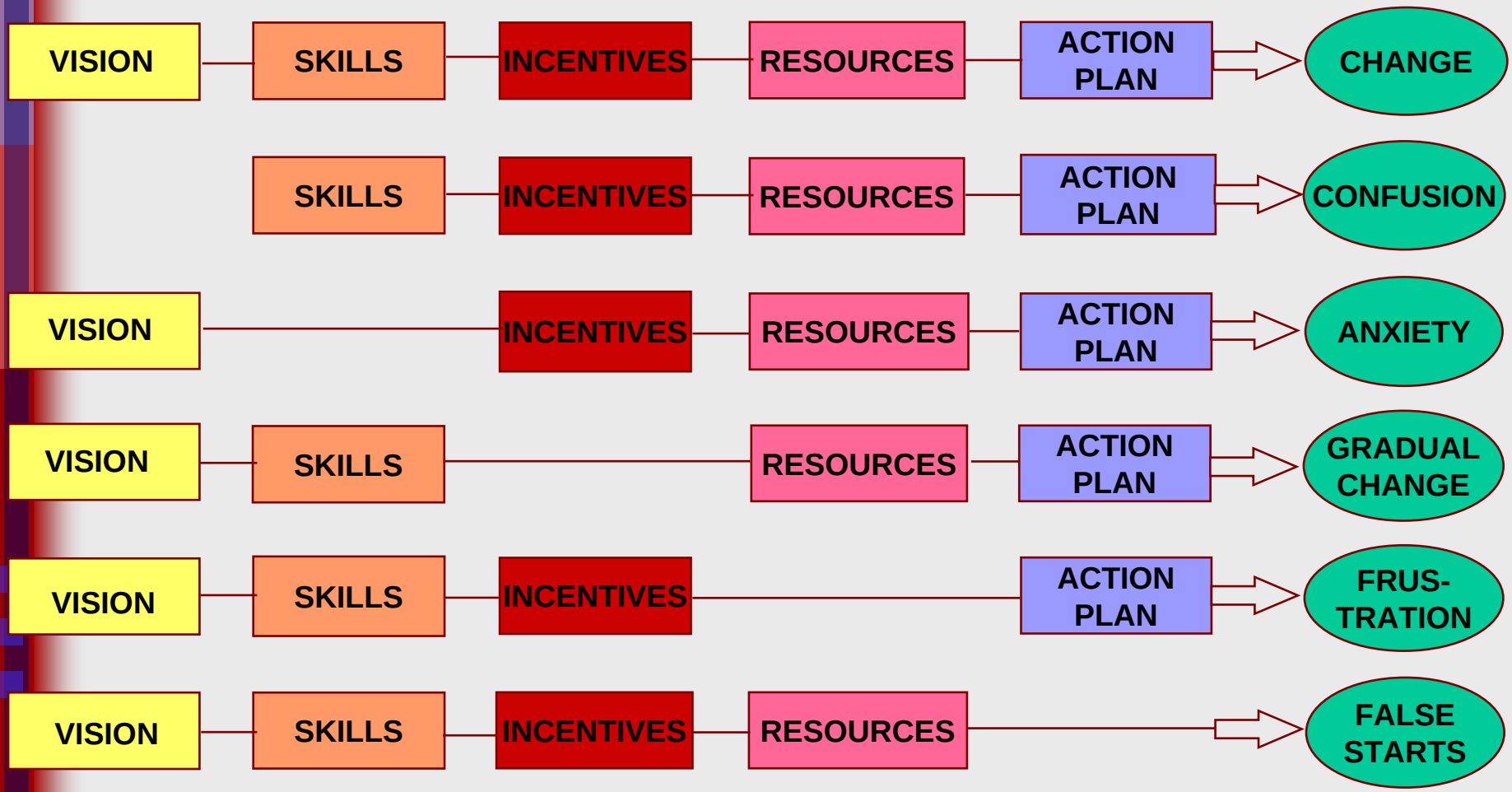
Managing Complex Change Requirements



"Managing Technological Change"
Carnegie Mellon University
Software Engineering Institute

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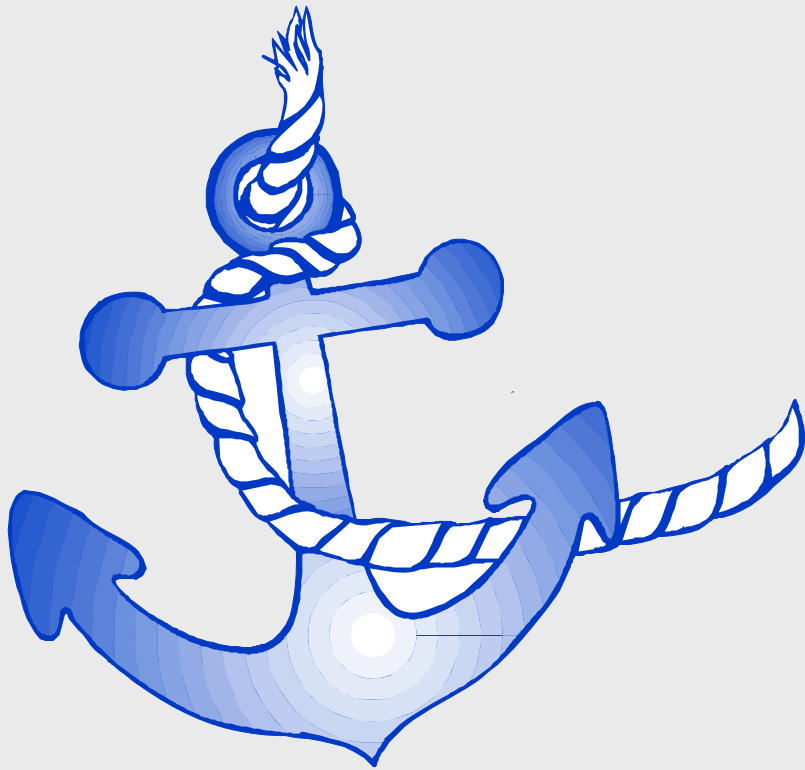
What People Need During Transition

- Information
- Inclusion
- Support
- Safety
- Skills
- Freedom from blame
- Rewards



"Managing Technological Change"
Carnegie Mellon University
Software Engineering Institute

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Attributes of Successful Changes

- Management Sponsorship
- The change is consistent with the organization's values, mission, and strategy
- Buy-in by those who will be affected
- Training
- Communication
- Reward system is changed

Change Effort Roles

- Inventors
- Entrepreneurs
- Integrators
- Experts
- Managers (Middle Managers)
- Sponsors (Senior Managers)

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Sponsors / Senior Managers

- Provide top management credibility and support for change projects
- Are prime communicators in interpreting how the change fits into the overall culture and vision of the organization
- Focus on relating the change effort to the broader goals of the organization
- Communicate why the change is needed to the total organization

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Middle Managers

- Middle Managers
  - Simplifies/interprets the direction provided by Senior Management
  - Delegates responsibility to Project Managers and Leads
  - Assigns priorities based on organization's business objectives and vision
  - Focuses on getting the job done at all costs
  - Serves as part of the Process Improvement Steering Group
  - Reports progress to the Sponsors or Senior Management including process improvement progress

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Sample Process Improvement Infrastructure

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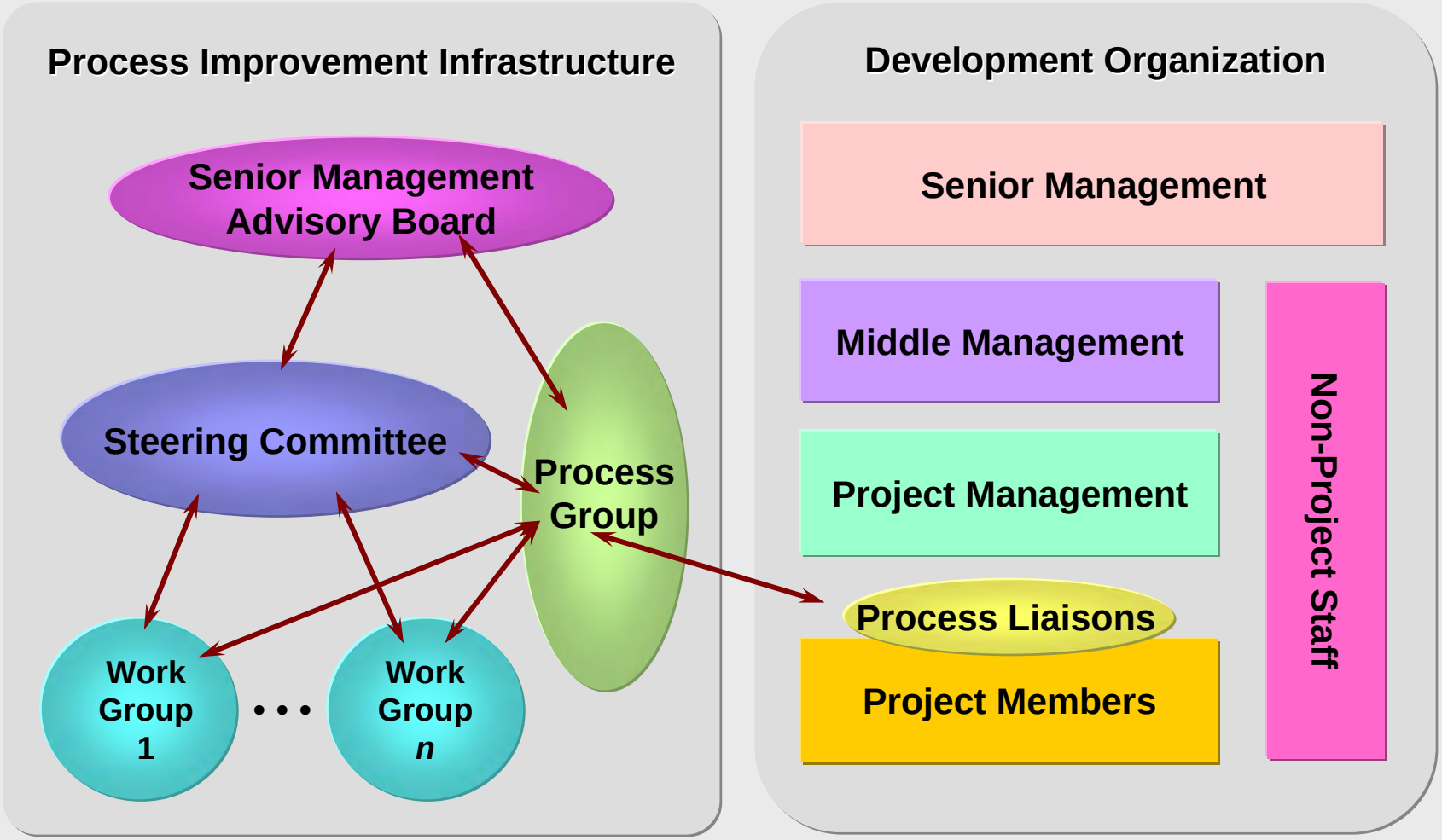
Sample Improvement Infrastructure



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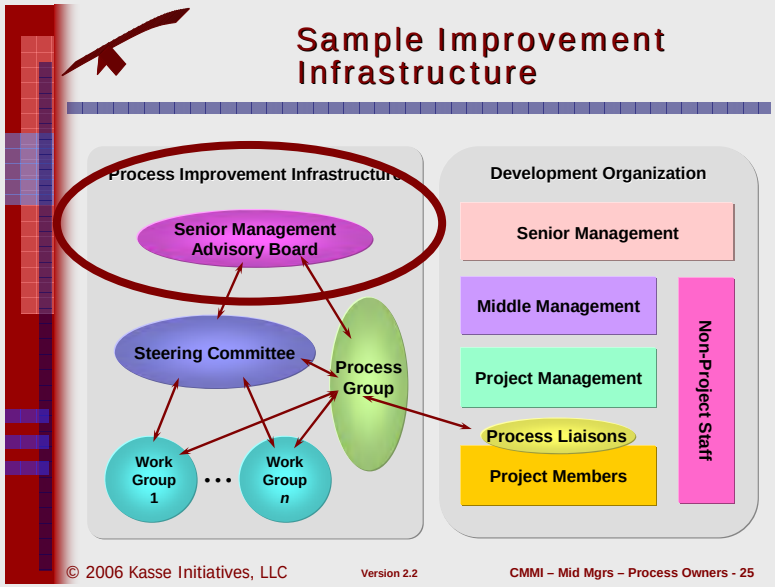
Senior Management Advisory Board (SMAB)

- Initially and continuously share the organization or business unit's vision and business objectives
  - Helps individuals to realize the value of their efforts in their everyday work and the value of the process improvement effort
- Relates the change effort to the broader goals of the organization (business strategy)



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Senior Management Advisory Board (SMAB) - 2

- Looks for measurable improvements to support the business objectives
- Creates the environment to ensure process improvement becomes a part of the culture and vision of the organization
  - Demonstrates regular and consistent visible support
    - for specific change actions
    - for continuous process improvement in general
- Communicates why the change is needed to the total organization
  - Approves/protects budget for the process improvement initiative
- Ensures that the necessary resources are available in a timely fashion

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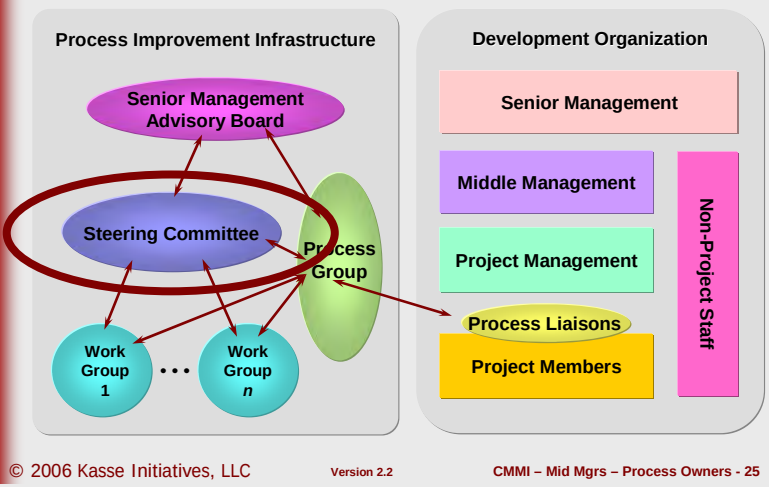
Steering Committee

- Ensures that process improvement activities are in line with the business goals as established by the SMAB
  - Reviews the proposed budget for the improvement effort
  - Makes recommendations to the SMAB regarding program direction, budget, and program risks

Sample Improvement Infrastructure



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Steering Committee - 2

- Ensures that the necessary resources for the Working Groups and Process Group are available in a timely fashion
  - Establishes the WGs for specific purposes
  - Supports, where needed, negotiations for people's time
- Conducts program oversight reviews on a periodic basis
  - Ensures process improvement activities progress in line with documented budgets and plans
  - Performs or delegates review/approval of WG deliverables
- Provides visible support for the Process Group and WGs

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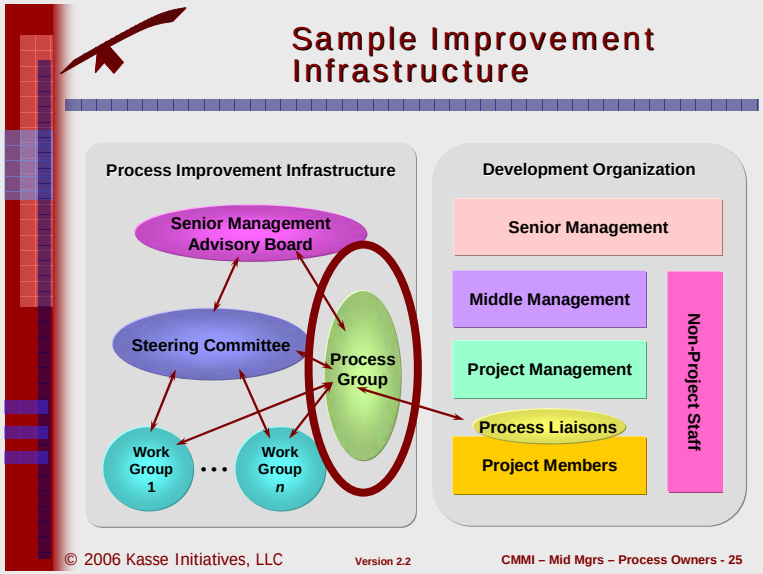
Process Group

- Focal group for action planning, process improvement, technology insertion, etc.
- Channel for institutionalizing knowledge of process methods, practices, and technology
- Champion of change
- Facilitator of improvement efforts at all levels
  - Organization
  - Project
  - Individual



What Does the Process Group Have to Know?

- Senior management strategic direction
- Organizational culture
- Organizational structure
- General knowledge of application domains
- Knowledge of modern software engineering techniques and methods
- Knowledge of software engineering standards (DoD, MOD, IEEE, ISO)
- Knowledge of software support activities such as QA and CM
- Managing Change
- Team Building
- Collaborative Consulting Skills
- Technology Transition
- Project Management
- Metrics

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Purpose of the Process Group

- Coordinate up, down, and across the organization
  - Conducts periodic SMAB reviews (at least quarterly)
  - Conducts periodic Steering Committee reviews (at least monthly)
  - Facilitates the activities of the Working Groups (daily)
  - Promotes technical awareness and education about process improvement

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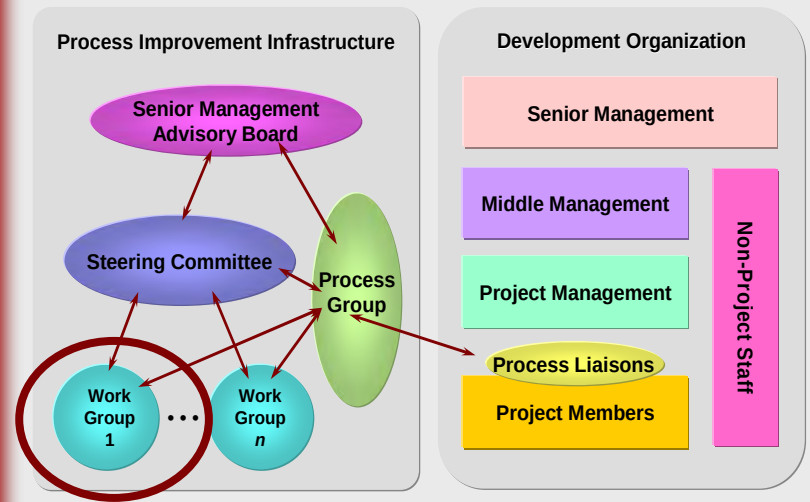
Working Groups (WGs)

- Develop the action plan for a specific focus area
- Develop new or improved processes, procedures, guidelines, templates, etc.
  - Based on a formally documented and approved plan
- Identify and evaluates technologies based on the organization's and project's processes
- Suggest and/or develop training plans
- Support the piloting of those processes

Sample Improvement Infrastructure



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- Evaluate pilot performance and revise the processes as necessary
- Report process improvement progress to the Steering Committee
- Share lessons learned on the Working Group with other Working Groups and project members
- Support the institutionalization of the tested and approved processes

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Proposed Membership of WGs

- WG Leader - (≥50%)
- Core Members - (≥30%)
- Process Group Representative - (≥100%))
- QA Representative - (≥30%)
- Members - (≥20%)
- Consultants - (5-10%)
- Reviewers - (5%)

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Middle Managers as Process Owners

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Middle Managers as Process Owners

- Process owners are often associated with those individuals who have the most technical expertise to lead a working group
- Middle Managers are the “owners” of the resources that must make the project successful AND the process improvement effort to happen
- When Middle Managers are the Process Owners, Senior Management is ensured that his or her vision and business objectives are being considered for each piece of the process improvement effort
  - Process improvement is no longer an exercise to satisfy the requirements of a model such as the CMMI

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Middle Managers as Process Owners - 2

- Middle Managers take the responsibility to ensure that the Process Group and especially the Working Groups have the proper resources, tools, and guidance to develop new processes or review existing ones and get them deployed on the projects
- Middle Managers must communicate with the Process Group and the Working Group members that are performing the process improvement activities for their focus area to:
  - Understand what progress is being made against the CMMI and other related standards and models
  - What barriers are holding the process improvement progress back
  - What changes must be made to make the process improvement effort more effective

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Middle Managers as Process Owners - 3

- Middle Managers can:
  - Offer the Working Groups guidance based on their interaction with the Senior Management team
  - Effectively utilize their power and status to overcome problems hindering the process improvement progress
  - Run interference for the change team
  - Protect resources for critical projects including the process improvement project so that all necessary work gets done
  - Continually update Senior Management on change process steps

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Middle Managers as Process Owners - 4

- Middle Managers can then ask for measures from the processes that are being developed and deployed on the projects and put themselves in a position to make risk management decisions based on data from process measures and not just “hope”
  - Increases their overall decision making capability
  - Puts them into a “control” position
- Senior Managers can expect accurate process improvement progress reporting

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Summary

- Make Middle Managers the Process Owners ensures that:
  - Ensure that Senior Management' vision and business objectives are being considered for each piece of the process improvement effort
  - They take the responsibility to ensure that the Process Group and especially the Working Groups have the proper resources, tools, and guidance
  - They communicate regularly with the Process Group and the Working Group members
  - Their power and status are effectively utilized to overcome problems hindering the process improvement progress
  - They protect resources for critical projects including the process improvement project
  - Accurate process improvement progress is reported to senior management against vision and business objectives

Case Study
ING (Postbank)

- Process improvement effort started in June 1996 with training and an assessment
- Process Group leader was given responsibility for the success of the process improvement effort and for achieving Maturity Level 2
- Middle Managers were not involved and frequently put up barriers to the Process Group
- Quality Assurance was not treated seriously
- Measurement existed at a bare minimum level

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Case Study
ING (Postbank) - 2

- After one full year had passed there was little progress to report
- Middle Managers were identified and assigned as “Process Owners”
  - Hated Process Consultants
  - Hated CMM
  - Hated Process Improvement
- Senior Manager held monthly process improvement progress meeting and asked Middle Managers what the progress was in regards to the focus area to which they had been assigned

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Case Study
ING (Postbank) - 3

- Quality Assurance became Quality Management
  - Core Team Members had 15-20 years of experience as developers, managers, and supplier managers (1%) of total development staff of 600
  - Every project had a less experienced Quality Coordinator
- The cultural change component of the process improvement effort was recognized and one culture coach was trained and assigned to every 10 developers

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Case Study
ING (Postbank) - 4

- Chief Architect became head of organizational-level CCB representing the architecture and business direction of the organization
- Process Group gained adequate numbers of full and part-time (≥50%)
- Middle Managers started to receive quantitative information about the successes and failures of the process improvement initiatives they were supporting putting them in the control position they had always sought
- Senior Manager clearly saw the process improvement initiative supporting their vision and business objectives

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Thank You

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You Shouldn't Have To Be An Engineer To Understand Your Process!

Raytheon Missile Systems
Mark Marsh and Lety Santillan

November 16, 2006

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Have you ever noticed how dry process is?

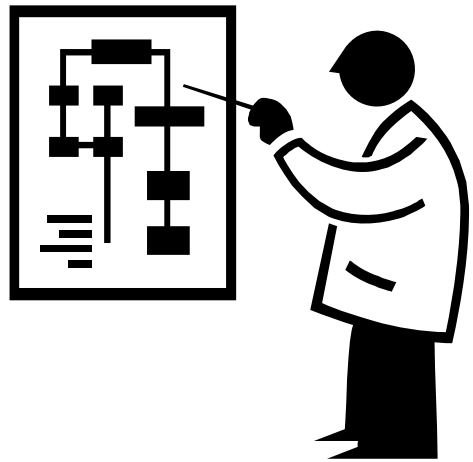
Raytheon
Missile Systems

Process for the Sake of Process Helps No One!

Processes are written to reflect the experience of the author

Raytheon Missile Systems

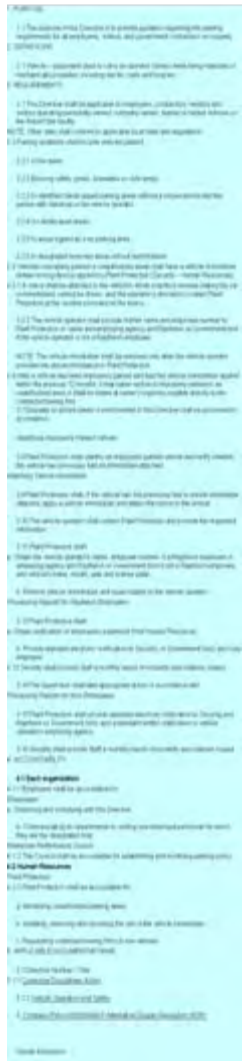
- Software Engineering led the process charge in the ’80s
  - Used Flowcharts
  - CASE tools
  - “data repositories”
- Object-oriented influences in descriptions
  - Subroutine processes
  - Instantiations of process
- Threads of processes (function points)
- Written for the worst case scenario
- Processes written to stand alone not to integrate with each other



Have you ever seen a GenXer use a flow chart?

Evolution of Process

- Process is not just for software anymore
- More and more “softer skills” use process
- They are picking up our “bad” habits
  - E.g. A parking instruction that is 4 pages long
  - Directives that contradict training materials



Who wants to read all this, anyway?

How do we see processes in real-life?

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Missile Systems

- One page fold out when you buy a computer
- Kneeboards for pilots
- Help bubbles onscreen
- The mysterious stranger that answers your questions in Final Fantasy or Second Life
- Help files
- FAQ's
- How your McDonalds order is completed

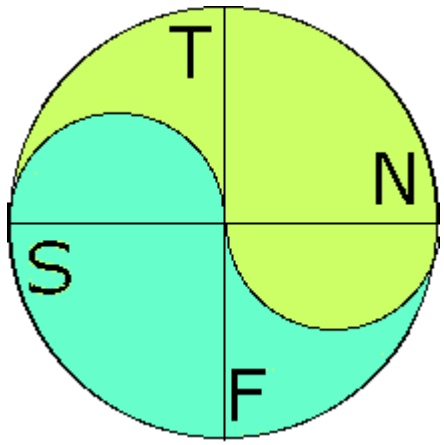
Are we confusing process requirements with what we really need?

Many different types of people use our processes

Raytheon
Missile Systems

- Many Authors
  - Carl Jung
    - Myers-Briggs
    - Florence Littauer
    - True colors
- Different types
  - Sensing
  - Thinking
  - Intuiting
  - Feeling

TRUE COLORS®



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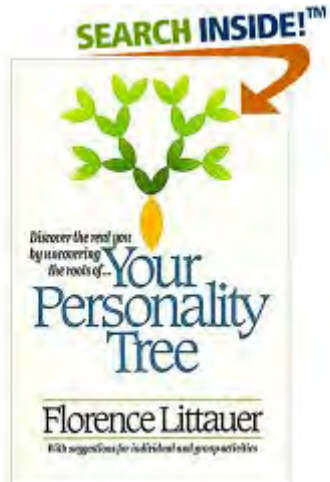

We are not all the same; we all positively contribute to the cause

Processes need to be understood

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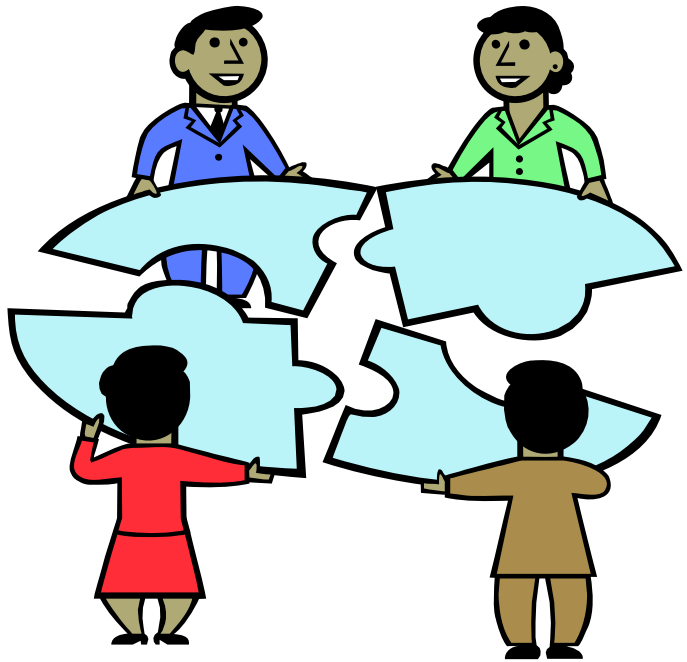
Missile Systems

- Issues with divergent understanding of processes results in classic interface failures and defects.
- The more types of people that work together on the team the more solutions they will come up with.
- Important to remember that Xer's and Millenniums have a different perspective than Boomers.



Can the new workforce use the process as it is written today?

Generational Diversity Who They Are

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Missile Systems

- Traditionalists: 1900-1945
  - Oldest and second smallest generation in the workforce
  - Experienced WWI and WWII, as well as the Great Depression
  - Faithful to an industry as well as an institution
  - Many are approaching retirement and are taking part time jobs
- Baby Boomers: 1946-1964
  - Largest generation in the work force
  - Raised in an era of extreme optimism, opportunity, and progress
  - Witnessed Vietnam and Watergate
  - Didn't learn to use computers until after they had entered into the workforce
  - Given credit for inventing the 60 hour work week
  - Team oriented, but highly competitive due to their large numbers
  - Are results driven but desire personal gratification
  - Tend to enjoy office politics, Workplace relationships are very important
  - Faithful to an industry

Does Generational Diversity Affect Process?

Generational Diversity Who They Are

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Missile Systems

- **Gen X’ers: 1965-1980**
  - Second largest generation in the workforce
  - Latch-key kids
  - Raised with TV's, microwaves, videocassette recorders, and personal computers
  - Grew up in a time of rising crime, drug use, and divorce rates of 40%
  - Need to know about the big picture, not just their piece
  - Technologically savvy and independent
  - Tend to dislike office politics, Seek a work/life balance
  - Every job is a stepping stone
  - Can be self-protective and skeptical
- **Millennials: 1981-1999**
  - Smallest generation in the workforce
  - Many are still in school, but some of the older millennials are entering the workforce
  - Never knew a time without computers
  - Parents could arrange their schedules around their kids' lives
  - Love technology and are extremely confident
  - Able to synthesize information and interpret what is important to them
  - View adults (elders) in their lives as people who will help them solve problems and will work in their best interest

How Can We Create Better Process for X’ers and Millennials

The Biggest Potential for Problems: X'ers and Boomers

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- Ways for X'ers to better work with Boomers
  - Show respect- be receptive to learning from the experience they have
  - Choose face-to-face conversations- technology came late to them and can be impersonal
  - Give them your full attention
  - Play the game- "Baby boomers are diplomatic and particularly adept at navigating politically charged environments"
  - Learn the corporate history- X'ers may come in with great ideas that require change, but understand where the company has come from first
- Ways for Boomers to better work with X'ers
  - Get to the point- state objectives clearly
  - Use email- a well worded, concise message can be more convenient than a meeting
  - Give them space- X'ers are independent and can figure out the best way for themselves to get results
  - "Get over the notion of dues paying"- X'ers grew up with parents who worked 60 hour weeks and had high divorce rates. They want to put in their 40 and go home. Rate them on ability, not time worked.
  - Lighten up- be open minded to new ideas and different ways of doing things. It's okay if work is fun.

Working Together We Can Improve Our Process

Learning Styles

- **Auditory-** Tend to prefer verbal instructions or talking about it with someone else. May become distracted by sounds or noises. Tends to forget faces but remember names or remember what you talked about. Prefers the telephone. Enjoys dialog and conversation**.**

- **Kinesthetic & Tactile-** Tend to gesture and use expressive movements. May become distracted by activity around them. They remember best what you did together. They prefer to jump right in and try it. Tend to ignore the directions and figure it out as they go along

- **Visual-** Tend to seek out pictures or diagrams. Look at directions and the picture. Tend to forget names but remember faces. Prefer direct, face-to-face, personal meetings. May become distracted by untidiness or movement

Which of these styles are your process written for?

Good Teams Need Well Rounded Process

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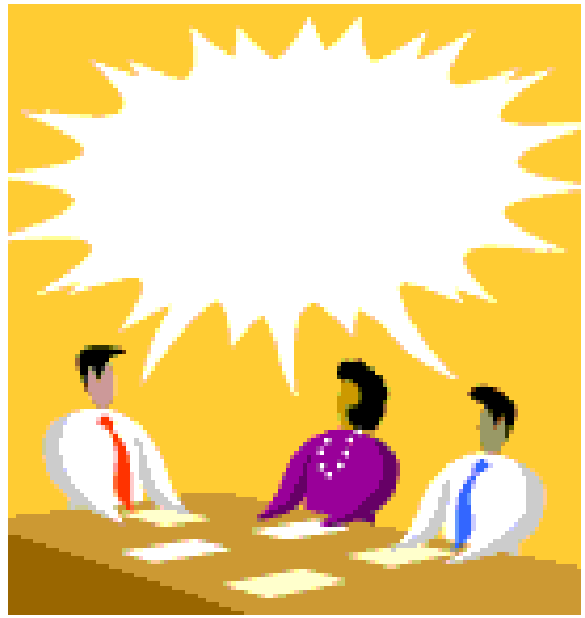
Missile Systems

- Robust teams include all types of learning styles
- As the Boomers retire can your new workforce use the process as it is written today?
- What is the impact on the company when processes are too complex for the new user?
- Verbose process is just wrong!!



True integrate teams need process that fits multiple styles

Things to Consider Creating Writing Process

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- Processes need to be understood by all learning styles
- Processes are tools to help one do things better, not just literary volumes
- The more simple the process appears, the easier it is to follow
- Be open to teaching the process in many different ways
- Put your self in the users spot is it still the best process
- Go out of your own comfort zone to accommodate different styles.
- Have fun!!

Process that are deployed in more than one style are more effective

Questions??

Thank you for your participation

Presentation Outline

Raytheon
Missile Systems

I. Introduction
II. How are processes captured
    a) SW wrote
    b) Flow Charts, Spaghetti, CASE Tools, Context Diagrams
III. Evolution of models
    a) Now looking at all types of disciplines/industries
    b) Don't understand well structured not well integrated
IV. Excerpt of IPO vs. Excerpt Securtiy/HR
V. Personality Types
    a) Process looks at 2 of 4 types
    b) Analytical and Action
    c) Blue and yellow have no idea what they are talking about
    d) Good team is well rounded all types of
VI. Take Aways
VII. Questions

I Have Had My CMMI Appraisal… What Do I Do Now? How to Establish a Process Improvement WBS

Aldo Dagnino
Director of Manufacturing Solutions

THE POWER TO KNOW.®

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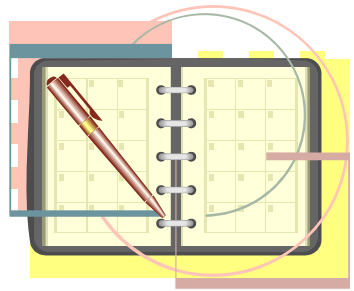
Agenda



- Introduction
- Work Breakdown Structure Characteristics
- Work Packages
- A Practical Example

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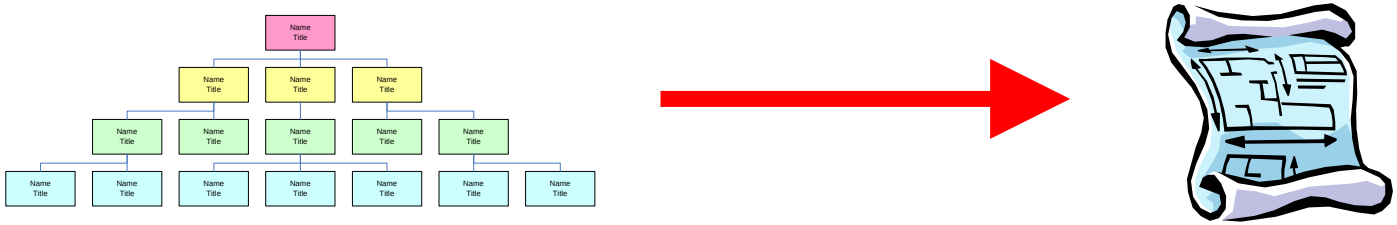
Problem Statement

- Creating a work breakdown structure (WBS) that will serve as a basis to create a process improvement plan utilizing the Final Findings obtained after a CMMI Appraisal



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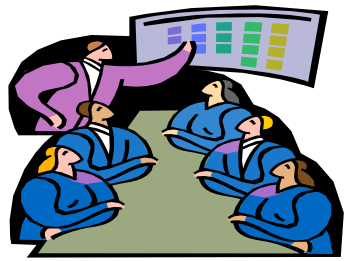
Assumptions



- A CMMI Appraisal has been recently conducted focusing on specific CMMI process areas (PAs)
- Findings from the appraisal provide details on strengths and weaknesses on the PAs in scope
- Details on weaknesses are actionable
- The Process Improvement team has experience developing plans

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CMMI Project Planning Process Area

- SG 1 – Establish Estimates
  - SP 1.1 - Estimate the Scope of the Project
    - **Establish a top-level Work Breakdown Structure (WBS) to estimate the scope of the project**
  - SP 1.2 – Establish Estimates of Work Product and Task Attributes
    - **Establish and maintain estimates of the attributes of the work products and tasks**
  - SP 1.3 – Define Project Lifecycle
    - Define the project life-cycle phases on which to scope the panning effort
  - SP 1.4 – Determine Estimates of Effort and Cost
    - **Estimate the project effort and cost for the work products and tasks based on estimation rationale**

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CMMI Project Planning Process Area

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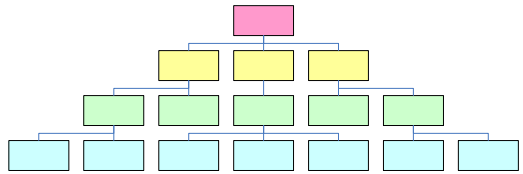
Sub-practices



- Develop a Work Breakdown Structure
- Identify work packages to specify tasks, estimates, responsibilities, and schedule

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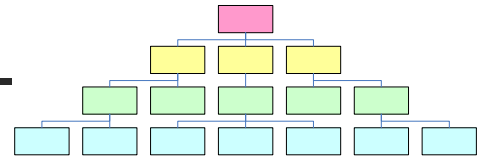
The Work Breakdown Structure – 1 –



- Serves to identify the work components needed to complete the development project
- It is the basis for size estimates
- The WBS is structured according to the way in which the work will be performed in the project
- The WBS reflects the way the project will be planned and tracked
- The WBS organizes the work into a hierarchical set of work relationships needed to accomplish the objectives of a project

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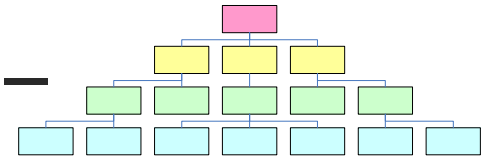
The Work Breakdown Structure – 2 –



- A top-level WBS serves to structure the initial estimates
- The WBS divides the overall project into an interconnected set of manageable components
- The WBS provides a scheme for identifying and organizing the logical units of work to be managed, which are called “work packages”
- The WBS provides a mechanism for assigning effort, duration, schedule, and responsibility
- The WBS is used as the underlying framework to plan, organize, and control the work done on the project
- The WBS allows to hierarchically organize the project
- The WBS provides a framework to track progress in the project

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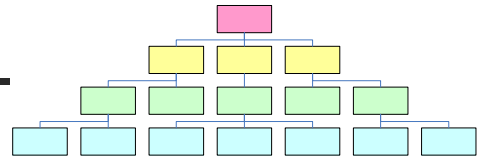
The Work Breakdown Structure – 3 –



- The WBS allows to identify:
  - Tasks associated with deliverables and supporting activities
  - Tasks for skill and knowledge acquisition
  - Tasks for development
  - Tasks for integration
  - Tasks for management of the project
  - Risks and associated mitigation strategies

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The WBS and Work Packages – 1 –

- The WBS identifies at the lowest level of the tree hierarchy “work packages” (WPs)
- WPs are units of work that can be assigned to a sub-team and can be individually tracked
- WPs is assigned a unique ID to be tracked in the Process Improvement Project Plan

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The WBS and Work Packages – 2 –

- The WBS Contains, at its lowest level, information related to:
  - The scope of the work to be performed
  - A list of deliverables associated with the work packages
  - A list of required resources to complete the work
  - Required skills and knowledge to complete the work

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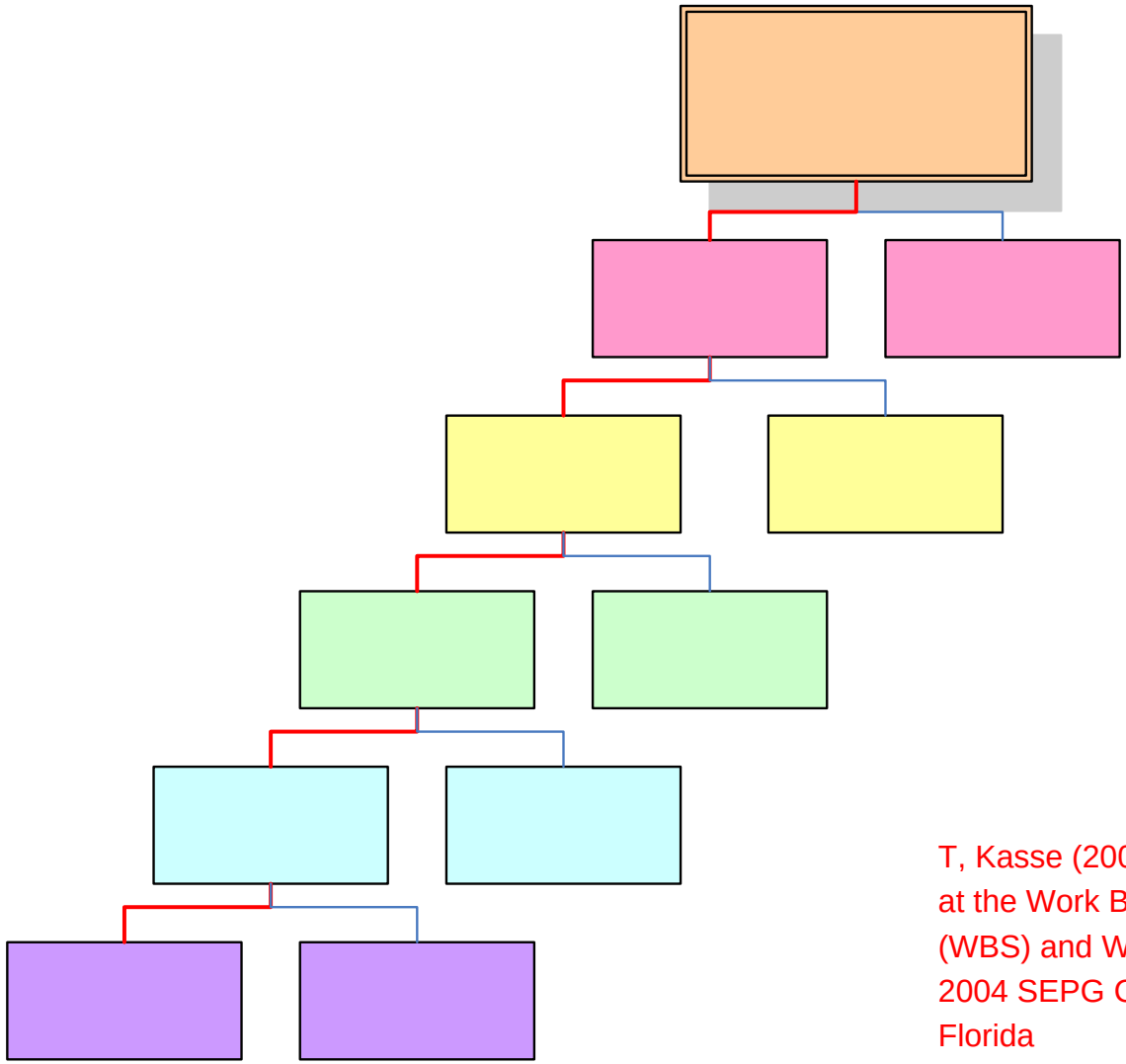
Six-level WBS Tree Hierarchy



T, Kasse (2004) " A Detailed Look at the Work Breakdown Structure (WBS) and Work Packages", 2004 SEPG Conference in Orlando, Florida

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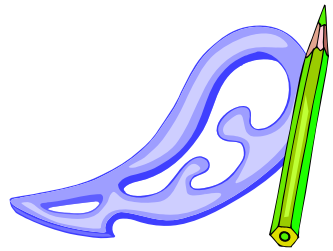
Work Package Template



Project Name

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An Example: Geographically Dispersed SW Development at SAS

- Sister development organization in India
- Often remote collaborative software development
- Management of remote development often based on personal relations
- Certain projects require more structured approach to manage remote software development, especially for newly formed groups

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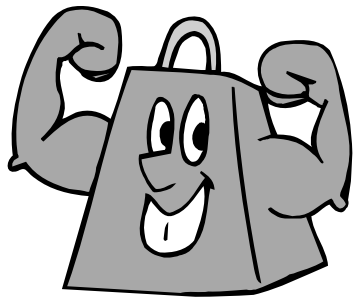
Findings CMMI Internal Class B Appraisal – 1 –



- Strengths
  - **Organizational policy to manage external suppliers exist**
  - **Supplier Agreements for COTS products are developed**
  - **COTS products are evaluated against requirements**
  - **Supply Chain Management handles the purchasing of commercial components for HW, SW and contractors**
  - **Remote sister Development organization uses same RE, CM, and defect tracking tools as Cary team**

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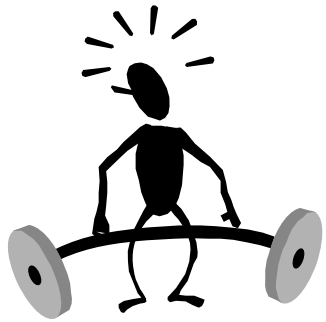
Final Findings – 2 –



- Weaknesses
  - **No organizational policy to manage remote development with sister organizations**
  - **No organizational procedure to manage development activities with sister organizations**
  - **No formal agreements are established with remote development teams in sister organizations**
  - **Transition of work products provided by sister organizations performed in informal manner**

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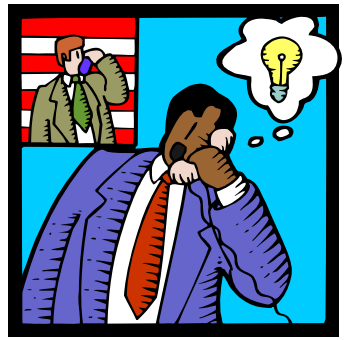
Final Findings – 3 –



- Recommendations
  - **Develop SAM Procedure and Process Map for remote development**
  - **Pilot SAM procedure**
  - **Integrate R&D SAM and Supply Chain Management procedures**
  - **Institutionalize SAM Process**

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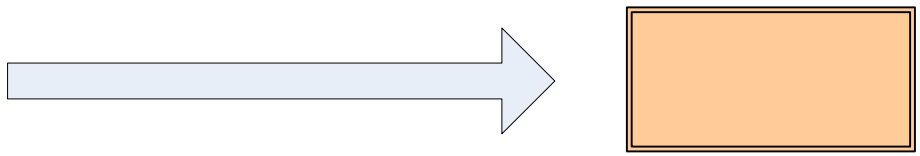
Project Goal Level WBS



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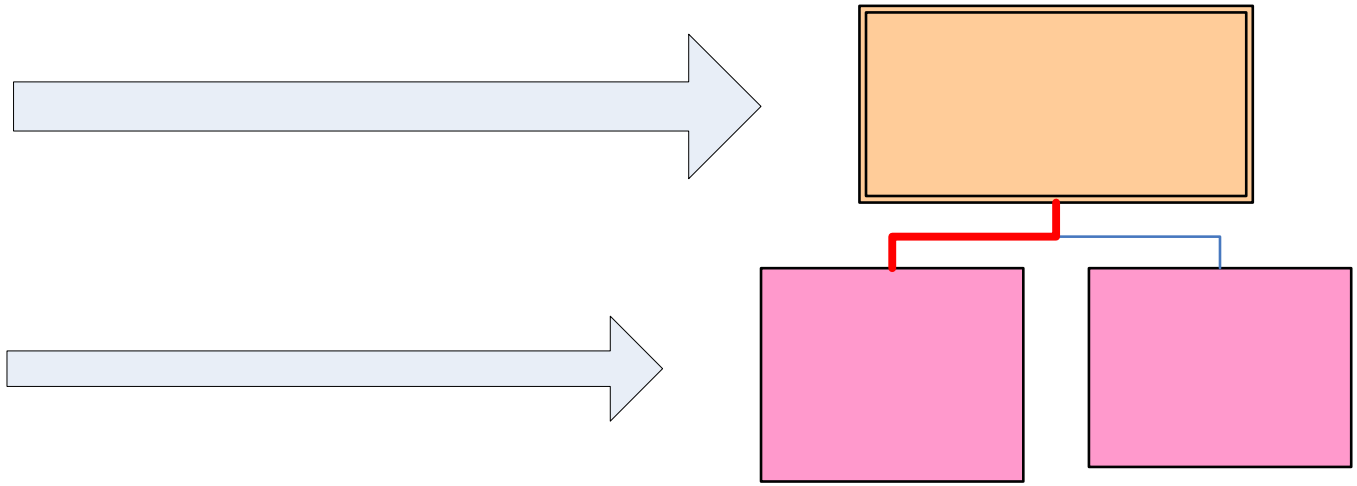
Project Level WBS



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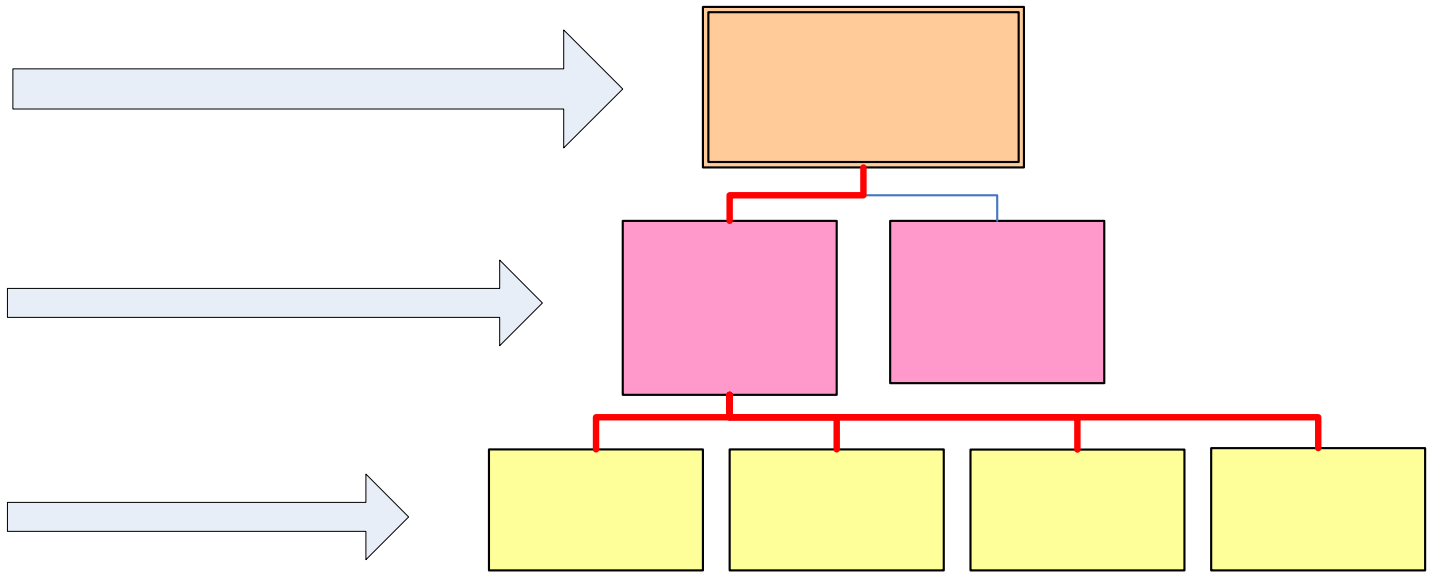
Task Level WBS



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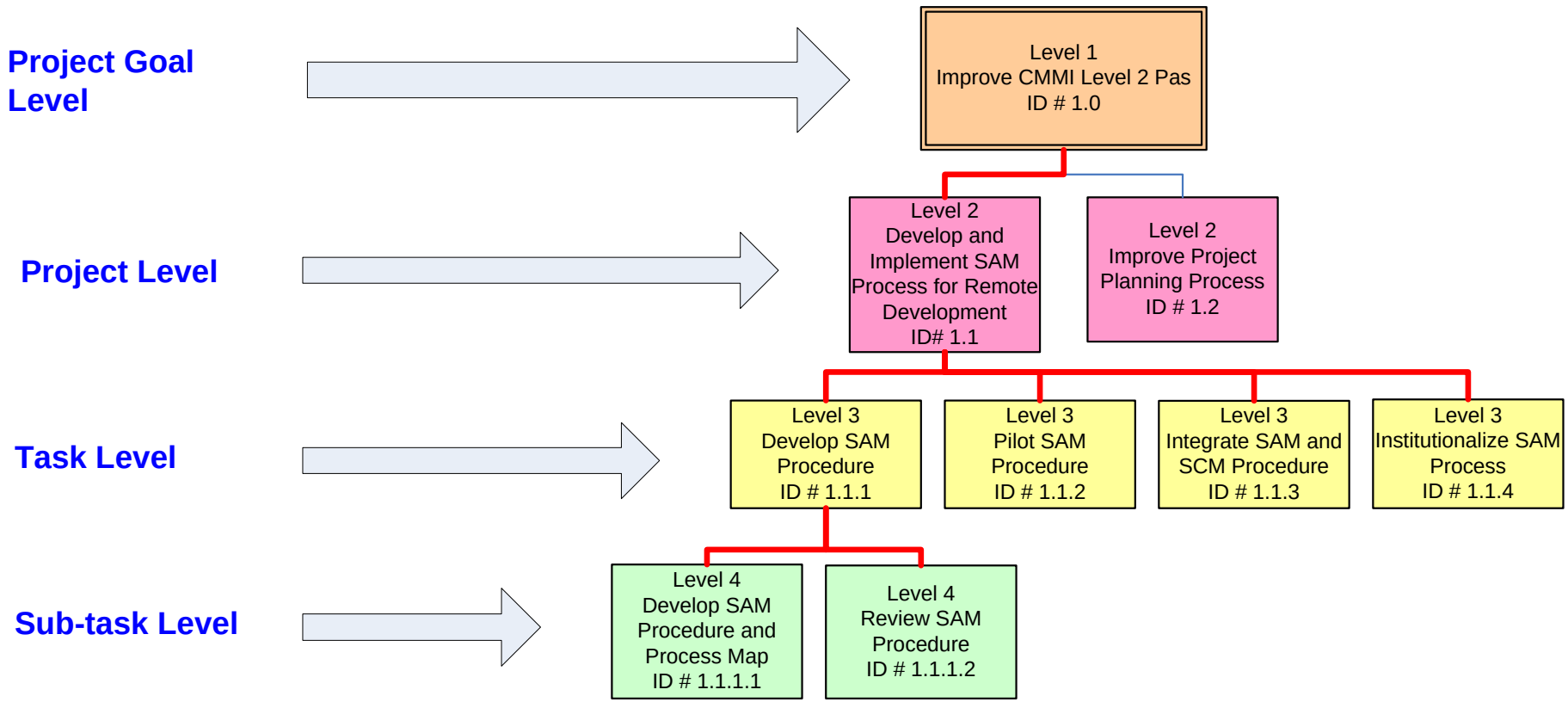
Sub-task Level WBS



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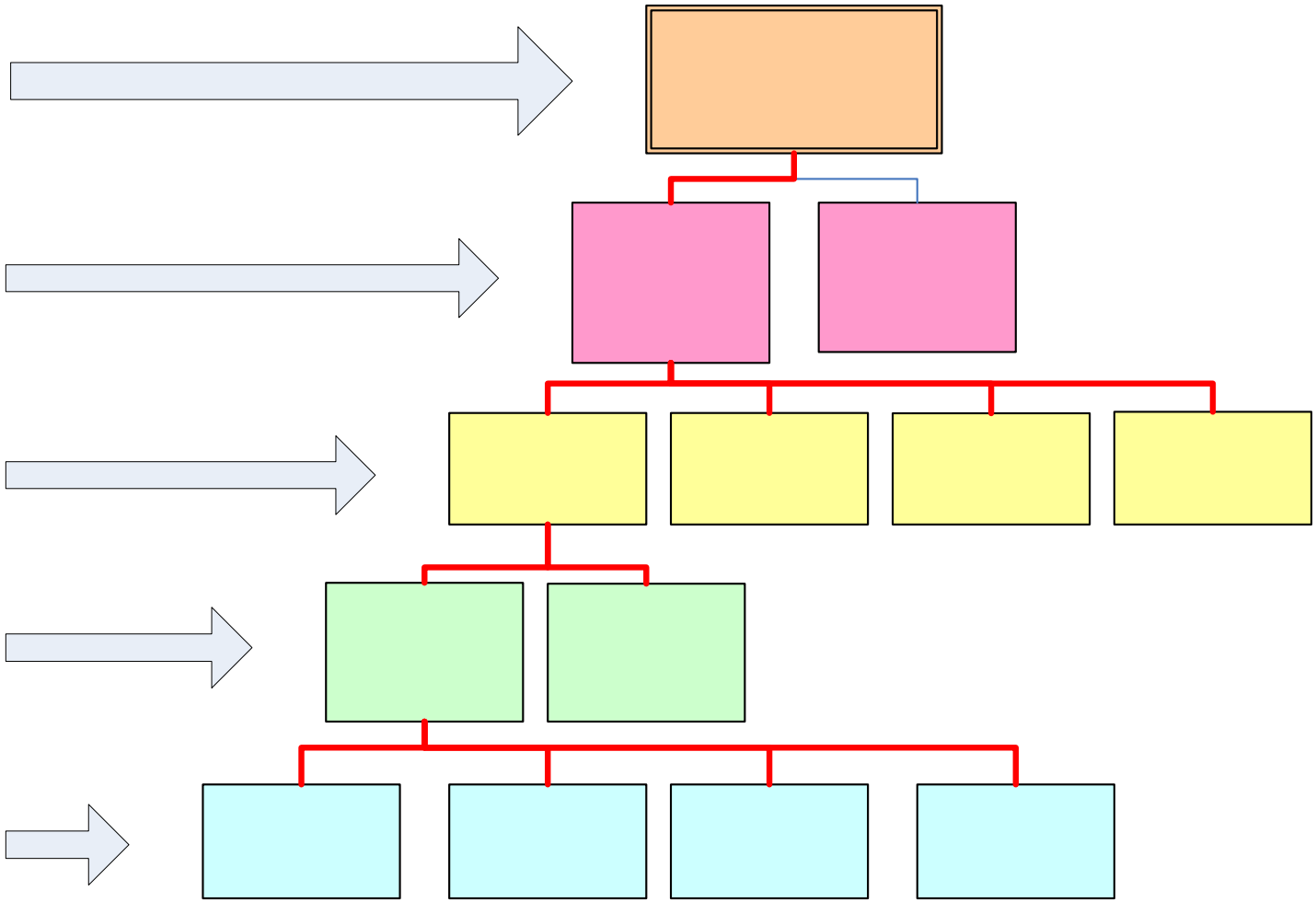
Work Package Level WBS



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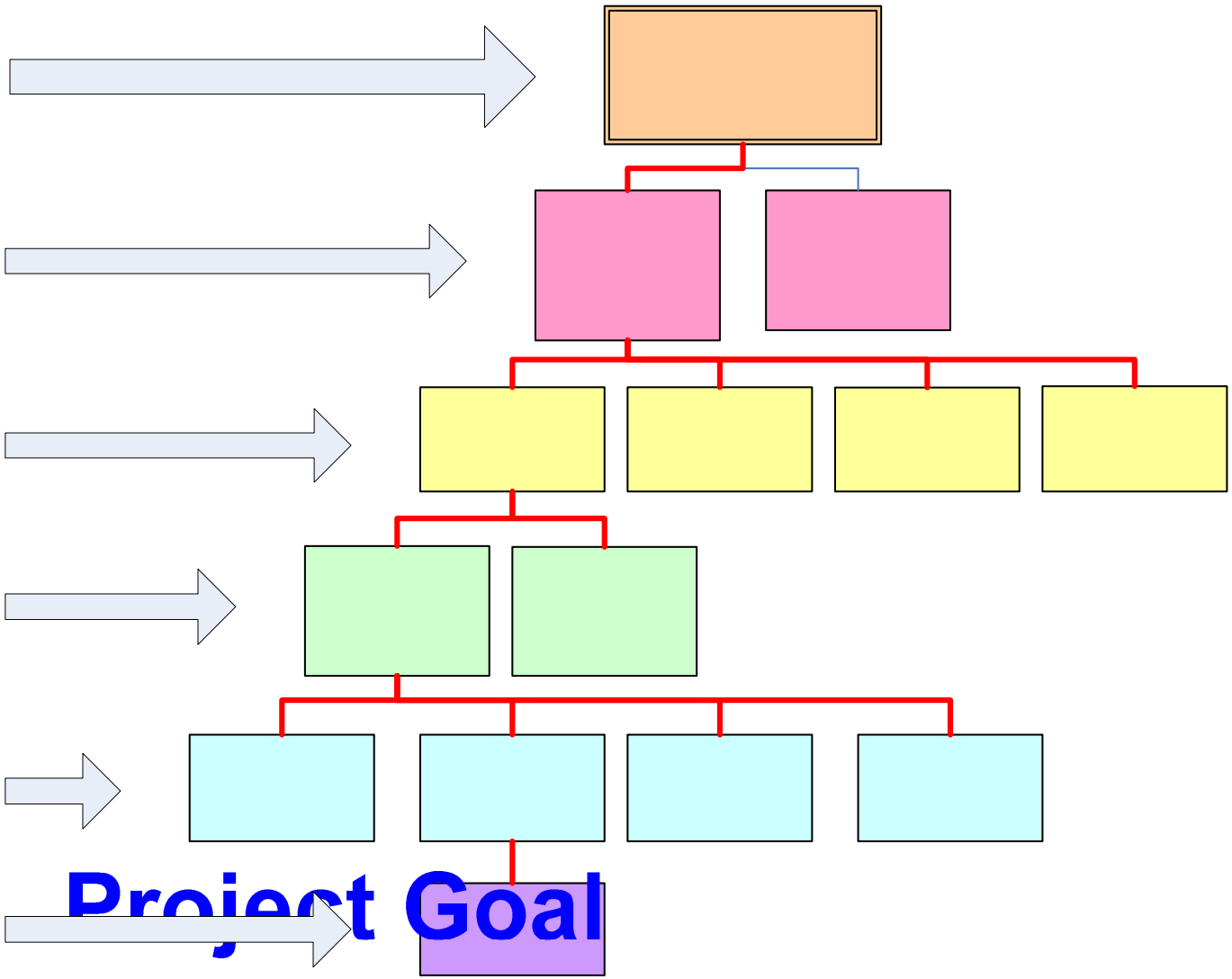
Effort Level WBS



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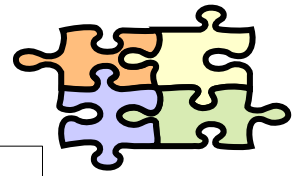
Work Package and Effort



Project Name	**Revision # and Date**
Develop and Implement Supplier Management Process for Remote Development Activities	*V 3.1 June 12, 2006*
Work Package Name	**Work Package #**
Brainstorm R&D SAM Procedure	*1.1.1.1.2*

Work Package Description

A group of selected domain experts in managing remote development in the past will brainstorm a viable process to follow in order to better manage remote development activities. An initial process map document will be created as the brainstorming session is carried out. Minutes of the meeting will be taken. The brainstorming session will begin with a presentation of the CMMI SAM PA by the SAM EPG

Deliverable(s)

Deliverable includes a first draft of the SAM process map and minutes of the brainstorming meeting that will be used as input to WP # 1.1.1.1.3

Guidelines for Work

Follow the organizational standards required in the development of new processes in the organization and process maps

People	Skills	Size Estimate	Time Estimate
SAM EPG Lead	CMMI SAM PA and facilitation expertise	2 page process map with medium level of difficulty	8 hours per person
Project Manager 1	Project Mgmt expertise		
Project Manager 2	Project Mgmt expertise		
Development Manager in India	Development expertise		
Development Manager in Cary	Development expertise		
Scribe	Mapping expertise		

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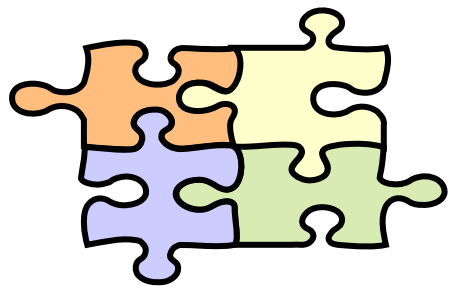
WBS in Detail Created by SAM EPG

- **Develop and implement SAM process (policy, procedure, and process map) for remote development**
  - **Develop SAM Procedure and Process Map for remote development**
    - **Design and Develop SAM Procedure and Process Map**
      - **Review Supply Chain Management Policy and Procedure**
      - **Brainstorm among SAM team new R&D SAM procedure**
      - **Document SAM process map**
      - **Document SAM procedure**
    - **Develop few relevant SAM metrics**
      - **Metrics required within the SAM procedure**
      - **Metrics to measure effectiveness of SAM procedure**
    - **Document required SAM templates**
      - **Remote Development Agreement**
      - **Metrics template**
  - **Pilot SAM procedure**
    - **Identify two pilot projects**
    - **Implement pilot projects identified**
    - **Implement pilot SAM metrics**
    - **Monitor pilot projects**
    - **Document lessons learned**
    - **Refine and finalize SAM procedure**
  - **Integrate R&D SAM and Supply Chain Management procedures**
    - **Identify all of the supply chain processes**
    - **Review R&D SAM and SCM processes jointly.**
    - **Identify interface points**
    - **Ensure that SCM representatives participate on the contract management team**
  - **Institutionalize SAM Process**
    - **Develop SAM Policy**
    - **Develop SAM Process training materials**
    - **Train organization relevant stakeholders**
    - **Implement new SAM process in all new development projects**
    - **Monitor SAM process in all projects**



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Conclusions

- It is necessary to go deeper than the information typically obtained in the Appraisal Final Findings
- Carry the work breakdown structure tree to the level at which you can define self-contained and measurable tasks that can be assigned to specific individuals or smaller team
- Decide on how you want to track your Process Improvement project
- Make sure you involve the people that are and will be directly involved in the specific process being improved

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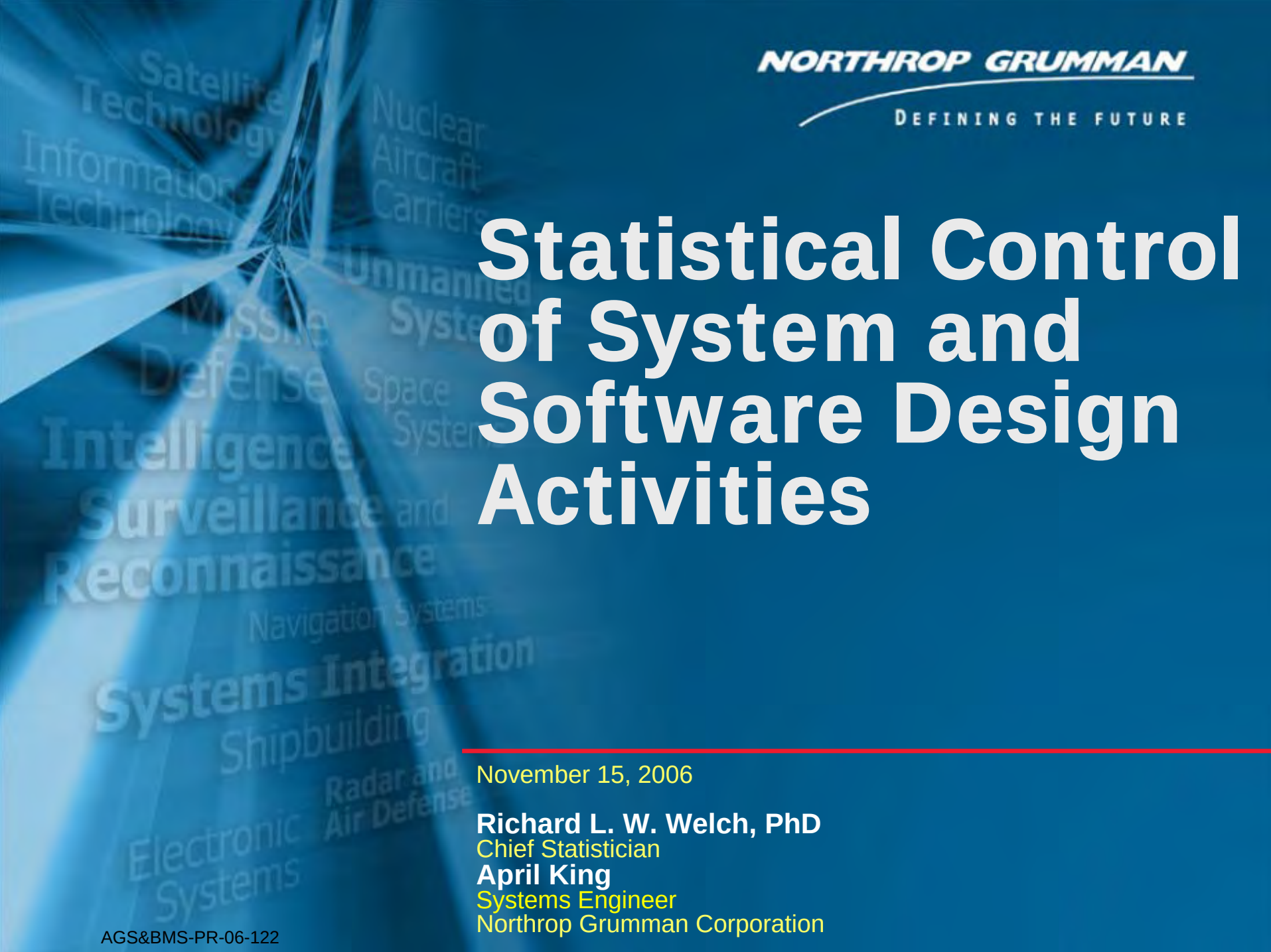

Statistical Control of System and Software Design Activities

November 15, 2006

Richard L. W. Welch, PhD
Chief Statistician
April King
Systems Engineer
Northrop Grumman Corporation

AGS&BMS-PR-06-122

Topics

- **Organizational overview**
- **The challenge of SPC early in the life cycle**
- **Practical difficulties & how we addressed them**
  - Process selection
  - Data rates
  - Statistical innumeracy
- **Ongoing issues**

- **Math details (for reference only)**

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Corporate Overview

- **Comprehensive business portfolio to address the defense and government markets**
  - Systems integration
  - Military aircraft
  - Unmanned aerial vehicles
  - C4ISR
  - Defense electronics
  - Information technology and networks
  - Naval shipbuilding
  - Space and missile defense
- **2005 sales of $30.7 billion**
- **125,000 people; 50 states; 25 international countries**
- **Headquartered in Los Angeles, CA**

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Northrop Grumman Integrated Systems

Electronic Systems	Information Technology	Integrated Systems	Newport News	Ship Systems	Mission Systems	Space Technology	Tech Services
Jim Pitts	Jim O'Neill	Scott Seymour	Michael Petters	Phil Teel	Jerry Agee	Alexis Livanos	James Cameron
President	President	President	President	President	President	President	President

Western Region
Gary Ervin

AEW & EW Systems
Duke Dufresne

AGS & BM Systems
Alan Doshier
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Deputy

Premier Aerospace and Defense Systems Integration Enterprise

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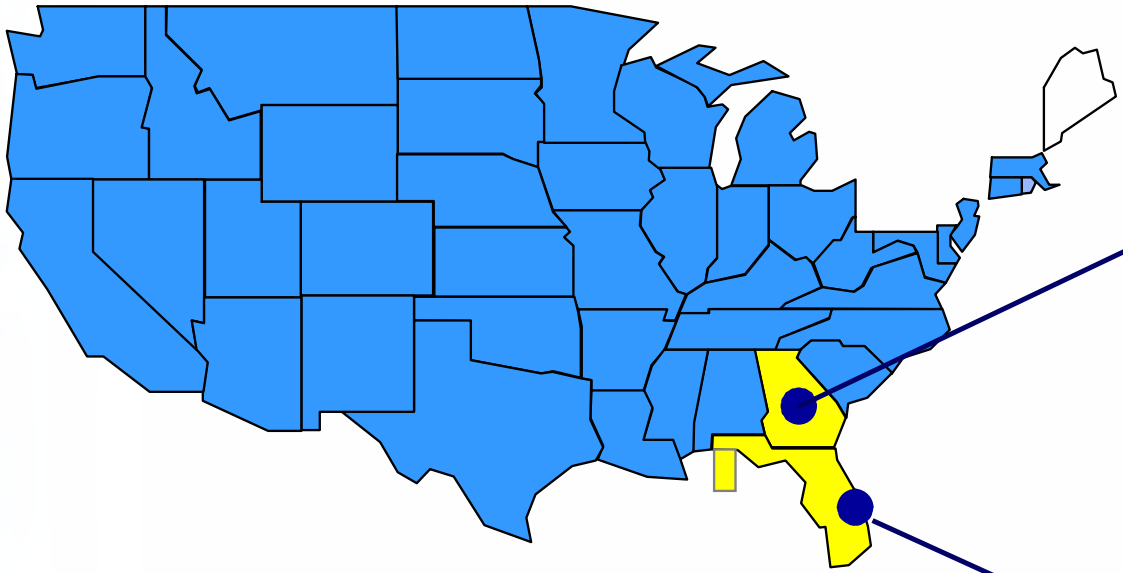

Joint STARS MOB

Level 5 CMMI-SE/SW/IPPD/SS	6/06
Level 5 CMMI-SE/SW	4/05
ISO 9001:2000/TickIT	9/04

Sys. Integration

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Where We Were

- **First demonstration of CMMI[SM] Level 4 and 5 capabilities focused on code inspections and peer review of test plans, procedures and reports**
  - High data rates inherent in these “back end” processes helped us to understand and overcome statistical difficulties
  - We gained practical lessons learned on the obstacles that had to be overcome
  - Senior author developed innovative log-cost model presented at 2005 CMMI[SM] Technology Conference and User Group
- **Positive business benefit (& successful CMMI[SM] Level 5 appraisal) resulted in strong senior management support to expand**

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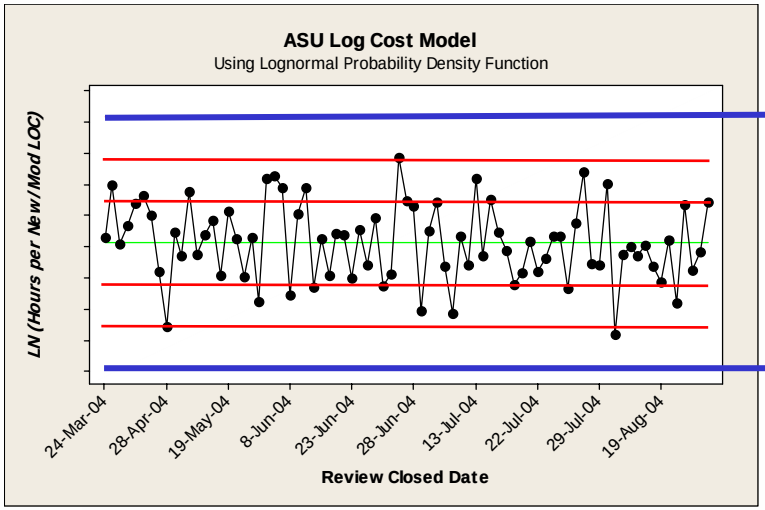
SPC Determines the Voice of the Process

Quantitative Project Management



Upper Control Limit

Average performance

Lower Control Limit

A stable process operates within the control limits 99.7% of the time

Analysis of

- **Special cause variation** focuses on recognizing & preventing deviations from this pattern
- **Common cause variation** focuses on improving the average and tightening the control limits
  - Offering opportunities for systematic process improvement that NGC & industry benchmarks indicate will yield an ROI averaging between 4:1 & 6:1

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Challenge

- **Desire to introduce successful SPC techniques for quantitative project management in the "front end" system and software design phases**
- **When coding starts**
  - Product development is one-half over
  - Opportunities to recognize and correct special & common cause variation in the design process are gone

DoD studies indicate first-year decisions determine up to 70% of total life cycle cost. Early, effective statistical control offers great practical benefit

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Practical Difficulties at Level 4

- **Getting started**
  - Selecting good candidates for statistical management
- **Little historical data & inherently low data rates**
  - Process model for successful statistical control
- **Statistical innumeracy**
  - Discipline needs to own the right skill set

- **Cautionary note: this assumes you have also taken care of the basics (CMMI[SM] Level 3)**
  - Budget and charter
    - Project impacts
  - Metrics infrastructure across engineering
    - Metric definitions
    - Data collection mechanisms
    - Consistency of processes across projects

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Getting Started

Process Selection for Statistical Management

- **Statistical control is imposed on sub-processes at an elemental level in the process architecture**
- **Processes are selected based on their**
  - Business significance – “sufficient conditions”
  - Statistical suitability – “necessary conditions”
- **Business checklist**
  - Is the candidate sub-process a component of a project’s defined “key” process?
    - Is it significant to success of a business plan goal?
    - Is it a significant contributor to an important estimating metric in the discipline?
  - Is there an identified business need for predictable performance as projects execute the subprocess?
    - Cost, schedule or quality

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Statistical Checklist

PRINCIPAL FACTORS INVOLVED IN SUB-PROCESS SELECTION FOR STATISTICAL PROCESS CONTROL		
PRIMARY QUESTION	**SUPPORTING QUESTION**	**DEMONSTRATED INDICATOR**
Are data collected?	Does the data collection system require update or redeployment?	Data collection system ready for deployment
What is the data rate? That is, how often will the process be repeated on the project?	Will the process be repeated frequently enough to develop control limits if such limits do not exist from baseline historical performance?	At least 20-30 data points exist or will be produced
Are there historical performance data?	Stable performance: Will the process be performed in roughly the same manner as on previous projects?	A documented procedure or training materials are used by those performing the process
Has a control metric been identified?	Has statistical analysis of past project performance identified measures that are indicative of overall process performance?	Control metric can be computed from the collected data
Does a baseline exist for the control metric?	What are the average and statistical variation of previous performance?	Performance excursions outside the control limits can be identified & attributed to their root causes
Do specification limits exist for process performance? (Optional)	Do limits exist beyond which process performance is deemed unacceptable?	Specification limits are documented

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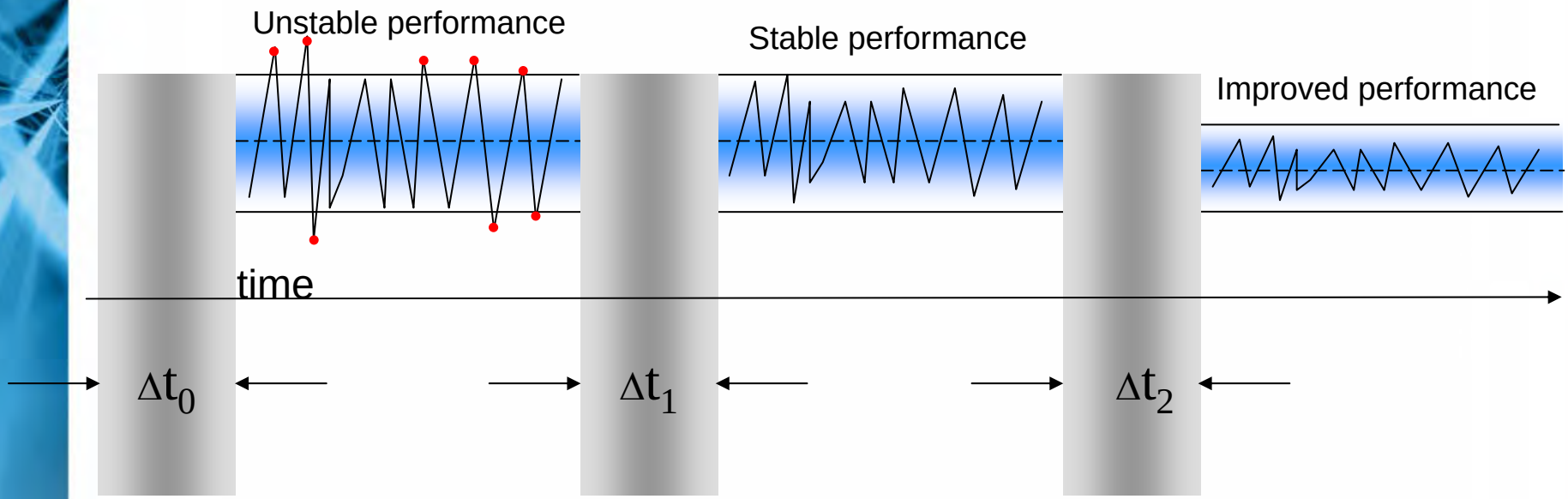
The High Maturity Data Dilemma



Δt_0 :
- Process selection
- Analysis of suitability for SPC

Δt_1 & Δt_2 :
- Identify improvement proposals
- Evaluate & prioritize proposals
- Select improvement
- Pilot improvement
- Deploy improvement

We can minimize Δt_0, Δt_1 & Δt_1 by careful management, but the length of the data runs will depend on the periodicity of the process itself

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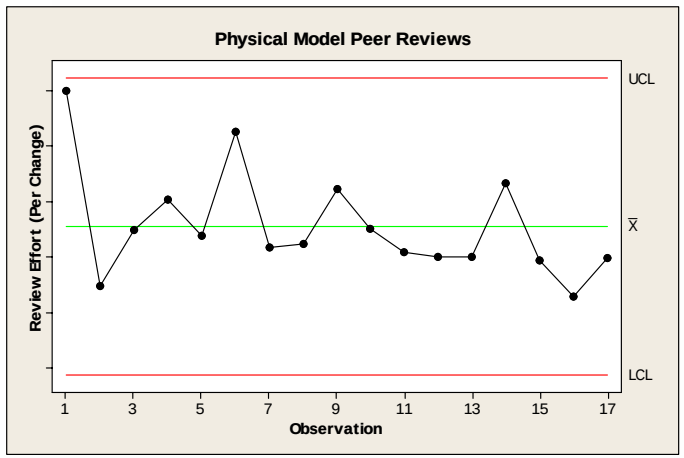
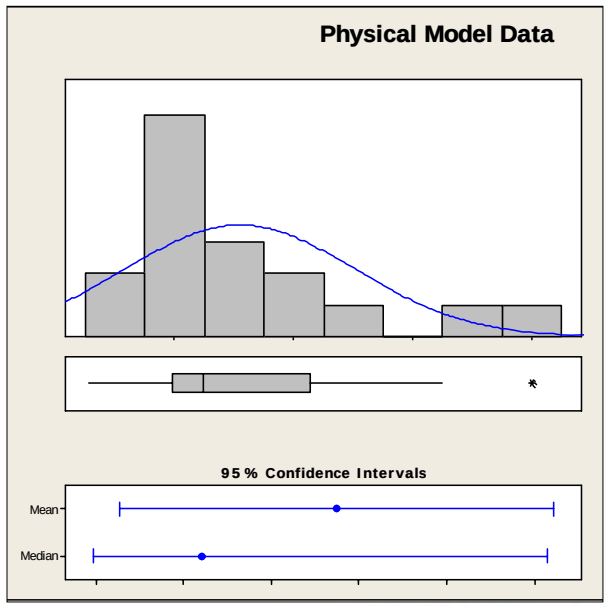
Reality at the Front End of the Life Cycle

- **9 candidate systems & software design processes identified for statistical management**
  - Small sample issues present
  - Control charts may look OK
  - Further analyses show data skews
  - How do we find the best model?





Anderson-Darling Test for Normality $p < 0.025$

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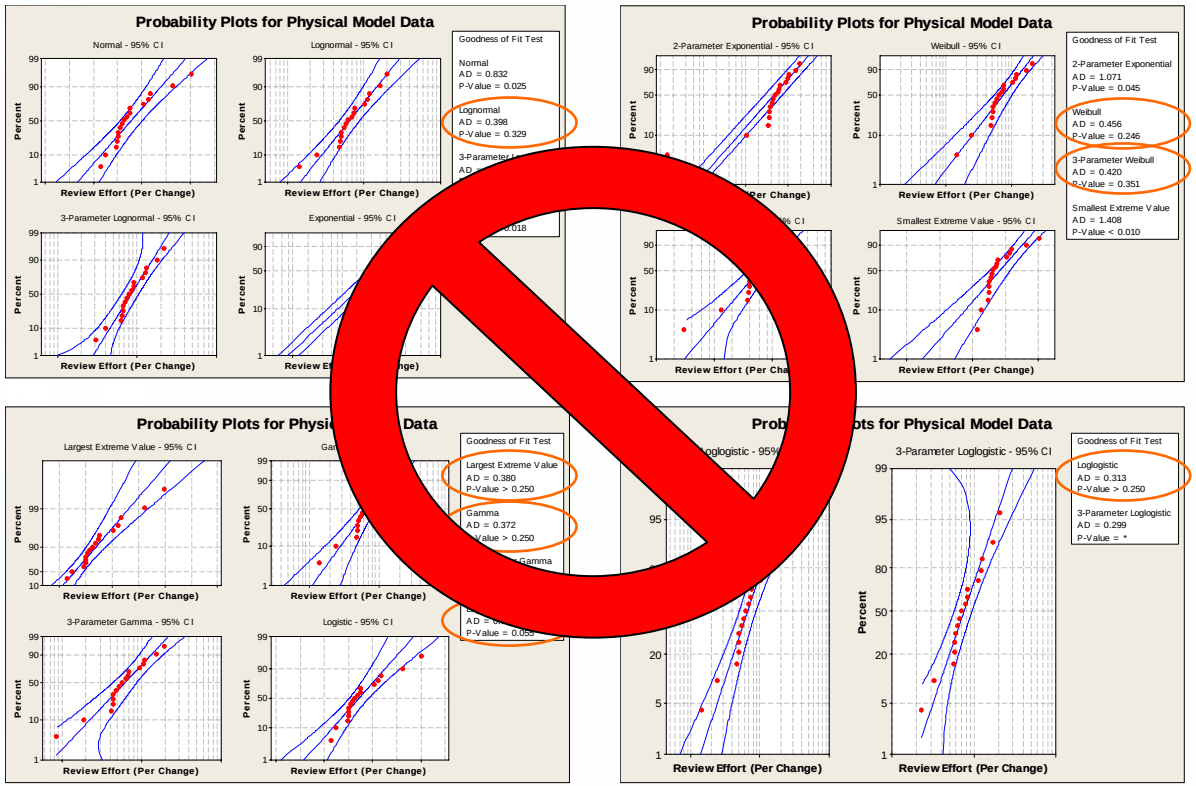
Finding the Right Model Is Not a Random Hunt!

- **Minitab's Individual Distribution Identification tool**
  - 14 simultaneous goodness-of-fit tests



- **7 models "pass" – what next?**
- **What happens when you collect one or two more data points?**
- **In this case, one of the models is actually correct!**
  - But you'll never be able to prove it like this

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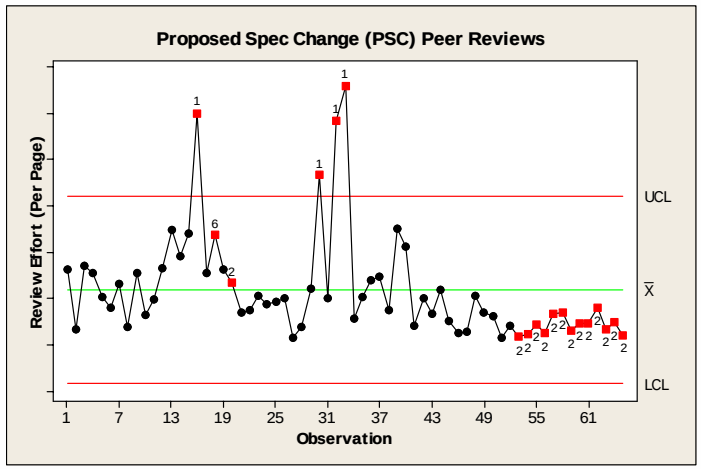
More Data

- **Larger samples don't solve everything**
  - How can you show this process is stable and in-control?
  - And if we can't control the effort, how can we compare defects in a meaningful way?



Anderson-Darling Test $p < 0.005$

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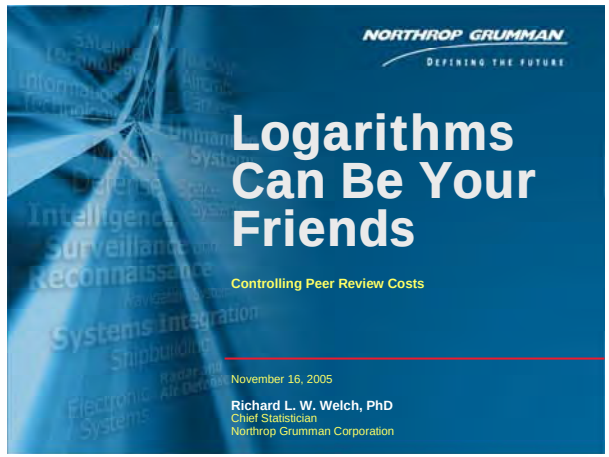
Stabilizing the Data

- **Senior author's presentation at last year's CMMI[SM] Technology Conference demonstrated the applicability of a log-cost model to control software code inspections**



  - Peer review effort behaves like commodity prices in the short term
  - The math is applicable to any per unit "price" of a repeatable engineering effort
  - Using natural log transforms data to normal distribution

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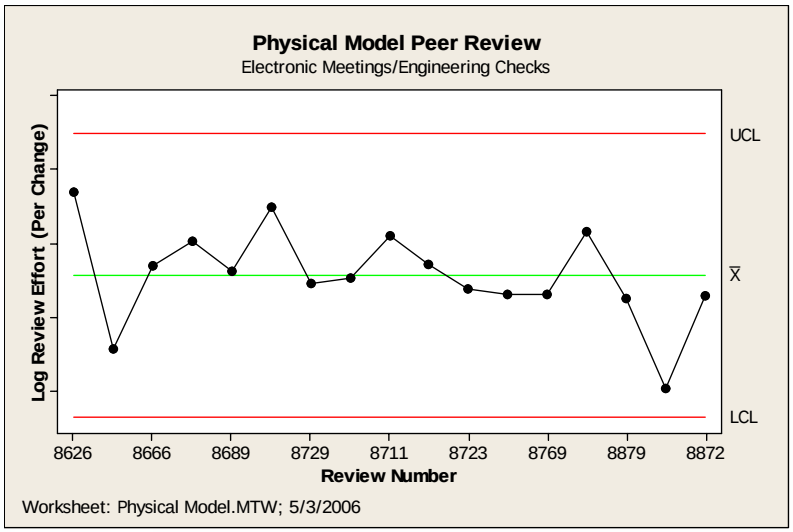
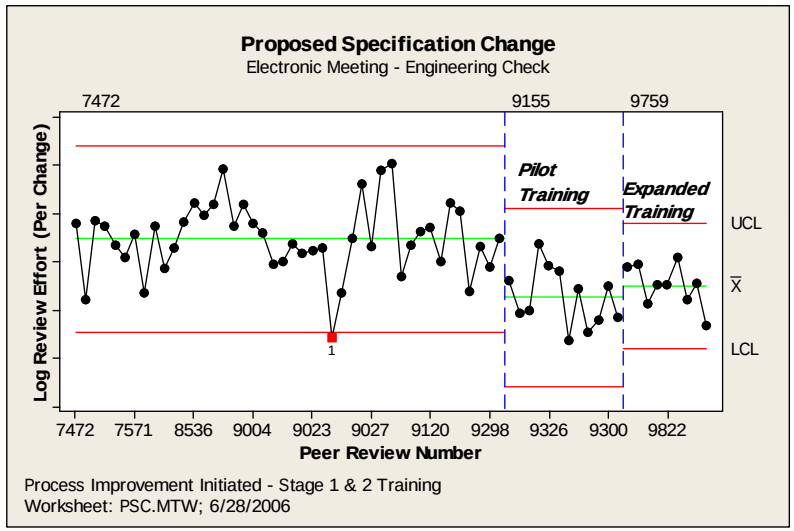
Log Transformed Series

Physical Model and PSC Examples



Anderson-Darling Test p < 0.329



Anderson-Darling Test p < 0.919

- **Can you eyeball the difference with slide 13?**

- **Did you realize slide 15 had**
  - 2 buried improvement cycles?
  - Only 1 special cause point - which wasn't flagged?

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The Two Models Compared

Raw Data

- **11% false alarm rate (Chebyshev's inequality)**
  - *Penalizes due diligence in peer reviews*
- **No meaningful lower control limit**
  - *Does not flag superficial reviews*
- **Arithmetic mean distorts the central tendency**
  - *Apparent costs can exceed budget*

Log-Cost Transformation

- **False alarms minimized**
- **Meaningful lower control limit**
- **Geometric mean preserves the budget**
  - *OK, you still have to find the antilog*
- **Dramatically improves the evidence of stability and control**

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Overcoming Statistical Innumeracy

Success Factors

- **Minitab**
- **"Dark green belt" training**
  - Curriculum tailored to focus on applied statistical techniques and Minitab familiarity
  - Deming principle applied in the class room
    - In God we trust, *all others bring data*
  - Lean and process management training covered in other courses
- **Green belt community of practice**
- **Chief statistician**

Key success factor: management recognition & support for the investment

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Statistically Managed Processes

Systems & Software Baselines

- **System Engineering**
  - System design & system architecture peer reviews of
    - System threads
    - System model (structure diagrams)
    - Physical model
    - UML diagrams
  - System & software requirements peer reviews of
    - Proposed specification changes (PSCs)
- **Software Engineering**
  - Software design peer reviews of
    - Software threads
    - Physical model
    - Component/task descriptions
    - Data model
  - Software code inspections
  - Software build process
  - Software build returns
  - Software test returns

Most are applicable to early life cycle phases

Note: baselines highlighted in blue use the log-cost model.

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Statistically Managed Processes

Other Engineering Baselines

- **Test & Engineering**
  - Peer reviews of test plans, procedures & reports
  - System Integration Lab (SIL) scheduling
- **Avionics**
  - Discrepancy Inspection Report (DIR) processing
  - Avionics Drawing Sign-off
  - Field Service Engineering Request (FSER) processing
  - Management of seller issues
- **Vehicle Engineering**
  - Electro-mechanical drawing errors
  - Vehicle subsystems (i.e., crew & equipment) drawing errors
- **Logistics**
  - AF Tech Order (AFTO) processing of the
    - Total contractor schedule
    - LSA group schedule
  - Integrated electronic technical manual (IETM) delivered quality

Statistically managed baselines span all life cycle phases & engineering disciplines

Note: baselines highlighted in blue use the log-cost model.

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Ongoing Steps

As a consequence of the successful expansion across all engineering disciplines and all life cycle phases, we have recognized the need to grow the infrastructure of trained, experienced statistical practitioners at the mid-level

- **Sector standards for certifying Green Belts, Black Belts & Master Black Belts**
  - Training
  - Project portfolio
- **Developing Black Belts cadre**
- **Future Master Black Belt cadre**

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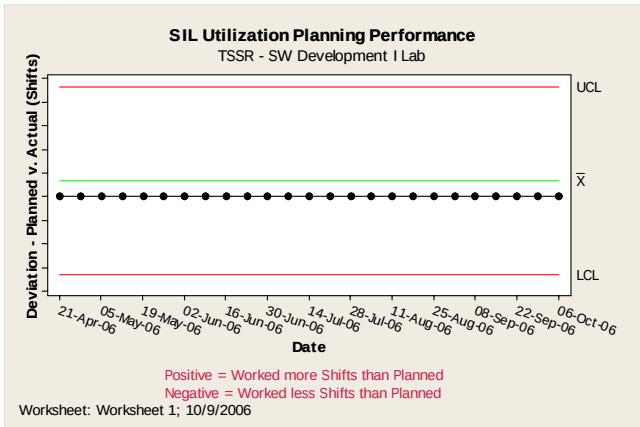
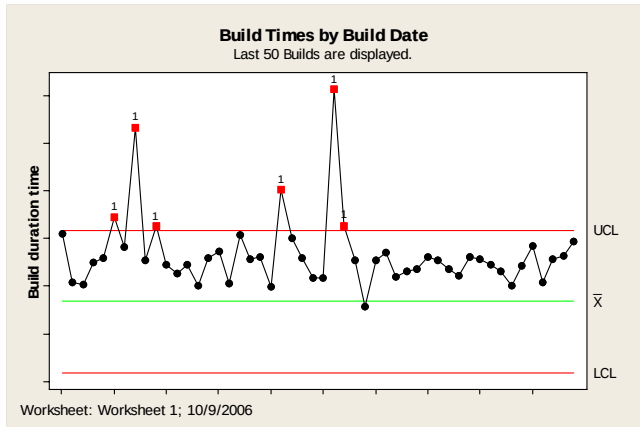
Pitfalls

- **Dealing with what was taught, but not learned in Green Belt class**
  - Monthly data won't work
    - It takes 20-30 months to accumulate 20-30 points
  - After-the-fact hypothesis testing is not a designed experiment
  - A time series is not a random variable
  - "Between the lines" doesn't mean in-control





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QUESTIONS

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DEFINING THE FUTURE

Reference Slides

From Last Year's Presentation

Math Details

- **Consider a stochastic process . . ., X_{-2}, X_{-1}, X_0, X_1, X_2, . . . that represents an asset price recorded over time, like a daily sequence of prices for shares of a stock or other commodity**
- **We assume at time t that the realization x_t of X_t is known, but the realization x_{t+1} of X_{t+1} is unknown**
- **The single-period log-return, $ln(X_{t+1}/x_t)$, is random and assumed to be normally distributed, at the given time t**
- **Under these assumptions, X_{t+1}/x_t is a lognormally distributed random variable, and therefore, so is X_{t+1}**

Math Details extracted from:
http://www.riskglossary.com/articles/lognormal_distribution.htm

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Salient Properties of the Model

- **When log-returns are normally distributed, the corresponding prices are lognormally distributed**
  - This model “is one of the most ubiquitous models in finance”
- **The distribution of log-returns and share prices have been validated empirically by many market studies accessible on the web**
- **For short time periods in a stable market, the mean return is 0**

Quotation from:
http://www.riskglossary.com/articles/lognormal_distribution.htm

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Lognormal Density Function

$$f(x) = \begin{cases} \dfrac{\exp\left(-\dfrac{1}{2}\left(\dfrac{\ln(x)-\mu}{\sigma}\right)^2\right)}{x\sigma\sqrt{2\pi}} & x > 0 \\ 0 & x \le 0 \end{cases}$$

$$X \sim \Lambda[\mu, \sigma^2] \qquad Y = \ln(X) \sim N[\mu, \sigma^2]$$

$$E(X) = \exp(\mu + \sigma^2/2)$$

$$Var(X) = \left(\exp(\sigma^2) - 1\right)\exp(2\mu + \sigma^2)$$

Math details can be found in any standard mathematical statistics reference, see for example, http://en.wikipedia.org/wiki/Lognormal_distribution.

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DEFINING THE FUTURE

Project Implementation Strategies in the CMMI

CMMI Technology Conference & User Group
13-16 November 2006

Rick Hefner, Ph.D.
Director, Process Management
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Background

- **An underlying principle of the CMMI model is the concept of conscious choices about how each process area will be implemented**
- **For example, in implementing Configuration Management, the project planner must decide:**
  - Which work products to place under configuration control (e.g., deliverables, designated internal work products, acquired products, tools)
  - What levels of configuration control (e.g., author, informal, formal) are appropriate for each work product
- **This presentation will study the strategic implications of the CMMI on planning and implementing project processes**

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Topics

- **The Concept of Conscious Choices**
- **Key Choices in CMMI**
  - Configuration management
  - Process and products audits
  - Verification, peer review, and validation
  - Others
- **Implications**
  - Project planning
  - CMMI appraisals

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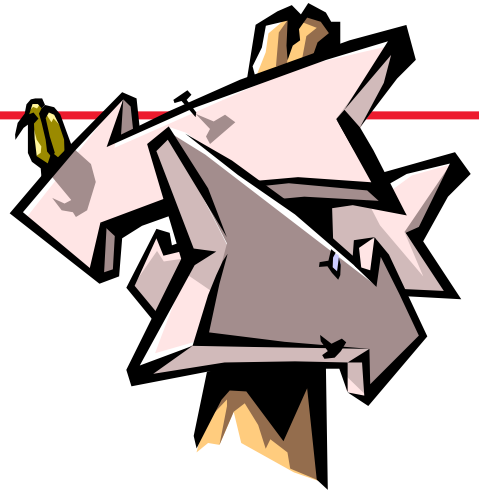
The Concept of Conscious Choices



- **The CMMI was written to apply to a variety of project environments**
  - Defense, commercial
  - Development, maintenance, services
  - Small to large project teams
- **The CMMI authors wrote the practices, expecting that different choices would be made concerning how they were applied**
  - E.g., “adequate”, “as appropriate”, “as needed”, “selected”, “identify” …
- **You must the interpret goals and practices in light of your organization’s business objectives**
  - BUT, you need to understand the intent behind the practice

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Conscious Choices in CMMI Process Areas

Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	*Quantitative management*	Quantitative Project Management Organizational Process Performance
3 Defined	*Process standardization*	Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management (for IPPD) Risk Management Decision Analysis and Resolution Requirements Development Technical Solution Product Integration Verification Validation
2 Managed	*Basic project management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed		

Levels 4 and 5 have similar choices

Verification and Validation require strategies

The Support process areas have several implied choices

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Conscious Choices in CMMI Generic Practices

GP 1.1 Perform Base Practices

GP 2.1 Establish an Organizational Policy
GP 2.2 Plan the Process
GP 2.3 Provide Resources
GP 2.4 Assign Responsibility
GP 2.5 Train People
GP 2.6 Manage Configurations
GP 2.7 Identify and Involve Relevant Stakeholders
GP 2.8 Monitor and Control the Process
GP 2.9 Objectively Evaluate Adherence
GP 2.10 Review Status with Higher Level Management

GP 3.1 Establish a Defined Process
GP 3.2 Collect Improvement Information

GP 4.1 Establish Quantitative Objectives for the Process
GP 4.2 Stabilize Subprocess Performance

GP 5.1 Ensure Continuous Process Improvement
GP 5.2 Correct Root Causes of Problems

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Configuration Management

SP 1.1 Identify Configuration Items
Identify the configuration items, components, and related work products that will be placed under configuration management.

- **Must identify ALL the products that will be controlled – not just CDRLs or delivered products**
- **Possible levels of control**
  - Control board authorizes and controls changes
  - Designated authority controls changes
  - Author controls changes
  - Anyone can make changes

Any artifact produced by a process.

Examples of work products that may be placed under CM include the following:

- Plans
- Process descriptions
- Requirements
- Design data
- Drawings
- Product specifications
- Code
- Compilers
- Product data files
- Technical publications

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GP 2.6 Manage Configurations

Must decide which work products are controlled and which are not

Any work products:
Specs, designs, code, test documents, CDRLs, plans, reports, minutes, action items, etc.

GP 2.6 Manage Configurations

Place designated work products of the process under appropriate levels of control.

Must decide the appropriate level of control for each work product:
Control board, management authority, author

Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	*Quantitative management*	Quantitative Project Management Organizational Process Performance
3 Defined	*Process standardization*	Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution Requirements Development Technical Solution Product Integration Verification Validation
2 Managed	*Basic project management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed		

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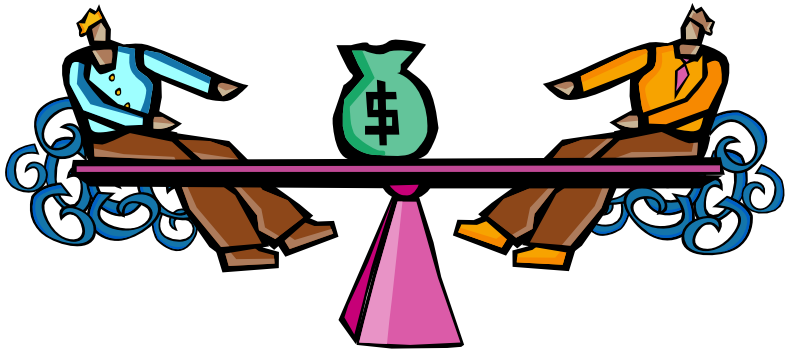
Sizing the Amount of CM/DM Needed

- **In the program management strategy, the project must decide which products to control, and what level of control**
  - Trade-off between the cost of more formal control and the risk of unauthorized changes
- **Must understand where the CM leverage points are**
  - Where does an unauthorized change cause significant problems?
- **Must understand the CM environment**
  - How much change is anticipated, and at what times?
  - Do the team members need more/less control?



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Process and Product Quality Assurance

SP 1.1 Objectively Evaluate Processes
Objectively evaluate the designated performed processes against the applicable process descriptions, standards, and procedures.

SP 1.2 Objectively Evaluate Work Products and Services
Objectively evaluate the designated work products and services against the applicable process descriptions, standards, and procedures.

- **Must select the processes, work products, and services to be evaluated (audited)**
- **Must decide what quality standards will be defined (e.g., coding standards)**
  - Organization sets standards based on market needs and "brand image"
  - Project sets standards based on customer needs
- **Project process descriptions describe the process to be followed**
  - Procedures are detailed process descriptions
- **Not all work products will have standards (e.g., coding standards)**

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Generic Practice for Quality Assurance

Could be interpreted to include both work products and processes

GP 2.9 Objectively Evaluate Adherence

Objectively evaluate adherence of the process against its process description, standards, and procedures, and address noncompliance.

Must define "minimal acceptable" quality

Level	Focus	Process Areas
5 Optimizing	*Continuous process improvement*	Causal Analysis and Resolution Organizational Innovation and Deployment
4 Quantitatively Managed	*Quantitative management*	Quantitative Project Management Organizational Process Performance
3 Defined	*Process standardization*	Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution Requirements Development Technical Solution Product Integration Verification Validation
2 Managed	*Basic project management*	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Performed		

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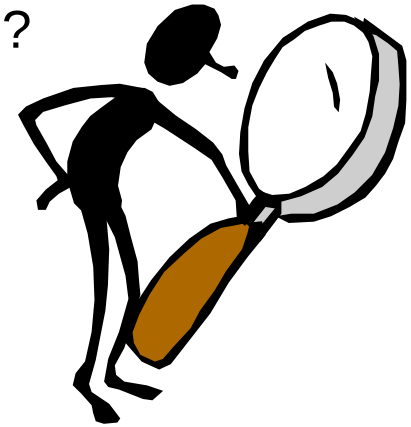
Sizing the Amount of QA Needed

- **In the program management strategy, the project must decide which work products and processes to define standards for, and how often to audit them**
  - Trade-off between the cost of more quality and the risk of re-work
- **Must understand where the QA leverage points are**
  - Where does poor quality cause significant problems?
- **Must understand the QA environment**
  - How much quality is expected, and of what type?
  - Do the team members need more/less auditing?



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Verification

Ensure selected work products meet their specified requirements

SG 1 Prepare for Verification

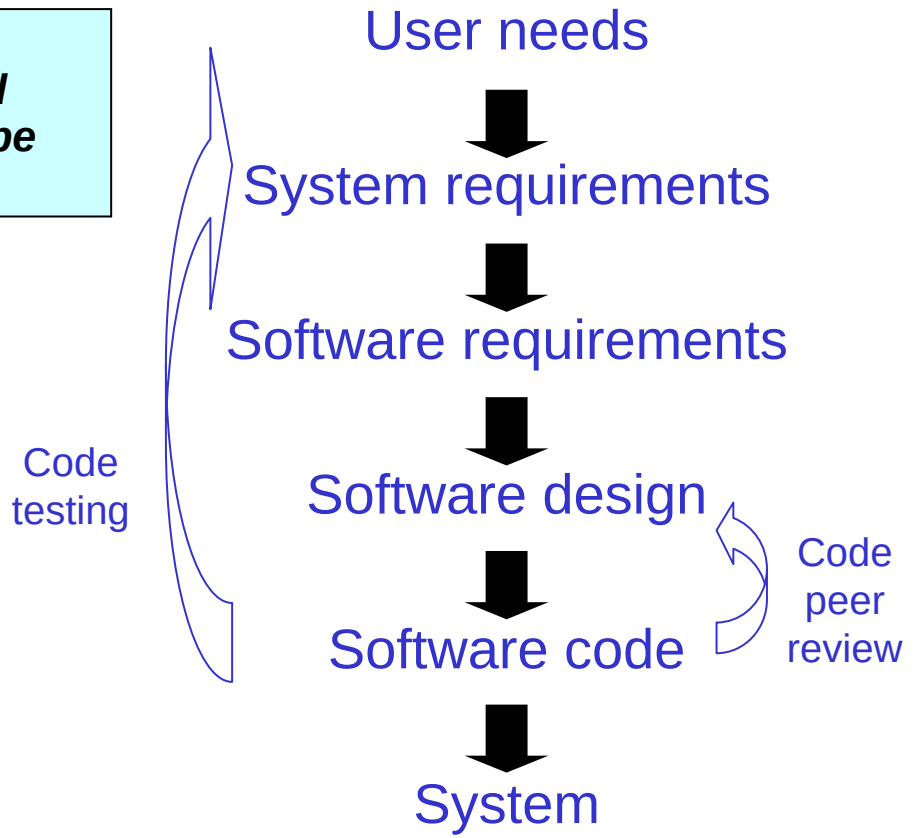
Preparation for verification is conducted.

SP 1.1 Select Work Products for Verification

Select the work products to be verified and the verification methods that will be used for each.

- **Which work products offer the greatest leverage?**
  - Impact of errors, visibility
- **How should the work product be verified?**
  - Peer review vs. testing vs. inspection
  - Efficiency, effectiveness

- **"Prepare" goal suggests a strategy (conscious choice)**
  - Integration, Verification, Validation



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Validation

Demonstrate that a product or product component fulfills its intended use when placed in its intended environment

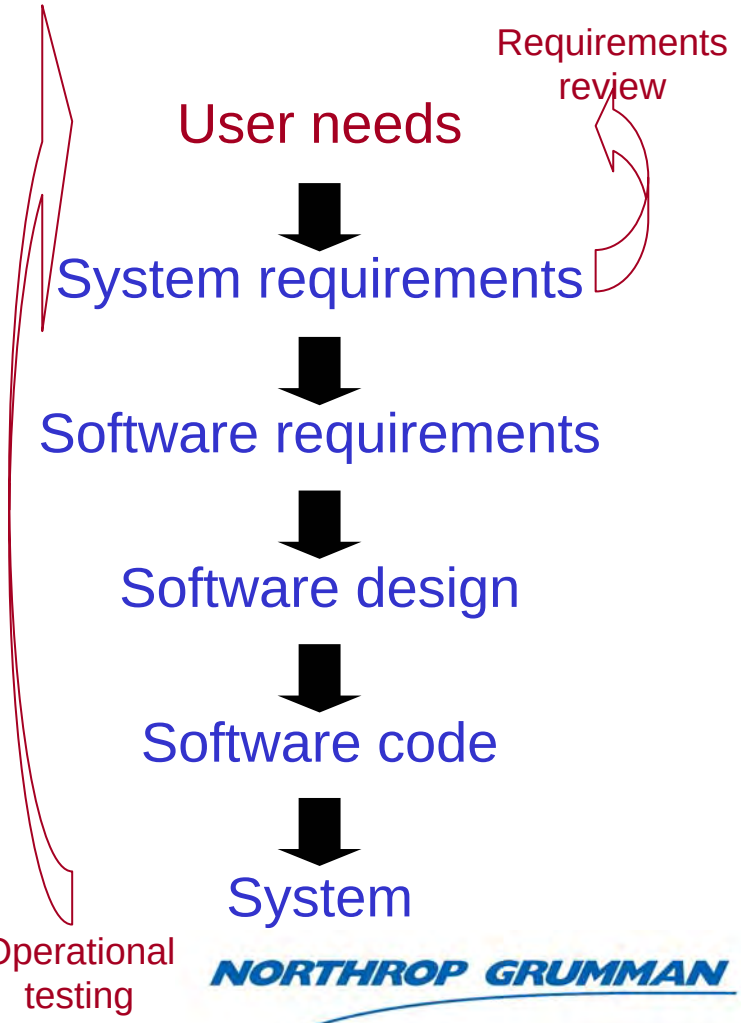
SG 1 Prepare for Validation

Preparation for validation is conducted.

SP 1.1 Select Products for Validation

Select products and product components to be validated and the validation methods that will be used for each.

- **Which work products offer the greatest leverage?**
  - Impact of issues, visibility
- **How should the work product be validated?**
  - E.g., user surveys, prototypes, milestone reviews, demonstrations, formal testing



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Other Conscious Choices

Choice	Considerations
Which measurements to make (M&A)	Cost, insight, information needs, measurement objectives
Which measurements to monitor, how often, what format (PMC, GP 2.8)	Cost, insight
Which decisions should be subject to a formal decision process (DAR)	Cost, risk of making the wrong decision
Integration sequence (PI)	Cost, incremental confidence, testing insight
Which stakeholders to involve, in what way (IPM, GP 2.7)	Cost, buy-in
How detailed to make policies (GP 2.1), processes (GP 3.1)	Cost, standardization, enforcement
What training to provide - organizational and project (GP 2.5)	Cost, knowledge transfer, competence
What improvement information to collect (GP 3.2)	Cost, knowledge transfer
Which process elements to quantitatively control (SPM, GP 4.2)	Cost, insight business value, ability to stabilize processes

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Implications

- **In planning, the project manager must consciously make these choices**
  - Project defined process (tailored from the organizational standard process) identifies the processes to be used
  - Project plans identifies the choices made on how to implement these process
- **For example, the organization can develop planning templates involving fill-in tables to capture the choices**
  - E.g., a stakeholder table (who, how, how often, etc.)
- **These choices must be clearly explained to appraisers**

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Summary

- An underlying principle of the CMMI model is the concept of conscious choices about how each process area will be implemented
- Recognizing the choices helps properly adapt the CMMI practices to fit the context of the organization and its projects

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Patterns: An Approach for CMMI Adoption

CMMI Technology Conference & User Group
13-16 November 2006

Rick Hefner, Ph.D.
Director, Process Management
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Background

- Patterns are a common way of expressing common contexts and problem-solution pairs, and are often used in software design
- In CMMI-based improvement, patterns can be used to show how sets of improvement practices can be combined to achieve successful improvements
- This presentation will introduce some typical patterns in process improvement

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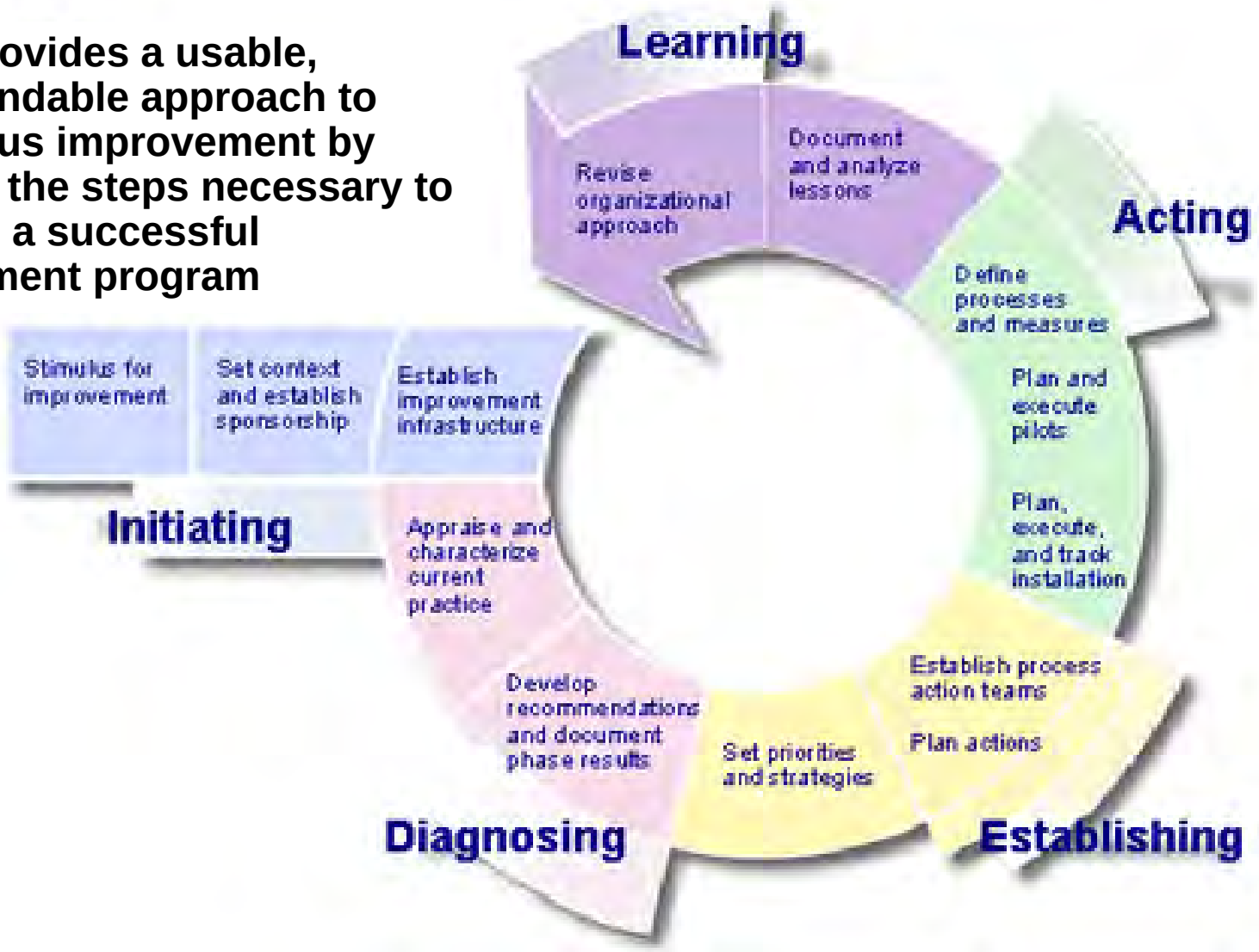
The IDEAL Model[SM]

IDEAL provides a usable, understandable approach to continuous improvement by outlining the steps necessary to establish a successful improvement program



"IDEAL: A User's Guide for Software Process Improvement ," Robert McFeeley, Software Engineering Institute, CMU/SEI-96-HB-001

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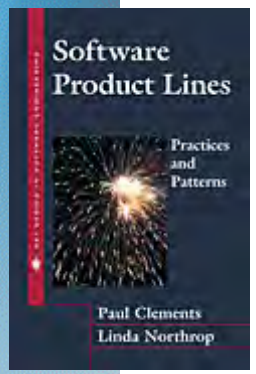
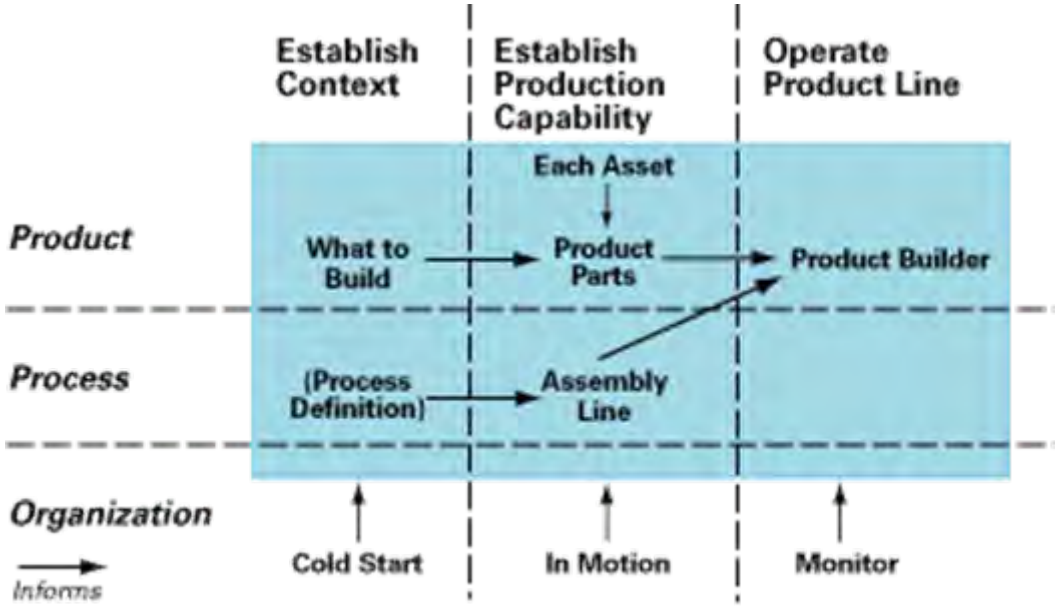
Patterns

Could patterns be applied to CMMI adoption?

- **Patterns are a common way of expressing common contexts and problem-solution pairs**
  - The context is the organizational situation
  - The problem is what part of a effort needs to be accomplished
  - The solution is the grouping of practice areas and the relations among them that together address the problem for that context
- **The book Software Product Lines: Practices and Patterns defines 12 patterns and 11 variants**





Adoption Factory Pattern

The Adoption Factory pattern is a composite pattern that describes the entire software product line organization.

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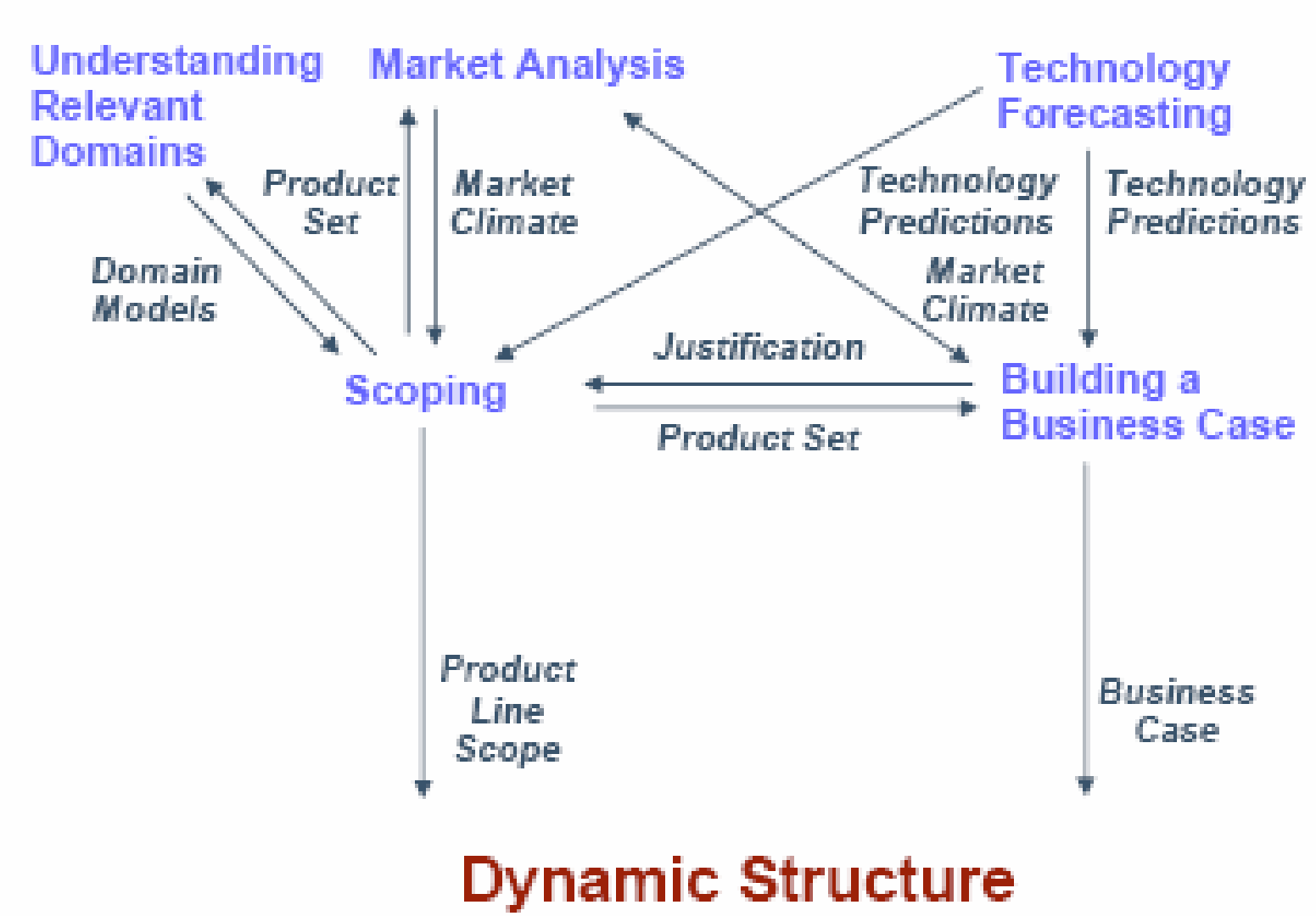
Example – What to Build Pattern (Software Product Lines)



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What Benefits Would Patterns Provide?

- **Address recurring CMMI adoption problems that arise in specific situations and present solutions to them**
- **Document existing, well-proven CMMI adoption experience**
- **Identify and specify abstractions that are broader in scope that single practice areas**
- **Provide a common vocabulary and understanding for CMMI adoption**
- **Document, explain, and plan CMMI adoption efforts**
- **Help manage the complexity inherent in CMMI adoption**
- **Can be combined to build complex CMMI adoption solutions**

Adapted from Pattern Oriented Architectures: A System of Patterns, Bushmann, et al, 1996 and Software Product Lines: Practices and Patterns, Clements and Northrop, 2005

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Structure of a Pattern

- **Context: Organizational situation**
  - Defense contractor
  - Commercial contractor
  - Small organization
- **Problem: What part of a effort needs to be accomplished**
  - Adopt CMMI for the first time
  - Transitioning from CMMI v1.1 to v1.2
  - Transitioning from Level 3 to Level 5
  - Maintain Level 5
- **Solution: The grouping of practice areas and the relations among them that together address the problem for that context**

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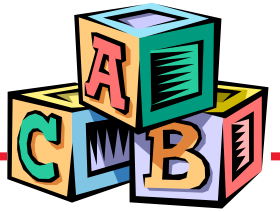
What Building Blocks Do We Have?



Software Product Lines	PRACTICE AREAS	
Software Engineering	**Technical Management**	**Organizational Management**
Architecture Definition	Configuration Management	Building a Business Case
Architecture Evaluation	Data Collection, Metrics, and Tracking	Customer Interface Management
Component Development	Make/Buy/Mine/Commission Analysis	Developing an Acquisition Strategy
COTS Utilization	Process Definition	Funding
Mining Existing Assets	Scoping	Launching and Institutionalizing
Requirements Engineering	Technical Planning	Market Analysis
Software System Integration	Technical Risk Management	Operations
Testing	Tool Support	Organizational Planning
Understanding Relevant Domains		Organizational Risk Management
		Structuring the Organization
		Technology Forecasting
		Training

IDEAL Model

- **Stimulus for Change**
- **Establish Context**
- **Build Sponsorship**
- **Charter Infrastructure**
- **Characterize Current and Desired State**
- **Develop Recommendations**
- **Set Priorities**
- **Develop Approach**
- **Create Solution**
- **Test/Pilot Solution**
- **Plan Actions**
- **Create Solution**
- **Test/Pilot Solution**
- **Refine Solution**
- **Install Solution**
- **Analyze and Validate**
- **Propose Future Actions**

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A Preliminary Set of CMMI Adoption Practice Areas

Initializing	Diagnosing	Establishing	Acting	Learning
Identify Need for Change	Learn Model	Identify Potential Improvements	Develop Infrastructure	Determine Appraisal Readiness
Scope Improvement Context	Identify Appraisal Goals	Establish Priorities	Pilot Implementations	Plan SCAMPI A
Establish Sponsorship	Select Appraisers	Strategize Approach to Infrastructure	Implement Project Improvements	Conduct SCAMPI A
Establish Diagnosing Responsibilities	Plan Gap Appraisal	Strategize Project Improvements	Implement Organizational Improvements	Conduct Causal Analysis on Findings
Identify Business Goals	Complete PIIDs	Strategize Organizational Improvements		Implement Corrective Actions
	Validate PIIDs	Establish Improvement Responsibilities		Implement Preventative Actions
	Conduct Gap Appraisal	Plan and Budget Improvements		
	Analyze Process Performance	Secure Sponsorship		

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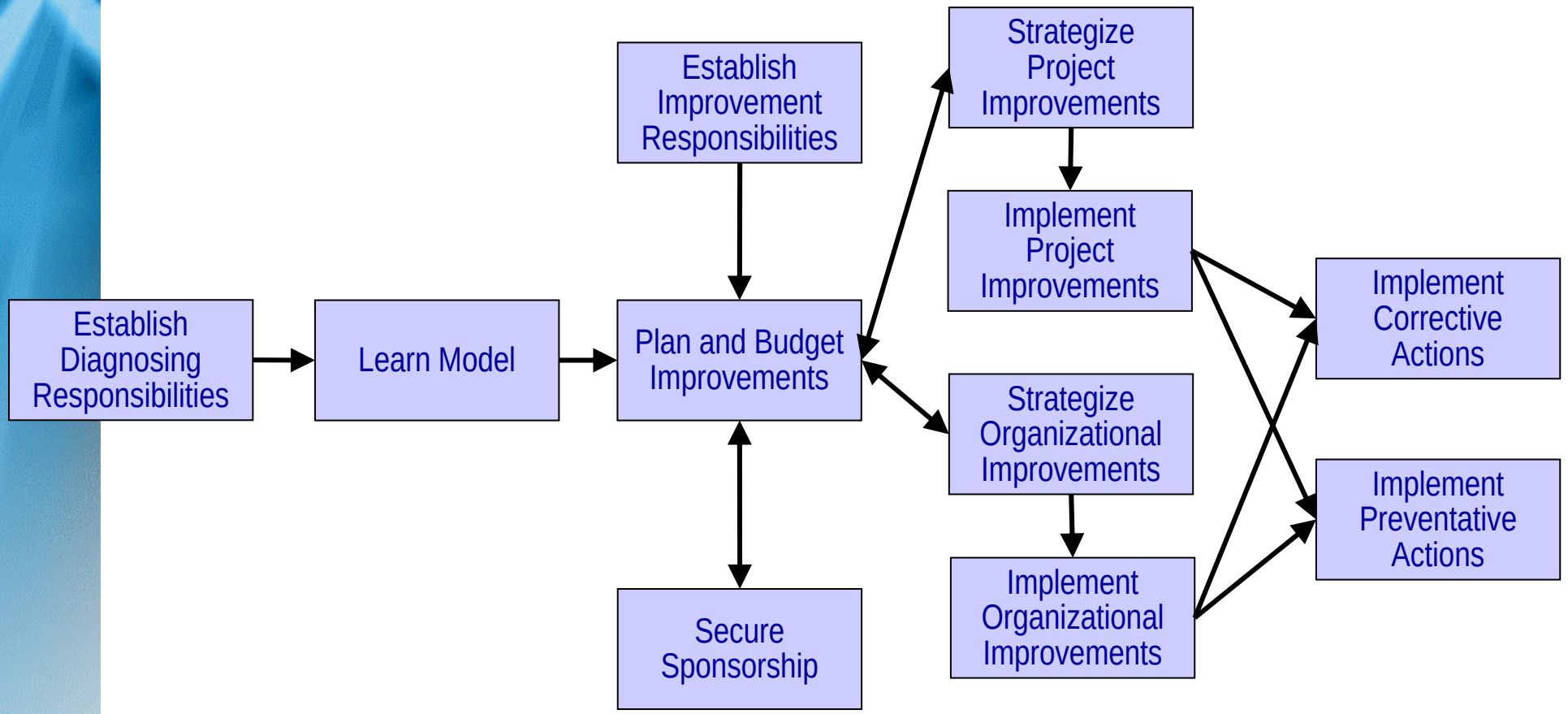
Example – Transitioning from CMMI v1.1 to V1.2

- **Context: Organization that has achieved their CMMI v1.1 goals**
- **Problem: Achieve similar goals against v1.2 quickly and cheaply**



Reference: "A Practical Roadmap for Transitioning to CMMI v1.2", R. Hefner, 2006 CMMI Technology Conference and User Group

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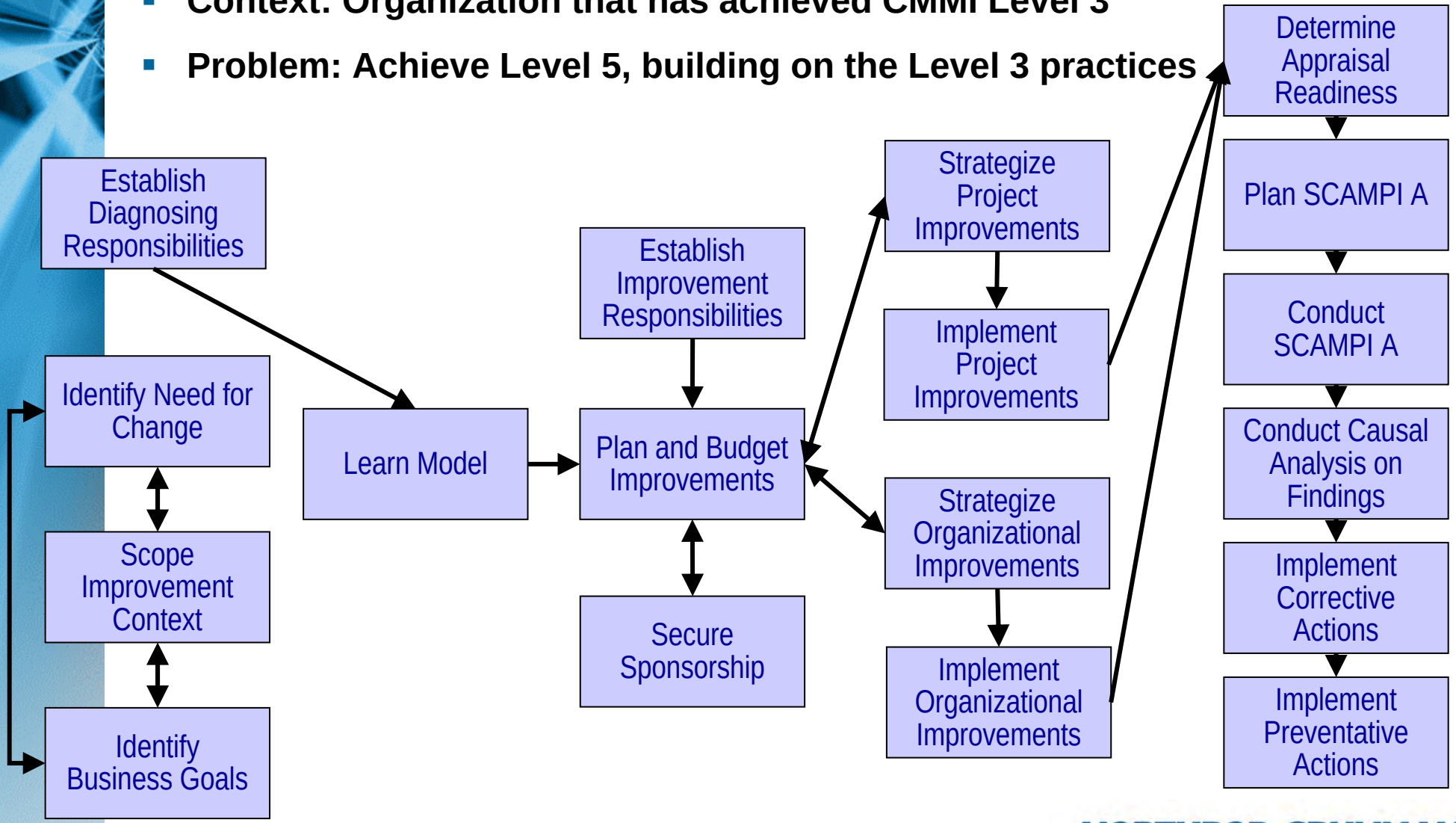
Example – Transitioning from Level 3 to Level 5

- **Context: Organization that has achieved CMMI Level 3**
- **Problem: Achieve Level 5, building on the Level 3 practices**



Reference: "**A Practical Guide to Implementing Levels 4 and 5**" (tutorial), R. Hefner, 2006 CMMI Technology Conference and User Group

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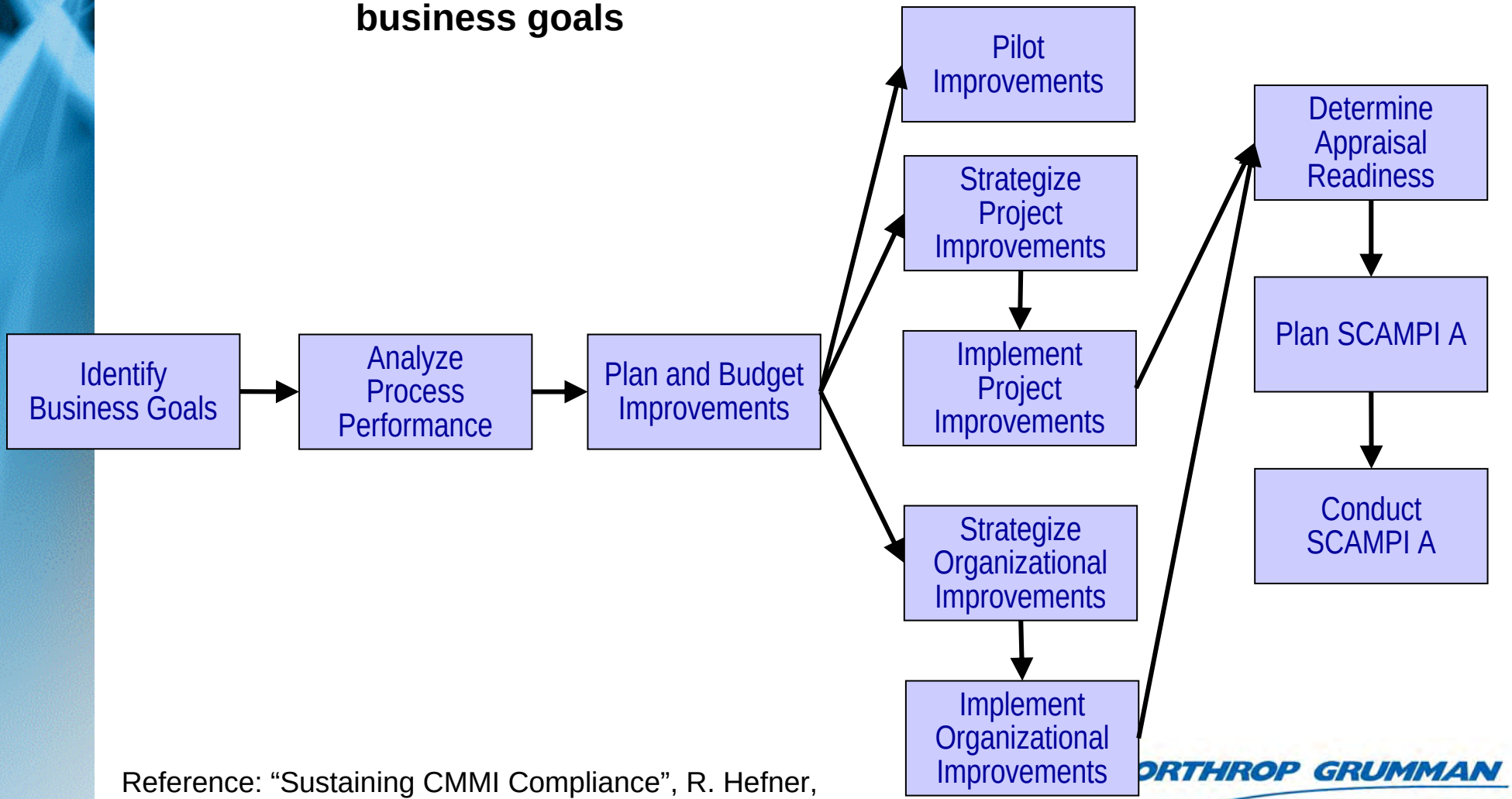
Example – Maintaining CMMI Level 5

- **Context: Organization that has achieved CMMI Level 5**
- **Problem: Maintain Level 5 process performance in light of changing business goals**



Reference: "Sustaining CMMI Compliance", R. Hefner, 2006 CMMI Technology Conference and User Group

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Conclusions

- Patterns can be used to show how sets of improvement practices can be combined to achieve successful CMMI adoption
- Further work must be done to fully define the set of practice areas and the most common context-problem-solution sets

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3H TECHNOLOGY

Presentation to the NDIA 6th Annual CMMI Technology Conference

Ruth T. Buys, Ph.,D.

November 13-16, 2006

Agenda

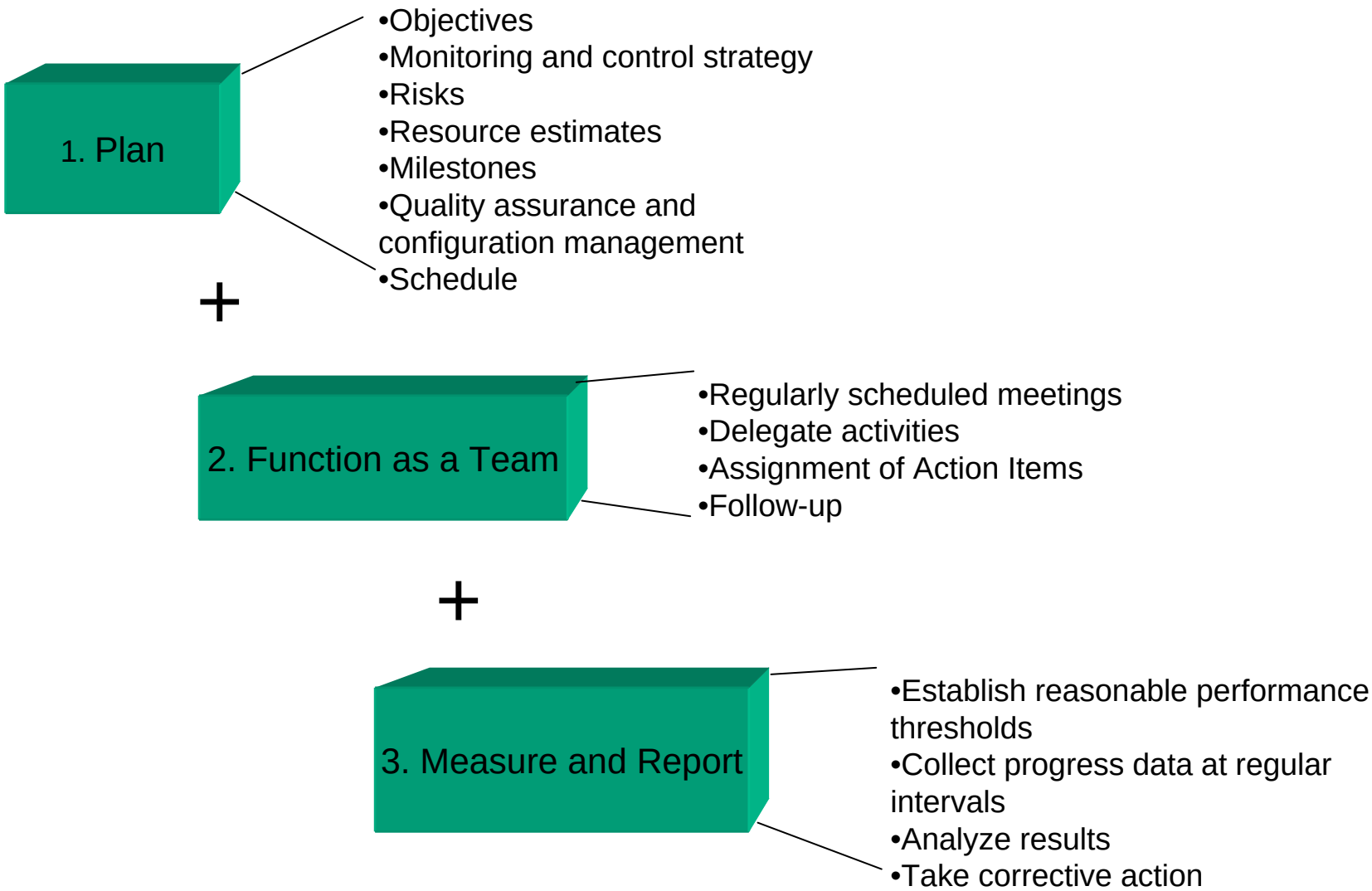
- Implementing processes for CMMI® Levels 2 and 3
  - Approach
  - Challenges
- Measurement
  - In the Measurement and Analysis Process Area
  - Estimates and Actuals for projects
- Benefits and Similar Observations

Implementing Processes for CMMI® Levels 2 and 3

Approach

- Set up the process improvement activity as a project
- Established the infrastructure first
- Selected documentation format
- Leveraged a strong set of existing practices
- Rolled out defined processes to pilot projects with training for everyone

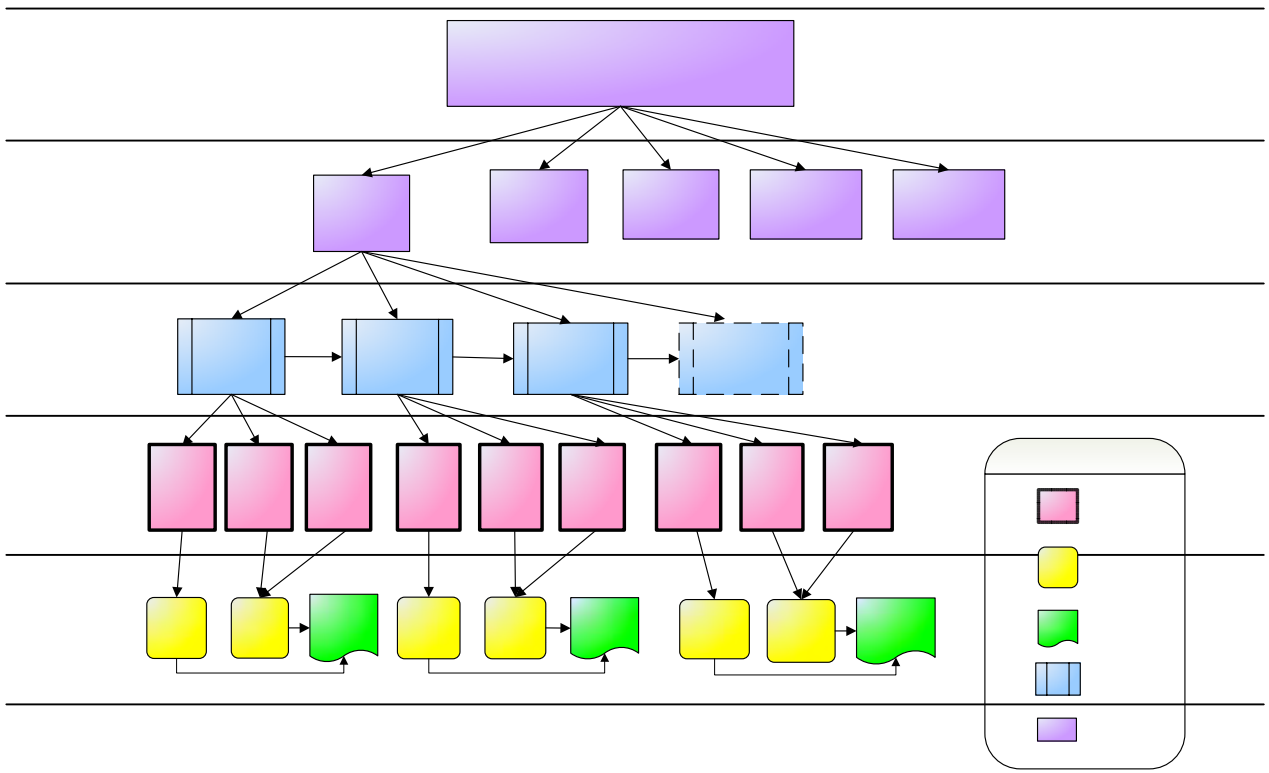
A Project Approach



The Process Infrastructure

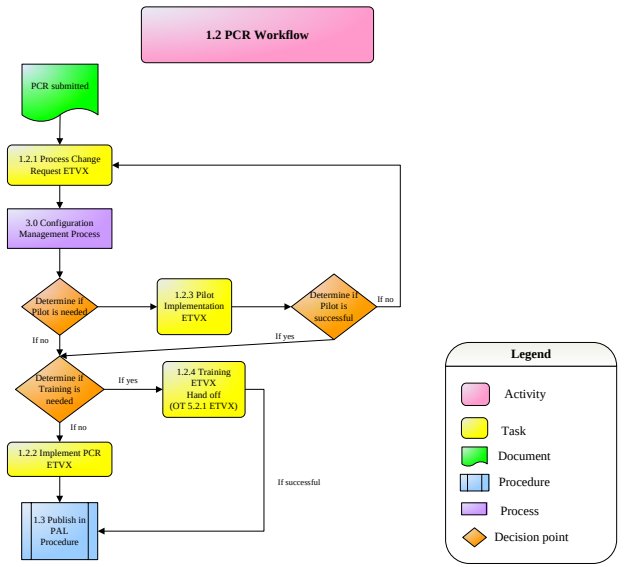
3H TECHNOLOGY

- Establish form of documentation
- Appropriate fit and formality for the organization
- Address functions of the model and the organization



Documentation Format

Flowcharts and Entry, Task, Verification and eXit (ETVX) tables



PRM-PD-02-1004

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Entry Criteria	Task(s) to be Performed	Job Aids	Exit Criteria
• Approved Process Change Requests	1. EPG CM determines need for a pilot or training. 2. Review Process Change Request and document EPG Implementation Decision. 3. Implement change according to the timeframe documented in the PCR or by the EPG. 4. Once the change is complete notify PCR owner and the EPG.	1. Process Change Request Form and work instructions. 4. Process Hierarchy Architecture 4. ETVX Diagram.	Approved/Declined/Postponed PCR.

Verification Steps
• EPG configuration audits • EPG configuration status reports

Existing Practices

3H TECHNOLOGY

- Estimating levels of effort
- Project schedules
- Vision documents
- Defect tracking in an automated tool
- Test scripts
- Independent quality assurance organization
- Version management for all documents

Roll out of Defined Processes

3H TECHNOLOGY

- Train pilot projects
- Invite everyone
- Rework as required

Challenges

- Everyone wanted to be on all the process action teams
- No one wanted to be a process area owner
- Constraints on membership in the Management Steering Committee
- Measures
- Tailoring
- Common practices
- Lack of well defined chain of command for reporting

New Words and Different Meanings

3H TECHNOLOGY

- Project Plan is not equal to a project schedule
- Validation can have many names
- Configuration audits are not the same as process audits
- Quality assurance is not testing
- Product integration occurs, even if it is not a distinct procedure
- Tailoring means flexibility, not a waiver

Tailoring

- Define project size thresholds (value, FTE, or duration?)
- How to record project tailoring selections
- Document the guidelines to include roles and responsibilities
- Notations on process or work product, optional, alternative practice or must use as-is

Identifying Existing Practices

3H TECHNOLOGY

- Confusion: same words, different meanings
- Confusion: different words, same meanings
- Confusion: new words
- Existing practices not fully documented
- Existing practices not consistently practiced
- Not all existing practices known across the organization

Measures

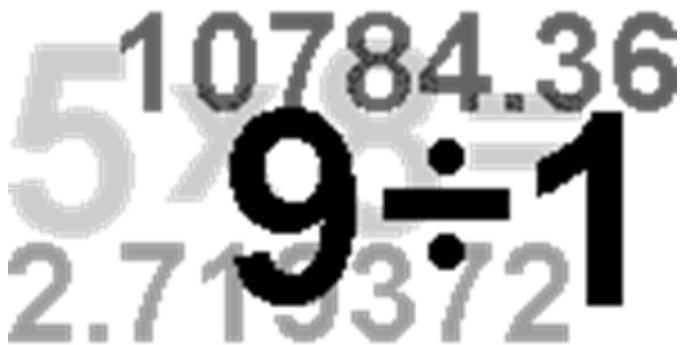
- Benefit hard to see
- We do enough of this already
- No time; the contract doesn’t pay for it
- How can you estimate these things? (Quality cannot be predicted (estimated))
- Size does not mean estimated resource or level of effort
- Staff level of effort is not the entire level of effort

Measurement

Measurement and Analysis Process Area

3H TECHNOLOGY

- Corporate level Measures Guide
- Four measurement categories
- Measures worksheet
- Industry best practices for thresholds
- Repository on Sharepoint
- Earned Value



Measures Categories

3H TECHNOLOGY

- For the Measurement and Analysis Process Area
  - Level of effort
  - Size
  - Quality
  - Schedule

Industry Best Practices

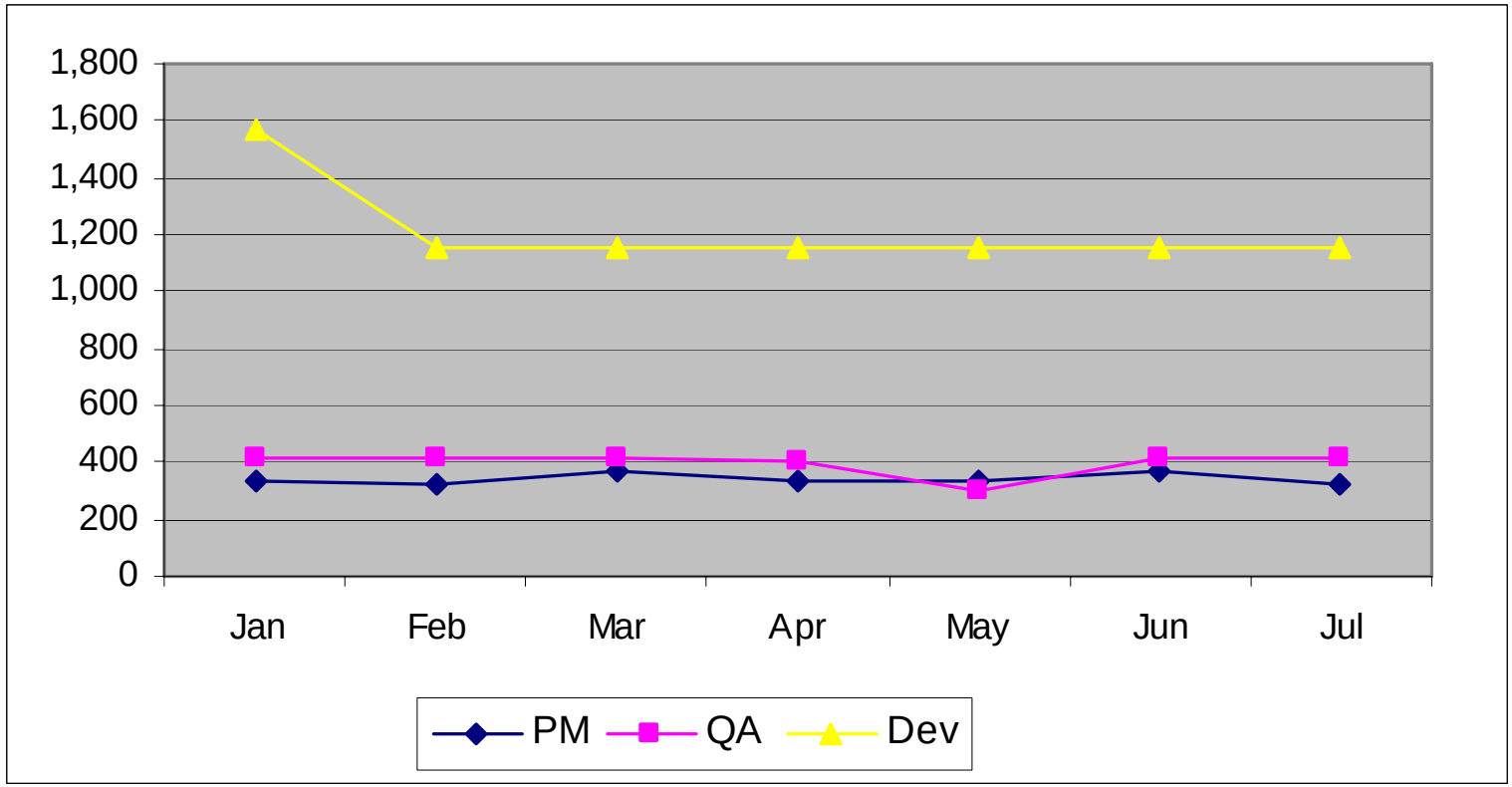
Measure	***Threshold for Analysis***	***Corrective Action***
Effort	10% *(Example: Cumulative labor time differs from the original estimate by 10% at any point in the project lifecycle)*	1.Review original estimating basis and determine impact on project schedule and cost 2.Assess impact on project risk 3.Report to relevant stakeholders
Quality	15% *(Example: Number of cumulative findings differs from the original estimate by 15% at any point in the project lifecycle.)*	1.Review original estimating basis and determine impact on project schedule and cost 2.Assess impact on project risk 3.Assess impact on deliverables 4.Report to relevant stakeholders

Measures Worksheet

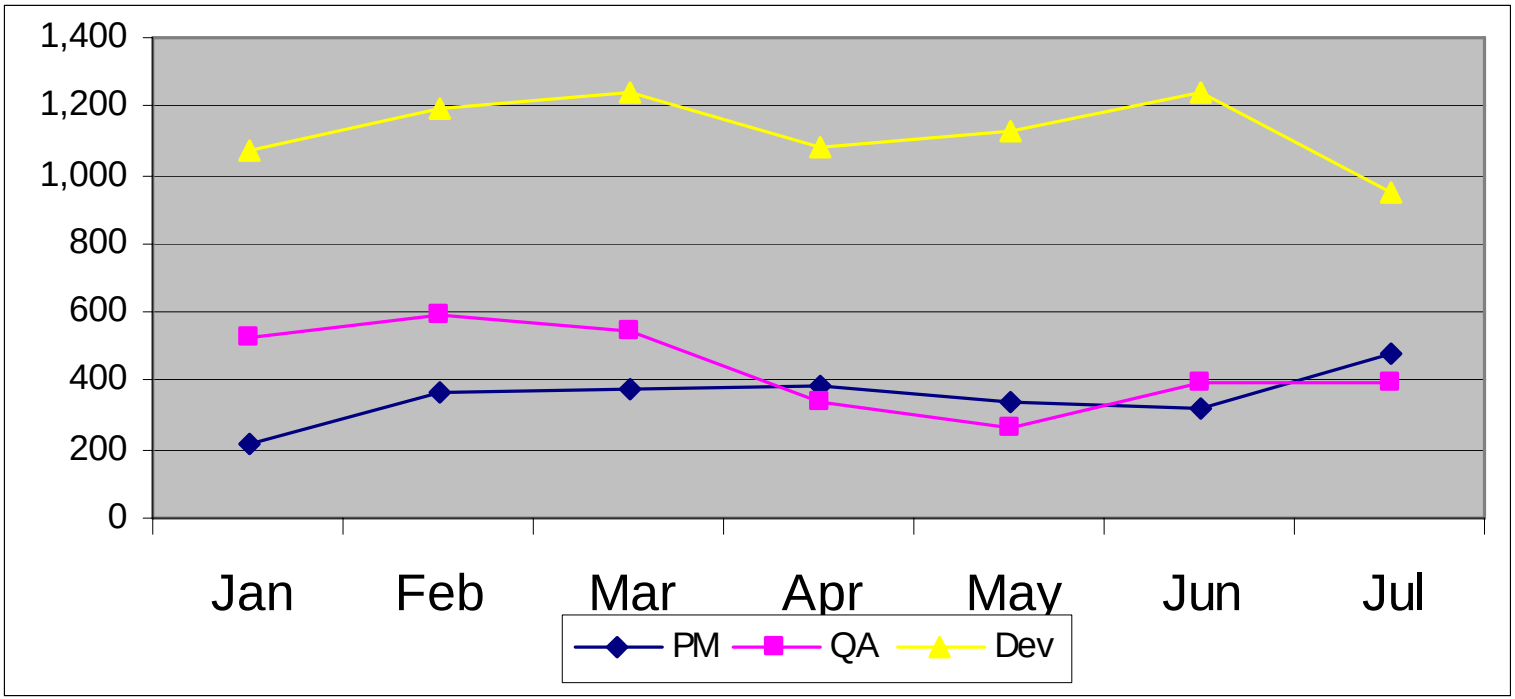
3H TECHNOLOGY

Measure	Measure Description	Initial Estimates	JAN	FEB	MAR	APR	MAY
Effort Estimates in Staff Hours	Effort Project End Estimate						
	Project Management						
	Quality Assurance						
	Product or Service Development						
Total Estimated Effort	Sum of Estimated Effort		0	0	0	0	0
Effort Actuals in Staff Hours	Project Management						
	Quality Assurance						
	Product or Service Development						
Total Actual Effort	Sum of Actual Effort		0	0	0	0	0

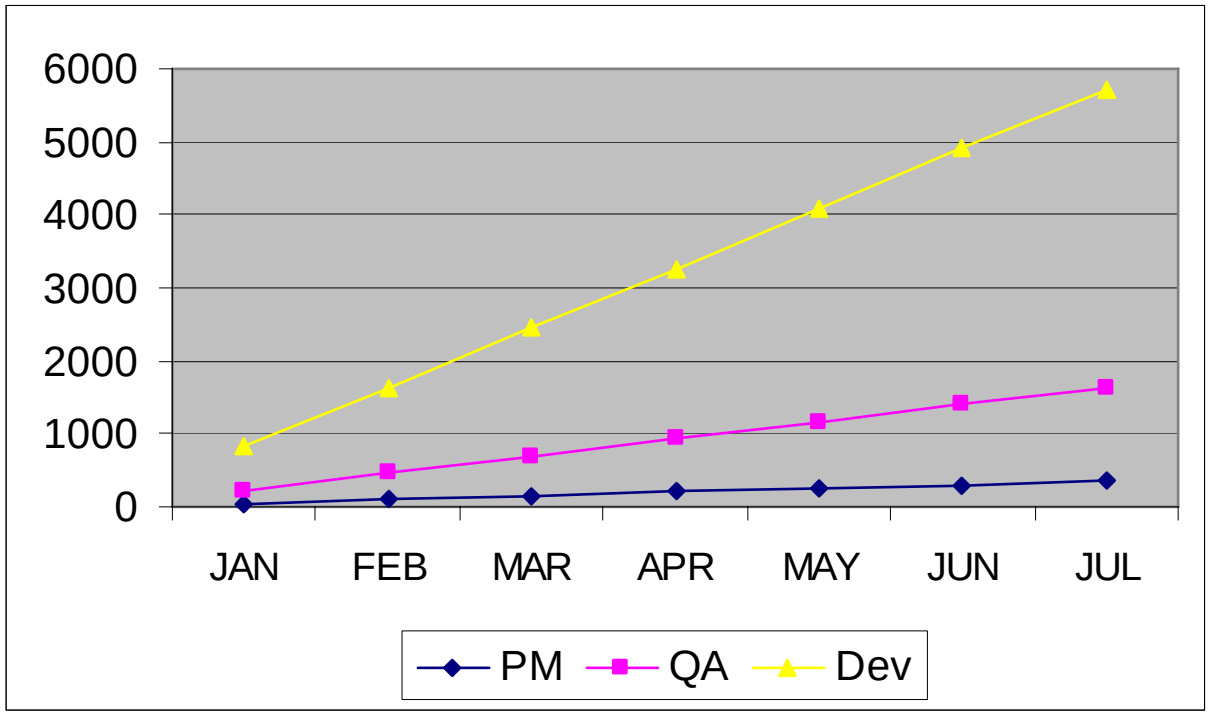
Measure: Estimated Effort - Project A



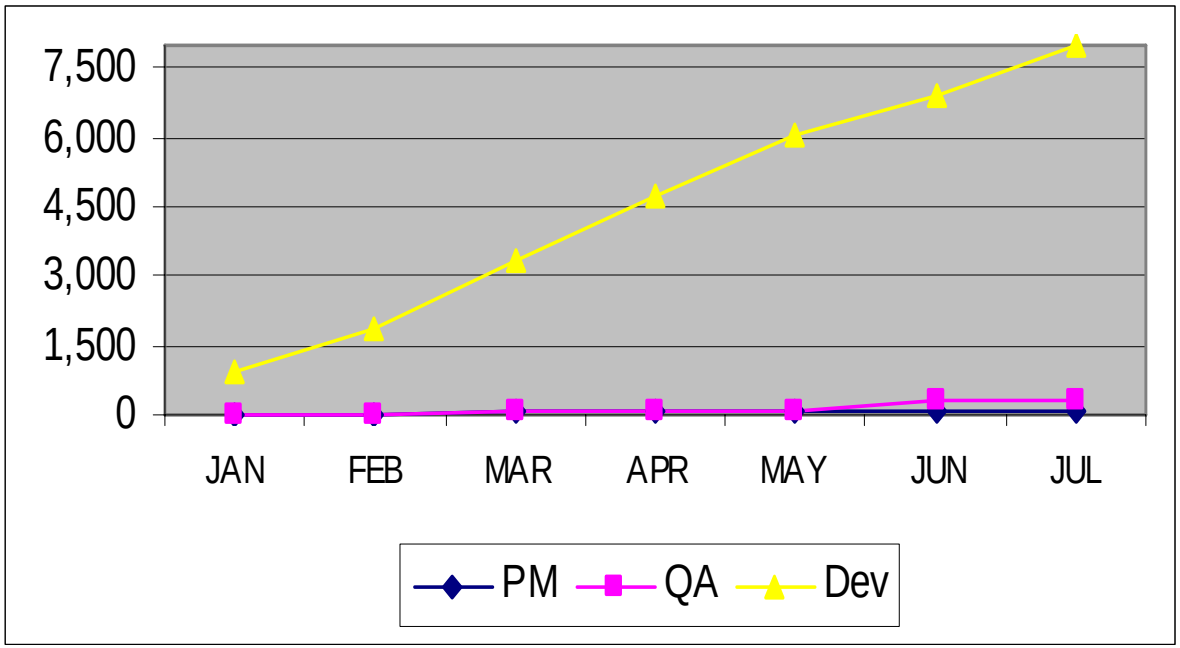
Measure: Actual Level of Effort – Project A



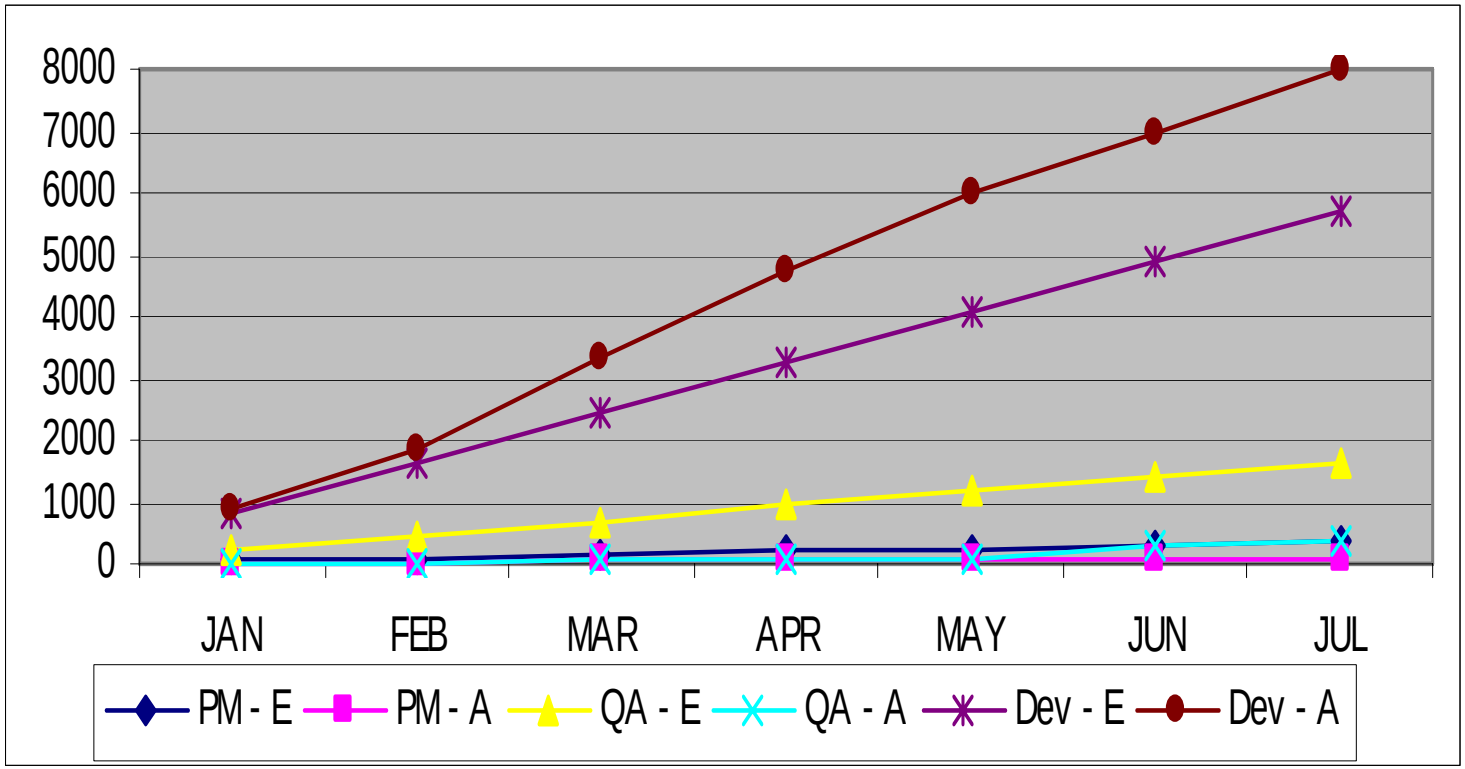
Measure: Estimated Effort – Project B



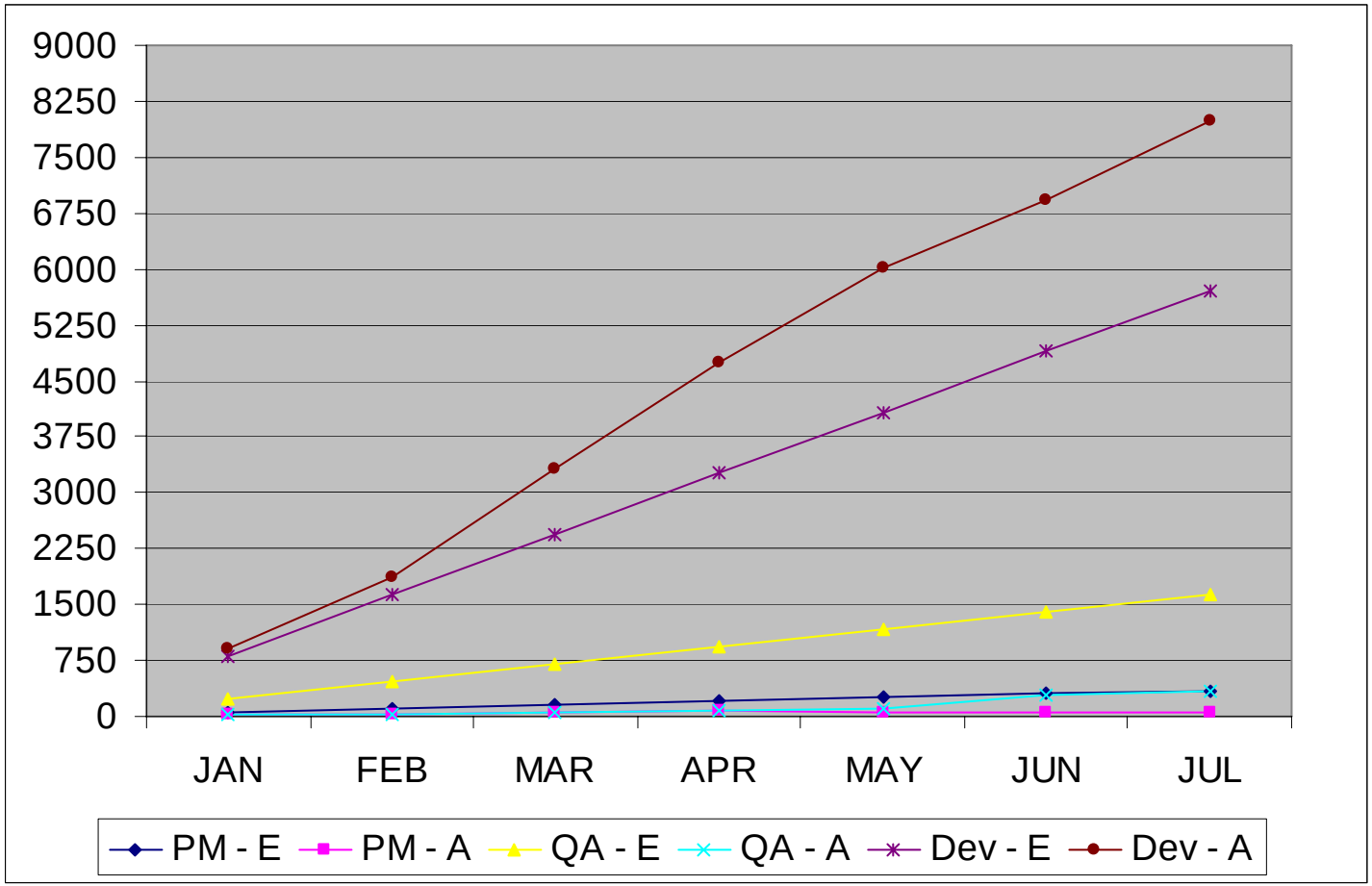
Measure: Actual Level of Effort – Project B



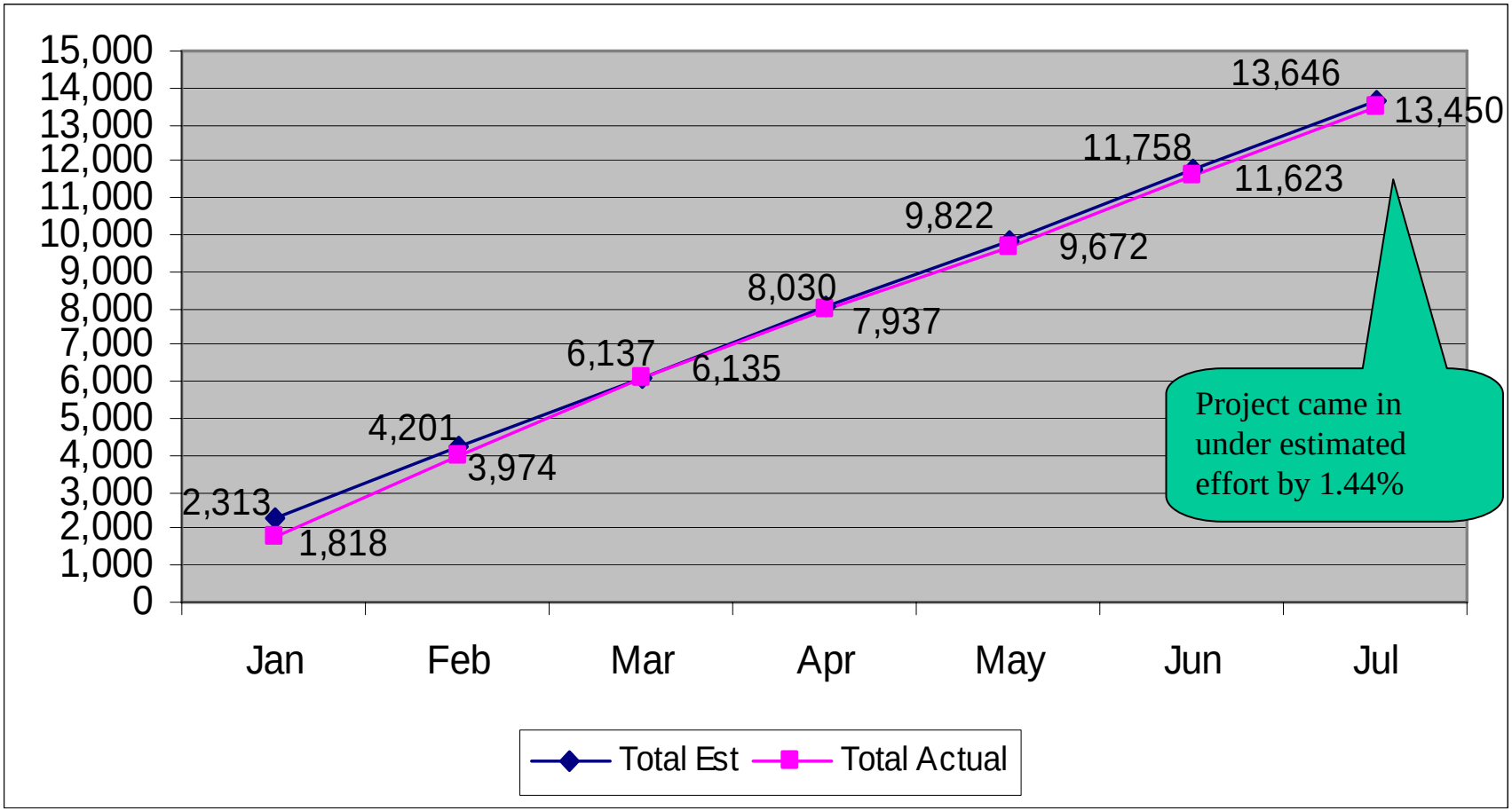
Measure: Estimated vs Actual Effort – Project A



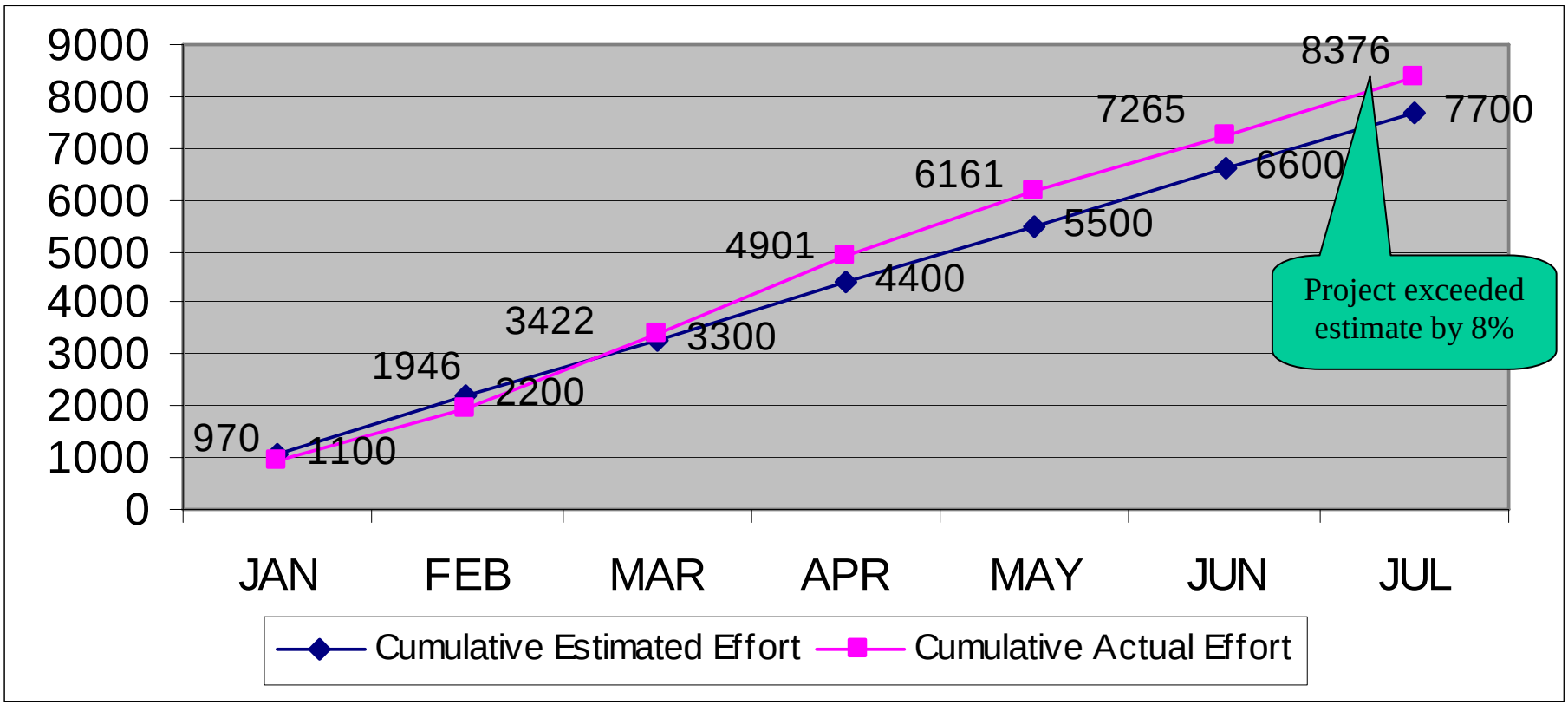
Measure: Estimated vs Actual Effort Project B



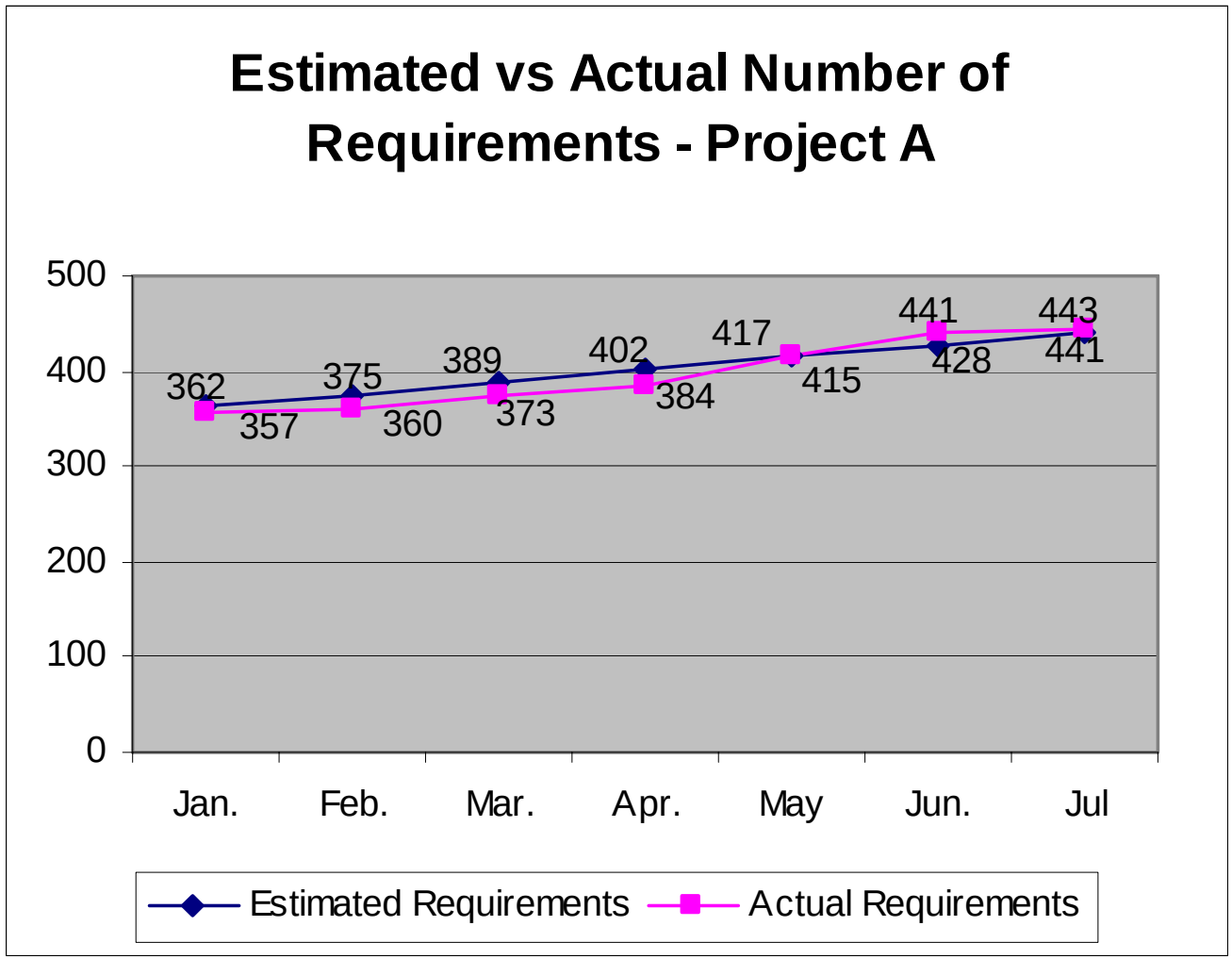
Measure: Effort Final Results – Project A



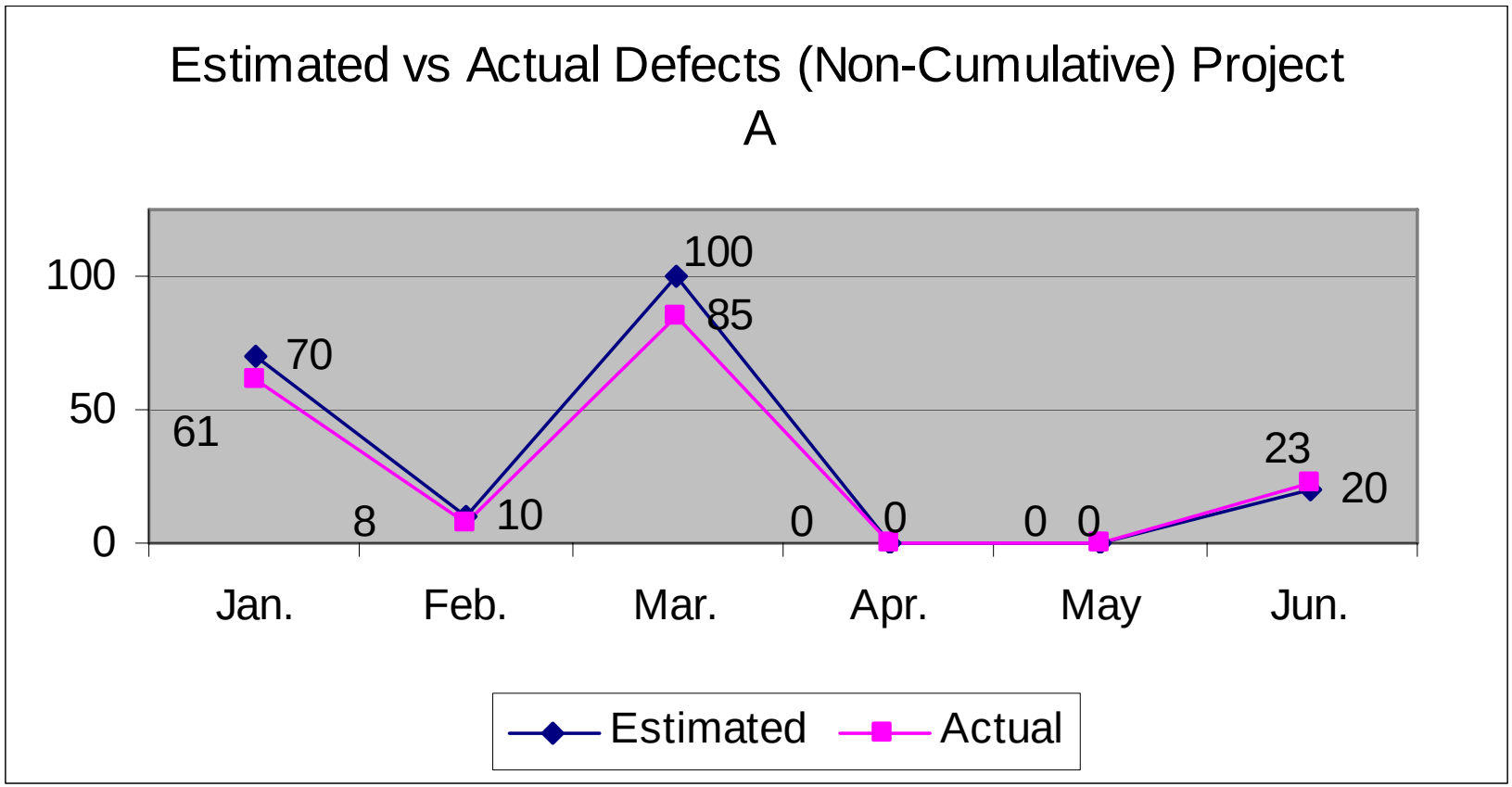
Measure: Effort Final Results – Project B



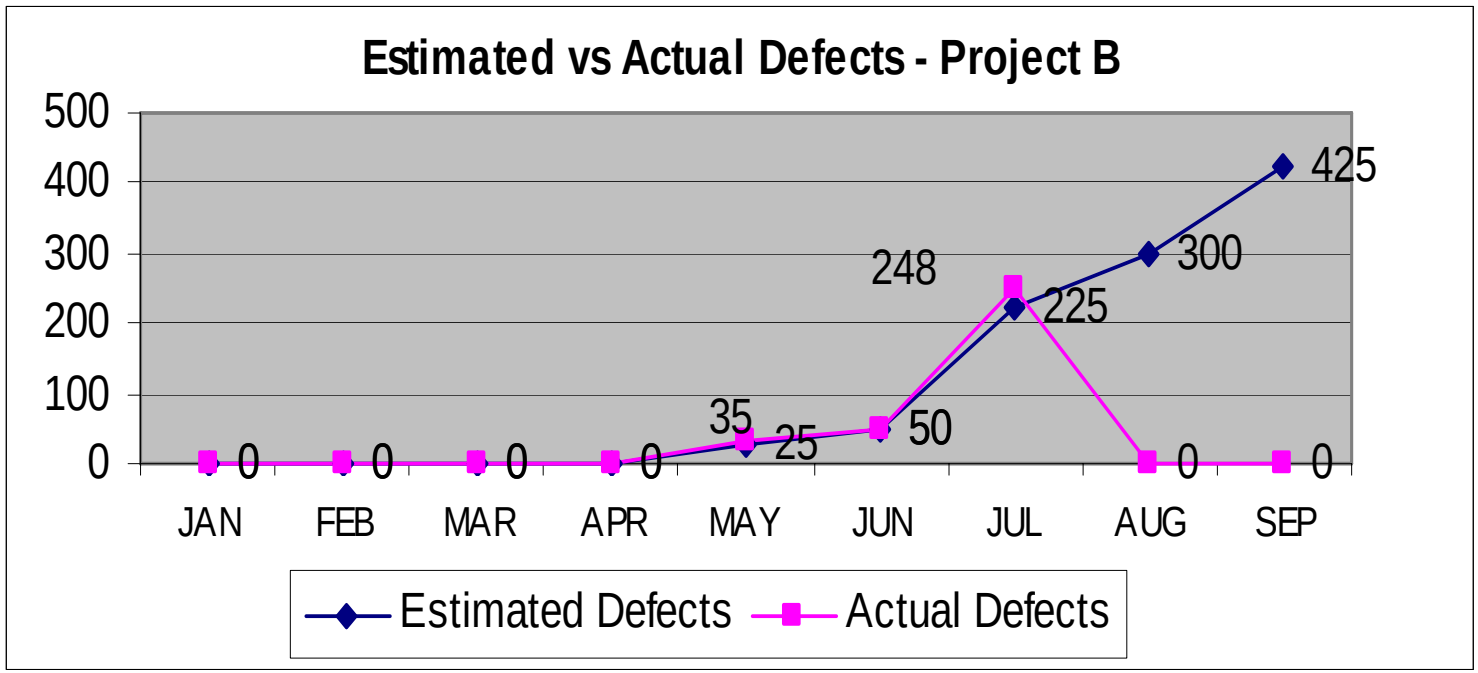
Measure: Size



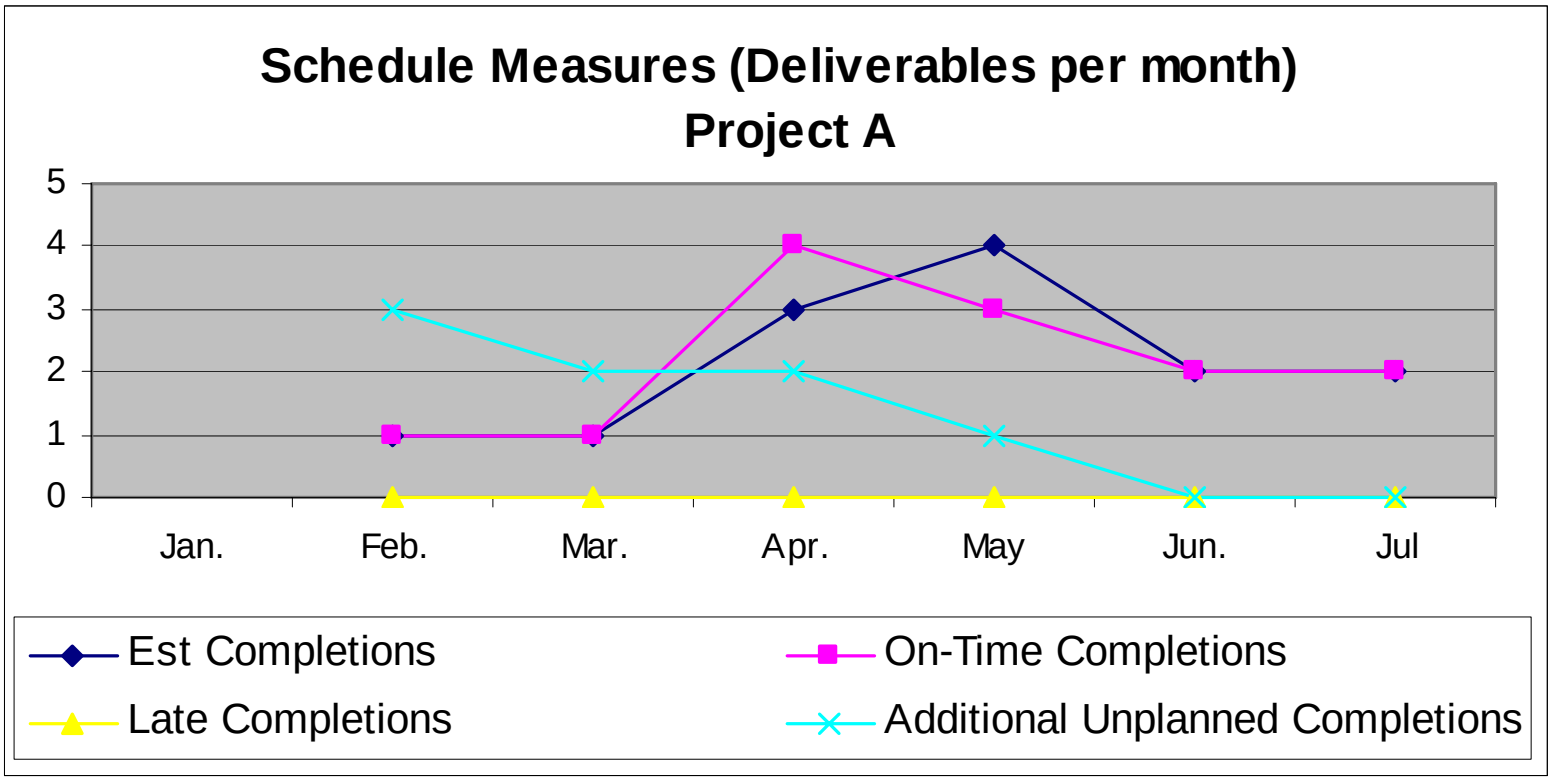
Measure: Quality



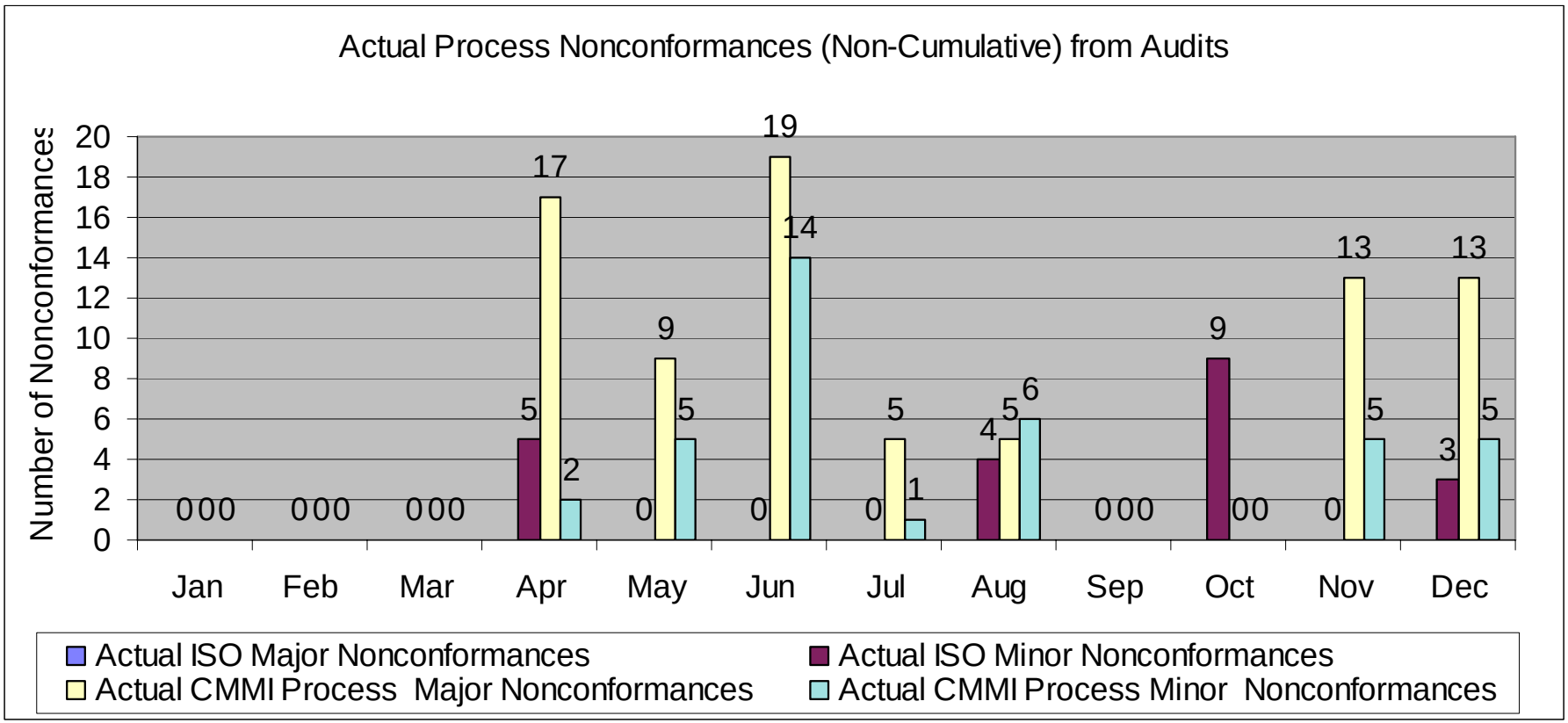
Measure: Quality



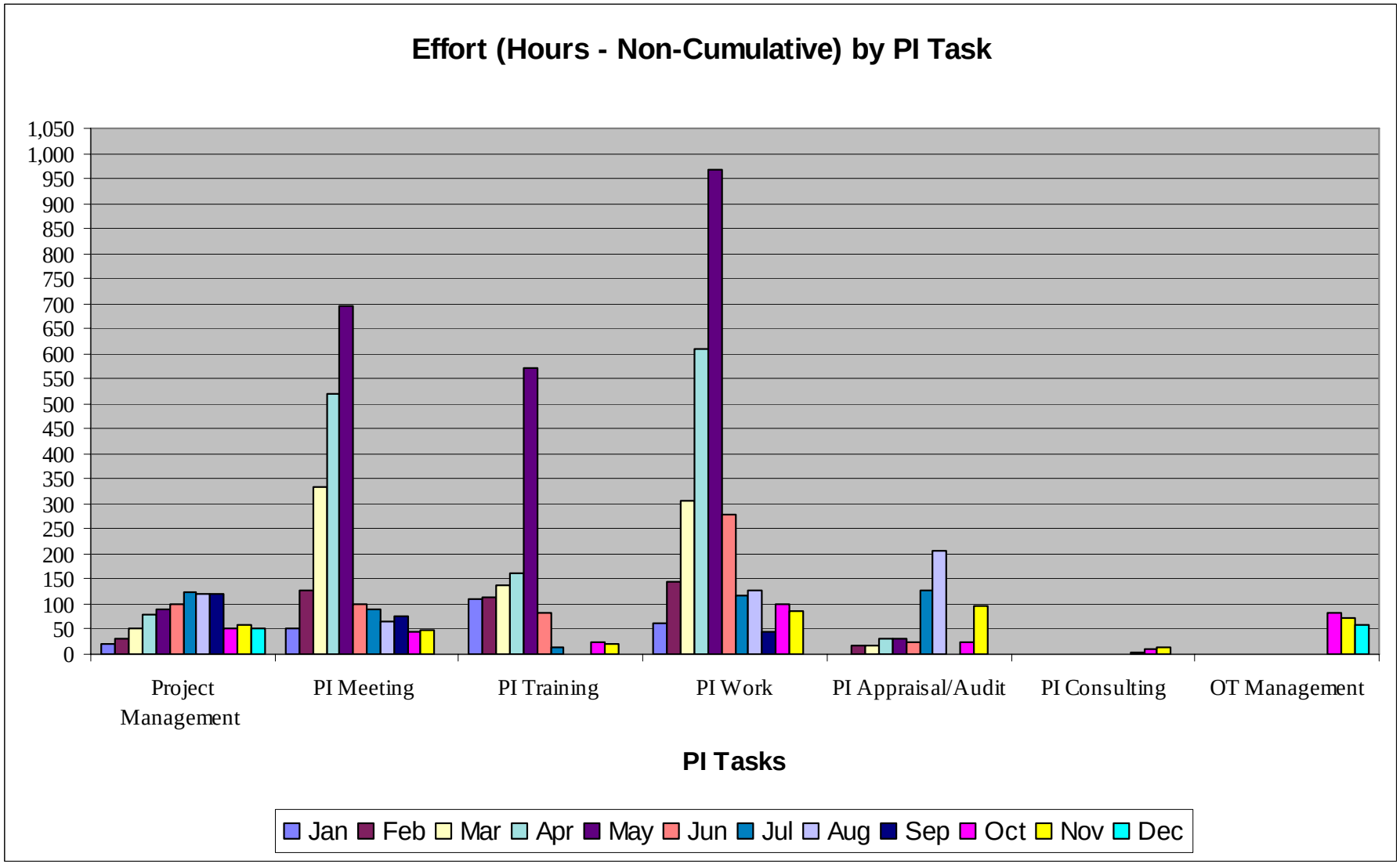
Measure: Schedule



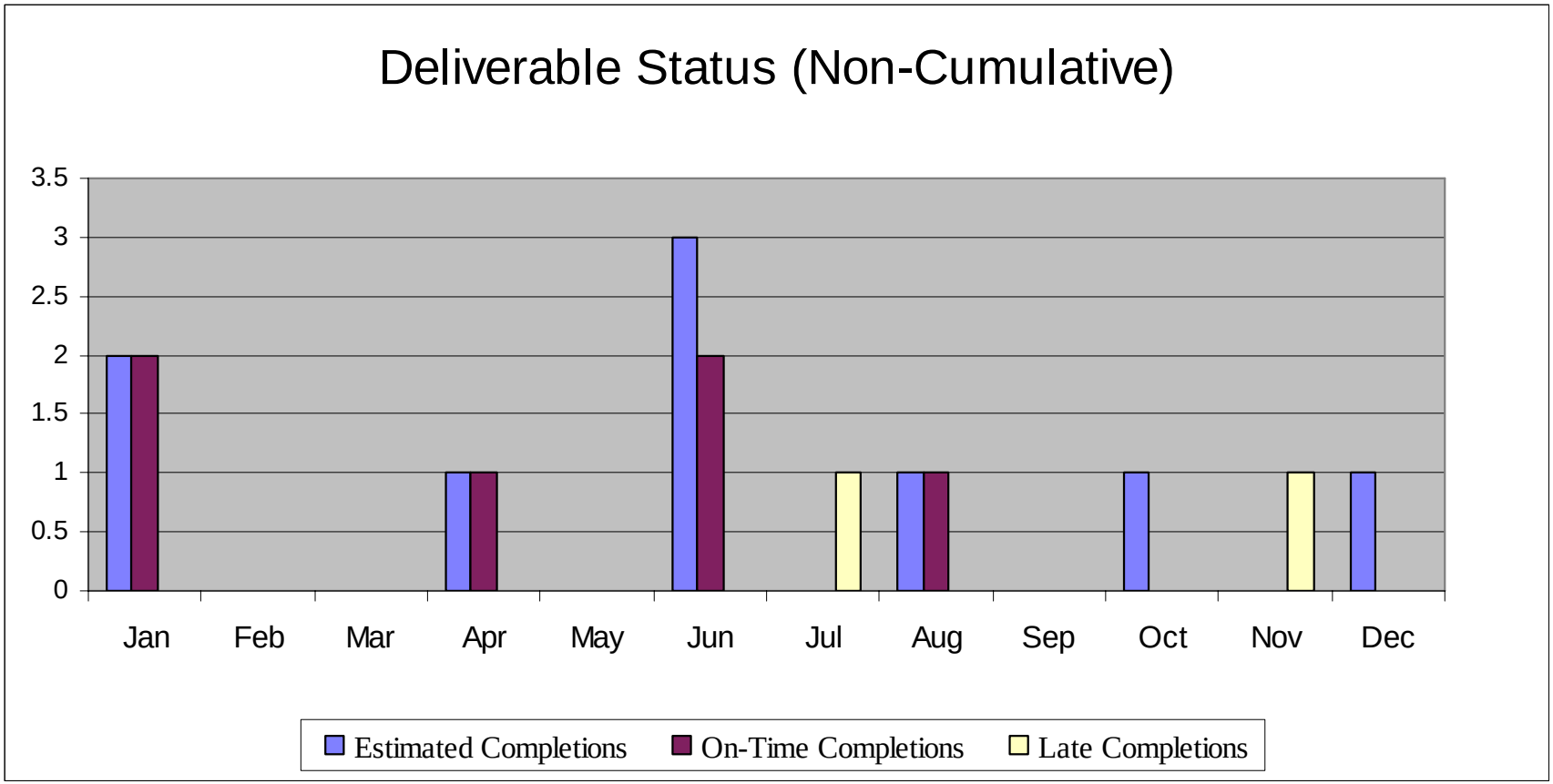
PI Measures - Quality



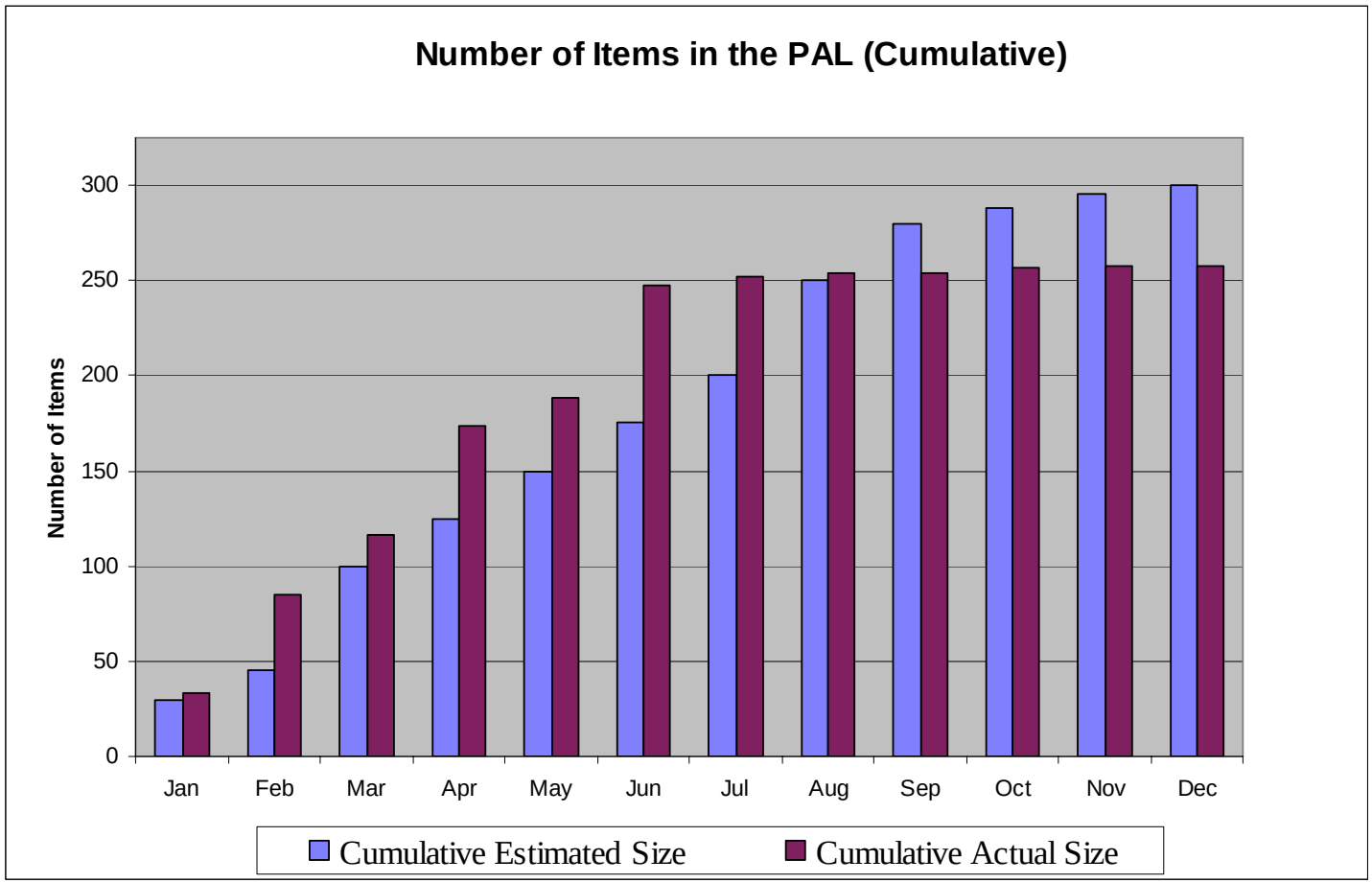
PI Measures - Effort



PI Measures - Schedule



PI Measures - Size



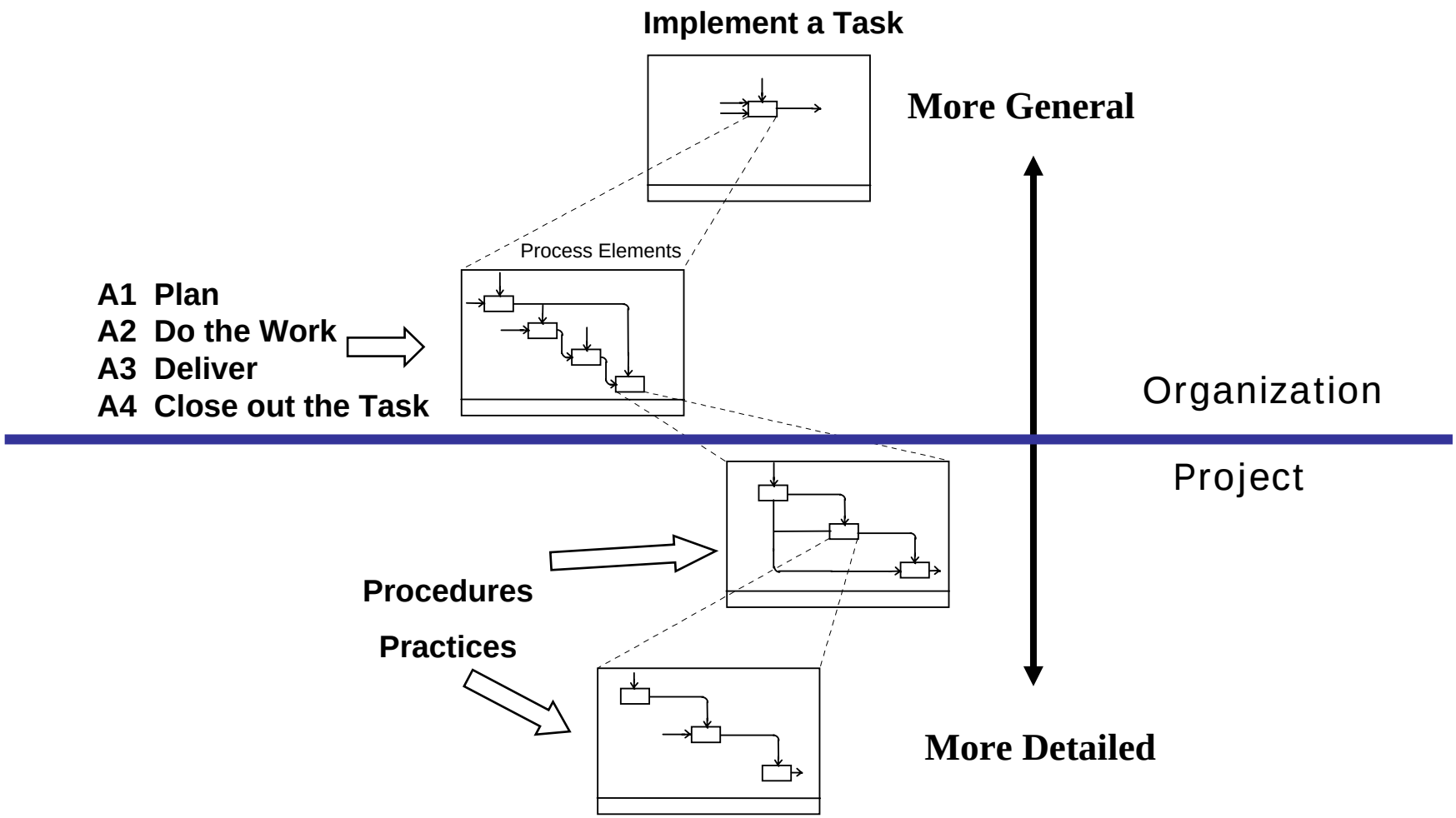
Benefits and Similar Observations

Benefits and Similar Observations

3H TECHNOLOGY

- Implementation perspectives
- Alternate Practices and Waived Process Areas
- Things We Got Right
- Lessons Learned
- Benefits

Implementation Perspectives



Process Decomposition Into Elements

Modified from a briefing developed by the Software Productivity Consortium NFP, Inc.

Alternate Practices and Waived PAs

- SP 3.2 Perform Configuration Audits (CM)
- Some Verification and most Validation performed by external group
- Supplier Agreement Management
- SP 1.3-3 Establish Product Integration Procedures and Criteria (PI)

Things We Got Right

- Practiced what we preached
- Set up the infrastructure before working the details
- Leveraged existing processes
- Engaged a consultant as objective third party
- Used measures at all stages to determine progress and justify all requests for resources and support
- Conducted a Class C, then a Class B before the Class A (with variation)

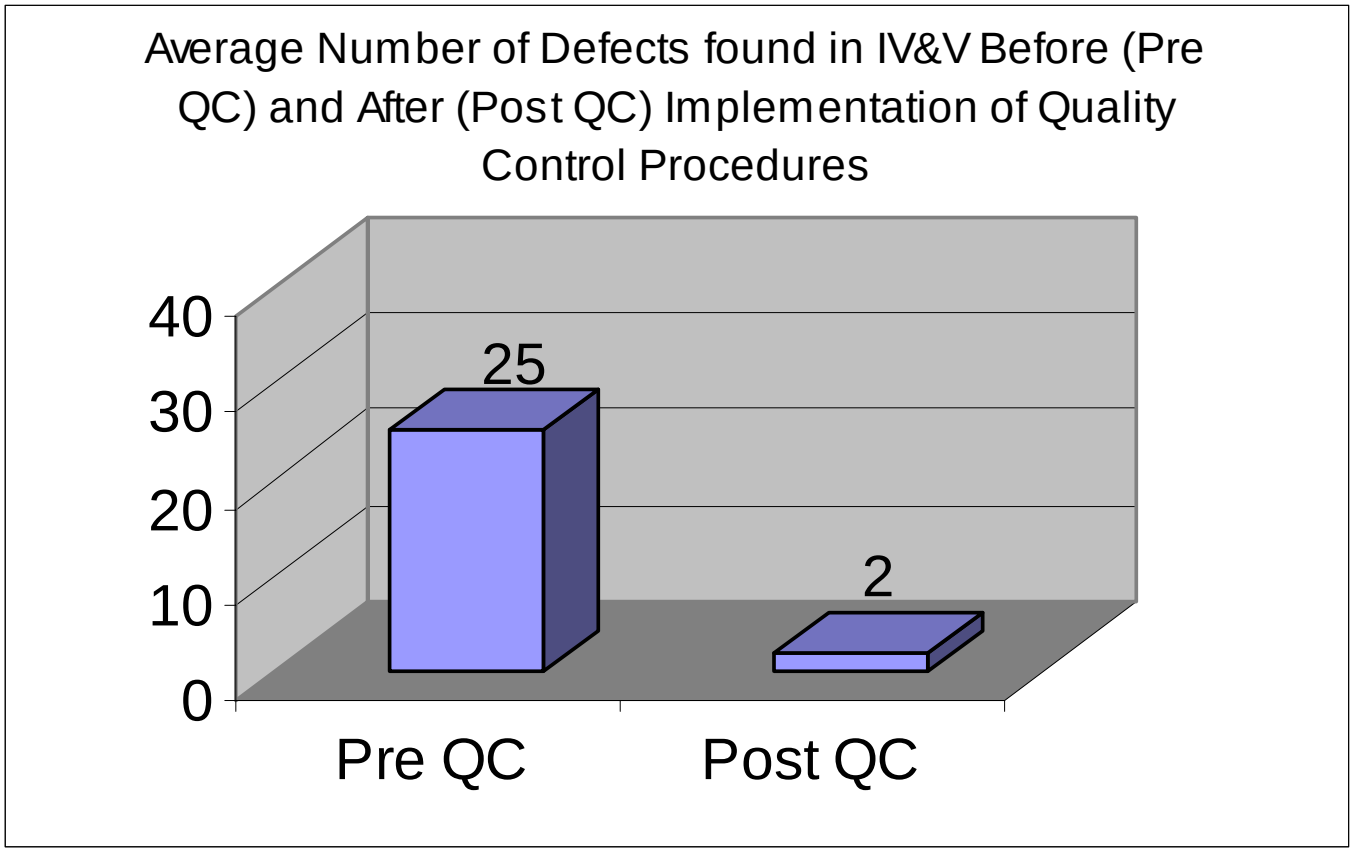
Lessons Learned

- Focusing on measures is worth the effort
- Including infrastructure early pays off
- Manual works, but automated is much better (action items, change management, version control)
- Consistent documentation standards make a difference in creating, documenting, tailoring, referencing and using processes

Benefits

- Quality control improvements
- Information sharing and communication among team members
- Clarification of roles and responsibilities
- Improved use of measures to make decisions
- Significant additional business opportunities

Quality Control Improvements



Information Sharing

- Diversity on the process action teams
- Cross-organization membership on the Engineering Process Group including ISO organizations
- Cross-organization membership on the internal process audit teams

Clarification of Roles and Responsibilities

- Roles and Responsibilities defined in a matrix
- Combined separate tasks by process/lifecycle phase, roles and process tailoring by size
- Created summary cards for certain roles

Roles and Responsibilities Matrix

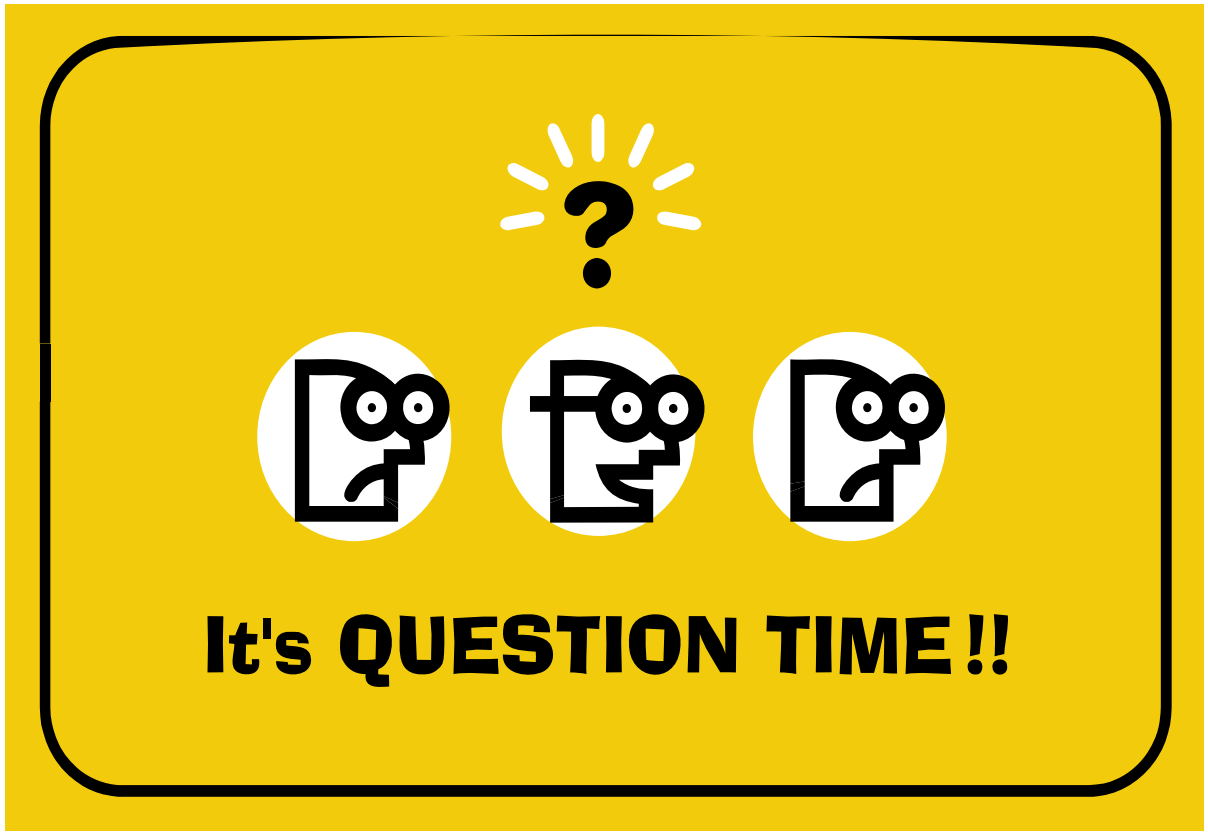
3HTECHNOLOGY

Project Duration, Size and/or Value Threshold:	<=3 months or <$150,000 or < 3 FTE staff resources and Risk and Criticality to Client Operations is Low or Medium								
Governing Statement:	Those responsible for creating work products must ensure that appropriate staff provide input, review and approve content				**Role and Responsibility**				
Process or Process Artifact	**Process(P) or Process Artifact(A)**	**Comment**	Due Date (if applicable, unless overridden by the contract)	Related Resources	**PM**	**TM**	**QM**	**CM**	**Senior Mgmt**
	Pre-Award								
No Tailoring or Alternate Practice		***Comment***							
Optional									
At Risk Form	A	Used when funds are not available but work is required.			C				R,A
Statement of Work or RFP	A	Customer/client generates this document	NA		R	R	R	R	R
SOW/RFP Proposal (including cost proposal)	A		By due date		C	I	I	I	A
Vision Document	A				C	R	R	R	A
Product									
	Project Management Process								
No Tailoring or Alternate		***Comment***							
		This is accomplished by the Project Setup Form. This can be delegated to PMs for pre-award work under $20K; is optional for work defined under existing T&M, FFP contracts and maintenance. Form goes to Finance. The At							

Improved Use of Measures to Make Decisions

- Decision Analysis for selecting technical implementation options, pilots and training for process change requests
- Setting measurement goals to guide analysis efforts
- Risk management
- Escalation of process audit results

Questions



2006 State of Software Measurement Practice Survey

NDIA CMMI Technology and Users Conference

Mark Kasunic
November 15, 2006

Software Engineering Institute | Carnegie Mellon

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Agenda

Introduction

- Survey objectives & approach
- The population being studied
- Sampling plan

Results

- Response rates and outcome
- Population demographics
- Attitudes and beliefs about measurement use
- Measurement guidance that is used
- Measures that are reported

Summary Observations

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Survey Objectives

The objectives of this survey are to characterize

- the degree to which software practitioners use measurement when conducting their work
- the perceived value of measurement
- approaches that are used to guide how measures are defined and used
- the most common types of measures used by software practitioners

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Characteristics of the Survey

We used a structured, self-administered questionnaire that was available both via the World Wide Web and in paper form.

The questionnaire was designed to be short (17 questions) and easy-to-complete with questions phrased in close-ended format. Several questions allowed for short open-ended responses.

Stratified random sampling was used to select candidate respondents from a population comprised of members from three different subpopulations.

Candidate respondents were offered incentives to participate including

- platinum membership to the Software Engineering Information Repository (SEIR) that provides access to documents otherwise unavailable through regular membership
- early access to the survey results

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The Population Being Studied

The population that we would have *liked* to have studied is the entire existing body of software practitioners in the world. However, such a representative database was unavailable to us.

The population that we did use for this study included individuals who:

1. were entered into the SEI customer relations database during 2004-2005
2. registered to gain access to the SEI's Software Engineering Information Repository (SEIR) during 2004-2005
3. became an SEI Member during 2004-2005

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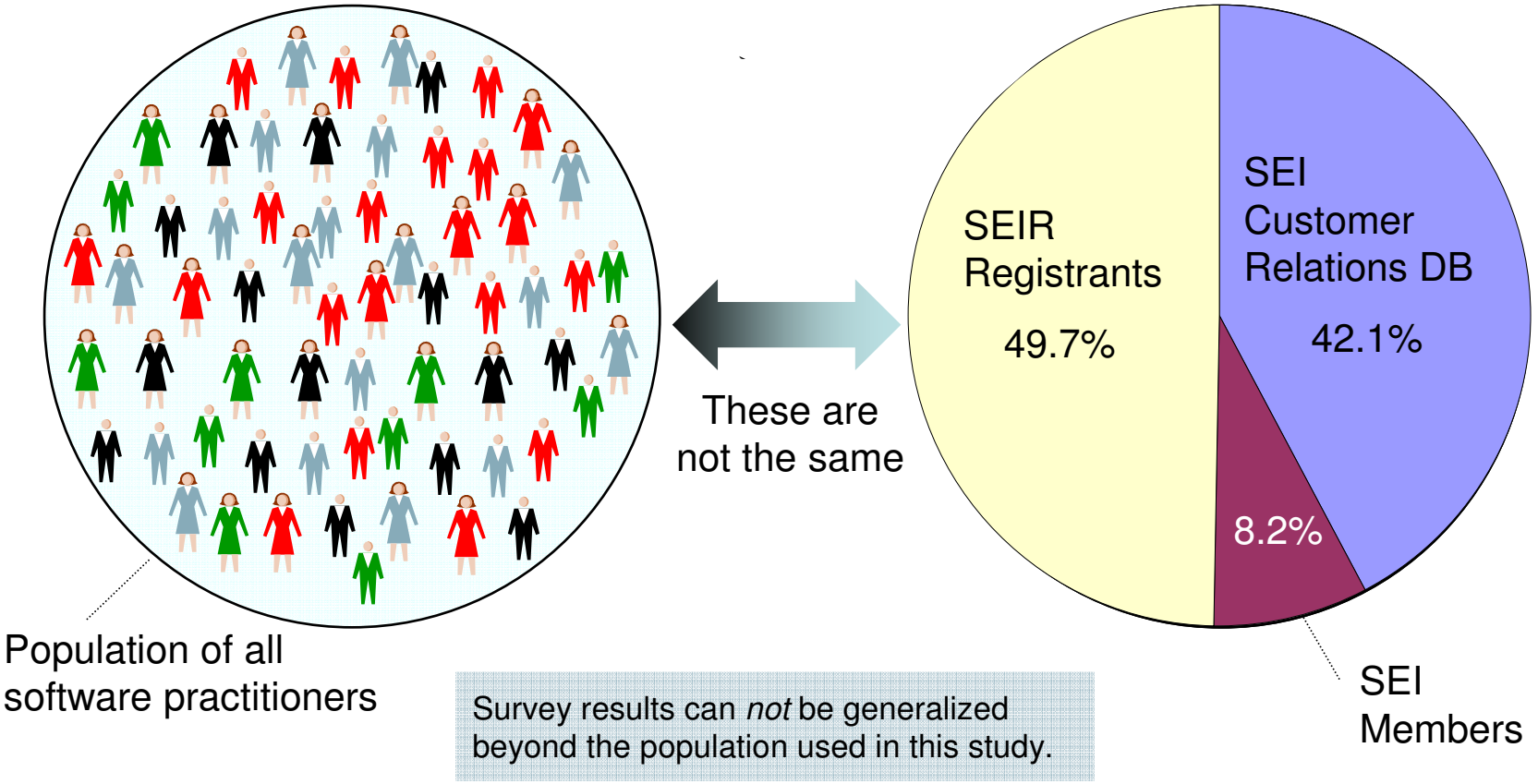
Important to Remember When Interpreting Survey Results



Survey results can *not* be generalized beyond the population used in this study.

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Sampling Plan

Subpopulation	Population Size	Sample Size	Adjusted Sample Size	Actual Sample Size
Customer Relations	6,398	603	2010	1670
SEI Members	1,242	434	1,242	951
SEIR registrants	7,540	612	2040	1539
Total	15,180	1,649	5,292	4,160

Calculated for:
precision of ± 2.5%
confidence of 95%

Adjusted based on estimated 30% response outcome.

- Invalid email addresses
- Non-responses
- Ineligible respondents

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Agenda

Introduction

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- The population being studied
- Sampling plan

→ Results

- Response rates and outcome
- Population demographics
- Attitudes and beliefs about measurement use
- Measures that are reported

Summary Observations

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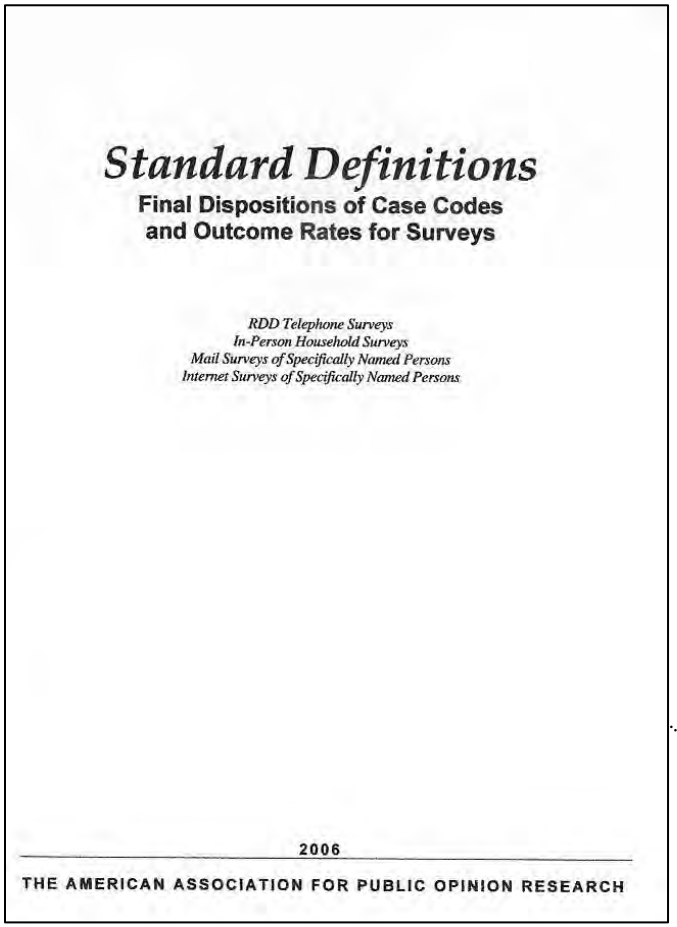
Response Outcome Rates



Minimum Response Rate

$$RR1 = 42.4\%$$

Counts partial interviews as respondents

$$RR2 = 50.7\%$$

http://www.aapor.org/pdfs/standarddefs_4.pdf

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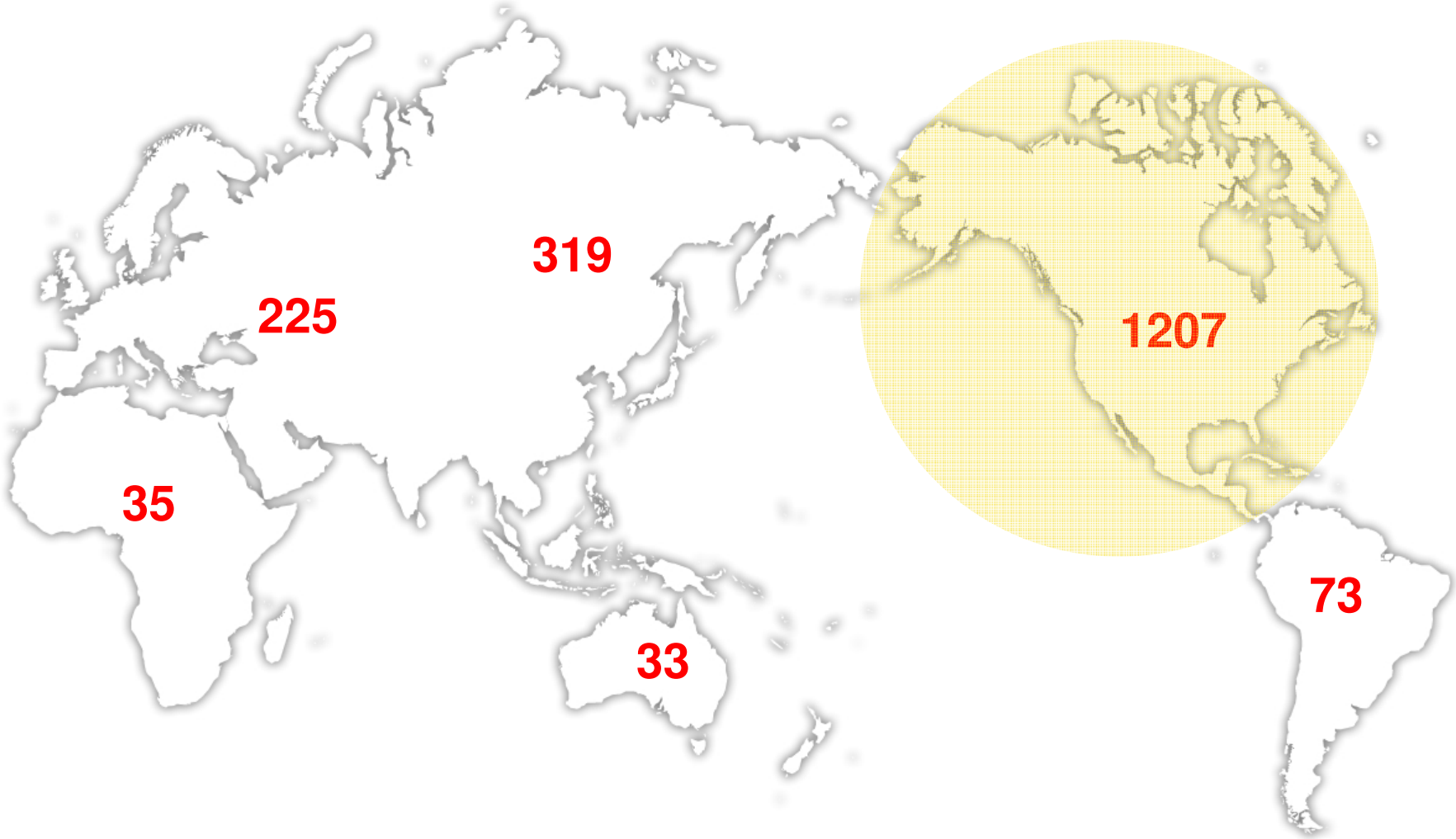
84 Countries Represented

Respondents by Continent



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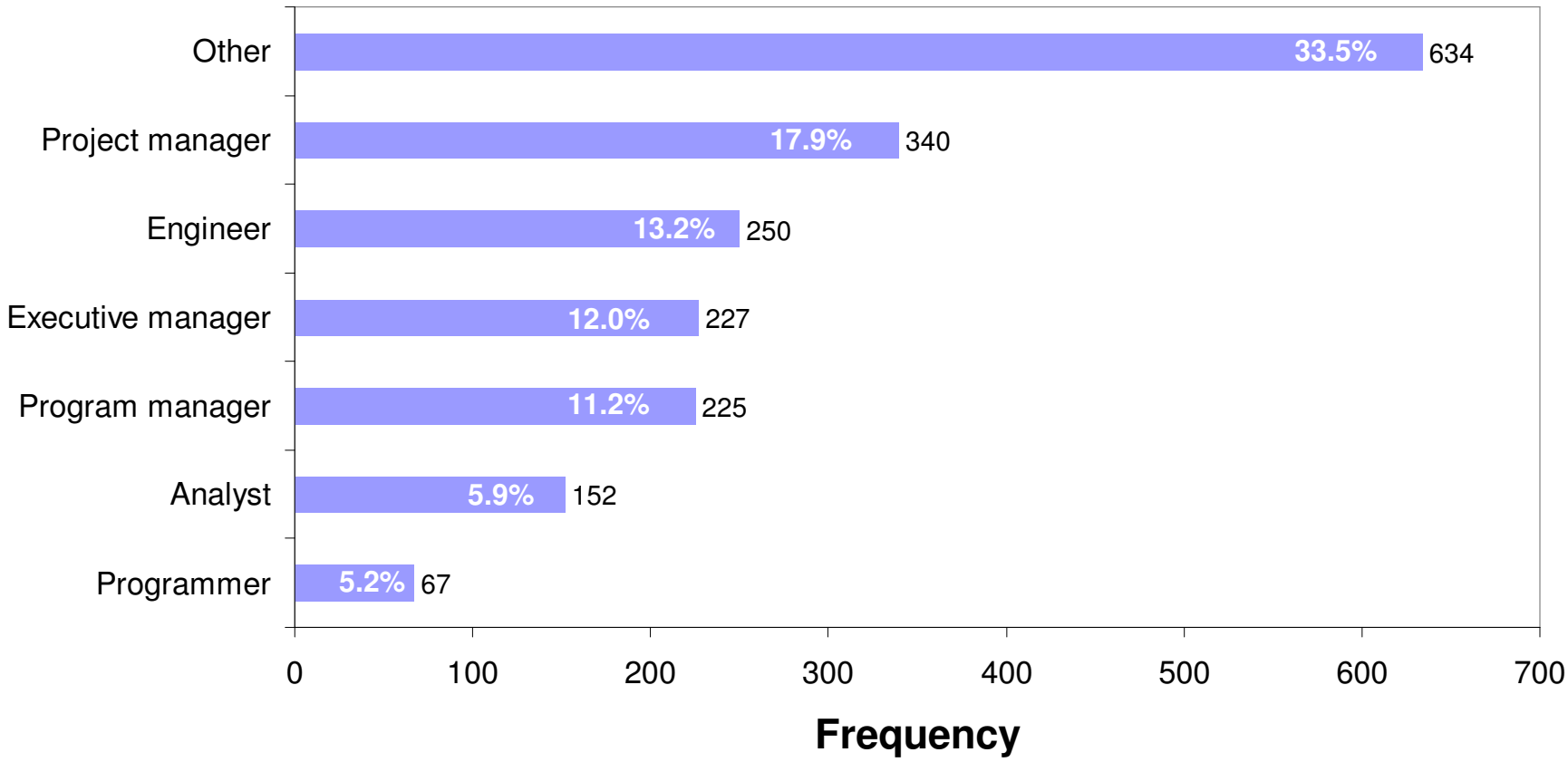
Survey Respondents



1895 Responses

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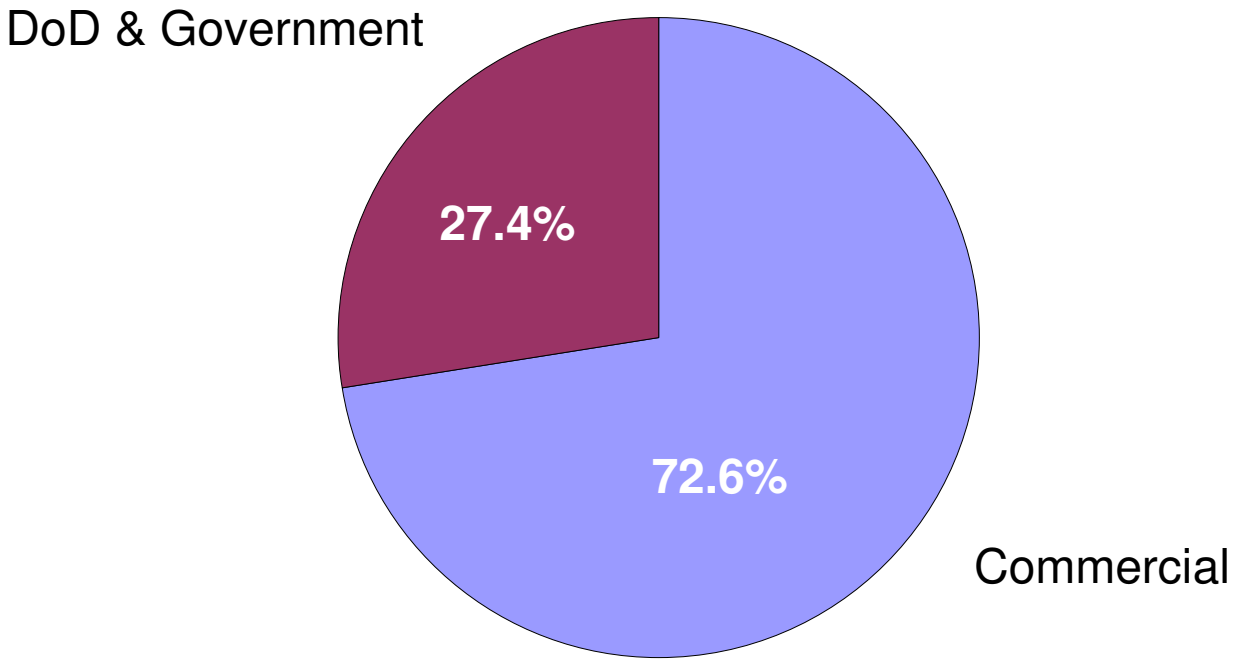
Approximate Population Proportions



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Agenda

- Results
  - Response rates and outcome
  - Were subpopulations different?
  - Population demographics
  - Attitudes and beliefs about measurement use
    - *How are you involved with measurement?*
    - *Are purposes for measurement understood?*
    - *Does measurement help?*
    - *Is measurement used to understand product/service quality?*
    - *Documented measurement processes?*
    - *Measurement definitions understood and consistent?*
    - *Do measurable criteria exist for products and services?*
    - *Is corrective action taken when thresholds are exceeded?*
  - Measures that are reported

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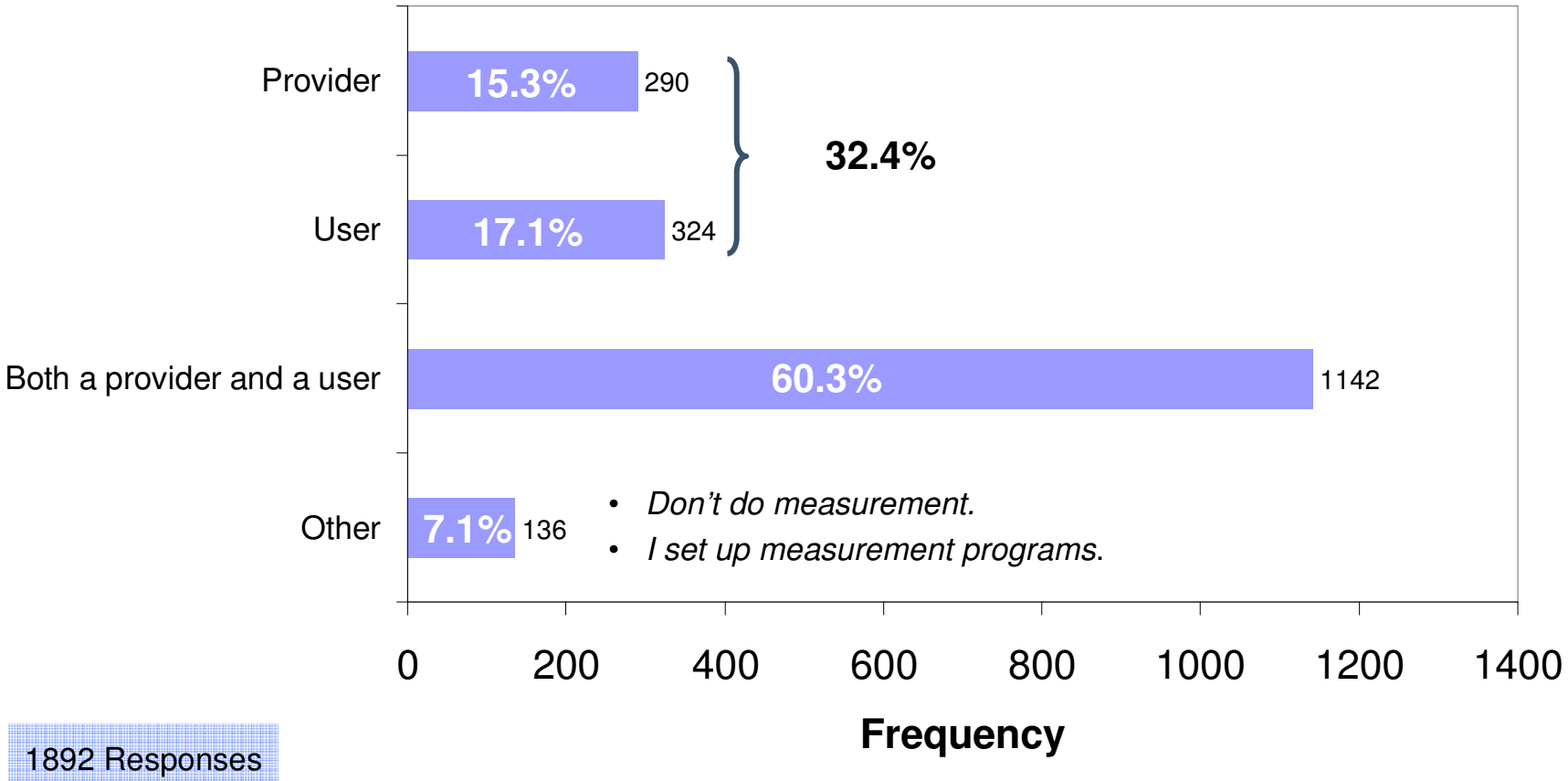
Involvement With Measurement



1892 Responses

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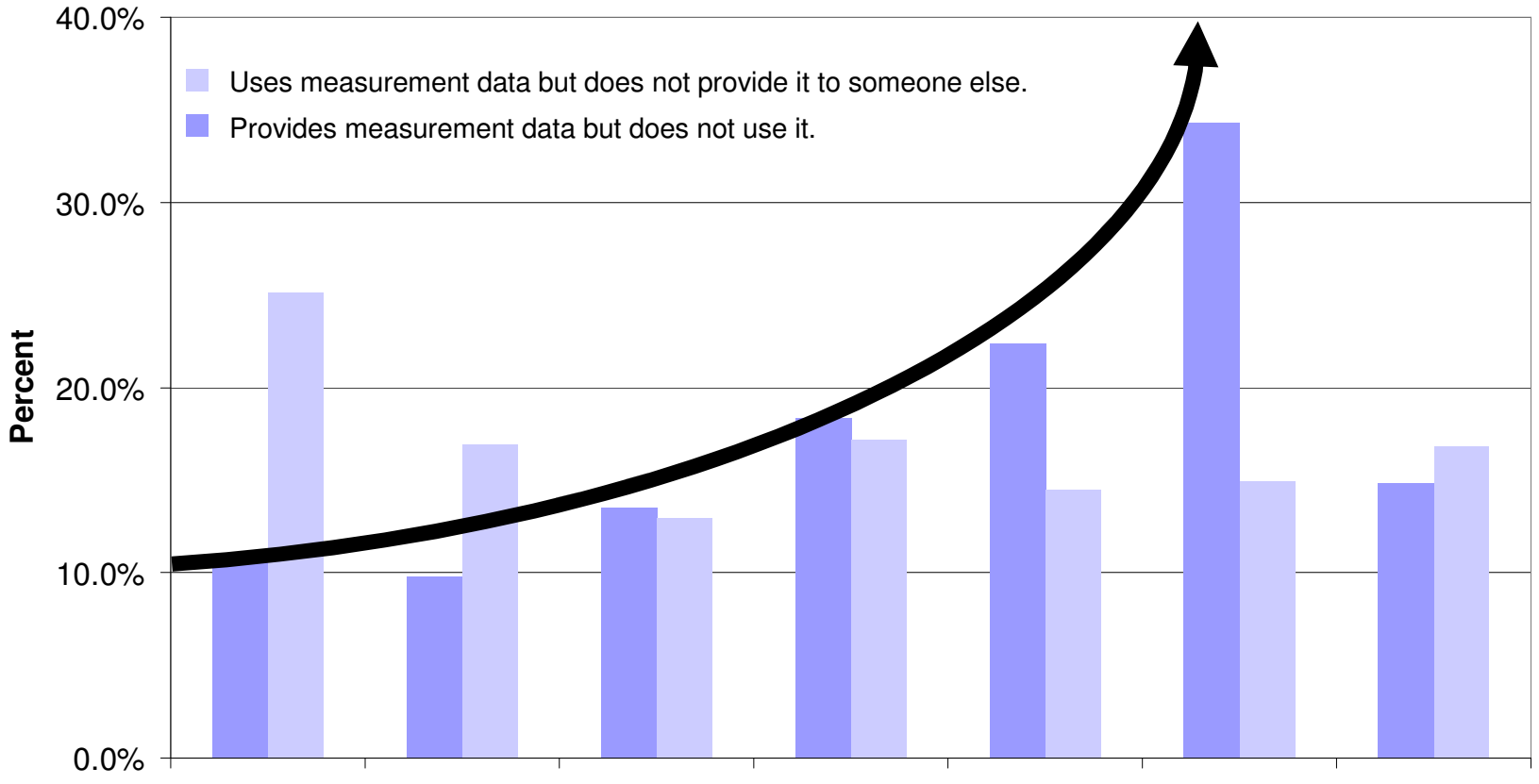
Provides (only) or Uses (only)



289 Provider
321 User

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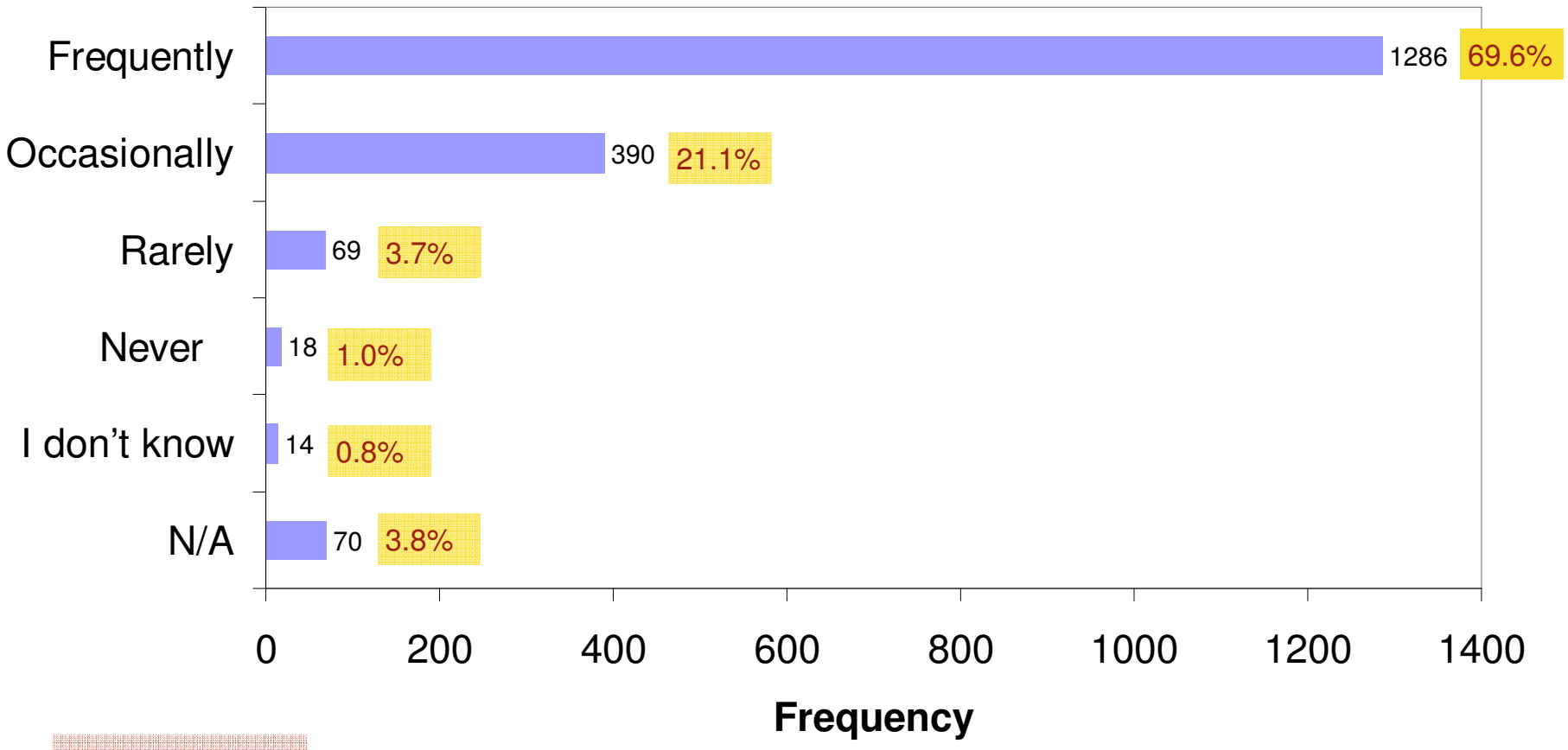
Purpose for Measuring Is Understood



1847 Responses

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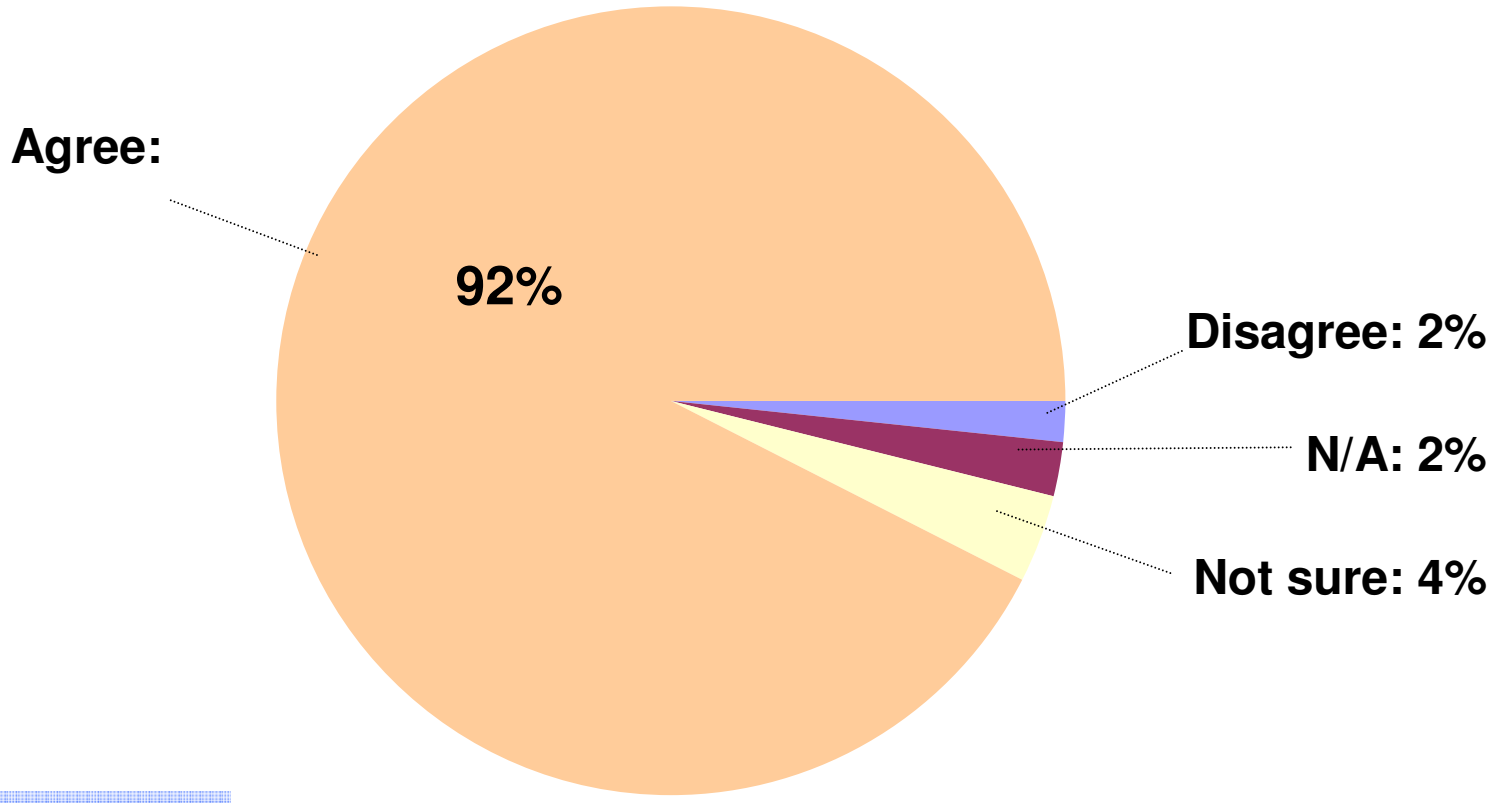
Believe That Measurement Helps (To Some Degree)



1868 Responses

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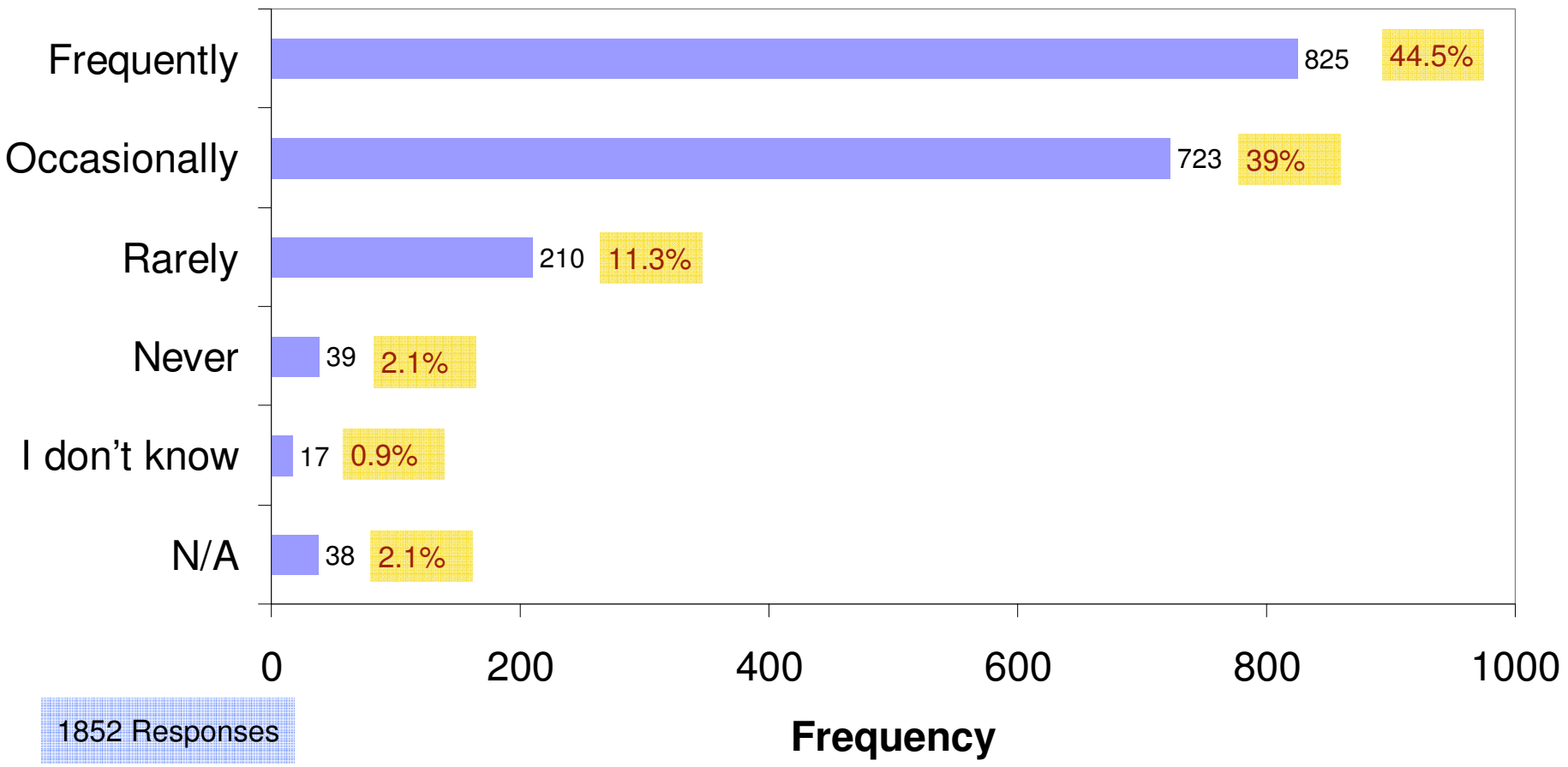
Measurement Used to Understand Quality of Products & Services



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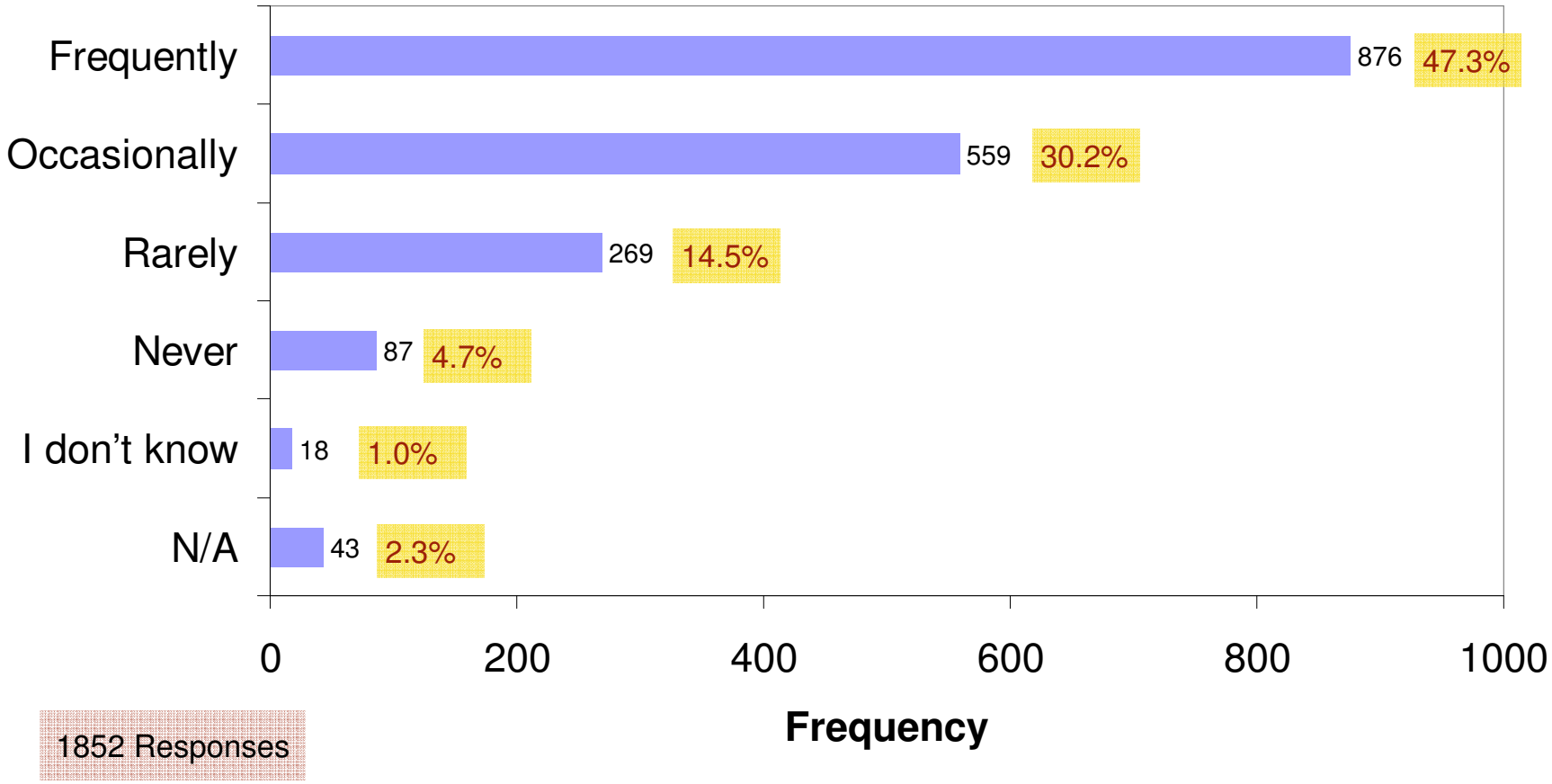
Documented Process for Collecting Measurement Data



1852 Responses

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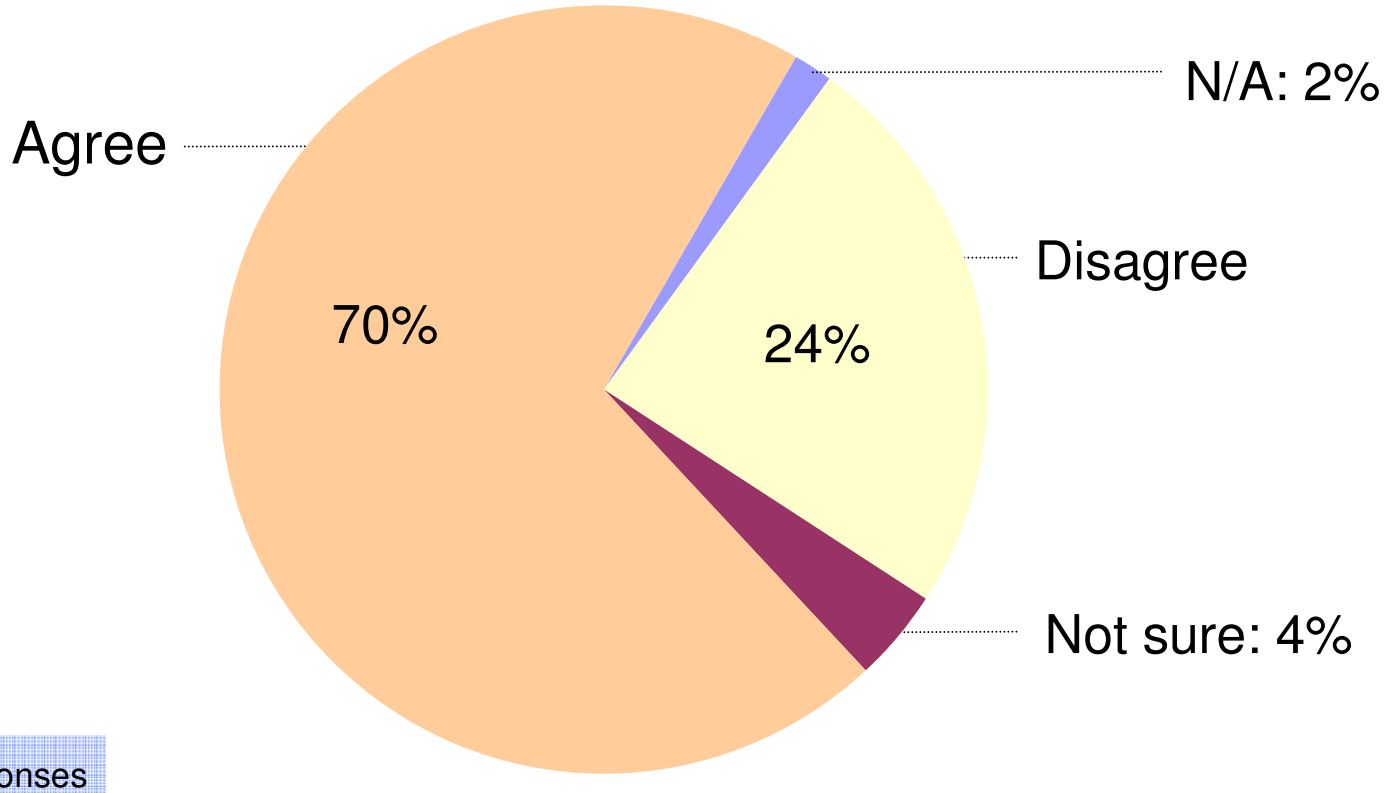
Measurement Definitions Are Understood & Consistent



1868 Responses

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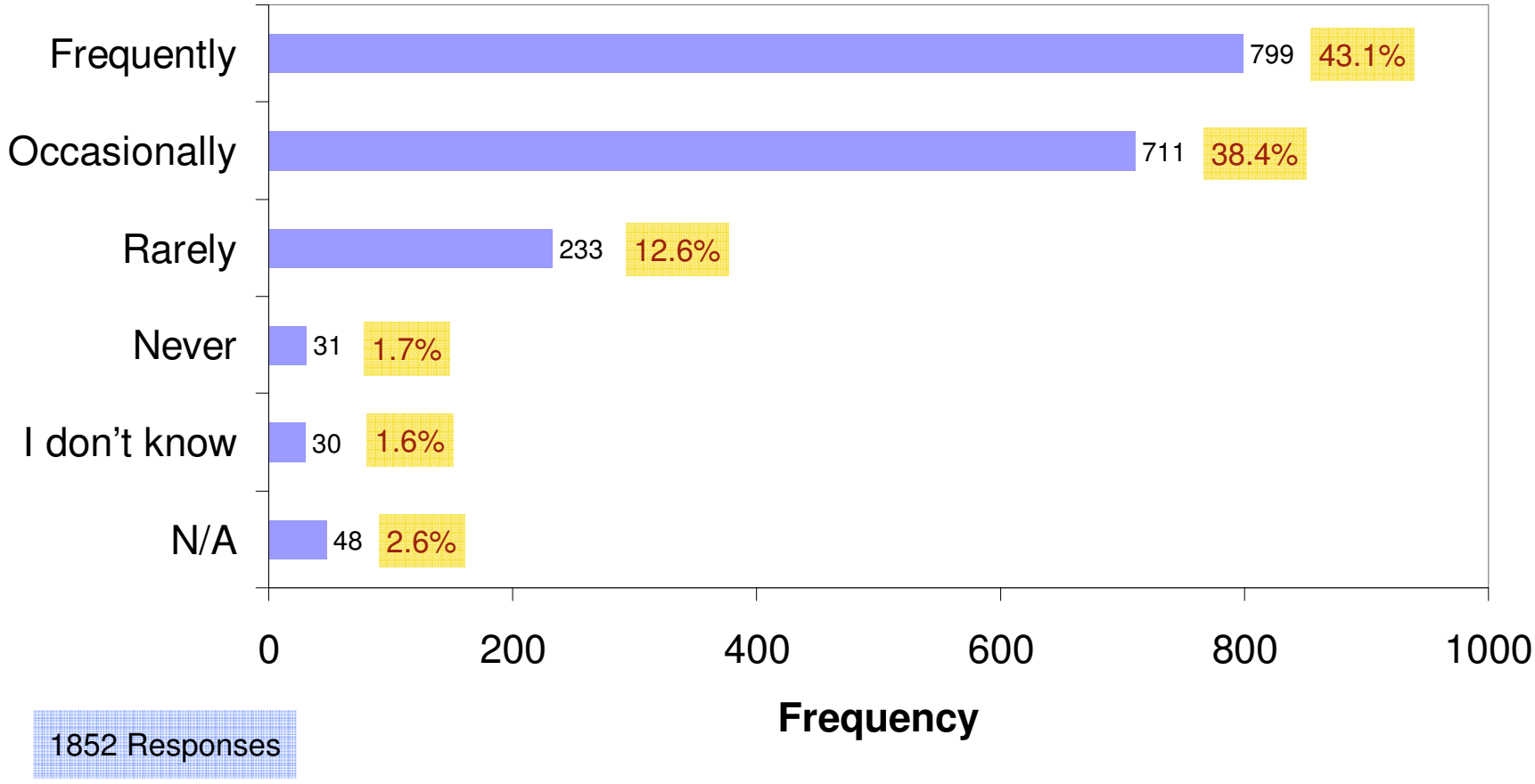
Measurable Criteria Exist for Products & Services



1852 Responses

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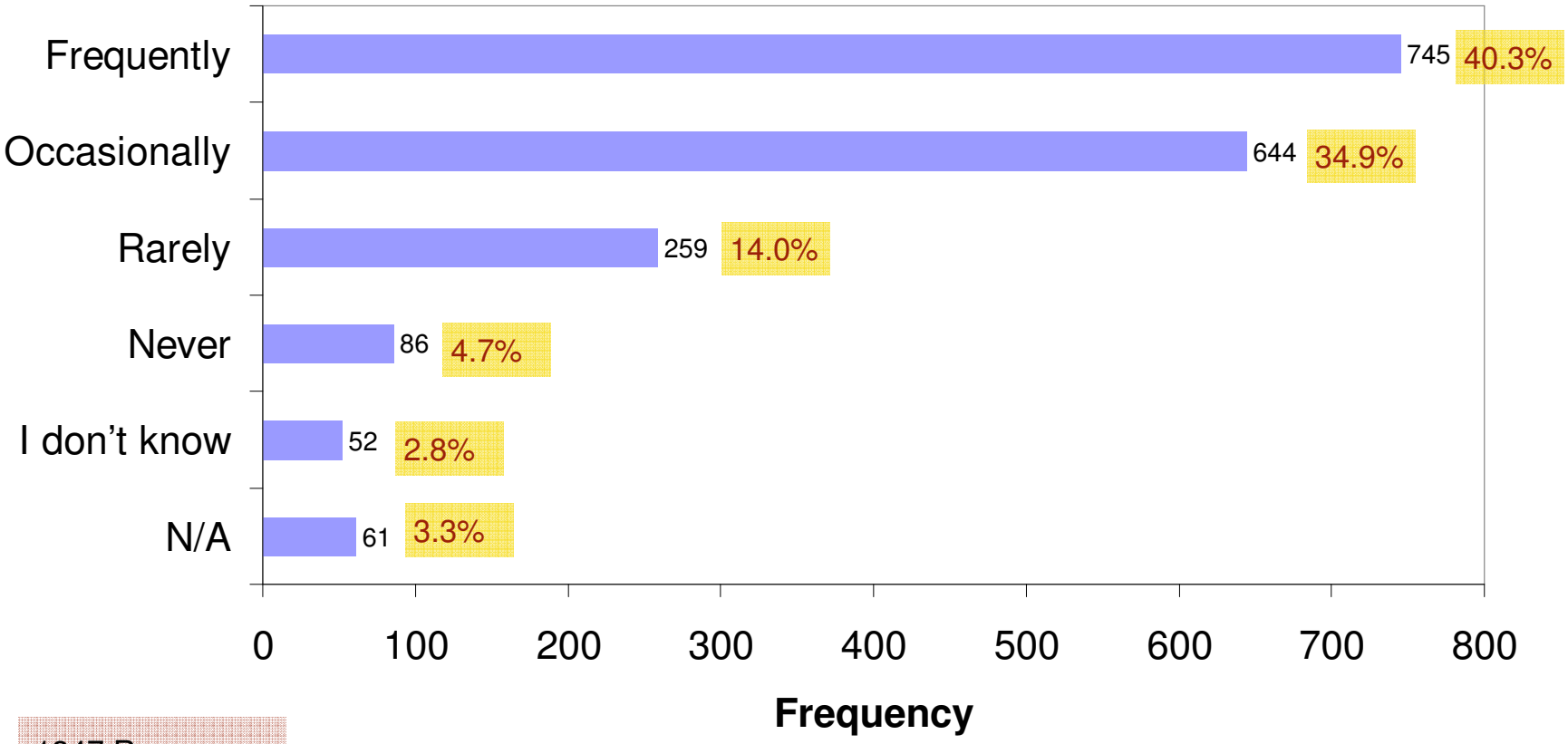
Corrective Action Taken When Measurement Threshold Exceeded



1847 Responses

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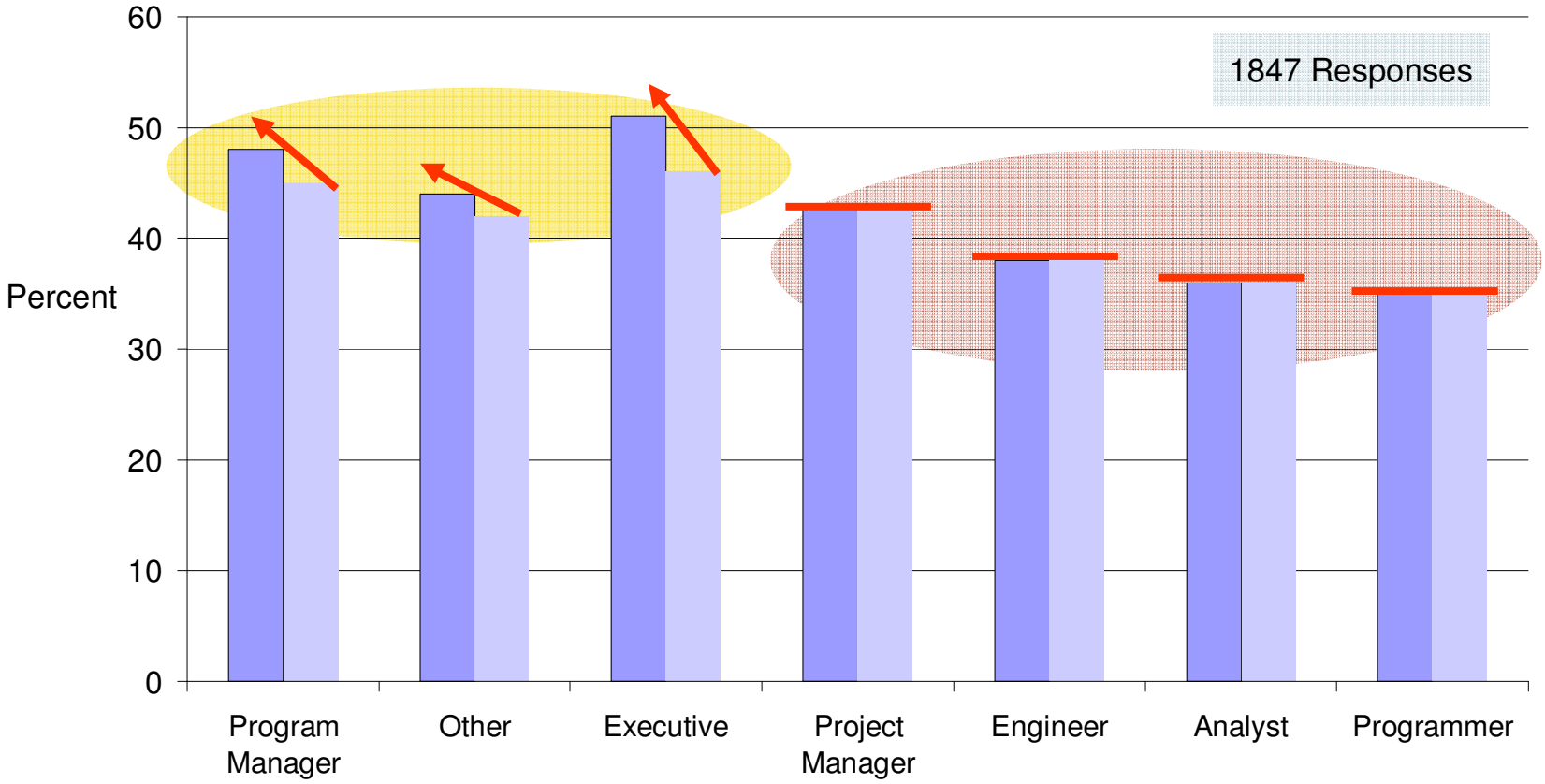
Action-Oriented Response to Measurement Information



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Agenda

Introduction

- Survey objectives & approach
- The population being studied
- Sampling plan

Results

- Response rates and outcome
- Population demographics
- Attitudes and beliefs about measurement use
- → Measurement guidance that is used
- Measures that are reported

Summary Observations

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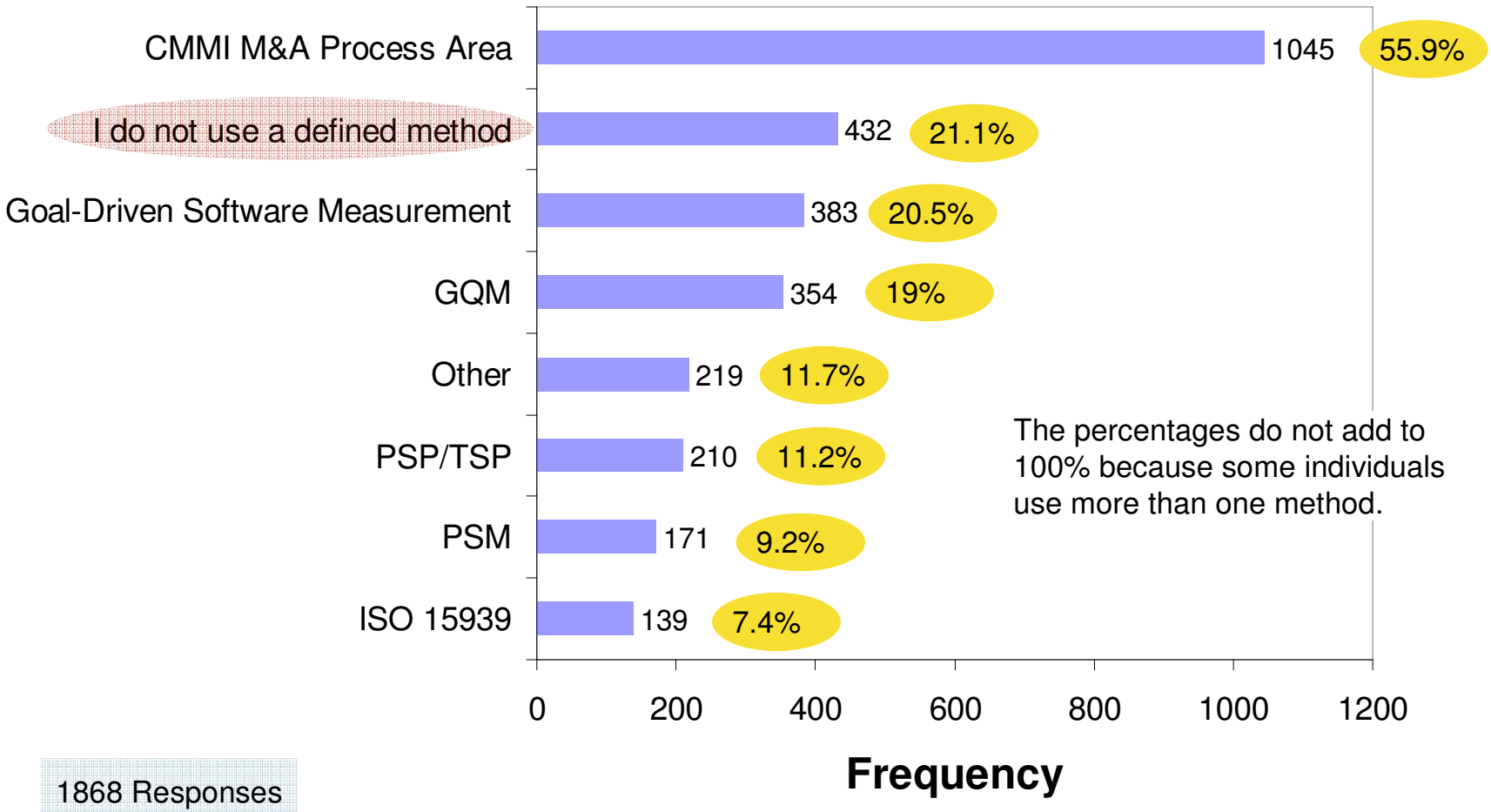
Measurement Methods Used



1868 Responses

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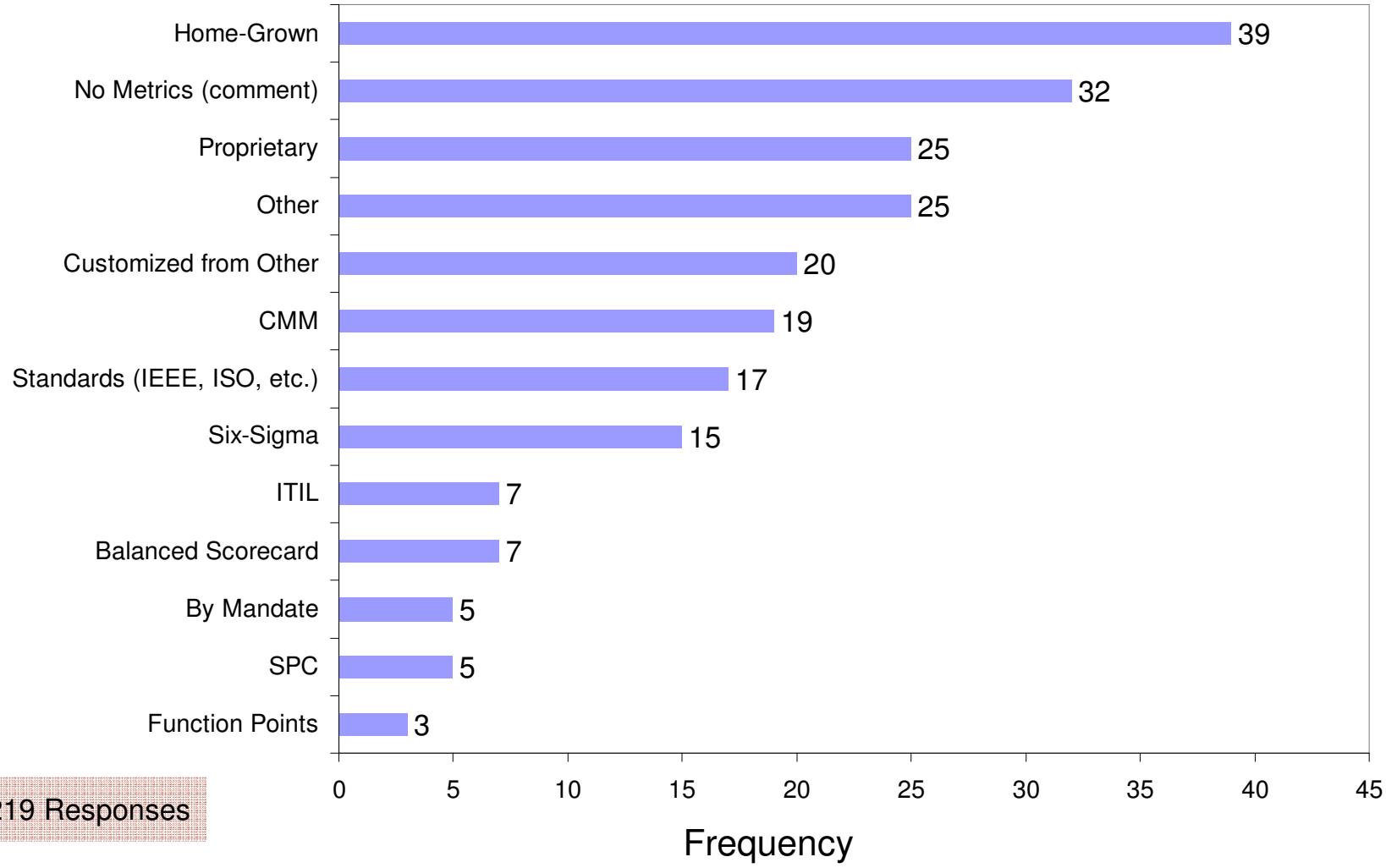
“Other” Methods Used



219 Responses

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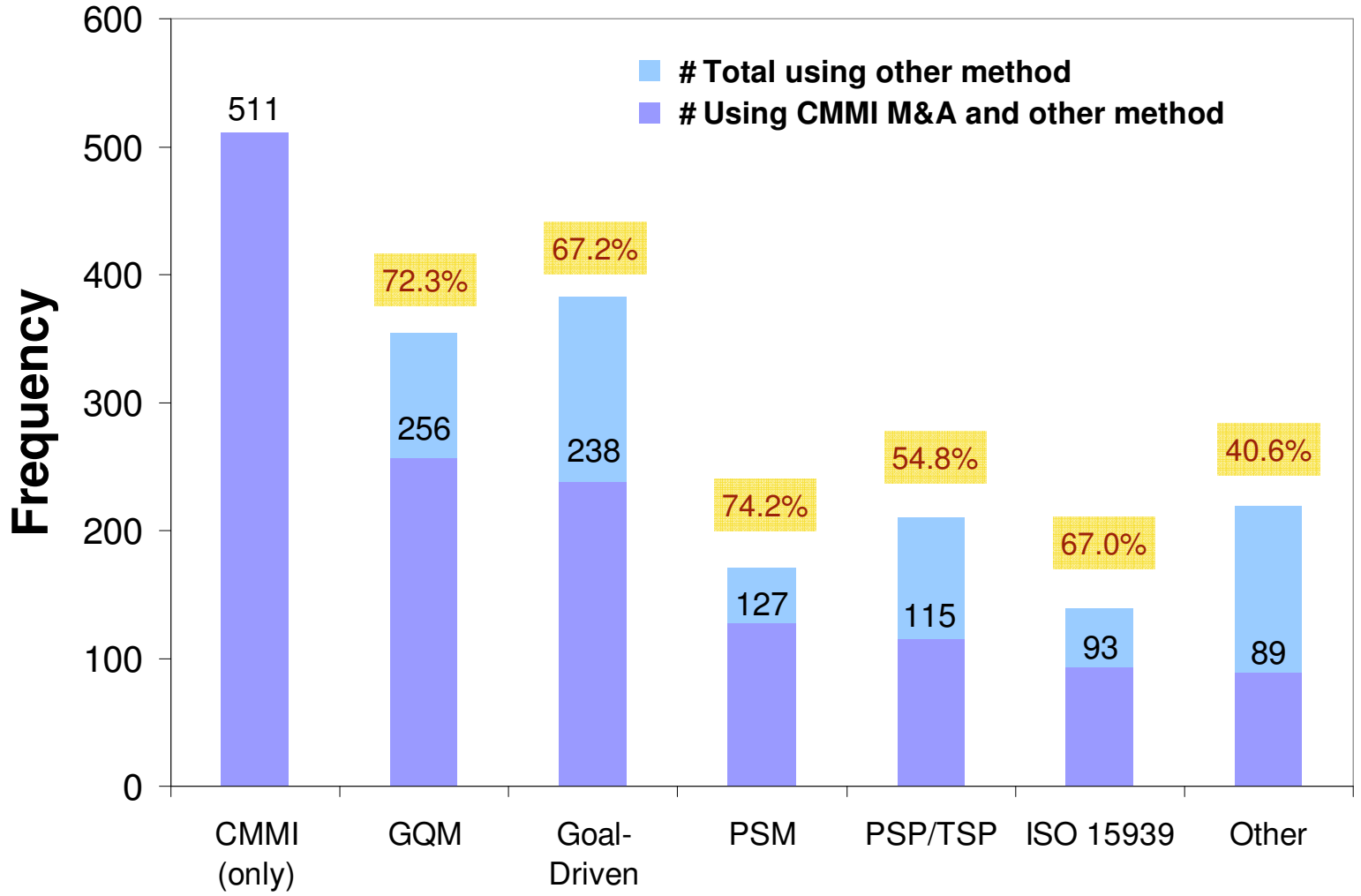
Those Using "CMMI M&A Process Area"



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Summary Observations

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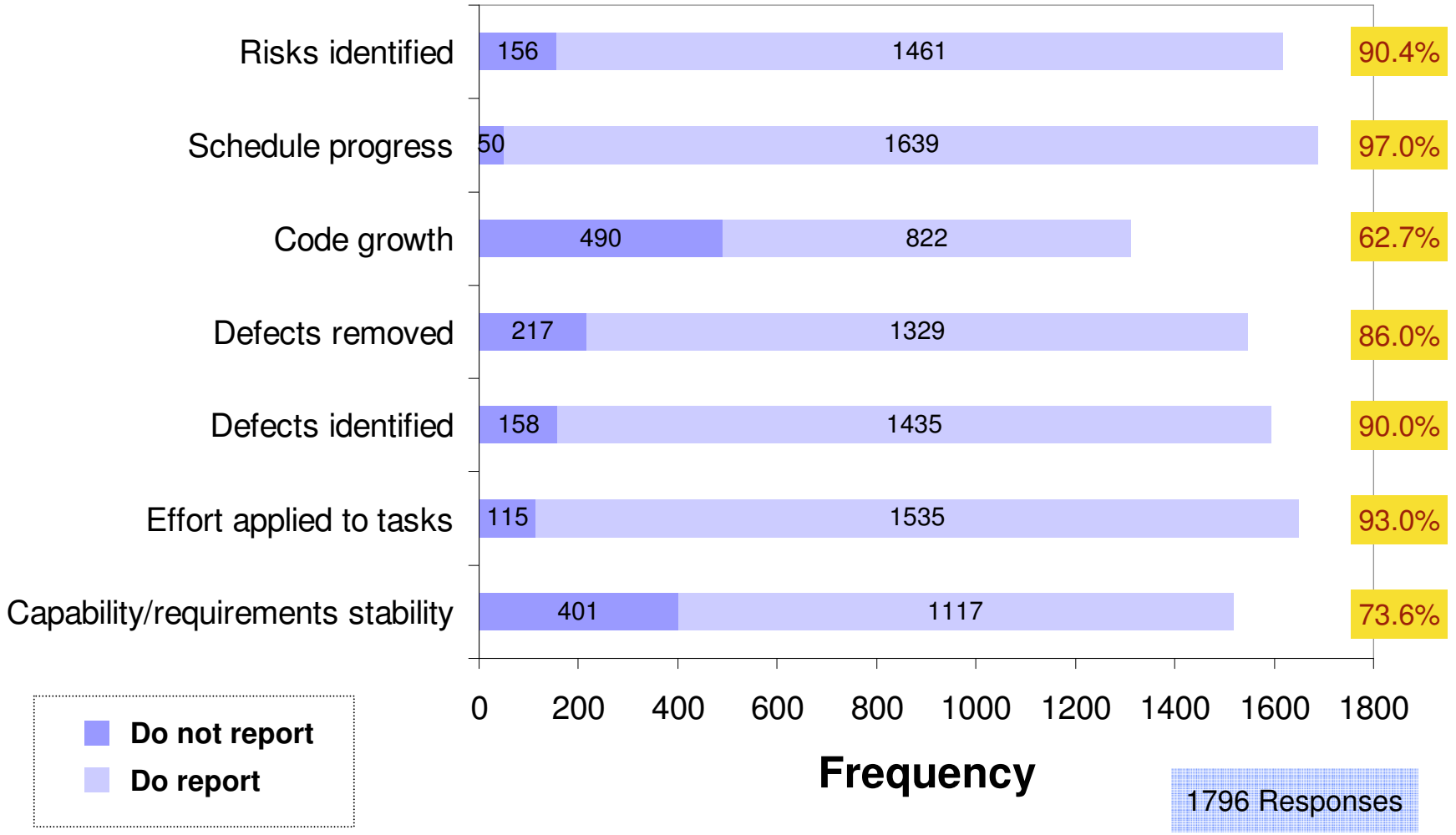
Measurements that Are Reported



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Agenda

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- Survey objectives & approach
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Results

- Response rates and outcome
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- Attitudes and beliefs about measurement use
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→ Summary Observations

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Influence of Role on Response - 1

In general, there were significant differences in response patterns when comparing management versus staff.

Management	Staff
Executive	Engineer
Program Manager	Analyst
Project Manager	Programmer

Statistical tests of significance demonstrated that the differences were significant with confidence of at least 99% in all cases (and 99.9% in some cases.

- Hypothesis test for equality of proportions
- Chi-Square test for significance

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Influence of Role on Response - 2

When compared to staff, management responded more strongly that

- they understand the purposes for measurement
- measurement helps their team perform better than without it
- they use measurement more often to understand the quality of their products and services
- they follow a documented process more often for collecting and reporting measurement data
- measurement definitions are commonly understood and consistent in their organization
- measurable criteria exist for their products and services
- corrective action is taken when a measurement-based threshold has been exceed

In general, the differences are statistically significant.

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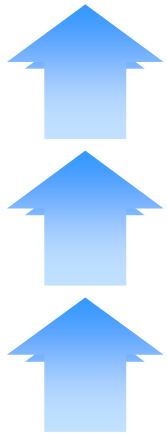
Influence of Organizational Size - 1

	Number in Organization		
	≤ 100	101 - 499	≥ 500
Using measurement-based data helps my team to perform better than without using it.	**78.4%**	**81.5%**	**86.8%**

** Percent that Agree or Strongly Agree.*

There exist measurable criteria for the products and services to which I contribute.	**37.0**	**46.4**	**54.7%**
I use measurement to understand the quality of the products/services that I work on.	**35.1%**	**41.1%**	**46.2%**
My team follows a documented process for collecting measurement data.	**65.7%**	**71.6%**	**72.1%**



** Percent that responded, "Frequently" to the listed questionnaire item.*

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Comparing Industry to Government

	Industry	Government
Using measurement-based data helps my team to perform better than without using it.	**84.5%**	**80.0%**
Definitions of measures used in my organization are commonly understood & consistent.	**37.1%**	**31.9%**

** Percent that Agree or Strongly Agree.*

Differences statistically significant with confidence 95%.

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Comparing USA to Other Countries

	USA	Other
Using measurement-based data helps my team to perform better than without using it.	**80.1%**	**85.9%**
Definitions of measures used in my organization are commonly understood & consistent.	**31.3%**	**42.4%**

** Percent that Agree or Strongly Agree.*

Differences statistically significant with confidence 99%.

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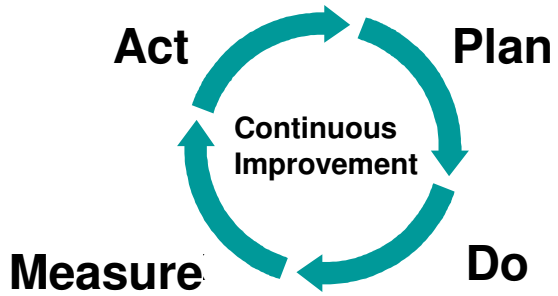
Using Measurement to Improve

It is notable and a bit alarming that only 40.3% of all respondents reported that corrective action is taken when a measurement threshold has been exceeded.

Close to 20% of respondents reported that corrective action is rarely or *never* taken when a measurement threshold is exceeded.

Measurement doesn't help much unless the information is acted upon.



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To be published this year:

The State of Software Measurement Practice: Results of 2006 Survey

TECHNICAL REPORT

CMU/SEI-2006-TR-009
ESC-TR-2006-009

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Acknowledgements

Thanks to my SEMA colleagues who contributed their ideas for this survey. This work benefited from their good review and feedback.

Robert Ferguson
Wolf Goethert
Laura Malone
Dennis Goldenson
Jim McCurley
Robert Stoddard
Dave Zubrow
Michael Zuccher

Also, Linda Parker Gates and Erin Harper provided helpful feedback. I thank them for their contributions. Special thanks to Peter Capell for detailed review and helpful feedback he provided on multiple work products associated with this effort.

Thank you to Connie Sapienza, Jim McCurley, and Mike Zuccher for their assistance with organizing the database information used in this effort.

Thanks to Laura Malone and Michael Zuccher for their extra effort required to implement the survey incentive offer associated with the Software Engineering Information Repository (SEIR).

Thanks to Dave Zubrow for management support of this effort.

Finally, thank you to the individuals that took the time to assist us with this research by responding to this survey.

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CMMI for Services:
Introducing the CMMI for Services Constellation

Craig R. Hollenbach
CMMI for Services Project Manager
Northrop Grumman Corporation

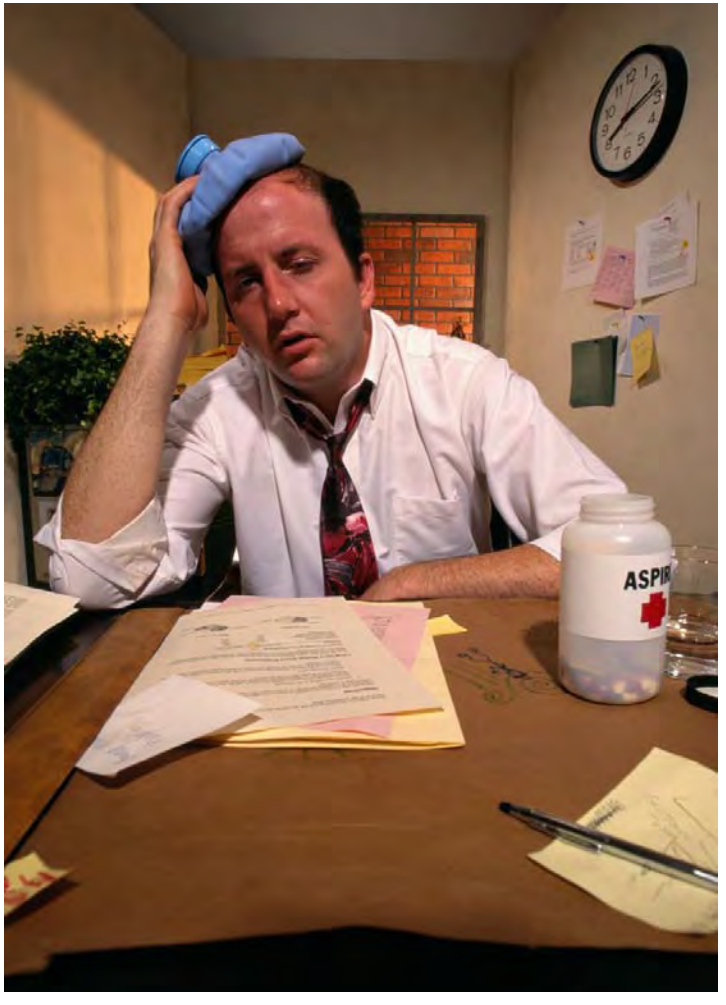
Brandon Buteau
CMMI for Services Chief Architect
Northrop Grumman Corporation

Agenda

- Main Message:
  - CMMI-SVC is a ***minimal*** and ***logical*** extension to CMMI v1.2 content, allowing current CMMI users to reuse CMMI investments to improve service performance

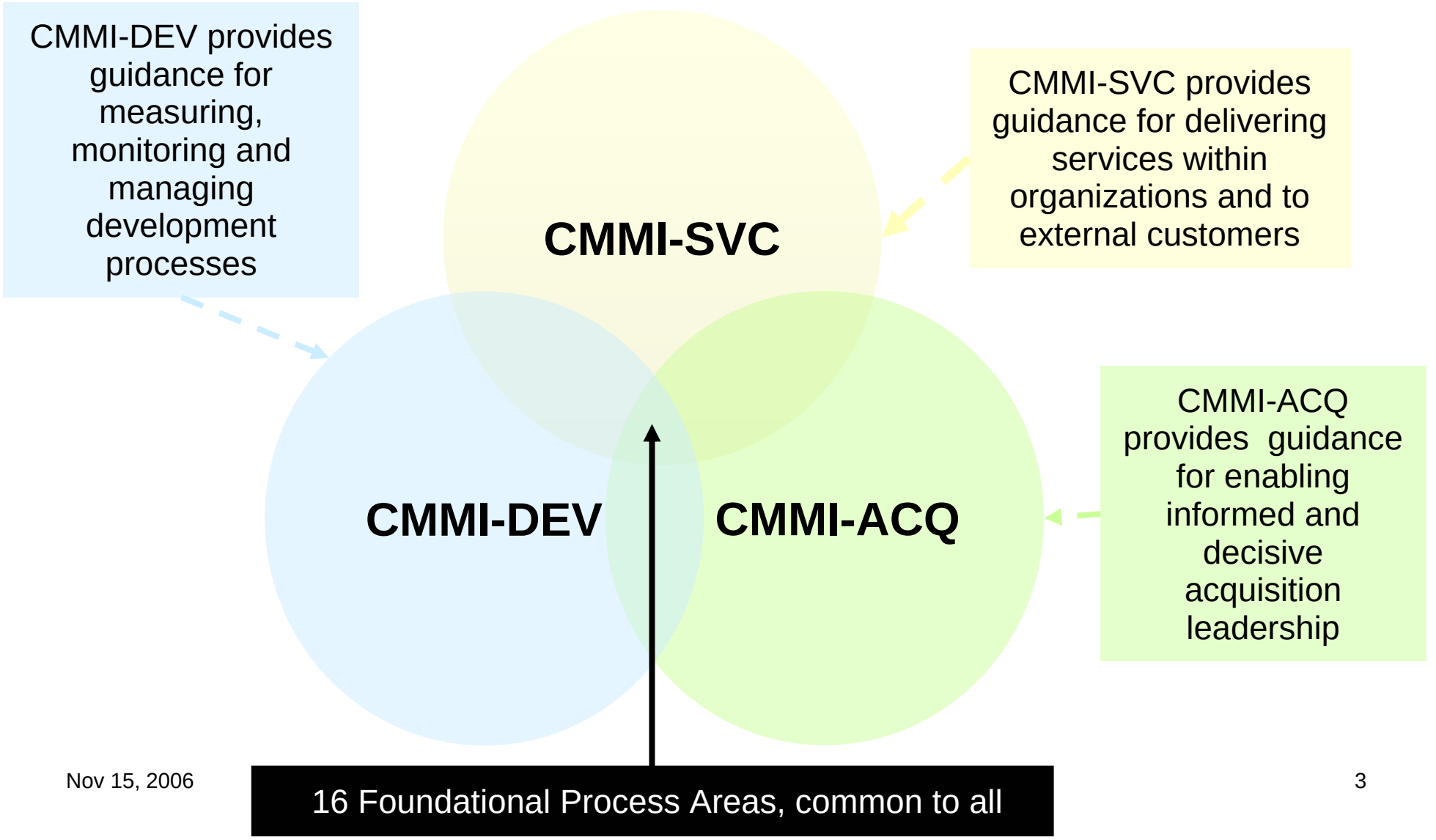
- Agenda:
  - CMMI-SVC's ***minimal*** model footprint
    - illustrating the substantial reuse of CMMI-DEV material
  - CMMI-SVC's ***logical*** construction
    - an introduction to CMMI-SVC model content

Why Services?



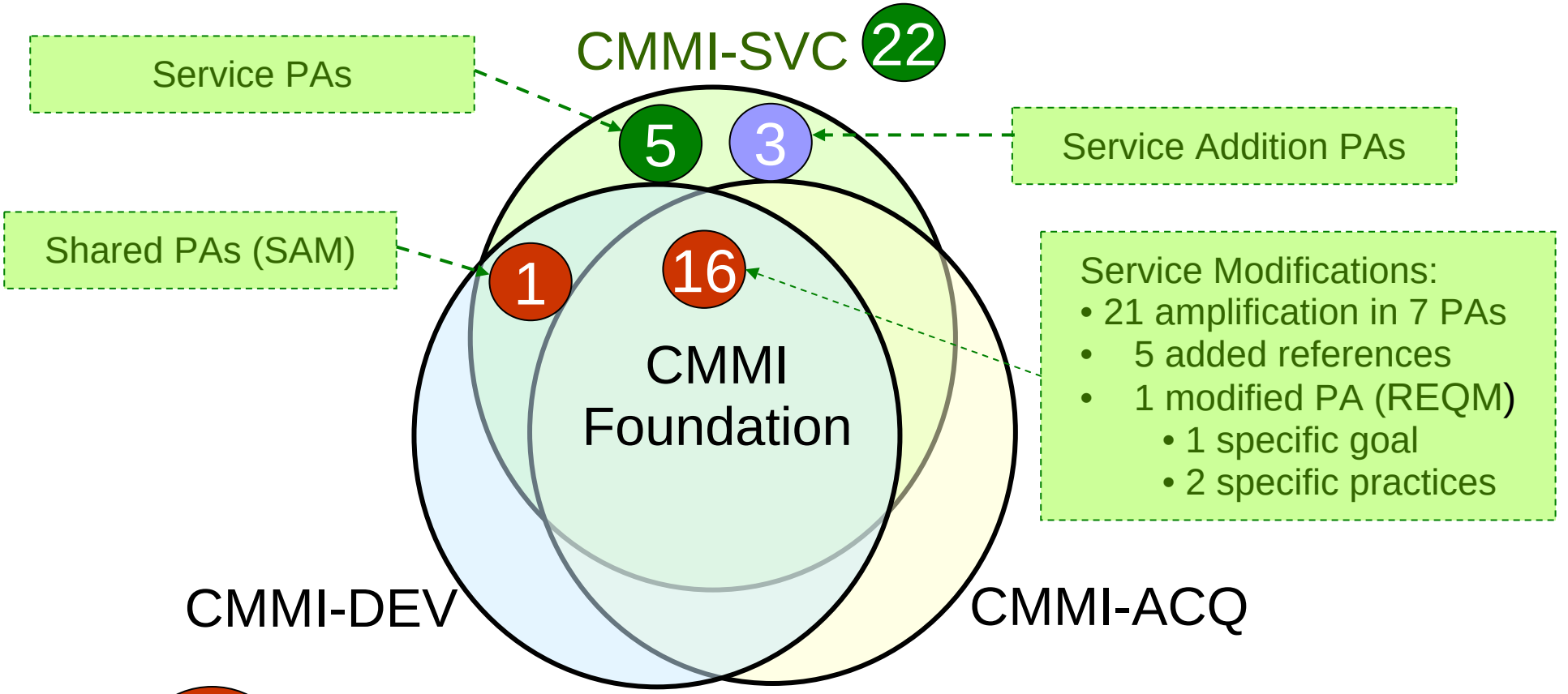
- Service society
- Customer discontentment
- Legislation
- Government and industry trends

Complementary CMMI Constellations



Reusable CMMI-SVC

CMMI for Services Constellation = 22 PAs + 3 Optional PAs



77%

% of CMMI-DEV PAs are reused;
% of Corporate Investments are potentially reusable!

What Makes Service Different?

- A service is an intangible, non-storable product
- Services can exhibit great variability regarding
  - Services requested (both number and type)
  - Incidents encountered
  - Resources needed (for a single request, over time)
  - Disruptions encountered (discontinuities including upgrades)
  - Quality of the services provided

CMMI Levels Applied to Services

- Mature service management prioritizes its improvements into 5 levels:
  1. Current, as-is services
  2. Basic service management and support discipline
  3. Organizational consistency of level 2-3 practices, including service delivery, and advanced management practices
  4. Quantitative predictors of key service qualities
  5. Optimization of key service qualities

Level 2 CMMI-SVC Practices

- At level 2, the maturing services organization adds to the foundational process areas:
  - Service requirement practices
  - Service request and incident handling

Service Requirement Practices

- Service requirement agreements are an important building block for effective service management.
- They specify terms and conditions for:
  - Provided services
  - Metrics
  - Service levels
  - Liabilities
  - Actions in specific circumstances

From http://www.iec.org/online/tutorials/service_level/

Requirements Management

- To require Service Requirements Agreements, the CMMI-SVC provides:
  - Requirements Management SVC (REQM)
    - Extends the foundational REQM to include the establishment and maintenance of written agreements between service providers and customers on service requirements and service levels.
    - The CMMI Services team chose to add a goal and two practices to REQM rather than a separate PA to reuse the requirements paradigm and to keep the model footprint smaller.

Service Request and Incident Handling

- Based upon the Service Requirement Agreement, the customer requests services and reports incidents.
  - Service request - request from a customer to deliver (part of) a previously agreed-upon service.
  - Incident - an interruption or potential interruption to the agreed level of service.
- A mature organization manages requests and incidents in an orderly fashion.
- CMMI-SVC provides:
  - Incident and Request Management PA - to ensure the timely resolution of requests for service and incidents that occur during service delivery

Level 3 CMMI-SVC Practices

- At level 3, the maturing service organization adds to the foundational process areas:
  - Advanced project management practices
    - Capacity and availability management
    - Service continuity management
  - Advanced support practices
    - Problem management
  - Service establishment and delivery practices
    - Predicated on the service system
  - Process management practices
    - Catalog of standard services and service levels

Advanced Project Management Practices

- CMMI-SVC provides:
  - Capacity and Availability Management (CAM)
    - Purpose: to plan and monitor the effective provision of resources to support service requirements
    - Addresses the resources necessary for supporting service request and peak demand, as well as service project tasks.
    - Based on measurements collected during level 2 activities
  - Service Continuity Management (SCON)*
    - Purpose: to establish and maintain contingency plans for continuity of agreed services during and following any significant disruption of normal operations
    - Addresses the actions in specific circumstances as laid out in the service requirements agreement

* optional process area (independent named service addition)

Advanced Support Practices

- CMMI-SVC provides:
  - Problem Management (PRM)
    - Purpose: to prevent incidents from recurring by identifying and addressing underlying causes of incidents
    - Dynamically and proactively handles known problems
    - Problem - a situation in the service system that is the underlying cause of incidents. All incidents have one or more underlying causes, regardless whether the service provider is aware of the cause or not.

Service System

- Service System is a necessary building block for understanding the effective delivery of services
- Service System – An integrated and interdependent combination of components, consumables, and people that satisfies service requirements.
  - A service system encompasses everything required for service delivery, including work products, processes, infrastructure, consumables, and customer resources.
  - The quality of a service is often dependent upon the quality of the service system.
  - A service system should be developed in a mature way.

Service Establishment and Delivery Practices

- The CMMI-SVC provides for:
  - Service Transition (ST)
    - Purpose: to deploy new or significantly changed service systems while managing their effect on ongoing service delivery
  - Service Delivery (SD)
    - Purpose: to deliver services in accordance with service agreements
  - Service System Development (SSD)*
    - Purpose: to analyze, design, develop, integrate, and test service systems to satisfy existing or anticipated service agreements

* optional process area (independent named service addition)

Process Management Practices

- Mature service management uses:
  - Catalog of standard services and service levels
- The CMMI-SVC provides for:
  - Organizational Service Management (OSM)*
    - Purpose: to establish and maintain standard services that ensure the satisfaction of the organization's customer base

* optional process area (independent named service addition)

CMMI-SVC Process Areas

Process Management

- Organizational Innovation and Deployment (OID)
- Organizational Process Definition (OPD)
- Organizational Process Focus (OPF)
- Organizational Process Performance (OPP)
- *Organizational Service Management* (OSM)*
- Organizational Training (OT)

Service Support

- Causal Analysis and Resolution (CAR)
- Configuration Management (CM)
- Decision Analysis and Resolution (DAR)
- Measurement and Analysis (MA)
- *Problem Management* (PRM)
- Process and Product Quality Assurance (PPQA)

Service Establishment and Delivery

- *Incident and Request Management* (IRM)
- *Service Delivery* (SD)
- *Service System Development* (SSD)*
- *Service Transition* (ST)

Project Management

- *Capacity and Availability Management* (CAM)
- Integrated Project Management (IPM)
- Project Monitoring and Control (PMC)
- Project Planning (PP)
- Requirements Management (REQM)
- Risk Management (RSKM)
- Quantitative Project Management (QPM)
- *Service Continuity Management* (SCON)*
- Supplier Agreement Management (SAM)

** Service Addition (optional)*

Process Area Staging

Process Area	Maturity Level	Goals/ Practices
Capability and Availability Management (CAM)	3	2 / 6
Incident and Request Management (IRM)	2	2 / 6
*Organizational Service Management (OSM)**	3	2 / 7
Problem Management (PRM)	3	2 / 7
*Service Continuity Management (SCON)**	3	3 / 10
Service Delivery (SD)	3	2 / 7
*Service System Development (SSD) ** *(Used in place of Development Model for small organizations)*	3	3 / 12
Service Transition (ST)	3	3 / 12

* optional process areas (independent named additions)

Conclusion

- CMMI-SVC is a ***minimal*** and ***logical*** extension to CMMI v1.2 content, allowing current CMMI users to reuse CMMI investments to improve service performance

Appendices

- Industry Participation
- Schedule
- References
- Authors & Contributors
- Referenced Service Models or Standards

Industry Participation

- Visit the public Services CMMI web pages
  - CMMI web page - http://www.sei.cmu.edu/cmmi/
  - CMMI for Services Public Workspace - http://bscw.sei.cmu.edu/pub/bscw.cgi/0/424939
- Participate in pilot and review period for the draft CMMI for Services (tentatively Nov 06 - Feb 07)
  - Submit change requests to draft release
  - Appraise your organization internally against the draft model and submit appraisal questionnaire

Tentative Schedule

- Oct-Nov 2006 — Steering Group review
- Nov-Feb 2007 — Piloting to refine practices
- Mar-May 2007 — Updates written and reviewed
- Jun-Aug 2007 — QA and final review
- Sep 2007 — Release of CMMI-SVC Product Suite

Subject to CMMI Steering Group Approval

References

- CMMI: The New Architecture - http://www.sei.cmu.edu/news-at-sei/columns/cmmi-in-focus/2006/05/cmmi-in-focus-2006-05.htm
- CMMI for Services Architecture – to be released with draft CMMI for Services model

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- Steve Stern, Lockheed Martin
- Barbara Tyson, Software Engineering Institute
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- Joanne O'Leary, Software Engineering Institute
- Claudia Raak, Wibas
- Rich Raphael, Northrop Grumman
- Bud Glick, Motorola
- Bill Curtis, Teraquest

Referenced Service Models or Standards

- IT service models and standards included in mapping and gap analysis:
  - Information Technology Infrastructure Library (ITIL)
  - British Standard 15000: IT Service Management (BS 15000)
  - Control Objects for Information and related Technology (COBIT)
  - Information Technology Services CMM (ITSCMM)

CMMI Implementation in Manufacturing Processes

SARIT ASSARAF

ITZHAK LAVI

ISRAEL AIRCRAFT INDUSTRIES LTD.

CMMI Conference –Denver Nov. 2006

Israel Aircraft Industries (IAI)

- Largest industrial company in Israel
  - 15000 employees, 2.3 B$ annual sales
- Involved in Development, Production, Maintenance and Service of Aerospace Systems
  - A large part of the annual sales are from Manufacturing, Maintenance and Service activities
- IAI divisions are ISO9000 and AS9100 certified
- Started SW-CMM based development process improvement efforts in 1992
- Started CMMI based efforts in 2002

Israel Aircraft Industries Groups and Divisions

Corporate Initiatives for Process Improvement

Competitiveness Ability Improvement (CAI)

- Production & Manufacturing Process Improvement
- Acquisition Process Improvement

System & Software Development Processes and Methodologies

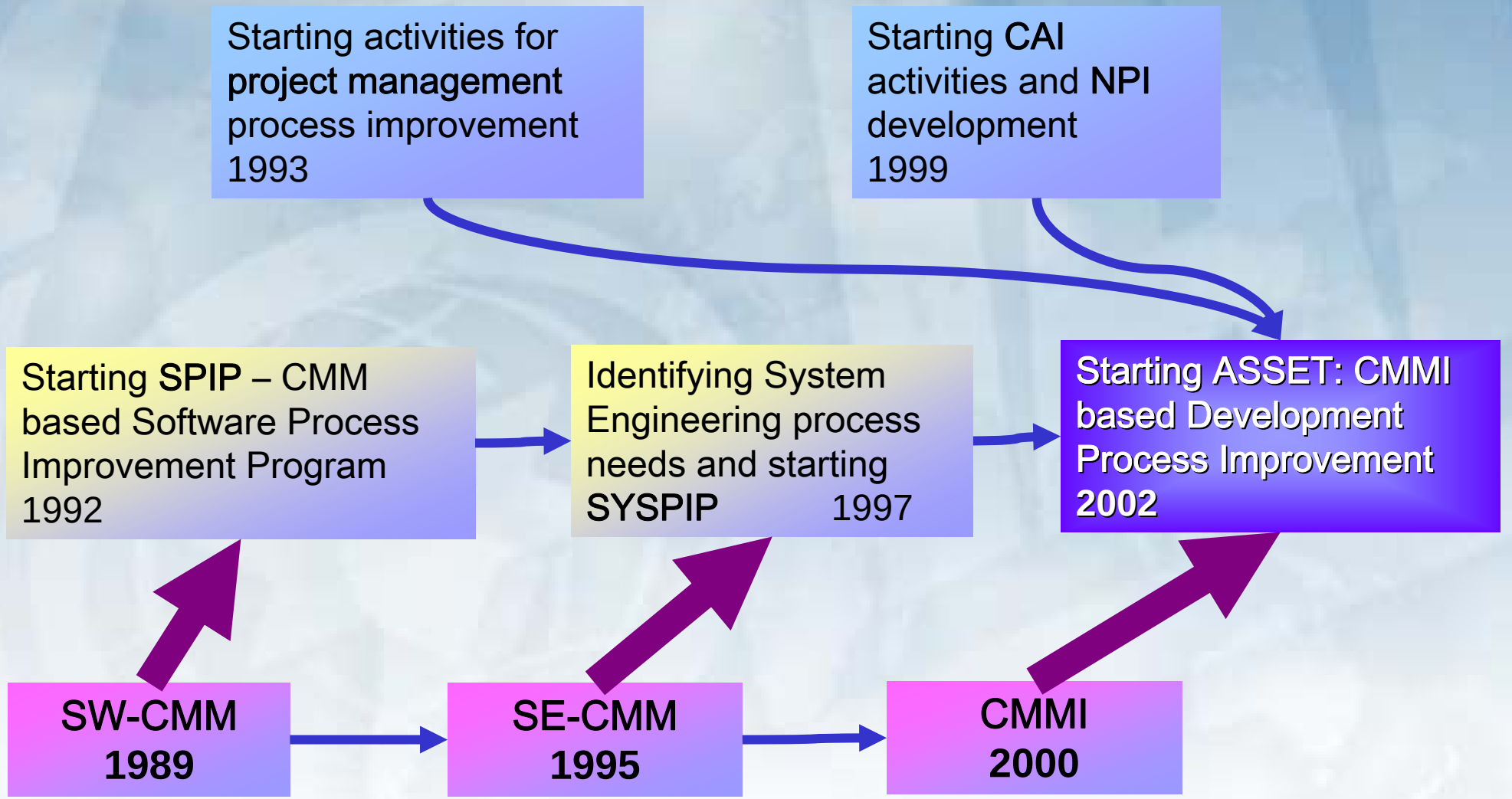
New Product Introduction (NPI)

IAI Uniform Project Process Framework

Quality Management

- Increase Quality
- Increase Sales
- Increase Profit

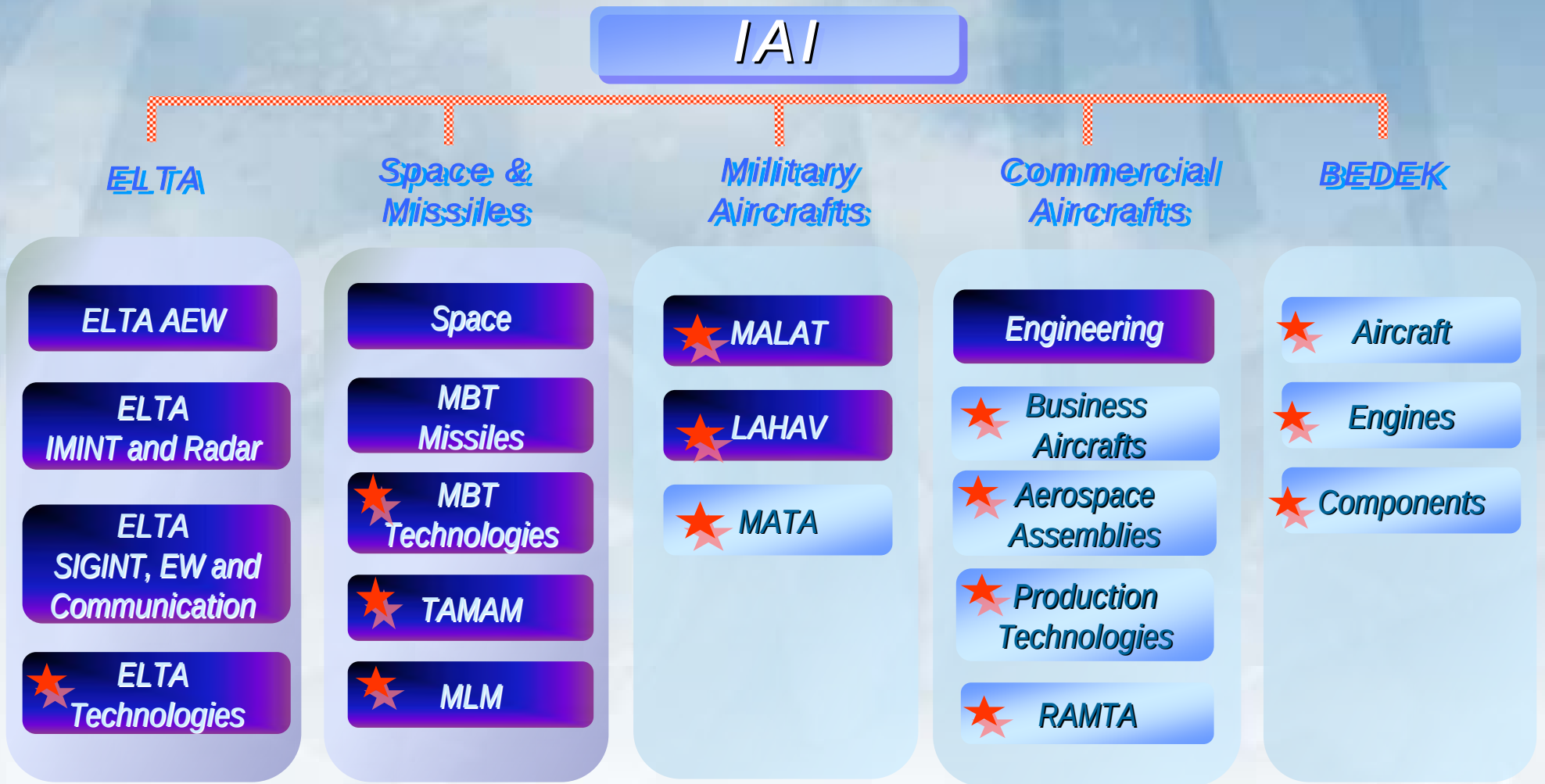
Israel Aircraft Industries Process Improvement Path -1



Israel Aircraft Industries process improvement path -2

- Process improvement efforts are coordinated at the corporate level and sponsored by the company VP of Operations
- Many infrastructure assets are developed at the corporate level and are adapted by the groups and divisions. Other assets are developed within the groups and divisions
- Process improvement implementation is conducted at the group and division level and sponsored by the group or division management
- Initially, CMMI based Process Improvement efforts were focused on Development Processes, while CAI (Competitiveness Ability Improvement) efforts were focused mainly on Manufacturing Processes

CMMI Implementation in IAI



CMMI Based Process Improvement Activities

Significant manufacturing activity

Using CMMI for Manufacturing Process Improvement

- CAI provides a collection of techniques for attaining higher Quality and Productivity while CMMI provides a framework for conducting integrated Process Improvement activities in an organization
- Most (if not all) CMMI Process Areas seem to fit Manufacturing as well as Development
  - Project Management Process Areas
  - Process Management Process Areas
  - Support Process Areas
  - Integrated Product and Process Development
  - Engineering Process Areas (?)
- IAI decided to include manufacturing processes in CMMI implementation scope in one of its divisions - LAHAV

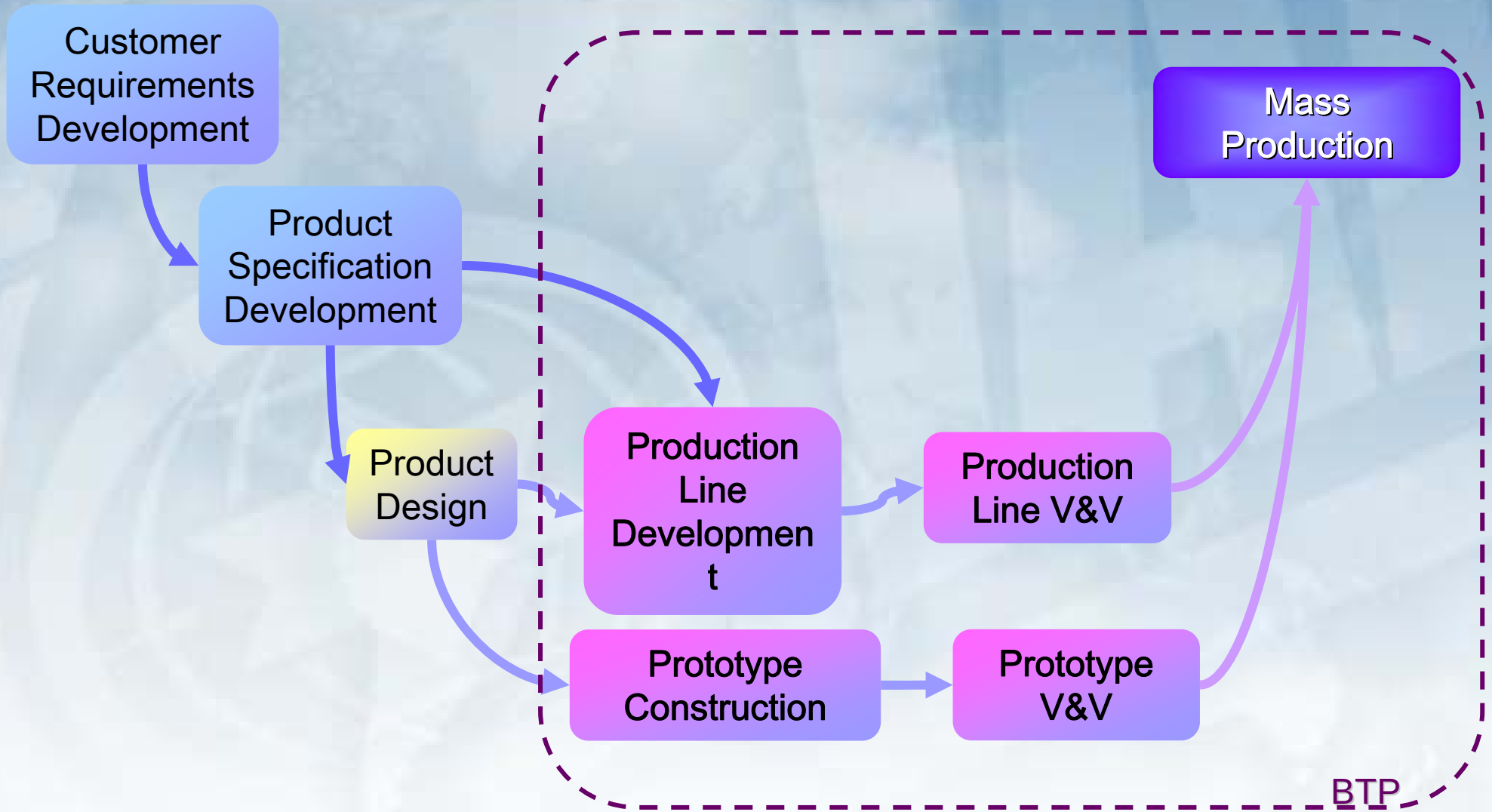
Applying CMMI in Manufacturing

- Applying Project Management, Process Management and Support Process Areas in Manufacturing is obvious
- Question:
  - How should Engineering Process Areas be interpreted and implemented in Manufacturing?
- Answer:
  - Production Engineering, including production infrastructure development
  - Addressing problems and managing changes in products and production line

Types of Manufacturing Projects

- Build To Spec (BTS)
  - The product specification is provided by the customer and the project has to design the product, design and build the production line, and manufacture products according to customer order
- Build To Print (BTP)
  - Complete product design is already available – either supplied by the customer or from previous BTS project, and the project (sometimes) has to design, build or change the production line infrastructure, and manufacture units according to customer order

BTS and BTP projects' Context



Applying CMMI in Manufacturing
Build to Spec (BTS) Projects

- Customer Requirements are defined mainly in terms of Product Specification
- Based on Product Specification, the product is designed, integrated and tested. The production line requirements are developed, and the production infrastructure is designed, integrated and tested
- The “developed product” includes not only the product to be manufactured, but also the production line infrastructure
- CMMI implementation is focused on both product design and Production Engineering Processes
- The production line infrastructure may serve manufacturing of several products in several production projects

Applying CMMI in Manufacturing
Build to Spec (BTS) Projects - Examples

- RD SP1.1: Elicit Needs
  - Analysis of Product Specifications and Stakeholders needs and expectations
- RD SG3: Analyze and Validate Requirements
  - Simulation of Product Design and the Production line
- TS SP1.2 + RD SP3.1: Operational Concepts and Scenarios
  - Product Operational Scenarios and Product Line Production Scenario
- TS SP3.2: Develop Product Support Documentation
  - Includes Production Line Support Documentation
- VAL: Validate the Product
  - Validation of the product prototype & production line using predefined scenarios
- PP and PMC: Plan and Monitor the Project
  - Product Engineering Management and Mass Production Management

Applying CMMI in Manufacturing

Build to Print (BTP) Projects

- Customer Requirements are defined mainly in terms of Product Technical Package
  - Drawings, Part Lists, etc.
- Based on Product Technical Package, the production line requirements are developed, and the production infrastructure is designed, integrated and tested
- The “developed product” is actually the production line infrastructure, and CMMI implementation is focused on Production Engineering Processes
- The production line infrastructure may serve manufacturing of several products in several production projects

Applying CMMI in Manufacturing
Build to Print (BTP) Projects-Examples

- RD SP1.1: Elicit Needs
  - Analysis of Product Design and Stakeholders needs and expectations
- RD SG3: Analyze and Validate Requirements
  - Simulation of the Production line
- TS SP3.2: Develop Product Support Documentation
  - Includes Production Line Support Documentation
- PI SP3.4: Package and Deliver
  - Packaging and delivering the product
- VAL: Validate the Product
  - Validation of the production line using pre-defined scenarios
- TS SP1.2 + RD SP3.1: Operational Concepts and Scenarios
  - Product Line Production Scenarios
- PP and PMC: Plan and Monitor the Project
  - Product Engineering Management and Mass Production Management

Lessons Learned -1

- CMMI can be applied to manufacturing projects
  - Usually all Process Areas are applicable and can appropriately be interpreted for manufacturing processes
  - When some Process Areas seem to be non applicable for manufacturing, the Continuous Representation can be used
- Although manufacturing processes are very different from development processes, they are still part of the division set of standard processes
- When manufacturing activities represent a significant portion of the activities in the division, they should be included in the CMMI implementation and appraisal scope, due to their significant contribution to the division's business

Lessons Learned -2

- Some Process Areas are easier and more natural to implement in manufacturing, such as:
  - Measurement and Analysis
  - Causal Analysis and Resolution
  - Quantitative Project Management
  - Organization Process Performance

Recommendations (1)

- When an organization starts to implement CMMI practices and plans CMMI process appraisals, it should not refrain from including “non developmental” processes, like manufacturing, in the scope, especially when these processes are responsible for a significant amount of the organization’s revenue
- In BTP projects the production line processes should be evaluated as well as the manufactured product

Thank You

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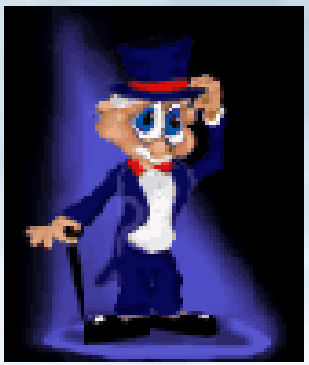
Sarit Assaraf - sassaraf@iai.co.il



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Lead Appraiser v1.2 Training

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Purpose

The purpose of this talk is to provide an overview of important appraisal concepts.

Topics

Appraisal Requirements for CMMI

SCAMPI^{SM} Appraisal Methods

Fundamental Concepts

Becoming a Lead Appraiser or Team Leader

Appraisal Requirements for CMMI

The Appraisal Requirements for CMMI (ARC) defines the requirements considered essential to appraisal methods intended for use with CMMI models:

- based on appraisal principles common to source methods
- defines three classes of appraisal methods that reflect common usage modes of appraisal methods

ARC requirements are allocated to each method class to align with usage mode characteristics.

ARC Appraisal Principles

Start with an appraisal reference model (e.g., CMMI for Development).

Use a formalized appraisal process (e.g., SCAMPI A).

Involve senior management as the appraisal sponsor.

Focus the appraisal on the sponsor's business objectives.

Observe strict confidentiality and non-attribution of data.

Approach the appraisal collaboratively.

Focus on follow-on and decision-making activities by producing actionable appraisal results.

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Topics

Appraisal Requirements for CMMI

SCAMPI Appraisal Methods

Fundamental Concepts

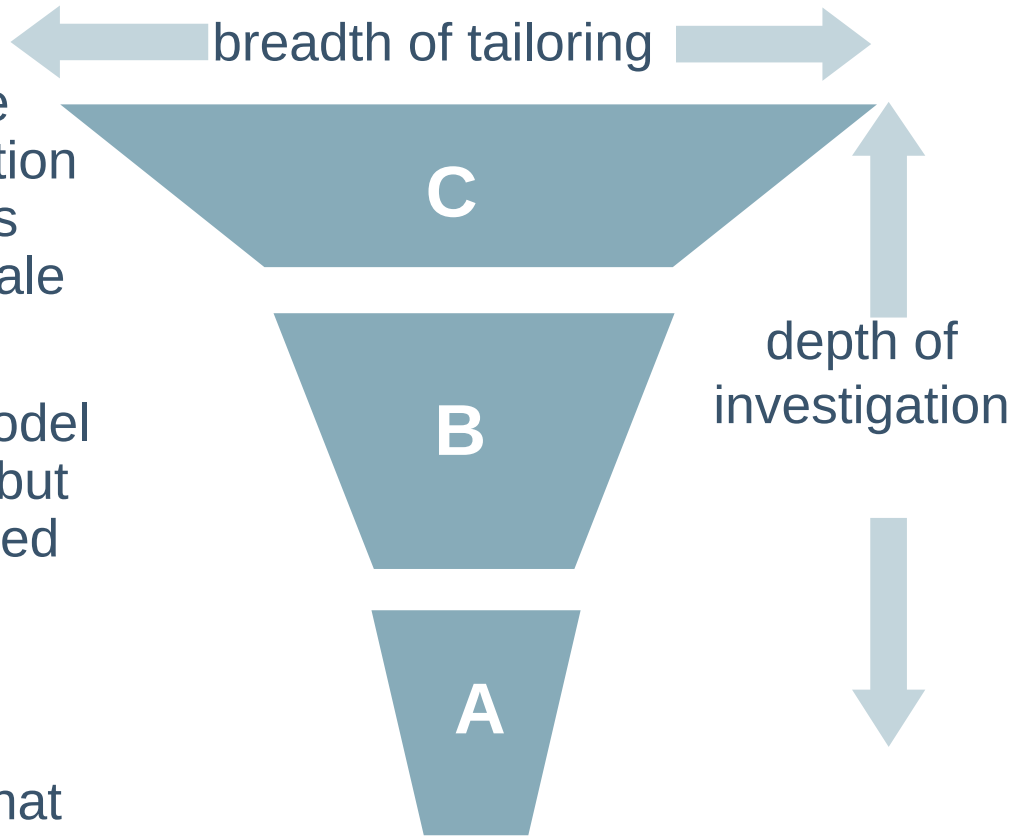
Becoming a Lead Appraiser or Team Leader

SCAMPI Family: 3 Classes of Appraisal Methods

SCAMPI C provides a wide range of options, including characterization of planned approaches to process implementation according to a scale defined by the user.

SCAMPI B provides options in model scope and organizational scope, but characterization of practices is fixed to one scale and is performed on implemented practices.

SCAMPI A Is the most rigorous method, and is the only method that can result in ratings.



Differentiating Attributes For Appraisals

The three key differentiating attributes for appraisal classes are:

- degree of confidence in the appraisal outcomes
- generation of ratings
- appraisal cost and duration

SCAMPI Requirements

Requirement	SCAMPI A	SCAMPI B	SCAMPI C
Types of Objective Evidence Gathered	Documents and interviews	Documents and interviews	Documents or interviews
Ratings Generated	Goal ratings required	No ratings allowed	No ratings allowed
Organizational Unit Coverage	Required	Not required	Not required
Minimum Team Size	4	2	1
Appraisal Team Leader Requirements	SCAMPI A lead appraiser	SCAMPI B and C team leader	SCAMPI B and C team leader

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Selecting Appraisal Methods

Consider a family of appraisal methods in determining overall appraisal needs:

- Fit the appraisal method to the actual need.
- Many appraisal needs can be met without maturity level or capability level ratings.

SCAMPI A may not be the most appropriate choice for organizations early in their process improvement cycle.

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Topics

Appraisal Requirements for CMMI

SCAMPI Appraisal Methods

Fundamental Concepts

Becoming a Lead Appraiser or Team Leader

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Fundamental Concepts

Appraisal

Appraisal reference model

Organizational unit

Organizational scope

Instantiation

Focused investigation

Objective evidence

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Appraisal

An examination of one or more processes by a trained team of professionals using an appraisal reference model as the basis for determining strengths and weaknesses.

Appraisal Reference Model

The CMMI model to which an appraisal team correlates implemented process activities.

Organizational Unit

The part of an organization that is the subject of an appraisal. An organizational unit deploys one or more processes that have a coherent process context and operates within a coherent set of business objectives. An organizational unit is typically part of a larger organization, although in a small organization, the organizational unit may be the whole organization.

Organizational Scope

The collection of projects and support functions that provides instantiations of practices used within, and representative of, an organizational unit.

Organizational Scope Determination

Samples in the organizational scope must be one of the three types below:

- Focus projects (FP): must provide objective evidence for every PA
- Non-focus projects (NFP): must provide objective evidence for one or more PAs
- Support Groups: must provide objective evidence for practices which address organizational infrastructure or functions

If the model scope includes project related PAs, the Organizational Scope must contain at least one FP

If the OU includes more than 3 projects, the Organizational Scope must include sufficient FP & NFP to generate at least 3 instances of each practice in each project-related PA in the model scope of the appraisal

Note: The MDD is silent on OUs with 1-3 projects. We recommend the Organizational Scope include all projects as focus projects.

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Organizational Scope Description

Critical factors that influence implementation of practices in projects and functions within the OU must be understood and identified

Possible Critical Factors include:

- application domains (or lines of business)
- geographical breadth
- disciplines (e.g., systems, SW, or HW engineering)
- effort types (e.g., development, maintenance, or services)
- project types (e.g., legacy or new development)
- customer types (e.g., commercial or government agency)
- lifecycle models in use within the organization (e.g., spiral, evolutionary, waterfall, or incremental)

- Sample project and support groups in the Organizational Scope must represent all critical factors identified and documented in quantifiable terms in the appraisal input and ADS

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Organizational Scope Example[1]

SCAMPI V1.2 Sample Description-1

- Organizational Unit: Division XYZ, United Widgets

- Projects excluded and rationale
  - All Research Projects – short duration and piloting new processes
  - Project XV11 – legacy using processes established Jan 2001

- OU Size: 30 projects, 300 people

- Critical Factors:
  - Application domains: Missile Command and Control
    Sonar signal processing
    MDA Information Technology
  - Geographical Breadth: Sunnyvale CA
    Denver CO
    Pittsburgh PA
  - Project Types: Development
    Sustainment

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Organizational Scope Example[2]

SCAMPI V1.2 Sample Description-2

- Organizational Scope
  - Project ABC – 84 people, development (Missile C2), 2 sites (Sunnyvale, Denver), Focus
  - Project Alpha – 22 people, sustainment (Sonar),1 site (Denver), Non-focus, PA:…
  - Project Delta – 52 people, development (Sonar),1 site (Denver), Non-Focus, PA:…
  - Project SEI – 42 people, sustainment (Missile C2), 1 site (Pittsburgh), Non-focus, PA:…

- Organizational Unit Coverage:
  - Population: 66%
  - Project: 13%
  - Application domain: 66%
  - Geographical breadth: 100%
  - Project Type: 100%

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Instantiation

CMMI practices are abstractions which are implemented and made real in their application and implementation by projects and organizations.

The context within which the practice is applied governs the implementation.

The details of the implementation as well as the context within which the practice is implemented is referred to as the instantiation (organizational or project).

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Focused Investigation

An appraisal is conducted as follows:

- A representative sample within the organizational unit is identified (i.e., projects and support groups).
- The implementation of each model practice is reviewed for members of the sample set.
- The extent to which each model practice is implemented across the sample set is representative of the extent to which the practice is implemented in the organizational unit.

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Objective Evidence

Documents or interview results used as indicators of the implementation or institutionalization of model practices. Sources of objective evidence can include instruments, presentations, documents, and interviews.

Two Types of Objective Evidence

CMMI appraisal methods are based on the consideration of objective evidence as the basis for formulation of weaknesses, strengths, and ratings.

SCAMPI Class A appraisal method only requires two types of objective evidence: documents and interviews.

Documents include hardcopy, softcopy, and hyperlinks.

Interviews are exploratory or focused questions targeted at managers, practitioners and/or users.

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Organizing Objective Evidence

In SCAMPI appraisals, objective evidence is organized using practice implementation indicators (PIIs).

PIIs are applicable to any practice or activity:

- The conduct of an activity or the implementation of a practice will result in “footprints” which are attributable to the activity or practice.
- They are necessary or incidental consequences of practice implementation.

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Three Types of PIIs

Direct Artifacts are tangible outputs resulting directly from implementation of a practice (e.g., typical work products).

Indirect Artifacts are artifacts that are a side-effect or are indicative of performing a practice (e.g., meeting minutes, logs, reports).

Affirmations are oral or written statements confirming or supporting implementation of the practice (e.g, interviews, questionnaires).

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Example of a PII Characterization

PP SP1.1:

Establish a top-level work breakdown structure (WBS) to estimate the scope of the project.

Direct artifacts:
- top-level WBS
- task descriptions
- work package descriptions

Indirect artifacts:
- meeting minutes
- team charter
- WBS development notes

Affirmations:
- "I worked on the WBS team."
- "We used the WBS to generate the estimates."

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Developing Appraisal Results

For SCAMPI B and C appraisals, practices are characterized based on objective evidence. These practice characterizations and strengths and weaknesses supporting these characterizations are the only appraisal outputs.

For SCAMPI A appraisals, practice characterizations are developed at the project level, then aggregated to the organizational unit. Goal ratings, process area satisfaction and (optional) maturity level or capability level ratings are then determined based on these practice characterizations and associated weakness statements. Outputs include ratings, strengths, and weaknesses.

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Topics

Appraisal Requirements for CMMI

SCAMPI Appraisal Methods

Fundamental Concepts

Becoming a Lead Appraiser or Team Leader

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Requirements for becoming a SCAMPI A Lead Appraiser

Be sponsored by an SEI Partner.

Participate as a team member on two SCAMPI A appraisals or one SCAMPI A and two SCAMPI B or C appraisals.

Successfully complete SCAMPI Lead Appraiser Training.

Successfully lead a SCAMPI A appraisal under the observation of a qualified observing lead appraiser (can also lead SCAMPI B or C appraisals).

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Requirements for becoming a Certified High Maturity SCAMPI A Lead Appraiser

Phase 1 – Effective Oct 2006

- Submit an application describing education, training and experience as describes at http://www.sei.cmu.edu/certification/scampihmla.html
- Upon acceptance of the application, an oral examination will be scheduled by the SEI Appraisal Program

Phase 2 – Effective Oct 2007

- Pass a written test based on the High Maturity Body of Knowledge (in development)
- Upon passing the written test, an oral examination will be scheduled by the SEI Appraisal Program

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Requirements for becoming a SCAMPI B&C Team Leader

Be sponsored by an SEI Partner.

Participate as a team member on two SCAMPI A appraisals or one SCAMPI A and two SCAMPI B or C appraisals.

Successfully complete SCAMPI B&C Team Leader Training.

Successfully lead a SCAMPI B appraisal under the observation of a qualified observing lead appraiser.

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Summary

This refresher provides only a high-level summary to help you understand important appraisal concepts.

For more information, see the SEI web site at:

http://www.sei.cmu.edu/cmmi/

and

http://www.sei.cmu.edu/collaborating/partners/trans.partners.html.

Strengthening the Credibility of Maturity Level 4&5 Appraisals: Improvements for SCAMPI Version 1.2

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

Will Hayes
November, 2006

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Contents / Agenda

SCAMPI Method Changes

- New Affirmations on the Appraisal Disclosure Statement (ADS)
- Sampling Requirements

SEI Quality Assurance Program

- Auditing of Every SCAMPI Appraisal
- Site Visits and Corrective Actions

Policy Changes

- Three Year Period of Validity
- Required Upgrade Training and Certification

Certification Program

- Application/Qualification Process
- Oral Examinations
- Phase II: Body of Knowledge (BOK) – based Certification

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SEI Appraisal Program

Program Responsibilities:

- Develop and maintain appraisal requirements and method descriptions
- Develop, maintain and teach appraisal courses
- Evaluate and maintain Lead Appraiser/Team Leader authorization, renewal and appraisal records
- Assure reliability and quality of appraisals for stakeholders of the CMMI Product Suite

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SCAMPI Method Changes:

New Features for Version 1.2

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Value-Added Changes

Strengthened Method Definition

- Appraisal Planning
- Appraisal Conduct
- Appraisal Reporting

Changes Based on:

- V1.1 Appraisal Experience
- User Change Requests
- Sponsor Direction
- Steering Group Prioritization

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Important Changes in Planning SCAMPI

Refined definition of “Organizational Unit”

Clarification of Sponsor and Lead Appraiser responsibilities

Specification of “Focus Projects” and “Non-Focus Projects”

Procedures for collecting data from other projects – if needed

Identification of critical factors in sampling

Definition of “Incremental Appraisal”

Prohibition against “Delta Appraisal”

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Important Changes in Conduct of SCAMPI

Detailed specification of start and end criteria – with 90 day limit

"*One Appraisal, one Organizational Unit, One Rating*"

- No project or discipline-specific rating (unless project=OU)

Documents used in appraisal must pre-date the start of the appraisal

Critical sub-processes under statistical management, and the process areas to which they relate must be documented in the finial findings.

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Important Changes in Reporting SCAMPI Results

Appraisal Disclosure Statement (ADS) Greatly Expanded

- Documentation of OU and Sampling – in quantified terms
- Listing of critical sub-processes under statistical management
- Mapping the critical sub-processes to the organization's objectives
- Expiration date for the appraisal results
- Affirmations from the Lead Appraiser and Sponsor

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Quality Assurance Program:

CMMI Steward Responsibilities

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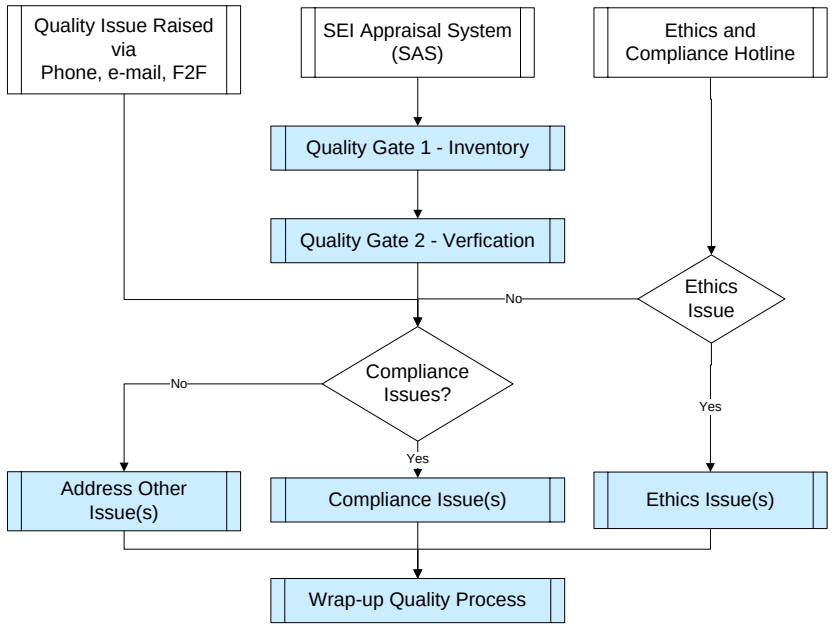
Using Defined Processes

Focus on Capturing “As-Is” Process

- Forging a shared understanding
- Clarifying roles and responsibilities
- Looking for efficiencies

With a Common Understanding

- Evolution of the Process
- Avoid “Process Replacement”
- Work for Measurable Process Improvement



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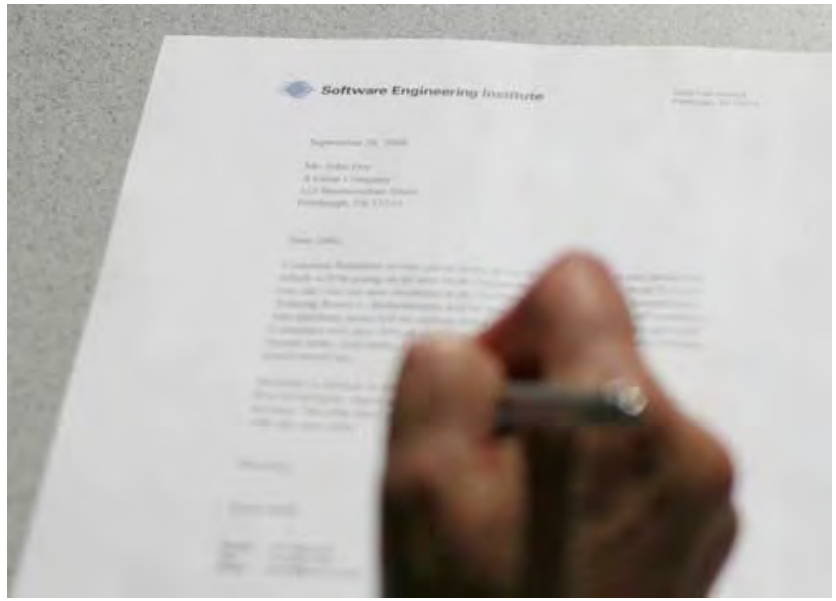
Paper Audits and Communications

Active Audit Program Underway

- Unusual trends reviewed
- Follow-up with Lead Appraisers and with Organizations
- Corrective actions taken

We Have Prioritized Our Efforts

- Focus on areas of potential high risk to our stakeholders
- Using historical data
- Working in partnership with SEI-Authorized professionals



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Good News From Quality Assurance!

SEI-Authorized Lead Appraisers Want Strong Quality

- Professionalism in our work is a shared value
- Lead Appraisers say “Thank You” when we audit them!
- Every participant in the process learns from these activities
- Good news from a QA audit is very nice to hear
- Bad news is being received very professionally and objectively

Important Work is Usually Not Easy Work

- Management commitment at all levels (SEI & CMMI Steering Group)
- A shared value for assuring a common ethical standard exists
- Clarifying boundaries, and preventing problems will be the challenge

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Policy Changes:

Setting Appropriate Expectations

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Policy Changes

Immediate Adoption of V1.2 ADS

No More Level for Life!

HMLA Certification

Sun-setting Policy

- 31 August, 2007

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Certification:

Moving Toward a Mature Profession

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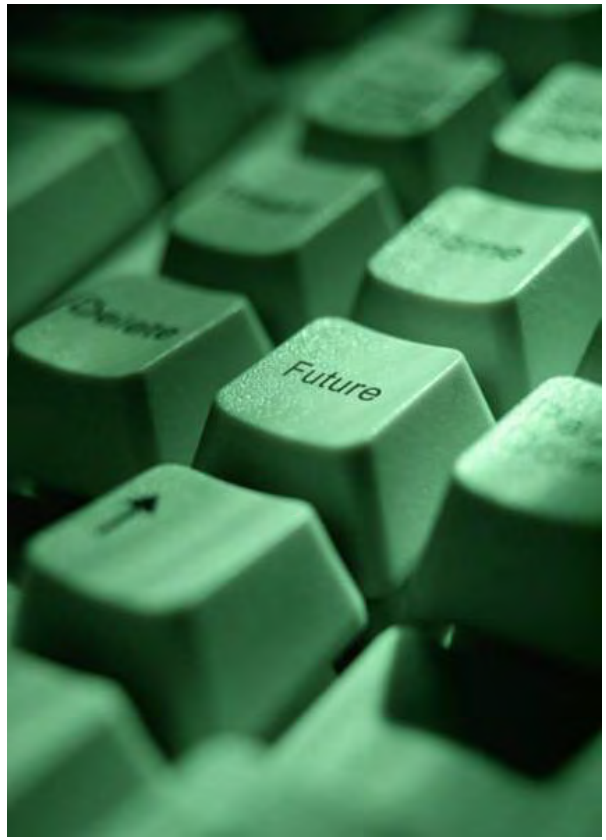
Maturing the Profession of Process Improvement

Though it is a Young Profession

- Many noteworthy accomplishments
- Substantial investment – globally
- Strong community of practice
- Many well-regarded people
- Standards of acceptable practice are moving to a greater level of specificity

Phased Approach

- Phase I: “High Maturity Lead Appraiser Certification”
- Phase II: Formalized Body of Knowledge & Certification Exam



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Status of Phase I Activities

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Application Design

Very Effective Community Survey Identified Important Pre-Requisites

The Application Comprised of the Following Major Sections:

- High Maturity Appraisal Experience
- Education and Training
- Experience Designing and/or Implementing High Maturity Practices
- Experience Designing and/or Delivering High Maturity Training
- Near-Term Plans for Conducting High Maturity Appraisals

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Application Scoring

Initial Application Scoring Rules

- Established, reviewed and revised by certification team
- Piloted on selected sample of 10 applications scored by 4 independent people
- Refined based on statistical analysis of inter-rater differences

Refined Application Scoring Rules

- Designed to minimize variability of interpretation
- Applied by at least two people scoring each application

Cut-Score Established Using Pareto Analysis – A Clear ‘Dividing-line’ Emerged

Every “Rejected” Applicant was then Invited to Re-Apply:

- More detailed set of questions tied to the scoring criteria sent in email
- A number of applicants were accepted based on re-application submission

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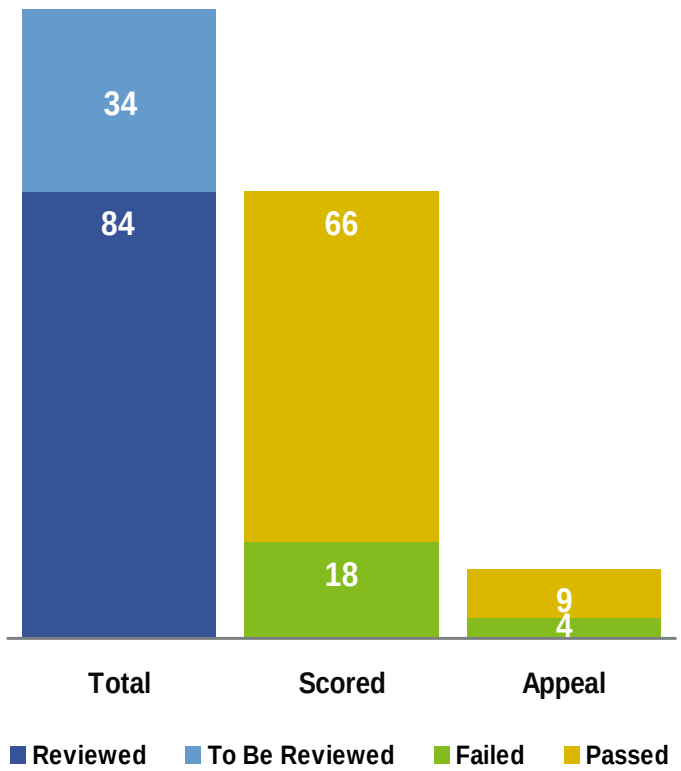
Application Processing Data



Application Scoring Data

- 121 Applicants
  - 84 reviewed thus far
  - 34 to be reviewed
- 84 Reviewed thus far
  - 66 passed
  - 18 failed
- 18 Failed
  - 13 appealed
    - 9 passed upon appeal

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Developing the Oral Examination

Oral exam questions, and the “listen for” phrases

- Developed based on input from Expert Group
- Reviewed among the Certification Team
- Pilot tested with SEI internal and external staff
  - Expert as well as novice examinees included in beta testing
  - Involved large proportion of examiners in each session
  - Detailed discussion of scoring criteria conducted

Conducted multiple “level-setting” sessions with examiners

- Strong sense of convergence on scoring criteria
- Every examiner gained experience before starting real exams

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Questions

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Contact Information

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Software Engineering Institute | Carnegie Mellon

U.S. Army Aviation and Missile Command (AMCOM)

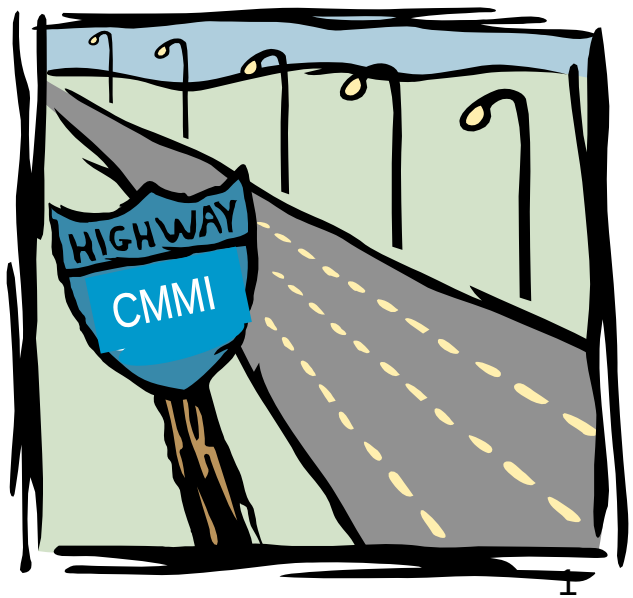
Redstone Arsenal, Alabama

Office of the Chief Information Officer/G6

The Road to Lean CMMI in a Small Federal Organization

Susan Bassham

Command Data/Applications Support
(Business Area)
Application Information Processes



Agenda

- About Us
- CMMI Status
- Terminology
- Construction Detours
  - Changes
  - Goals
- Navigation
  - Road Map
    - Lean/Six Sigma
  - New Direction
    - Lean CMMI
- Repairs Along the Bumpy Road
- Current Points of Interest
- Future Destination

About Us

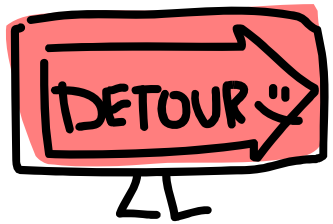
- Small Government Software Development Organization (70 government & 70 contractor employees)
- Develop business applications in support of aviation and missile mission
- Software products consist of web based applications, support of AKO fielded websites, mainframe sustainment

CMMI Status

- Currently assessed at SW-CMM Level 2
- Implemented Lean CMMI activities
- CMMI Appraisals Conducted
  - Class C
  - Class B
- Preparing for SCAMPI A Appraisal in early next year

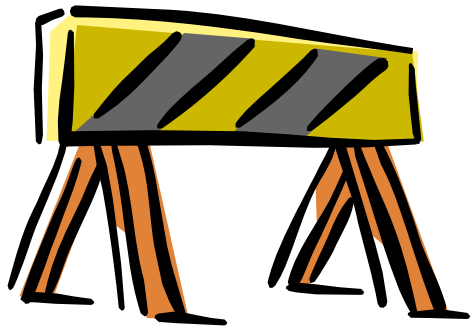
Terminology

- **Value Stream Map (VSM)** – standard method for documenting current and future states of 3 flows in total system: physical product flow, information flow, and time flow.
- **Kaizen** – Japanese word meaning “take apart and make better,” a standardized approach to problem solving.
- **Lean** – concept that focuses on improving customer value by removing the 8 deadly wastes: waiting, underutilized people, defects, extra processing, transportation, motion, inventory, over processing.
- **Lead Time (LT)** – Total flow days from customer order to receipt of full order.
- **Cycle Time (CT)** – hands-on touch time without wastes.



Construction Detours

Barriers



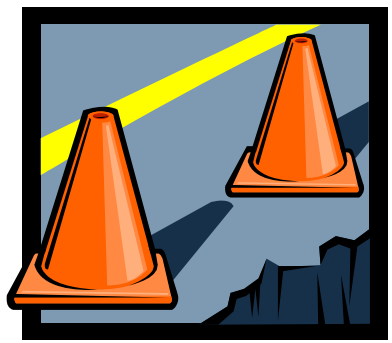
- Worked toward SW-CMM Level 3
  - Technical Working Groups
    - Started and stopped
    - Developed additional documentation
  - Piloted the Level 3 processes
    - Little buy-in
    - Duplication
    - Frustrated employees
- Lengthy development cycle for large products
  - Average delivery 374 days
  - High defect rate
  - Process took too long
- Attempted to define process for multiple project types
  - Urgent, small products
  - Larger products
  - COTS products

While we detoured…

Things were changing

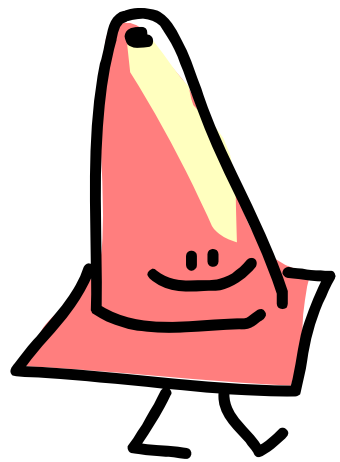
Lean/Six Sigma

- Army Materiel Command (AMC) embraced Lean/Six Sigma and directed adoption by Subordinate Commands
- AMCOM Leadership required continuous improvement using Lean/Six Sigma Tools
- Conducted Value Stream Map in Feb 2005
  - Identified current wastes, delays, duplication
  - Refocused teams on a long term ideal state
  - Developed a near term future state (chunking approach)



Why Change?

- Software Engineering Process (SEP) needed improvements
  - Too complex
  - Duplication across documentation
  - Took too long to complete, especially for small products
  - Delayed product delivery
- Sunset of the SW-CMM
- Keep/increase customer base
- Better utilize our resources
- Improve morale

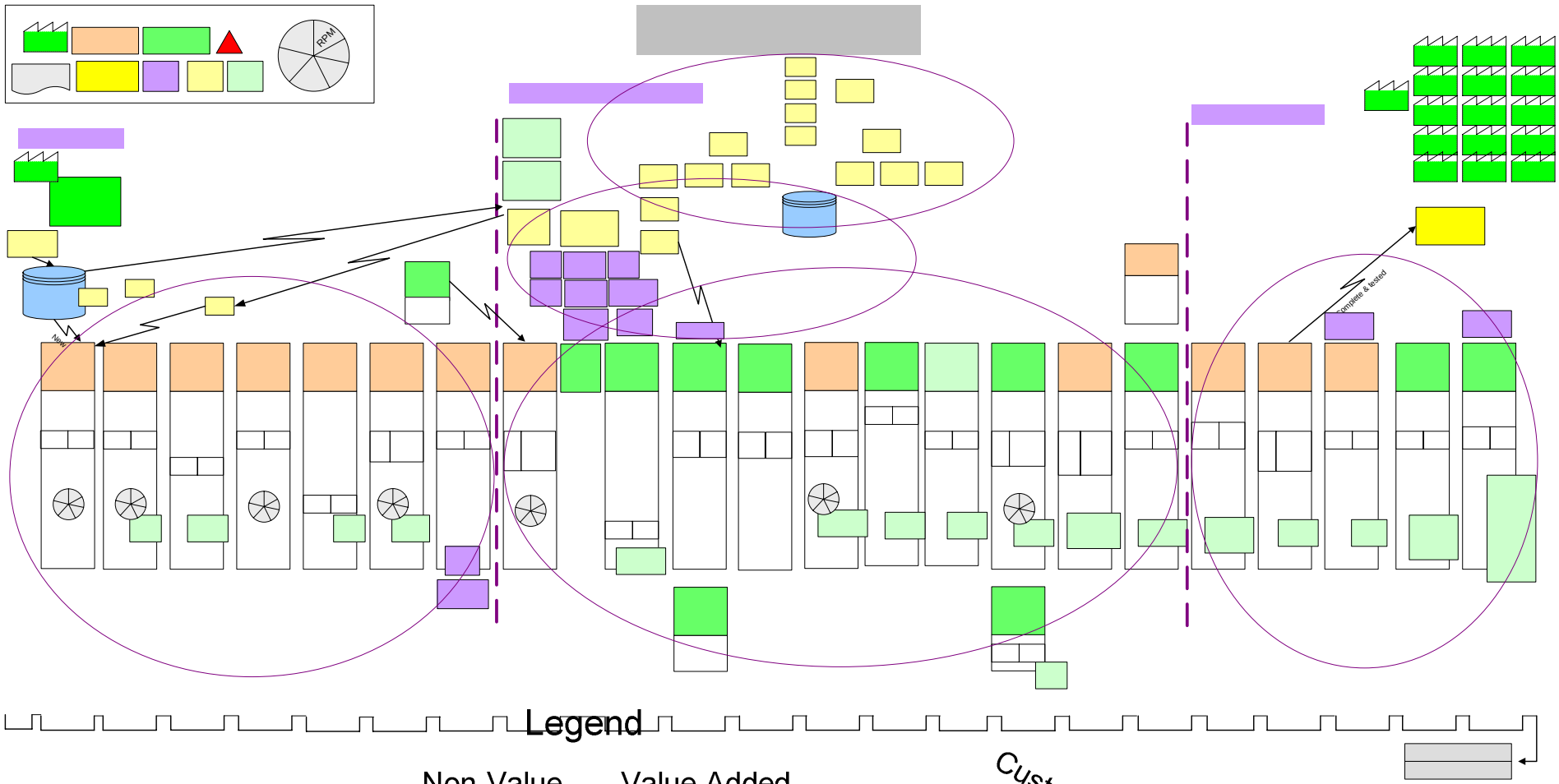


Goals

- Level the workload and share resources to accommodate increasing demands
- Provide first time quality
- On time delivery
- Reduce lead time
- Standard, easy to follow Map
  - Streamline
  - Eliminate duplication
- Collect valuable metrics – Visual at a Glance
- Improve customer and employee satisfaction
- Improve communication within the organization
- Achieve CMMI maturity level

Navigation with a Map and New Direction

Value Stream Map



Software Engineering Process (SEP)

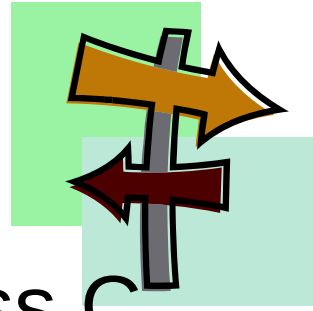
- Loop 0 – Concept Definitions and Product Requirements
- Loop 1 – Job Planning and Analysis
- Loop 2 – Design and Development
- Loop 3 – Implementation and Test

Lean: The Roadmap

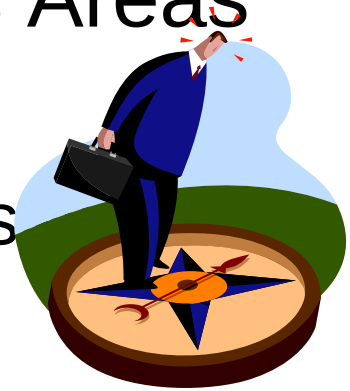
Value Stream Map Event

- Implementation Plan
  - Kaizens, Projects, Tasks
- Insight into Lean Concepts
  - Reduce wastes
  - Eliminate delays and unnecessary approvals
  - Focus on flow

New CMMI Direction



- Performed initial Gap Analysis with Class C
- Trained employees, supervisors, and champions on Intro to CMMI Version 1.1
- Developed first cut at a Lean(er) SEP
- Created Milestone Schedule for future appraisals and process releases
- Conducted Class Bs on ML 2 Process Areas
  - Identified deficiencies
  - Held Kaizen events to address weakness



Business Objectives
(used for appraisal focus)

- Develop lean CMMI software development capability to better respond to customer
- Improve product quality
- Improve process quality
- Increase productivity

Repairs Along the Bumpy Road

Lean Events

- Conducted VSM 31 Jan – 4 Feb 05
- Held 26 Lean Events during 05 and 06
  - Requirements and Planning, Workload Management, Design and Development, Web Standards, QA, CM, Metrics, Risk Management
- Employees empowered to make decisions and quick changes
- Briefed PCCB (formerly known as SEPG) at end of each event
  - Make decisions real-time
  - Accept, reject, modify proposed process changes
  - Reduce delays in implementation

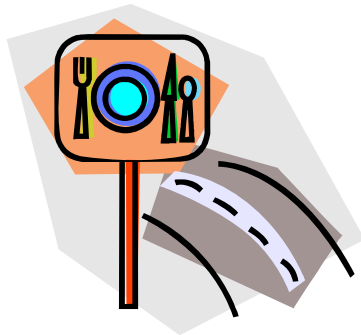
SEP Version Releases

Incremental Implementations:

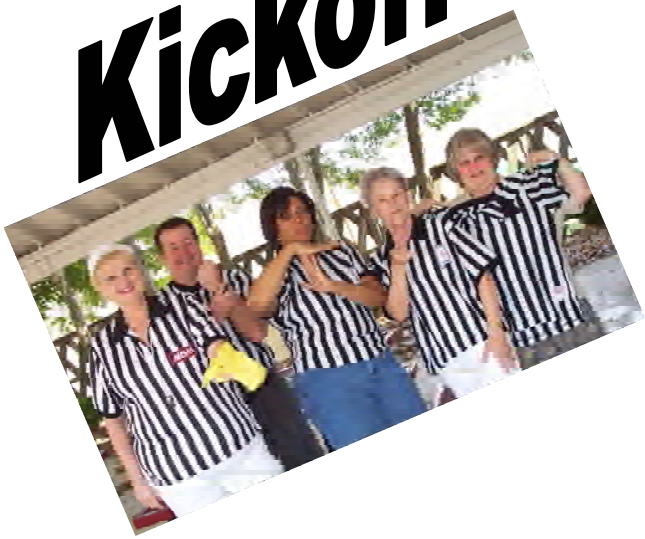
- Jun 05, Version 5 (Interim)
- Dec 05, Version 6 (Loop 1 Rollout)
- Feb 06, Version 6.1
- Feb 06, Version 6.2
- Mar 06, Version 7 (Loop 2 Rollout)
- Jul 06, Version 8
- Aug 06, Version 9
- Sep 06, Version 10 (Loop 3 Rollout)
- Nov 06, Version 10.1

Celebrations Along the Way

An Afternoon at the OSCARS



Kickoff



Dec 05 Rollout

Final Frontier

Improvements

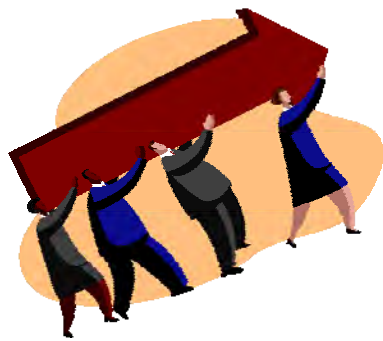
- Changed Terminology
  - Process to Value Stream
  - Phase to Loop
  - SEPG to PCCB
  - Project to Product
- Introduced Lean Thinking
  - Faster, incremental releases
  - Test driven approach
  - Quality built in from the start
  - Better teaming

Supervisor's Working Group (SWG)

- Both Government and Contractor Reps
- Develop Enterprise Plans for customers
- Meet weekly to balance the workload and staff jobs
- Record Lead Time status per job

Process Configuration Control Board (PCCB)

- Membership from each role (Champion, SWG, TL, SPL, LAD, QE/Tester, CM/IA)
- Communicate Value Stream Map changes to peers
- Facilitate buy-in throughout the organization
- Approve SEP Change Requests and manage SEP Version Releases
- Assist in training the workforce



Changed Metrics

Metric	Baseline	New Process
Lead Time	374 days	105 days
Phases	9	4
# Activities	63	22
# Documents	25	0 (Collect data)
# Approvals	65	6

Lessons Learned

- People resist change – prepare for CAVE people
- Focus – minimal task switching
- Collect measurements often, check against goals
- Visual status boards help manage workload
- Pros/Cons to Interim Rollouts
- Peer Groups – key to successful continuous improvement
- Teaming with Wagon Wheel approach
- “Test-First” Approach reduces defects

Standardization: What's in it for me?

- Makes decision-making easier!
- Reduces errors, defects, rework, cost!
- Improves quality and customer satisfaction!
- Reduces frustration!
- Is the baseline for improvement! (no standardization, no systematic improvement!)

Standardization is key to teamwork!

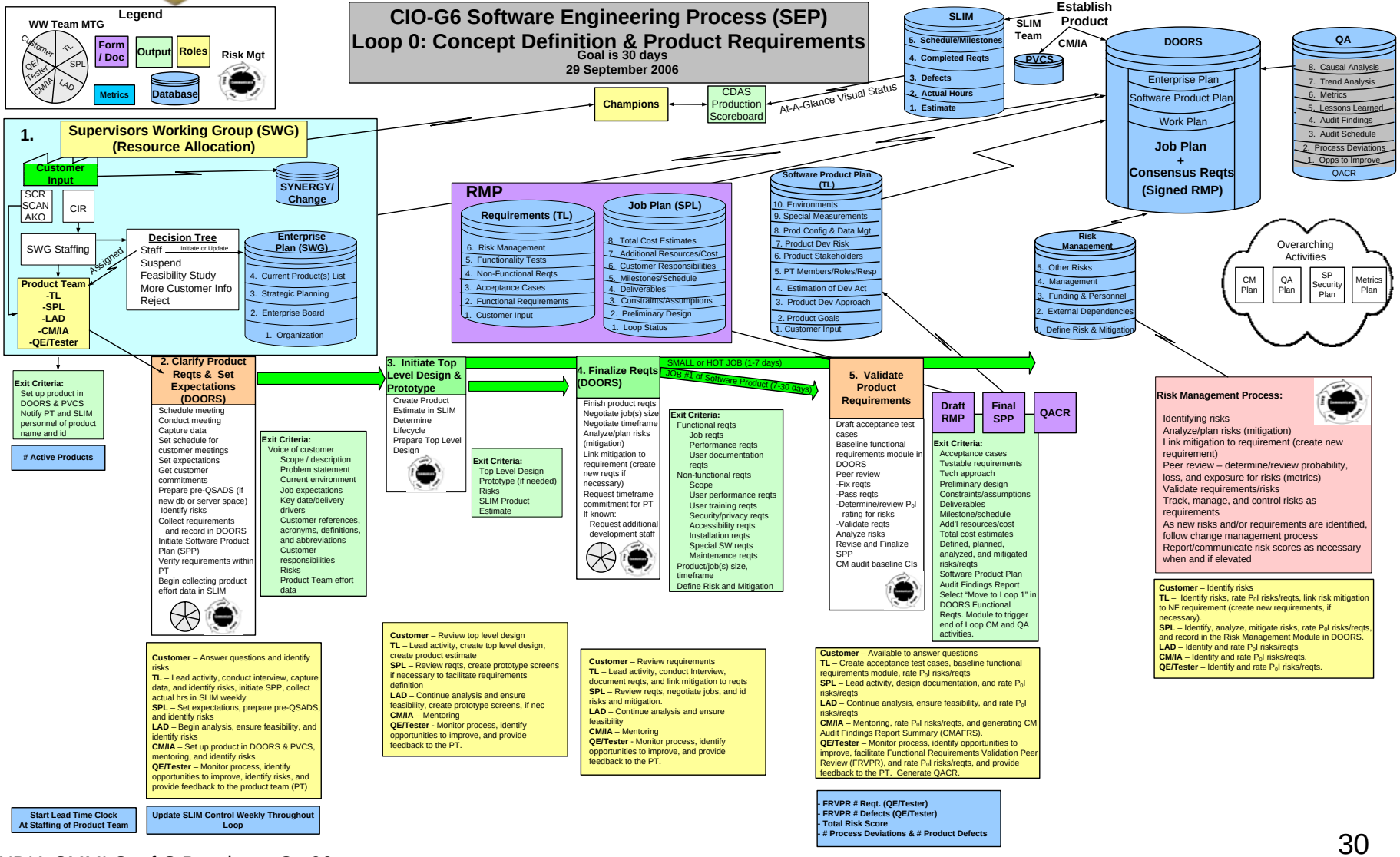
Current Focus

Visual Management

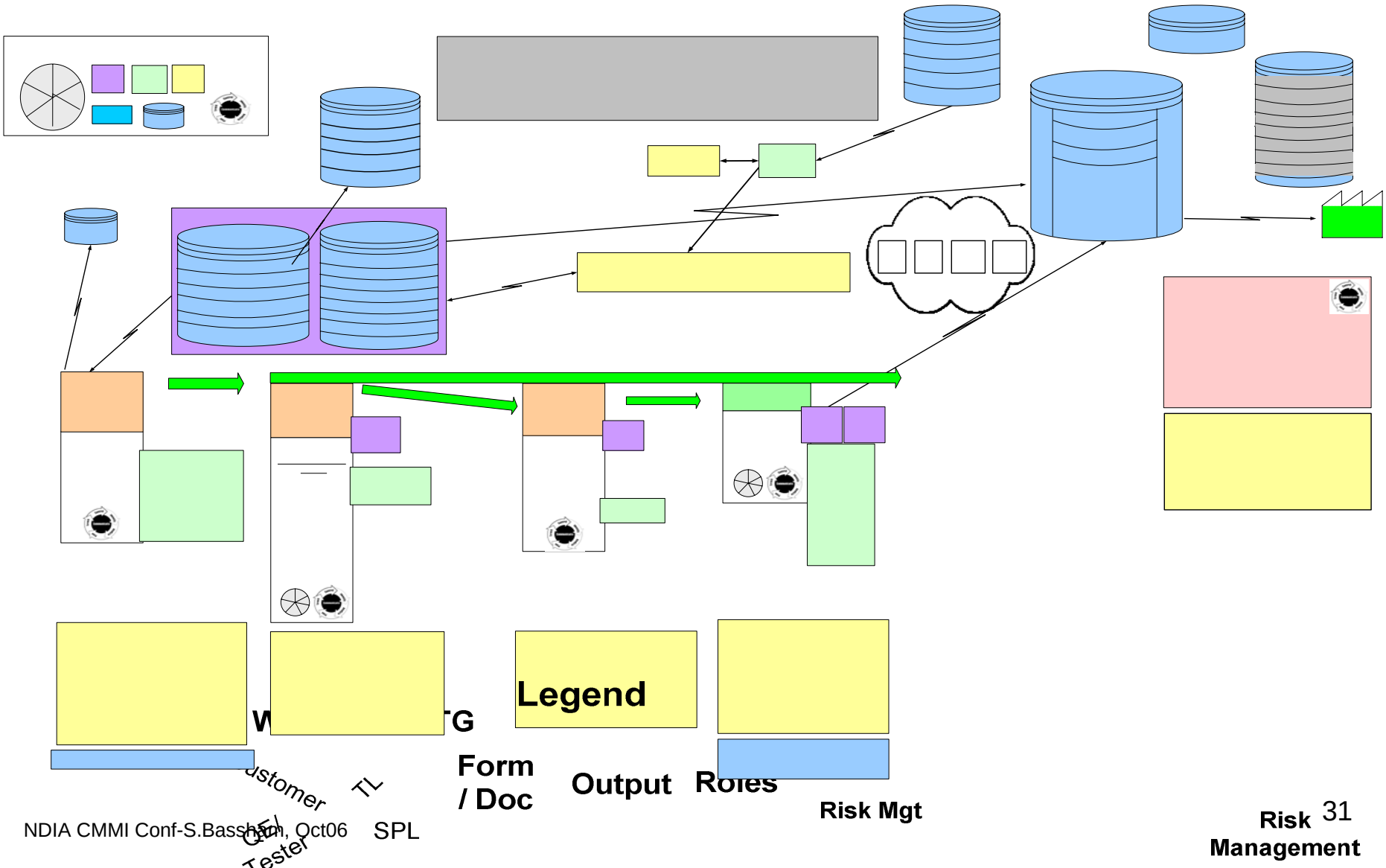
Reduce wastes of searching, defects, waiting:

- Visual graphical flow for each Loop
- Visual Online Help with drilldown
- Step by step checklists by activity and role

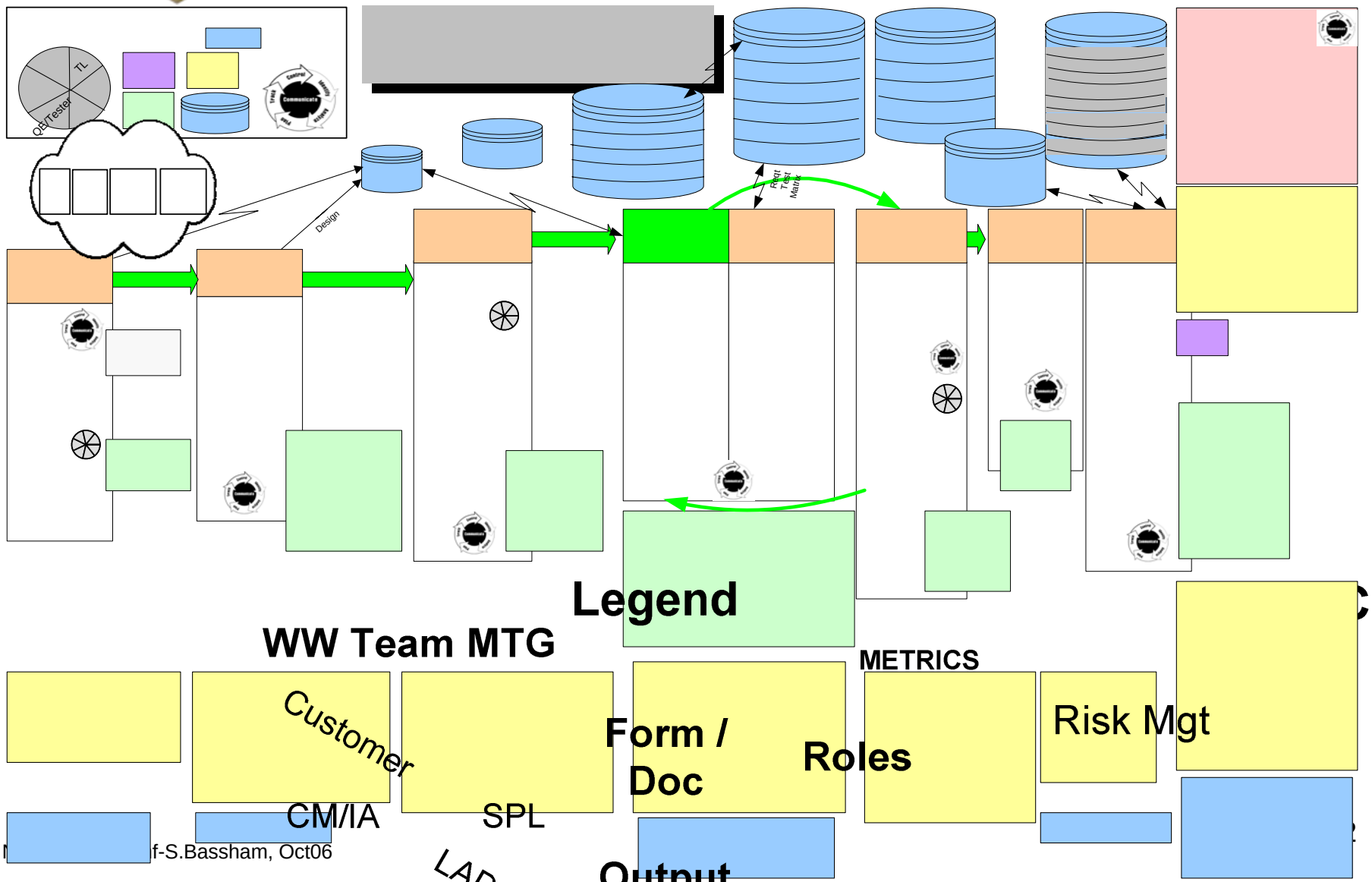
Loop 0 SEP VSM



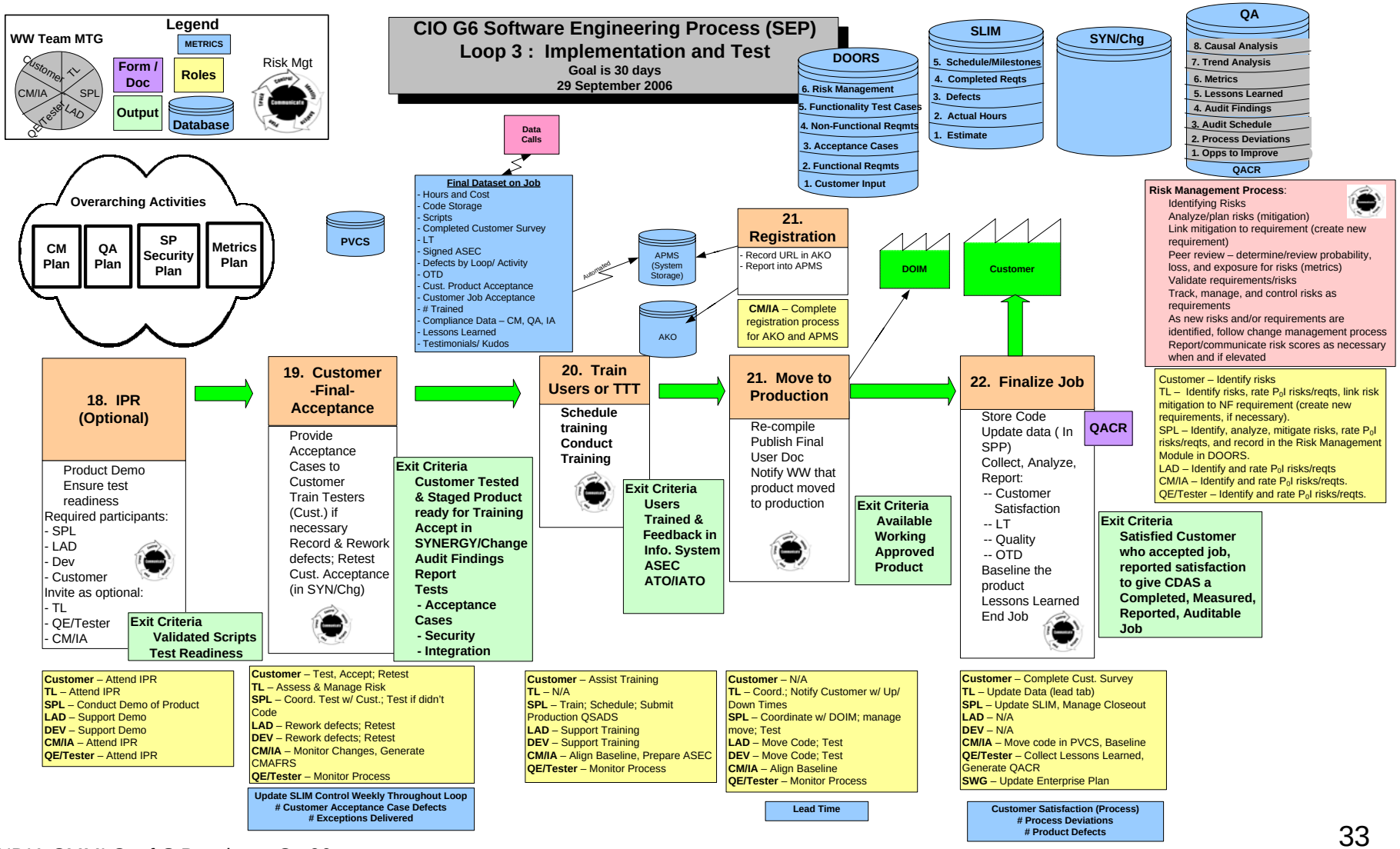
Loop 1 SEP VSM



Loop 2 SEP VSM



Loop 3 SEP VSM



Lean Internal Training

- Continuously improve
  - Add, Change, Modify, Delete
  - Innovative deliveries and celebrations
    - Rollout Celebrations
    - SEP Fair
- Provide high level overview
- Specialized Peer Group training sessions
  - Hands on tools
  - Simulate!
  - Role expertise

Future Steps
on
Our Lean Journey

Visual Status “at a Glance”

- Visual Management using metrics data
  - Enables better decision making
  - Insight into opportunities to improve
  - Allows monitoring of lead time and other metrics
- Dashboard concept
  - Data at your fingertips
  - Information for all roles
  - Meet the needs of managers and data calls

Continuous Improvement!

- Utilize Lean/Six Sigma Tools
  - Apply creative problem solving
  - Put SEP controls in place
  - Measure results
- Lean CMMI
  - Enhance business/management processes
  - Standardize
  - Improve Customer Satisfaction (product and SEP)
  - Plan/prep for Level 3-4 appraisals

Questions?

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Glossary

- **PCCB** - A collection of specialists from each role including management who facilitate the definition, maintenance, and improvement of the process(es) used by the organization.
- **SWG** - An authorized group within the organization that balances the workload across the organization; provides product tracking and oversight; and assists in the implementation, sustainment and continuous improvement of the Software Engineering Process.
- **TL** - Leadership role on the Product Team who is responsible for Loop 0 (Concept Definition & Product Requirements) and ensuring the success of software product development.
- **SPL** - Technical leadership role on the Product and Development Team responsible for success of software product development.
- **LAD** - Leadership role on the Product and Development Team who is responsible for design and development of the software product.
- **QE/Tester** – Technical role on the Product and Development Team who is responsible for Quality Assurance and Testing activities during the software product development.
- **CM/IA** – Technical role on the Product Team who is responsible for Configuration Management and Information Assurance activities during the software product development.

Raytheon

Customer Success Is Our Mission

Easing project planning for Small Programs

Ken Weinberg

El Segundo, CA

kiweinberg@raytheon.com

November 15, 2006

Agenda

- Small and Large Program Characteristics
- Comparison of Three Processes for Large and Small Projects
- Desired Single Process for Large and Small Projects
- History of Small Project Process
- Improved Process with Guidance for Small Projects
- Sample Small Project Templates

These thoughts are based on my experiences working with projects for over 20 years, and do not necessarily reflect experiences across Raytheon

Typical Small Program Characteristics

- Staffing for 3-8 Engineers
- Program Life 12 Months
- Small Proposal Activity
- Limited Customer Participation
- Single Product Deliverable/No Data Deliverables
- Minimal Customer process focus
- Limited Requirements
- Standard Facility and Resource Requirements

Typical Medium/Large Program Characteristics

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- Staffing for 100 Engineers
- Program Life 5-10 Years
- Significant Proposal Activity
- Regular Customer Participation
- Significant Contract/Data Deliverables
- Customer Process Expectation
- Defined Requirements
- Defined Methods of Verifying Requirements
- Good Profit Opportunity
- Unique Facility and Resource Requirements

Standards (CMMI, ISO) Written for Large Programs with Typical Program Phases
Organizational Processes Derived From These Standards

Org Process Designed for Medium/Large Programs

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- Extensive Planning Phase
- Involve Stakeholders
- Extensive Schedule with Dependencies
- Program Managed with Metrics
- Formal Requirements Traceability
- Extensive Testing/test Levels
- Significant Management Interest
- Formal Communication Important to Keep Project Teams Coordinated

Good Candidates for Appraisals

Small Project Process Needs

- Limited Planning Phase
- Involves Fewer Stakeholders
- Schedule with Major Milestones
- Metrics Used to Convey Program Status to Management
- Derived Requirements with Limited Traceability to Higher Documents
- Creative Methods of Verifying Requirements
- Limited Testing/test Levels
- Less Extensive Management Interest
- Formal Communication is a Burden

Small Projects Can Follow Good Process, but …

•Do Not Need as Much Formal Communication Among Team Members

•Cannot Easily Afford to Produce Enough Artifacts to Make Good Candidates for Appraisals

The Challenge

- Standards (CMM, CMMI, ISO, Corporate Initiatives) written for large programs
- Organization processes derived from these standards
- Small projects can follow good process, but
  - A large formal process may be a burden
  - Often find “process” intimidating

Comparison of Three Processes for Large and Small Projects

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- Planning Phase
- Metrics
- Testing/Requirements Verification

Planning Phase Characteristics

- **Medium/Large Program**
  - Extensive planning phase
  - Detailed IMP, IMS, staffing plan, interdependencies
  - Customer imposed requirement specification
  - Facility Plan
- **Small Project**
  - Brief planning phase
  - Schedule with major technical milestones, staffing plan
  - High level requirements (or goals)
  - Facility planning

Planning Phase – Similarities and Differences

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- Similar
  - Planning Phase
  - Schedule
  - Statement of Work
  - Budget
  - Staffing Plan
  - Requirements
  - Facility Planning
- Different
  - Details
  - Interpretation

Metrics Characteristics

- Medium/Large Program
  - Extensive Metrics (Technical, Programmatic, Quantitative)
  - Used to Monitor, Manage and Improve Program
  - Convey Status to Management and Customer Monthly
- Small Project
  - Limited Technical and Programmatic Metrics
  - Scoped Version of Standard Metrics used to Monitor and Manage Program
  - Convey Status to Management

Metrics – Similarities and Differences

- Similar
  - All programs track progress with metrics
  - All programs report metrics to management
    - Consistent reporting format
    - Compare trends across organization
- Different
  - Details and frequency
  - Usage

Testing/Requirements Verification Characteristics

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- **Medium/Large Program**
  - Formal peer reviews
  - Multi Level Independent Reviews with Engineering Technical Experts and Management, and Customer
  - Extensive/multi-level testing
  - All requirements verified
  - Formal documentation/records
  - Customer participation
- **Small Project**
  - Informal peer reviews
  - Combined single Independent Review with Engineering Technical Expert and Management
  - Single level testing
  - All requirements verified
  - Informal documentation/records
  - Often no customer participation

Testing/Requirements Verification – Similarities and Differences

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- Similar
  - All programs conduct peer reviews
  - All programs conduct independent reviews
  - All programs verify requirements
- Different
  - Details

Common Process Themes From All Examples

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- All Types of Programs Benefit From Process Discipline
- All Types of Programs Follow Core Process
  - Planning
  - Requirements
  - Metrics
  - Testing/Verification
  - Configuration Management
- Different
  - Scope/Details
  - Interpretation

The Goal

- Use the Same process for large and small projects
  - Compliant With the CMMI Model, ISO/AS9100, Corporate Standards
- Keep Directives Short and Simple
  - Provides project buy-in to process
  - Generic wording
    - Document Requirements in SRS ➔ Document Requirements
    - SOW ➔ Tasks
  - Almost no required formats
- Smaller projects rely heavily on supplemental non-directive guidelines and templates for tailoring and implementation guidance
- Pre-Tailor directives not used by most small projects (e.g. Formal Customer Reviews)
  - Scoped from full process to cover characteristics used by most small projects
  - Review scoped tailoring for further refinement
    - May add back in items tailored out when appropriate

History

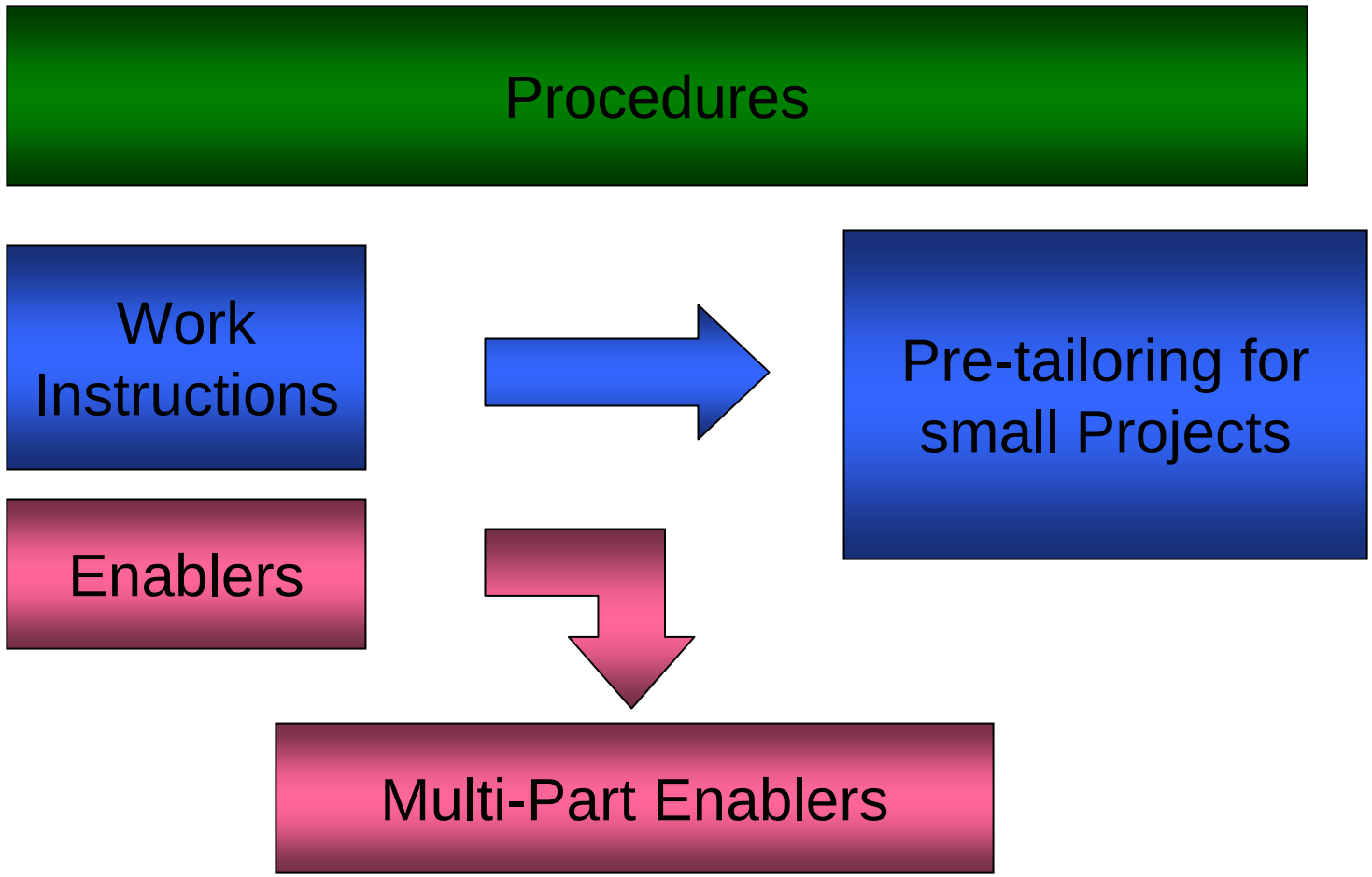
- Large Process
  - Fully compliant with CMMI models
  - Produced artifacts to make assessments/appraisals easier for appraisal teams
  - Used model “jargon”
  - Overwhelming for small projects
- Initial Small Software Process – Based on Products: Requirements Document, Test Plan, Version Description Document, etc.
  - Used only portions of directives related to products
    - Used large process - unclear which portions applied
    - Non-uniform process – not applied consistently
    - Not conducive to process improvement
    - Not compliant with standards
- Separate Software Small Process – Scoped Specified Directives Into New Directive System
  - Used existing infrastructure support
  - Achieved over a 75% reduction in directives, pages and paragraphs
  - Still a separate directive system

Improved Single Process with implementation guidance for smaller projects

Full Process

Procedures	Directive/ Non-Tailorable	High Level Directly Traceable to CMMI, ISO, Corp Stds
Work Instructions	Directive/ Tailorable	Lower Level, Further Direction on "How" to Meet Requirement
Enablers	Non-Directive	Guidelines/ Templates

Improved Process



Tailoring Template Example

DOCUMENT	NAME	A	C	R	N/	Comments
EI-01-16	Cost Estimating		X			Small projects only need one costing procedure (see Par. 5.10a). Cost realism analysis (Par. 5.11) not required. All bids need mgt approval; projects <$1 require Dept. Mgr approval, projects >$1M require Center Mgr approval
EI-01-21	Process Tailoring	X				Comb
EI-01-23	Project Management Team	X				
EI-01-29	Work Product Management and Stakeholder Involvement	X				See s
EI-01-30	Objective Evaluation	X				See d
EI-01-31	Program Management Plan		X			Folde
EI-01-34	Project Teaming				X	Not ap
EI-01-35	Program Data Archive		X			Will us
EI-10-02	Project Measurement & Analysis		X			Repor
EI-11-01	Formal Decision Making		X			See s
EI-14-01	Start-up Management Review	X				(Not r
EI-14-02	System Functional (Requirements or Concept) Management Review				X	Not re
EI-14-03	Prelim. Design Management Review				X	Not re
EI-14-04	Critical Design (Detail Design and Build Readiness) Management Review				X	This S
EI-14-05	Test Readiness Management Review				X	Not re
EI-14-06	Production Readiness Management Review				X	Not ap
EI-14-07	Transition & Closure Management Review	X				(Not r
EI-14-08	Independent Review of Start-up Plans		X			Small
EI-14-09	Independent Reviews of Product Design and Production Readiness		X			Peer reviews will be expanded to include Systems Engineering and any other applicable SME
EI-15-01	Peer Review	X				If effort is upgrade of existing system, only changes and interfaces need be reviewed.

Comments Section:

- Blank (initially) for Large Projects
- Template for Small Projects Contains Scoping and Implementation Guidance

Sample Tailoring Template Detail

DOC Number	NAME	TAILORING CODE	Comments
EI-14-04	Critical Design (Detail Design and Build Readiness) Management Review	**ACCEPT**	See small project template
EI-14-05	Test Readiness Management Review	**N/A**	Not required for projects designated Technology Demonstration
EI-14-08	Independent Review of Start-up Plans	**ACCEPT**	Small Project Templates Used for plans
EI-15-01	Peer Review	**CHANGE**	If effort is upgrade of existing system, only changes and interfaces need be reviewed.
EI-02-01	Software Requirements	**ACCEPT**	This need not be a formal document with a specific format. DOORs or an EXCEL spreadsheet are OK as long as they are controlled after baseline.
EI-03-05	Software Preliminary Design	**ACCEPT**	Preliminary and Detailed Design Phases are often combined on small projects
EI-04-01	Software Integration and Testing	**CHANGE**	Software Test Plan and Software Test Description may be combined, or included in another document. Software Test Report may be red-lined Software Test Description
EI-04-13	Software Unit Test	**CHANGE**	Plan for regressing test is re-running selected sections of Software Test Description, if analysis shows regression testing is required. Unit testing (and unit test documentation) may be combined with integration
EI-04-14	Software Corrective and Preventative Action	**ACCEPT**	This is generally accomplished during monthly project leadership meetings.

Work Product Management Plan Example Template

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Work Product Control Level Checklist/ Stakeholder Involvement		Note: Unless otherwise noted, all items are stored on the project server											
Project Name: Sample	Date: December 12, 2005						**Stakeholder Roles/Disciplines**						
	Control Level				Function	Peer		Program	Line org	SE	SW	Config/	
Name of Work Product	Create	Eng	Develop	Formal	Responsi	Rev	Customer	Manager	Center/Dept	IPTL	IPTL	Data Mgt	Quality
Software Development Plan (SDP)			x		SW					A	A,R	S	S
SW Schedule	x				SW			S	I	I	A,R	I	I
EMS Tailoring Report		x			SW			A	A	S	A,R	S	S
SW Meeting Minutes, Agenda, Action Items	x				SW						R	S	S
SCCB Package/Minutes		x			CM						A	R	
ToX Agenda, Minutes, Action Items		x			SE/SW				R,S,I,F	S	S	I	I
Software Problem Reports (SPR)			x		SW					I	A,R	S	I
SW Quality Plan			x		QE					I	A,R	S	R,A
SW Code			x		SW						A,R	S	I
SW Version Description Document			x	x	SW/CM					A	A,R	S	A
SW CM Reports		x			CM						I	R	I
SW Coding Standards		x			SW						A,R		I
SW CM Plan			x		CM					I	I	A,R	S,I
SW Peer Reviews	x				SW	X				C	A,R		I
Work Product Management/Stakeholder Plan		x			PM/SW					S	A,R	I	I
Software Requirement Documentation			x		SW	X				A	A,R	S	I
Software Design Documentation		x			SW	X				I	A,R	S	I
Software Test Documentation			x		SW	X				I	A,R	S	I
Software Test Report			x		SW	X				I	A,R	S	I

When Identifying Stakeholders use the following codes

R = Responsible for producing the completed work product

A = Responsible for approving the work product

S = Provides support in the production of the work product

C = May be consulted in the generation of the work product

I = Needs to be informed of the completion of the work product or any changes to the work product

F = Can be used to facilitate the development of the work product

N = Not applicable to the development of the work product. This code may be used to provide clarity when several stakeholders are involved in the generation of a work product

Summary

- Goals
  - ISO/AS9100, Corporate Standards, CMMI model compliant, as scoped
  - Smaller projects not planned to major role in appraisals
- Method
  - Start with full process
  - Use generic wording where possible
  - Keep it short and simple ➔ really short and simple
  - Scope for smaller projects
  - Rely heavily on non-directive templates and guidelines

Questions ? ? ?

Getting to Level 3 Risk Management (#3772)

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Topics

Comparison of Level 2 and Level 3 Risk Management

Step by Step Approach to Level 3

The Desired Outcome

References

Questions

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Comparison of Level 2 and Level 3 Risk Management

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Level 2 Risk Management is a Snap

Level 2 Risk Management consists of:

- One Project Planning Specific Practice (PP SP2.2) – Identify Project Risks
- One Project Monitoring & Control Specific Practice (PMC SP1.3) – Monitor Project Risks
- Three pages of text

Because this is a Level 2 activity:

- The process used does not need to be defined and can be different for each project

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Level 3 Risk Management (RSKM) is an entire Process Area

Level 3 Risk Management consists of:

- Three Specific Goals with a total of 7 Specific Practices
- Twenty-two pages of text (more than the entire Project Monitoring & Control section)

Because this is a Level 3 activity:

- A defined process tailored from the organization's process is required

Level 3 Risk Management requires a comprehensive risk management strategy

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RSKM Specific Goals and Practices

SG 1 Preparation for risk management is conducted

SP 1.1 Determine risk sources and categories

SP 1.2 Define the parameters used to analyze and categorize risks, and the parameters used to control the risk management effort

SP 1.3 Establish and maintain the strategy to be used for risk management

None of this was required for Level 2 risk management!

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RSKM Specific Goals and Practices (cont)

SG 2 Risks are identified and analyzed to determine their relative importance

SP 2.1 Identify and document the risks

SP 2.2 Evaluate and categorize each identified risk using the defined risk categories and parameters, and determine its relative priority

Except for having defined categories and parameters this is also required in Level 2 (PP SP2.2)

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RSKM Specific Goals and Practices (cont)

SG 3 **Risks are handled and mitigated, when appropriate, to reduce adverse impacts on achieving objectives**

SP 3.1 Develop a risk mitigation plan for the most important risks to the project, as defined by the risk management strategy

SP 3.2 Monitor the status of each risk periodically and implement the risk mitigation plan as appropriate

Level 2 only required the risk monitoring aspects of this goal!

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Getting to Level 3 Risk Management

Risk management is not the same as worrying about your project!*

** Waltzing with Bears by DeMarco and Lister, p. 64*

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Is Level 3 Risk Management Worth It?

Level 3 Risk Management has many benefits:

- Helping new project teams perform adequate risk management
- Improving budget and schedule adherence
- Predicting an adequate risk reserve
- Managing risk rather than watching risks happen
- Identification of systemic organization issues that can be resolved by management
- Understanding the actual impact of risk on your projects
- Learning through shared, relevant experiences

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Step by Step Implementation Approach

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Where to Start

- Locate as much risk information from past projects as possible. If you are a Level 2 organization, you should have risk lists and monitoring records.
  - If you are not a Level 2 organization, and don't have risk lists and monitoring records, it's probably better to wait until you do.
- Why start with historic data?
  - If you don't develop your risk management strategy based on actual experience, the end product may not be used because it is viewed as irrelevant.
- Select a relevant risk taxonomy for comparison

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About Risk Sources and Categories

- Risk sources describe potential places where risk originates
- Risk categories are buckets for grouping and analyzing risks so they can be dealt with effectively
- Risk sources and categories can facilitate thorough risk identification on all projects
- Thorough risk identification provides greater benefit to the project

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Step #1 - Identify Risk Sources

- Risk sources describe potential places where risks originate. They can be:
  - Internal to the project (for instance, the technology being used, a fixed schedule, complexity)
  - External to the project (for instance, weather, changing regulations, political instability of a country)
- Review each risk to identify its likely source(s)
- After you've identified common sources of risk from your data, look at other taxonomies to improve the thoroughness of your source list

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How Am I Going to Do This, Exactly?

One way to facilitate this process:

- Print historic risk information (risk statement, impact, mitigation plans, etc) on index cards or other similar sized physical media – you may need to select a sample subset if too much data exists
- Use different stickers to identify potential sources
- Log the source for each sticker type
- Place stickers on the index cards as appropriate
- One index card can have multiple stickers!
- Review the list of sources for consolidation opportunities
- Get more than one person involved!

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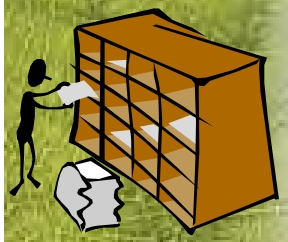

Step #2 – Identify Risk Categories

Risk categories are buckets for grouping and analyzing risks so they can be dealt with effectively. Often categories are just a higher grouping of sources from a taxonomy, but how else can categories be used?

- Phase of the life cycle in which the risk usually manifests
- Organizational group responsible for handling the risk (Senior Management, Systems Engineering, Project Management, etc)
- Internal or External to the organization
- What groups make sense in your organization?

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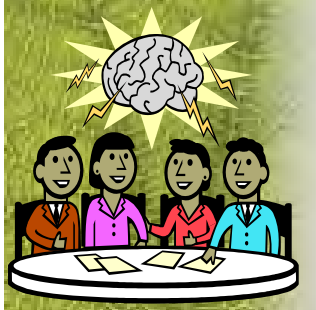

Step #3 - Define Risk Identification Methods

- Balance thoroughness with creative thinking by combining a structured method with brainstorming
- Involve appropriate stakeholders, not just the project team
- Structured methods can include:
  - Walking through the WBS
  - Walking through the requirements
  - Walking through the project plan
  - Walking through a list of risk sources or risk taxonomy
  - Reviewing historic risk data and lessons learned from similar projects

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Step #4 – Adopt Risk Statement Standards

- People often confuse issues, problems, and risks
- A risk is an event or condition that may occur in the future, and which will have an impact on the project if it did occur
- An issue is a risk that has already occurred, nothing can be done to prevent it
- A problem might have no project impact
- A standard risk statement format helps everyone identify and describe risks consistently:
  - If {condition present} then {impact}
  - If {event} then {consequence}

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Step #5 - Clarify Impact and Probability Definitions

- Tailor impact definitions to your organization based on historic data:
  - Impact includes more than just schedule and budget, it could include safety, quality, security, employee morale, or customer satisfaction
  - Safety issues could cause minor injury to one individual or serious injury to a large number of individuals
  - Security issues can range from disclosure of individual personal data to issues of national security
- Probability can be described using quantitative or qualitative values:
  - In either case, define and agree upon the meaning of these values in your organization

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Step #6 - Define Standard Triggers and Thresholds

- What standard thresholds are important?
  - Are some risk categories more critical than others?
  - Do projects with a higher (or lower) than average level of risk require a different approach?
  - Will projects with certain levels of risk simply be dismissed?
  - What is the priority, impact or probability cutoff for risks that must consider mitigation?
- What standard triggers are important?
  - Does the occurrence of a high priority risk trigger involvement of certain levels of management?
  - Does the identification of a new, high priority risk trigger specific action?

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Step #7 - Define Risk Responses

- There are many risk responses besides mitigation and contingency, including transferring, avoiding, monitoring and possibly even ignoring! What risk responses are valid in your organization?
- When is each risk response appropriate? Provide guidance, not just options
- Which risks will have responses developed? Which will just be monitored? Which will be ignored?
- Define the expected activities associated with each risk response (for instance, accept versus ignore)
- Review historic data to identify risk responses that have worked in the past

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Step #8 - Define Cost-Benefit Calculation Method

- Every risk does NOT need a mitigation plan!
- Sometimes mitigation is just too expensive. Consider:
  - The effort required to implement the mitigation
  - The likely reduction in probability and impact of the risk as a result of the mitigation
  - Weigh the total cost of mitigating against the projected impact of the risk should it occur
- Establish a minimum threshold for when mitigation should even be considered, for instance, only risks with at least Medium probability and Medium Impact

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Step # 9 - Document the Risk Management Strategy

A Risk Management Strategy :

- Is a comprehensive risk management approach for a project tailored from an organizational standard
- Translates organizational risk management expectations into a project-specific strategy, including:
  - Project-specific risk sources, categories, tools, measures, thresholds
  - Risk tolerance of the project sponsors
  - Overall approach to dealing with risk on the project
- Can be part of a risk management plan and a subset of the overall project plan which needs to be reviewed with the project stakeholders

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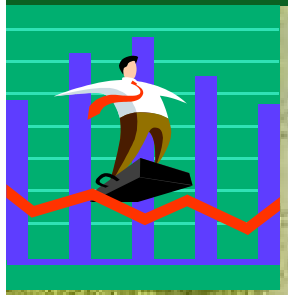

Step #10 - Identify Performance Measures

- What do you need to know about risk management?
  - Are we spending too much or too little effort on risk management?
  - How well are we estimating probabilities and impact?
  - How many problems occurred during the project that could have been anticipated as risks?
  - How well are we characterizing overall project risk?
  - How effective are our risk responses?
  - How effective is our risk reserve allocation and usage?
- Will these measures enable you to monitor and control the risk management process?

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Step #11 - Develop and Deliver Training

Tailor your training to the various stakeholders in the process:

- Customers need to understand their involvement and what risk related information they will be seeing
- Senior Management needs to know how to support the process and what their role is
- Project Managers need in-depth training on all aspects of the process
- Analysts, Designers, Developers, Engineers, Testers, Support Personnel need the ability to recognize and report risks to the appropriate individuals

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Step #12 – Perform Quality Assurance

Implement process and product quality assurance:

- Develop a checklist for verifying the risk management process is followed
- Identify risk related work products (such as risk lists), determine which should be audited and develop standards to evaluate them against
- Incorporate these activities into your process and product quality assurance plans

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Step #13 – Address Generic Goal 2

Some Level 2 Generic Practices may already be addressed for Risk Management via Project Planning and Project Monitoring and Control, but consider:

- Do your policies include expectations specific to risk management? (GP2.1)
- Are there new risk management planning tasks that need to be scheduled and assigned? (GP2.2, GP2.4)
- Are new tools and job aids being introduced? (GP2.3)
- Are there new risk work products that projects need to maintain under configuration management? (GP2.6)
- Is the expected involvement of all stakeholders in the risk management process defined (including Senior Management)? Is there a way to track and monitor their involvement? (GP2.7, GP2.10)

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Step #14 – Address Generic Goal 3

To address Generic Goal 3, you should:

- Document the risk management process and provide tailoring guidance
- Provide a mechanism to collect the outputs of each project's risk management process for future reference
- Provide a mechanism for individuals and teams to provide feedback and improvement suggestions based on their usage of the risk management process

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What RSKM Implementation Looks and Feels Like

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Typical RSKM Activities and Behaviors

In an organization that has implemented CMMI-based RSKM processes, you could see these activities and behaviors:

1. Senior Management reviews the risks before approving project plans
2. Risk reserves are allocated and monitored
3. All team members can identify risks
4. Risk identification is encouraged and rewarded
5. Serious consideration is given to analyzing risks, developing and monitoring risk responses

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Typical RSKM Work Products and Artifacts

In an organization that has implemented CMMI-based RSKM processes, you will typically see these work products and artifacts:

1. Risk Registers (Lists)
2. Risk Strategies
3. Risk Status Reports
4. Risk Measures
5. Risk Source and Category Lists

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Risk References

The following references may be useful:

1. A Guide to the Project Management Body Of Knowledge (PMBOK®) Third Edition, Project Management Institute, for more information visit www.pmi.org
2. Continuous Risk Management Guidebook, Software Engineering Institute, for more information, see www.sei.cmu.edu/publications/books/other-books/crm.guidebk.html
3. Waltzing with Bears, Managing Risk on Software Projects, Tom DeMarco and Timothy Lister

The companion paper for this presentation includes additional references and is on the Conference CD

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- Natural SPI's web site: www.naturalspi.com

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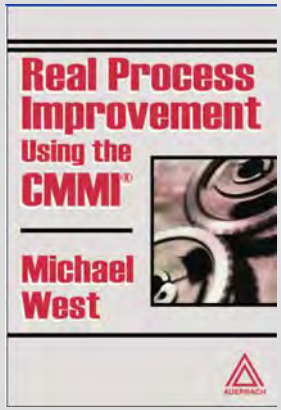
SEI Partner



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Getting to Level 3 Risk Management

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BAE SYSTEMS

Interfaced vs. Integrated Process

BAE Systems
Electronics and Integrated Solutions Operating Group
Nashua, New Hampshire
USA

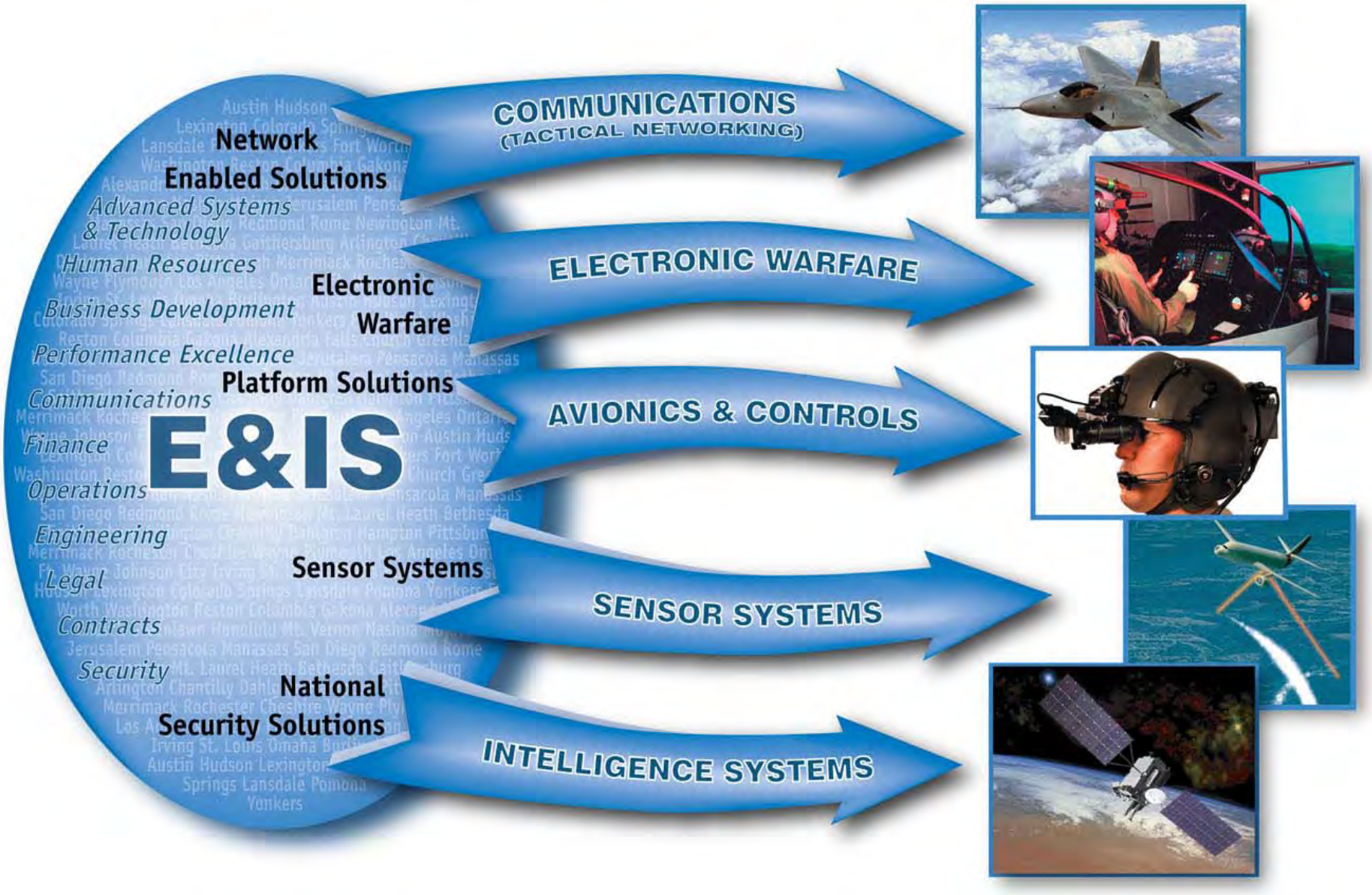
Agenda

BAE SYSTEMS

- Organization Overview
- Process Improvement Approach
- Resulting Process Architecture
- Process Improvement Results
- Conclusions

Electronics & Integrated Solutions

BAE SYSTEMS

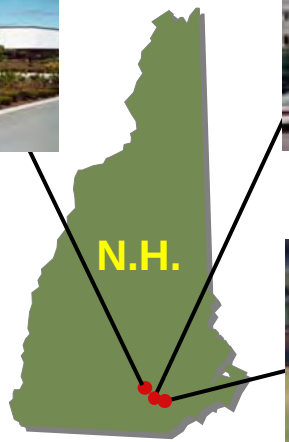


Electronic Warfare

BAE SYSTEMS

Pomona

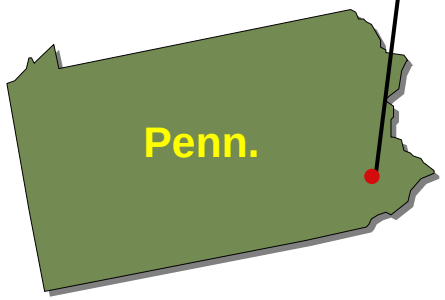
Merrimack

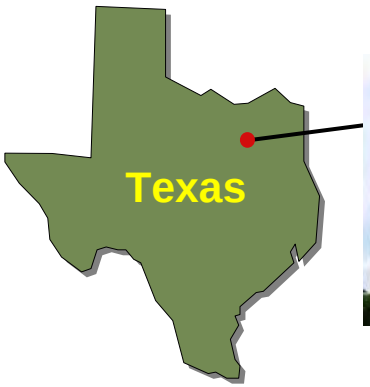


Nashua

Hudson

Lansdale





Fort Worth

Yonkers

Sensor Systems

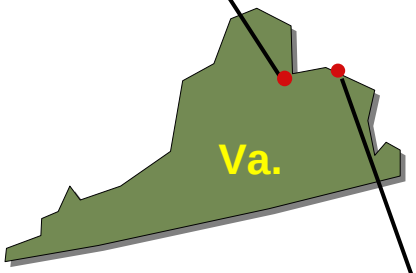
BAE SYSTEMS

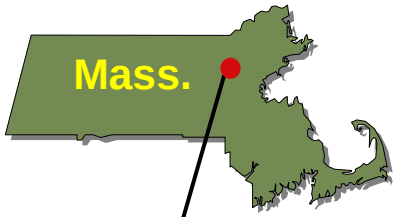
Mojave

Austin

Manassas

Jerusalem (Rokar)

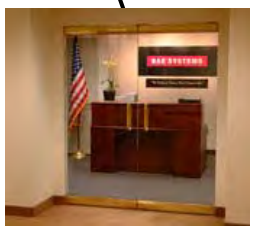




Merrimack

Nashua

Lexington



Washington, D.C.

Process Improvement Time Line

BAE SYSTEMS

BAE SYSTEMS Lifecycle Management

CMMI® Released by SEI

PMBOK® Focus Introduced

Customer Requirements for CMMI® Level appearing in RFPs

External Drivers

Software Process Assessed at SW CMM® Level 4 (9/01) Previous appraisals at Level 3 (94, 98, 00)

System Engineering Process at EIA-731 L2+ going for L3

Other Engineering Processes well defined & followed

Program Management Process Defined, Inconsistently Followed

IPDP Effort Begins

5 Opportunities for Improvement (OFI) assigned to IPDP

IPDP Identifies Solutions to 14 Program Operating Model (POM) Issues for Leadership Ratification

Update SW process to SW-CMM Level 5

System Engineering Process Assessed at EIA-731 L3 (10/02)

IPDP Management Process Pilots March-June

Implement IPDP Technical Processes for System Engineering and Software Engineering

Deploy IPDP V1.0 (9/03)

All Key Projects have transition Plans by 12/03

Form Enterprise Process Group (EPG) 7/03

Start new Projects using IPDP

Full CMMI SE/SW/IPPD/SS based Assessment of Process at Level 4 via Class B appraisal (10/04)

Implement Corrective actions from Class B appraisal

CMMI SE/SW Class A appraisal at Level 3 (4/05)

Implement process improvements to enhance usability

Expand Level 4 and 5 behaviors from Software to Systems

2001 2002 2003 2004 2005

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PMBOK is a registered trademark of the Program Management Institute

Background

BAE SYSTEMS

- Current Process Improvement Activities began in 2002 designed to
  - Address project performance issues identified in 2001
  - Take the capability of the process to the next level
- Leverage the best practices in place
  - Within the local organization
  - Within sister organizations in BAE Systems
- Basis for process improvement
  - Capability Maturity Model Integrated (CMMI SE/SW/IPPD/SS v1.1) and
  - The tenets of the Program Management Institute; Program Management Body of Knowledge

Approach Overview

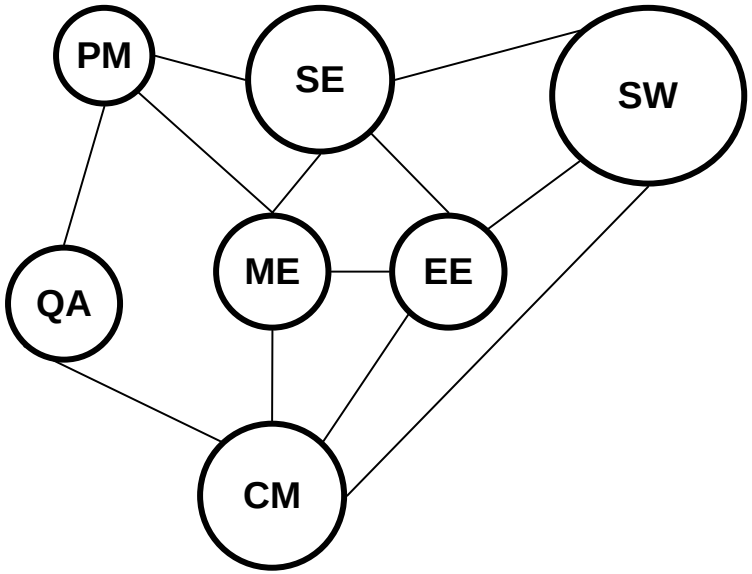
BAE SYSTEMS

- Process improvement activity to be organized as a project
  - Defined budget
  - Formally planned
  - Representation from all disciplines
    - Engineering, Project Management and support disciplines
- Use a full system engineering approach to developing the process
  - Requirements analysis and definition
  - System Design
  - Implementation
  - Integration
  - Pilot (verification)
  - Deployment
- Early decision needed on how to document the enhanced process
  - Knit existing processes together into an **INTERFACED** process or
  - Develop a single **INTEGRATED** process

Types of Process Implementations (slide 1 of 2)

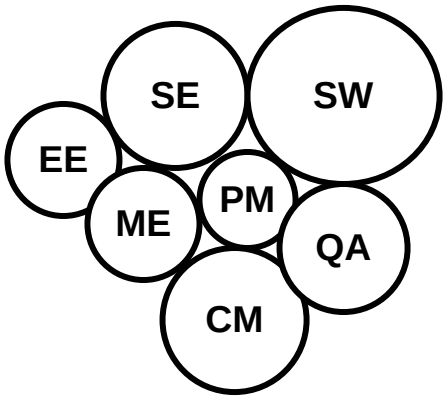
BAE SYSTEMS

Non-Integrated Process



- Each function defines its own process to its own understanding of needs
- Each function does similar things in different ways
- Communication, sharing of product and information is along narrow defined paths
- Collaboration is adhoc to non-existent

Interfaced Process

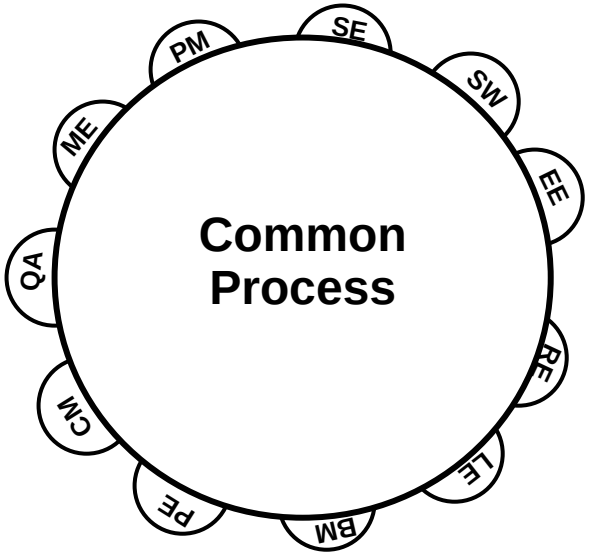


- Add defined Interfaces and interactions into each functional process (touch points)
- Each function defines its own process to a common understanding of needs
- Each function does similar things in compatible ways
- Communication, sharing and collaboration are built into each functional process set.

Types of Process Implementations (slide 2 of 2)

BAE SYSTEMS

Integrated Process



- Common process for all functions with extensions as necessary
- Each function does similar things in the same way
- Communications, sharing and collaboration are a natural outcome of working to the same process

Considerations

BAE SYSTEMS

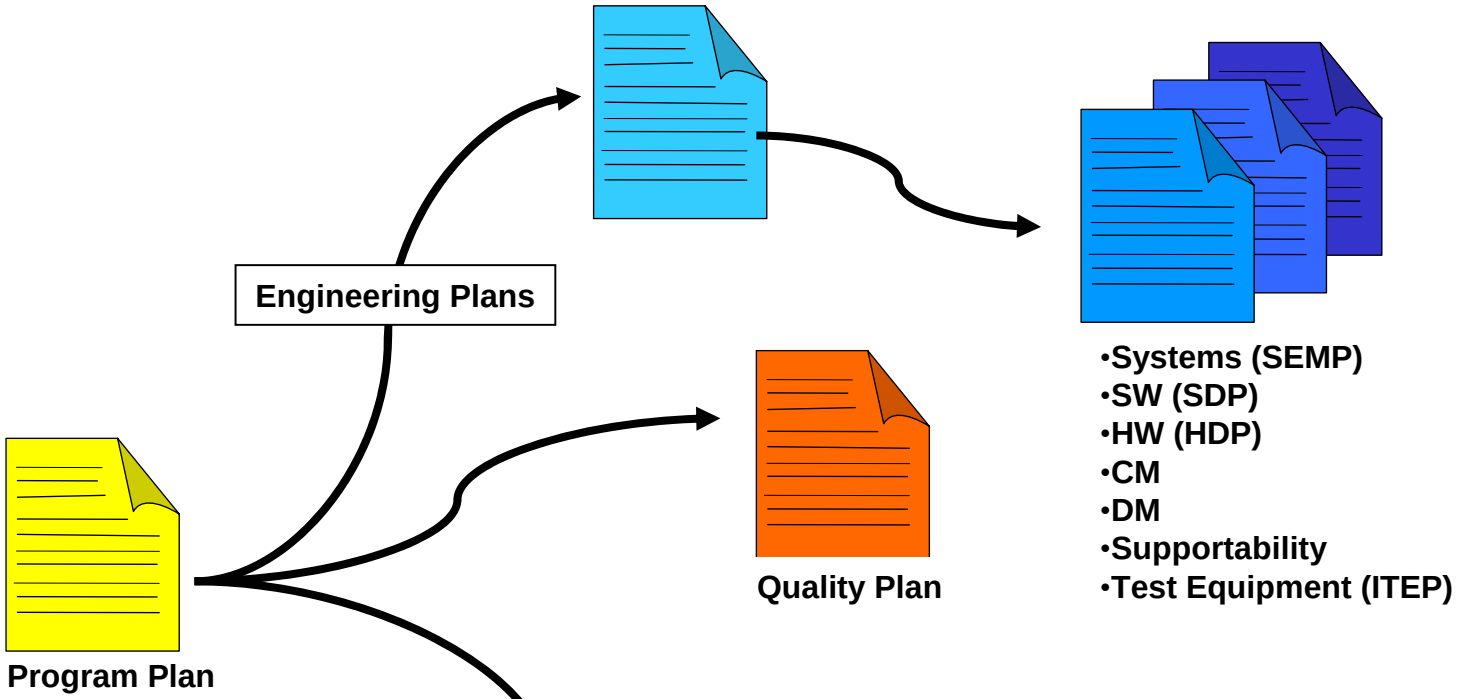
Interfaced Process

- Pros
  - Less overall work
  - Discipline processes to be executed are documented all together
  - Level of detail of process can be adapted to the maturity of a discipline
  - Infrastructure to support the processes is already in place
- Cons
  - No clear owner of integrated behavior
  - Total volume of process is greater
  - More cost and effort to maintain
  - Difficult to keep all parts of the process in alignment

Integrated Process

- Pros
  - Single clear owner of integrated behavior associated with the process
  - Easier to maintain
    - Single place to make changes
    - Smaller overall process description
  - Less infrastructure require to support the process
  - Forms the basis of a more extensible process architecture
- Cons
  - Requires more work to develop and deploy
  - Requires more stakeholder involvement in reviewing and agreeing to the process

Selecting the Approach:
Analyze Pre-Integration Program Plan Hierarchy



•Operation/Manufacturing Process Plan
•Material Plan
•Installation Support Plan
•Program-specific Capital Equipment Plan
•Program-specific Facilities Plan
•DTUPC Plan

Selecting the Approach: Analysis of Plans

BAE SYSTEMS

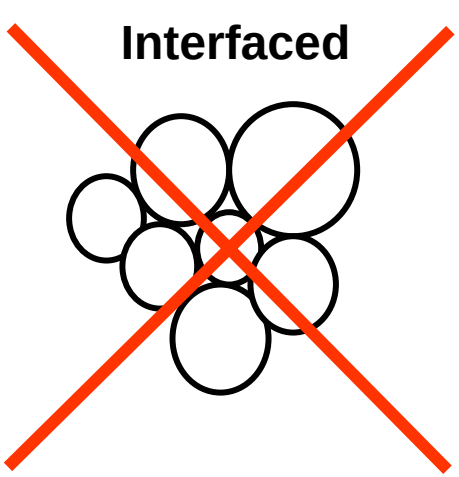
- Plans were structured as stand-alone documents
  - Not hierarchical
  - Many common attributes
  - No consistency
- Plans were functionally oriented
- Some plans contained process descriptions that were duplicated from project to project
- Templates for plans existed
  - Checklists were not value added or non-existent
  - Content not consistent across projects or within projects

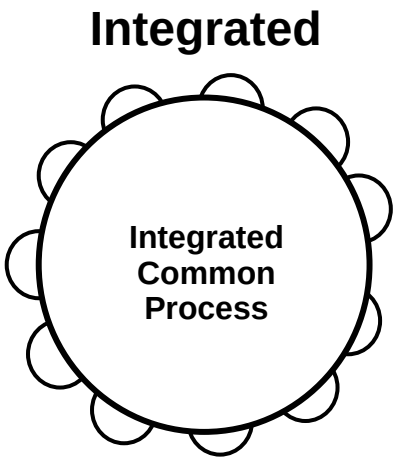
Planning Elements	CMMI	LCM	MDP	Project	System	Software	PSEP	CM	Quality	HW	Support	DM
Project Scope												
Description/Overview		x		x				x	x	x		
Charter	x											
Purpose/Mission/Objective's	x	x	x	x				x				x
Benefits and Enablers		x		x			x					
Goals				x								x
Success Criteria		x		x								
Vision	x	x		x			x					x
Customer Requirements and Assumptions			x	x								
Constraints	x				x	x					x	
Assumptions	x											
Work Products												
Work Product Control Table	x				x	x					x	
Baseline Control Table					x							
Technical Baseline												
Product Content					x					x	x	
Decision Analysis and Resolution (Trade Studies)	x				x							
Verification/Validation	x				x	x	x			x		
Process												
Lifecycle	x				x							
Project Defined Process	x				x	x	x			x	x	
PE Tailoring Matrix					x	x				x	x	
Project Unique Process	x				x	x				x		
Process Appraisal & Audit Process	x							x	x			
Schedule												
Project Schedule and CP Analysis			x	x								
Integrated Master Schedule	x	x	x	x					x			
Major Milestones	x	x										
Detailed Schedule					x				x	x	x	x
WBS												
WBS Matrix	x		x	x								
WBS Dictionary	x		x	x								
Cost												
WBS/Program Organization Labor Matrix			x	x								
Labor Budget by WBS over Life of Project	x			x					x	x		
Supplier and Material Dollar Budgets			x	x								
Earned Value Techniques			x									
Other Direct Cost Dollar Budget (by type)			x									
Rationalization of Budgets to Contract Dollars			x	x								
Labor Budget by CAM (work packages)				x								
Dollar Expenditure Plan Over Life of Contract				x								
Organization												
OBS	x	x		x			x	x	x	x	x	x
Roles and Responsibilities	x			x				x	x	x	x	x
Interfaces/Coordination							x			x	x	
Resources												
Key Resources		x									x	
Facilities	x		x		x					x	x	
Staffing				x	x	x		x	x	x	x	
Training/Specialty Knowledge and Skills	x				x	x			x		x	
GFE/GFS	x			x	x				x	x	x	
Reuse	x				x							
Development Environment	x				x	x				x	x	
Capital Equipment			x							x		
Verification Equipment	x											
Stakeholders												
Related IRAD							x					
Stakeholder Involvement/Commitments	x				x		x		x	x		
Between Process Phases							x					
Conflict/Issue Resolution	x						x					
Supplier Agreements	x	x	x	x	x	x	x			x	x	
Product Assurance	x		x						x			
Information Management												
Data Item Submittal/Management												x

Developed a matrix of plans and common elements

Elements are More Common Than Unique!

BAE SYSTEMS





- Our analysis of **Interfaced vs. Integrated** set our direction toward an integrated process
- Our analysis of existing project plans and processes served as an **early validation** that an Integrated process was possible and the correct approach

- We needed to establish a process architecture that supported an integrated approach
  - Common procedure level descriptions
  - With natural, transparent extensions to support discipline needs

A Good Process Architecture is the Key to a Successful Integrated Process

Requirements Analysis Approach

BAE SYSTEMS

- Use the CMMI subpractices as discrete requirements
- Add requirements from other governing process frameworks not included in CMMI
  - ISO 9001-2000 (AS9100)
  - Program Management Institute Body of Knowledge (PMBOK)
  - BAE Systems Life Cycle Management
- Develop specific requirements to describe how projects will operate
  - Called Program Operating Models (POMs)
  - Reviewed and agreed to by all functions and all levels of management
    - Approved by organization leadership
  - Examples:
    - Structure projects as Integrated Product Teams (IPTs)
    - How to staff and de-staff projects
    - Expansion of Configuration and Data Management into Information Management

Single Database Created to Capture All Requirements

Integrated Product Development Process (IPDP) Structure

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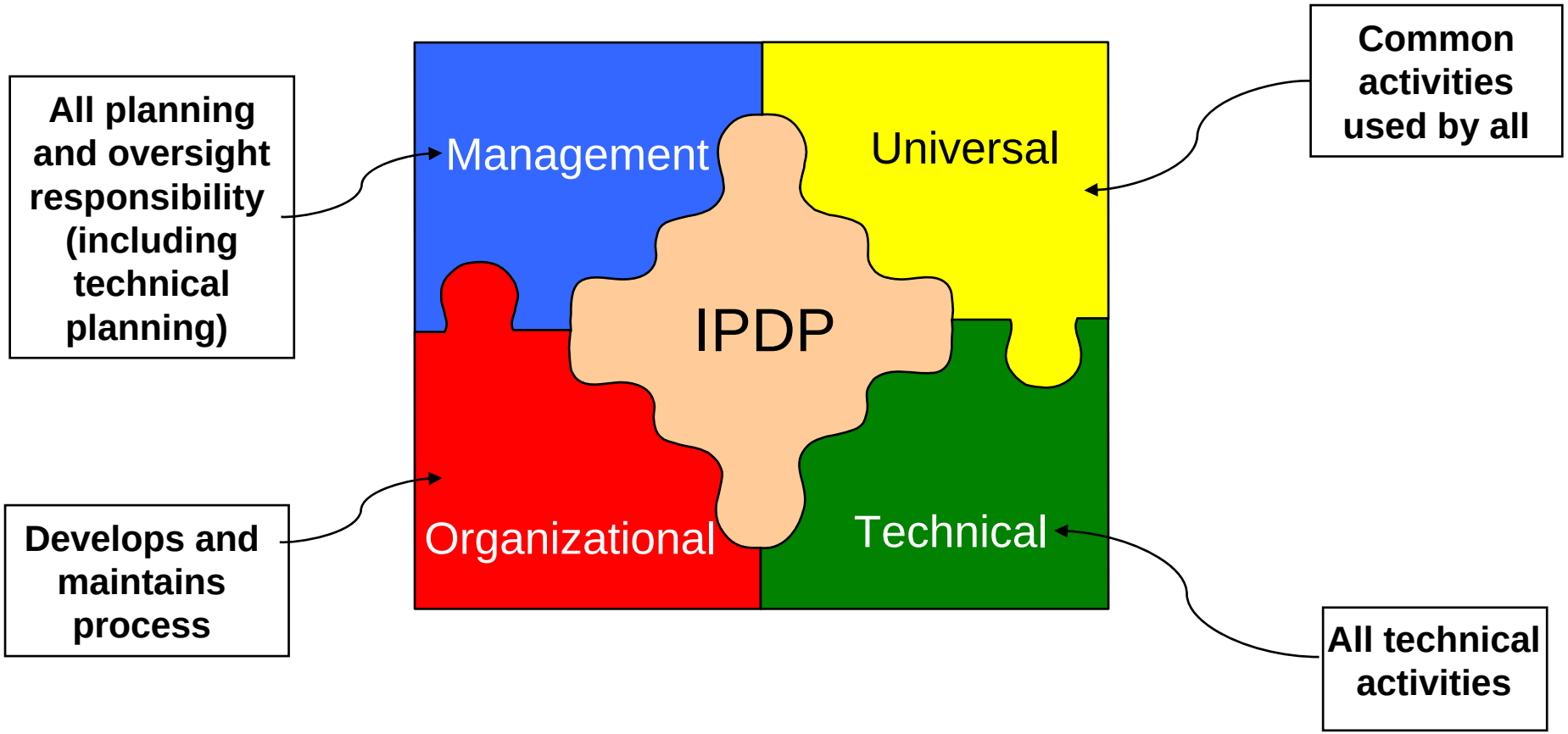

Requirements were Allocated to One of Four Zones

Each Zone has Process Elements

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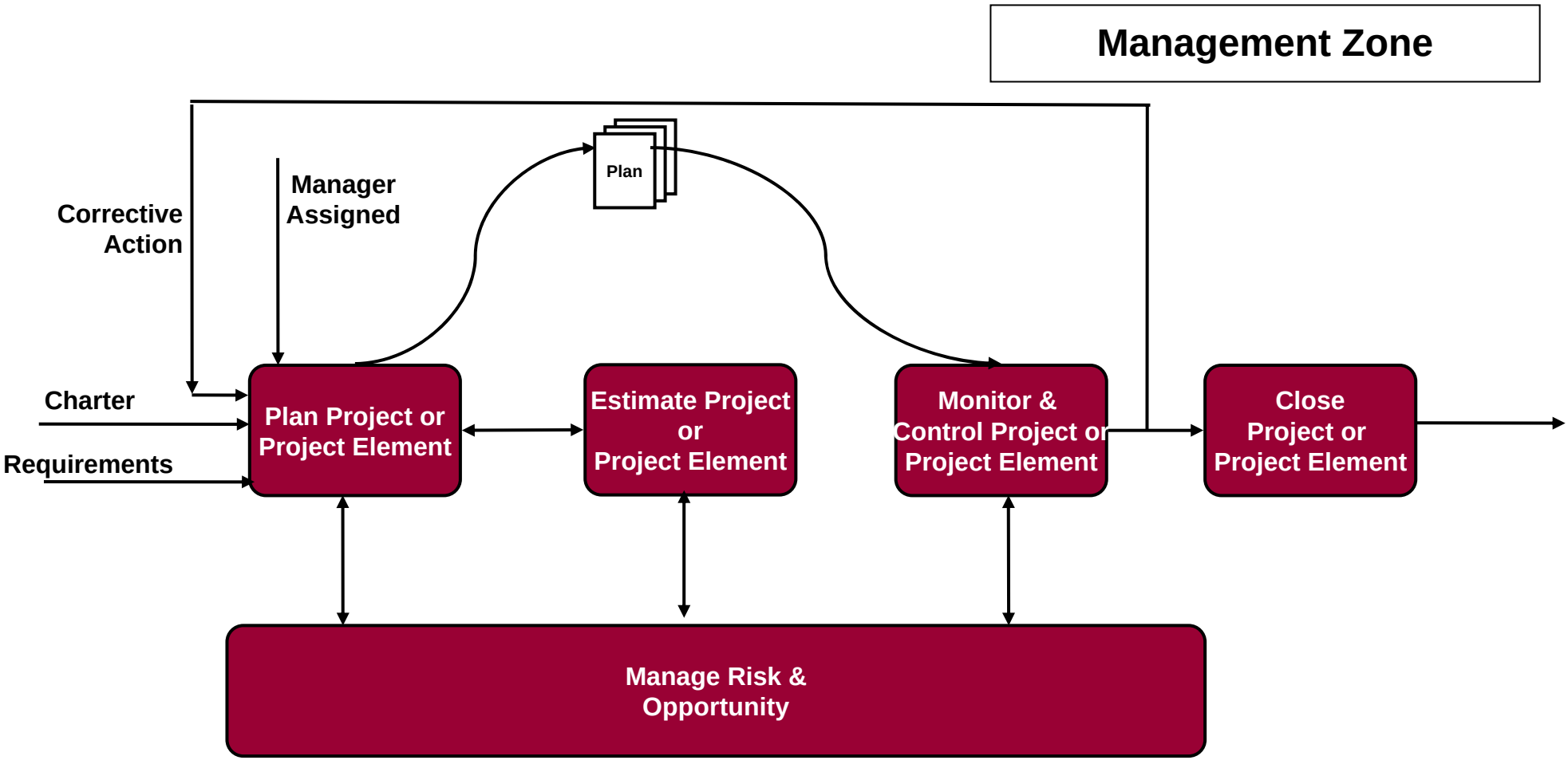

Requirements Grouped into Process Elements

Anatomy of a Process Element

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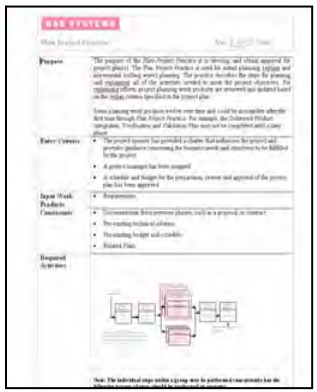
Practices

- –One or more per process element
- –Contains
  - – Inputs & outputs
  - – Entry & exit criteria
  - – Flow diagram
  - – Steps to be performed



Review Lists

- – At least one for each work product referenced by the practices
- – May be discipline specific
- – Contain rules for the development and review of the work product
  - - Required rules
  - - Expected rules
  - - Project specific rules

Templates

- – For work products that require specific formatting or
- – To provide the user with a starting point

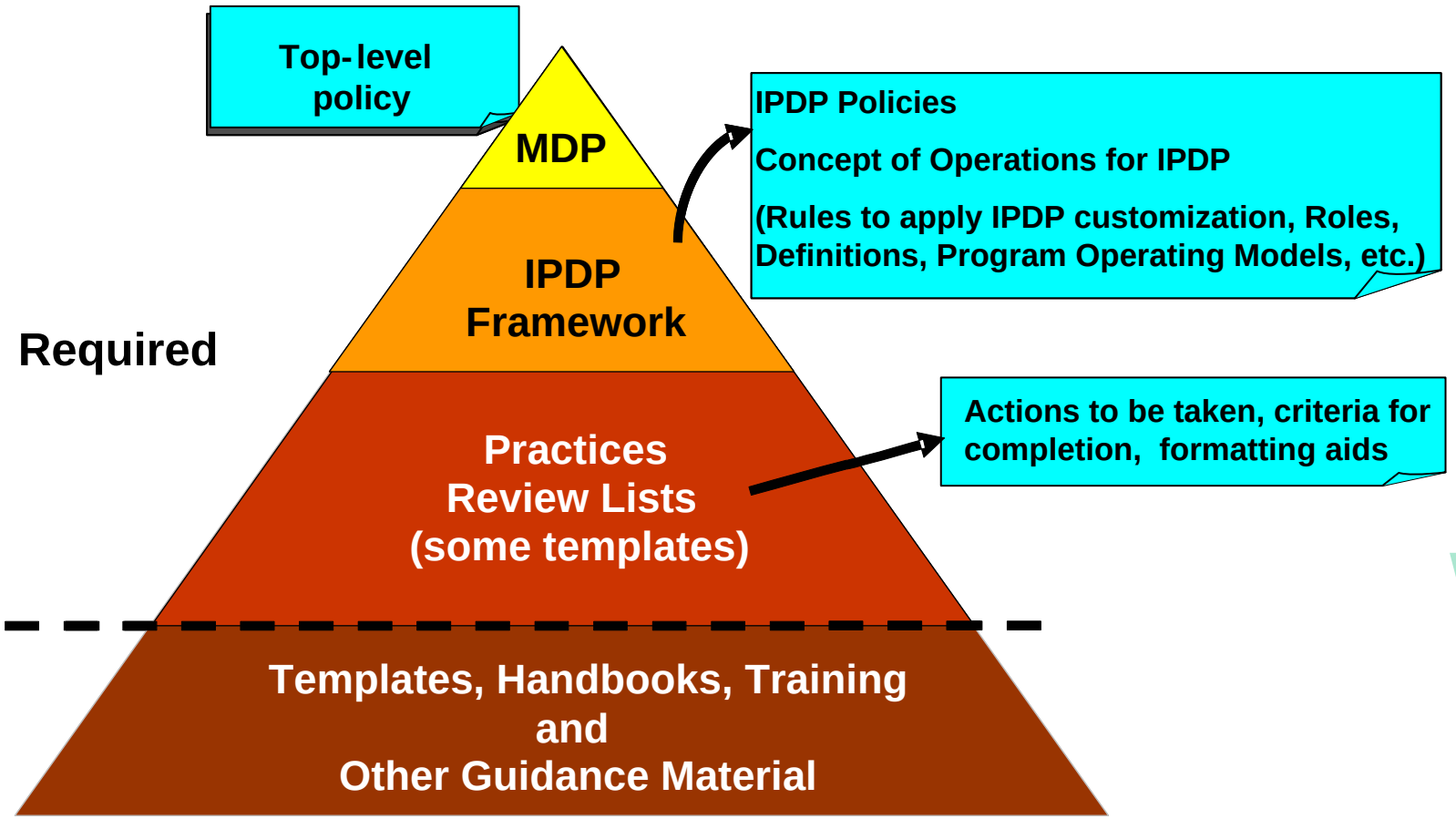
Practices, Review Lists and Templates Form the Process Building Blocks

Overall IPDP Architecture

BAE SYSTEMS

Overarching documents, such as

BAE Systems Policies & Life Cycle Management



Value of this Architecture

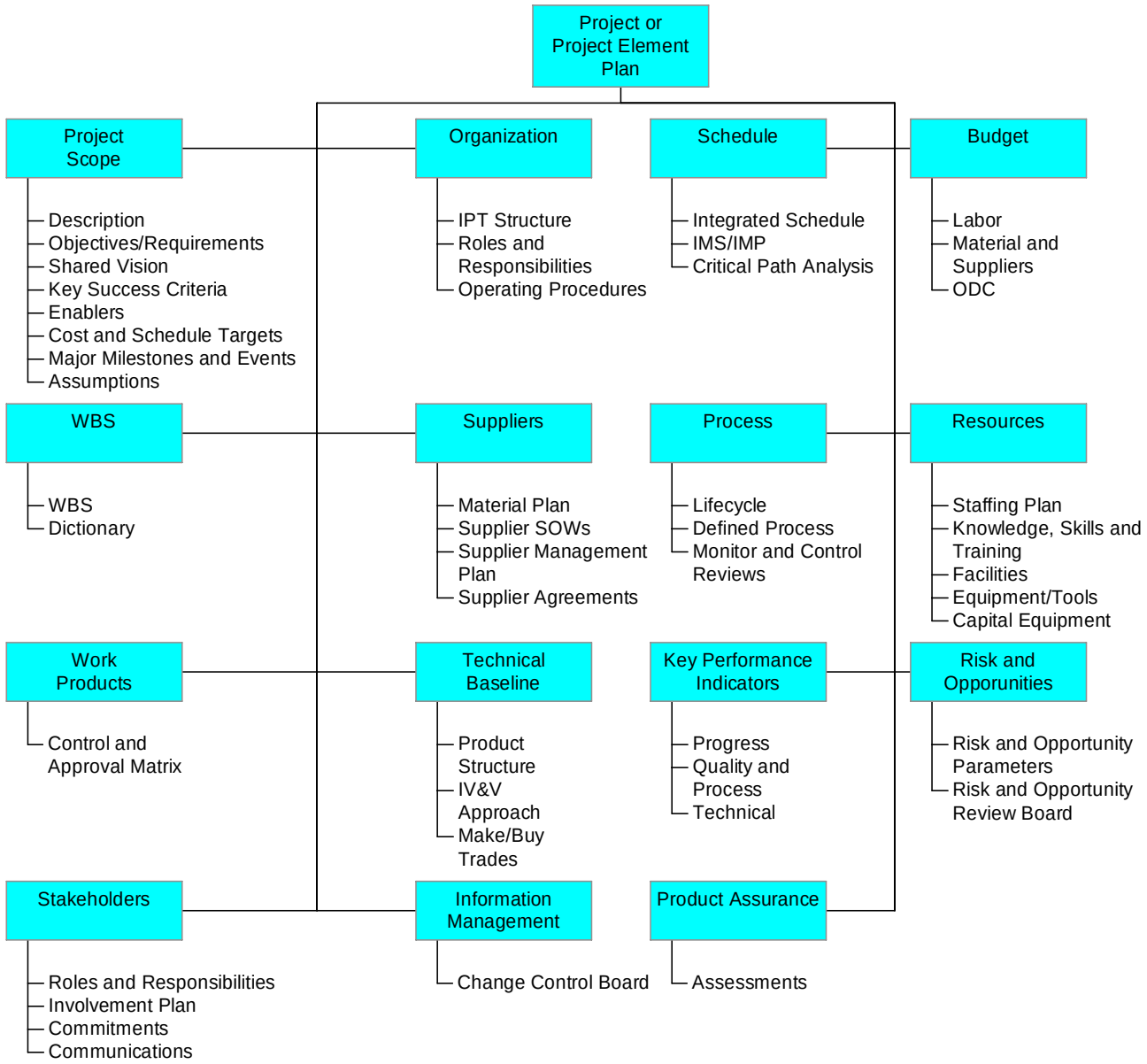
BAE SYSTEMS

- Practices are written at a high level
  - Common to all disciplines
  - Describe what has to be done
  - Describe how to the level of consistency and commonality needed
- Overall process is work product centered
  - Each work product has a review list
    - Describes the elements that must exist in a quality, compliant work product
  - Allows each discipline to have unique review lists to support their needs
    - Example:
      - Common Size Effort Review List
      - Size Effort Review List - Software
      - Size Effort Review List – Mechanical
      - Size Effort Review List – Electrical
      - etc…
  - Work products can be
    - Used to scale (tailor) the implemented process. For example:
      - A table style work product can define the frequency of meetings and events
      - A table style work product can define the level of stakeholder involvement
    - Shared and reused between different documents on the project
    - Used to keep larger documents living (up to date)

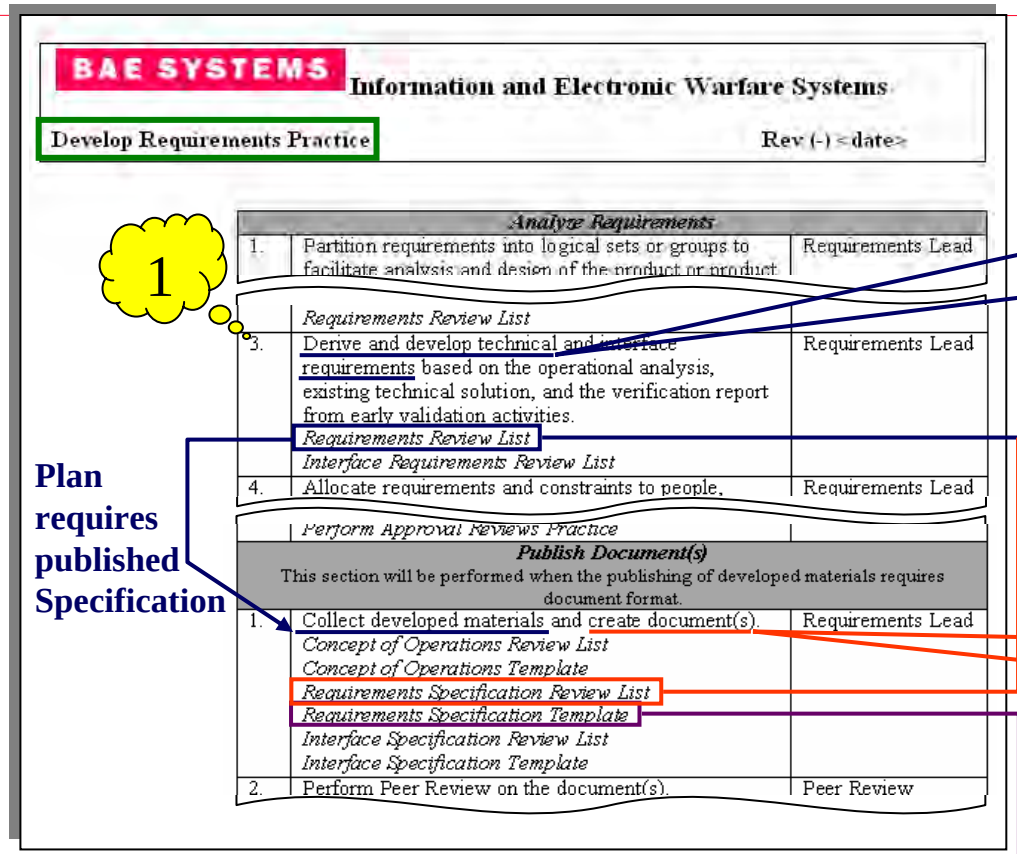
Examples of Planning Work Products

BAE SYSTEMS

- Templates and review lists ensure consistency and facilitate development of each planning element
- Review lists at each level of planning hierarchy define required elements and content



Examples of Practices, Review Lists and Templates



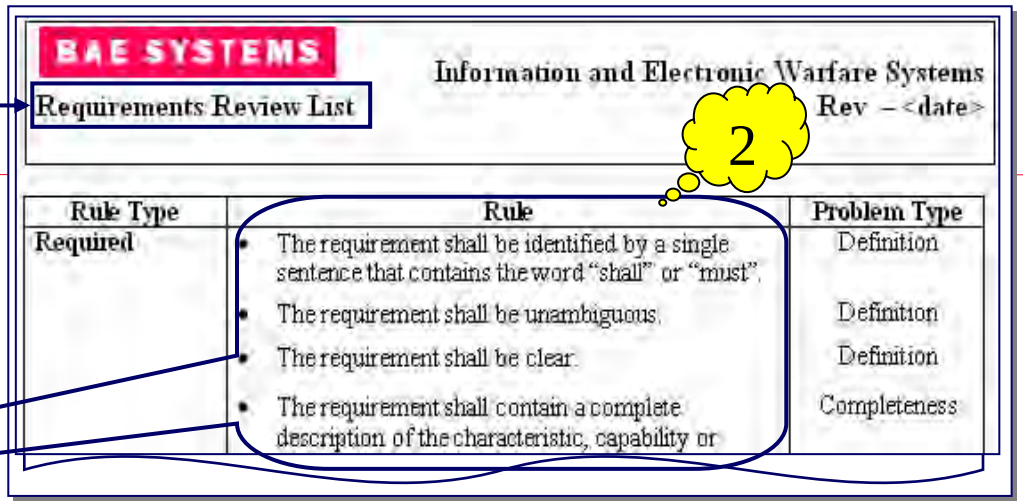
BAE SYSTEMS — Information and Electronic Warfare Systems

Develop Requirements Practice — Rev (-) <date>

	Analyze Requirements	
1.	Partition requirements into logical sets or groups to facilitate analysis and design of the product or product	Requirements Lead
	Requirements Review List	
3.	Derive and develop technical and interface requirements based on the operational analysis, existing technical solution, and the verification report from early validation activities.	Requirements Lead
	Requirements Review List	
	Interface Requirements Review List	
4.	Allocate requirements and constraints to people.	Requirements Lead
	Perform Approval Reviews Practice	
	Publish Document(s) This section will be performed when the publishing of developed materials requires document format.	
1.	Collect developed materials and create document(s).	Requirements Lead
	Concept of Operations Review List	
	Concept of Operations Template	
	Requirements Specification Review List	
	Requirements Specification Template	
	Interface Specification Review List	
	Interface Specification Template	
2.	Perform Peer Review on the document(s).	Peer Review

1

Plan requires published Specification

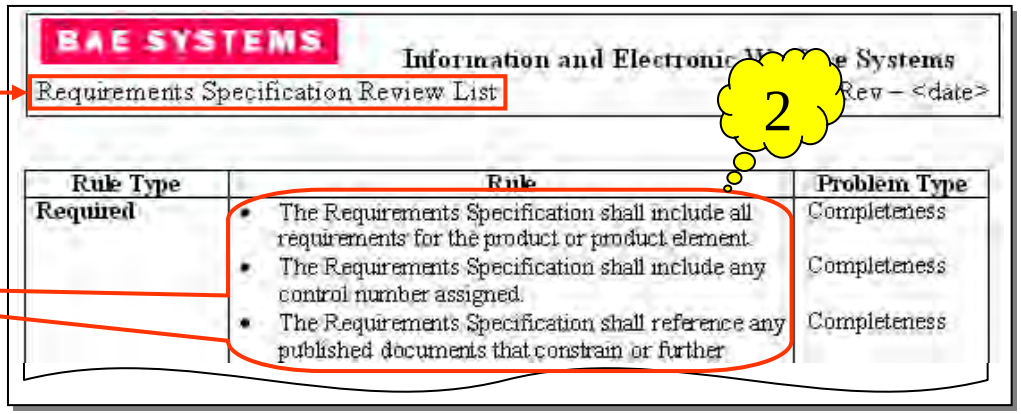


BAE SYSTEMS — Information and Electronic Warfare Systems

Requirements Review List — Rev – <date>

2

Rule Type	Rule	Problem Type
Required	• The requirement shall be identified by a single sentence that contains the word "shall" or "must".	Definition
	• The requirement shall be unambiguous.	Definition
	• The requirement shall be clear.	Definition
	• The requirement shall contain a complete description of the characteristic, capability or	Completeness

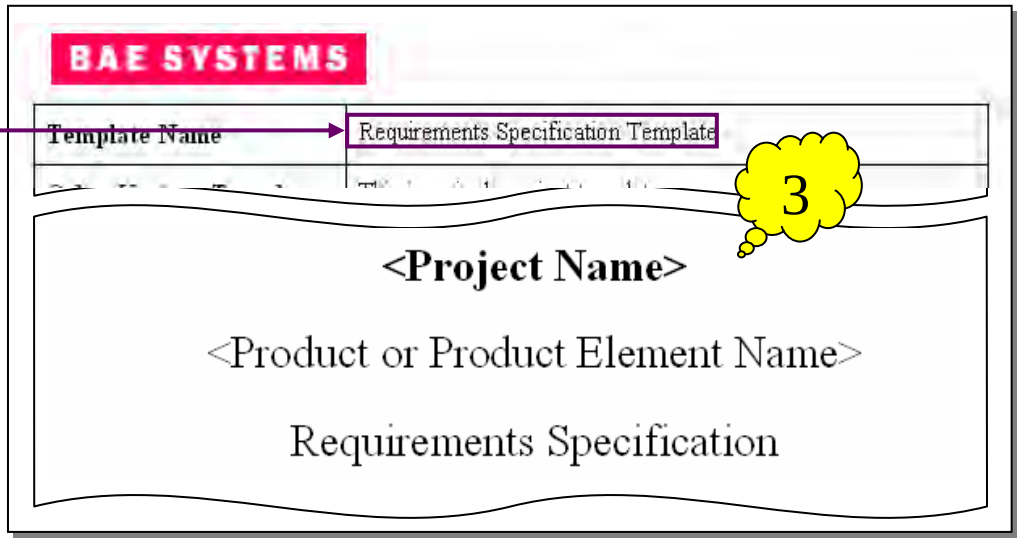


BAE SYSTEMS — Information and Electronic Warfare Systems

Requirements Specification Review List — Rev – <date>

2

Rule Type	Rule	Problem Type
Required	• The Requirements Specification shall include all requirements for the product or product element.	Completeness
	• The Requirements Specification shall include any control number assigned.	Completeness
	• The Requirements Specification shall reference any published documents that constrain or further	Completeness



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Template Name	Requirements Specification Template

3

<Project Name>

<Product or Product Element Name>

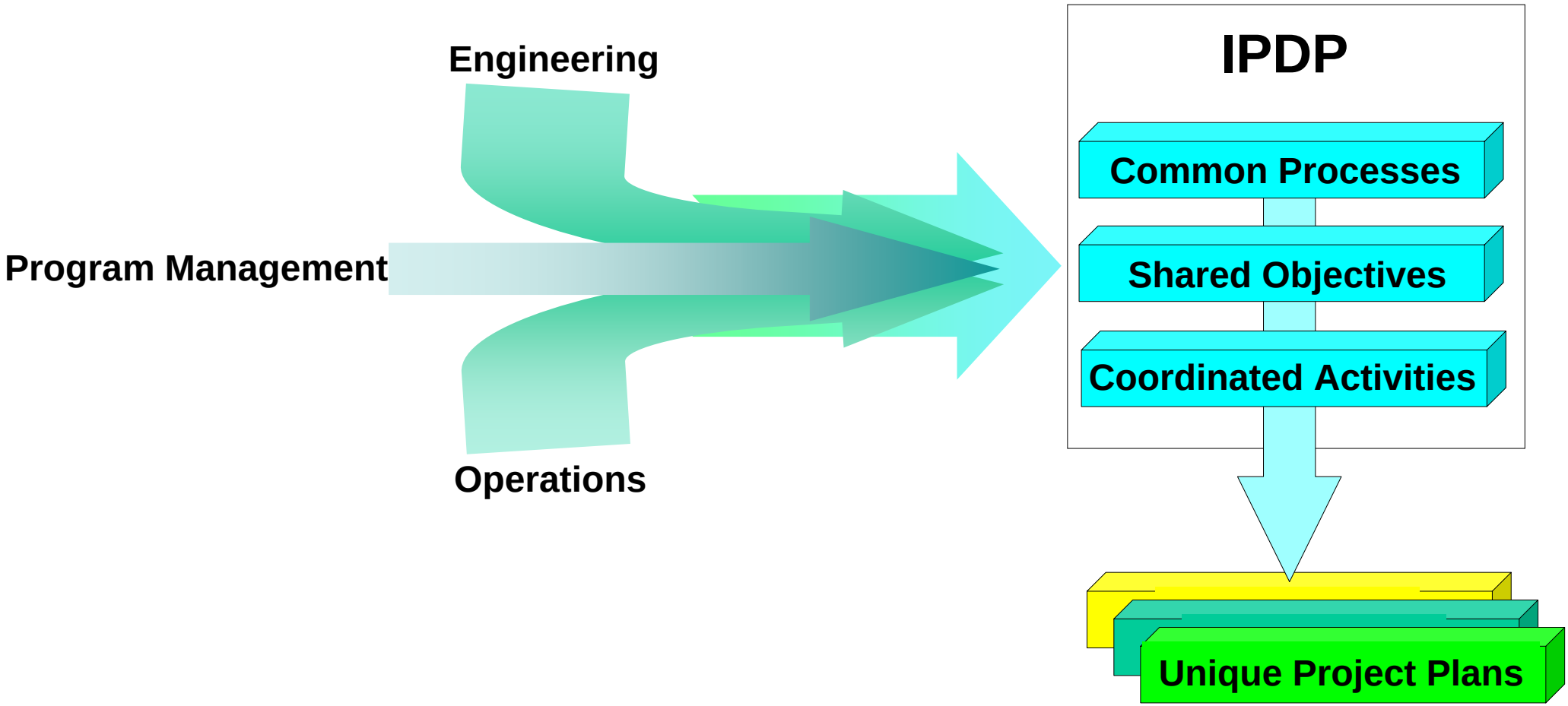
Requirements Specification

1. **Practice lays out the steps**
2. **Review List provides the rules and are specific to a work product**
3. **Template aids in formatting**

Integrated Product Development Process

A Single Integrated Process

BAE SYSTEMS



Integrates the Major Functions on Development Projects

IPDP is:

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- A full implementation of the CMMI SE/SW/IPPD/SS v1.1 model
  - Includes practices through Level 5
- Adds definition and implementation to Lifecycle Management framework
- Incorporates best practices from
  - Other BAE Systems business units
  - Industry sources
  - Program Management Institute Body of Knowledge (PMBOK)
- Addresses identified project performance issues
- Supports different project types and customer communities
- A fully integrated process definition
  - One approach used at multiple levels for
    - Management – planning and monitor & control
    - Requirements, Design, Integration and Test
- The process was appraised using a Class B appraisal in October ’04 up to and including Level 4
  - Project corrective actions from that appraisal were closed by February ’05
  - Organization corrective actions were closed by December ’05
- CMMI SE/SW model used for successful Class A appraisal at Level 3 in April ’05
  - Process included IPPD aspects but process areas and goals were not assessed

Pre-IPDP Discipline Practices by Process Areas

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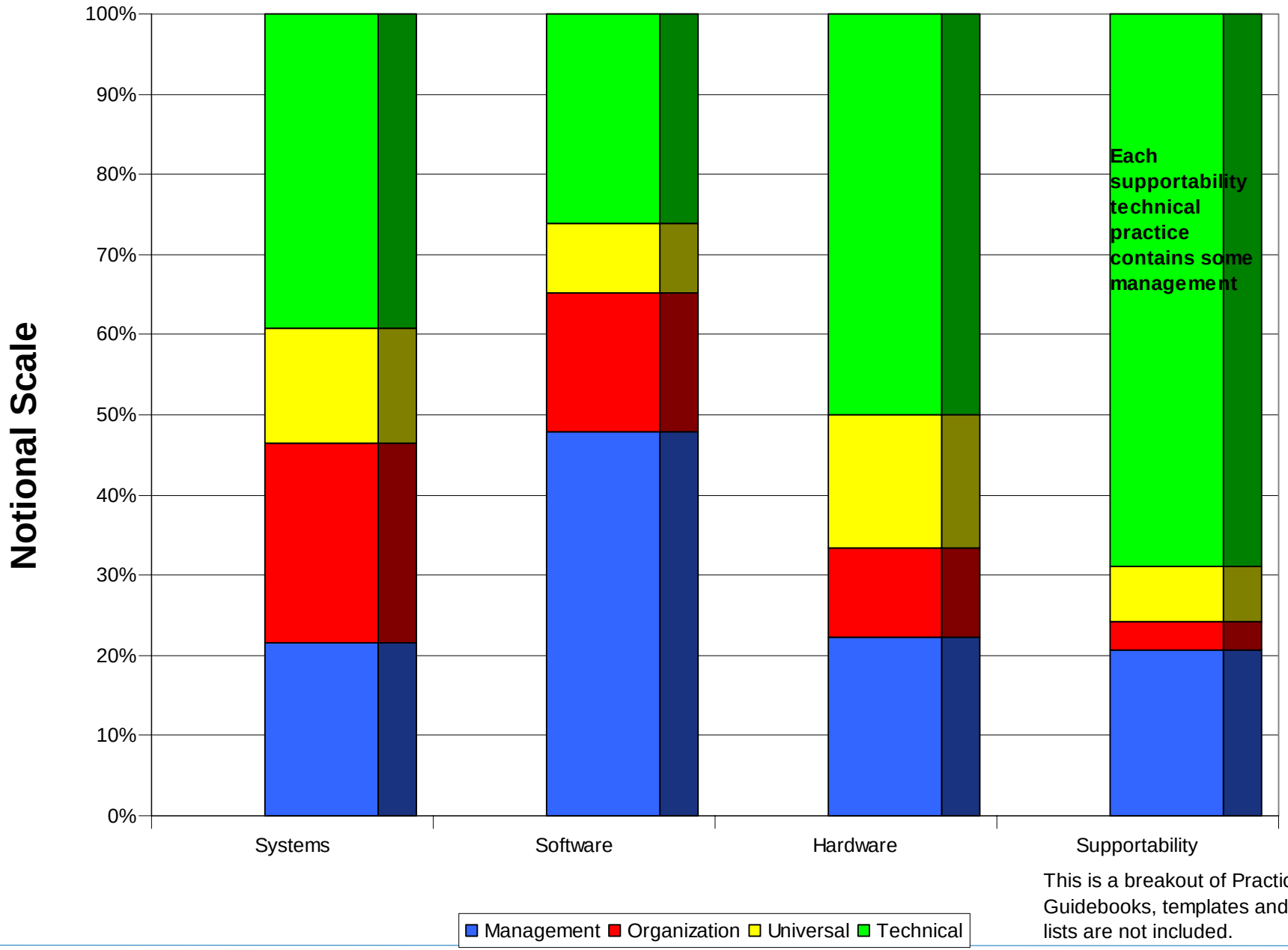

This is a breakout of Practices only. Guidebooks, templates and review lists are not included.

IPDP Notional Breakout of Technical Processes

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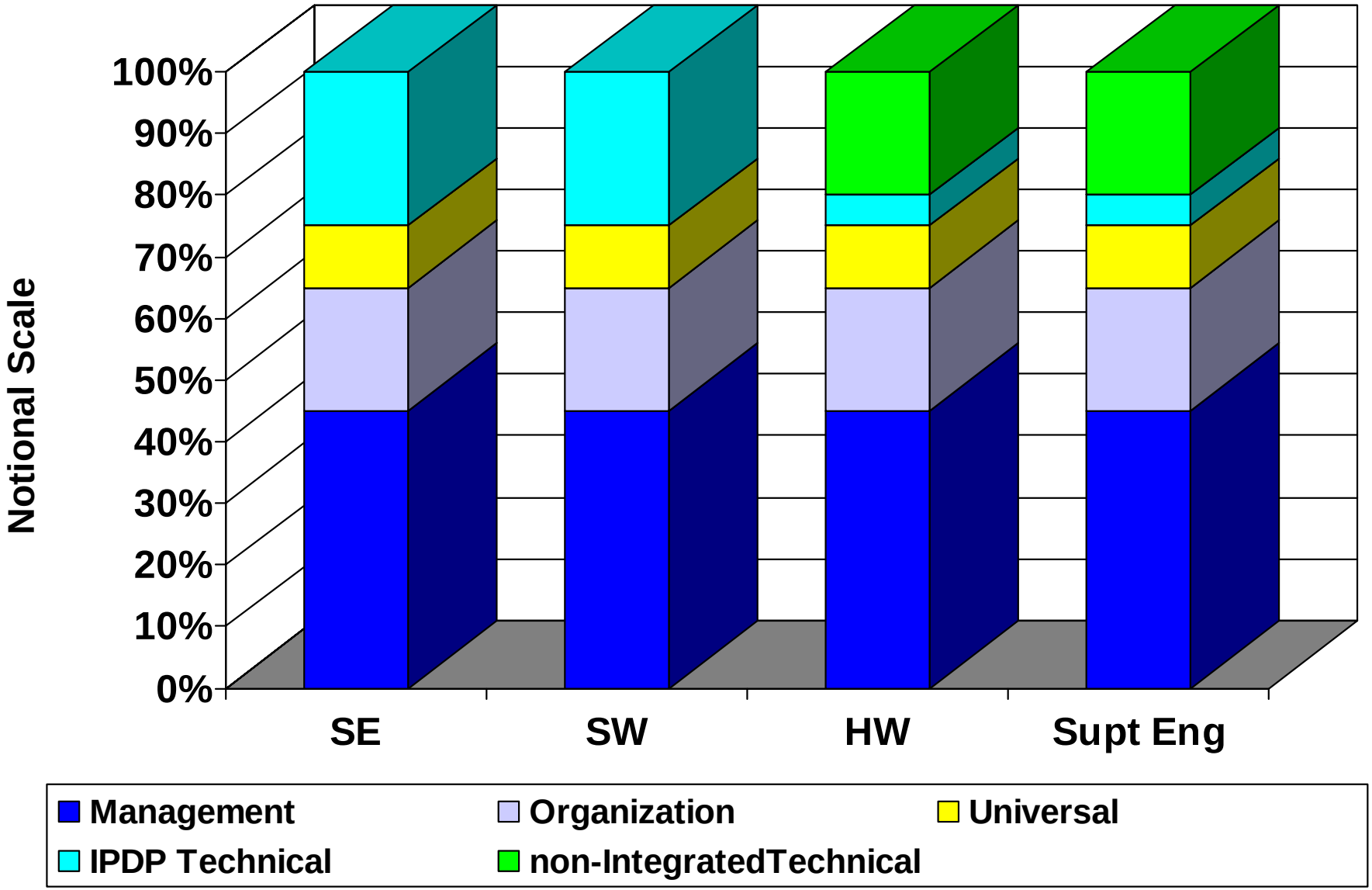

Conclusions

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- We created an **Integrated** process that is
  - Easy to maintain
  - Supports multiple project types and customer communities
  - Has been successfully deployed
- A highly extensible, well documented process architecture
  - Allows new processes to be added in a simple easy way
  - Resists changes that create a Plate of Spaghetti process
- A comprehensive process requirements database
  - Documents how each process requirement is implemented
  - Makes it easy to understand the impact of any purposed change to the process
  - Makes it easy to understand the impact of any change to the requirements
- Lessons learned
  - Heavy stakeholder involvement is needed early and often in the process development activity
  - Maintaining buy-in by the disciplines without all the attributes of ownership is difficult
  - All requirements need to be captured, not just unique requirements

Final Thoughts

BAE SYSTEMS

- **Questions**
- **Comments**

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Staying Atop Mt CMMI

Thomas Lienhard
Raytheon Missile Systems

Timothy Davis
Retired – Raytheon Missile Systems

Raytheon

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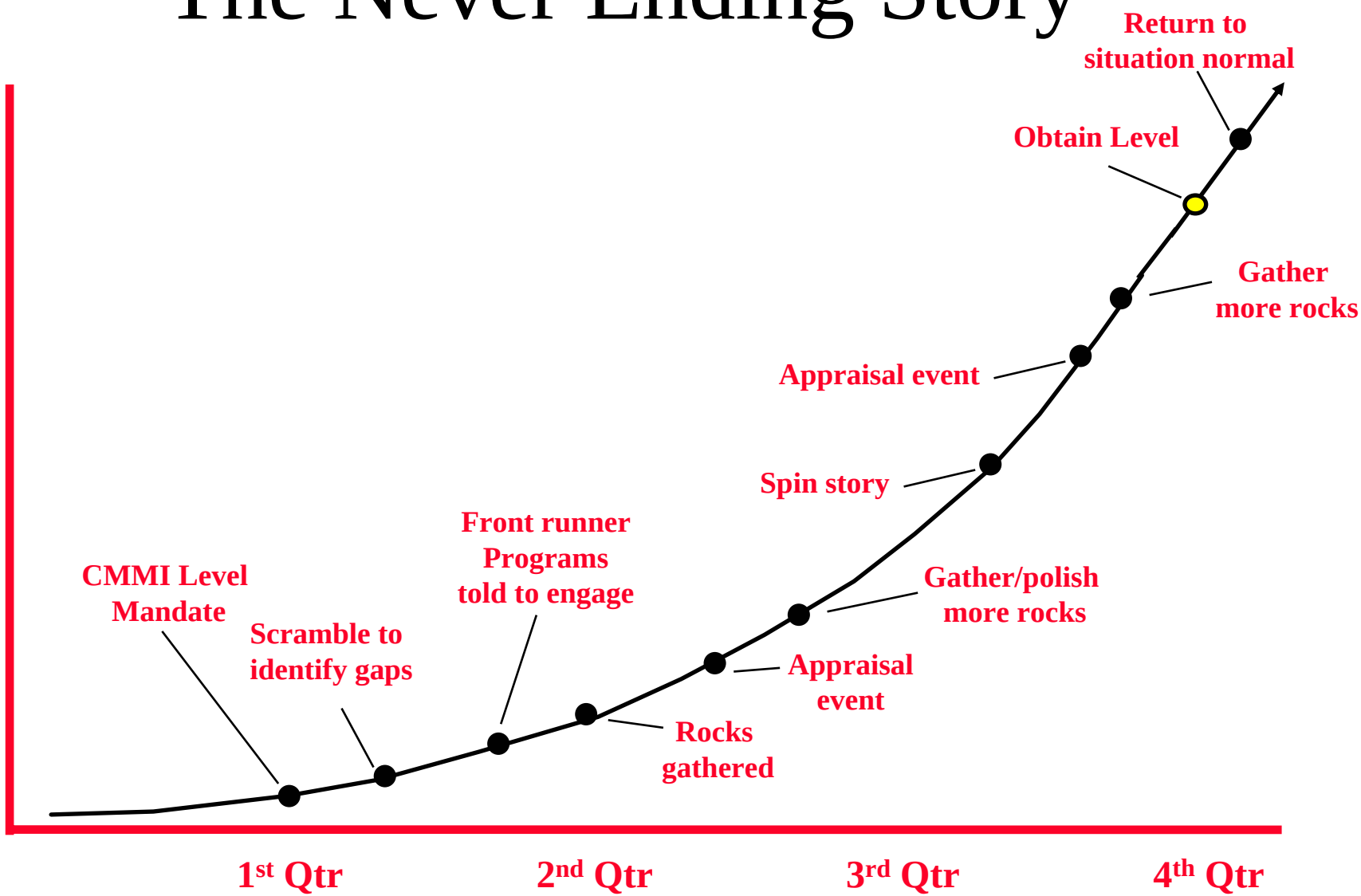
The Never Ending Story



Common story seen over and over again

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Breaking the Cycle

- This has been played out over and over
- Some organizations who have been through this before, do put things in place as not to back-slide
  - Reward the programs and people
  - Capital Investments
  - Establish new goal
- But most still back slide, Why?

Sustaining Foundational Pillars

- Sustaining High maturity is dependent on how solid is the lower foundation
  - Management Commitment and Support
  - Resources
  - Program Buy-in
  - People
  - Process
  - Organizational Objectives/Goals
  - Infrastructure

Is Yours a House Built on Sand or Bedrock?

Spreading the Support Across Pillars

- Success starts with Management Support and Resources
- As the other pillars are established, take hold, and become part of the culture, they become less critical

If the infrastructure is sound, sustainment is possible

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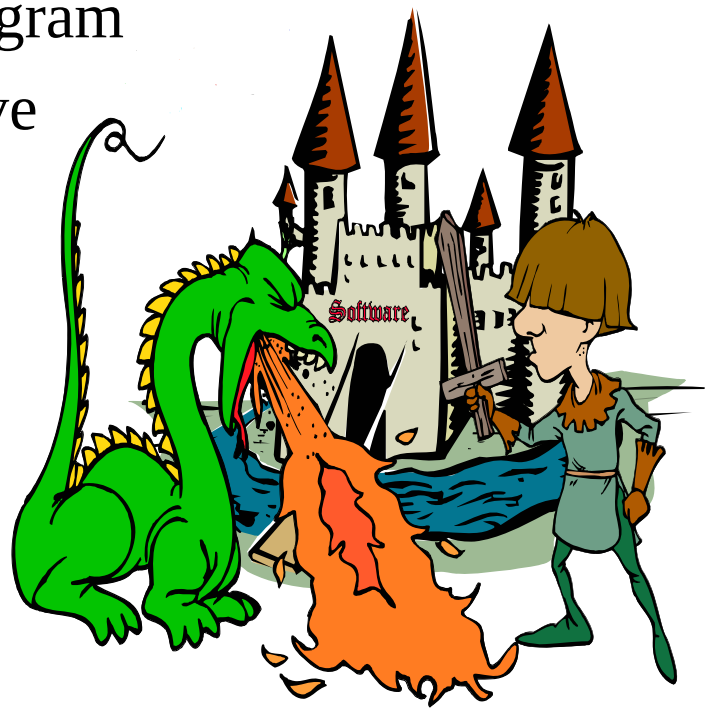
Foundation Attackers

- High Maturity is not a perpetual machine. It takes effort to sustain the gains or the foundation will eroded and the structure will collapse
  - Lack of continued sponsorship
    - Organizational changes
    - Got the Level - attention is elsewhere (acquisitions, crisis of the day)
  - Competition for Resources
    - Funding directed to other initiatives
  - Program's were never bought in, it was a mandate
    - Program schedule more important than process improvement promises
  - No career path for people, process not seen as important
    - Staff turn over - Shift in personnel and teams' makeup
  - Process is too cumbersome, one size fits all, no proven ROI
    - Process for process sake
  - The Number was the Goal
    - Deploy narrow and high not wide
  - Lack of accountability

Complacency and Atrophy Take Over

How to Mitigate the Attackers

- Be aware they exist
- Understand the journey, not destination
- Plan and allocate for future years
- Get the pillars built, deployed, and improve
- Treat Process Improvement like a program
- Plan, Monitor, Verify, Report, Improve
  - Resources, training, stakeholders, risks



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Proven Insurance

- Must begin with a strong foundation
- Management must be committed, active, INVOLVED sponsor providing adequate resources
- Must be a career path to attract and retain people with right skills
  - Availability is not a skill
- The number cannot be the goal
- Can't rest on your laurels – an organization is always moving – it may be forward or back
- Process that works for the particular business and objectives
  - Not one that was "bought"
  - Must show benefit or ROI
  - Process for process sake
- Programs understand why they would want to do this
  - Not just - your bonus depends on it
  - Balance short term schedule success with long term improvement promises
- Make sure there is a goal of maintaining current maturity
  - Goal posts mark the end zone, Without them in sight we may not realize we are getting farther away instead of closer.
  - On-going periodic reviews and surveillance audits
- Establish and maintain dedicated teams (measurement, EPG, Quality Improvement)

Use the Infrastructure to Fight Off Attackers

Observations That Appear to Work

- Use an evolutionary approach providing pre-planned increments of capability
- Upgrade the related support infrastructure
- Continue involvement in external activities which are shaping CMMI
- Mature existing processes instead of creating new processes
- Allow programs to mature as well as the organization
  - Programs include what is important to them
  - Programs allowed to innovate and the organization replicates
- Cover the entire lifecycle: Concept, Development, I&T, Manufacturing, Product Shelf Life

Must Add Value to Programs, i.e., The Business

Top 10 Excuses NOT to Sustain High Maturity

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1. I'm too busy, it's chaotic around here.
2. We've got it under control.
3. I'll lose my creativity.
4. We'll just buy a tool!
5. We'll work smarter.
6. Not important to my boss.
7. My organization is different.
8. We're going to reorganize.
9. We have too much "real" work to do.
10. We don't do process.

Problems Encountered

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- **Some levels of management were uncomfortable with the true capability**
- **Aggregating on-going programs with completed programs**
- **Rationale Subgroup assumptions were incorrect**
- **Treating all measures as normally distributed**
- **Statistically controlling an indicator (SPI, CPI) rather than a subprocess (design defect removal rate)**
- **“Process Dodgers”**
- **Statistical “Purists”**

Process Physics – Some Things Just Take Time

CASTAWAYS
CASTAWAYS

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Questions

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Missile Systems

Motivating the Team to Continuously Improve after the CMMI Rating

Raytheon Missile Systems
Lety Santillan and Bill Borkowski

November 16, 2006

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How Do You Start Motivating??

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It is Critical that You Create a Supportive Environment

How do you Create an Atmosphere that Supports Improvement?

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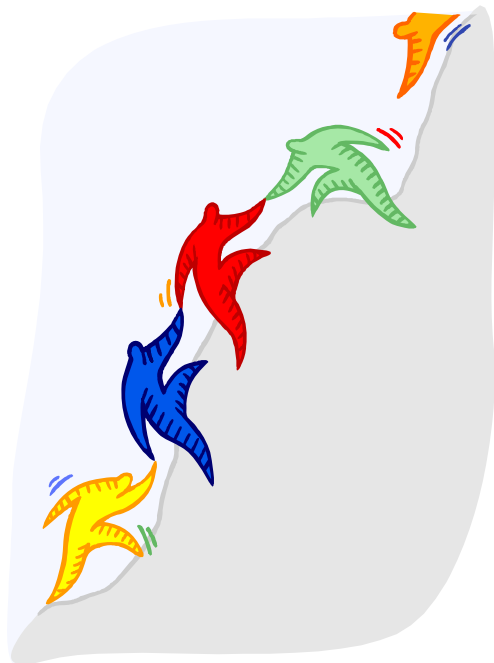
- Focused vision and goal
- People aligned to common goal
- Voice to the “Top Decision Makers”
- Co-Location
- Open communication
- Open environment where critical issues can be discussed
- No fear
- Okay to fail
- Okay to be a unique individual
- Have fun!!



Environment, Communication, and Focus are Key

Our Success Story

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Missile Systems

- Our team worked hard to achieve CMMI® goal
- Strong leadership commitment
- Lots of communication
- Daily meetings
- Supportive environment
- We had a lot of fun

When You are Working as a Team Anything is Possible!

Our Moment of Courage: We lost our way

- Leadership changes happened at the top level
- Management moved on to new positions
- Many team members went on to new programs
- There was a new process of the day but our organization was not in charge of it.
- No goal in site
- No focus
- Little direction or vision

How Do You Find Your Way Once You Lose It?

How do you get it back?

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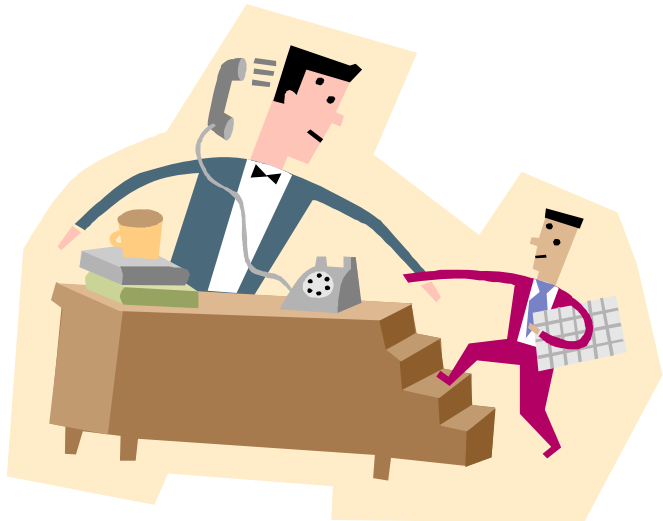
- Used 6 Hats by Edward De Bono
- Had Fun
- Leveraged our past improvement towards new initiatives
- New Communication Plan
- Leadership was invigorated
- Common Agenda was to improve our product and processes
- New focus
- Communications



Creating New Process for Every New Initiative Costs Too Much

Our Success Stories

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Missile Systems

- Program was a frontrunner for our process improvement activities.
- Once the goal was achieved program manager continued strong communication.
- Common focus on producing best product.
- Accountability was factor.
- Leveraged existing process as new initiatives/requirements were given.
- Customer like the approach and awarded more work (new Contract).

When We Leverage Off What Already Exists We Do It Better

Tips for Maintaining or Regaining Momentum

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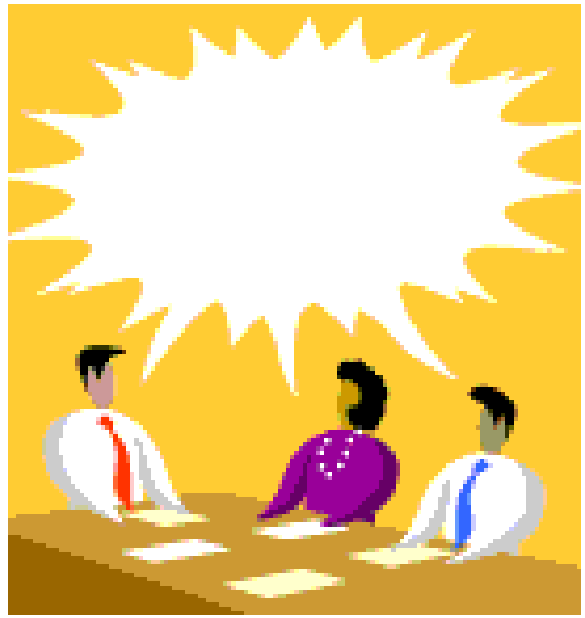
- Communication
- Enterprise wide vision and voice
- Leveraging of existing process and infrastructure
- Strong communication plan and execution
- Accountability at all levels to ensure successful deployment



It is Easier to Maintain or Salvage than to Start from Scratch

Questions ?

Thank you for your participation

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Enterprise Level of Process Improvement

National Defense Industrial Association
6th Annual CMMI® Technology Conference and User Group
November 13-16, 2006

Author's Name(s): Linda A. Kovar
Nancy M. Raymond

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Introduction

- This presentation explains the Space and Airborne Systems (SAS) Opportunity Improvement Board (OIB) and its process for
  - Collecting process improvement proposals
  - Identifying innovations for the organization that will help its quality and process performance
  - Prioritizing and analyzing the proposals with respect to the organization's objectives
  - Selecting proposals for further consideration
  - Determining the cost and return on investment of the proposal
  - Piloting the implemented proposals to select which ones to deploy to the organization
  - Deploying improvements that provide positive impact to the organization's objectives
  - Measuring the effects of the deployed improvements

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Benefits of Enterprise Level Improvements

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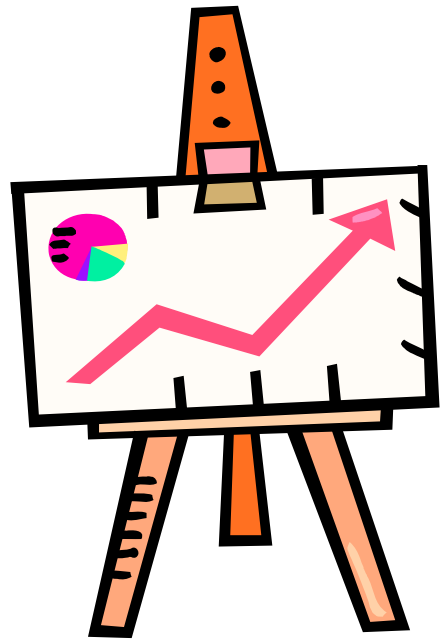
- The desire to help programs and the organization be successful drives organization improvement
- Improvements are implemented to
  - Help programs meet their quality and process-performance objectives
  - Improve the organization's performance on current and future programs
- A CMMI level 5 organization's focus is:
  - "… on continually improving the range of process performance through both incremental and innovative improvements." (Chrissis, p. 77)



Help programs succeed with improvements that are aligned with the organization's goals and objectives.

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Identifying Improvement Opportunities

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- Anyone in the organization can identify an enterprise improvement opportunity through
  - Process change requests
  - Data analysis (program level and organization level)
  - Symposiums and conferences (internal and external)
  - Lessons learned (programs and organization)
  - Other feedback to the organization
- Feedback is collected and tracked on-line as part of the SAS Enterprise Management System (EMS)

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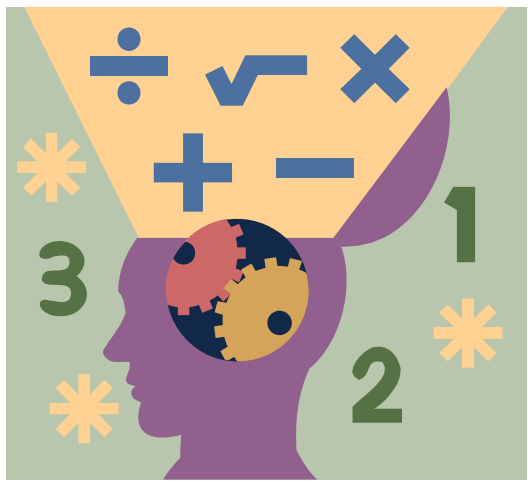
Prioritizing and Ranking

- The enterprise established an Opportunity Improvement Board (OIB) to prioritize and rank the submitted improvement opportunities with relationship to
  - The organization's goals and objections
  - The statistical understanding of the organization's current process capability
  - The estimated cost-to-benefit ratio



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Stakeholder Involvement

- The Opportunity Improvement Board (OIB) membership includes key personnel from the Enterprise Process Group
  - EPG Lead is the Chair
  - All disciplines represented
  - All sites represented

- The OIB recommendations are reviewed and approved by the Integrated Process Steering Team (IPST) whose membership includes senior representation from
  - All engineering centers
  - Program management
  - Supply Chain Management
  - Quality
  - The EPG

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High Level Opportunity Improvement Flow

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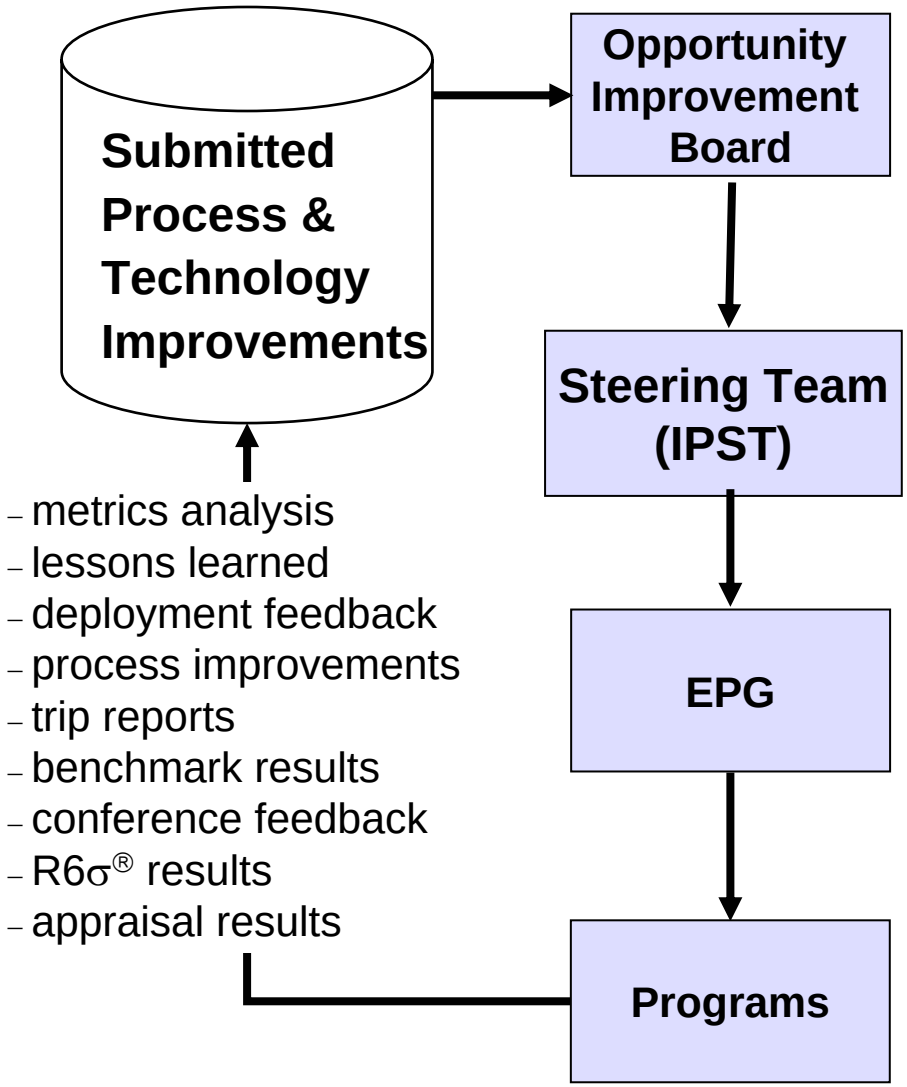

Prioritizes and ranks

Reviews and Approves

Executes Improvement

- **Define**
- **Pilot**
- **Measure**
- **Deploy**

R6σ® Raytheon Six Sigma

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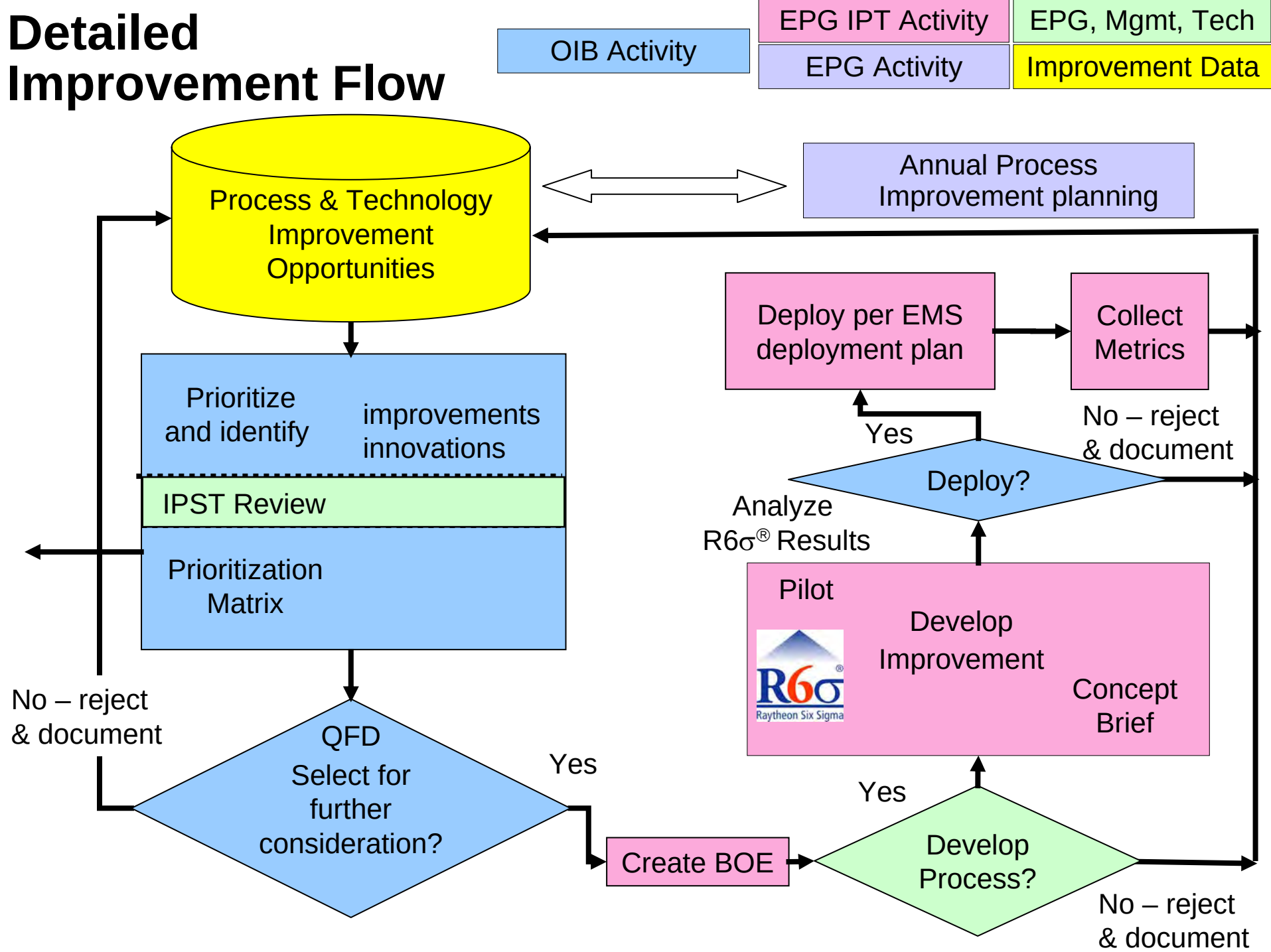
Detailed Improvement Flow



Prioritization Details

OIB Activity | EPG IPT Activity | EPG, Mgmt, Tech | EPG Activity | Improvement Data

Prioritize and identify improvements innovations

Analyze cost & benefit of Proposals

No – reject & document

cost: benefit ratio sufficient ?

Yes

Improves Org's Processes?

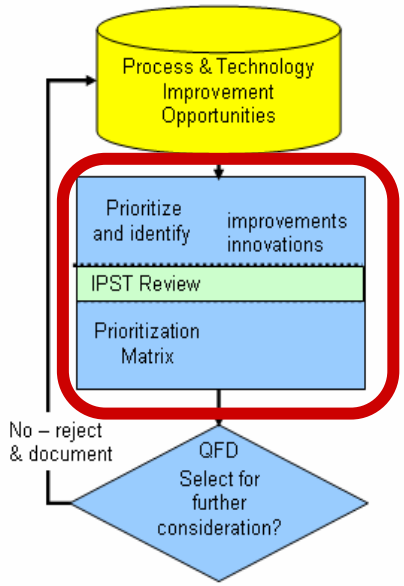
Yes

IPST review

Prioritization Matrix

Yes

QFD



Improvements are prioritized based on weighted criteria

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Supports Business Strategy (Goals/Metrics)
Scope of Improvement (Expected percentage of programs helped)
Urgency
Objective Data to Substantiate Need for Change
Probability of Successful Implementation
Proposal is Supported (by organization metrics)
Expected Return on Investment (ROI)

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Priority improvements are mapped to Goals (QFD)

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WHAT vs. HOW

Value	Symbol	Strength of Relationship
9	H	High
3	M	Medium
1	L	Low

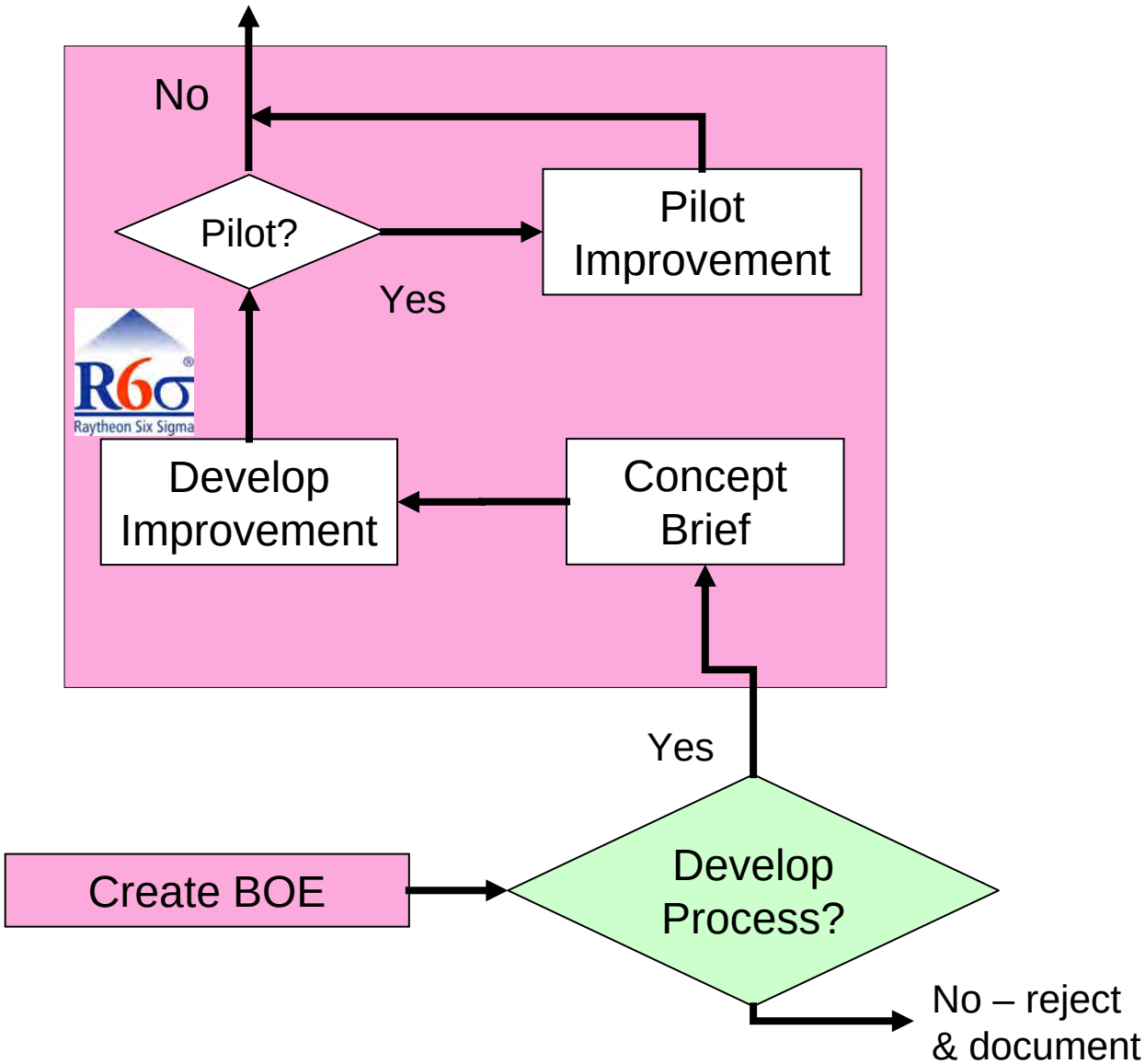
Title: SAS EPG OIB 2005 Selection
Project:
Name:
Date: 5/05/05

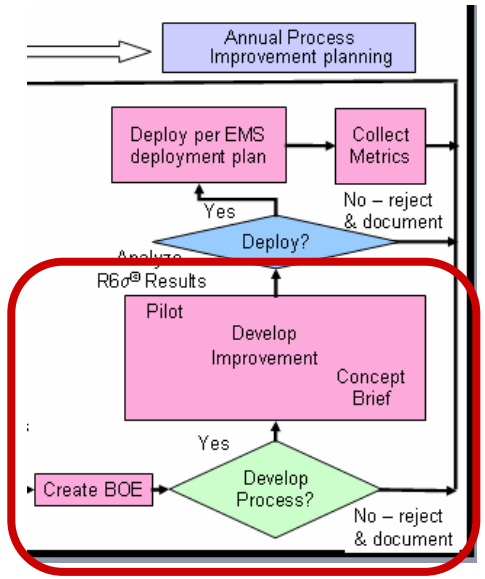
Hows

			Importance	1 Test Verticality Methodology	2 High Reliability & Space Program Processes	3 Develop ARD Template	4 Cleanroom Process	5 Appraisal Tool	6 ME EMS Process	7 PMP Engineering Merge	8	9	10	11	12
Whats	1	CMMI Level 5 Subprocesses	5	H		H	H								
	2	Stabilize Level 3	4	H	H	H			H	H					
	3	CMMI Level 3 in HW	3	H	H	H			L	L					
	4	One SAS	2						H	H					
	5	IPDS Alignment	1						L						
	6	Maintain ISO Compliancy	5												
	7		0												
	8	**Other**	0												
Technical Planning	**Technical Weights**	**Absolute**		108	63	108	45	0	58	57	0	0	0	0	0
		Relative		25%	14%	25%	10%	0%	13%	13%	0%	0%	0%	0%	0%
		Importance		5	3	5	3	0	3	3	0	0	0	0	0
	Technical Targets	**Value**													
		Unit													
		Direction													
	Competitor Benchmark	1													
		2													
		3													
	Select Hows to Flow Down to Next Level			keep	keep	keep	keep	discard	keep	keep	discard	discard	discard	discard	discard

Implementation Details

OIB Activity | EPG IPT Activity | EPG, Mgmt, Tech | EPG Activity | Improvement Data





BOEs include:
- Barriers/Risks
- Cost
- Schedule
- Expected ROI

Concept Brief

- The Concept Brief describes the proposed implementation including:
  - The benefits to the programs and organization
  - The impact to the practitioners
  - The transition and deployment plans
  - Implementation details
  - Schedule
  - Resources

- Concept briefs are reviewed with the stakeholders prior to implementing the improvement

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EPG Oversight

- The Enterprise Process Group (EPG)
  - Implements the selected improvement projects
  - Monitors the status of the improvement projects
  - Manages the deployment of the implemented improvement projects that are chosen for full scale deployment
  - Measures the impact of process improvements on the organization's capability
  - Manages the OIB process throughout the year
  - Reviews opportunity improvement suggestions as part of its annual planning

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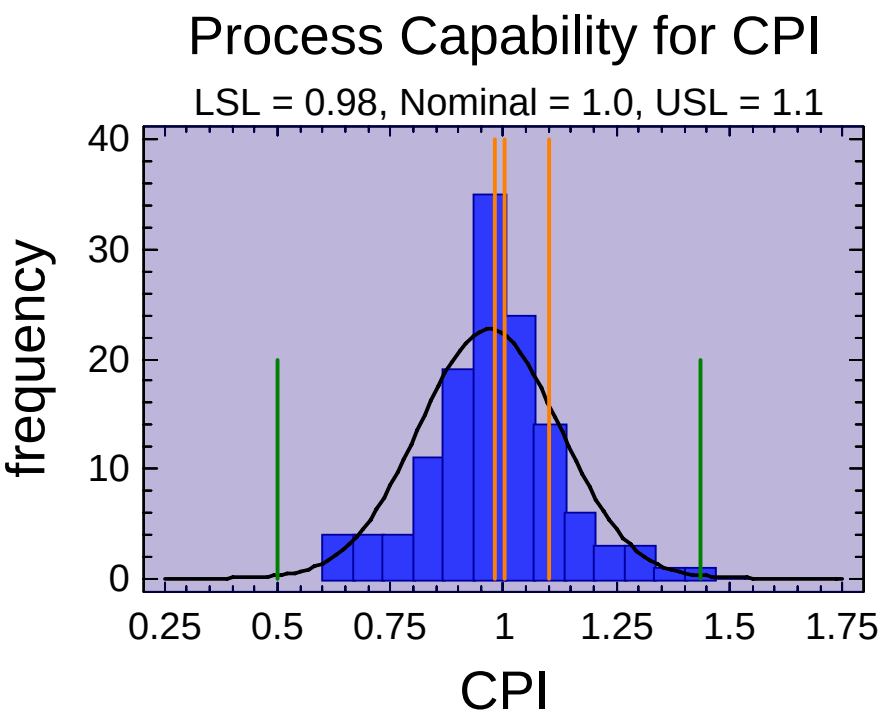
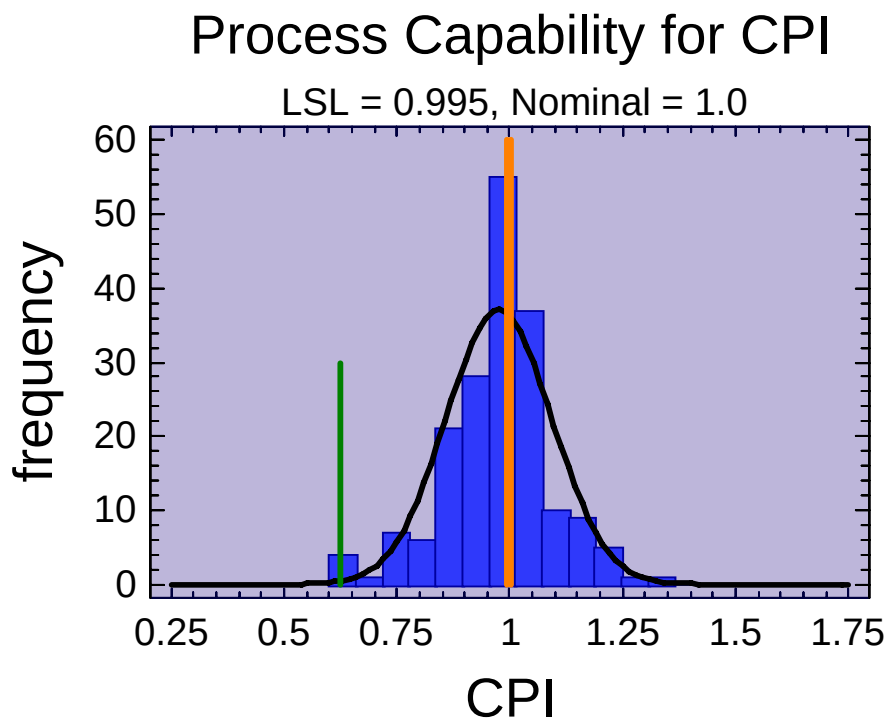
Measurement

- Improvements are measured collectively
- The organization's process capability is measured and analyzed quarterly to understand the impact of the collective improvements

Expected Range of Values **February 2005**	0.50 to 1.44 $\overline{X}$ = 0.97, s = 0.16 n = 133, C_{pk} = -0.02

Expected Range of Values **December 2005**	0.62 to 1.33 $\overline{X}$ = 0.98 s = 0.12 n = 185 C_{pk} = -0.05





Process Improvement shown in Program Cost and Schedule Performance

Nov 2004 - Mar 2005

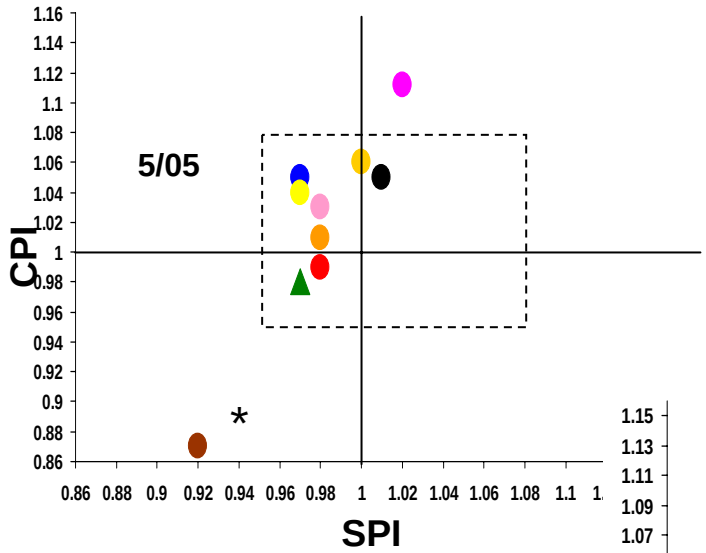
- Supply Based Optimization
- Objective Evaluations
- Program Planning
- EMS Process Tailoring
- Peer Review
- Defect Logger
- Integrated Mgmt Review
- Work Product Mgmt
- Technical Solution Data
- Statistical Process Control
- Process Assets Library
- HW Development Planning
- Managing with Metrics

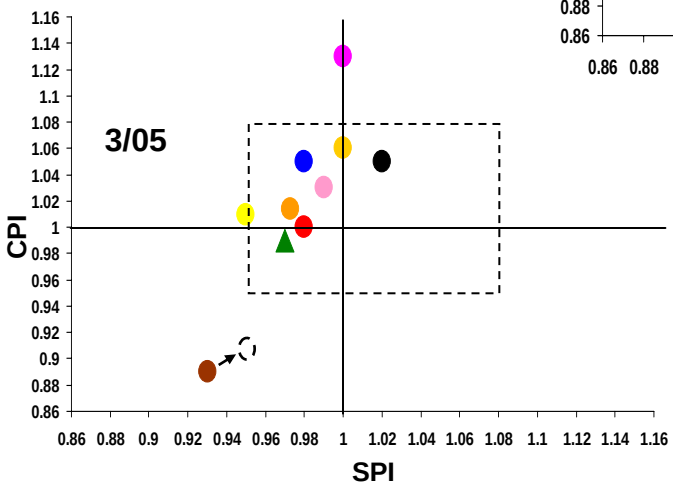
Mar 2005 - May 2005

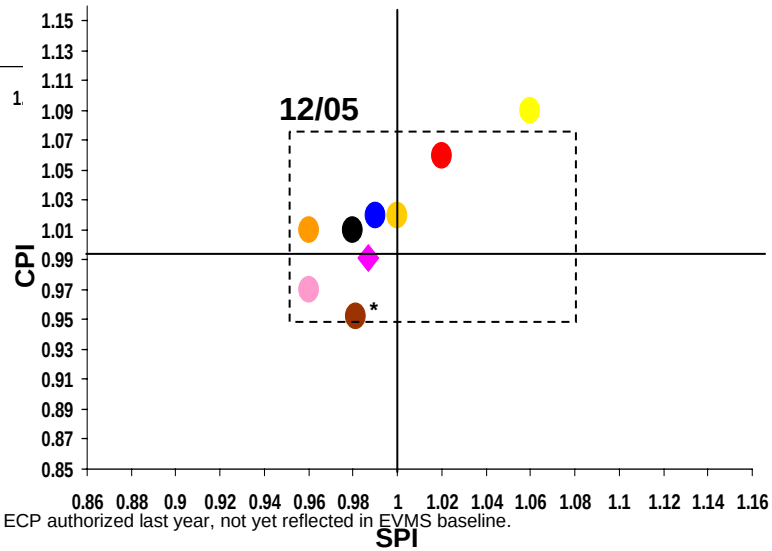
- Structured Decision Making
- Lessons Learned
- Risk and Opportunity Management
- SW Integration & Test
- FRACAS

May 2005 - Dec 2005

- Interface Management Process
- Qualification by Similarity
- Update Gap Tailoring Tool
- Cost Collection
- FRACAS
- PLE
- RMS
- Mechanical Engineering
- High Reliability
- Systems Safety – Phase I
- COTS
- Updated Lessons Learned Database







*Major ECP authorized last year, not yet reflected in EVMS baseline.

Summary

- The SAS organization improvement process
  - Designed to help the programs succeed
  - Supports the Organization's goals and objectives
  - Involves appropriate stakeholders
  - Results in improvement to the organization's process capability

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Questions

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Biography

- Linda Kovar is a Senior Manager of Programs at Raytheon Space and Airborne Systems in El Segundo, California. She is the Enterprise Process Group (EPG) lead for their process improvement activities. In August 2005, she successfully led the activities in achieving a combined Systems, Software and Hardware CMMI Level 3 for the business unit which encompasses 7000 engineers in several states. She is currently leading the Enterprise Process Integration activities to focus on a CMMI Level 5 maturity across all of SAS Engineering. Linda has 25 years with Raytheon where she has held positions in Program Management, Functional Management, Technical Staff, Test Program development and software engineering. She is a certified Raytheon Six Sigma expert, has a BS degree in Computer Engineering from the University of California Los Angeles and is a graduate of the Anderson School of Executive Management.

- Nancy Raymond is the Deployment Support Cross Product Team Lead in the Space and Airborne Systems Enterprise Process Group. Nancy has been with the company for 28 years. For most of her time at Raytheon, Nancy has been a software and process engineer on programs and within the organization. Nancy's specialties include software planning, estimation, and metrics. Nancy has been involved with the development and deployment of CMM/CMMI compliant processes for more than 10 years. Nancy has a Masters Degree in Mathematics from Carnegie-Mellon University.

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platinum
REGISTRATION

CMMI and ISO 9001

A Registrar's Perspective

Objectives

- Explore Fundamental Differences
- How Differences Influence Operations
- Choosing a Criteria, Defending the Choice

Why Bother Thinking About It?

- More customers are forcing standards on suppliers
- Those customers don’t live with the results of those decisions
- Understanding the differences can help defend choices to customers (and maybe influence them)

Differences are Fundamental

- CMMI - Developed by Systems / Software / Defense Professionals
- ISO 9001 – Developed by International Organization for Standardization

Dissimilar Scope and Focus

- CMMI - Systems Engineering, Software Engineering, Integrated Product and Process Development, and Supplier Sourcing
- ISO 9001 - Generic
- CMMI - “Improving Processes for Better Products”
- ISO 9001 - “Quality management systems – Requirements”

Requirements

- CMMI - Generic and specific practices, with discipline amplifications
- ISO 9001 - Requirements only. Same for all companies, industries, disciplines

Assessment Results

- CMMI – Determines Maturity
- ISO 9001 – Based on Conformity

- Size Does Matter
  - CMMI - 729 Pages
  - ISO 9001 - 33 Pages

Net Effects

- ISO 9001 more flexible and cheaper
- CMMI easier to claim (considering maturity)
- CMMI more appropriate for software, systems, product development
- Choosing what's appropriate, and explaining the differences to stakeholders is what's important

Selection Considerations

- Customer’s requirements
- Management’s desires
- Competitor’s status
- Business objectives

Implementation Differences

- Identification of Requirements
- Documentation
- New Processes and Records
- “Claiming” Process (through assessments)
- Maintenance
- Infrastructure and Costs

Approaches (and Defenses)

- Nothing – Lean and mean
- ISO 9001 Compliant
- ISO 9001 Registered
- ISO 9001 Registered, Addressing Specific Guidance Documents
- ISO 9001 Registered, Developed for Selected CMMI Maturity
- CMMI SCAMPI Assessed

Closing Credits

Matt Leiphart

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Conference Abstract

From the very first glance at the CMMI standard, it is obvious it is more comprehensive and detailed than ISO 9001. Due to the differences in structure, presentation, language, and detail, it can be difficult to identify exactly how different the standards are, and determine how those differences would influence the operation of a an organization that uses one standard over the other. This presentation will explore the differences between the two standards to provide insight that can help determine which standard is best for a given organization. The presentation will also provide information to help organizations explain to customers and other interested parties how both standards fit into the overall management processes of the organization, and how the use of both standards benefits them.

NDIA
CMMI® Technology Conference
Denver, Colorado
November 13-16, 2006

The Unseen Benefits of the Change Request Process

Scott Banks
Mark Pellegrini

Electronic Systems Laboratory
Georgia Tech Research Institute
Georgia Institute of Technology

Georgia Tech Research Institute (GTRI) Overview

- Unit of the Georgia Institute of Technology
- 1200+ employees
- 70% of research employees hold advanced degrees
- Wide variety of products
- Customers include federal and state government; and industry
- Competitively bid projects range greatly in size and duration
- More Info: http://www.gtri.gatech.edu/

Topics to Cover

- What is a problem report
- What a problem report is not
- Why problem reports are a good thing
- How problem reports fit into your development process
- Problem report lifecycle
- Types of information to collect
- Problem report metrics
- Summary

What is a Problem Report?

- PR, SPCR, Bug, OCR, CR, EPR, ECR…
- Project requirement
- Creates a paper trail
- Documents changes at any point in development cycle
- Easy PM tool (How are we doing?)
- Part of release documentation
- Business development tool

What is a Problem Report?

- Part of the CMMI v1.2 Configuration Management Support Process Area ML2
- Specific Practice: SP 2.1 *Track Change Requests*
- Typical Work Product: Change Requests
- Subpractices:
  1. Initiate and record change requests in the change request database.
  2. Analyze the impact of changes and fixes proposed in the change requests.
  3. Review change requests that will be addressed in the next baseline with the relevant stakeholders and get their agreement.
  4. Track the status of change requests to closure.

What a Problem Report is Not

- Not optional
- Not a personal performance indicator
- Not a singular project tool
- Not a contest
- Not only for S/W
  - Documentation
  - Systems/Hardware
  - COTS
  - Subcontractors
  - Process

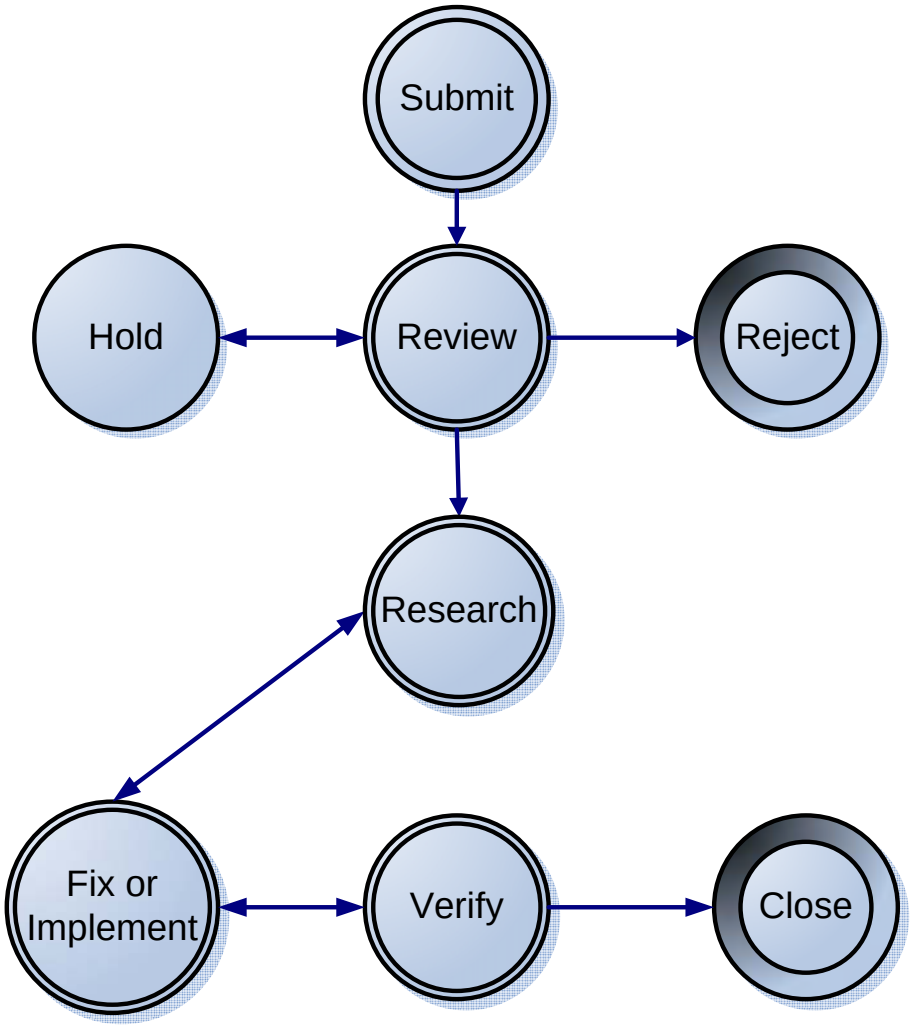
Why Problem Reports are a Good Thing

- Great communications tool
- Provide a status snapshot
- Manage clients and subcontractors
- Issues don’t get lost
- Help control the product
- Bring new hires up to speed
- Business development
- Help make informed decisions

How Problem Reports Fit Into the Development Cycle

- At what point during the process should problem reports be written
- Who should see problem reports

Problem Report Lifecycle



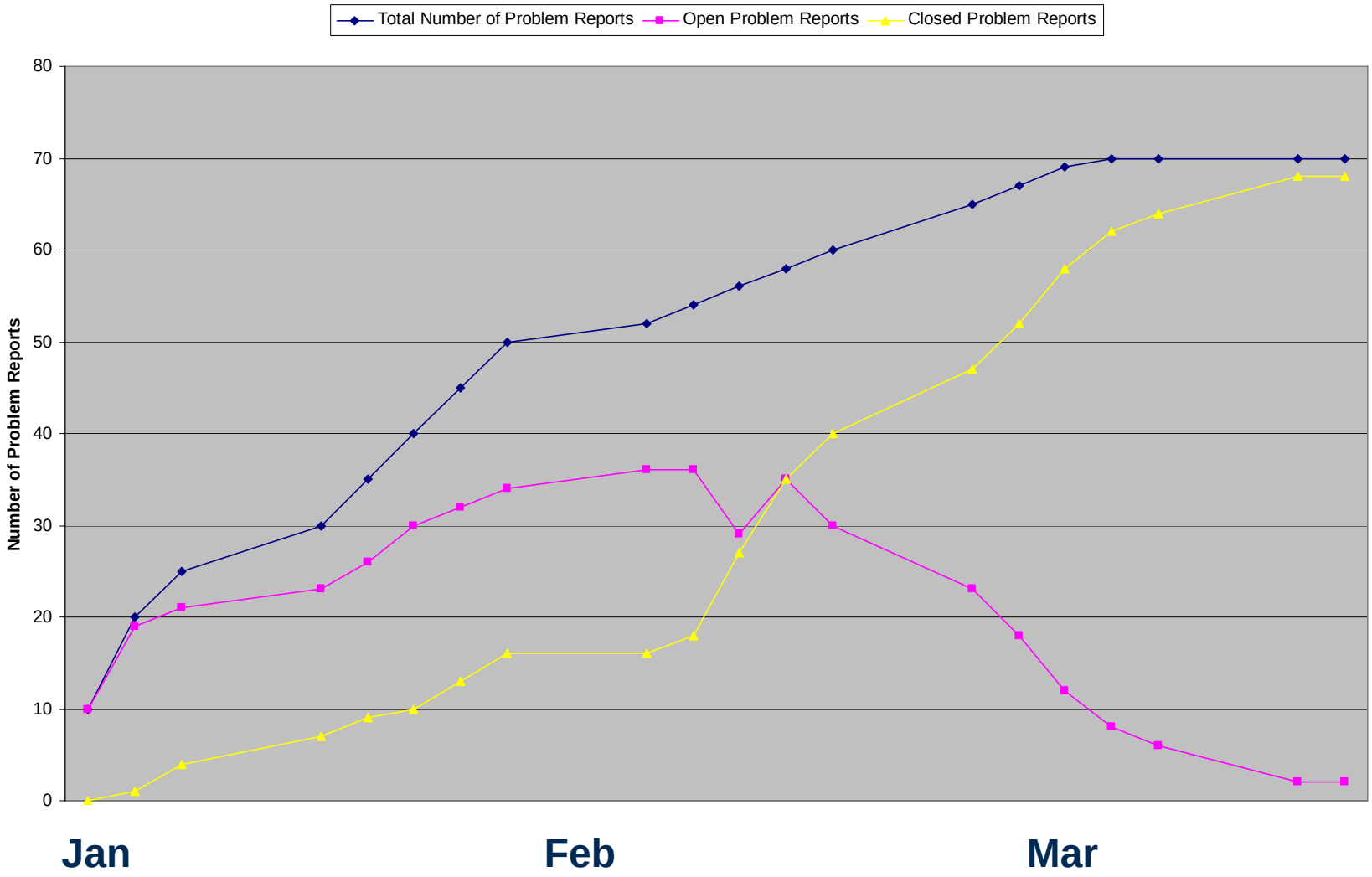
Types of Information to Collect

- Unique ID
- Description
- State of problem report
- Functionality or application
- Where in the process it was written
- Severity
- Priority
- Dates
- Estimations

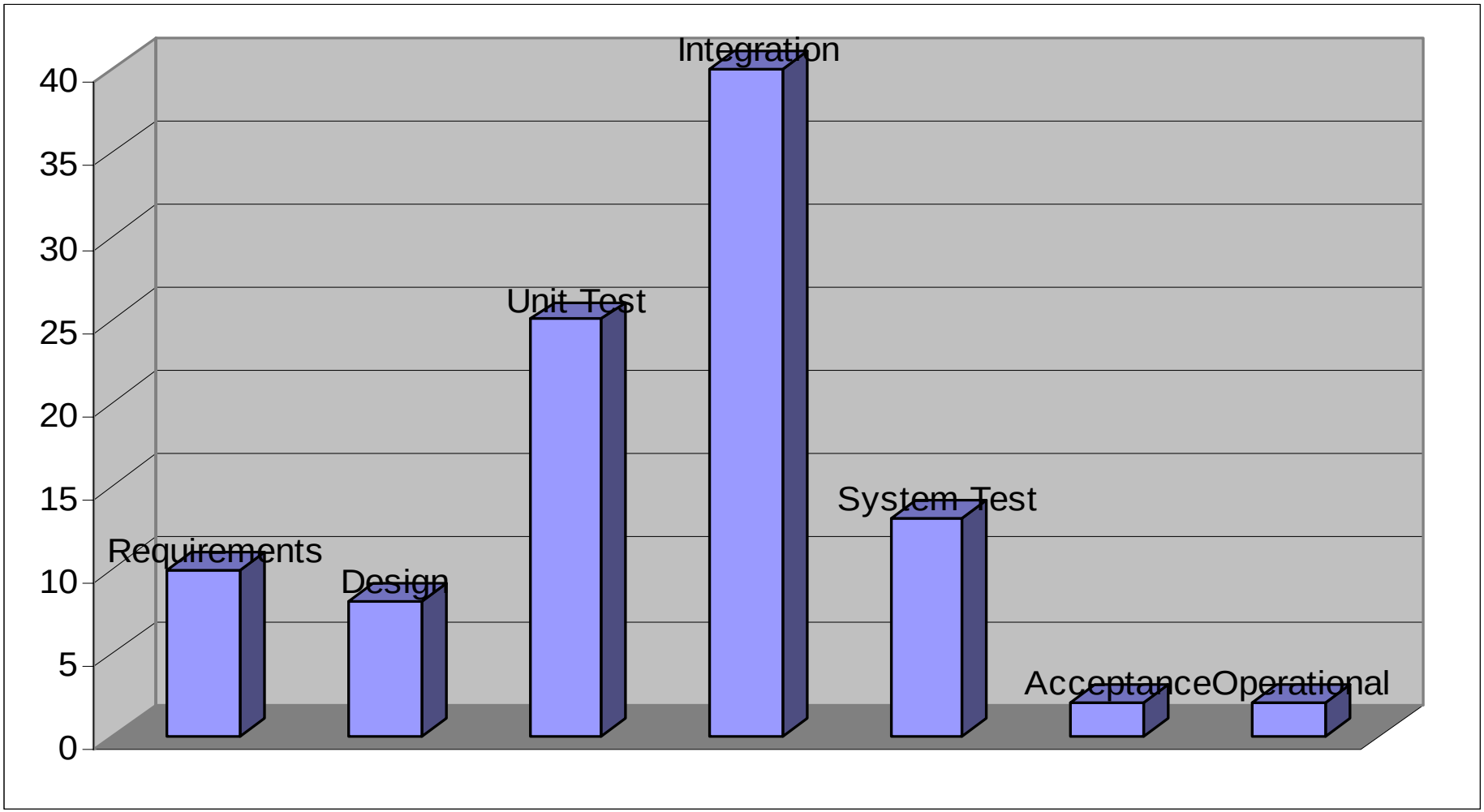
Problem Report Metrics

- Open vs. closed
- Where defects are introduced
- Closure rate
- Days to verify
- Open per function or application
- When defects are found

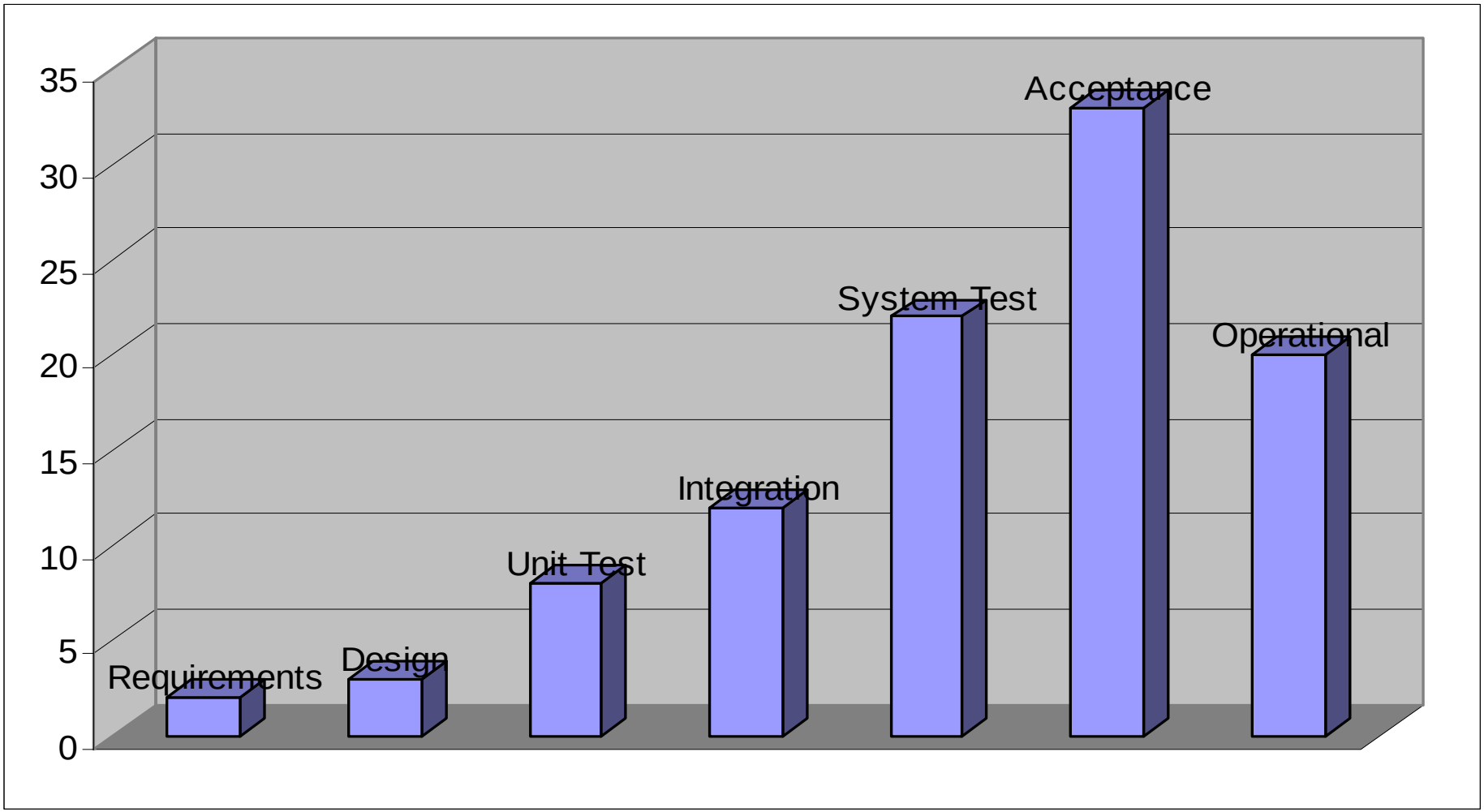
Problem Report Closure Rate



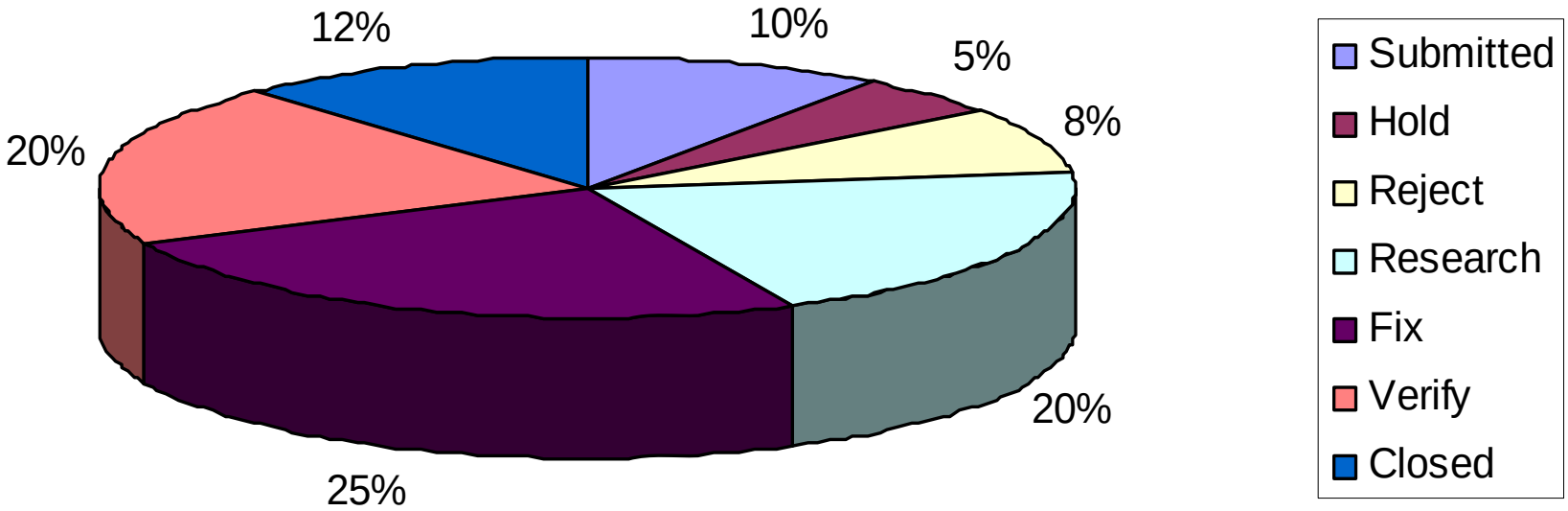
Problem Report Graphs - Where Found



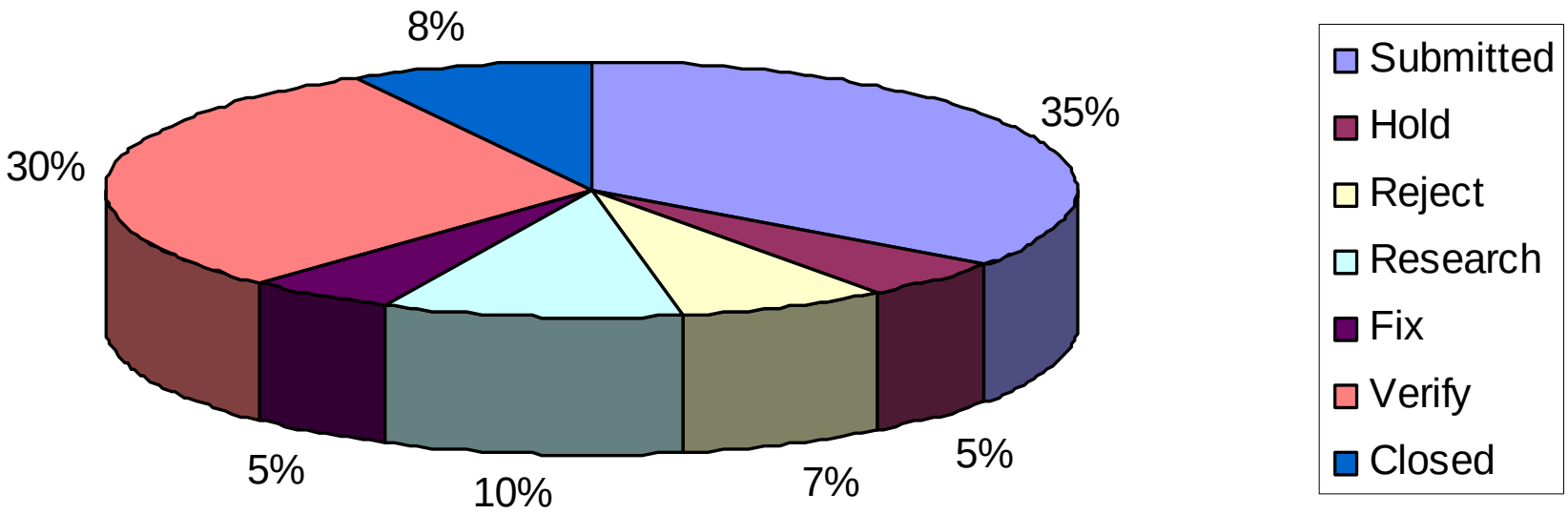
Problem Report Graphs - Where Found



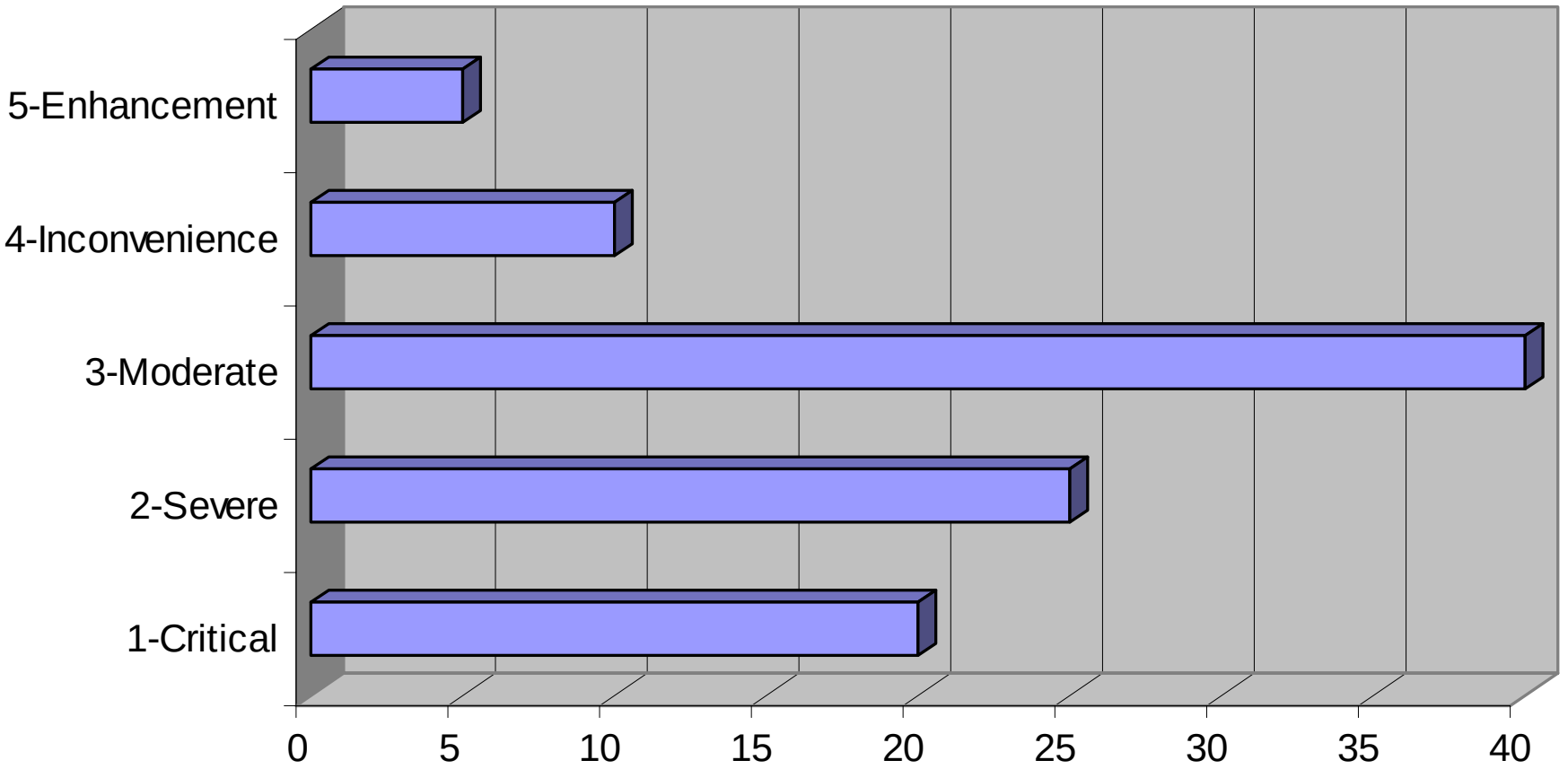
Problem Report Graphs – Status



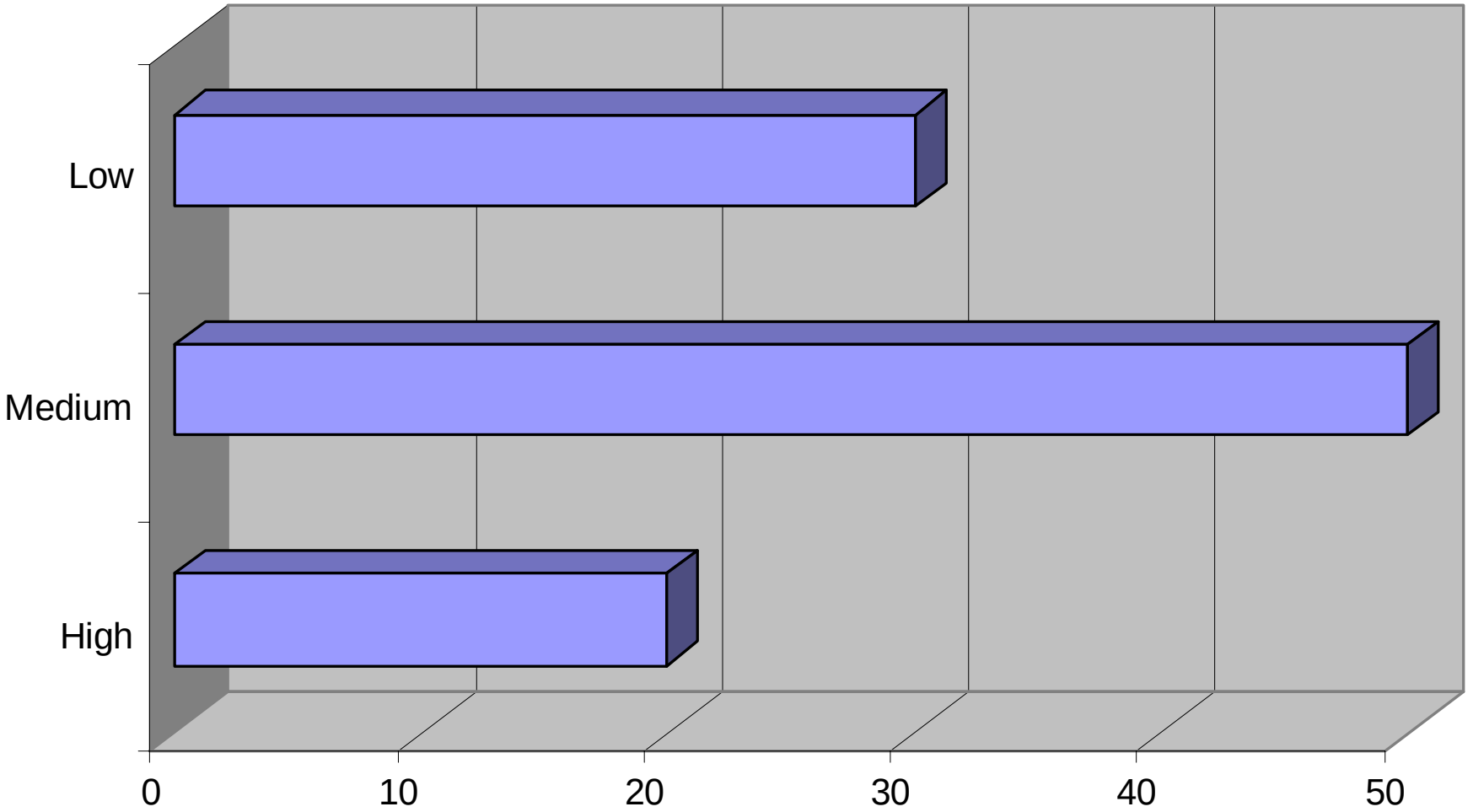
Problem Report Graphs – Status



Problem Report Graphs – Severity



Problem Report Graphs – Priority



Excuses

- Takes more time to document the change than to actually make it
- This will reflect poorly on my work
- I don’t want the customer to know what our problems are
- Stop writing problem reports so we can release

Summary

- Simple way to gain project insight and make informed decisions throughout
- Good project communications tool
- Helps keep things under control
- Don’t misuse
- “Tool” should support your process and needs. Consider things like web interface, queries, report generation, customization or integration

Questions?

Contact Information

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- **Mark Pellegrini**

  mark.pellegrini@gtri.gatech.edu

- **More Info about GTRI:**

  http://www.gtri.gatech.edu/

GALORATH

Integrating Planning, Control, Measurement & Analysis CMMI™ Process Areas To Achieve More Successful Software Projects

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- **Integrating Planning, Control, Measurement & Analysis CMMI™ Process Areas To Achieve More Successful Software Projects**

- **Project Planning and Project Monitoring and Control, two CMMI® Level 2 Process Areas, are essential to Software Project Management. Prior to project initiation, the relationship between these two process areas tends to be strong. Unfortunately, the status quo tends to exhibit a breakdown in this relationship once the project has begun. The result is an open-loop situation: we know where we planned to be and where we are; however, we don't know where and when we will likely end up.**

- **This paper first reviews the fundamentals of Parametric Estimating and Performance Measurement**
- **and then proposes an integrated process uniting Project Planning, Project Monitoring and Control, and Measurement and Analysis. The benefits of this integration are an increased probability that: 1) a project's plan is achievable (i.e., it honors the laws of software project dynamics and keeps from "death marches"); and 2) actual performance matches reasonably-expected (planned) performance; (i.e., that a project is delivered on time and within budget); and 3) if there are troubles that there is an early warning of trouble and possibilities for managers to remediate. Finally, the paper chronicles, through the use of selected artifacts, an actual project employing this integrated approach.**

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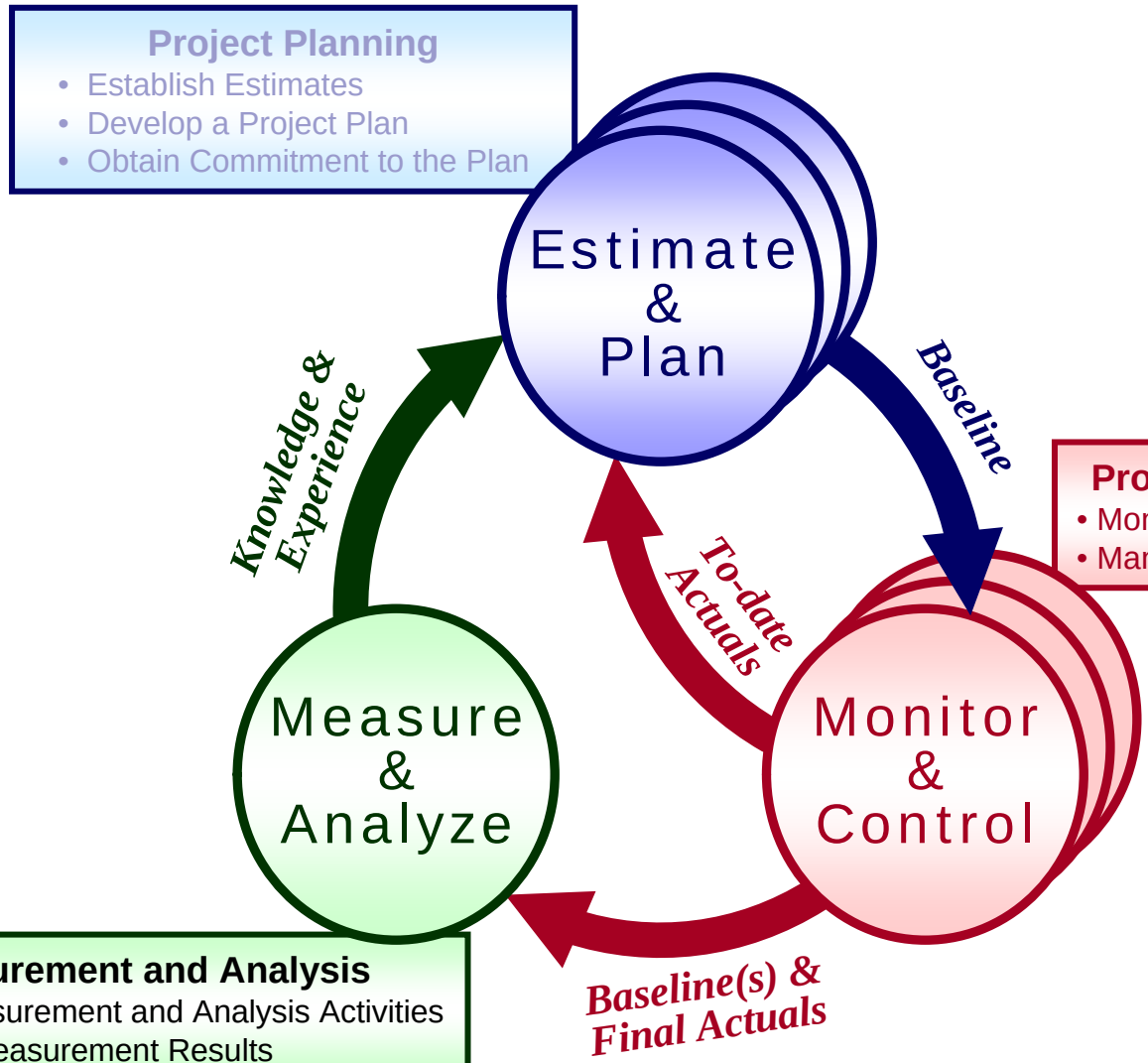
CMMI Key Process Areas Require Estimation With Feedback



✓**Foundation of Risk Management &**
✓**Quantitative Project Management**

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Fundamentals of Software Estimation

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Poor Estimates Effects on Projects

- **Inaccurate estimates can have significant impact on project success:**
  - Poor implementations
  - Critical processes don't scale
  - Emergency staffing
  - Cost overruns caused by underestimating project needs
- **Lack of well defined objectives, requirements, & specifications, results in creeping scope resulting in:**
  - Forever changing project goals
  - Frustration
  - Customer dissatisfaction
  - Cost overruns and missed schedules
  - Project Failures
- **Incorrect estimates / bad plans are a root cause of subsequent program risk**

Estimating & Planning are key to software project success

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We Can't Afford Not To Spend Time and Money On Viable Estimates and Project Plans

Adapted From Aspire S. Hunt

- **Apollo**
  - Most Apollo program faults were software related
- **Loss of NASA Spacecraft**
  - FORTRAN statement error caused loss of 1st NASA probe to Venus
- **After success with Ariane 4, the maiden flight of Ariane 5 ended in destruction when design defects in the control software were revealed by the faster horizontal drifting speed of the new rocket.**
- **Financial & Program Impacts**
  - Airbus A310 45,000 hours expended against software development (20,000 hours budgeted!)
  - American Airlines lost nearly $1billion due to software faults
  - In 1991 after 3 lines of code (in millions of lines of code in a signaling program) were changed, telephone systems in California and the Eastern Seaboard went off line
- **Loss of Life**
  - Gulf War 1 Patriot Missile tracking failure due to 0.36 second software driven clock.
  - And so on …….

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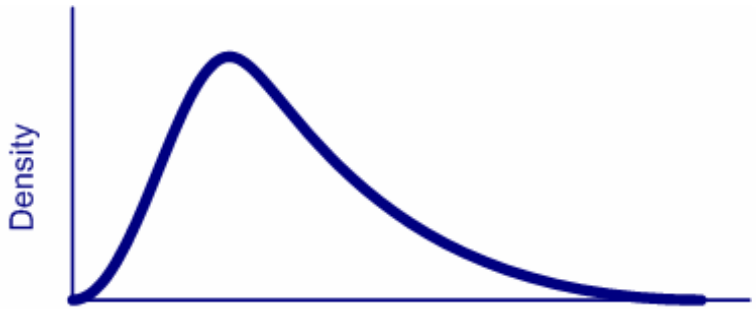
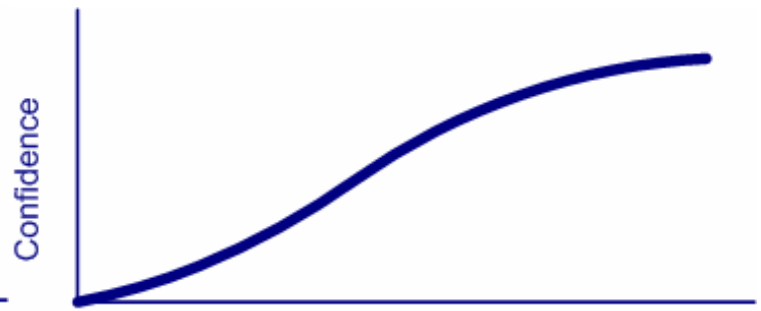
An Estimate Defined

- **An *estimate* is the most knowledgeable statement you can make *at a particular point in time* regarding:**
  - Effort / Cost
  - Schedule
  - Staffing
  - Risk
  - Reliability

- **Estimates more precise with progress**
- *A WELL FORMED ESTIMATE IS A DISTRIBUTION*





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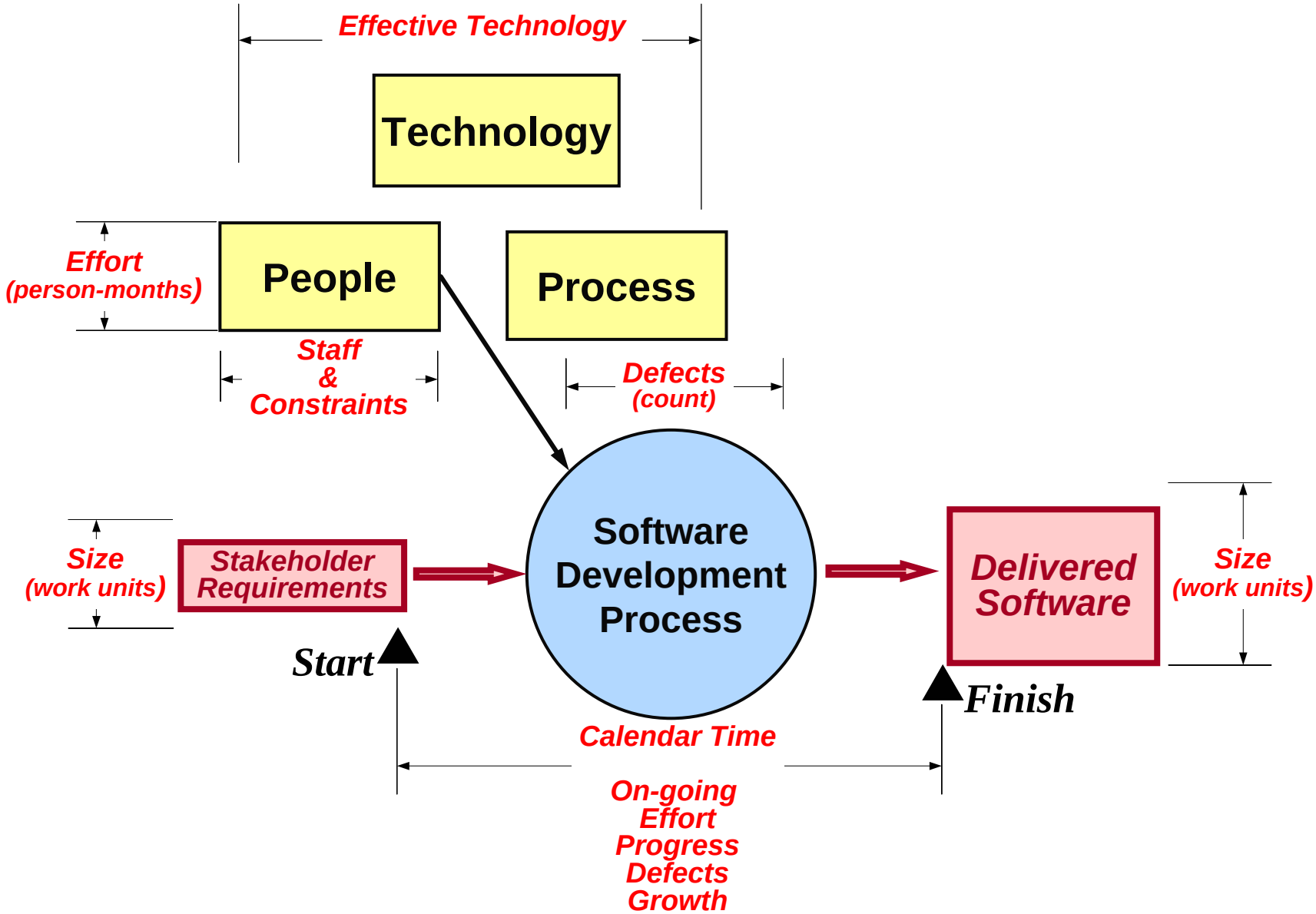
Software Development Core Metrics



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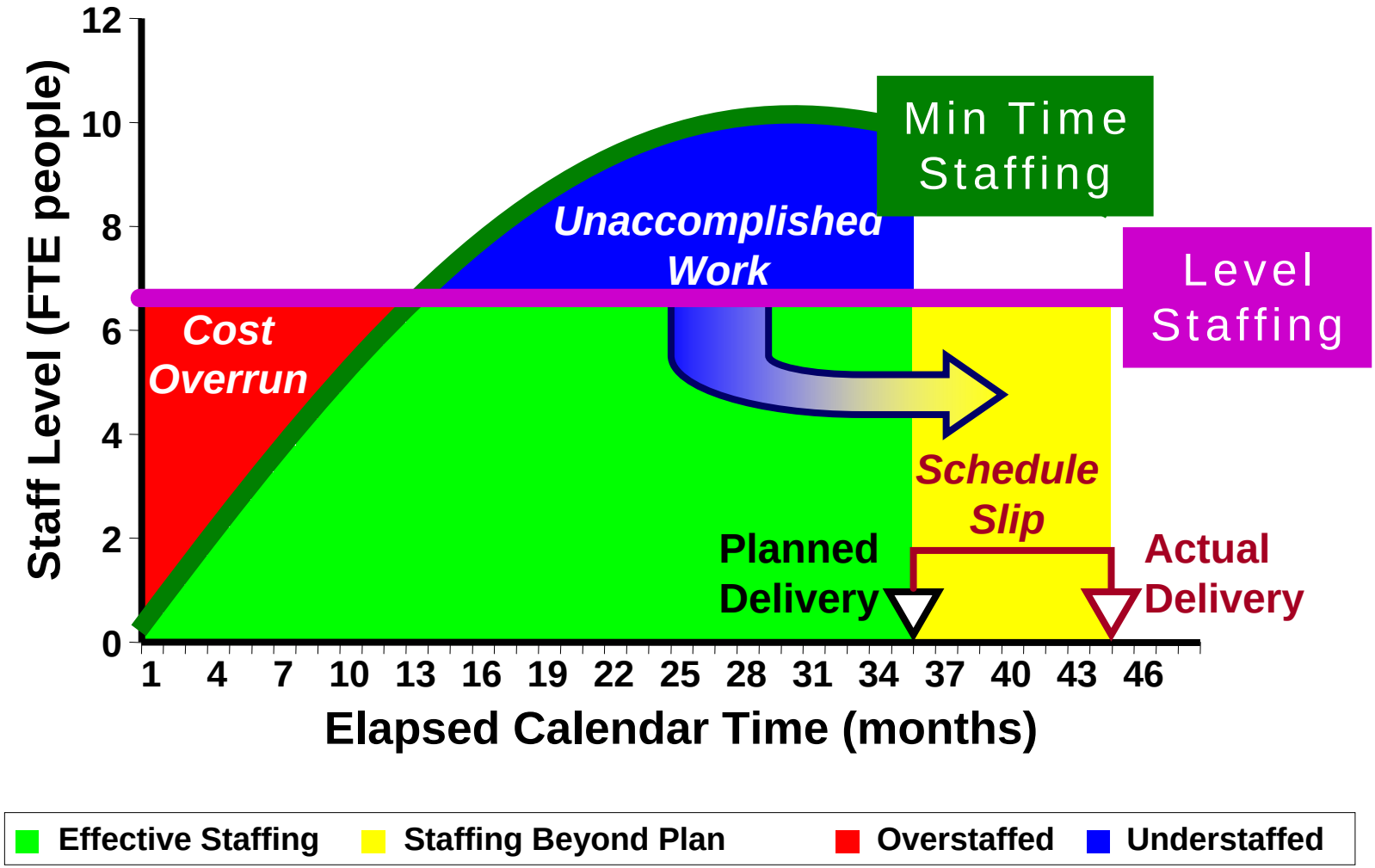
SEER-SEM Provides Staffing Plans that Avoid "Death Marches" and Failed Projects Applying "Brooks Law"



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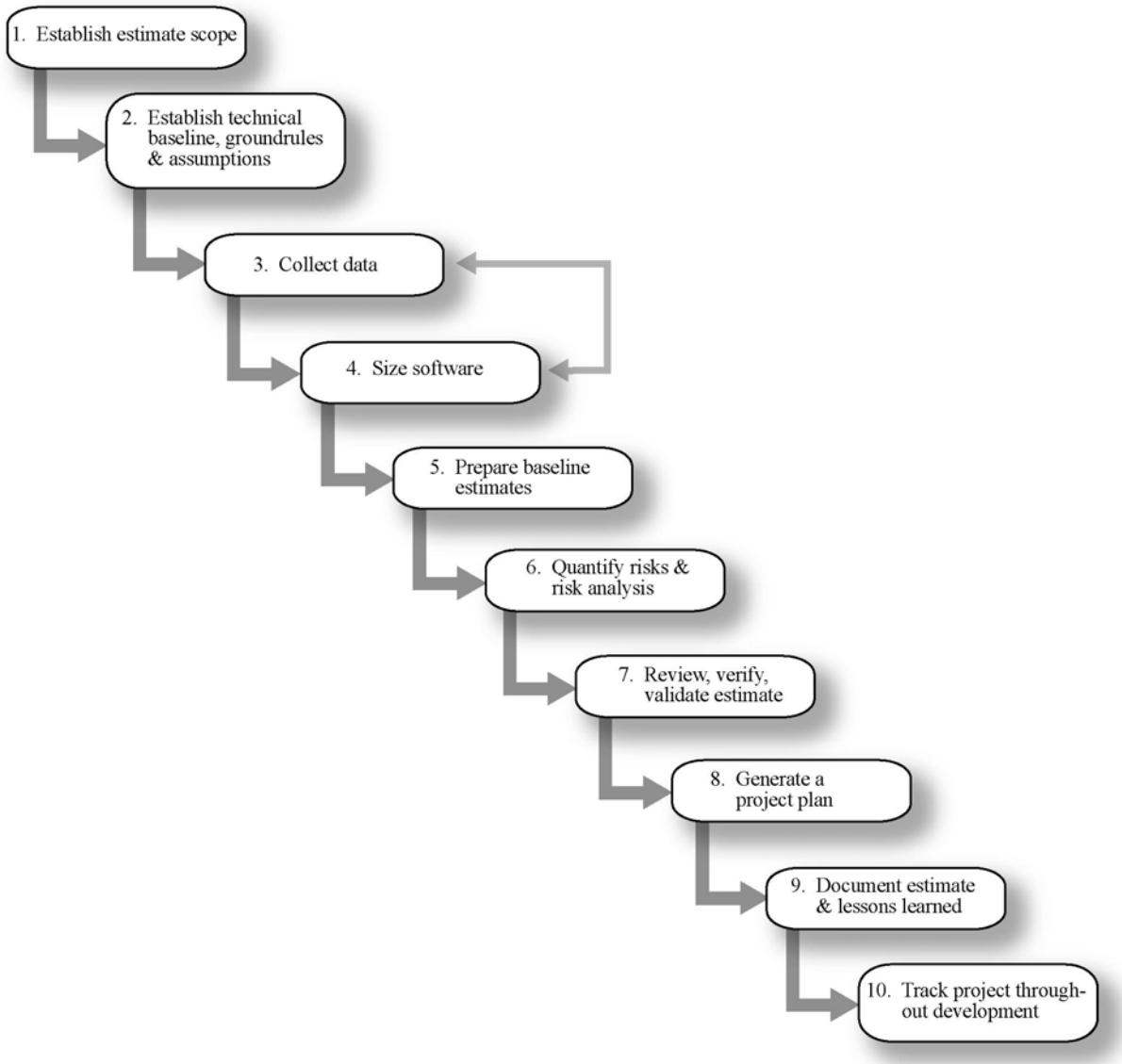
10 Step Software Estimation Process Supports Software Best Practices



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Step One: Establish Estimate Scope and Purpose

- **Define and document estimate expectations, scope & Purpose**
  - Provides a baseline against which to gauge the effect of future changes
  - Reduces misunderstandings & contradictory assumptions
- **Estimate should be considered a living document**
  - As projects change, data changes or new information becomes available, it should be documented and factored into the estimate in order to maintain the project's integrity

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Define What's Included in the Estimate

- **Development effort breaks down into…**
- **What functionality will be developed**

- **How will it be done?**
  - Activities & phases

- **Who will do the work?**
  - Personnel labor categories

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Step Two: Establish Technical Baseline, Groundrules, & Assumptions

- **Functionality included in the estimate or range must be established**
  - If detailed functionality is not known, groundrules and assumptions state what is and isn't included in the estimate.
  - Issues of COTS, reuse, and other assumptions should be documented as well.
- **Groundrules and assumptions form the foundation of the estimate**
  - although early at early stages they are preliminary and therefore rife with uncertainty, they must be credible and documented
  - Review and redefine these assumptions regularly as the estimate moves forward.

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Technical Baseline

- **Describe each work element**
  - Core functionality
  - Key qualitative modeling inputs
  - Size, if available
- **Identify multiple builds/releases (if any)**
- **Reference or excerpt available documentation**
- **Provide rationale & justification for BOE**

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Ground Rules & Assumptions

- **Groundrule: given requirement of the estimate (e.g. software must support windows and Linux)**
  - Be sure to provide source
- **Assumption: assumed to scope estimate**
  - Be sure to provide source and substantiation
- **What's known, what's unknown**
- **Anything relating to scope**
  - What's included, what's excluded
- **Anything relating to modeling inputs**
  - Who you interviewed and when
  - What you learned

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Step Three: Collect Data

- **Software Data Collection Process key considerations**
  1. Motivate potential data providers to participate
  2. Avoid nondisclosure agreements containing clauses requiring exclusivity or destruction of data if you can
  3. Provide data collection forms and instructions beforehand, in both hard copy and electronic formats
  4. Provide clear definitions but recognize providers may not read them
  5. Identify which data are *required*, *highly desirable* or *desirable*
  6. During the face-to-face interview confirm data is realistic and valid
  7. Grade to indicate confidence
  8. Normalize data via well-documented process & Keep both the raw and normalized data

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Data Collection

- **Begin with available documentation**
  - SDP, TRD, SRS, COO, ORD, CARD, BAFO, BOE, SOW
  - A-level Spec, Program Schedule, Contractor Presentations
- **Perform interviews where & when possible**
  - Development contractor(s)
  - Program office personnel, FFRDC engineers
  - Preparation is paramount!
  - Use a questionnaire, sent in advance
  - Phraseology determines answers
  - Confirm key definitions
  - Be willing to challenge, point out inconsistencies

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Step Four: Software Sizing

- **Spend Time on sizing**
  - Include rework that will be required to develop the product,
- **Estimate *least likely most* range.**
- **Some widely used methods of estimating product size are:**
  - Expert opinion
  - Analogy
  - Formalized methodology
  - Statistical sizing — Provides a range of potential sizes that is characterized by *least*, *likely*, and *most*

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Steps to Estimating Software Size

- **Use a software sizing method that is consistent and repeatable**
  - Reestimate as specs change
  - Establish baseline definition of the size metric & identify normalization process if different from the definition chosen

1. **Define sizing objectives**
   - Are you trying to describe the size of individual computer programs, plan major milestones in the estimation process, or adjust for project replanning? Varying granularities of sizing detail will be appropriate
2. **Plan data and resource requirements of the sizing activity**
3. **Identify and evaluate software requirements, a set of software specifications that are as unambiguous as possible**
4. **Use several independent techniques and sources and put findings in a table**
5. **Track the accuracy of the estimate versus actuals as the project progresses, and reestimate the product size periodically with actual data.**

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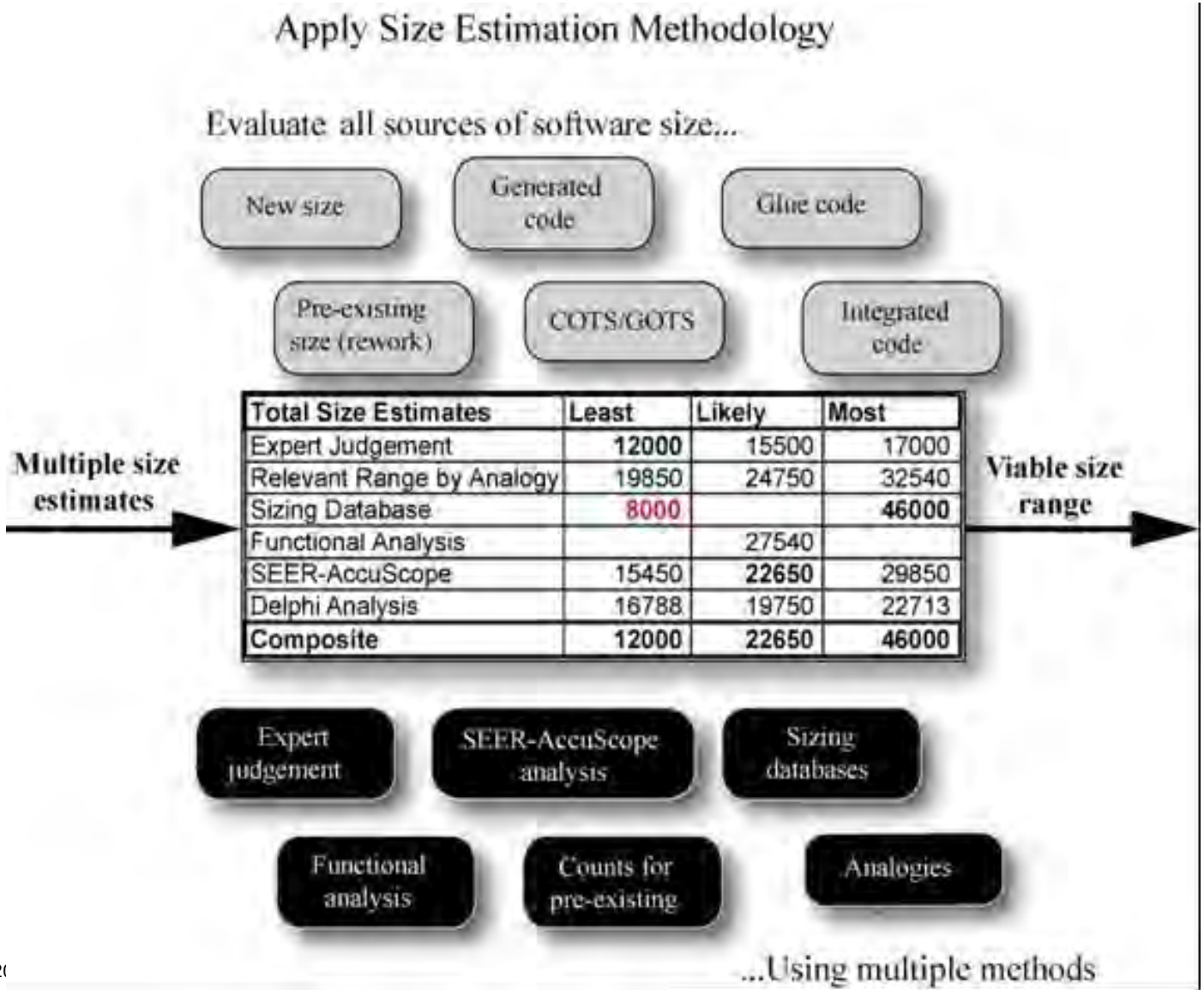
Galorath Size Estimation Methodology



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Step Five: Prepare Baseline Estimate

1. **Trained, experienced, and skilled people should be assigned to size the software and prepare the estimates**

2. **it is critically important that they be given the proper technology and tools**

3. **Project manager must define and implement a mature, documented, and repeatable estimation process**

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Estimation Approaches

- **Guessing (which is not recommended)**
- **Using existing productivity data exclusively (also not recommended)**
- ***Bottom-Up Estimating***
  - Bottom-up (a.k.a. grassroots) estimating, decomposes the software to its lowest levels by function or task and then sums the results
  - Can be effective for smaller systems and where estimates are carefully produced
- ***Parametric Software cost models***
  - Provide means for applying a consistent method for subjecting uncertain situations to rigorous mathematical and statistical analysis
  - When used properly they are more comprehensive than other estimating techniques and help to reduce the amount of bias that goes into estimating software projects
- ***Delphi Based Estimates***
  - Several expert teams or individuals, each with an equal voice and an understanding up front that there are no correct answers, start with the same description of the task at hand and generate estimates anonymously, repeating the process until consensus is reached
- ***Activity-Based Estimates***
  - Begin with requirements & size then define the required tasks, which will serve to identify the overall effort that will be required
  - Typically Major cost drivers focused on non-coding tasks included in effort estimate
  - Build a task hierarchy (WBS) that represents how the work will be organized and performed
  - This work breakdown structure can be the backbone of the project plan

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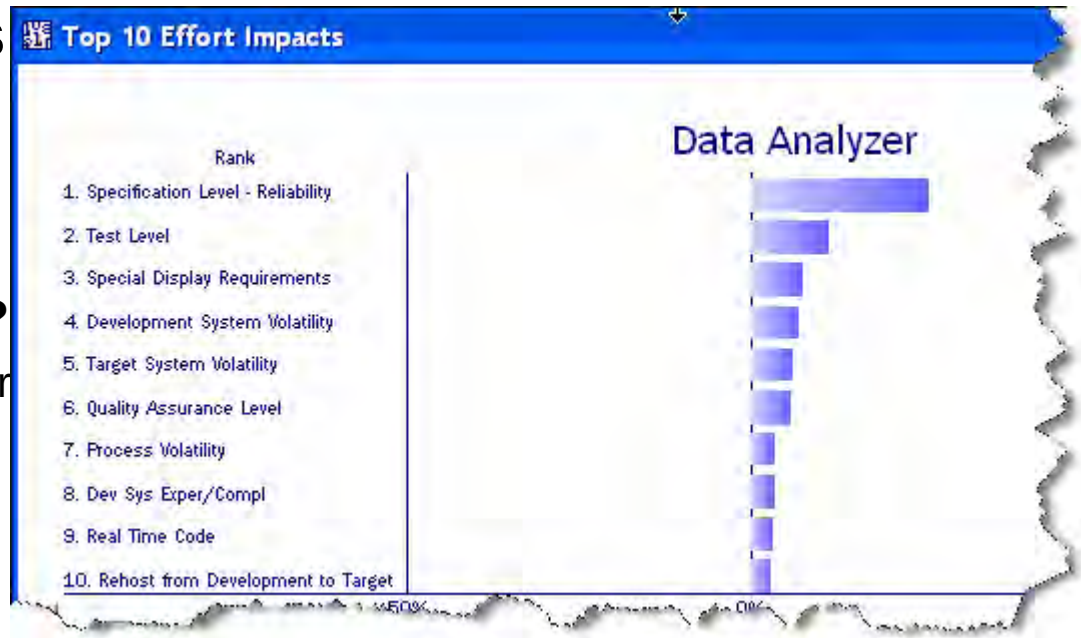
Generate the Estimate

- **Using your chosen methodology and tool, do a first run**
- **Never report preliminary results!**
- **Focus on the inputs**
  - Verify completeness
  - Verify accuracy
- **Focus on the outputs**
  - Sanity check for reasonableness, completeness
- **What's driving the estimate?**
  - SEER-SEM top ten parameter
- **Use "fresh eyes" to review**
  - Ask a colleague for help
  - Set aside overnight



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Update/Refine the Estimate

- **Optional or more specific information may become available in the future**
- **Follow configuration control guidelines to keep estimates straight**
  - Change log
  - Naming conventions
  - File storage
- **Maintain estimating integrity – eschew artificially driving the estimate to a predetermined result**

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Step Six: Quantify Risks and Risk Analysis

- **Risk can produce loss of time, or quality, money, control, understanding, and so on.**
  - Loss associated with a risk is called the risk impact
- **Approximate the probability that the event will occur**
  - Risk probability: Likelihood the risk, measured from 0 (impossible) to 1 (certainty) When the risk probability is 1, the risk is a problem since it is certain to happen.
  - Determine how risk can be mitigated
  - Risk control involves a set of actions taken to reduce or eliminate a risk.
- **Risk management identifies & addresses internal & external potential threats**
  - Problems associated with sizing and estimating software potentially can have dramatic negative effects.
  - If problems can be foreseen & causes acted upon in time, effects can be mitigated
- **Although cost, schedule, and product performance risks are interrelated, they can also be analyzed independently**
  - Risks must be identified as specific instances in order to be manageable
  - Statistical risk/uncertainty analysis should be a part of schedule & effort estimation process

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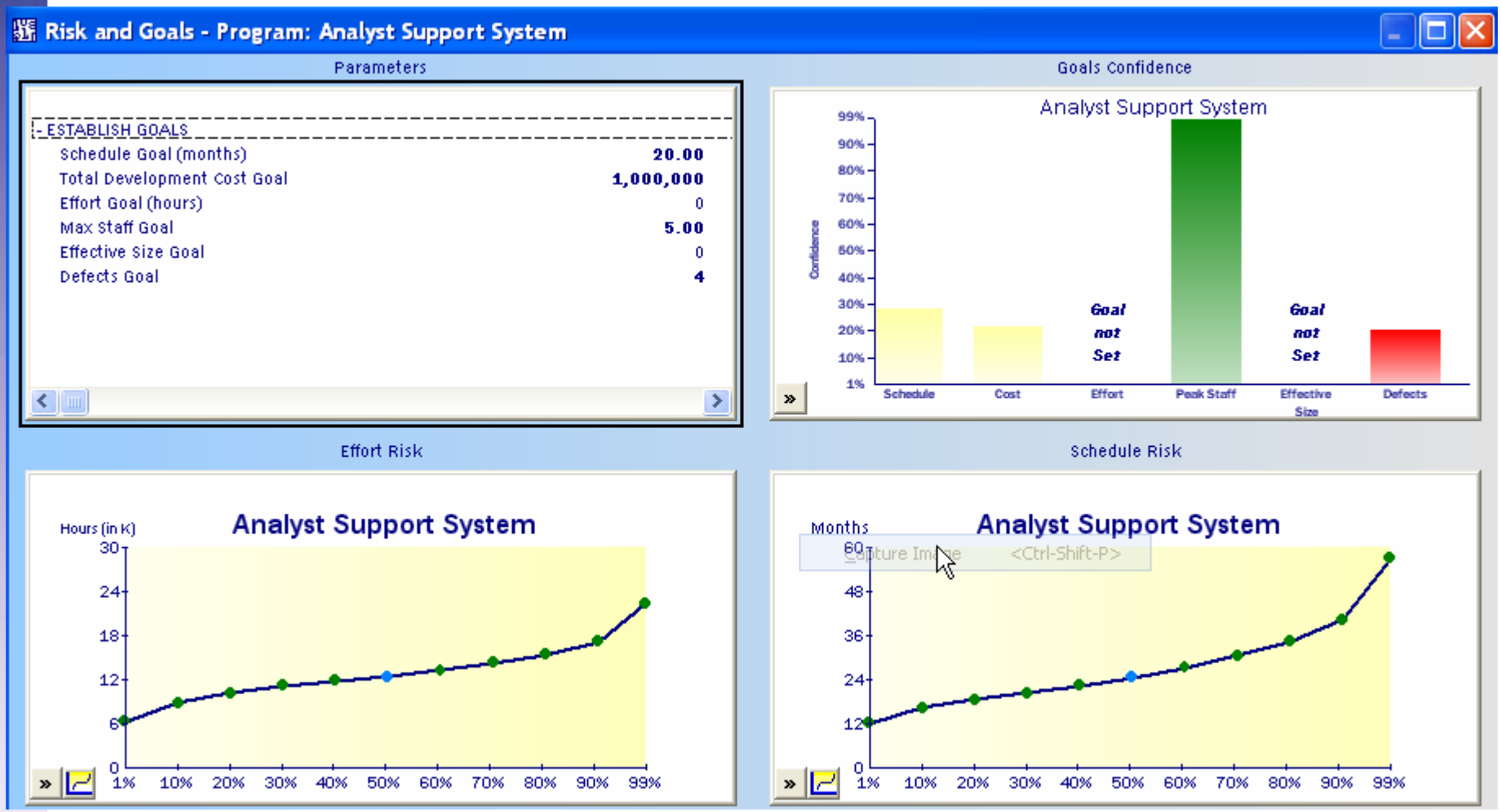
Understanding Risk and Uncertainty is Essential To Project Management



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Step Seven: Estimate Validation and Review

- **Ideally, validation performed by one who was not involved in generating the estimate**
- **Assess estimate assumptions**
- **Ensure groundrules are consistent applied**
- **Rigorous validation process exposes faulty assumptions, unreliable data and estimator bias**
  - Provides clearer understanding of the risks inherent in your projections
  - Having isolated problems at their source, you can take steps to contain the risks associated with them, and you will have a more realistic picture of what your project will actually require to succeed
- **Failing to validate the estimate may result in much greater downstream costs, or even a failed project**

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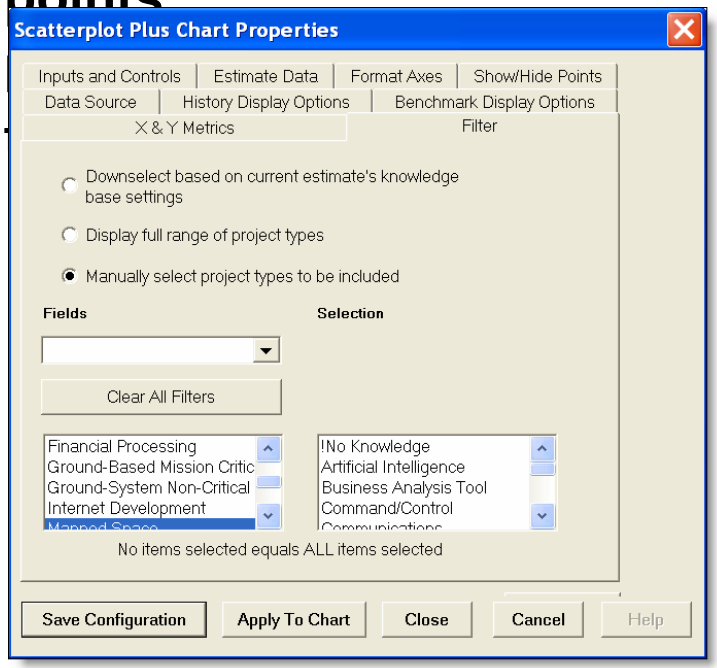
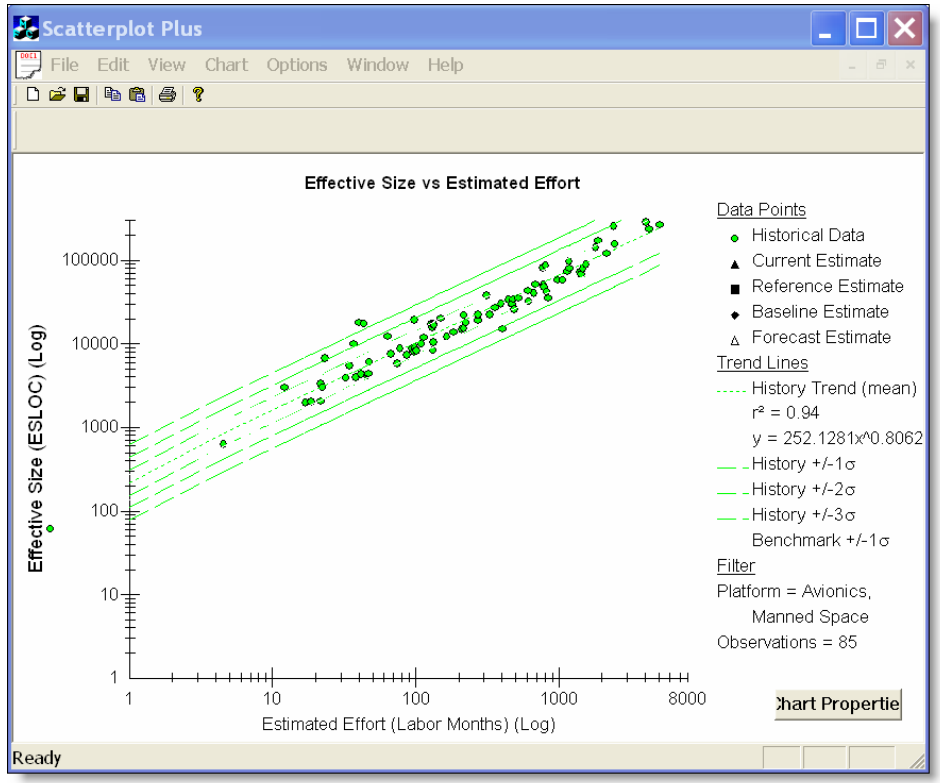
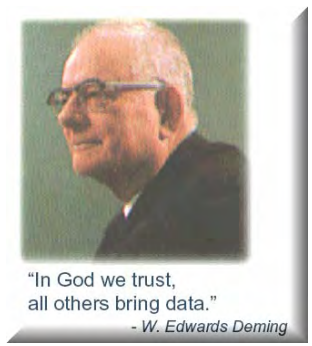
Compare Parametrics With Metrics and Sanity Checks

- Works with common repository
- Shows actual data, ranges, and correlations
- Plots SEER-SEM estimates and contrasts with data points
-







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Step Eight: Generate A Project Plan

- **includes allocating estimate cost & schedule & allocating the cost and schedule to a function and task-oriented work breakdown structure**
- **Issues**
  - Inexperienced managers may not properly evaluate decisions effects over the long run.
    - lack necessary information
    - believe time to develop the information will make the project suffer
  - Other managers make decisions based on what they think higher management wants to hear
  - Good manager understands project realities even if it is not what higher management wants.
    - Job is to explain the reality in language his managers can understand
    - Problem managers although they may mean well, either lead a project to an unintended conclusion or, worse, drift down the road to disaster.
- **Software management and planning problems have been recognized for decades as the leading causes of software project failures**
  - bad management decisions
  - Incorrect focus
  - destructive politics

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Revitalizing the Software Aspects of Systems Engineering

- **Memorandum of 13 June 2004 from Undersecretary of the Air Force: "Revitalizing the Software Aspects of Systems Engineering"**
- **Number 1 (of 10) recommendation: High Confidence Estimates**
  - "Estimate the software development and integration effort (staff hours), cost and schedule at high (80-90%) confidence."
- **•Number 2 recommendation: Realistic Program Baselines**
  - "Ensure cost, schedule and performance baselines are realistic and compatible. … The program budget must support the high confidence estimates for effort (staff hours), cost, and schedule."
- **Number 3 recommendation: Risk Management**
  - "Continuously identify and manage risks specific to computer systems and software as an integral part of the program risk management process. Ensure the risks, impact, and mitigation plans are appropriately addressed during program and portfolio reviews."

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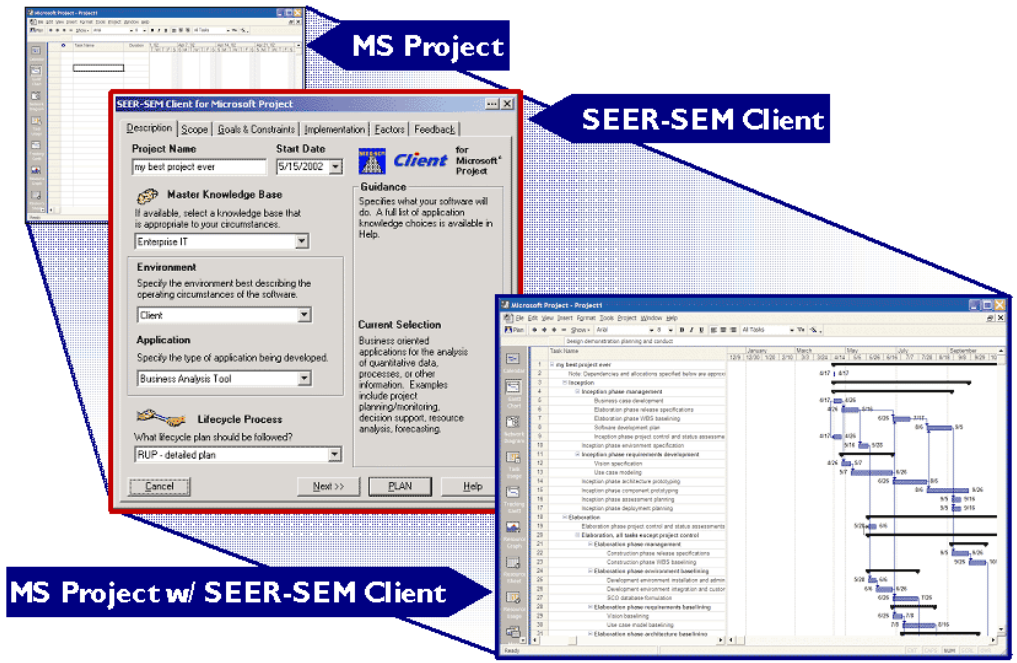
Expand Product WBS to Task level Plan

Transforms Microsoft Project into a powerful tool for planning software development projects.

- Automatically constructs a complete project plan
  - ***with relatively few inputs***
  - ***or directly from your SEER-SEM project estimate.***
- You can create custom life cycle templates.
- You can customize labor categories to reflect the way that your organization assigns tasks to departments or labor categories to accurately plan staff allocation for a project.



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Step Nine: Document Estimate and Lessons Learned

- **Document upon estimate complete AND project complete**
  - document the pertinent information
  - record the lessons you learned. By doing so, you will have evidence that your process was valid and that you generated the estimate in good faith, and you will have actual results with which to substantiate or calibrate your estimation models.
- **Be sure to document any missing or incomplete information and the risks, issues, and problems that the process addressed and any complications that arose**
- **Document key decisions made during the estimate & results**
- **Document dynamics that occurred during the process e.g.**
  - interactions of your estimation team
  - interfaces with clients
  - trade-offs made to address issues identified during the process.
- **Conduct a lessons-learned session as soon as possible after the completion of a project while the participants' memories are still fresh.**
- **Every software project should be used as an opportunity to improve the estimating process**

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Step Ten: Track Project Throughout Development

- ***Refining Estimates throughout Project***
- **Once a project has started, use estimates as a basis for performance measurement & project control**
- **Monitor actual effort & duration of tasks and/or phases against planned values to ensure you have the project under control**
- **Applying earned value techniques along with parametric estimation can help ensure successful projects**
- **Evaluate defects & growth in addition to simple earned value**

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Earned Value as a Root Level Software Management Technique

- **Many think of earned value as a high level program control metric**
- **But Earned value analysis is most valuable when the units of work are small (1-2 week activities)**
- **Use binary earned value…**
  - Either not done (earned 0 value) or
  - Complete (earned full value) for the task
- **Galorath has used earned value at the root level as a core technique for saving failing software projects**

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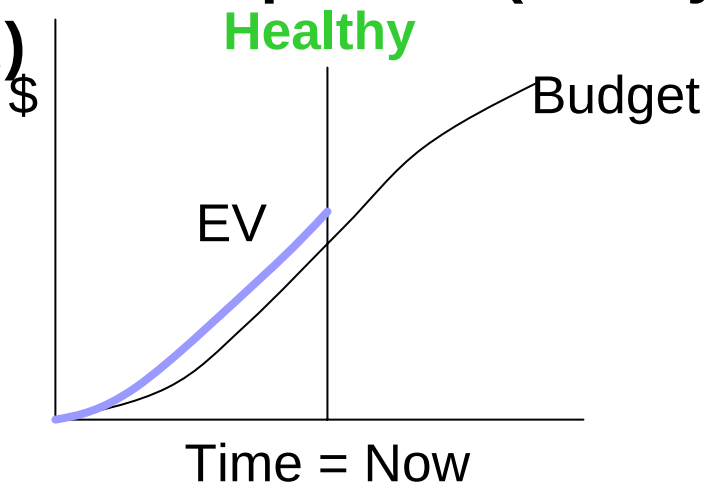
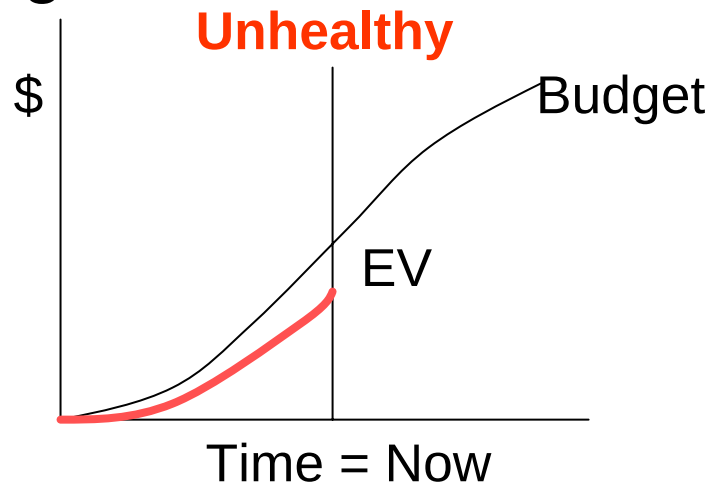
Use Earned Value To Quantify Progress Versus Effort

- **The main concern of EVM is what has been accomplished in a given time and budget, versus what was planned for the same time and budget**
  - A project is generally deemed healthy if what has been accomplished is what was planned, or more
  - A project is deemed unhealthy if accomplishment lags expectations
- **Definition: Earned value = budgeted value for the work accomplished (what you got for what it cost you)**





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CMMI Process Areas For Planning, Monitoring & Control

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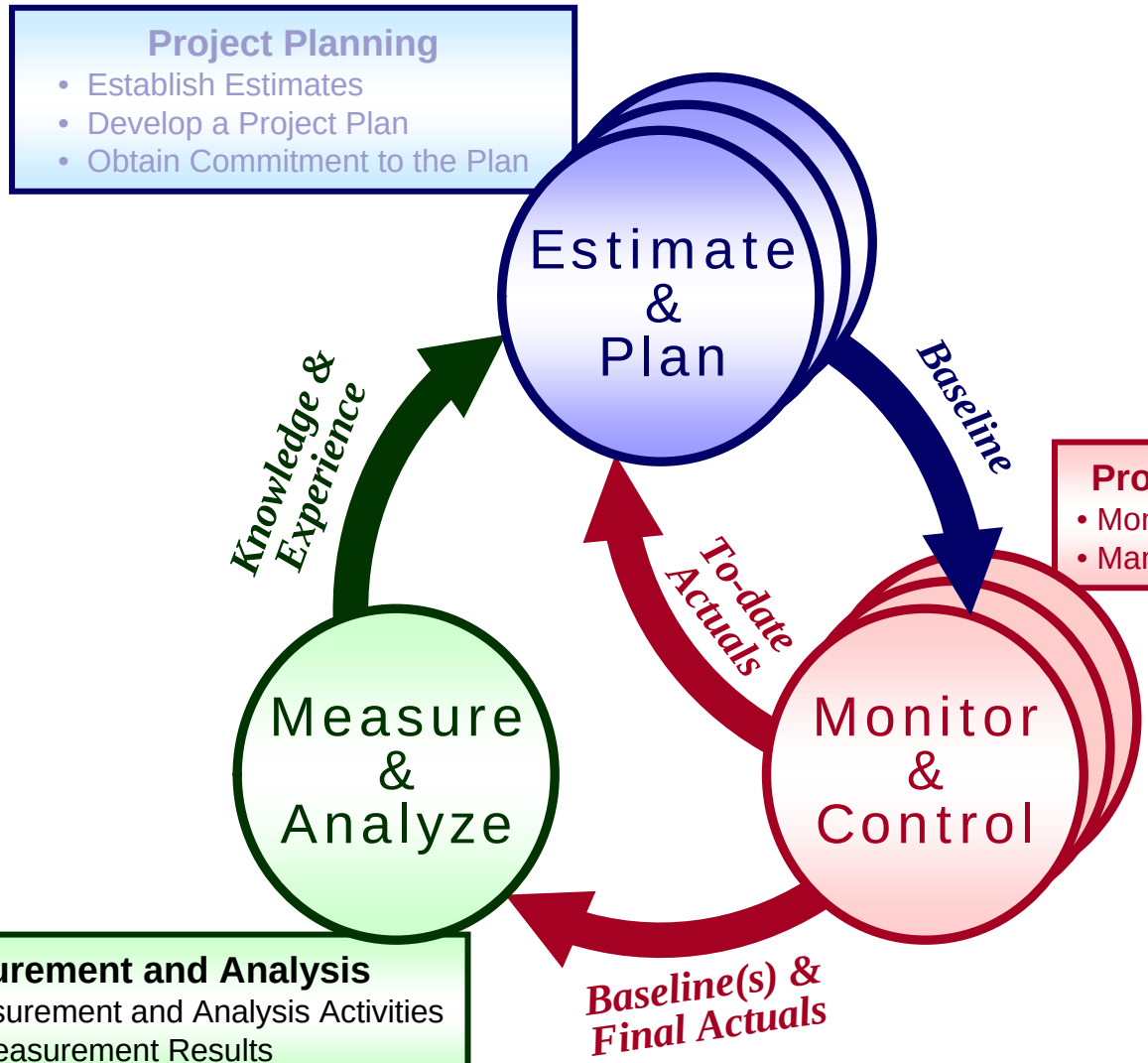
CMMI Key Process Areas Require Estimation With Feedback



✓**Foundation of Risk Management &**
✓**Quantitative Project Management**

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The CMMI Process Areas
Source: CMMI Tutorial

Category	Process Area
Project Management	1. Project Planning 2. Project Monitoring and Control Supplier Agreement Management Integrated Project Management(IPPD) Integrated Supplier Management (SS) Integrated Teaming (IPPD) 3. Risk Management 4. Quantitative Project Management
Support	Configuration Management Process and Product Quality Assurance 5. Measurement and Analysis Causal Analysis and Resolution Decision Analysis and Resolution Organizational Environment for Integration (IPPD)
Engineering	Requirements Management Requirements Development Technical Solution Product Integration Verification Validation
Process Management	Organizational Process Focus Organizational Process Definition Organizational Training Organizational Process Performance Organizational Innovation and Deployment

We will concentrate on:
1. Project Planning
2. Project Monitoring & Control
3. Measurement & Analysis
4. Risk Management
5. Quantitative Project Mgmt

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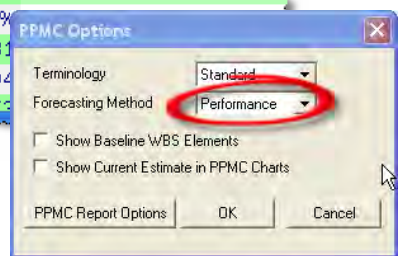
SEER-PPMC Parametrics Combined With Traditional EVM Captures Software Project Trouble More Completely

SEER-PPMC: Performance Mode
Significant Overrun Aparrent

Data Value	Baseline Estima		
Development Schedule Months		17.97	12%
Development Effort Months		108.57	25%
Development Effort Hours		16,502	25%
Development Base Year Cost	1,2	1,595,906	25%
Start Date	2,	2/02/04	
Completion Date	6,	7/31/05	
Effective Lines Only			
Effective Functions Only			
Effective Size			
PERFORMANCE INDICES			
Cost Performance Index (CPI)	0.80		
Schedule Performance Index (SPI)	0.81		
Composite Performance Index (XPI)	0.81		
Time Performance Index (TPI)	0.90		
VARIANCE			
Cost Variance (CV) (Hours)	-1,038		
Schedule Variance (SV) (Hours)	-968		
Time Variance (TV) (Months)	-0.97		
ACCOMPLISHMENTS			
Hours thru Latest Snapshot	5,200		
Cost thru Latest Snapshot	502,895		
Earned Value thru Latest Snapshot	4,162		
Earned Value % thru Latest Snapshot	31.51%		
Planned Hours thru Latest Snapshot	5,131		
Projected Productivity Lines/PM	61.94		
Projected Productivity Functions/PM	0.73		



SEER-PPMC: Basic (EVM) Mode
Overrun Not as Apparent

Data Value	Baseline Estimat		
Development Schedule Months		16.77	4%
Development Effort Months		93.73	8%
Development Effort Hours	1	14,247	8%
Development Base Year Cost	1,27	1,377,824	8%
Start Date	2/	2/02/04	
Completion Date	6/		
Effective Lines Only		1,602	
Effective Functions Only		78	
Effective Size		6,675	
PERFORMANCE INDICES			
Cost Performance Index (CPI)	0.80		
Schedule Performance Index (SPI)	0.81		
Composite Performance Index (XPI)	0.81		
Time Performance Index (TPI)	0.90		
VARIANCE			
Cost Variance (CV) (Hours)	-1,038		
Schedule Variance (SV) (Hours)	-968		
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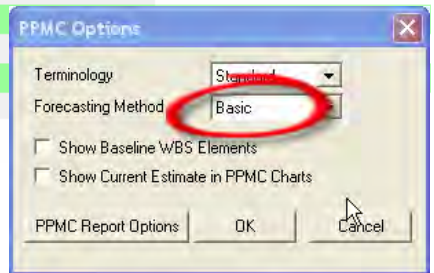
Planned Hours thru Latest Snapshot			
Projected Productivity Lines/PM			
Projected Productivity Functions/PM			



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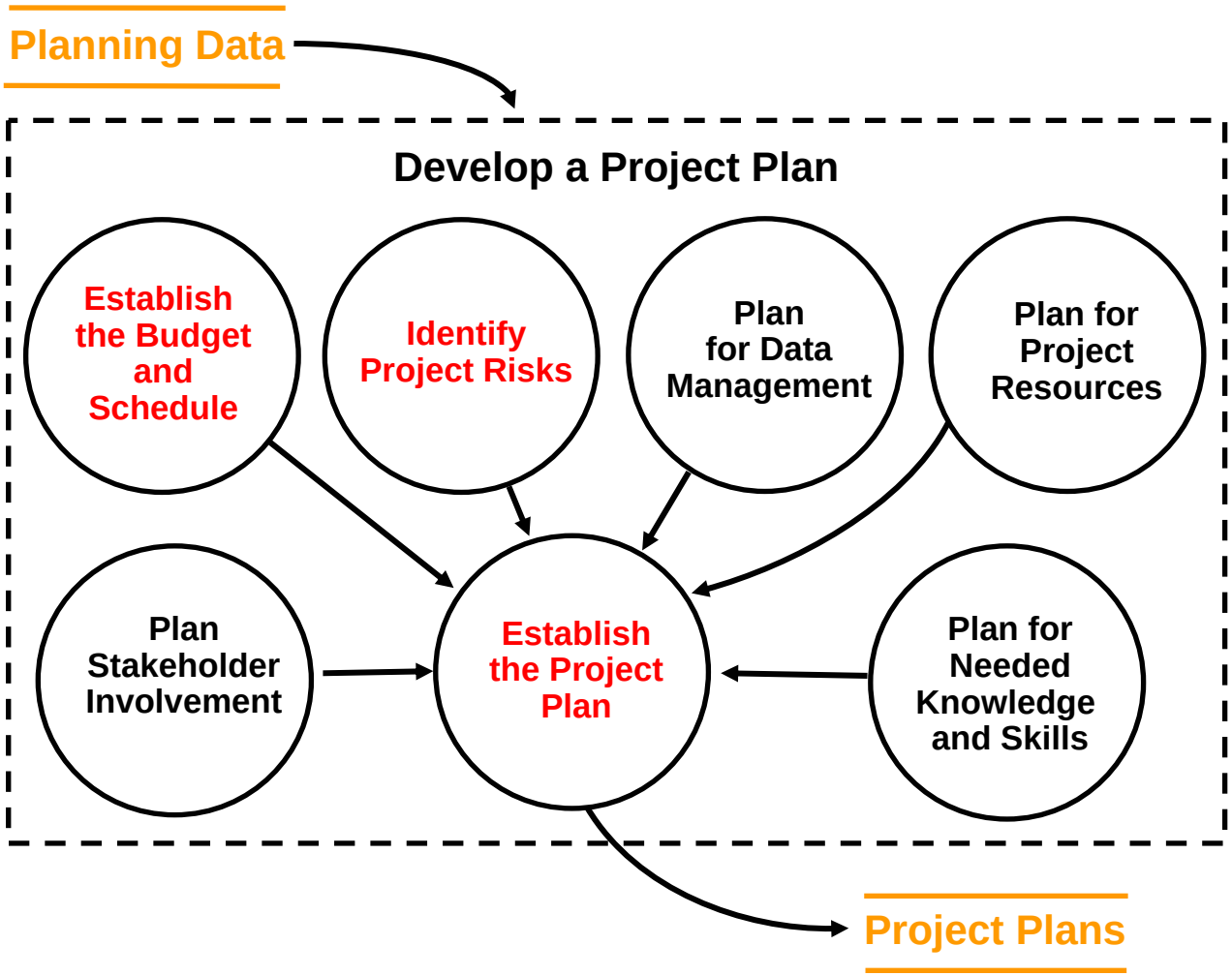
CMMI Project Planning Requires Schedule & Effort Estimation & Planning – Context Source CMMI Tutorial



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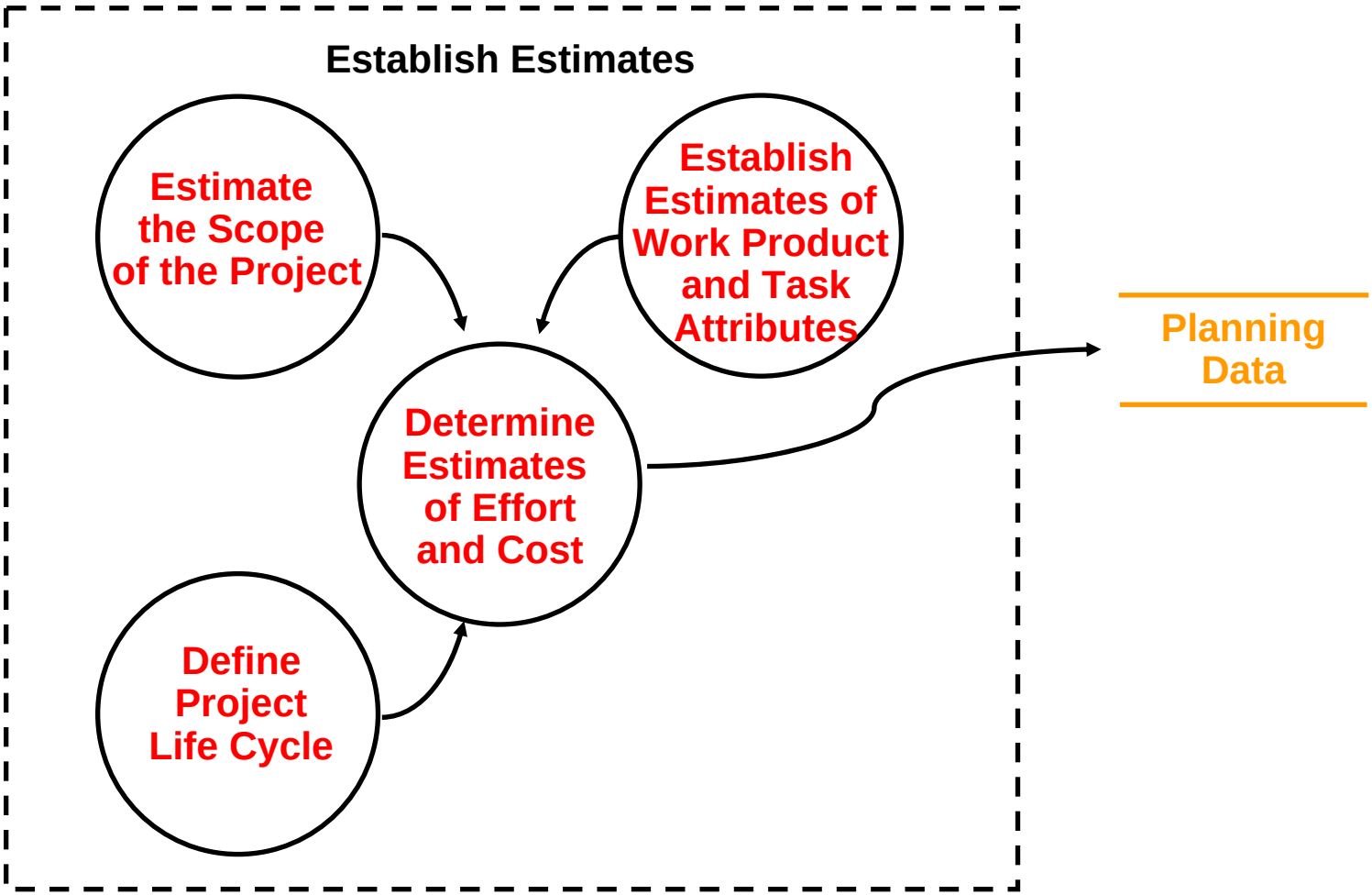
CMMI Estimation Requires Effort, Schedule, Scope – Context Source CMMI Tutorial



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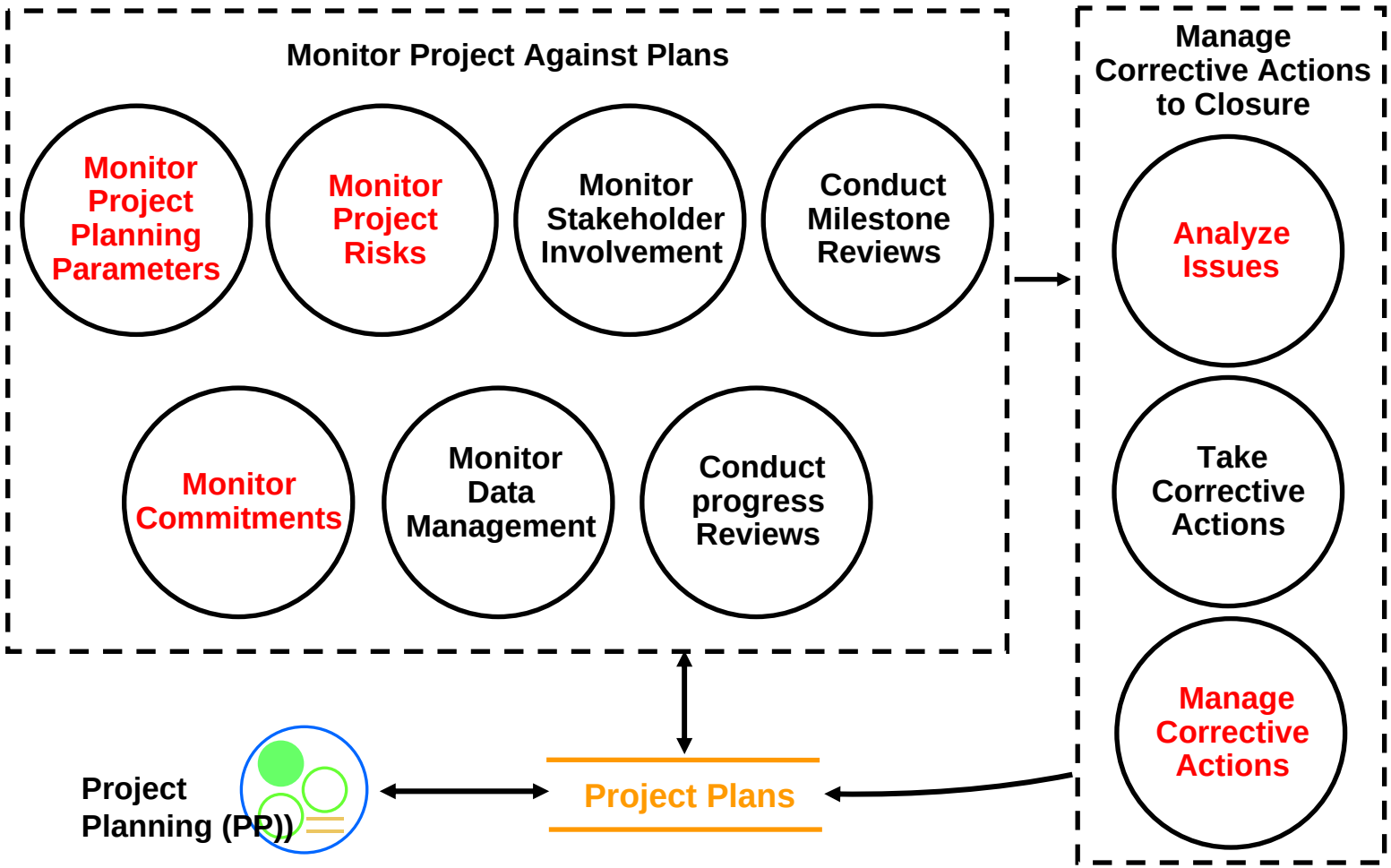
CMMI Project Monitoring & Control – Context

Source CMMI Tutorial



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The First Step To EVM Is A Workable Plan for Cost & Schedule

"…Using EVM properly puts a considerable burden on team members to plan and schedule projects -- skills often in short supply at federal agencies"

… Norman Enger, OMB

http://www.fcw.com/article91403-11-14-05-Print

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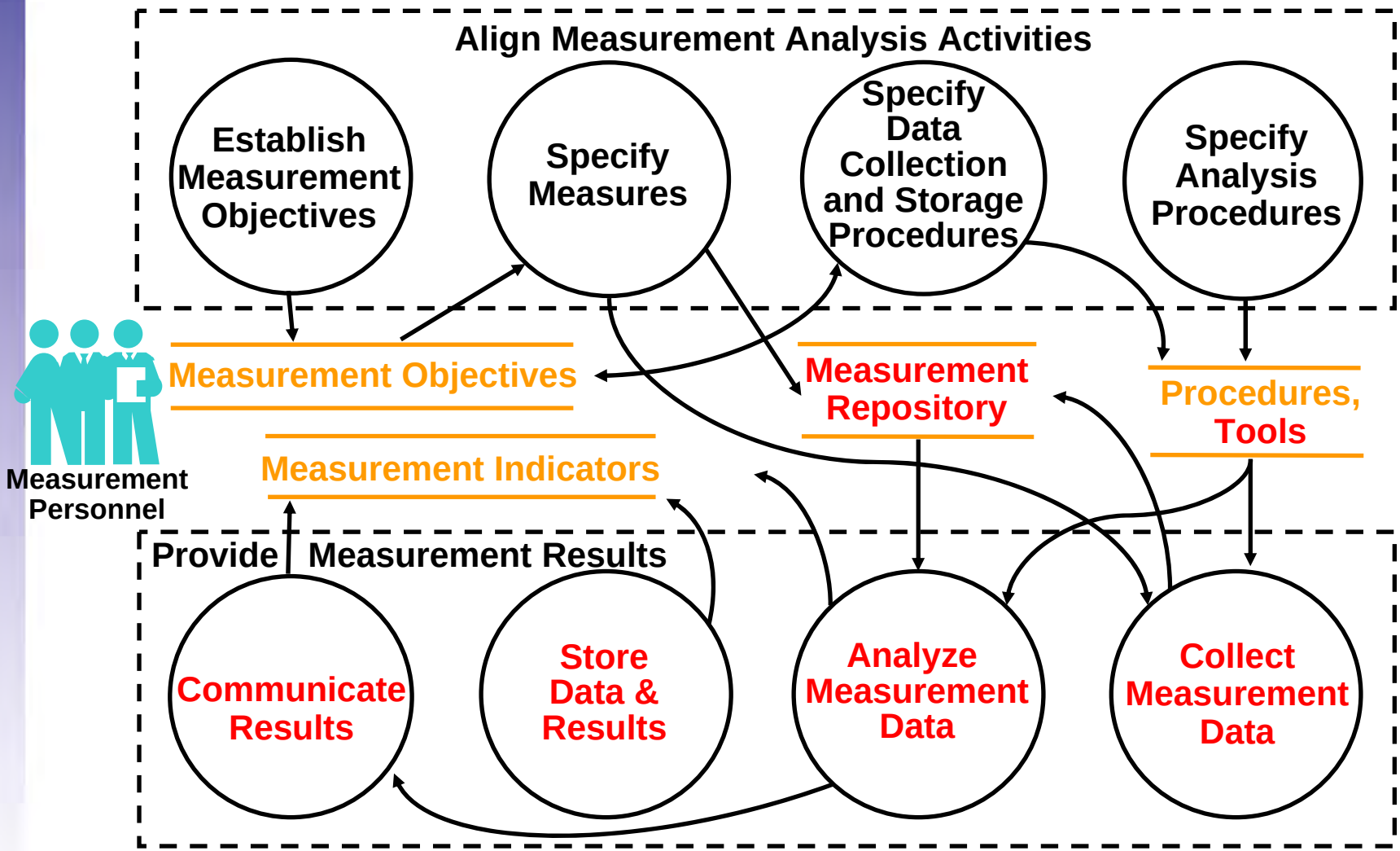
CMMI Measurement & Analysis – Context: Source CMMI Tutorial



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Risk Management Source: CMMI Tutorial

- **Purpose:**
  - Identify potential problems before they occur, so that risk handling activities may be planned and invoked as needed across the life of the product or project to mitigate adverse impacts on achieving objectives
- **SEER Provides the cost & schedule impacts of such risk**
- **According to Mike Evans “We can tell them they have a problem. SEER can quantify what the impact is”**

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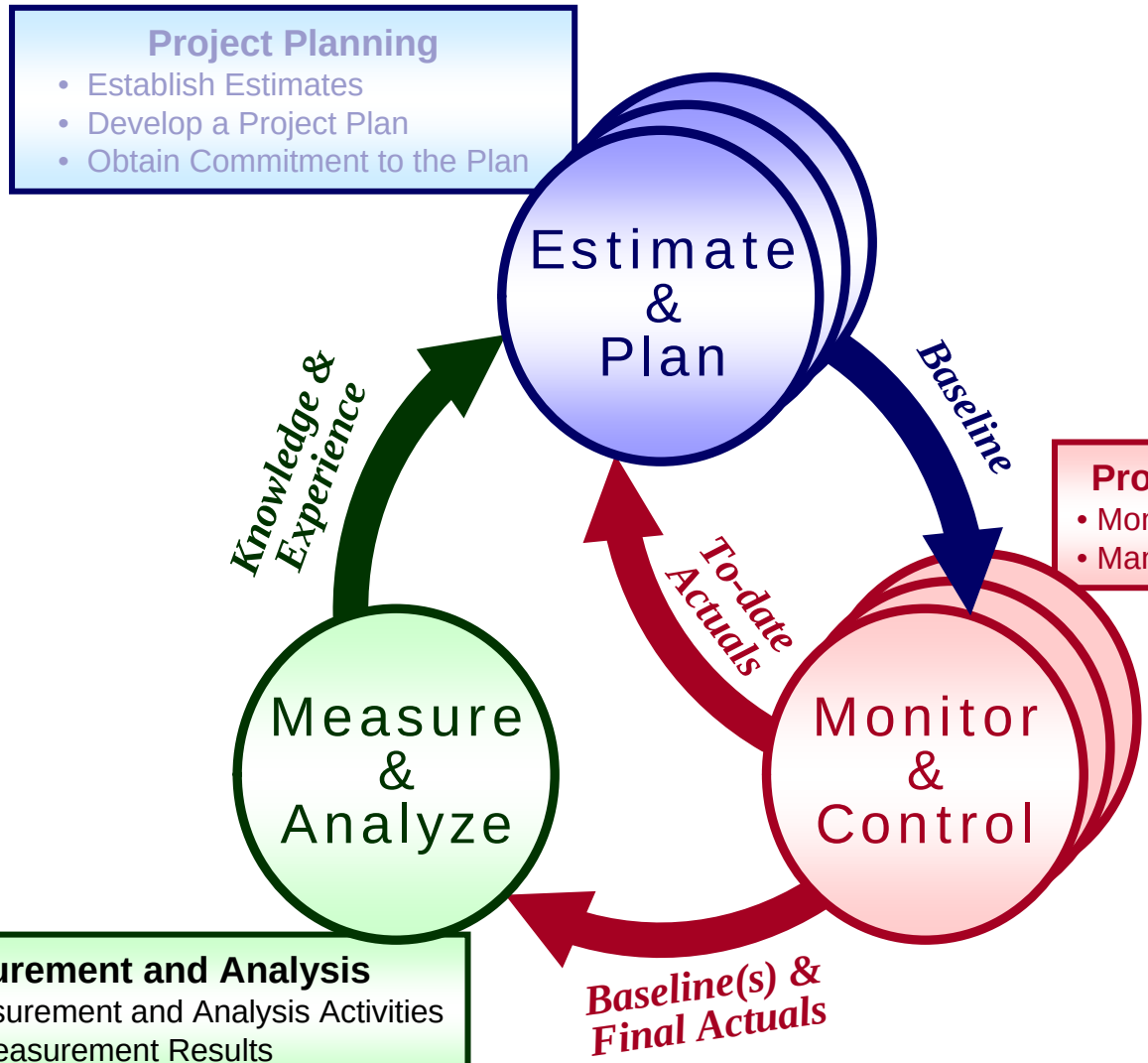
CMMI Key Process Areas Require Estimation With Feedback



✓**Foundation of Risk Management &**
✓**Quantitative Project Management**

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Performance Measurement: Earned Value Analysis Can Make Projects More Successful

- **"Earned Value Analysis" is an industry standard way to:**
  1. measure a project's progress
  2. forecast its completion date and final cost
  3. provide schedule and budget variances along the way.

- **Provides consistent, numerical indicators with which you can evaluate and compare projects**

- **Earned value (Performance Measurement) techniques are just as viable using effort for root level project management**
  - Effort Value – units of labor; e.g.:
    - person-hours, staff-hours, effort-hours, labor-hours
    - person-months, staff-months, effort-months, labor-months

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Earned Value Measures Support CMMI Tracking & Control

Source: PMBOK & Galorath

- *Baseline Budget* **– Budget at Completion (BAC)**
- *Planned Value* – **Budgeted Cost of Work Scheduled (BCWS aka PV)**
  - Planned Value: Budgeted cost for work scheduled to be completed up to a given point in time
- *Earned Value* – **Budgeted Cost of Work Performed (BCWP aka EV)**
  - Progress: Budgeted value for work actually completed during a given time period.
- *Spent* – **Actual Cost of the Work Performed (ACWP aka AC)**
  - Actual cost (AC) - Total cost accomplishing work during a given time period.

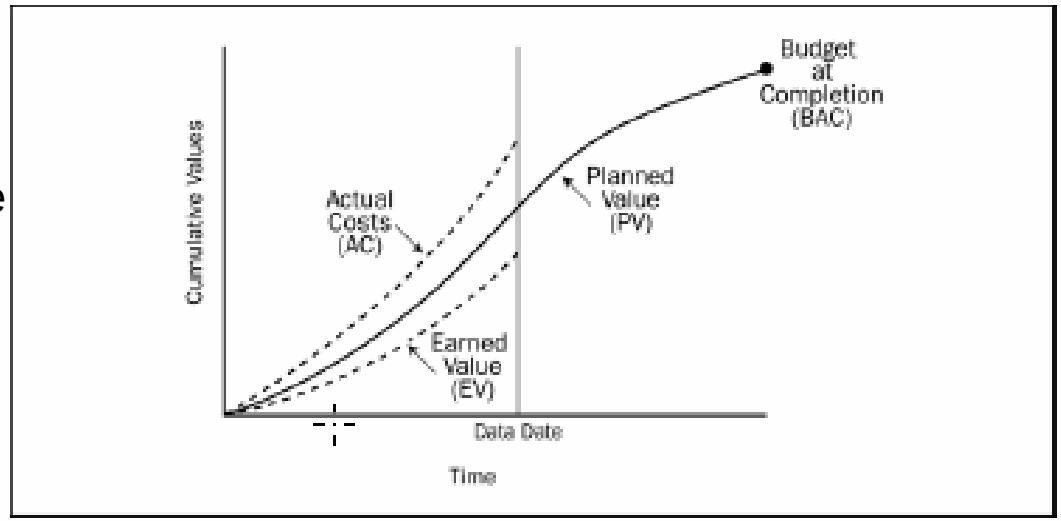

Figure 7-7. Illustrative Graphic Performance Report

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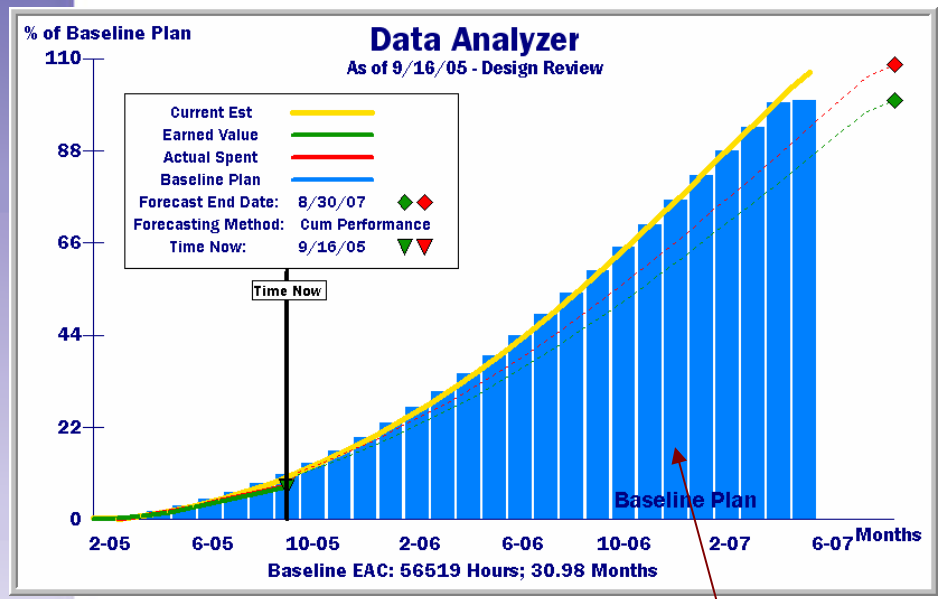
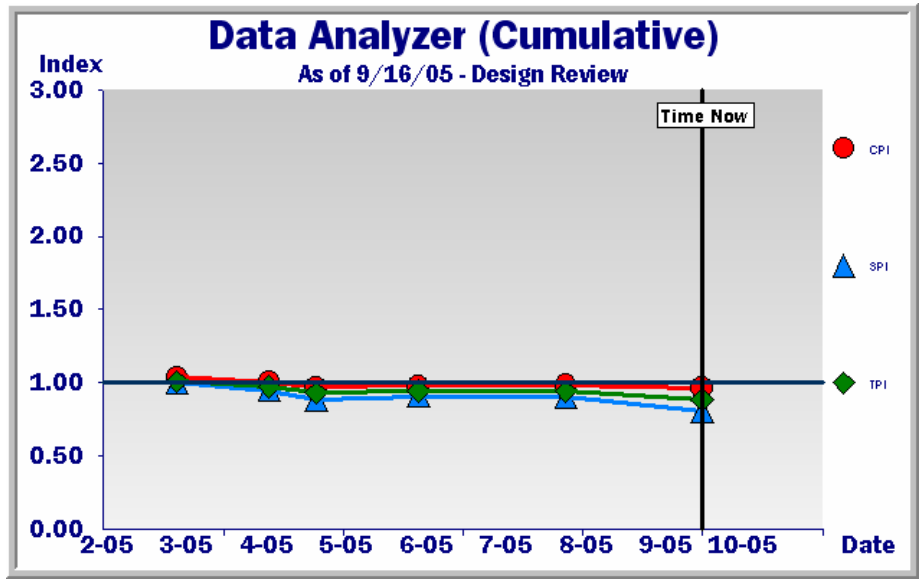
Looking at Progress Over Time

See how actual and earned effort measure up to the baseline plan

See CPI, SPI and TPI trends over time





Month	19	
Date	Jan-06	
METRIC	BASELINE	CURRENT
Plan % comp	54.6 %	54.6 %
Earned Value %	47.1 %	47.1 %
Actual (spent) %	56.7 %	56.7 %
Total Hours	51,165.4	
Schedule	26.9	
Constraint	MIN TIME	

Click on any month to see specific information

CPI = Cost Performance Index;

The ratio of earned to actual cost of work performed

SPI = Schedule Performance Index;

The percent of the investment that has been completed

TPI = Time Performance Index;

The ratio of elapsed time from start to plan & start to time-now

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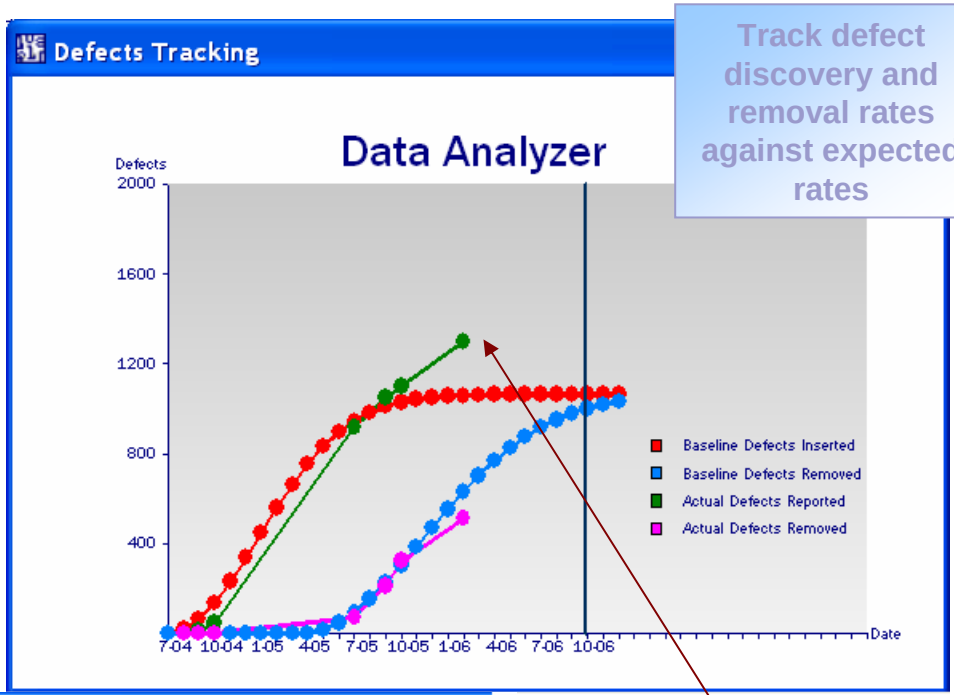
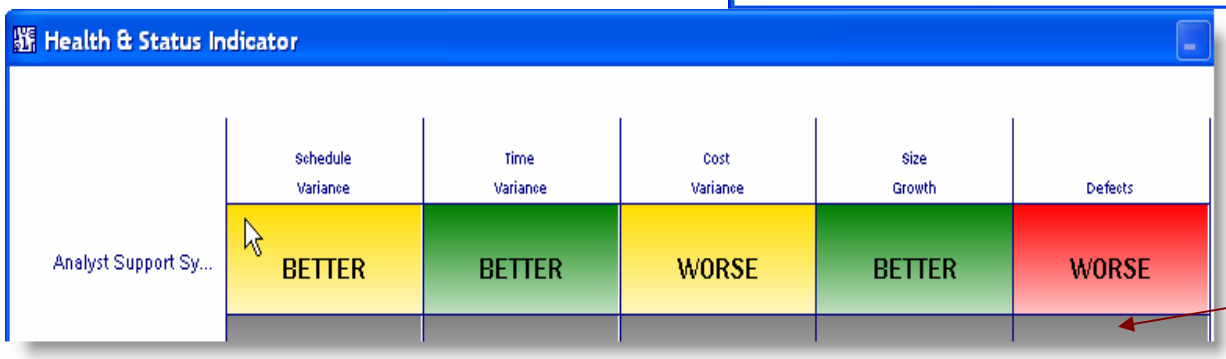
Defects and Growth Impact Software Process

Track defect discovery and removal rates against expected rates



Heath and Status Indicator shows status and trends from the previous snapshot

Thresholds are user definable



Increased defect reporting rate shows a worsening trend

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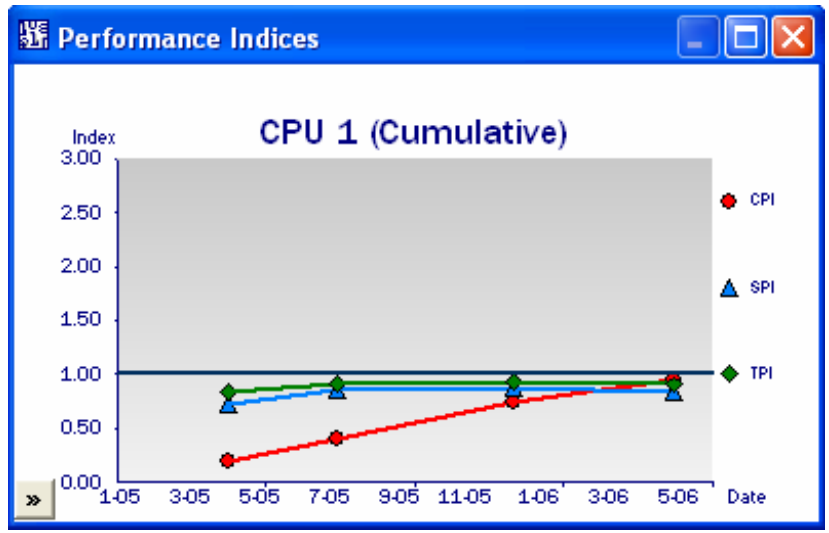
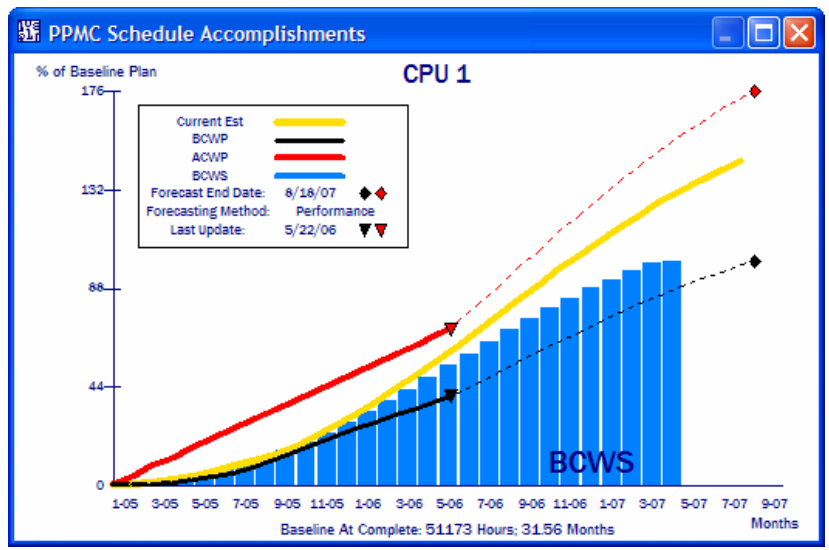
Parametric Project Monitoring & Control

Provides Performance Measurement aspects of ANSI/EIA-STD-748

- Adds Performance Measurement (*Earned Value*) methods to SEER-SEM
- Accepts progress & expenditure inputs
- Provides cost, schedule, and time variances
- Provides cost, schedule, & time indices
- Performance-based cost & schedule Estimate at Completion
- Displays health and status indicators





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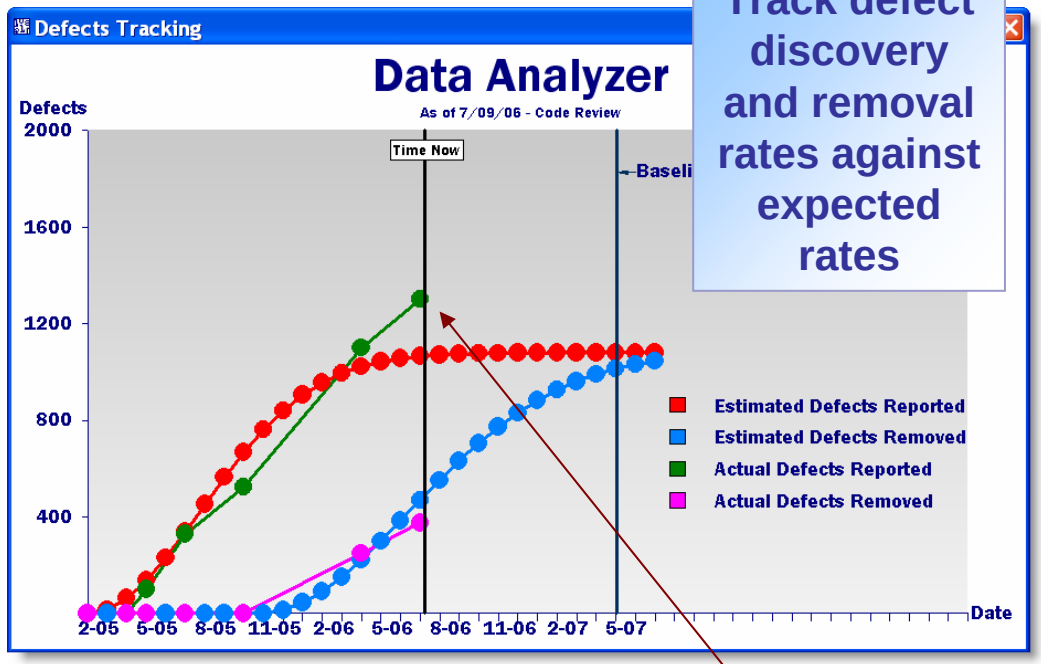
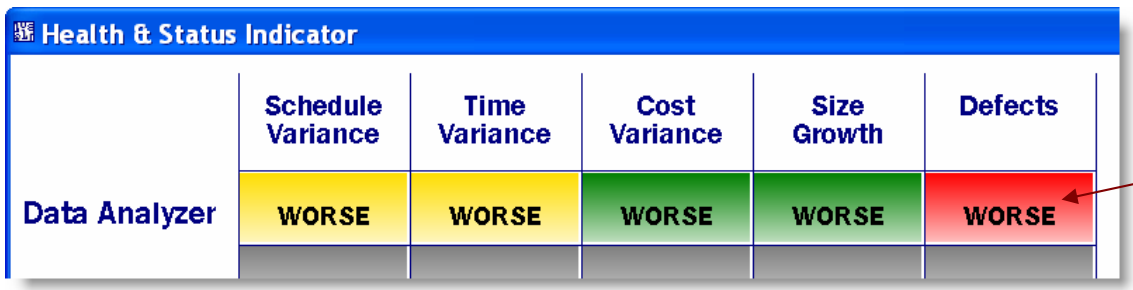
Defects & Size Growth Are Additional Core Metrics

Track defect discovery and removal rates against expected rates



Heath and Status Indicator shows status and trends from the previous snapshot

- Including Size Growth and Defect Discovery/Removal Rate
- User defined control limits to control the transition between red-yellow-green



Increased defect reporting rate shows a worsening trend

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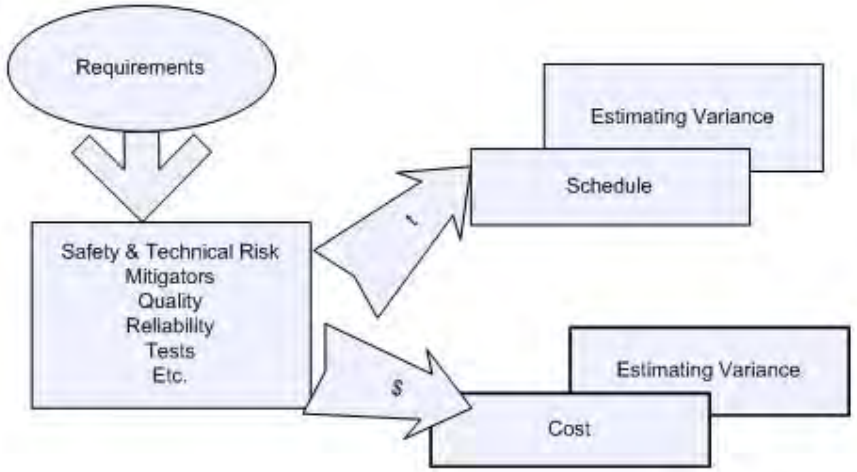
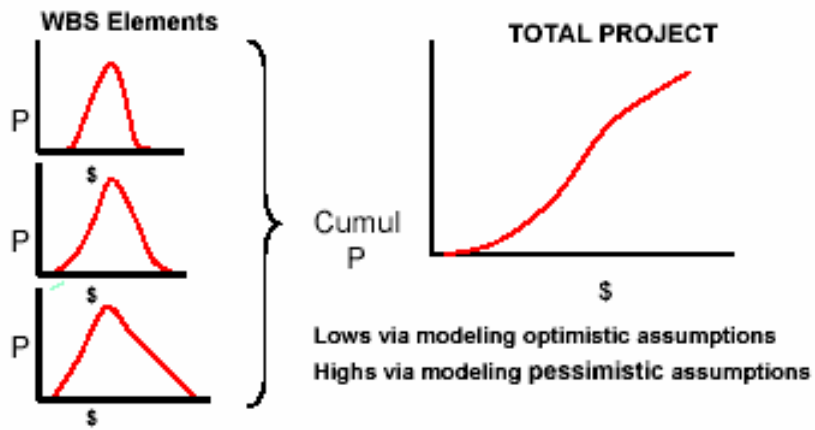
"Dollarizing" Risks
Source J. Hamaker

Risk Areas

- Technical / Performance / Engineering
- Schedule
- Cost
- Safety





- Estimates are really probability distributions
- Sources of uncertainty
  - Project uncertainties
  - Model variance
  - Cost / risk analysis quantifies budget / plan with acceptable confidence levels

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Parametric Modeling Supports CMMI

- **Parametric Cost Estimating Methods**
  - Estimating methods based on physical or performance characteristics and schedules of the end items
- **Parametric Estimation Model Definition**
  - Mathematical representation of parametric estimating relationships that provides logical, predictable correlation between the physical or functional characteristics of a system, and the resultant cost, schedule, and other attributes of the system.
    - Comprised of cost estimating relationships (CERs) and other parametric estimating functions, e.g., cost quantity relationships, inflation factors, staff skills, schedules, etc.
    - Provides logical repeatable relationship between input variables and resultant cost

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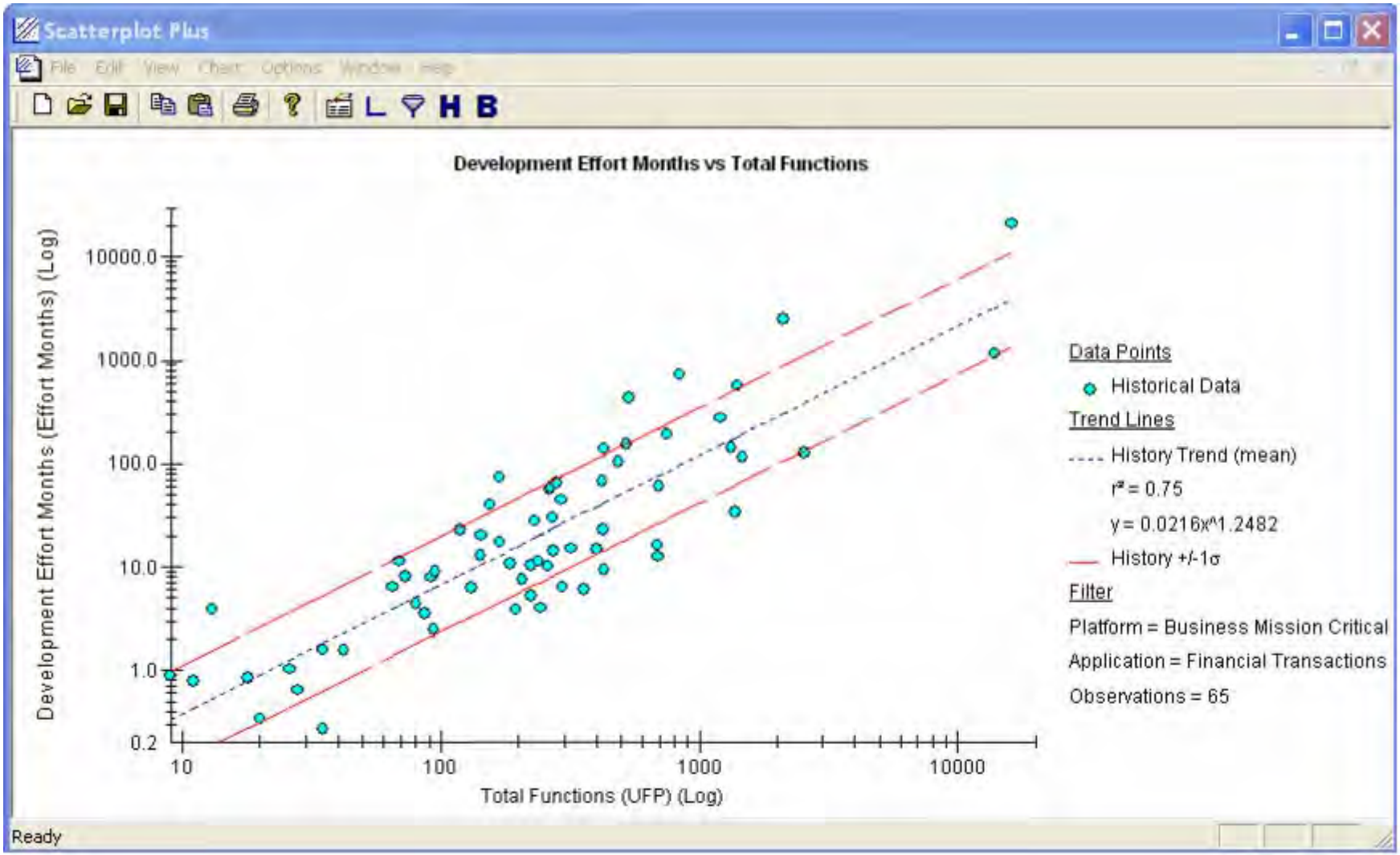
Example Simple Cost Estimating Relationship (CER) Shows Effort Based On Size



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Uncertainty and Risk
(Source Q. Redman)

- **A Point Estimate is never correct!**
- **There is always potential variability in inputs.**
- **But…**
  - 26% of program managers do not accept risk assessment at all, not even "slightly".*
  - 44% of risk ranges are intuitive judgments, without historical data or guided-survey.*

	Low	Nominal	High
Advanced Development - Total	**68,348**	**97,132**	**257,492**
Government In-House Costs @ 35%	17,720	25,182	66,757
Advanced Development - Contractor	**50,628**	**71,950**	**190,735**
Program Management	2,448	5,103	19,100
System Engineering	4,805	7,731	33,425
Design Engineering	4,526	9,980	33,193
Hardware Manufacturing (Prototype)	24,150	**25,421**	27,963
Software Development	14,064	**14,805**	16,285
Tooling and Test Equipment	45	1,034	13,847
System Integration	0	1,880	11,937
System Test and Evaluation	453	3,541	20,532
Data	136	1,013	6,526
Training	0	288	2,547
Facilities	0	627	2,865
Spares	0	528	2,515

	Low	Nominal	High
System Develop. & Demo. - Total	**184,881**	**273,557**	**361,292**
Government In-House Costs @ 35%	47,932	70,922	93,668
System Develop. & Demo. - Contractor	**136,949**	**202,635**	**267,623**
Program Management	2,448	17,285	19,100
System Engineering	13,155	17,547	33,425
Design Engineering	16,093	21,952	33,193
Hardware Manufacturing (Prototype)	85,865	**90,385**	99,423
Software Development	18,753	**19,740**	21,714
Tooling and Test Equipment	45	2,866	13,847
System Integration	0	6,368	11,937
System Test and Evaluation	453	11,993	20,532
Data	136	3,432	6,526
Training	0	6,623	2,547
Facilities	0	2,123	2,865
Spares	0	2,323	2,515

	Low	Nominal	High
Procurement - Total	**2,149,874**	**3,162,081**	**6,722,475**
Government In-House Costs @ 25%	429,975	632,416	1,344,495
Procurement - Contractor	**1,719,899**	**2,529,665**	**5,377,980**
Program Management	36,007	116,424	551,182
System Engineering	18,003	98,129	367,455
Design Engineering	0	28,274	124,935
Hardware Manufacturing	1,497,878	**1,576,714**	1,734,385
Software Development	77,994	**82,099**	90,309
Tooling and Test Equipment	18,003	83,576	367,455
System Integration	18,003	107,276	367,455
System Test and Evaluation	23,404	144,698	492,389
Data	3,601	33,680	110,236
Training	9,002	30,769	80,840
Facilities	0	7,484	36,745
Spares	18,003	142,703	551,182
Operational Site Activation	0	77,838	503,413

	Low	Nominal	High
O&S Costs - Partial Total	4,241,190	5,173,716	8,377,451
Fielding	747,220	913,742	1,485,838
Sustainment (O&S)	2,689,990	3,289,472	5,349,016
Spares and Repair Parts	747,220	913,742	1,485,838
Personnel	56,760	56,760	56,760

*U.S. Aerospace Risk Analysis Survey, Hollis M. black, III, SCEA Estimator October 1999

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7 Characteristics of a Dysfunctional Software Project (Source: Mike Evans, et al.)

- Failure to Apply Essential Project Management Practices 57%
- Unwarranted Optimism and Unrealistic Management Expectations 41%
- Failure to Implement Effective Software Processes 30%
- Premature Victory Declarations 20%
- Lack of Program Management Leadership 13%
- Untimely Decision-Making 8%
- Lack of Proactive Risk Management 3%

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Estimation Lessons Learned

- **The longer the development schedule the higher the risk of key personnel turnover**
- **EVM shouldn't be used alone**
  - Other metrics are necessary to be kept in concert with the EVM metrics in order to keep a project on track
- **Measure early**
  - Before trouble
  - Early milestones that are under-budget are not necessarily a good sign
  - Programs that skimp on the early, upfront planning; requirements and design work, will most likely be in trouble later.
- **Follow known, proven development processes**
- **Estimation, planning, tracking, controlling – then using the information to do better next time**
- **Recognize that you have a problem**

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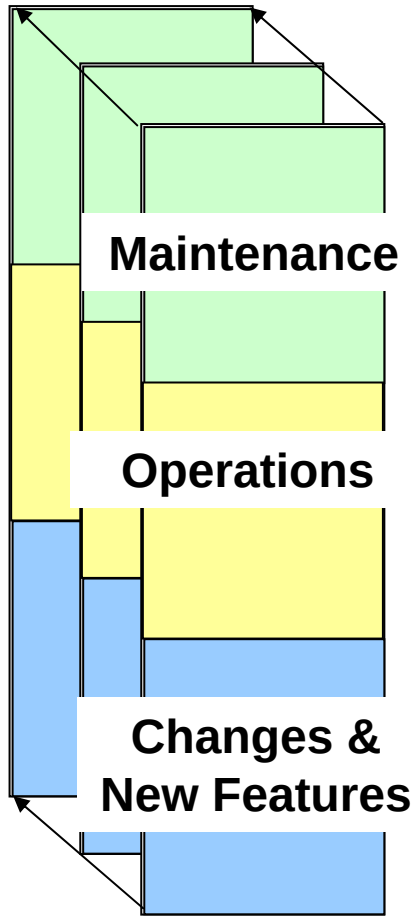
BAE SYSTEMS

Engineering in a Non-Development Environment

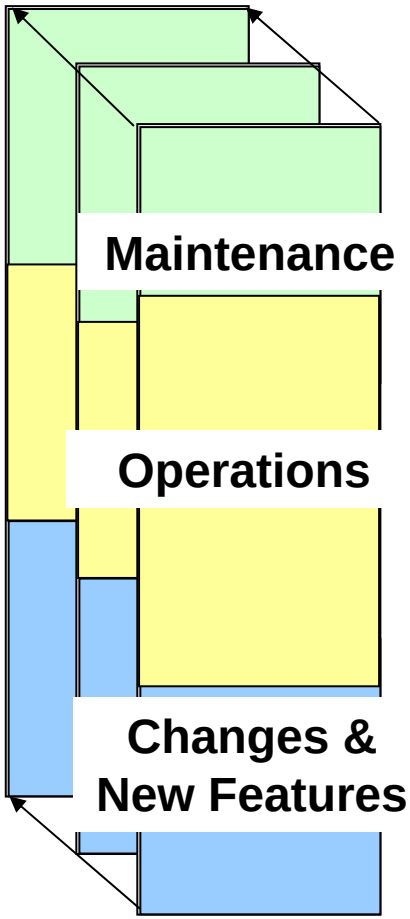
Kathy King and Thomas Zience

Challenges in a Level of Effort Services Organization - 1

- CMMI Challenges
  - **Inability to develop an Organizational Set of Standard Processes** – Little commonality among contracts
  - **Inability to establish a project's defined process -** Customer mandated processes, procedures and tools
  - **Little or no engineering –** Fixes to existing functional architecture



Challenges in a Level of Effort Services Organization - 2



- Business Challenges
  - **Fixed staffing levels with changing workload demands**
    - Help desk call volume
    - Inherited legacy system problems
    - Service Level Agreement requirements
  - **Inability to share best practices –**
    - Customer controlled processes
    - Lack of commonality among contracts
  - **Environment challenges**
    - 24-7 operation
    - Remote, local, pager support

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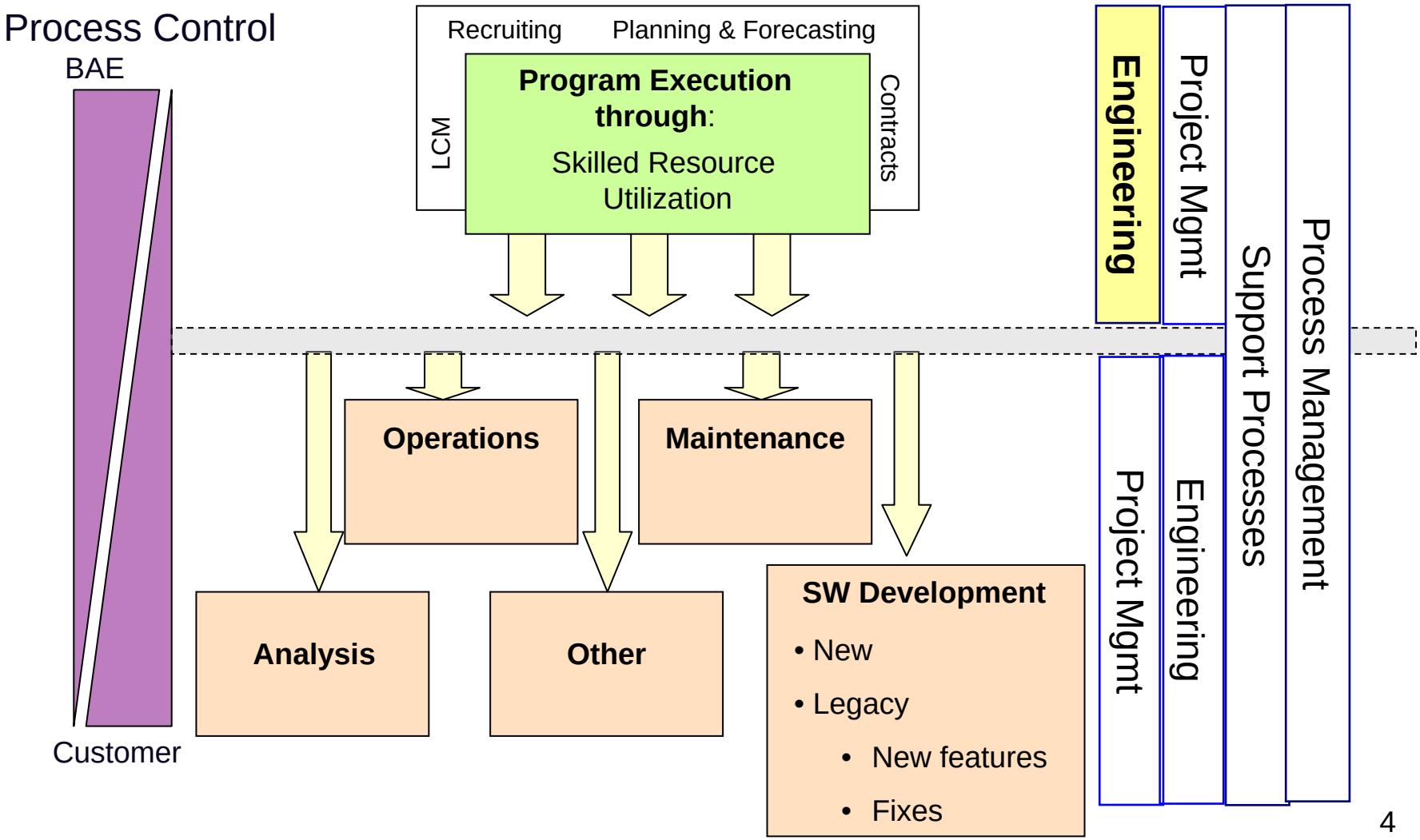
Integrating Engineering Practices at the Top Level



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Skilled Resource Utilization Processes

- Describe business activities
- Five basic processes
  - Define the Work
  - Design the Staffing Solution
  - Fill the Positions
  - Define the Project Approach
  - Monitor and Control
- SRU processes integrate the Project Management, Engineering, and Support Process Areas (PAs)

BAE SYSTEMS

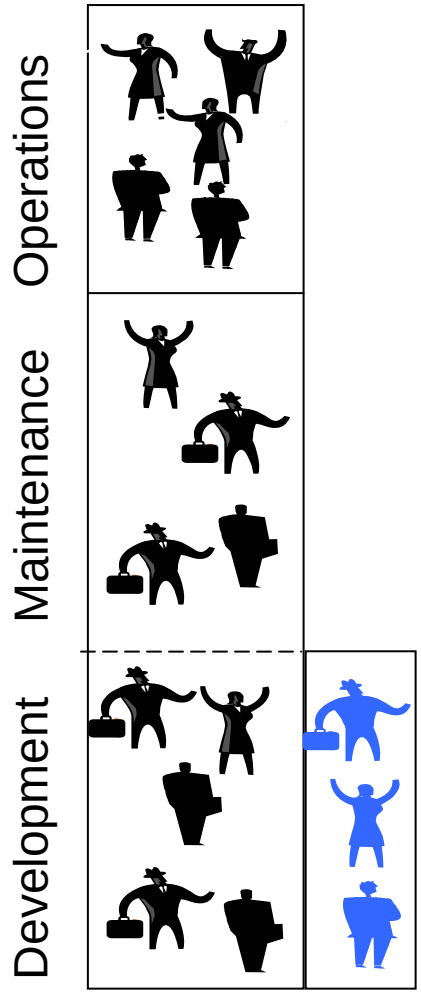
Interpreting Key Terms in the Model

Project	Funding period
System/Product	Staffing Solution
Product Components	Staff Member with specific skills
Functional Architecture	Service Architecture
Interface Requirements	Requirements for Interfaces with Customer, other Teams, and Other Staff Members
Technical Data Package	Skills, Certifications, and Clearances

BAE SYSTEMS

Requirements Development

- Customer Requirements and Expectations
  - Staffing number with specified skill sets
  - Service Level Agreements (SLAs)
  - Services to be performed
  - Staffing Constraints
- Con ops and functional architecture
  - Description of services, relationships and interfaces
  - Environment - multiple contractors, shifts, travel
- Analysis of requirements
  - Necessary and sufficient?
  - Balance (cost and workload variability)
- High interaction with other PAs
  - Technical Solution
  - Validation



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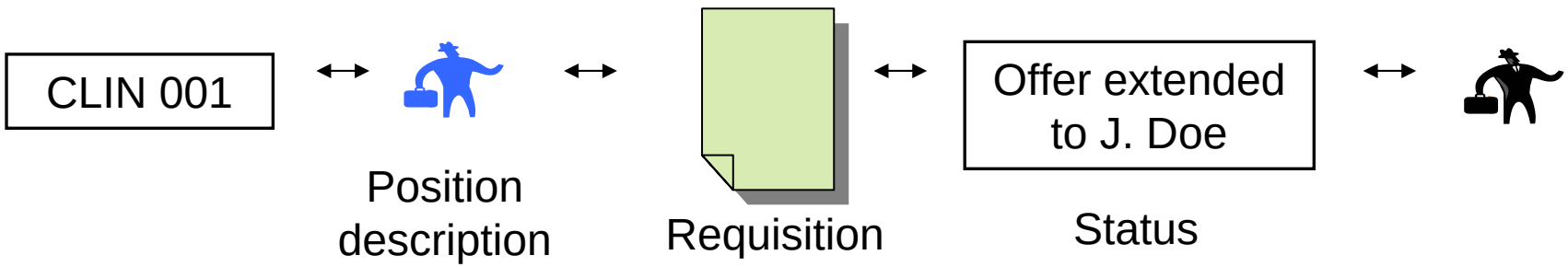
Requirements Management

- Requirements include
  - Customer requirements – staff numbers and skills, SLAs
  - Derived requirements – based on design of staffing solution, validation activities – may include non-staff resources
- Requirements traceability matrix maps requirements to individuals
- New or changed requirements for staff are analyzed using the Requirements Traceability matrix
  - Reassignment of existing staff
  - New hire requisitions (may change based upon experience)



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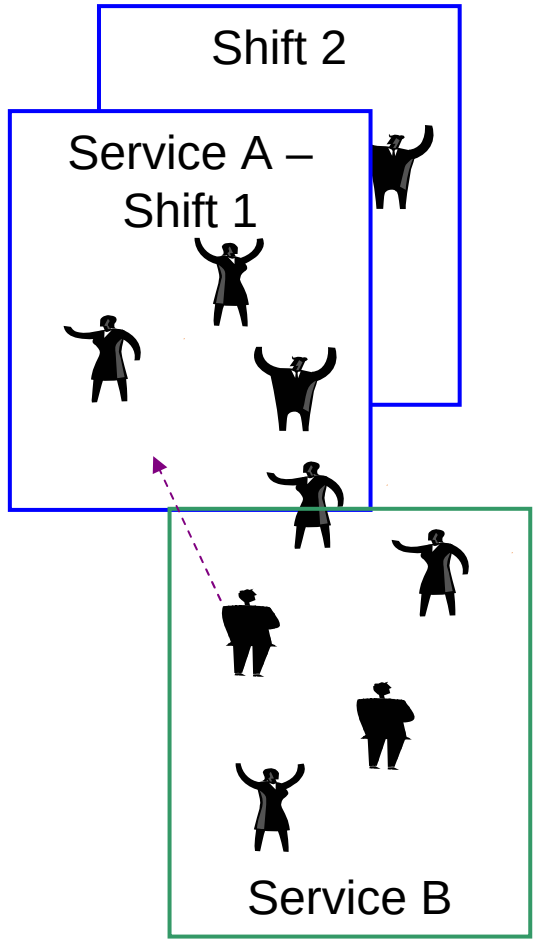
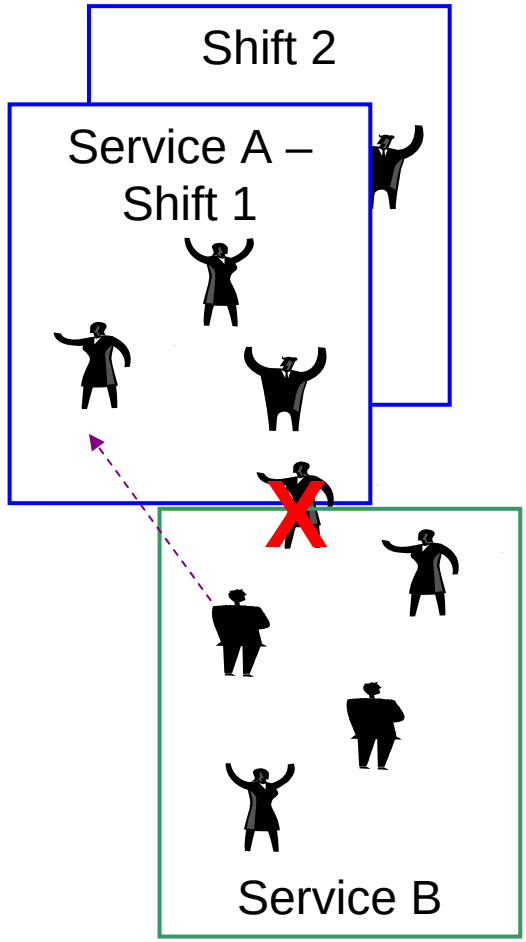
Technical Solution

- Design of staffing has two perspectives
  - Individual staff – skill, experience level
  - Total staffing solutions
- Design factors
  - Position to skill match – primary and backup
  - Positions may be mapped to multiple requirements
  - Shift schedules – overlap and rotation alternatives
  - Presence – on-site, remote, pager
  - Emergency procedures
- Non-staff resources may be part of design, e.g. tools
- When applied
  - Initial
  - Based on validation results - workload variation, additional skills
  - Attrition
  - Perceived future trends



Technical Solution (cont.)

- Implementation involves acquisition of resources
  - Transfers
  - Hiring
  - Supplier Agreement Management applies -
    - Staff are considered product components
    - Non-staff resources, e.g. tools, pagers
- Design constraints
  - LOE limitations
  - Contract specifications



Product Integration

- Product Integration strategy – staged integration of staff and other resources into customer environment
  - Over time
  - Across shifts
  - Across geographical locations
- Readiness of products for integration – ability to bring staff on board
- Interface specifications – part of the communications plan
- Assemble the product components – staff members
  - Orientation and security briefings
  - Mentor assigned
- Evaluation of assembled product
  - Verification of skill level
  - Non-staff support resources (e.g. pagers, or phone call transfers)

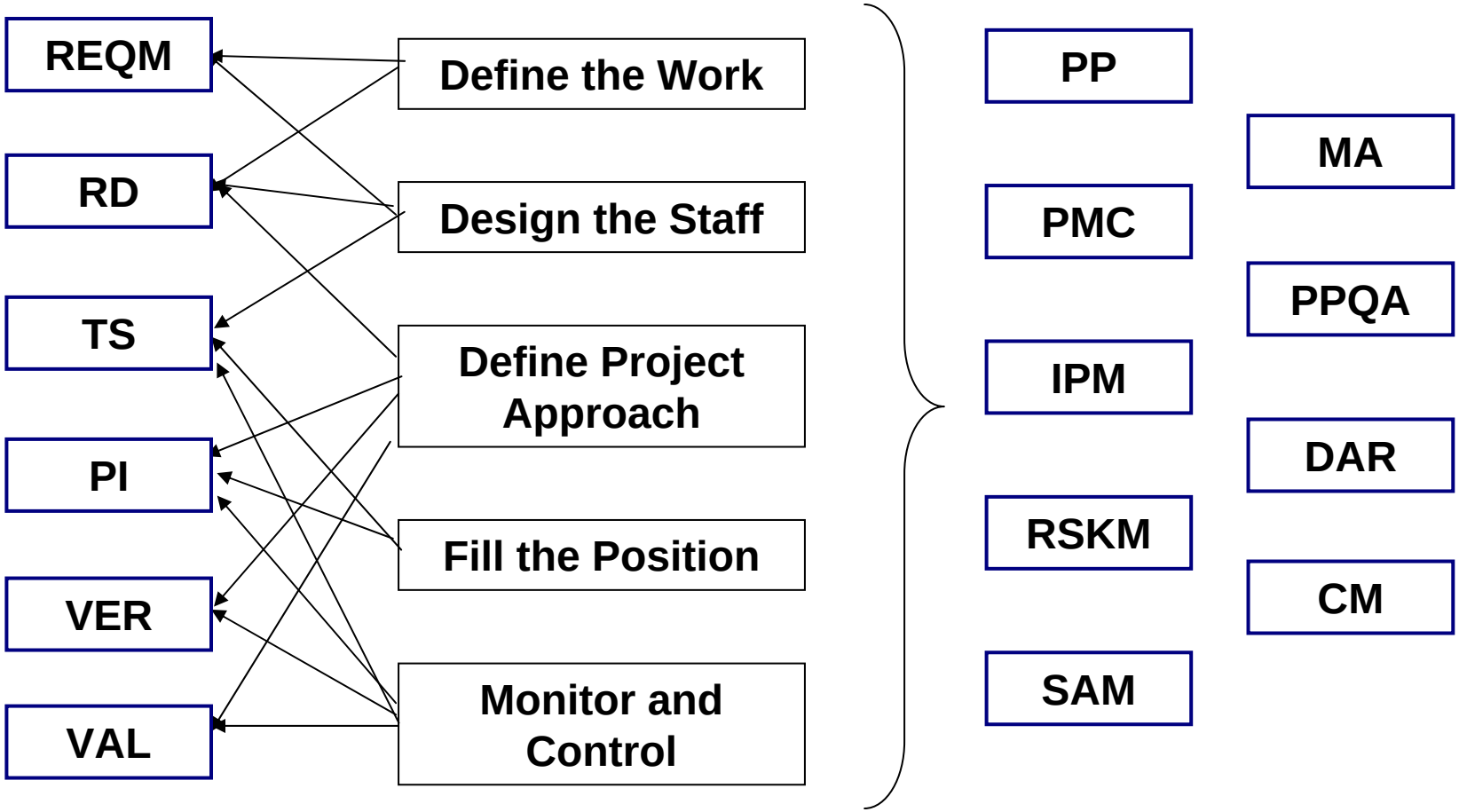
Verification

- Verification - Staffing satisfies contract requirements – what the customer states is required
  - Staffing levels
  - Cost
  - SLAs
- Defect analysis and resolution
  - Upgrading staff skills
  - Reassignment or scheduling
- Peer reviews
  - Mostly performed on plans
  - Internal transfers – assignments panel
  - Staffing candidates – candidate evaluation form

Validation

- Satisfaction of customer expectations – what we determine is needed beyond customer stated requirements
- Probably the most important Process Area in a services environment
  - Ultimate project success – ability to retain staff
  - Growth in business with customer
- Are the contract requirements sufficient for success?
  - Can SLAs be met with current staffing solution?
  - Is staffing design sustainable?
  - Plan for Award/Incentive fee
- Performed throughout the contract period – at least monthly
- May result in
  - Redesigning the staffing solution
  - Incorporating non-staff resources into design

Mapping Our Process to CMMI



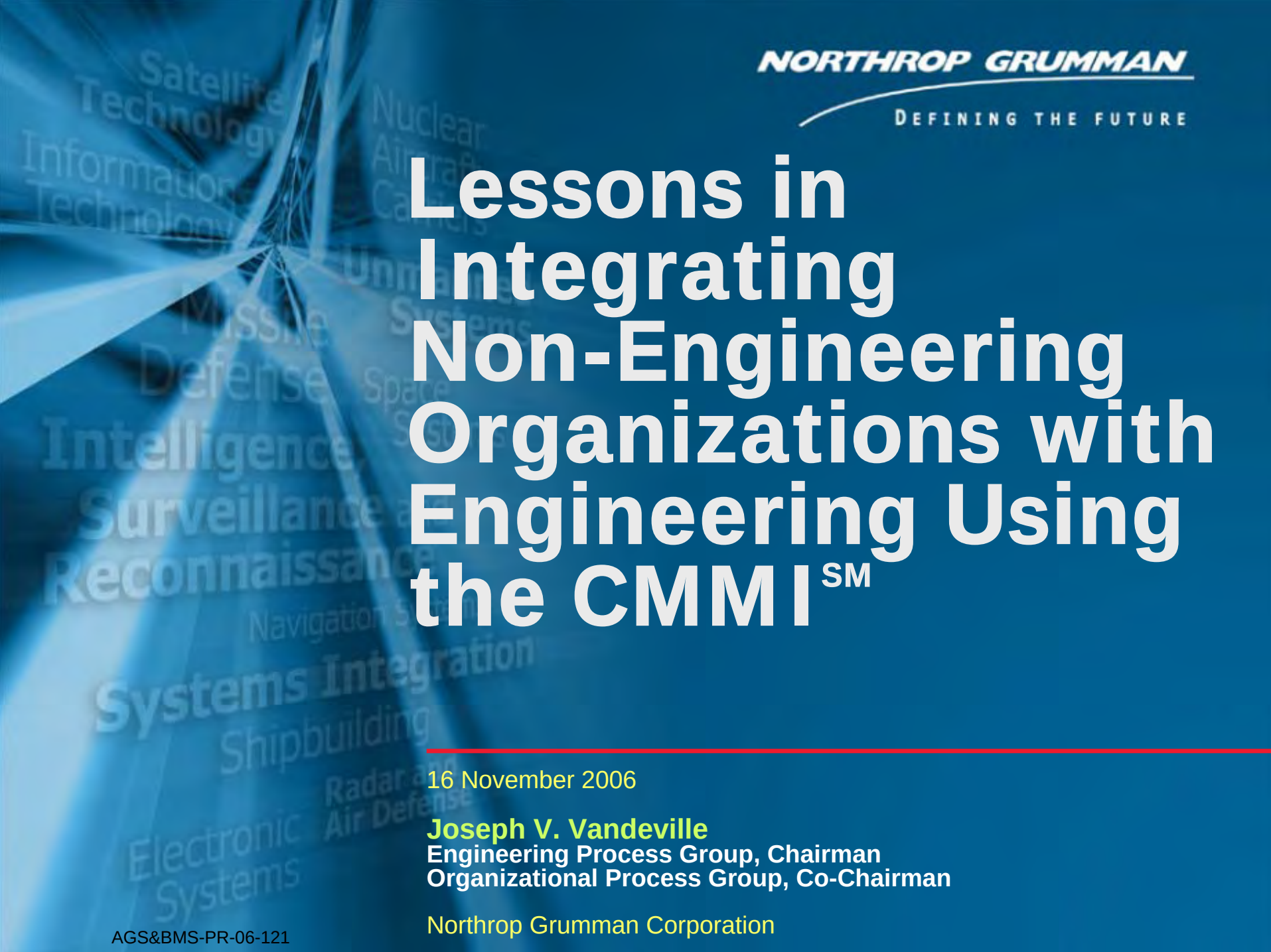
Summary

- Engineering Process Areas add rigor to designing and managing staff solutions in an LOE Services environment
- Benefits of Integrating the Engineering and Project Management Process Areas above the line
  - Relieved confusion with similarly name below the line processes
  - Led to a business driven process architecture
  - Opened new opportunities for business driven improvements beyond project teams – recruiting, finance and planning
- Engineering Process Areas with the greatest impact to business
  - Technical Solution – ability to design complex staffing solutions
  - Validation – evaluate and improve staffing solutions
- Appraisal challenges
  - Quality Assurance is performed on SRU processes
  - Appraisal requires Process Area goal satisfaction

BAE SYSTEMS

Contact Information

- Kathy King – BAE Systems Information Technology
  - kathy.king@baesystems.com
- Thomas Zience - BAE Systems Information Technology
  - thomas.zience@baesystems.com



Lessons in Integrating Non-Engineering Organizations with Engineering Using the CMMI℠

16 November 2006

Joseph V. Vandeville
Engineering Process Group, Chairman
Organizational Process Group, Co-Chairman

Northrop Grumman Corporation

AGS&BMS-PR-06-121

Topics

- **Overview Of Our Organization And Process Improvement History**
- **Organizational Scope**
  - Different Views
  - Restricted Scope For Materiel
- **Shared Vision**
  - Our Definition
  - Shared Vision Flow-down
- **Organizational Process Areas**
  - Integrating Them
  - Supporting Infrastructure
- **Checking The Extent Of Integration**
- **Continuing To Grow**
- **Summary Of What We Learned**

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Corporate Overview

- **Comprehensive business portfolio to address the defense and government markets**
  - Systems integration
  - Military aircraft
  - Unmanned aerial vehicles
  - C4ISR
  - Defense electronics
  - Information technology and networks
  - Naval shipbuilding
  - Space and missile defense
- **2005 sales of $30.7 billion**
- **125,000 people; 50 states; 25 international countries**
- **Headquartered in Los Angeles, CA**

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Northrop Grumman Integrated Systems

Electronic Systems	Information Technology	Integrated Systems	Newport News	Ship Systems	Mission Systems	Space Technology	Tech Services
Jim Pitts, President	Jim O'Neill, President	Scott Seymour, President	Michael Petters, President	Phil Teel, President	Jerry Agee, President	Alexis Livanos, President	James Cameron, President

Western Region
Gary Ervin

AEW & EW Systems
Duke Dufresne

AGS & BM Systems
Alan Doshier
Leroy Barnidge
Deputy

Premier Aerospace and Defense Systems Integration Enterprise

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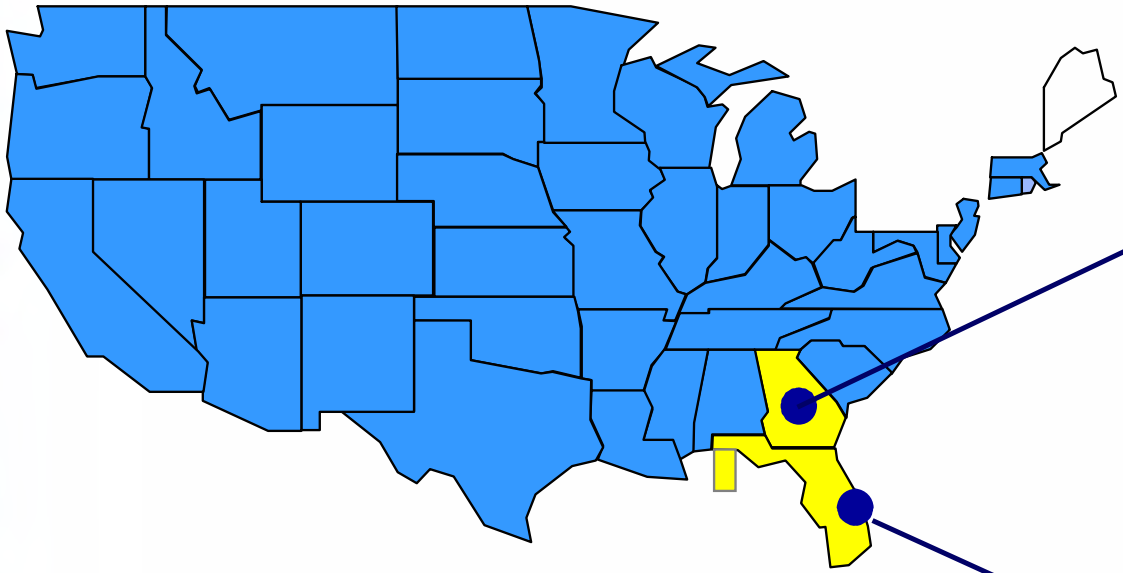
AGS&BMS Major Sites



Joint STARS MOB

Level 5 CMMI-SE/SW/IPPD/SS	6/06
Level 5 CMMI-SE/SW	4/05
ISO 9001:2000/TickIT	9/04

Sys. Integration

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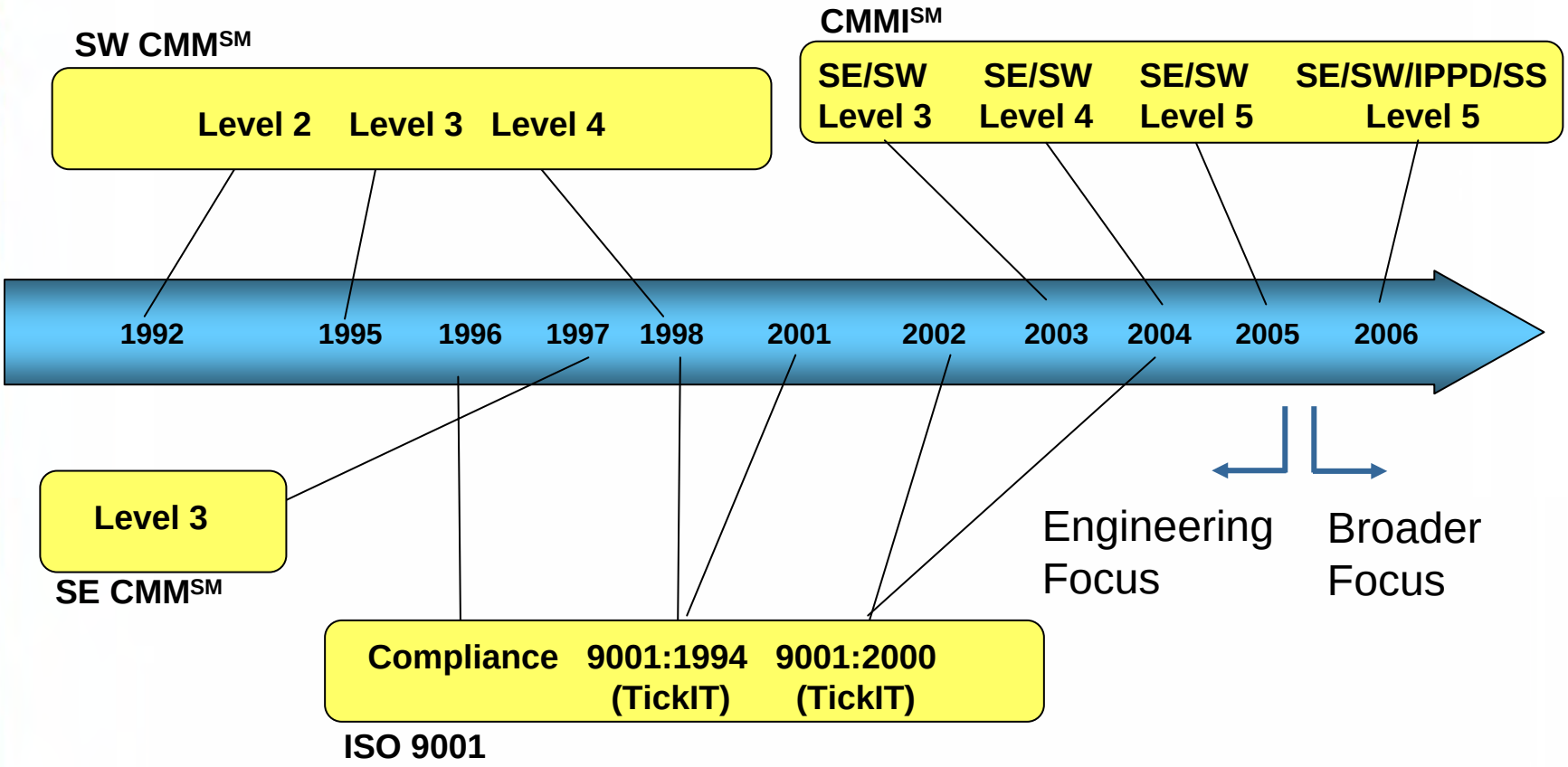
Process Improvement History



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Expand Your Organizational Scope

- **Benefits seen in software engineering were expanded into systems engineering**
- **Why not expand these benefits into other areas?**
- **Expectation was that expanded scope would yield progressively greater process awareness and benefits**
- **Initial expansion was**
  - The rest of engineering beyond systems & software
  - Materiel - to bring in supplier sourcing practices
  - Program Management - to bring in IPPD practices

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Organizational Scope

- When the model was SE/SW - the organization was “engineering”
- When non-engineering departments are included, what does the term “organization” mean?
- Be careful in using the term “organization” - the CMMI has requirements for the “organization”

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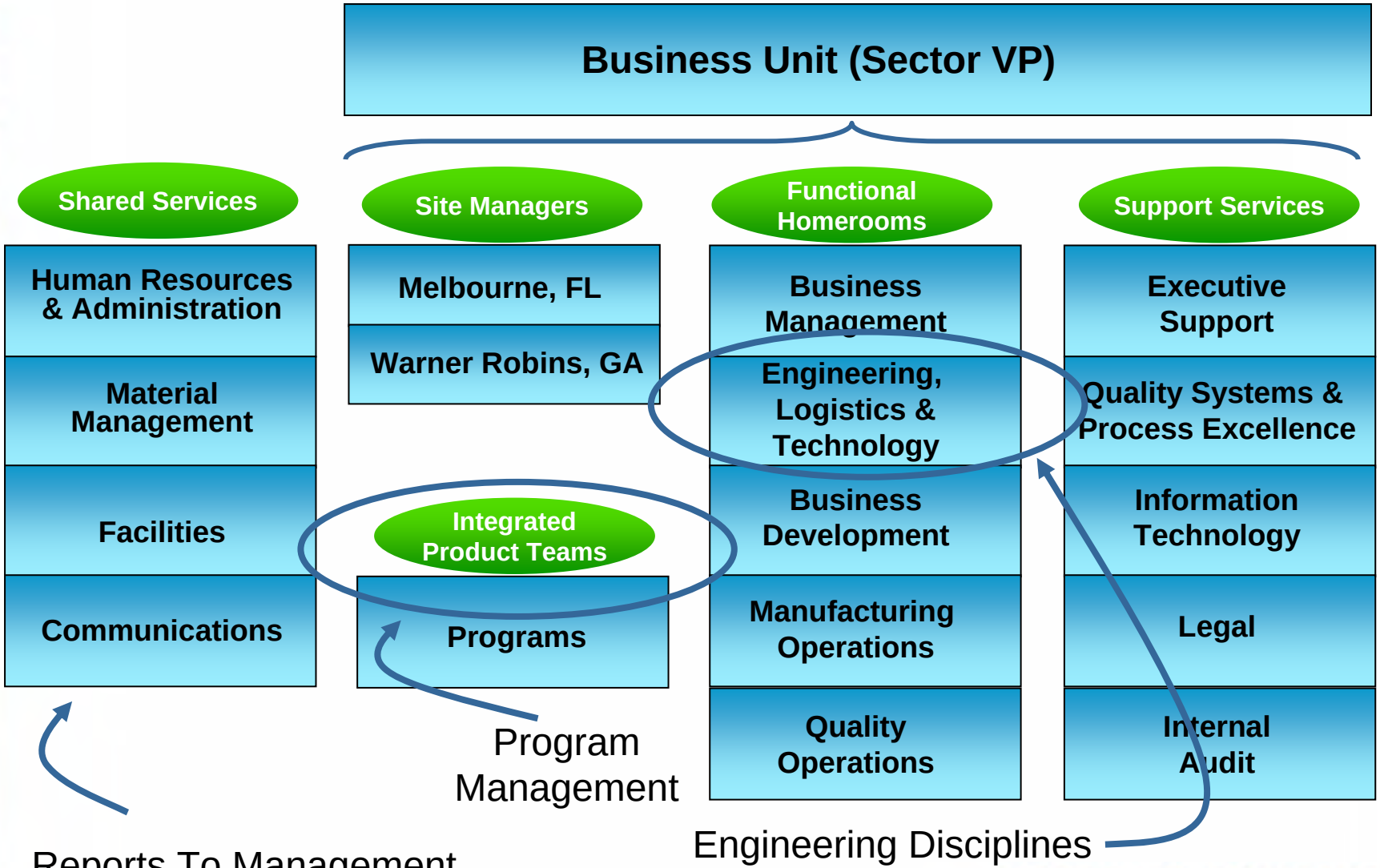
AGS & BM Systems



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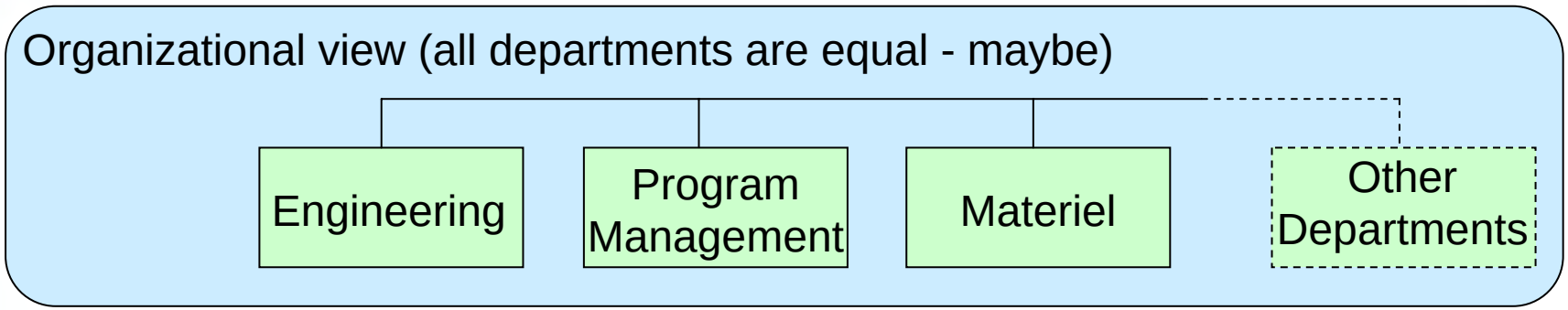
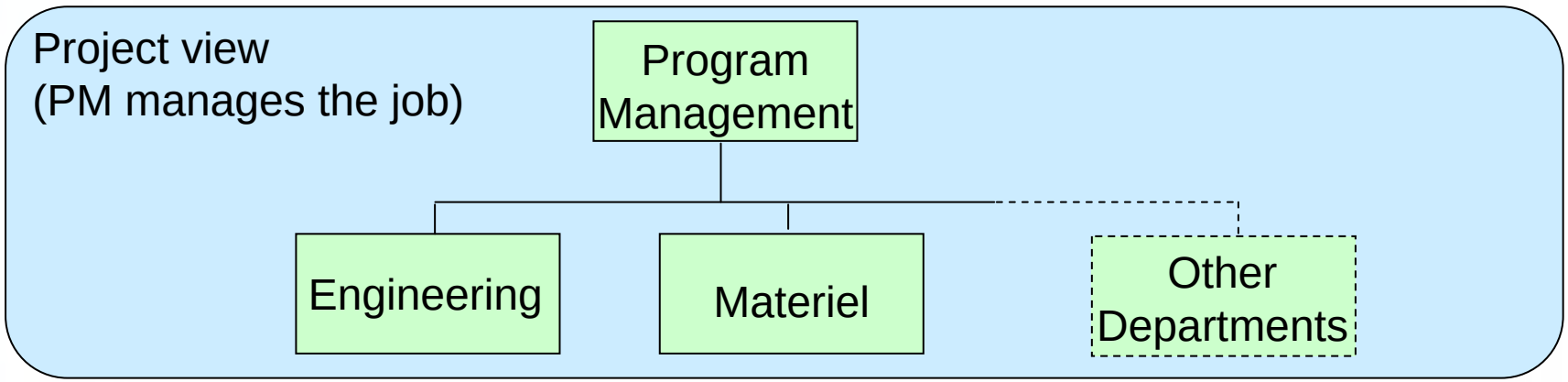
Organizational Scope - Different Views

- **What is your organizational scope?**
- **How do you want it portrayed?**





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Restricted Scope for Materiel

- **The Business Unit is the organization being appraised**
- **Materiel is IN SCOPE**
  - Materiel is considered part of organization for project-type process areas (mostly SAM, MA, ISM, PI and IT)
  - Generic practices (e.g., defined process, plans, resources, responsibilities, training, manage configurations, relevant stakeholders, monitor and control process, review status, objectively evaluate adherence)
- **Materiel is OUT OF SCOPE**
  - Materiel is not considered part of organization for organizational process areas (OPF, OPD, OT, OEI)
  - Materiel is not considered part of organization for “organizational” generic practices (e.g. organizational policy, collect improvement information)

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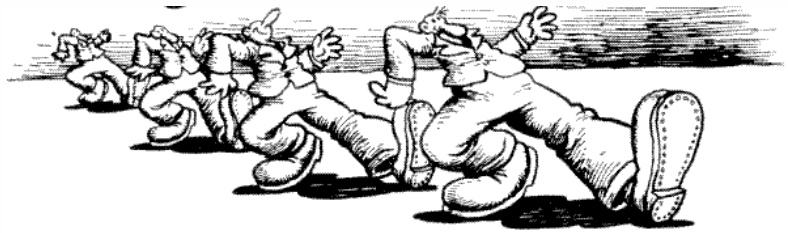
Shared Vision

- It’s the “organization’s” shared vision - not just engineering
- How “high” up in the organization do you go?
- How do you get it flowed down?
- How low in the organization do you flow the shared vision?



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Shared Vision - Our Definition

Our "shared vision" consists of our business objectives with an associated set of expected values and behaviors.

- **The business objectives are defined at a high level for corporation and are flowed down and decomposed for the sector, business area, projects/teams and individuals**
- **The set of values and behaviors are defined at the corporate level and flowed down "as is" to the sector, the business level and ultimately to every individual at Northrop Grumman**

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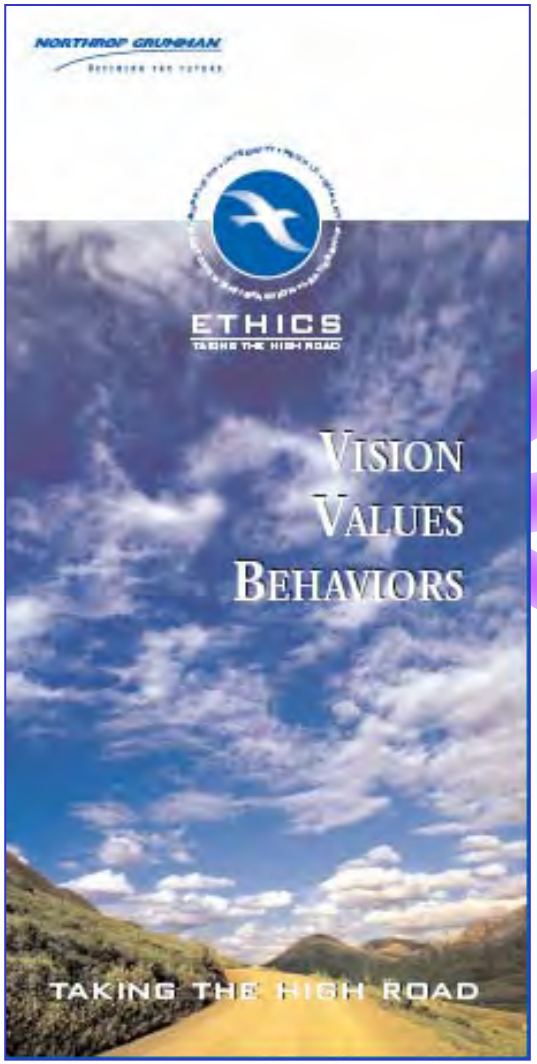
Corporate Shared Vision



Our Vision

Our vision is to be the most trusted provider of systems and technologies that ensure the security and freedom of our nation and its allies. As the technology leader, we will define the future of defense—from undersea to outer space, and in cyberspace.

We will:

- Conduct ourselves with integrity and live our Company Values
- Deliver superior program performance
- Foster an internal environment of innovation, collaboration, and trust

In so doing, Northrop Grumman will become our customers' partner of choice, our industry's employer of choice, and our shareholders' investment of choice.

Our Values

We, the women and men of Northrop Grumman, are guided by the following Values. They describe our company as we want it to be. We want our decisions and actions to demonstrate these Values. We believe that putting our Values into practice creates long-term benefits for shareholders, customers, employees, suppliers, and the communities we serve.

We take responsibility for quality...

Our products and services will be "best in class" in terms of value received for dollars paid. We will deliver excellence, strive for continuous improvement and respond vigorously to change. Each of us is responsible for the quality of whatever we do.

We deliver customer satisfaction...

We are dedicated to satisfying our customers. We believe in respecting our customers, listening to their requests and understanding their expectations. We strive to exceed their expectations to offer reliability, quality and on-time delivery.

We provide leadership as a company and as individuals...

Northrop Grumman's leadership is founded on talented employees effectively applying advanced technology, innovative manufacturing and sound business management. We add more value at lower cost with faster response. We each lead through our competence, creativity and teamwork.

We act with integrity in all we do...

We are each personally accountable for the highest standards of behavior, including honesty and fairness in all aspects of our work. We fulfill our commitments as responsible citizens and employees. We will consistently treat customers and company resources with the respect they deserve.

We value Northrop Grumman people...

We treat one another with respect and take pride in the significant contributions that come from the diversity of individuals and ideas. Our continued success requires us to provide the education and development needed to help our people grow. We are committed to openness and trust in all relationships.

We regard our suppliers as essential team members...

We owe our suppliers the same type of respect that we show to our customers. Our suppliers deserve fair and equitable treatment, clear agreements and honest feedback on performance. We consider our suppliers' needs in conducting all aspects of our business.

Our Behaviors

One:
Live the Company Values
We all have the company values listed on the back of our badges—Quality, Customer Satisfaction, Leadership, Integrity, People, Suppliers, Integrity must characterize everything we do. We want everyone who comes in contact with us to know that we do things the right way at Northrop Grumman. We don't take short cuts.

Two:
Focus on Operating Excellence
Northrop Grumman is very well positioned strategically. We must focus on program performance to deliver on the full operating and financial potential of our company.

Three:
Act With Speed
Northrop Grumman is a much larger company today than we were. With this increased size comes the challenge of operating in a timely fashion. We must avoid bureaucratic delays. We must be agile enough to act faster than our competitors. This "small company" behavior has characterized Northrop Grumman all along and in order we must continue.

Four:
Communicate Openly
We want good news to travel fast and bad news to travel even faster up the line. We need to be mindful of the importance of honestly communicating problems as well as breakthroughs. The sooner we communicate a problem, the easier it is for us to marshal our company's resources to solve it.

Five:
Collaborate Across the Company
Northrop Grumman's power comes from the talented people who make up our company. By cooperating and sharing our knowledge with each other seamlessly across organizations, we can make our company even stronger.

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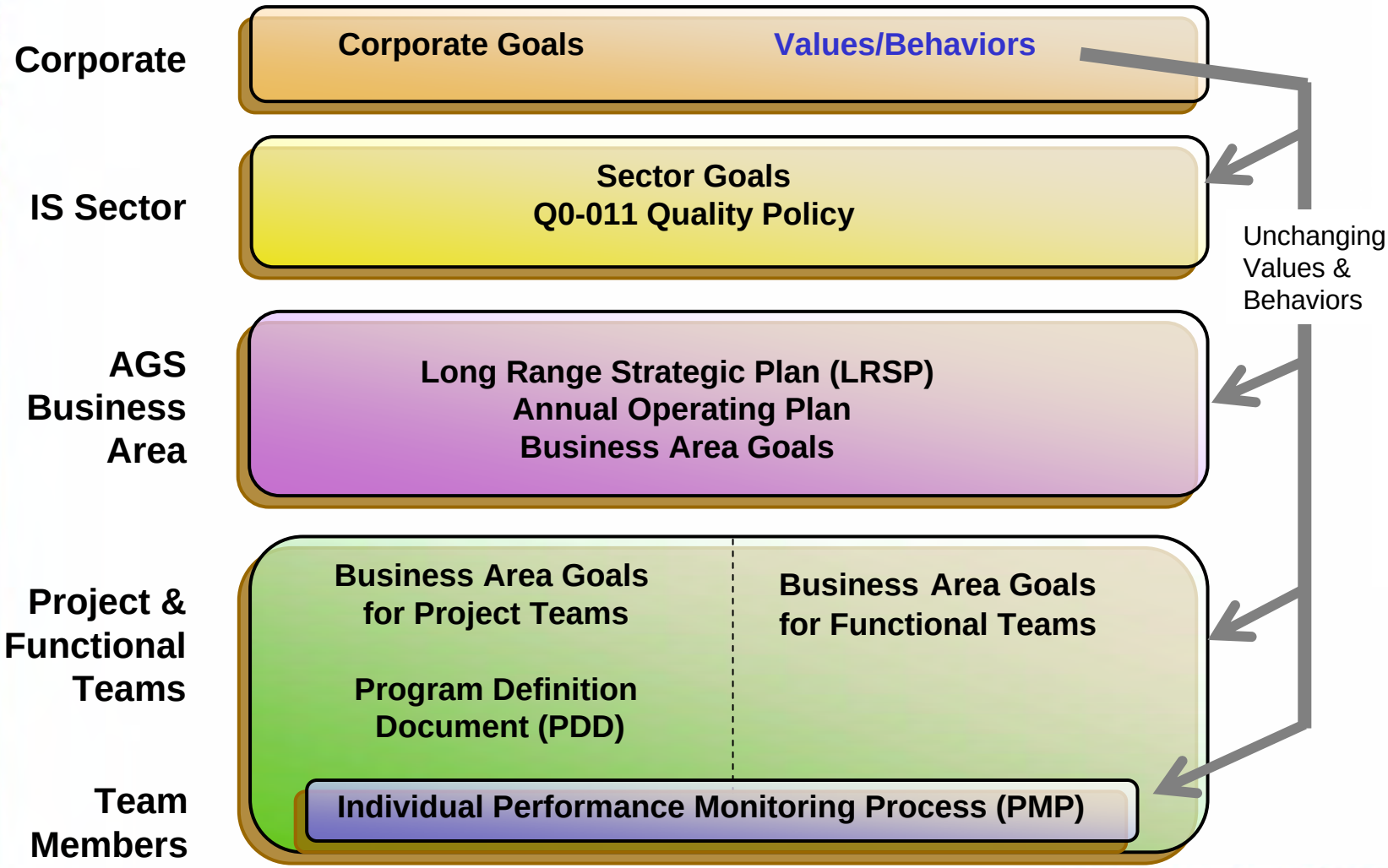
Shared Vision Flow-Down



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Performance Monitoring Process (PMP)

- **Yearly defined tasks, projects, & goals identified (including requirements, schedule, cost, quality) - evaluated at least three times throughout the year**
- **Ethical conduct evaluated - Adherence to company standards of conduct; behavior and decisions are consistent with Northrop Grumman Values**
- **Work style characteristics evaluated including**
  - Collaboration/Teamwork
  - Process Improvement
  - Interpersonal Skills
  - Leadership (Managers Only)
- **Leadership competency (for managers) evaluated, including**
  - Acts Ethically
  - Builds Teams and Relationships
  - Treats People with Respect, Including Customers, Suppliers, and Competitors
  - Collaborates Effectively

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Organizational Process Areas

- You need to map the CMMI[SM] organizational requirements onto the organization you have identified as within scope
- You need to determine if and to what degree different parts of the “organization” need to be integrated

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Organizational Process Areas

- **Is there an integrated approach to the CMMI[SM] organizational process areas?**
  - OPF - Process improvement activities (are we leveraging improvements across the organization?)
  - OPD - Process assets (common repository?)
  - OT - Training (one training plan or multiple?)
  - OEI - Integrated Work Environment (is it really integrated?)
  - OPP - Performance Baselines (how do they “flow up” or “combine”?)
  - OID - Improvements & Innovations (how are they selected across the “organization”)
  - GP 2.1 Organizational Policy (does it cover the whole “organization”)
  - GP 3.2 Collect Improvement Information (is it shared across the “organization”)

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Integrating the Organizational Processes

Multi-disciplinary teams empowered to evaluate and continuously improve organizational processes

Materiel
Manufacturing
Product Quality
Business Mgmt
Program Mgmt
Business Developmt
Command Media
Human Resources
Sites
Programs

EL&T
SE&T
Software
Test & Eval
Vehicle Eng
Avionics
Logistics
Eng Project Mgmt
Lean / Six Sigma

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Is Your “Organization” Really Integrated?

- Are there any “feel good” metrics you can check?

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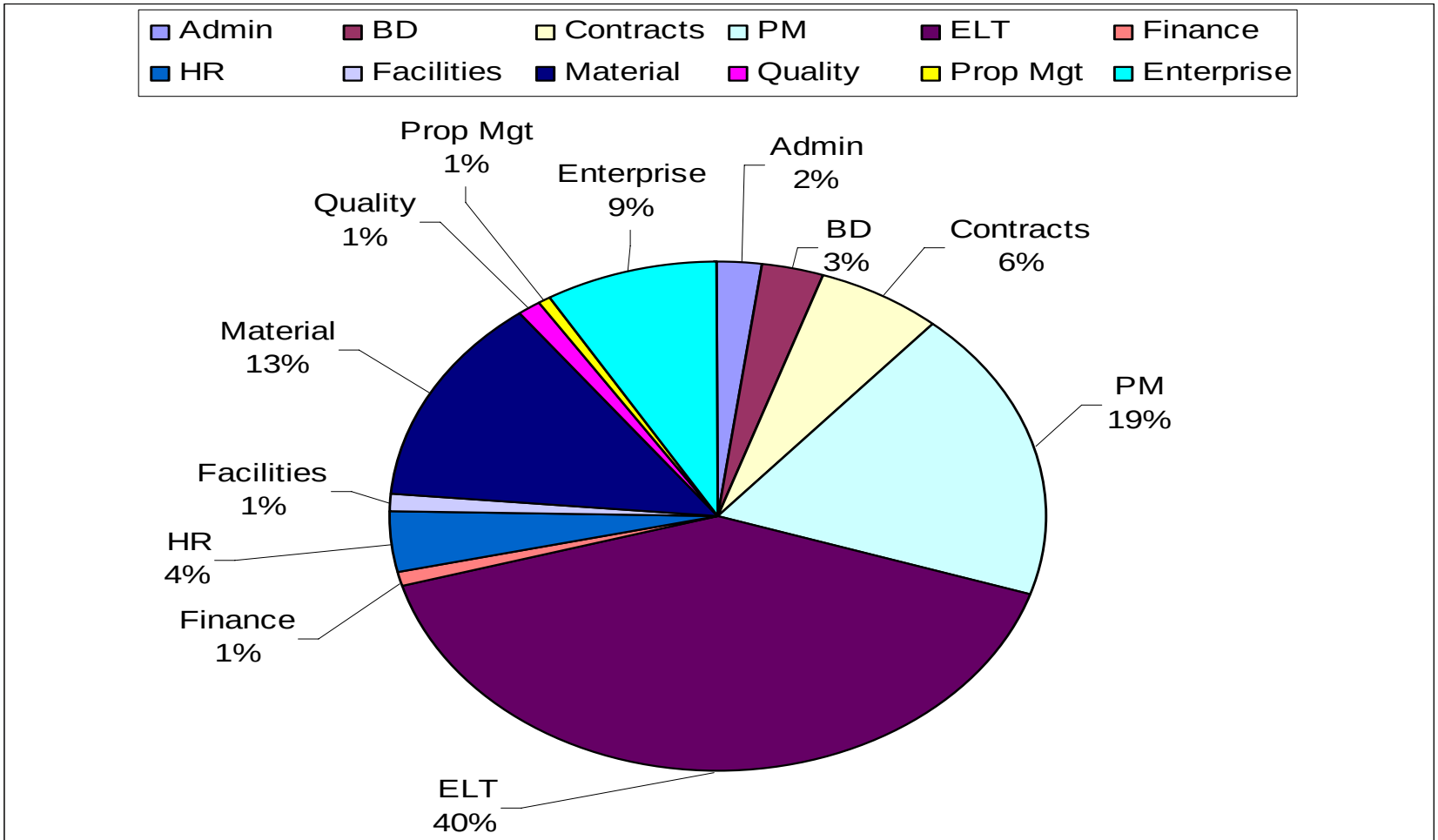
Procedure Distribution



Procedure Data												
Admin	Bus Dev	Contracts	PM	ELT	Finance	HR	Facilities	Material	Quality	Property Management	Enterprise	Total
4	6	11	35	75	2	7	2	25	2	1	16	186

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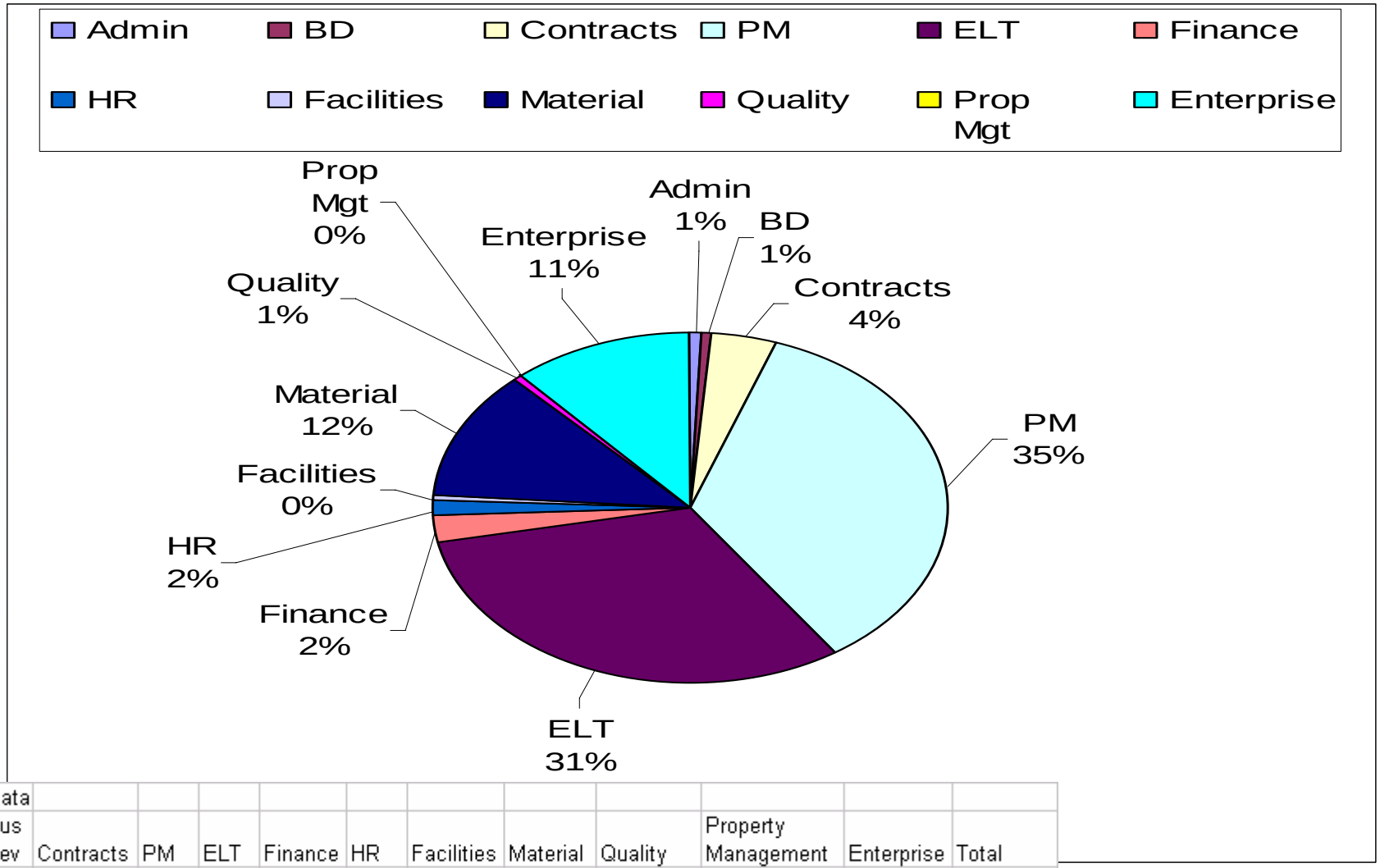
Artifact Distribution *



Artifact Data												
Admin	Bus Dev	Contracts	PM	ELT	Finance	HR	Facilities	Material	Quality	Property Management	Enterprise	Total
23	27	129	1157	1030	79	50	14	397	19	3	374	3302

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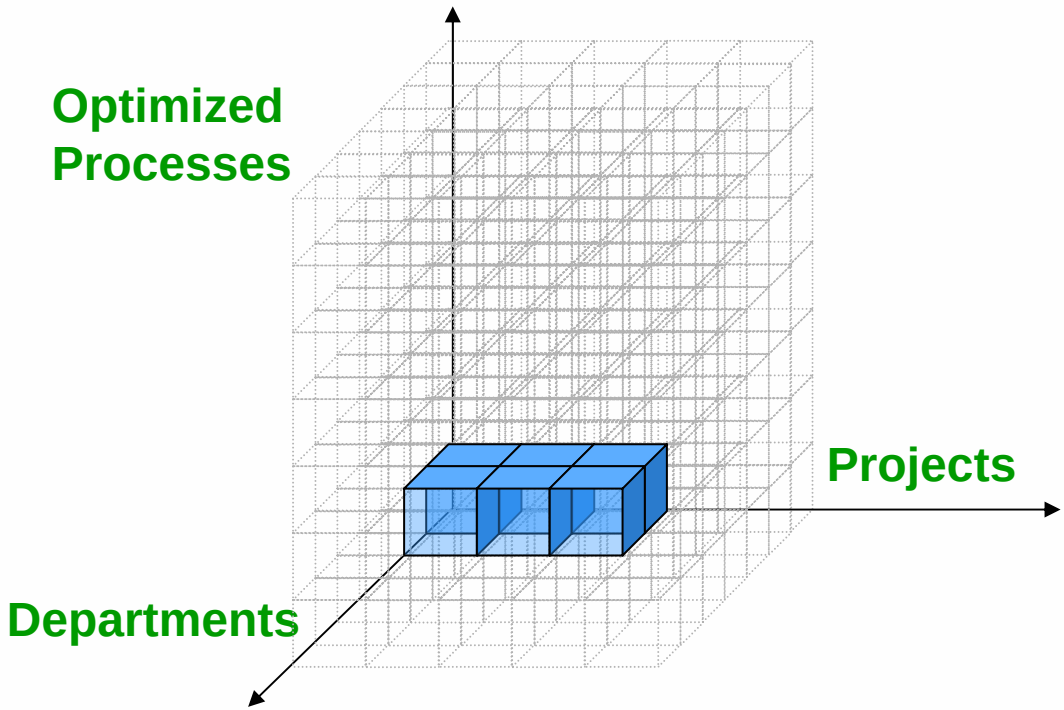
Growing the Capability

What happens after Level 5 . . .



. . . You Keep Improving

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Summary

- Don’t be afraid to expand CMMI[SM] usage outside of engineering
- It may be easier to satisfy CMMI[SM] practices as you move outside of engineering
- Many non-engineering departments have excellent process capability - you can learn from them
- Executive management will likely be strong supporters of expand organizational scope
- Practitioners (especially project personnel) will likely be strong supporters - they recognize that many departments are needed to successfully develop products
- You may find redundant processes that can be streamlined and interfaces that can be improved

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QUESTIONS

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DEFINING THE FUTURE

A Practical Roadmap for Transitioning to CMMI v1.2

CMMI Technology Conference & User Group
13-17 November 2006

Rick Hefner, Ph.D.
Director, Process Management
Northrop Grumman Corporation

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Background

- **CMMI v1.2 represents a major improvement in the CMMI, responding to thousands of community change requests**
- **The new model is simpler and more straightforward in some ways, but more complex in others.**
- **Current users of CMMI v1.1 should carefully consider strategies in transitioning to the new model**

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Agenda

- **Model changes and strategies for transition**
  - Model architecture
  - Supplier management
  - IPPD (even for those who don't currently use it!)
  - Process deployment
- **Appraisal changes and strategies for transition**
  - ADS
- **What does it all mean?**

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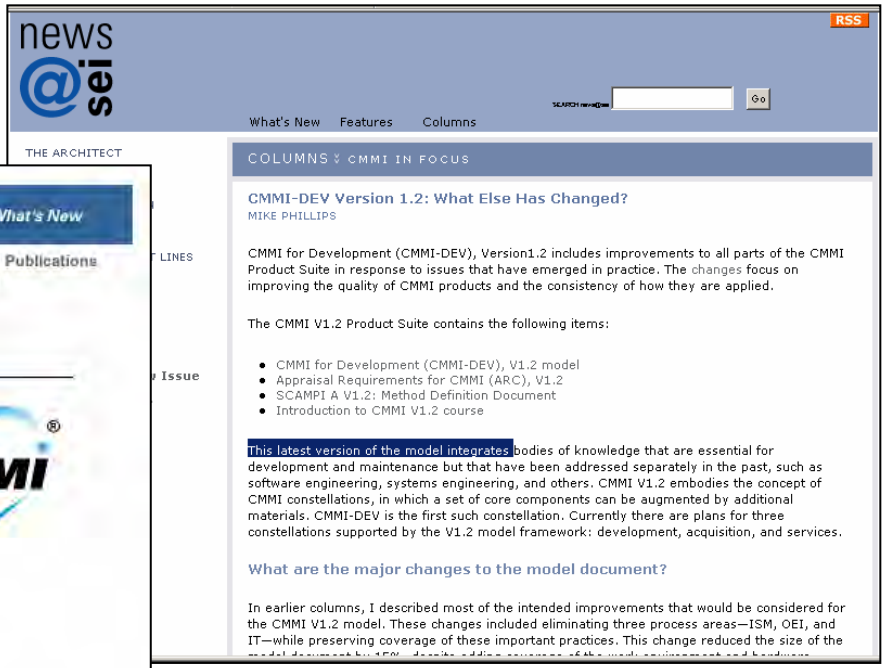
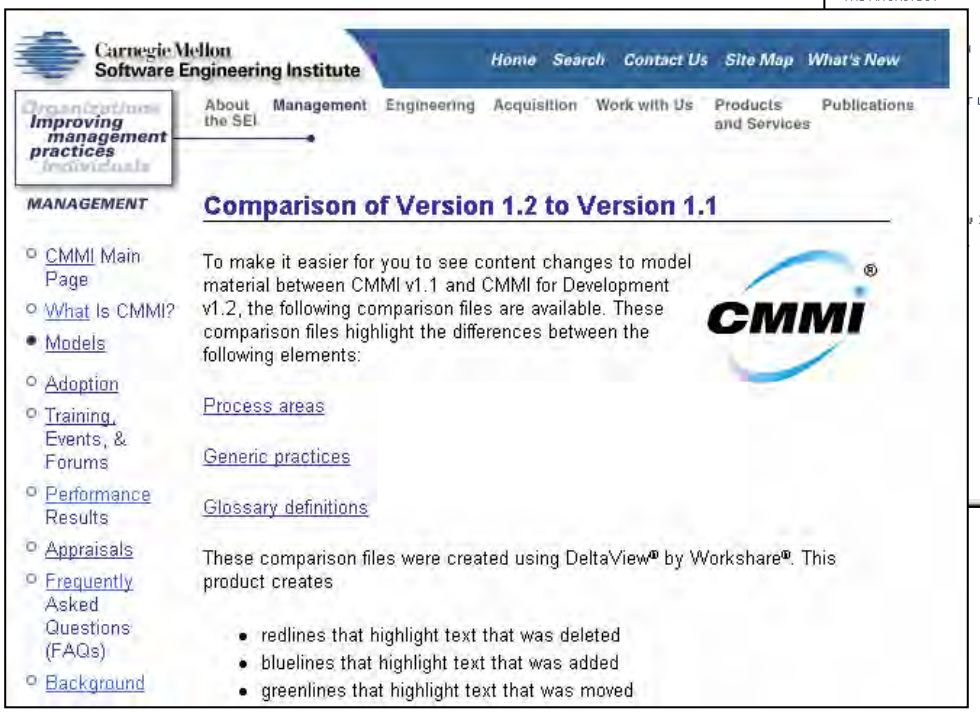
Key References

- http://www.sei.cmu.edu/cmmi/adoption/cmmiv12-changes.html
- “CMMI v1.2,” David Phillips, SEI (Monday tutorial)
- “CMMI V1.2 Overview,” David Phillips, SEI (Wednesday presentation)
- “SCAMPI 1.2 Updates,” Dr. Jack Ferguson, SEI (Wednesday presentation)





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Model architecture changes

- **A "constellation" approach was adopted for the family of CMMI models to be developed**
  - CMMI for Development (CMMI-DEV) takes the place of the old CMMI v1.1
  - CMMI for Services (CMMI-SER) addresses services
  - CMMI for Acquisition ACQ (acquisition) addresses the acquisition of products and services
- **Added hardware amplifications**
- **Eliminated advanced practices (little strategic impact)**
- **Eliminated common features (little strategic impact)**

Strategy Implications

- Consider expanding the scope of your improvements to include hardware, services, acquisition
- New disciplines may struggle with basic adoption issues (e.g., Level 1 to 2)

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Elimination of Integrated Supplier Management

V1.1

Supplier Agreement Management

SP 1.1 Determine the type of acquisition for each product or product component to be acquired.

SP 1.2 Select suppliers based on an evaluation of their ability to meet the specified requirements and established criteria.

SP 1.3 Establish and maintain formal agreements with the supplier.

~~SP 2.1 Review candidate COTS products to ensure they satisfy the specified requirements that are covered under a supplier agreement.~~

SP 2.2 Perform activities with the supplier as specified in the supplier agreement.

~~**Integrated Supplier Management**~~

SP 2.1 Monitor and analyze selected processes used by the supplier.

SP 2.2 For custom-made products, evaluate selected supplier work products.

SP 2.3 Ensure that the supplier agreement is satisfied before accepting the acquired product.

SP 2.4 Transition the acquired products from the supplier to the project.

V1.2

Supplier Agreement Management

SP 1.1 Determine the type of acquisition for each product or product component to be acquired.

SP 1.2 Select suppliers based on an evaluation of their ability to meet the specified requirements and established criteria.

SP 1.3 Establish and maintain formal agreements with the supplier.

SP 2.1 Perform activities with the supplier as specified in the supplier agreement.

SP 2.2 Select, monitor, and analyze processes used by the supplier.

SP 2.3 Select and evaluate, work products from the supplier of custom-made products.

SP 2.4 Ensure that the supplier agreement is satisfied before accepting the acquired product.

SP 2.5 Transition the acquired products from the supplier to the project.

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Strategies for transitioning to the new Supplier Agreement Management

At the organizational level:

- **Classify the types of suppliers used within the organization**
  - True subcontractors (who follow their own processes to produce custom-made products)
  - Integrated suppliers (who follow our processes)
  - COTS vendors
  - In-house suppliers
  - Customers (GFE)
- **For each type, determine appropriate methods (and responsibilities) for projects to:**
  - Evaluate and select suppliers (SP 1.2)
  - Establish formal agreements (SP 1.3)
  - Work with the suppliers (SP 2.1)
  - Select key processes; monitor and analyze them (SP 2.2)
  - Select key work products; evaluate them (SP 2.3)
  - Ensure the agreement is satisfied (SP 2.4)
  - Transition the acquired product (SP 2.5)
- **Define acceptable variations of these methods**

At the project level:

- **Determine the type of acquisition for each product or product component to be acquired**
- **Define the methods (and variations) to be used**

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Sample Organizational Guidance

	True subcontractors	COTS Vendors
Evaluate and select suppliers	RFP, process evaluation	Use pre-approved vendor
Establish formal agreements	Contract	Purchase Requisition
Work with the suppliers	Monthly status meetings, milestone reviews	NA
Select key processes Monitor and analyze	Req definition, testing Req Review, quantitative analysis of defects	NA
Select key work products Evaluate them	Specification, test plans Peer review	NA
Ensure the agreement is satisfied	Witness sub test	Inspection
Transition the acquired product	Tape transfer	FTP

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IPPD changes

Project Management
Project Planning
Project Monitoring and Control
Supplier Agreement Management
~~Integrated Teaming*~~
~~Integrated Supplier Management**~~
Integrated Project Management (for IPPD*)
Risk Management
Quantitative Project Management

Engineering
Requirements Development
Requirements Management
Technical Solution
Product Integration
Verification
Validation

Support
Measurement and Analysis
Process and Product Quality Assurance
Configuration Management
~~Organizational Environment for Integration*~~
Causal Analysis and Resolution
Decision Analysis and Resolution

Process Management
Organizational Process Focus
Organizational Process Definition
Organizational Training
Organizational Process Performance
Organizational Innovation and Deployment

IPPD Changes
- Removed OEI, added to OPD
- Removed IT, added to IPM
- Moved “Enable IPPD Management” to OPD
- Moved “Apply IPPD Principles” to IPM
- Revised IPPD material to be consistent with the other model material

*IPPD extension in v1.1
**Supplier Sourcing extension in v1.1

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IPPD Extension

Organizational Process Definition +IPPD

SG 2 Organizational rules and guidelines, which govern the operation of integrated teams, are provided.

SP 2.1 Establish and maintain empowerment mechanisms to enable timely decision making.

SP 2.2 Establish and maintain organizational rules and guidelines for structuring and forming integrated teams.

SP 2.3 Establish and maintain organizational guidelines to help team members balance their team and home organization responsibilities.

Integrated Project Management +IPPD

SG 3 The project is managed using IPPD principles.

SP 3.1 Establish and maintain a shared vision for the project.

SP 3.2 Establish and maintain the integrated team structure for the project.

SP 3.3 Allocate requirements, responsibilities, tasks, and interfaces to teams in the integrated team structure.

SP 3.4 Establish and maintain integrated teams in the structure.

SP 3.5 Ensure collaboration among interfacing teams.

Strategy Implications

- The resulting IPPD extension reflects good management
- These practices could be adopted on projects not organized around Integrated Product/Process Teams
- Organizations may wish to develop IPPD rules for deployment to some projects

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Additions to the non-IPPD version of the model

Organizational Process Definition

SP 1.6 Establish and maintain work environment standards

Integrated Project Management

SP 1.3 Establish and maintain the project's work environment based on the organization's work environment standards.

Strategy Implications

- The environment (tools) is now considered part of the organization’s standard process, and must be tailored by the projects

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Process deployment changes

Organizational Process Focus

SG 3 The organizational process assets are deployed across the organization and process-related experiences are incorporated into the organizational process assets.

SP 3.1 Deploy organizational process assets across the organization.

SP 3.2 Deploy the organization's set of standard processes on projects at their startup and deploy changes to them as appropriate throughout the projects' lives.

SP 3.3 Monitor the implementation of the organization's set of standard processes and use of process assets on all projects.

SP 3.4 Incorporate process-related work products, measures, and improvement information derived from planning and performing the process into the organizational process assets.

Integrated Project Management

SP 3.1 Establish and maintain the project's defined process from project startup through the life of the project.

Strategy Implications

- The organization must define how changes to the standard processes will be redeployed to projects
  - This may suggest re-architecting the structure of the standard process, i.e., parts that change over time and parts that don't
  - Impacts on the tailoring process
- ALL projects should be using the standard processes and process assets
  - Gives appraisal teams the right to look at other than" focus projects" – should deter "cherry picking"
  - The monitoring of process assets use may require technology or procedures for the Process Asset Library

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Appraisal changes

- **Rating changes**
  - Process areas outside of the model scope are rated as Out of Scope
  - Process areas that have insufficient data to be rated are rated as Not Rated
  - Process areas in the model scope, but outside the organizational scope are rated as Not Applicable
  - The only process area that can be Not Applicable is SAM (determined by the appraisal team)
- **Appraisals can now include better sampling approaches:**
  - Focus projects – all PAs
  - Non-focus projects – some PAs
- **The Appraisal Disclosure Statement (ADS) now requires:**
  - Organizational sampling criteria and decisions (e.g., projects included, projects excluded, percentage of organization represented)
  - Basis for maturity/capability level 4 and 5 appraisal results must be mapped to quality and process-performance objectives

Strategy Implications

- An organization that does not implement all processes can not get a ML rating
  - May require re-write of contractual requirements, which means educating the customer on model applicability
- Non-focus projects allow better sampling approaches
- Although the new ADS does not change the sampling process, it provides greater visibility
  - How will customers use this insight?

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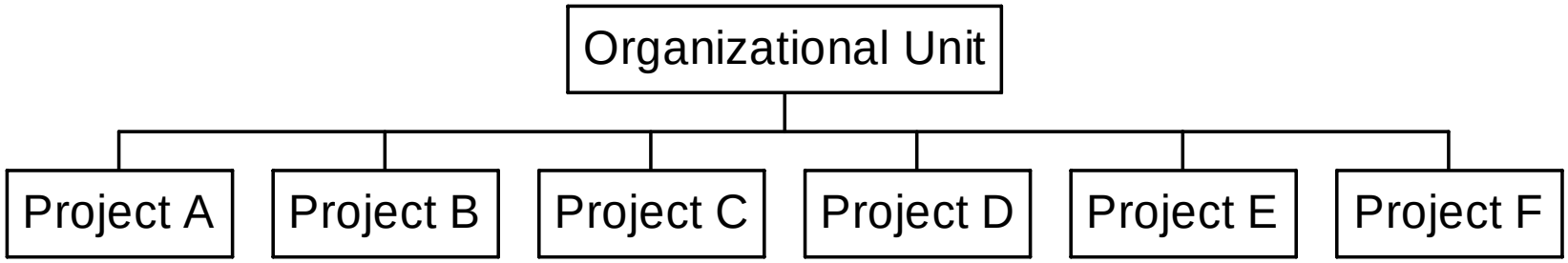
Appraisal Sampling Strategies



- **How many focus projects? Non-focus?**
- **Select focus projects by size? Importance? Typicality?**
- **How many process areas to sample in the non-focus projects?**
- **Which process areas to sample?**
- **Sample common process areas?**
- **Who sets sampling – Organizational Unit? Lead Appraiser?**

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Northrop Grumman Mission Systems Process Deployment Approach

- **<u>All</u> projects perform process tailoring during proposals**
  - Without a defined process, it is impossible to bid accurately
  - Templates are used to generate plans consistent with the project's defined process*
- **<u>All</u> projects undergo a CMMI-based evidence review within the first 90 days**
  - Ensures that projects are implementing proven processes
- **<u>All</u> projects participate in our SCAMPI A appraisals**
  - Ensures that all projects benefit from mature processes
  - Send clear message that CMMI has value**

*" Project Implementation Strategies in the CMMI ," R. Hefner, CMMI Technology Conference and User Group, 2006 (Wednesday PM)

**" Sustaining CMMI Compliance," R. Hefner, CMMI Technology Conference and User Group, 2006 (Thursday AM)

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Summary

- CMMI v1.2 represents a major improvement in the CMMI, responding to thousands of community change requests
- The new model is simpler and more straightforward in some ways, but more complex in others.
- Current users of CMMI v1.1 should carefully consider strategies in transitioning to the new model

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Carnegie Mellon
Software Engineering Institute

Pittsburgh, PA 15213-3890

CMMI® Version 1.2 SAM+ISM

NDIA CMMI Technology Conference
November 16, 2006

Mike Phillips
Software Engineering Institute
Carnegie Mellon University

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Thanks to Gary Wolf and D'Ann Hunt from Raytheon; Denise Cattan of SPIRULA; Rick Hefner of Northrop-Grumman

Major Themes

Reduce complexity & size

Increase coverage

Increase confidence in appraisal results

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Reduced Model Complexity & Size

Eliminated the concepts of advanced practices and common features

Incorporated ISM into SAM; eliminated Supplier Sourcing (SS) addition

Consolidated and simplified the IPPD material; eliminated two process areas (OEI, IT)

Consolidated all definitions in the glossary

Adopted a single book approach

Reduced report size 15%

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Historical Perspective

Software Subcontract Management (CMM) became Supplier Agreement Management (CMMI V1.0)

- "Not applicable" designation in appraisals reduced from 56% to 20%
- Emphasis on COTS added due to historical difficulties

V1.02d added acquisition flavors with 3 levels of supplier attention (SSM, ISM, QSM)

V1.1 consolidated these into "Supplier Sourcing" PA, ISM

- Some SAM subpractices become ISM specific practices
- Multiple CRs argue for consolidation

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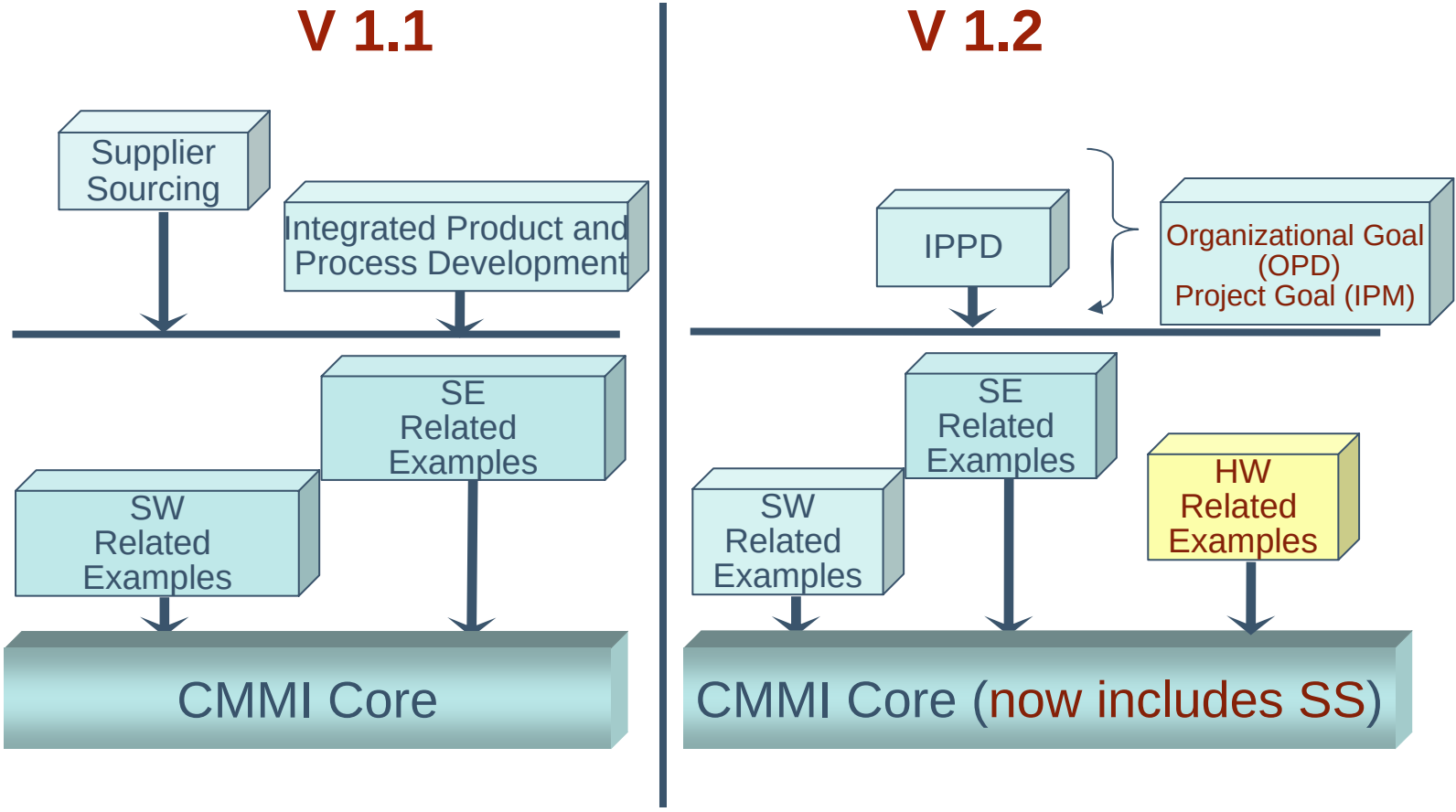
CMMI Model Combinations



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Consolidation Themes

Eliminate SS distinction to reduce complexity

Reduce PA number to simplify appraisals

Maintain ISM theme of greater insight into supplier's development activities to reduce product development risk

Reposition COTS emphasis to "make-buy" analysis in TS

Avoid "raising the bar" for SAM

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Supplier Agreement Management

Specific Goal	Specific Practice
Establish Supplier Agreements	**1.1 – Determine Acquisition Type** **1.2 – Select Suppliers** **1.3 – Establish Supplier Agreements**
Satisfy Supplier Agreements	**2.1 – Execute the Supplier Agreement** **2.2 – Monitor Selected Supplier Processes** **2.3 – Evaluate Selected Supplier Work Products** **2.4 – Accept the Acquired Product** **2.5 – Transition Products**

v1.1 SP2.1 “Review COTS Products,” was eliminated. “Identify candidate COTS products that satisfy requirements” is a new subpractice under the Technical Solutions Process Area SP1.1, “Develop Alternative Solutions and Selection Criteria.”

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Key informative material

"The content of the agreement should specify the reviews, monitoring, evaluations, and acceptance tests to be performed, if such activities are appropriate to the acquisition or product being acquired." (SP1.3)

"For most vendor agreements where a product is not being developed or for smaller, less critical components, the selection process may determine that monitoring is not appropriate." (SP2.2)

"The scope of this specific practice is limited to suppliers providing the roject with custom-made products, particularly those that present some risk to the program due to complexity or criticality." (SP2.3)

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Sample Organizational Guidance

	True subcontractors	COTS Vendors
Evaluate and select suppliers	**RFP, process evaluation**	**Use pre-approved vendor**
Establish formal agreements	**Contract**	**Purchase Requisition**
Work with the suppliers	**Monthly status meetings, milestone reviews**	**NA**
Select key processes Monitor and analyze	**Req definition, testing Req Review, quantitative analysis of defects**	**NA**
Select key work products Evaluate them	**Specification, test plans Peer review**	**NA**
Ensure the agreement is satisfied	**Witness sub test**	**Inspection**
Transition the acquired product	**Tape transfer**	**FTP**

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Small Project Challenges of CMMI in Large Organizations

6th Annual CMMI® Technology Conference and User Group

Hyatt Regency Tech Center, Denver, CO
November 16, 2006

Mr. John Bethmann
Principal Systems Engineer

Ms. Ruth Wuenschel
Principal Systems Engineer

Mr. Corey Norris
Manager Systems Development Process

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Agenda

- Introductions
- Overview of **Our Company**
- Describe the **Challenges** we faced
- Describe how we categorized projects
- Show how we tried to "**Address the challenges**"
- Closing comments

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Our Company – Concurrent Technologies Corporation (*CTC*)

- An independent, nonprofit, applied research and development professional services organization
- Staff of 1,500+ professionals
- More than 35 locations
- Approximately 900,000 sq. ft., including laboratories and demonstration facilities
- Federally compliant contractor
- Concurrently certified to **ISO 9001/14001** in August, 1998
- Assessed at **Maturity Level 3** of the Capability Maturity Model Integration Systems Engineering/Software Engineering (CMMI-SE/SW®), Version 1.1 in March, 2003 for systems and software engineering activities
- Certified to **AS9100** in April, 2005 for aerospace activities

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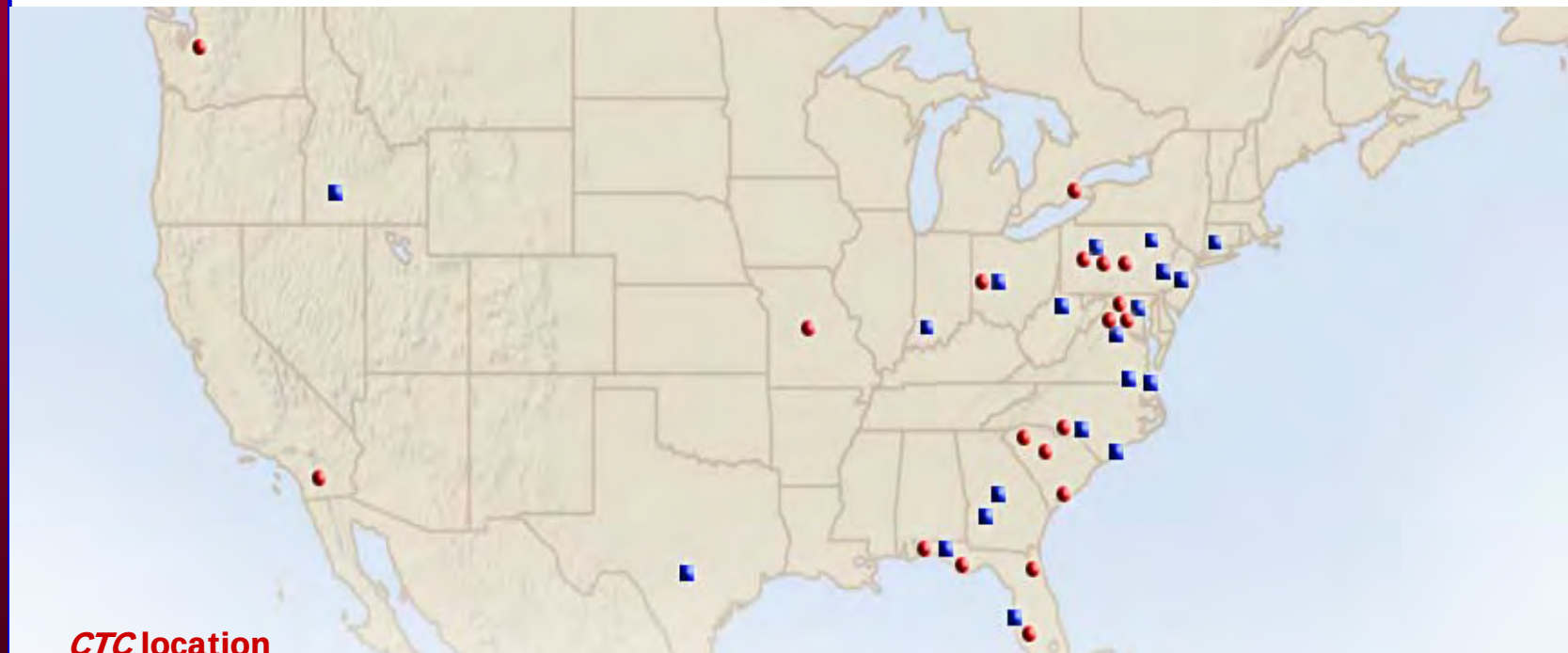
CTC Locations



CTC location

Annapolis Junction, MD • Bremerton, WA • Charleston, SC* • Columbia, SC • Crystal City, VA • Dayton, OH
Fayetteville, NC • Fort Leonard Wood, MO • Greenville, SC • Hamilton, ON, Canada • Harrisburg, PA
Jacksonville, FL • Johnstown, PA • Largo, FL • Panama City, FL • Pensacola, FL* • Pittsburgh, PA* • San Diego, CA
Stuttgart, Germany • Washington, DC*

*** *CTC* location and *CTC* on-site location**

CTC on-site location

Albany, GA • Alexandria, VA • Camp Lejeune, NC • Fort Bragg, NC • Fort Dix, NJ • Indiana, PA • Lackland AFB, TX
Morgantown, WV • Mountain Home AFB, ID • New Carrollton, MD • Norfolk, VA • Philadelphia, PA • Shalimar, FL
Tampa, FL • Tobyhanna, PA • Virginia Beach, VA • Warner Robins, GA • Wright Patterson AFB, OH

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Our Growth Profile

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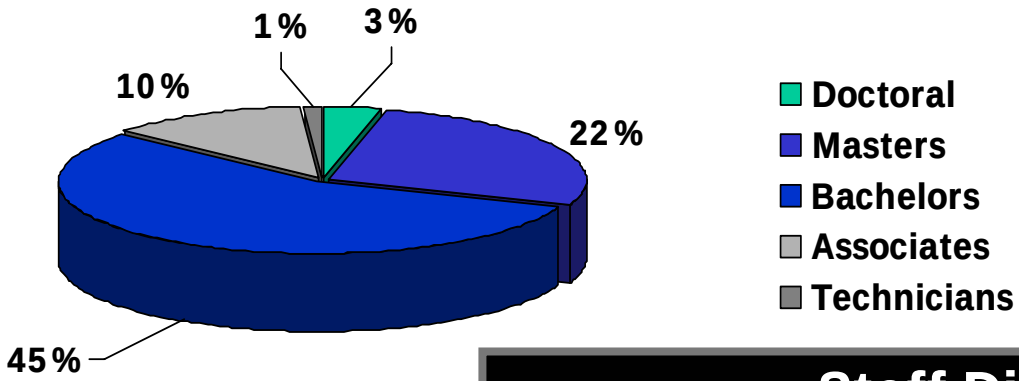
Staff Make-up



Staff Disciplines	
Electrical & Mechanical Engineering	14%
Computer Science & Mathematics	21%
Communications Technology	23%
Environmental & Chemical Engineering	9%
Metallurgical & Materials Engineering	3%
Engineering & Science	9%
Business & Others	21%

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Selected Services and Capabilities

- Advanced Coatings and Coatings Removal
- Advanced Distributed Learning
- Advanced Materials and Processes
- Automation, Controls, and Data Acquisition
- Command and Control Systems
- Communications and Outreach
- Corrosion Prevention and Control
- Environmental Technology Demonstration and Validation
- Fuel Cell Test and Evaluation
- Information Assurance
- Intelligence Analysis
- Logistics Optimization
- Management Systems
- Manufacturing Improvement
- Modeling and Simulation
- Supply Chain Integration
- Sustainability
- Systems Design and Analysis
- Systems Integration
- Systems/Software Engineering
- Technology Management
- Visualization

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Challenges We Face
CTC Project make-up

- Number of People: 1500
- Number of Projects: 230
- Average Project Size 5 FTEs
- Typical Large Program: 35 FTEs
- Typical Small Program: 1 FTE

So What?

- Although it looks **Large** it's **small**
- Processes need to tailor to projects of varying size
- We realized this impacts how we do business

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Challenges We Face Multiple Disciplines

- Disciplines
  - Engineering
  - Sciences
  - Construction Management
  - Communications
  - Education and Training
  - Business (program management and other)
- **Variety of tools and templates required to support**
- Different terminology used in each field

So What?

- Broad types of projects
- Intelligent staff with strong opinions
- **Not practical** to implement **one size fits all**
- We realized this impacts how we do business

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Challenges We Face
Multiple Standards

- ISO 9001
- AS 9100
- ISO 14000
- VPP – Voluntary Protection Program
- CMMI – across the company

So What?

- Underestimated effort required to train staff
- Large effort required to manage and maintain
- **Not practical** to implement **as multiple quality systems**
- We realized this impacts how we do business

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Current Procedure Presentation

- Sequential Listing based on old ISO 9001:1996 sections
- Additions for each new standard
- Need to improve usability of the system
- Numbering scheme not structured to handle new procedures added over time

How we categorized projects

Quality Management System Environmental Health and Safety (QMS/EHS)

- Quality Planning Checklist asks
  - "Is the project designated as a Systems Development project?"
- Systems Development QA Lead determines if project is a system development or service.
  - Below the Threshold - 2100 hours
  - Projects are of two distinct types:
    - **Service Projects**
    - **Systems Development Projects**

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What happened

- System definition was misunderstood by staff and management
  - Only for software types
- Projects mixed services and systems
  - Lacked guidance on how to decide
  - People reverted to what they knew to get things done
- Created auditing confusion for staff

Addressing the Challenges
What is the starting point

- Analysis of internal records showed we have a variety of types and sizes of projects
- Took a step back and said "What is *CTC* concerned with?" – **Quality product that meets or exceeds the Clients needs.**
  - Within Budget
  - Controlling Risk
- Reviewed Technical Management Literature on Project Classifications
- Decided to implement a Project Classification Framework based on size and risk

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Basis for Framework

- Technical Management research conducted by Wesley J Howe School of Technology Management, Stevens Institute of Technology
  - Dr. Aaron J. Shenhar
- Ohio State CIO Office
  - http://oit.osu.edu/projmanage/PDF_files/OSUPMFrmwk_1.00.pdf

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Sizing Matrix

Project Classification – Sizing Matrix		
Project Class	Lower Limit	Upper Limit
1	0	$W
2	$W+1	$X
3	$X+1	$Y
4	$Y+1	$Z
5	$Z+1	Infinity

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Risk Matrix

Risk Factor	Low (0)	Medium (1)	High (2)	Very High (3)
Team Size	<5	5-9	10-14	>15
# Work Groups	1-2	3-4	5-6	>7
Technology / Technique / Process	Expert	Familiar	New to CTC	Cutting Edge / Rocket Science
Complexity	Well defined no problems	Known Some problems	Multiple approaches	Unknown or vaguely defined
Political Profile / Impact	Small Impact	Medium Impact	Large Impact	Very Large Impact

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Project Classification - Risk Adjustment

- Risk adjustment
  - 0 to 10 → no affect
  - 11 to 13 → Increase 1 level
  - 14 to 15 → Increase 2 levels
- Size Matrix + Risk adjustment = Project Class

Phases of the “System”

- Proposal Development
- Contract Award
- Planning
- Execution
- Closeout

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Configuration Management – Planning (1)

	Project Class				
	1	2	3	4	5
Planning					
Develop Configuration Management Approach					
Version Control – Documents	X	X	X	X	X
Version Control - Hardware		X	X	X	X
Internal CCB			X	X	X
Client Linked CCB				X	X
Formal Configuration Control with CCB					X

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Configuration Management – Planning (2)

- Completes the work started in the proposal
- Addresses changes from proposal to award
- Orients the entire team on the process and procedures to be used
- Scaled requirements from simple version control to full up configuration management

Configuration Management – Execution (1)

- Maps back through planning and proposal development
- Provides specific Project Class Activities
- Links directly to the procedures that are applicable
- Informs the project what is assessable and auditable

Configuration Management - Execution

	Project Class				
	1	2	3	4	5
Execution					
Program Management					
Identify/Monitor Risks		X	X	X	X
Maintain Risks in Risk Radar			X	X	X
Configuration Management					
Plan Versioning	X	X			
Plan Configuration Management			X	X	X
Engineering					
Manage Baselines			X	X	X
Version Control of Work Products	X	X	X	X	X

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Closing Remarks

- Process must be organized and tailored to suit the needs of the project (within *CTC*'s business processes)
- No one size fits all
- Many approaches to process activities – focus on what your company needs
- Classify based on size and risk
- Focus on the amount of process rigor that is needed for the class level of the project

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Questions?

Submitted Abstract (1)

- Small to medium organizations, those with staff between 25 and 250 people <Lessons Learned from Adopting CMMI for Small Organizations, Slide 6>, represent unique challenges when trying to adopt the tenets of the Capability Maturity Model Integration. Some of these challenges have been documented in initial studies conducted by the SEI and its partners. However, no attention has been given to organizations composed of many functional disciplines that have a large overall work force but operate projects supported by smaller working organizations. These types of organizations present unique challenges to adopting many of the process areas in a quantitatively and qualitatively managed manner. To be successful, *CTC*'s approach was to recognize that different functional disciplines might require multiple procedures to complete the tasks, possibly different tools, and definitely different terminology.

Submitted Abstract (2)

- The process areas of Configuration Management, Risk Management, and Project Planning are key areas that *CTC* has found that cross these functional disciplines. These areas provide insight into critical differences between sub-organizations. Within CM, several challenges exist even with decades of written works on the subject. What is important under one discipline or within one project may not be in another; how do you define the standards to identify what should be managed? Within Project Planning, how does an organization identify the roles and responsibilities clearly, when they change from contract to contract? Do you force one size to fit all or highlight the unique needs of each functional discipline? Risk Management is standard, but how does a company that has over 280 projects with over 1400 employees that do not have many similarities organizationally analyze them for improvement? The presentation will provide recommendations on how to successfully approach these unique challenges.

Submitted Abstract (3)

- *CTC* is a nonprofit, applied research and development professional services organization with 35 offices.

CTC
Concurrent Technologies Corporation

Concurrent
Technologies
Corporation

CMMI Applications in a Small Setting Finance Organization for Process Performance Optimization

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November 15, 2006

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Introduction

Back Ground

- In 2001, the CMMI v.1.1 was released as an integrated model for software development and systems engineering applicable to implementing process improvement for both development and services organizations.
- In 2002, a leadership team in a small setting, facing multiple short and long term business challenges, decided to investigate the feasibility of implementing the practices in the CMMI throughout their organization.
- The recommendations of their feasibility study to implement CMMI practices, was endorsed by their customer, and the small setting began their process improvement journey in 2002.
- Starting in 2003, the small setting has provided yearly presentations describing a wide range of on-going process improvement activities , including planning and implementing of the CMMI process areas, and process performance results.
- This presentation concludes this series of presentations and focuses on the benefits of implementing CMMI based processes into support functions of finance and contracts and subcontractor management.

2003 Business Case Rationale for Implementing Formal Process Improvement Across the Organization

Business Case Rationale in 2003	Key CMMI Category Applicability
1. Infrastructure support is expected to provide more services while minimizing costs over the life cycle of technology programs, such as subcontractor management, cash flow forecasts and staffing projections.	Project Management Process Management Support
2. Agility to successfully respond to rapidly changing business environments and customer priorities and requirements is critical to long term survivability, including a successful re-compete.	Process Management Support
3. Planning and controlling life cycle costs needs to focus on implementing capable/mature processes in the support services as well as the technology programs.	Project Management Process Management Engineering Support
4. Application of the CMMI model practices and SCAMPI^{SM} appraisal methods provide a common framework to achieve process capability and maturity in both the technology programs and infrastructure support functions.	Process Management Engineering

Background of Journey

Rationale for Initiating Journey

This small setting faced extreme challenges of 1) maintaining profitability while managing increasing performance costs, 2) responding to a dynamically changing customer environment and 3) planning for a re-compete of the contract.

Organization Overview

This small setting supported their major customer by performing on-site and off-site engineering and scientific services and product development for space based applications.

Kick-Off Activity

Multi-domain leadership team assembled to plan the multi-year journey to higher maturity levels. The initial version of the plan launched pilot projects in the small software development organization and concurrent support functions of finance, contracts, procurement and HR.

Initial Obstacles

The small setting faced initial obstacles of trained resources to implement planned process improvements such as processes to integrate key program and technical functions as well as staff training in the CMMI® , performance measurement, and SPC techniques.

Progress Improvement Planned Timeline 2003 - 2006

Technology Projects

Process Improvement Plan

Software & Systems Engineering
Class A
Appraisals

ML 2
(CL 3
10 PAs)

ML 5

ML 5

Spring 2003

September 2003

September 2004

March 2005

2006

Leadership Team

Infrastructure Services

Quantitative Management
Technology
Transfers

Finance

Contract Award

Finance Organization CMMI Maturity Level 5 Thumbnails

Organization Size	Seven staff
Process Training Sessions	Three day Introduction to the CMMI (2004), Statistical Process Control (SPC) and optimization (2004) In-house SPC resource provided mentoring (2004 – 2005)
Scope of Model (CMMI-SE/SW Version 1.1 (Continuous)	Implemented practices from all Maturity Level 5 process areas Achieved Maturity Level 5 via equivalent staging
Process Model	The basis for the process model was the established and maintained corporate financial processes. Extensions, consistent with the corporate accounting processes, included an Excel implementation of revenue optimization providing forecasting intervals for: 1. Monthly headcount and spend rate 2. Accuracy of an invoicing report
Measurements	Implemented existing required corporate financial performance measurements and FTE headcount, spend rate and invoicing accuracy forecasting intervals.

Finance Organization CMMI Maturity Level 5 Thumbnails (Continued)

Process Resources	1.25 process improvement staff and SPC resource One member of the finance organization was the CMMI coordinator The revenue optimization model developed by the manager of the finance organization using individuals and moving range.
Formal appraisals	Class C – Spring, 2004, Class B – Summer, 2004 Class A – March, 2005
Appraisal Team Domain Composition (7 team members)	Systems Engineering, Project Control (Finance), HR, Organization Process Improvement Lead
Example of a Services Interpretation of the Validation Process Area	The Validation Process Area was implemented using the monthly customer Performance Management Review (PMR) session to validate the accuracy of the receivable report as part of the delivery activity. Before the receivable report could function successfully in the customer's environment (integrated into the customer's financial MIS), the PMR was conducted to validate the accuracy and format of this report.
Body of Evidence	12 affirmation sessions 500 artifacts/280 affirmations

Summary of Experiences

Program control
(project performance)

Contracts/subcontracts
(subcontracting quality and schedule)

Finance Forecasting Model

Functioned using a legacy of formal process models for revenue and profit and standard performance measurements at the beginning of the CMMI journey in 2003.

Implemented improvements on existing processes, revenue models and measurements to expedite journey to develop an integrated process model to forecast accuracy of monthly invoice.

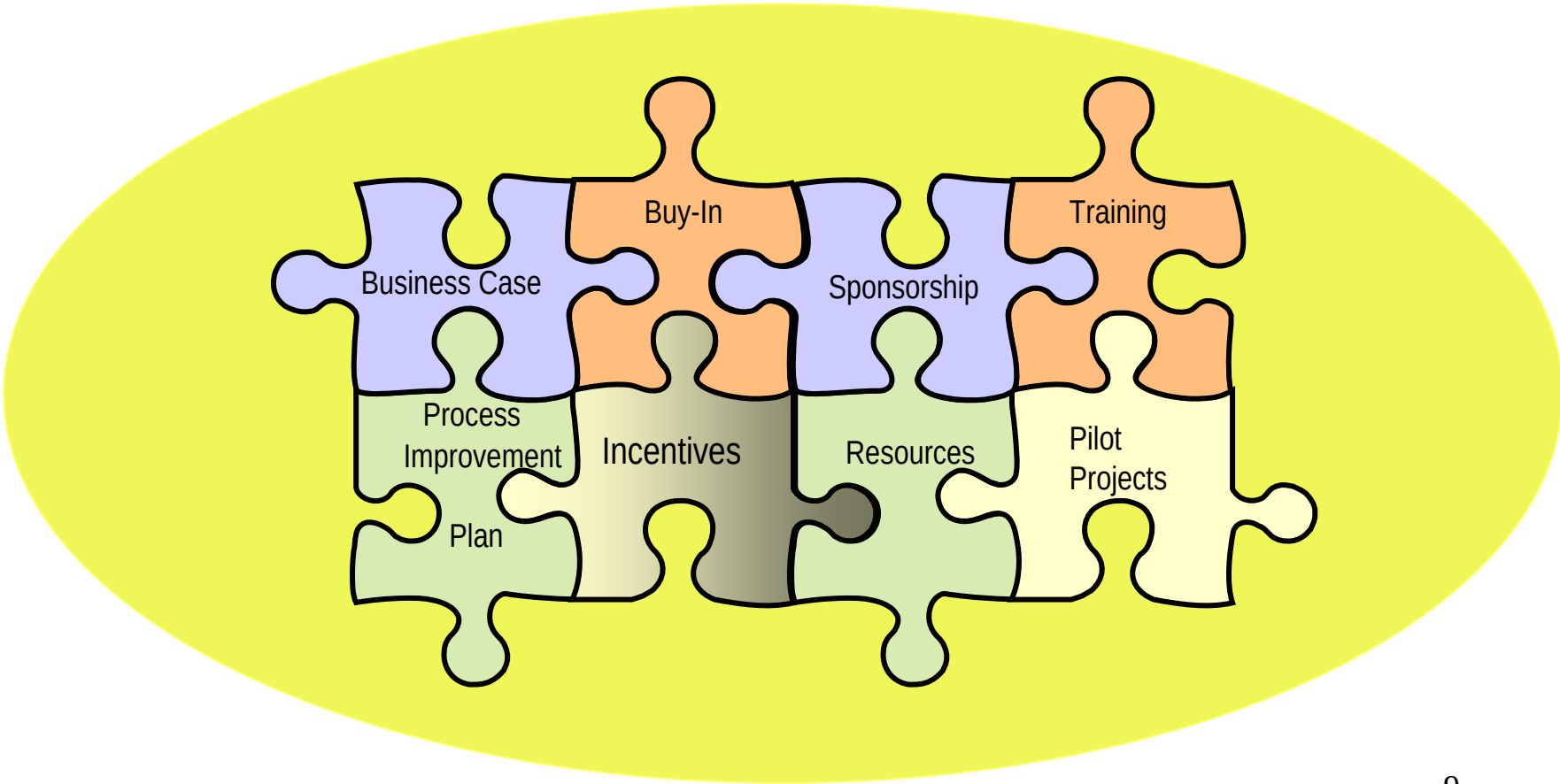
Process performance model included a risk assessment of subcontractor performance and project performance.

Implementation of SPC techniques highly compatible with existing single point variance analysis of revenue generation, contractual performance requirements, project and subcontractor performance.

Efficiently transitioned to the use of the CMMI model definitions and continuous process improvement concepts in improving and implementing forecasting.

CMMI Implementation Success Factors

There are a well documented set of process improvement success factors seemingly invariant of organizational size, such as higher management commitment, resources, appropriate stakeholder involvement in the planning, execution of the pilot projects and a compelling business case.



Five Observations of Process Improvement Institutionalization in Small Settings

In 2002 and now in 2006, the published lessons learned describing process improvement success factors focused on larger development and engineering organizations.

From over three years of observations of process improvement institutionalization in this small setting:

1. Smaller settings have less formality in their chain of command and their service support functions and are usually “one of a kind” closely modeled for a specific customer base.

2. The resulting flexibility resulting from less organizational formality provides agility to rapidly change to meet emerging business challenges.

3. A less formal environment is also conducive to open communications and a less formidable decision making process.

4. Organizations with open communications typically are more receptive to new ideas and have greater motivation to participate in the planning and implementation of new processes.

5. One direct benefit of openness in communications in small settings is the process performance models are efficient and the on-going modifications during institutionalization periods consume less time.

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DEFINING THE FUTURE

Sustaining CMMI Compliance

CMMI Technology Conference & User Group
13-16 November 2006

Rick Hefner, Ph.D.
Director, Process Management
Northrop Grumman Corporation

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Background

So you've passed your CMMI appraisal - what now?

- **Many organizations have experienced difficulty in maintaining CMMI-compliant behavior**
  - Projects regress into old habits
  - Senior management turns their attention to other challenges
  - None of the investment pays off
  - When the time comes to re-appraise, you have to start all over
- **This presentation will examine techniques for sustaining and capitalizing on your CMMI achievements**
- **It focuses on the primary reasons why projects and organizations fail to institutionalize CMMI practices, and suggest ways to overcome them**

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Topics

- **What institutionalization is – and how to spot it**
- **Why institutionalization fails**
- **Keys to institutionalization:**
  - Addressing the underlying beliefs
  - Accountability
  - Management commitment and support
  - Effective use of audits and appraisals

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What Institutionalization Is

Institutionalization: The ingrained way of doing business that an organization follows routinely as part of its corporate culture.

- CMMI-DEV v1.2

When mentioned in the generic goal and generic practice descriptions, institutionalization implies that the process is ingrained in the way the work is performed and there is commitment and consistency to performing the process.

An institutionalized process is more likely to be retained during times of stress.

GG 2 Institutionalize a Managed Process

GP 2.1 Establish an Organizational Policy

GP 2.2 Plan the Process

GP 2.3 Provide Resources

GP 2.4 Assign Responsibility

GP 2.5 Train People

GP 2.6 Manage Configurations

GP 2.7 Identify and Involve Relevant Stakeholders

GP 2.8 Monitor and Control the Process

GP 2.9 Objectively Evaluate Adherence

GP 2.10 Review Status with Higher Level Management

GG 3 Institutionalize a Defined Process

GP 3.1 Establish a Defined Process

GP 3.2 Collect Improvement Information

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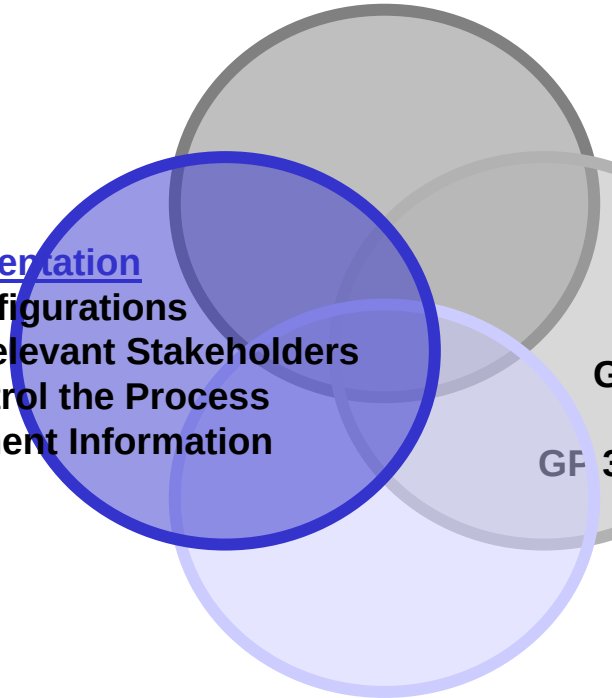
Common Features –
A Lost Perspective in CMMI v1.2!

Commitment to Perform
GP 2.1 Establish an Organizational Policy



Directing Implementation
GP 2.6 Manage Configurations
GP 2.7 Identify and Involve Relevant Stakeholders
GP 2.8 Monitor and Control the Process
GP 3.2 Collect Improvement Information

Ability to Perform
GP 2.2 Plan the Process
GP 2.3 Provide Resources
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GP 3.1 Establish a Defined Process

Verifying Implementation
GP 2.9 Objectively Evaluate Adherence
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Organizational Culture

A pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way you perceive, think, and feel in relation to those problems.

Artifacts

- The practices that can be observed in such areas as dress code, leadership style, communication processes

Espoused values

- The elements the organization says it believes in, the factors that it says influence the practices in which it engages

Basic underlying assumptions

- Unstated beliefs the organization has come to accept and abide by

Organizational Culture & Leadership, Edgar H Schein

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Standardized Programs

Standardized programs are programs in which the details of the program's processes are always intended to be performed in a specific way. They are instituted where it is necessary (or desirable) that the results of the program be predictable. They are established for the express purpose of the program's means controlling the program's ends.

- *"The Cultural Dimensions Of Standardized Programs", D. Larry Fraser*

Standardized programs are useful in:

- Product Consistency
- Oversight Facilitation
- Expectation Dependability

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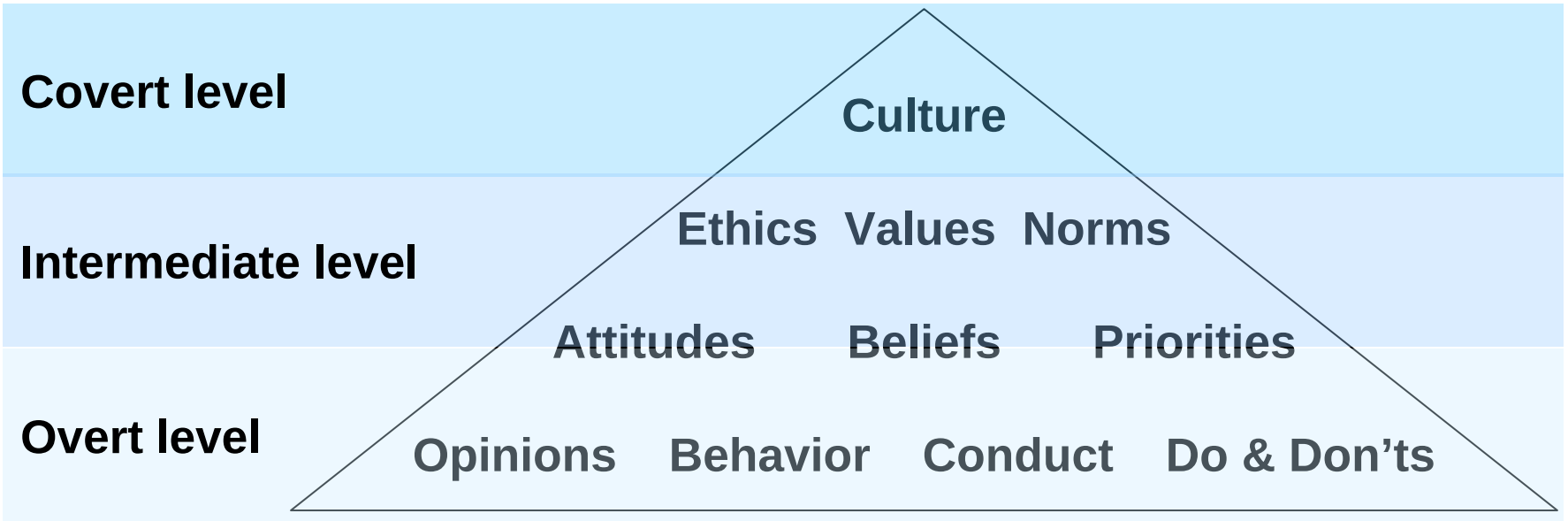
Why Institutionalization Fails

- Few engineers or managers are trained in organizational psychology
- Improvement efforts implement the generic practices (i.e., change the artifacts) without understanding or addressing lower level contributors to culture



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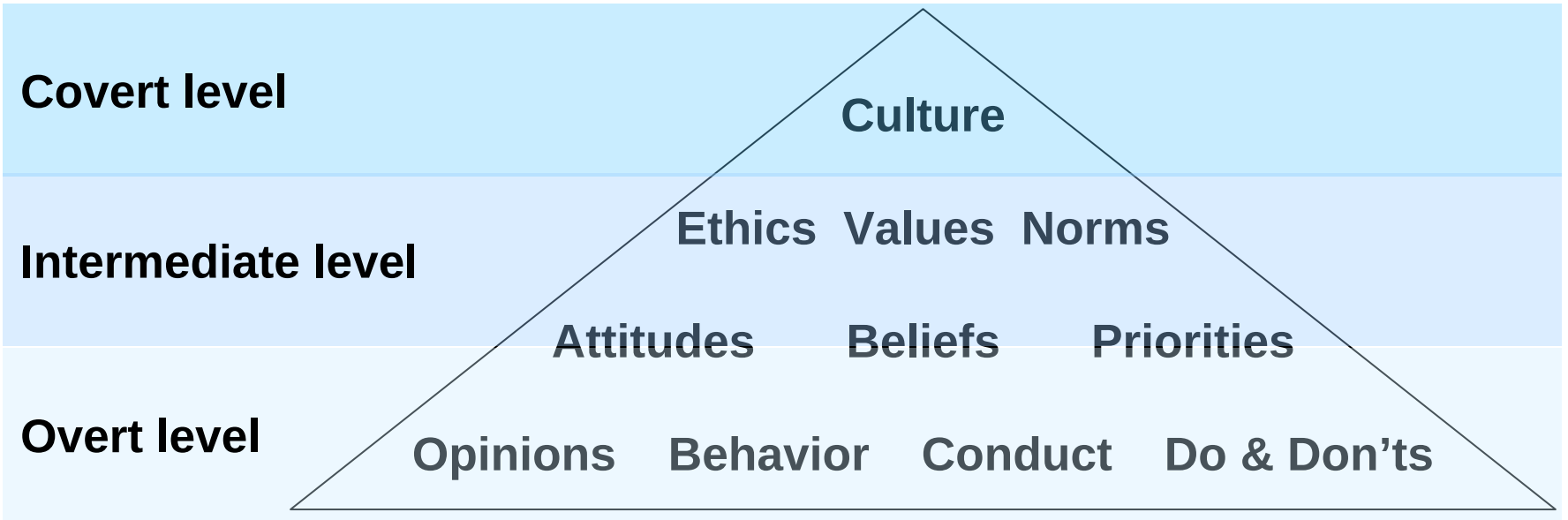
Addressing the Underlying Beliefs

- **Sponsors and performers must have a strong vision of the desired culture**
  - What are my roles and responsibilities?
  - What changes in behavior are required?
  - What are the underlying beliefs and values?
  - How do I benefit – WIIFM?



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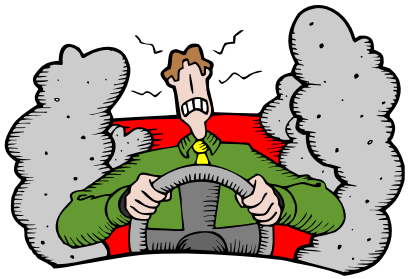
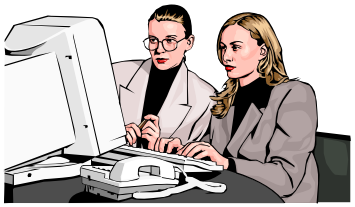
Five Dimensions of Work

Reference: Richard Hackman & Greg Oldham, Work Redesign



- ***Skill variety*** **- The degree to which the work requires you to exercise a variety of skills**
- ***Task identity*** **- The degree to which the work requires you to complete a whole, identifiable piece of work**
- ***Task significance*** **- The degree to which your work affects others and contributes to social welfare**
- ***Autonomy*** **- The degree to which you have control over the means and methods you use to perform your work**
- ***Job feedback*** **- The degree to which carrying out the work itself provides you with direct and clear information about how effective you are.**



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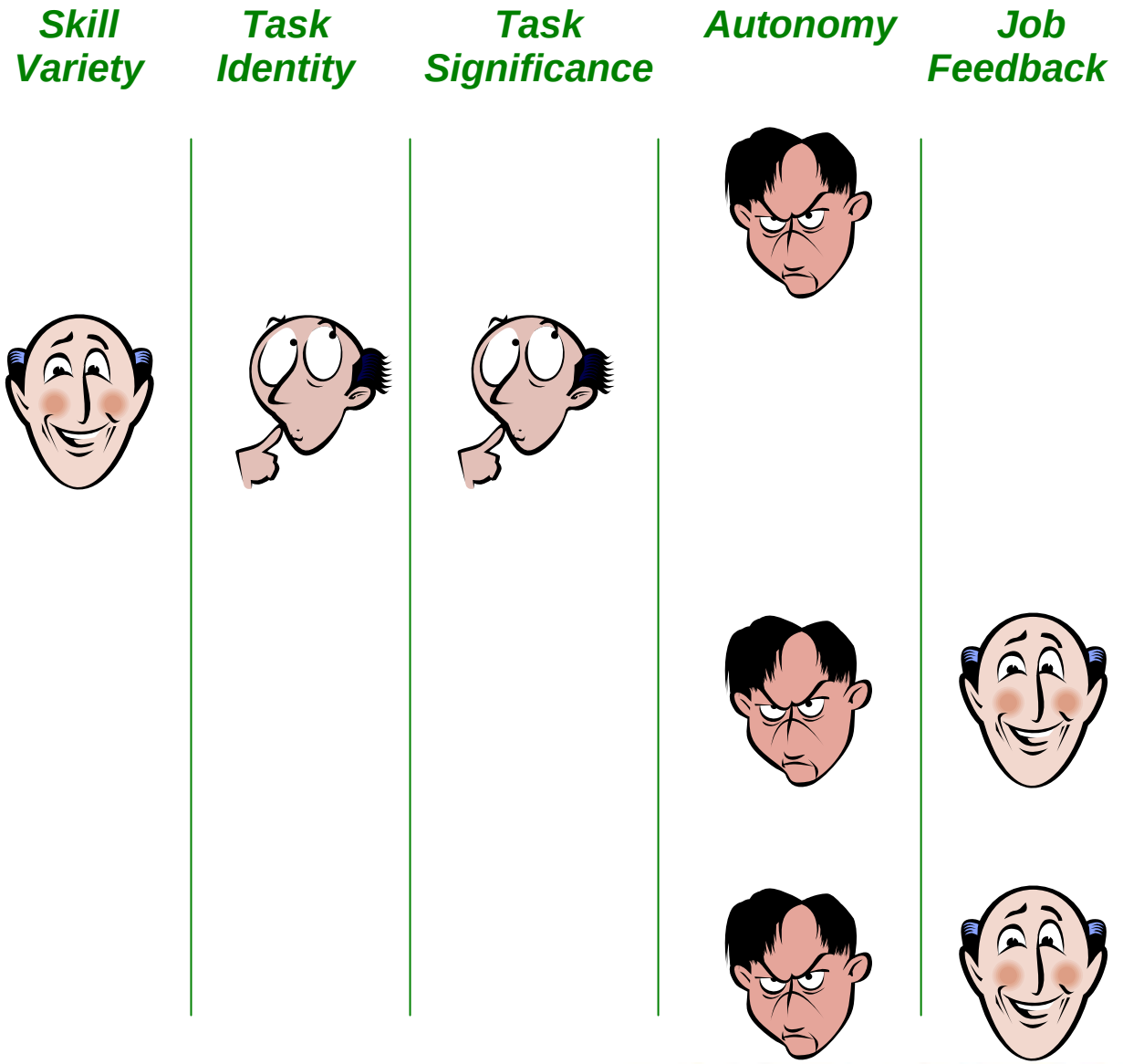
Perceptions of the CMMI Common Features Based on Work Environment Preferences

Commitment to Perform
- Establish an Org. Policy

Ability to Perform
- Plan the Process
- Provide Resources
- Assign Responsibility
- Train People
- Establish a Defined Process

Directing Implementation
- Manage Configurations
- Involve Stakeholders
- Monitor/Control the Process
- Collect Improvement Info

Verification
- Obj. Evaluate Adherence
- Review with Higher Mgmt



"Aligning CMMI Strategies with Individual, Project, and Organizational Perspectives," Software Technology Conference, 2003

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Key Messages

- **Achieving and maintaining mature processes is essential to meeting our business goals**
  - Predictability, performance, quality
- **CMMI involves short-term investment for long-term gain**
- **CMMI is an enabler (not a guarantee) of project success**
  - Other aspects (people, technology, customer relationship, etc.) are equally important
  - The value is often risk reduction (which may be difficult to measure)
- **CMMI is a a set of proven, industry best-practices**
  - Adoption is about learning how to apply these practices to our work
  - The practices may feel awkward and have limited value until we learn them
  - It's OK to make mistakes – we will get better over time
- **When the entire organization is behaving maturely, everyone's job becomes easier**
- **Continuous improvement is a way of life**

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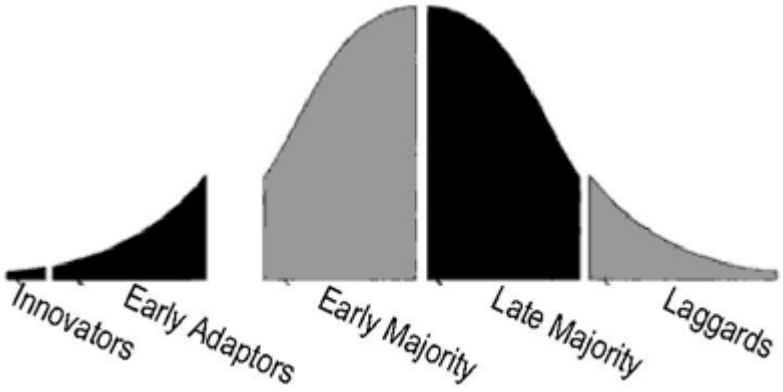
Accountability

- **Adopting and sustaining CMMI is about each practitioner learning and performing the new behaviors**
- **The role of management in cultural change is to hold people accountable for the new behaviors and conduct**
- **Change agents can enable management by:**
  - Helping them have a clear vision of the new culture
  - Identifying inappropriate behavior
  - Providing tangible, objective measures of adoption/sustainment



"Crossing The Chasm", Geoffrey Moore

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Management Commitment and Support

Management:

- **Understands the key messages**
- **Is willing to take actions to reinforce them**
- **Provides resources to support/sustain process improvement efforts**
- **Sets expectations that essential project functions will be funded and processes will be followed**
  - Project planning, estimation, tailoring, CM, QA, etc.
- **Supports process improvement and sustainment, rather than passing appraisals**
- **Rewards mature processes development and sustainment rather than individual heroics**
  - Tell me how you will reward me, and I'll tell how I will behave

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Effective Use of Audits and Appraisals

- **Process and product audits provide tangible, objective measures of adoption/sustainment**
  - Policies, processes, and standards must reflect the desired behaviors
- **Appraisals evaluate the effectiveness of the audit program**
  - Standardized tools, approaches, and methods
  - Consistency of appraisers – if they understand the way we are structured and operate, there is less time required to understand what we are doing.
  - Pre-appraisal activities to prepare projects for the appraisal process
- **The frequency of audits and appraisals, and the sampling, must reflect the progress of the cultural change**
  - As the culture begins the change, more frequent and more in-depth audits/appraisals are required
  - Later, the amount of audits/appraisal may decrease, if the culture has truly changed

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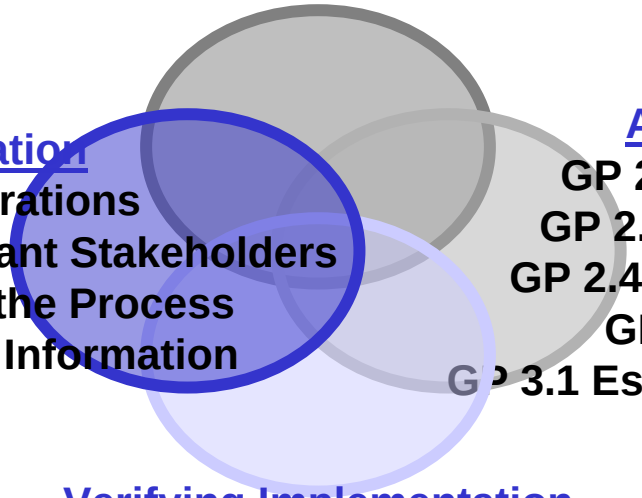
Summary

- **Process improvement can be sustained by understanding and focusing on institutionalization**
  - Addressing the underlying beliefs
  - Accountability
  - Management commitment and support
  - Effective use of audits and appraisals

Commitment to Perform
GP 2.1 Establish an Organizational Policy



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BAE SYSTEMS

Maintaining Institutionalization After the Appraisal Team Leaves

BAE Systems
Electronics and Integrated Solutions Operating Group
Nashua, New Hampshire
USA

Presentation Agenda

BAE SYSTEMS

- Introduction
  - The Organizational Facts
  - Experience Basis for Premise and Presented Approach

- "Elastic Band Phenomenon"
  - Comfort Zone Scenarios

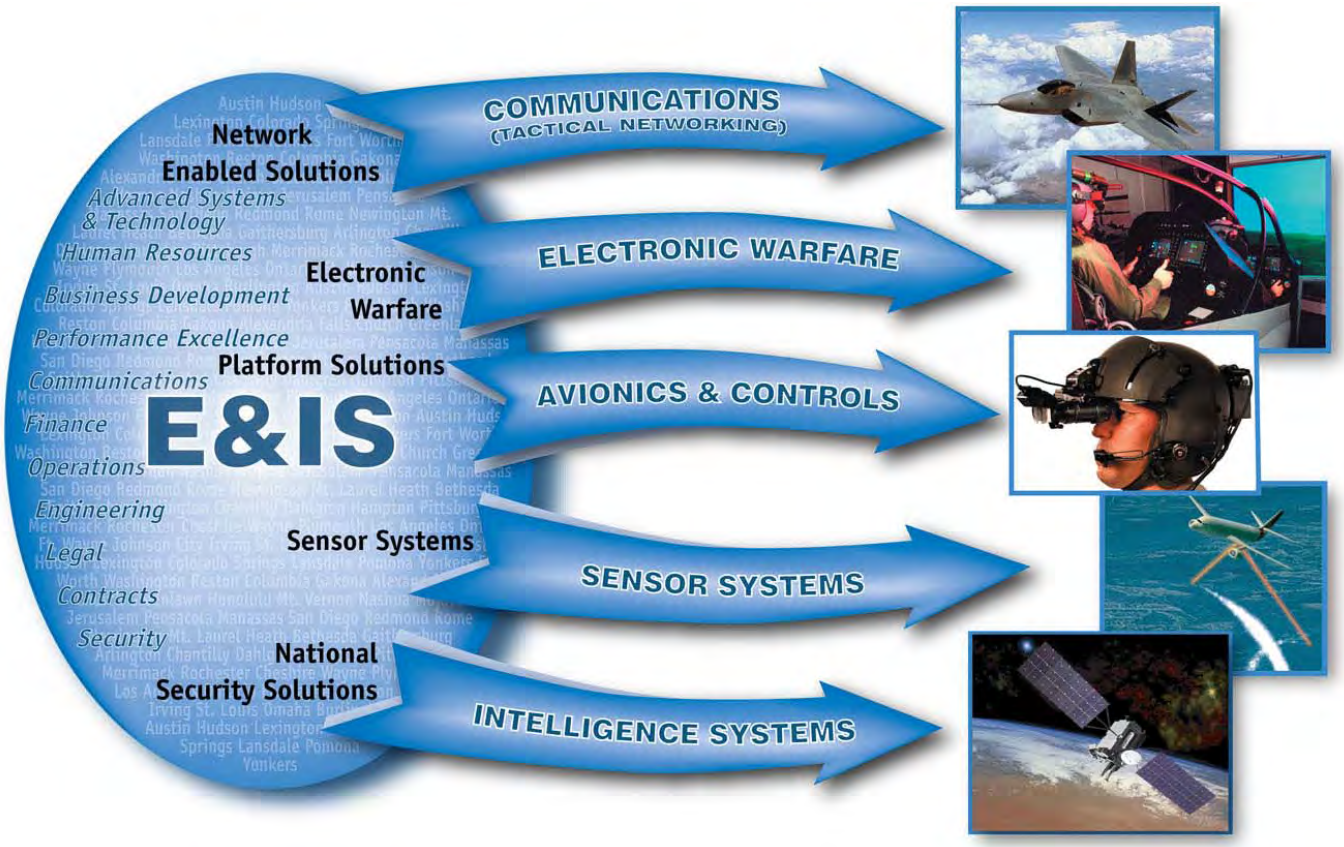
- Making It Easy To Do The Right Things

- Conclusion

- Final Thoughts

Electronics & Integrated Solutions Operating Group

BAE SYSTEMS

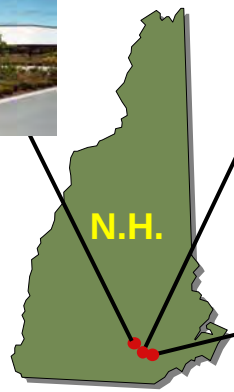


Electronic Warfare

BAE SYSTEMS

Pomona

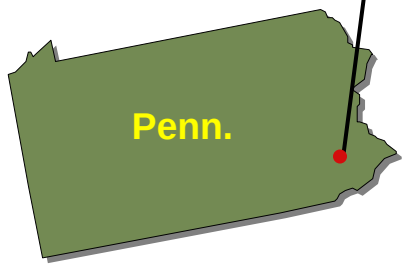
Merrimack

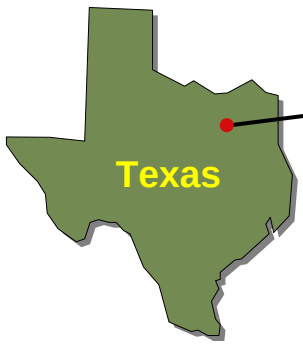


Nashua

Hudson

Lansdale





Fort Worth

Yonkers

Sensor Systems

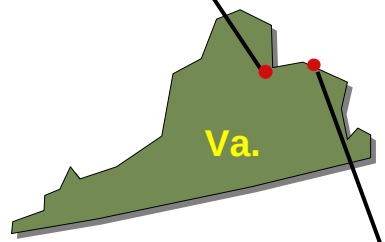
BAE SYSTEMS

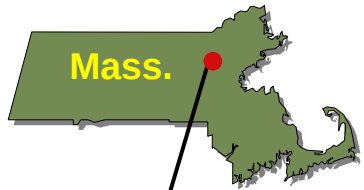
Mojave

Austin

Manassas

Jerusalem (Rokar)

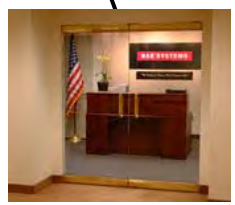




Merrimack

Nashua

Lexington



Washington, D.C.

Experience Basis for Premise and Presented Approach

BAE SYSTEMS

- Twelve years experience with appraisals and assessments
  - Four Software CMM® assessments
  - Two EIA / IS 731 appraisals
  - Two CMMI® appraisals
- SEI certified *Introduction to CMMI®* instructor on Enterprise Process Group staff
- Enterprise Process Group participant on SEI SCAMPI℠ upgrade team

Process Development Time Line

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2006 Continue evolving process based on process improvement suggestions
Further expanding use of process

2005 Expanded Level 4 and 5 behaviors from systems and software
Implemented process improvement to enhance process usability
Class A appraisal assesses process (CMMI® SE / SW) at Level 3

2004 Class B appraisal assesses process (CMMI® SE / SW / IPPD / SS) at Level 4
Integrated Product Development Process implemented

2003 Enterprise Process Group officially formed
Management and technical (SE / SW) processes developed

Customer requirements for CMMI® appearing in RFPs

2002 Systems Engineering Process assessed at EIA / IS - 731 Level 3
SW process updated to SW-CMM Level 5
Development of an integrated process begins

2001 Gap analysis performed for engineering and program management processes
Software process assessed at SW-CMM Level 4

2000

1998 Software process assessed at SW-CMM Level 3

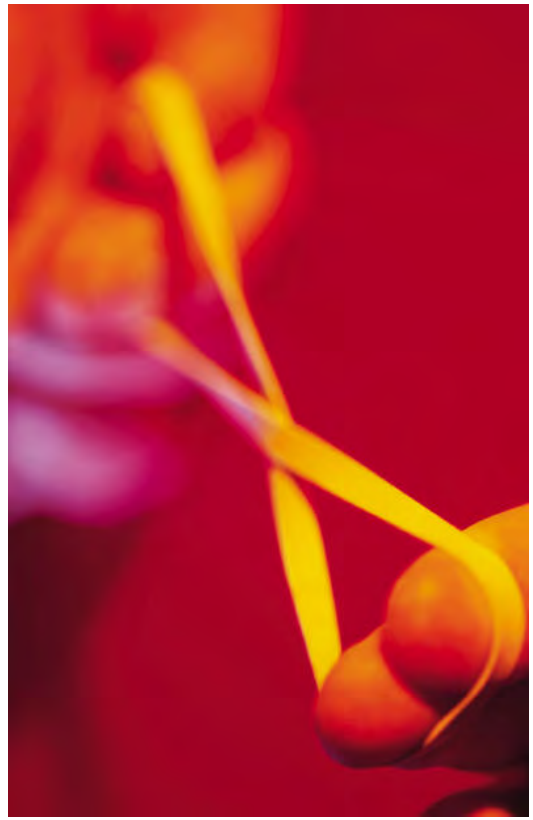
1994

BAE SYSTEMS Lifecycle Management
CMMI® released by SEI
PMBOK® focus introduced

The “Elastic Band Phenomenon”

BAE SYSTEMS

- The Elastic Band Phenomenon Premise
  - Once a formal appraisal or audit has been completed, the high energy and extra attention to process compliance will naturally wane, and the organization will tend to migrate toward the pre-appraisal comfort zone



Comfort Zone Scenarios

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The appraisal coverage (AC) is less than the organization's comfort zone (CZ)

- Following the appraisal, the organization remains in its comfort zone

---

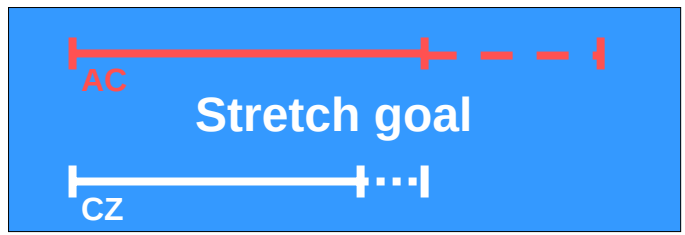
The appraisal coverage is equal to the organization's comfort zone

- Following the appraisal, the organization remains in its comfort zone

---

The appraisal coverage stretches the organization's comfort zone

- Following the appraisal, the organization reverts back to some point less than its original comfort zone (Elastic Band Phenomenon)



Post-Appraisal Organizational Impact
(Reduced Comfort Zone)

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Any reduction to process compliance emphasis may result in:

- Non-uniform application of the process
  - Reduced familiarity with the process through non-use
  - Increased cost of rework for process compliance
- Confusion as to when it is right to follow the process
  - Impression that compliance is only needed to pass appraisals
- Practitioners' frustration with management for providing mixed signals on process compliance
  - Partial/Minimal process compliance; quality suspect

Potential for Poor Project Planning and Poor Project Execution

Making It Easy To Do The Right Things

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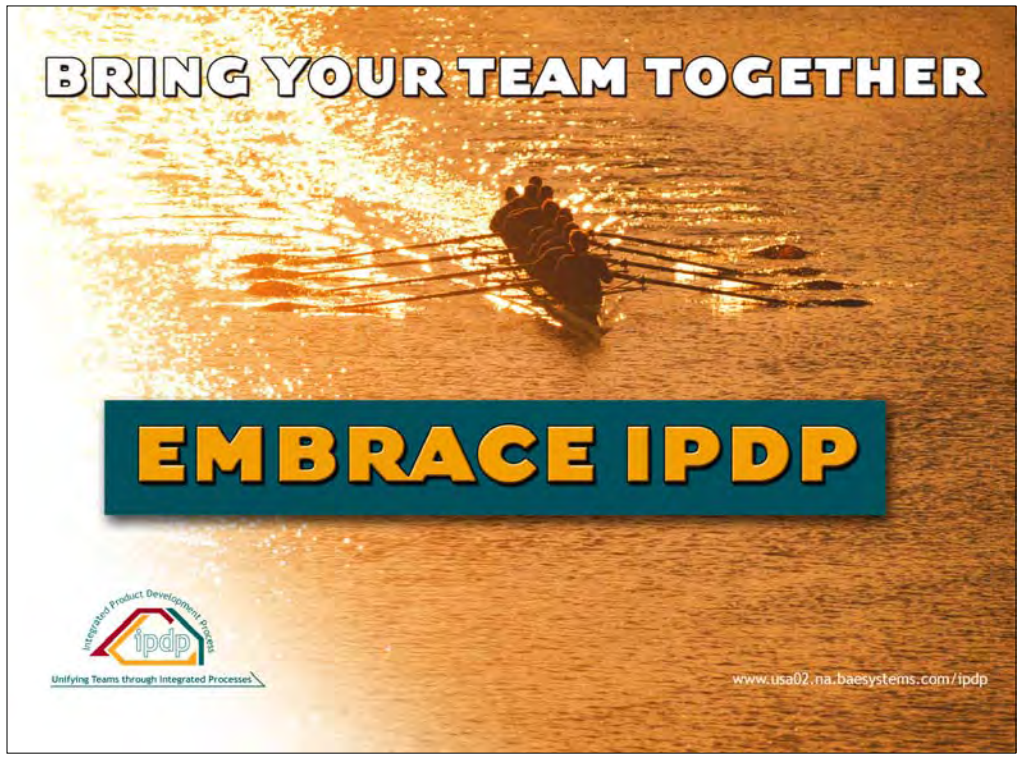
- To facilitate institutionalization, the Enterprise Process Group ensures the process is easy to use

- Approaches/techniques we are using:
  - Process marketing
  - Ease of access
  - Process training
  - Facilitated project start-up
  - Planning work product reviews
  - Process automation and process aids
  - Internal process assessments
  - Active process ombudsman
  - Web-based process tips
  - Solicited process improvement ideas

Process Marketing

BAE SYSTEMS

- Display eye-catching posters around your company
- Instill a message:
  "Bring Your Team Together"
- Reinforce with a slogan:
  "Unifying Teams Through Integrated Processes"
- Develop a logo:
  "IPDP" is our Integrated Product Development Process



Ease of Access

BAE SYSTEMS

Institute a comprehensive Web site that is easily navigated

Process Training

BAE SYSTEMS

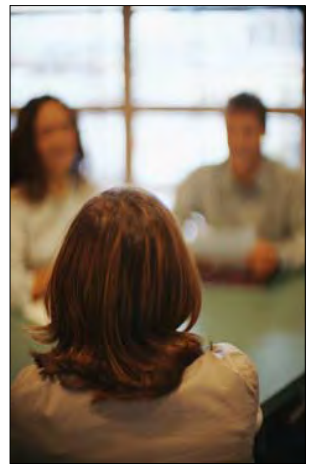
- Effective training is key to the success of a process
  - Multiple levels of training required
- Process introduction course
  - General material and recent changes
  - Annual refresher required
- Integrated training for both the planning and execution phases
  - Includes project management and technical management
- Related training for Peer Reviews, Decision Making, Risk Management, and Supplier Management

Facilitated Project Start-up

BAE SYSTEMS

- The Enterprise Process Group and the Project Team coordinate the launch activities to develop a comprehensive project plan in a timely manner

- The Project Launch mentoring environment
  - Is a series of modules designed around project planning
  - Provides reinforcement of the process
  - Scopes the process based on project attributes
  - Facilitates planning work product development with project team leads



Planning Work Product Reviews

BAE SYSTEMS

– The Enterprise Process Group is actively engaged in the project's planning activities

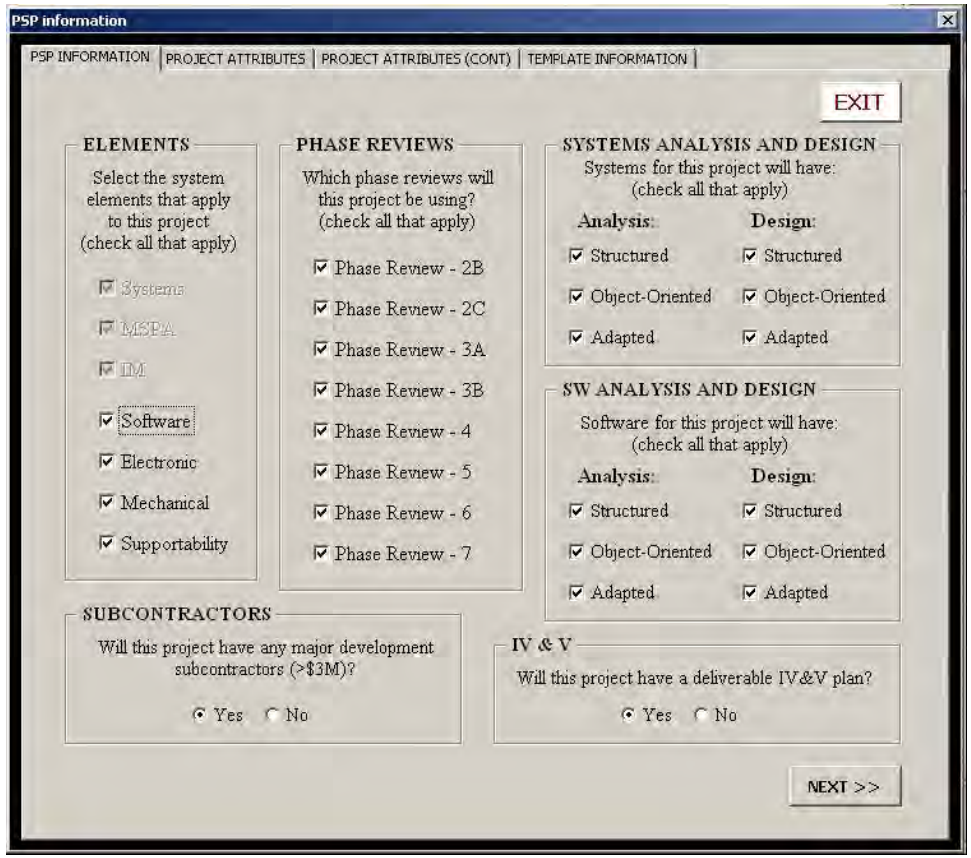
- Guides planning work product development during Project Launch
- Participates as a stakeholder
- Checks planning work products compliance
  - Review lists guide the development of work products and are used as the checklists for audits

Enterprise Process Group Partners with the Project Team during Project Planning

BAE SYSTEMS

Process Customization Aid

- Uses a series of questions to help the project team select the applicable process elements
- Establishes the standard project shared area
- Pre-populates project information within the planning work products

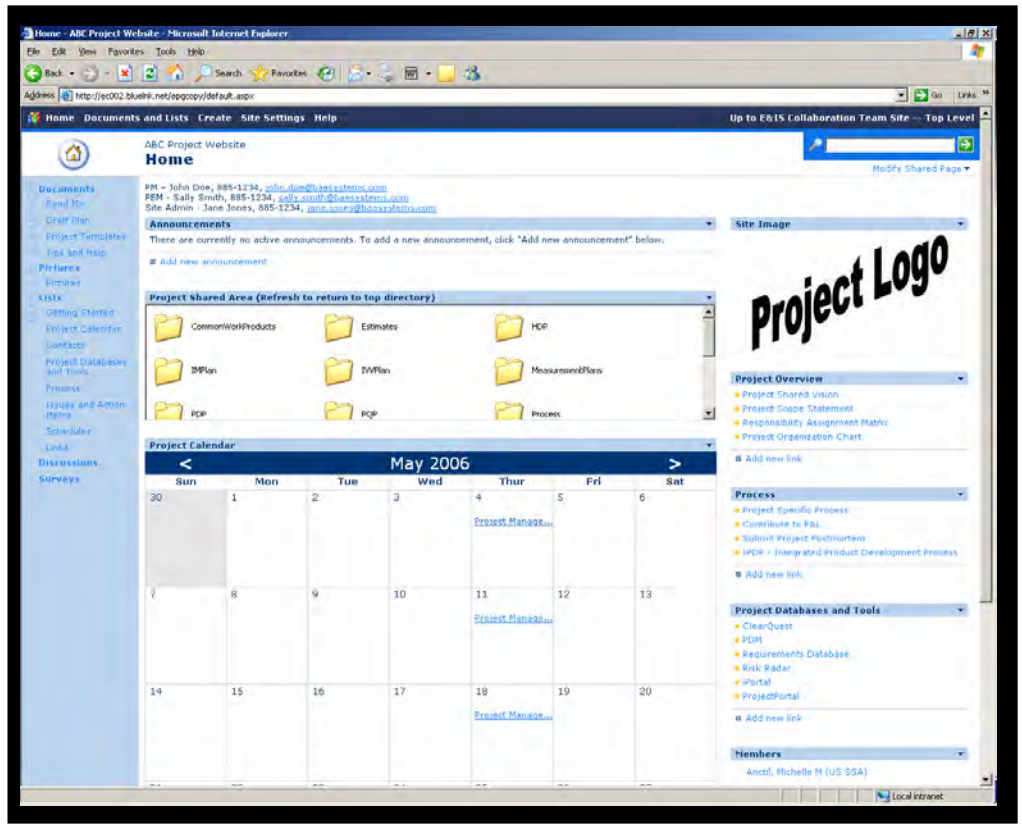


Automation facilitates process use and compliance

BAE SYSTEMS

Project SharePoint Template

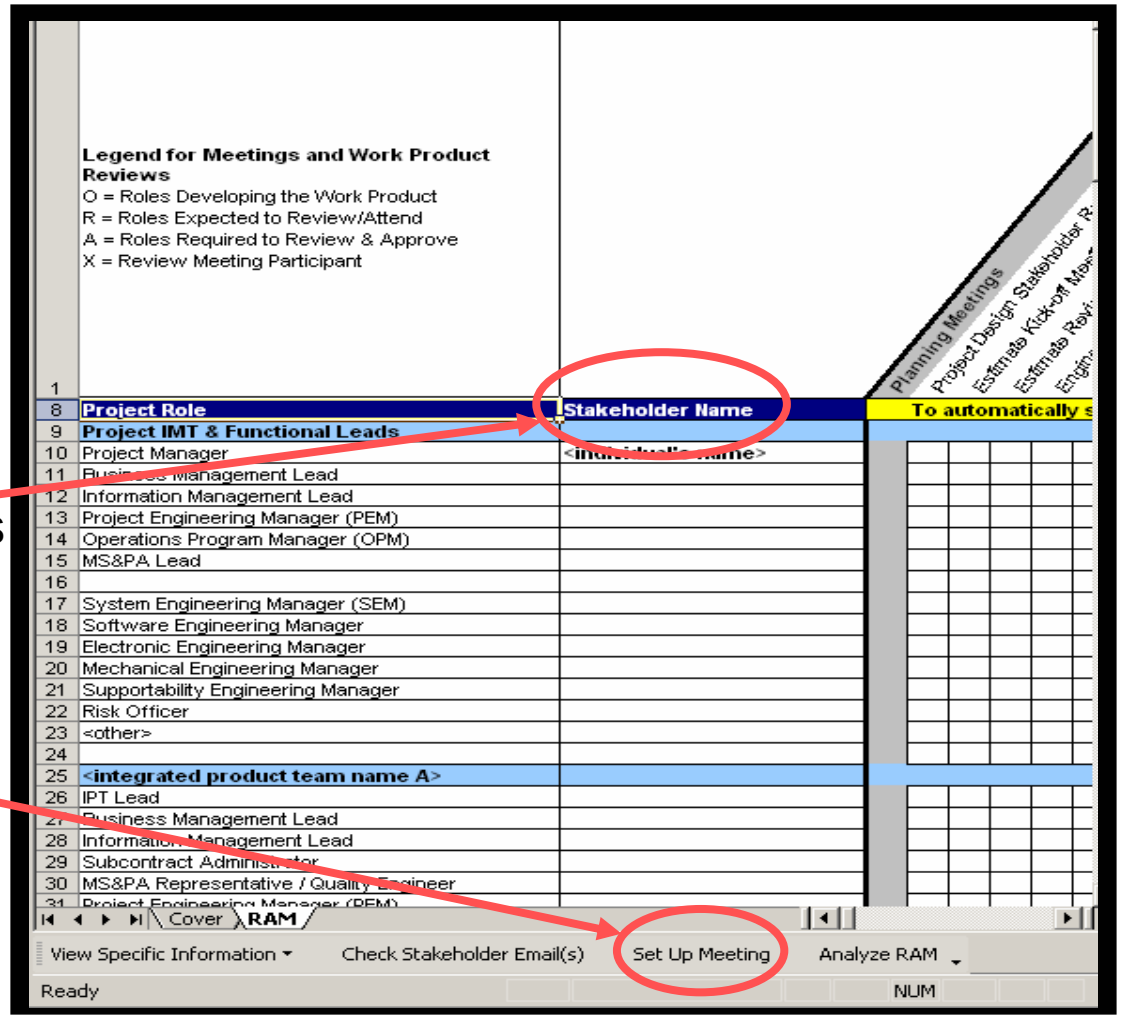
- Enables a collaborative team environment
- Supports and automates aspects of the process
  - Issues & actions tracking
  - Project calendar
- Provides a single point of access for project information
- Common format allows new project personnel to quickly find project information



BAE SYSTEMS

Responsibility Assignment Matrix (RAM) Aid

- Facilitates preparation for project meetings and work product reviews
- Ensures accurate stakeholder involvement for specific reviews
- Automates meeting invitations using MS Outlook
- Creates agenda, attendee list and minutes template



Internal Process Assessments

BAE SYSTEMS

- Align with CMMI® and are independently conducted
  - Performed on individual projects
  - Staffed with people knowledgeable in the CMMI® and the organizational process
  - May be conducted periodically on projects with long durations
  - Similar to a Class B (without the organizational elements)
- Check for compliance with CMMI® and the organizational process
- Assess application and understanding of the process
- Indicate the effectiveness of:
  - Process institutionalization
  - Process training
  - Project start-up process

Active Process Ombudsman

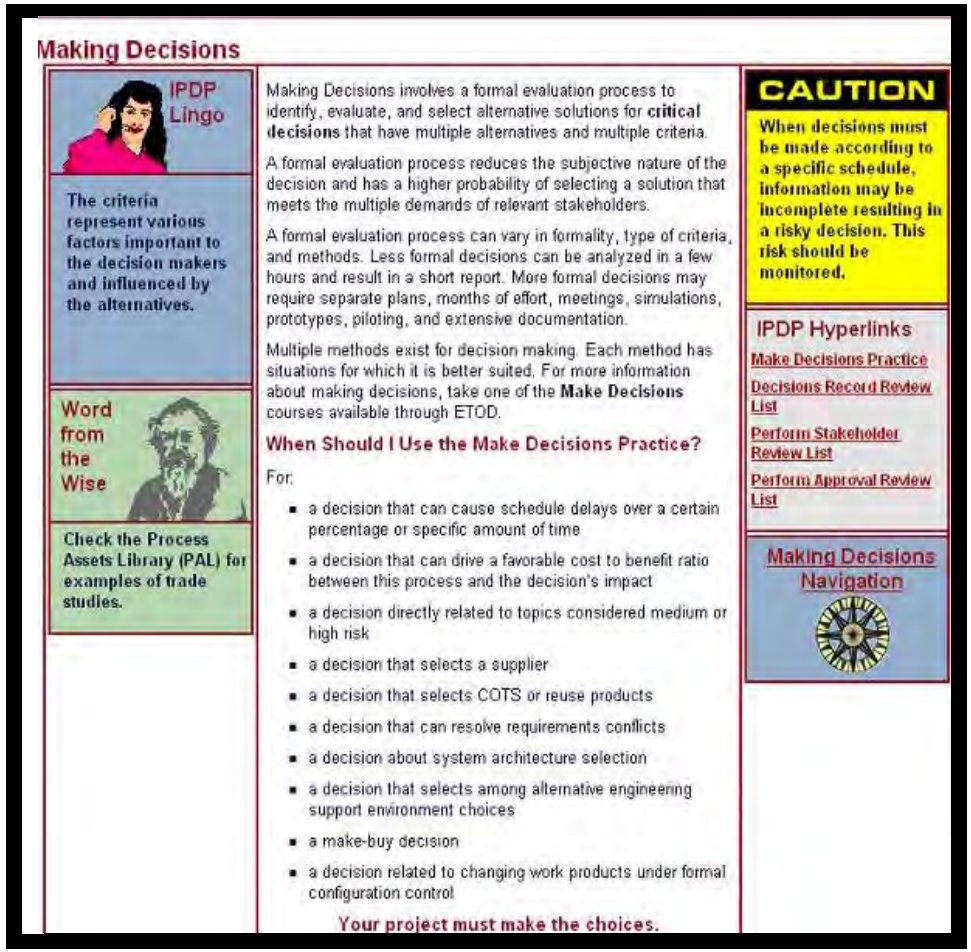
BAE SYSTEMS

- Web-based mechanism to ask process-related questions
  - How does the process apply?
  - Where do I find…?
  - Can you tell me how this practice relates to my project?
- Quick response is provided
  - Process Ombudsman confirms content and intent with requestor
  - Answer is developed and vetted with process team
  - Response sent back to requestor
- Web-based Frequently Asked Questions (FAQs) developed from Process Ombudsman activity

Web-based Process Tips

BAE SYSTEMS

- Process Tips provide quick access to additional guidance
  - Focused on specific process topics
- Portal to the process
  - Provides interpretation of process intent
  - Reinforces process definitions
  - Reinforces correct behavior
  - Alerts of common misunderstandings
  - Links to related items



Solicited Process Improvement Ideas

BAE SYSTEMS

- Enterprise Process Group actively solicits improvement suggestions from users
  - Accomplished directly through the Process Web site
  - Rewards for best suggestions
  - Results in process updates
- User involvement facilitates buy-in
  - Enables best practices
  - Encourages continuing inputs
  - Improved process enhances process institutionalization

Institutionalization is Enabled through User Involvement

Institutionalization….Raising the Bar (Expanding the Comfort Zone)

BAE SYSTEMS

- Expand the use of process to a wider spectrum of projects
  - Familiarize the largest possible audience with the process and the process terminology
- Leverage process, by its use, during proposal preparation
  - Ease transition between the proposal, and project planning and execution
    - Development of planning artifacts, technical plans, top-level system architecture that are aligned or compliant with the process
  - Design quality in (by use of the process) from the beginning

Reduces future Elastic Band Phenomena

Conclusion

BAE SYSTEMS

- Establish an organizational standard process
  - It must be comprehensive, concise, coherent; yet easily usable
- Be watchful of the organization being pulled out of its comfort zone, and then relaxing to a previous level or lower (Elastic Band Phenomenon)
- Provide process support and process aids to reduce the tendency to revert to a relaxed state
  - To make the process easier to understand and use correctly
  - To make compliance routine; not unique (institutionalization)
- Implement process improvement as part of the process
  - Methods to suggest improvements must be easy to use
  - Suggestions must be embraced as improvement opportunities

Final Thoughts

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–Questions?

–Comments?

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Raytheon
Missile Systems

It's a #$!>% Mess: How to Leverage Today's Process into Tomorrow's Initiatives*

Raytheon Missile Systems
Terri Bryant and Lety Santillan

November 16, 2006

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Does this look Familiar???

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Process for the Sake of Process Helps No One!

Users Perspective on Process

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Missile Systems

- Too many conflicting processes
- No consistency among directives and processes
- My functional organization tells me one thing, but my program another
- Waste of time and money
- Process gets in the way of “real work”
- What does this process stuff really do anyway?
- I am behind schedule and don’t have time for process stuff

With So Much Process, When Can I Get My Work Done?

Program Manager's Perspective on Process

Raytheon
Missile Systems

- Too Expensive
- Too much process, not enough budget!
- I don't need to use process, I make this company money without it!
- What does this process stuff really do anyway?
- I am meeting schedule and budget, process just gets in the way!
- Why does the organization tell me to use process without paying for it?
- My Customer is not going to pay for process work!

I Am Meeting Schedule and Budget, Process Just Gets in the Way!

EPG's Perspective on Process

- Conflicting initiatives
- All things for all people
- Continuous new direction
- Flavor-of-the-day response
- Passive sponsorship

Continual "Redirection" Leads to Confusion and Ineffectiveness

Our Moment of Courage: What Did Not Work

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Missile Systems

- Our Customer created a new set of requirements for certain types of programs.
- Our Company decided to create Corporate-Level Initiatives to answer our Customer's needs.
- Our Organization created a whole new set of directives to answer the need, without leveraging all the efforts that had already been created as part of AS9001, CMMI…etc.

A Process Created in Isolation is a Waste of Time

What Did Not Work

- Silo Processes
- No Big Picture
- New initiative = new process
- Poor Communication
- No Accountability
- Unorganized Deployment
- No common agenda, too many hidden agendas
- Assumed compliance

Creating New Process for Every New Initiative Costs Too Much

Our Success Stories

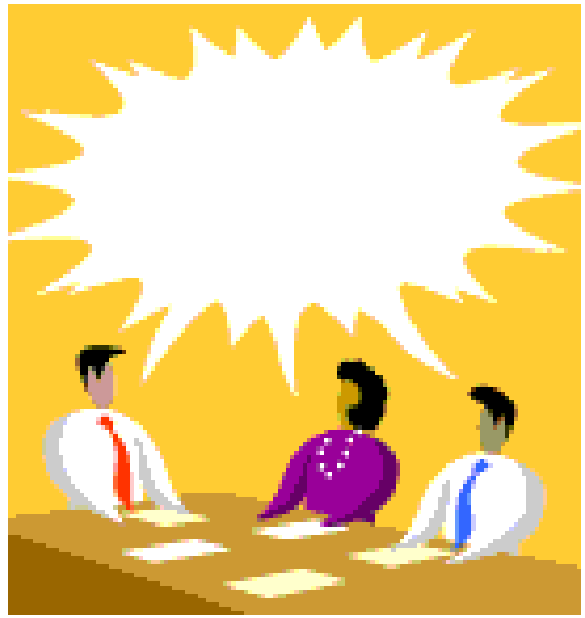
Raytheon
Missile Systems

- The new directive system looks beyond initial charter
- Synergy by using an Enterprise-wide Change Review Board (CRB)
- The organizational horsepower to make decisions!
- All new initiatives now have a place where all interested parties can come together and knowledge share/ collaborate.

When We Leverage Off What Already Exists, We Do It Better

What Did Work

- No new initiative without CRB reviewing it
- Enterprise wide vision and voice
- Leveraging of existing process and infrastructure
- Strong communication plan
- Accountability at all levels to ensure successful deployment



Knowledge Sharing Across the Enterprise

Questions??

Thank you for your participation

Presentation Outline

Raytheon
Missile Systems

I. Introduction
II. Scene/Act
    a) User Perspective
    b) Program Perspective
III. What did not work
    a) Courage/RDS system
IV. What did work/success
    a) Visibility into deployment
    b) Programs using PD, Tailoring, Gates
    c) RDS work in Progress
V. Lessons Learned
VI. Questions

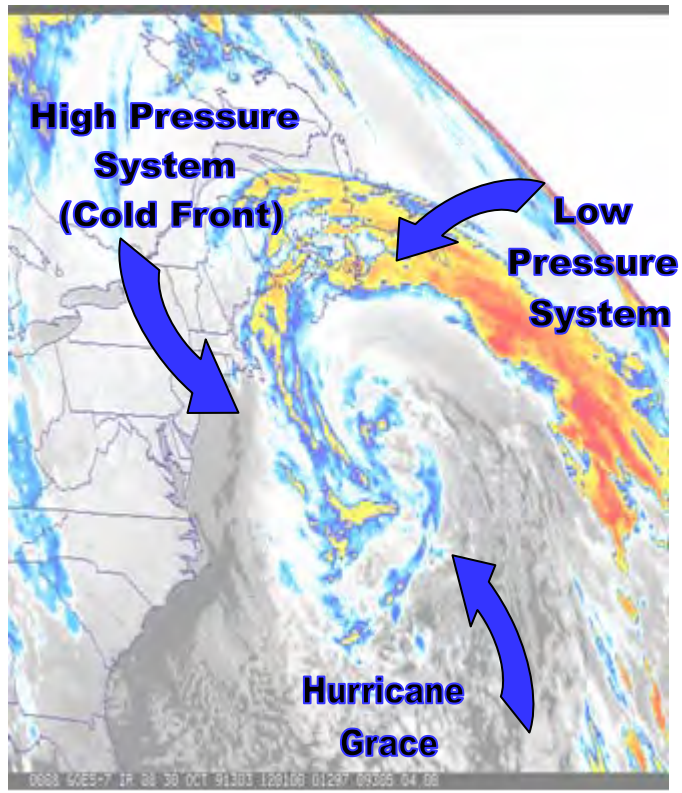
Systematically Tailoring the Organization's Standard Process for a Project

Date: November 16, 2006
CMMI Technology Conference and User Group

Presented By: Dr. Kenneth E. Nidiffer
nidiffer@systemsandsoftware.org
(703) 742-7110

Agenda

- Exponential Growth in Software
  - Expansion in Software Process Assets
- Current State of Practice
  - Large Organizational Standard Processes (OSPs)
  - Manual Tailoring of OSPs to Project Define Processes
- Problems with Manual Tailoring
- Automated Rules-Based Tailoring
- Lessons Learn, Contributions & Road Ahead



"Perfect Storm" Event, October 1991
National Oceanic & Atmospheric Administration

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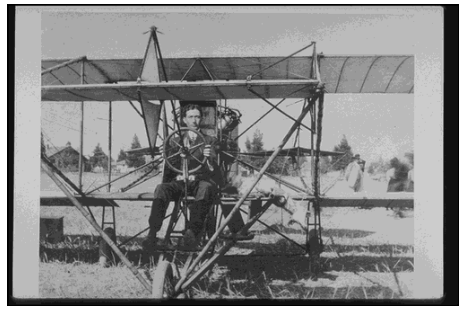
Exponential Growth in Software Usage & Assets

* Provided by Lockheed Martin

In The Beginning



1960's

F-4A
1000
LOC

1970's

F-15A
50,000
LOC

1980's

F-16C
300K
LOC

1990's

F-22
1.7M
LOC

2000+

F-35
>6M
LOC

Market Dynamics: Drivers That Increase the Demand on Additional Systems & Software Assets

Platform	***Customer Emphasis*** →	**Enterprise**
Requirements	***Acquisition Model*** →	**Objectives**
Dominant Prime	***Program Execution*** →	**Strategic Teaming**
"Boxes"	***Integration Challenge*** →	**"Layers & Stacks"**
Proprietary	***Architectures and Standards*** →	**Plug & Play**

The emerging dynamic is to address both sides, and do so with compressed delivery schedules via improvements in systems engineering

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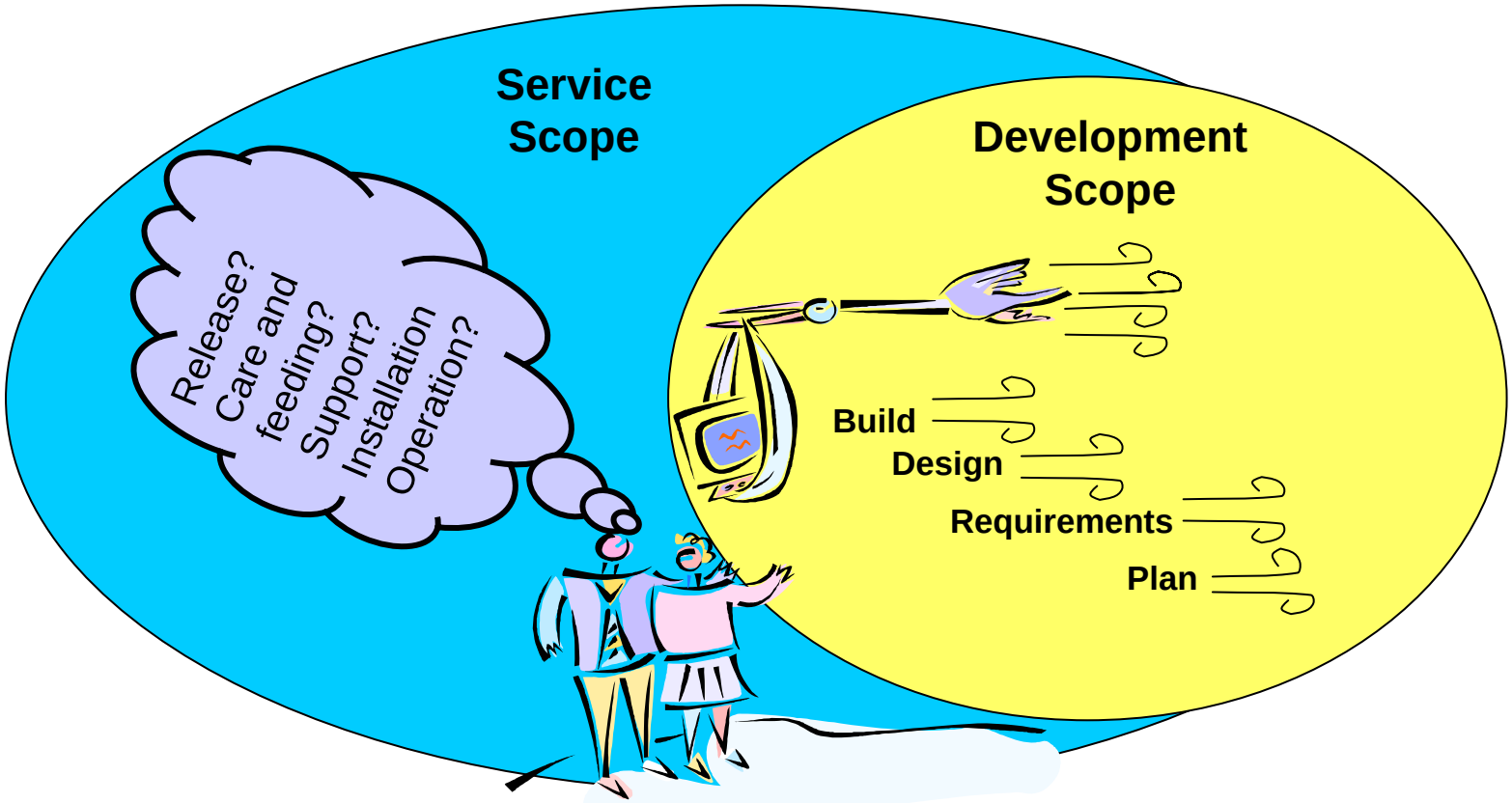
Example: Shift to Service Delivery versus Produce and Delivery Perspective



Services represent 80% of the US economy (Source: Paulson, Linda. "Services Science: A New Field for Today's Economy." IEEE Computer Society, August 2006).

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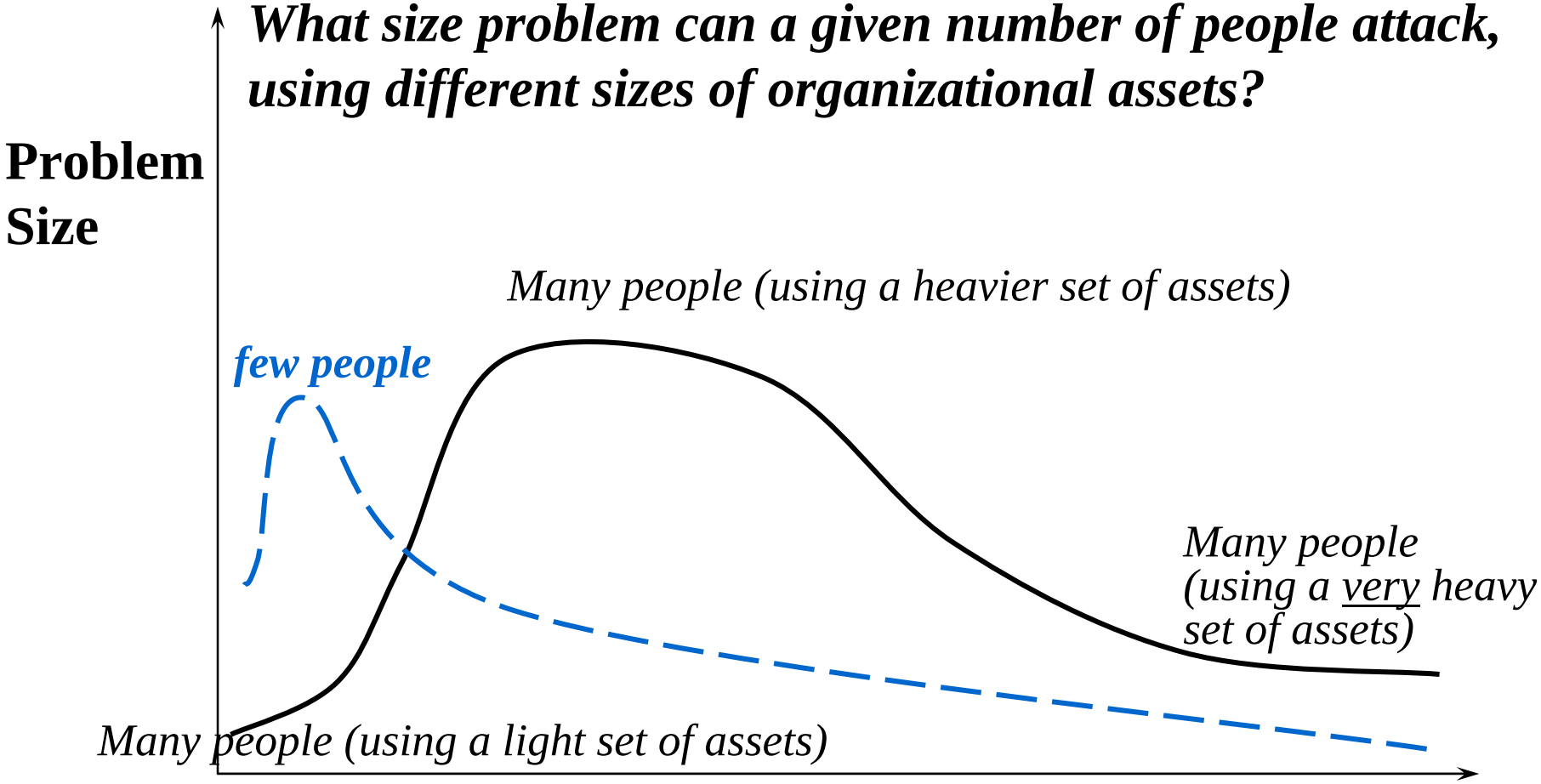
Expansion in Process Assets Versus Usage*



*Slide adapted from Alistair Cockburn, Presentation at SSCI, 3/29/06

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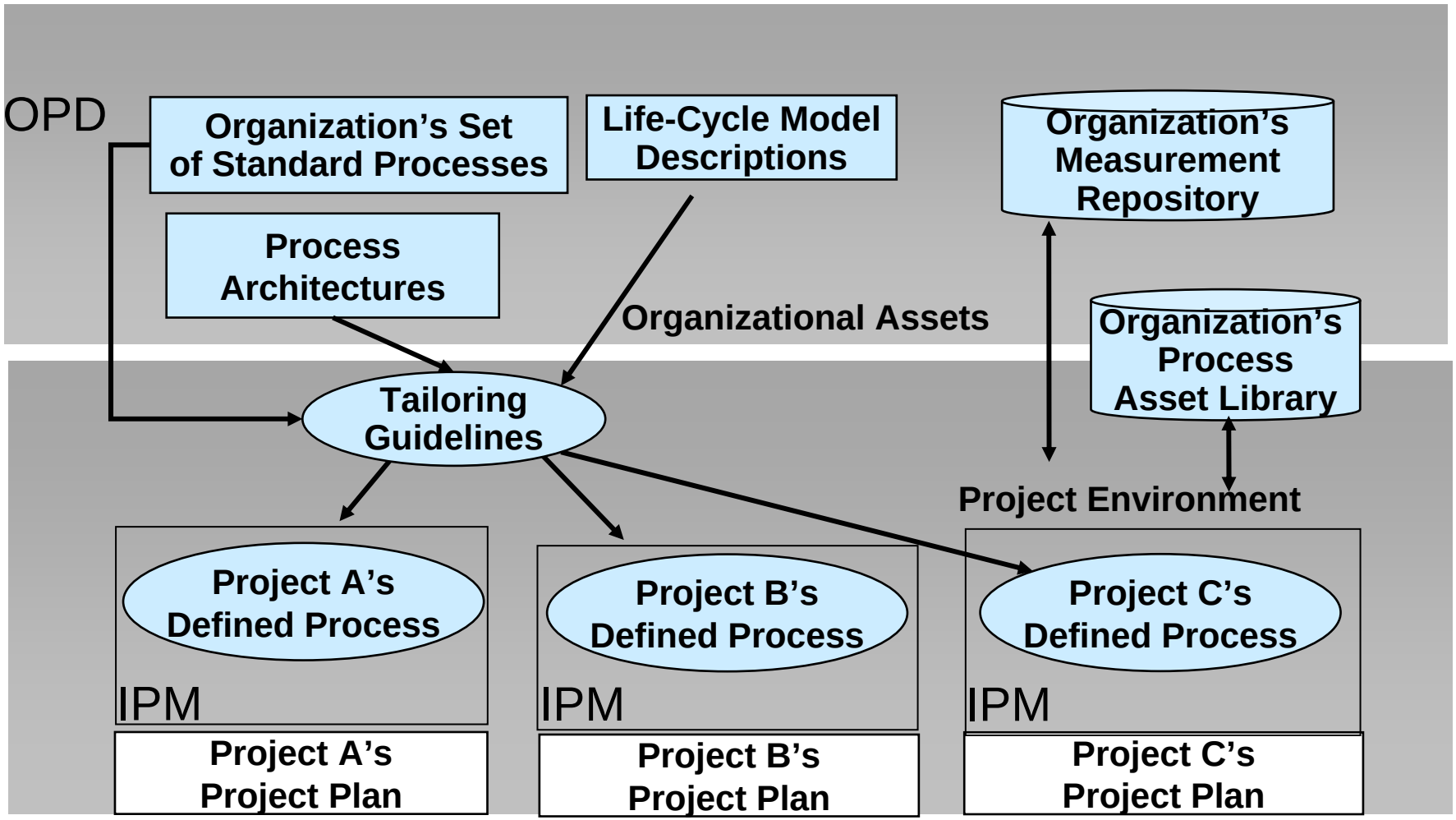
Tailoring the Corporate OSPs to Lighter Project Defined Processes



*Training material registered in the U.S. Patent & Trademark Office by Carnegie Mellon University.

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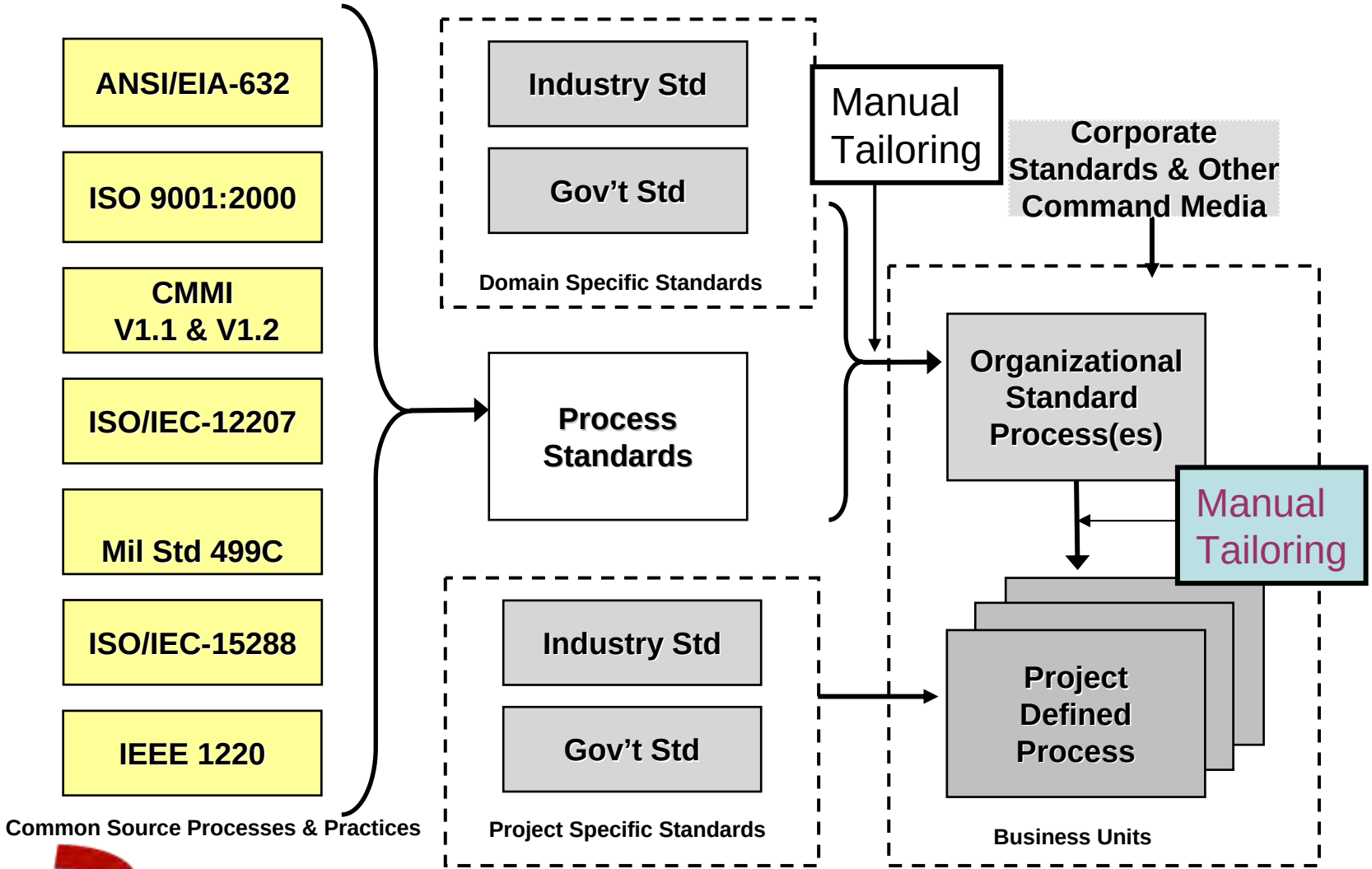
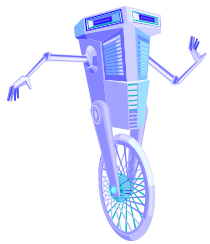
Tailoring Example: Software & Systems Engineering Processes & Practices



Focus

In Theory, These Steps Should Work:

1. Classify program using characteristics



7. Assemble program defined process

2. Select analogous programs based with similar characteristics

4. Find sources for uncovered processes (OSPs or other)

6. Tailor processes to unique program needs

3. Identify processes with no coverage

5. Select sources for process tailoring

The difference in “Theory” and “Practice” is that in theory they are the same however in practice they often are not

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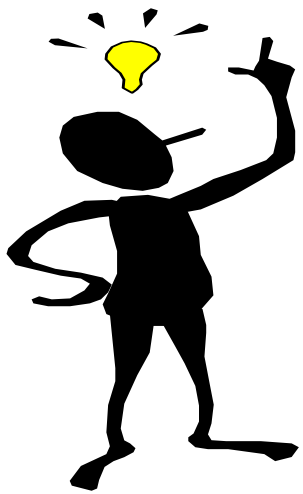
Acknowledged Problems with Manually Tailoring

- Low perceive value by program managers
- Insufficient knowledge and implementation of tailoring rules
- Too much data
  - Organization Standard Process consists of hundreds of process elements; thus, difficult to determine which ones are applicable to their project
- Insufficient planning time available
- Lack of qualified resources
  - Organizations who are lucky enough to have professional members of their technical staff who can manually perform the needed tailoring are often not available

Potential Solution: Automated Rules-Based Tailoring Engine

What is the feasibility to using an intelligent agent (e.g. Tailoring Engine) to inform and direct the selection and tailoring of the OSP based on a set of business rules?



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Proof of Concept Approach

- Research the field (please see references)
  - Identified key issues and risks
- Selected a “Proof of Concept” approach
- Develop an engagement plan
  - Defined the problem statement among key stake holders
- Defined the type of OSP we wanted to tailor based on automated process tailoring needs
- Selected a publicly available, accepted and reasonably complete functional process guide as a mock OSP
- Defined the type of tailoring tool we needed based on our tailoring requirements
- Selected the tailoring tool
- Developed a set of tailoring rules for the proof of concept demonstration
- Collected contributions and lessons learned

The Formulation of Effective Tailoring Rules Challenging Due to Project Asset Attributes

Common Source Standards

- Project Characteristics
  - Are requirements well known? (Yes: Waterfall, O&M or Incremental life cycles; No: Prototyping, Incremental, or Evolutionary life cycles)
  - Security Requirements?
  - System Size (S, M, L)
  - Level of Risk

- Project Characteristics (cont'd)
  - How complex is the system? (#COTS, #Shalls, #Interfaces, #Users, SOS, #HWCIs, #SWCIs, DP rqts)
  - System Composition (HW, SW, both)
  - Product Intent (Feasibility Study, R&D, Operational Program)
  - Contract Type (FFP, T&M, CPFF, Award Fee)
  - Scope (Formality, Control, Structure)

OSP Example: Systems Engineering Standards

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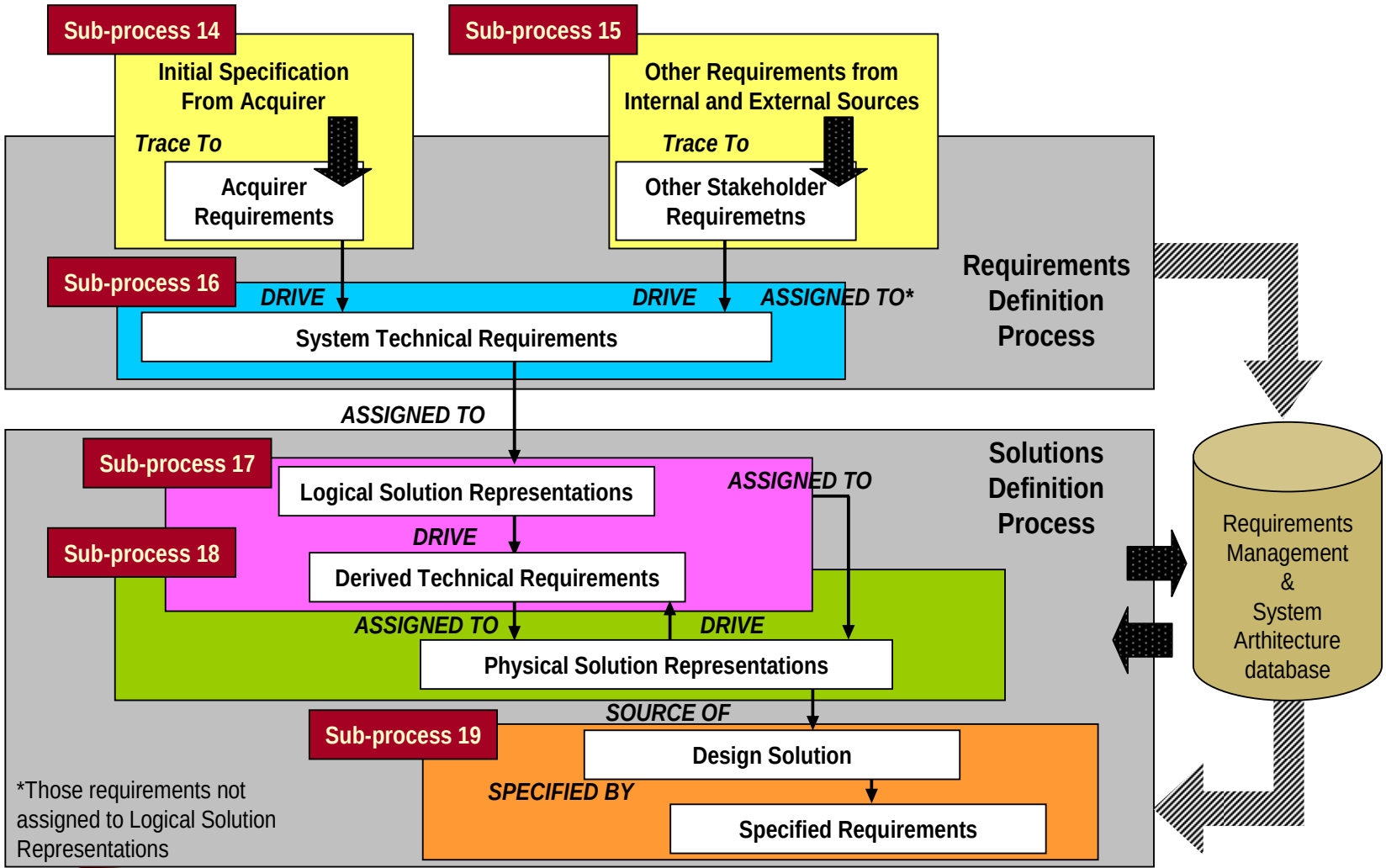
Interdependence of Engineering Sub-processes: Naval Systems Engineering Guide and EIA 632



Deceptive Similarity of Industry Standards

- Because the source standards cover roughly the same ground, we anticipated that “normalizing” them would be relatively straightforward
- We expected to find (and did!) differences in:
  - Scope, terminology and level of detail
- Subtler differences emerged in the source standards’ codification of:
  - Product life cycle
  - Development life cycle model
  - Recursive application of process throughout a system hierarchy
- Industry standards do not cover all the necessary processes (e.g. finance, legal, ethics, etc)

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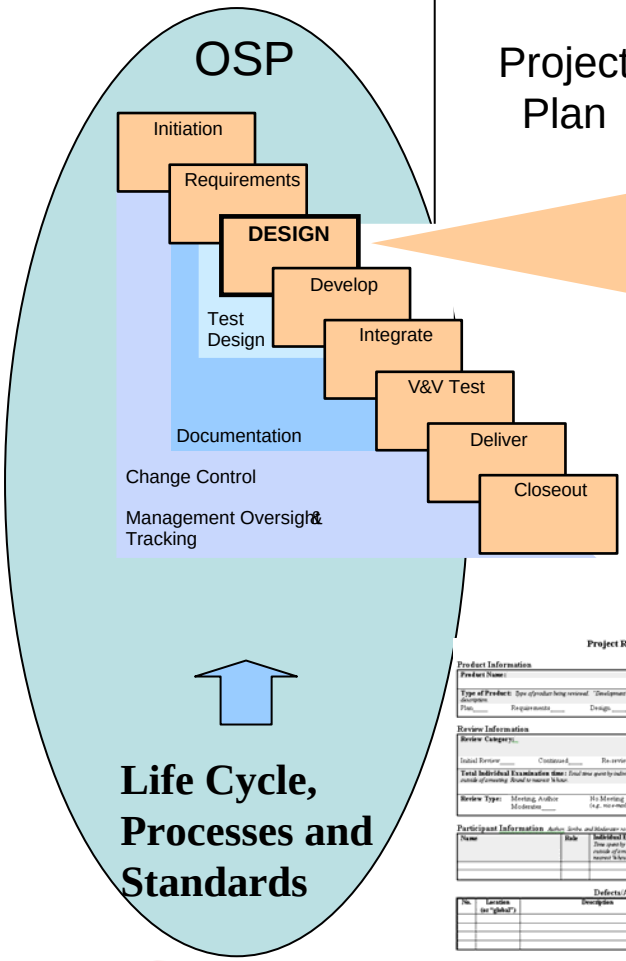
"Inter-connectiveness" of Process Steps

Navy SE Sub-Process	Preceding Process	Next Process	Inputs	Outputs
Acquirer Requirements (SP14)	SP 22 Systems Analysis Process, SP26 Requirements Validation Process	SP 2 Acquisition Process, SP4/5/7 Planning Process, SP 10/11 Assessment Process, SP 12 Control Process, SP 16 Requirements Definition Process, SP22 Systems Analysis Process, SP 26 Requirements Validation Process, SP 31 System Verification Process, SP 33 End Products Validation Process	ICD, CDD/ORD, Engineering Investigation Reports, Utilization & Readiness Reports, Specifications from higher level system building blocks, Sponsor high level operational concept graphic architecture (EXT), Effectiveness analysis reports (SP 22), Effectiveness models (SP 22), Acquirers Requirements Validation Revisions (SP 26)	ICD(SP 2/4/7/10/11/16/31/33), Effectiveness Analysis Request (SP 22), Measurement of Effectiveness (SP 5/7/16), CDD or CPD(SP 2/4/7/10/11/16/31/33), Specifications from higher level system building blocks (SP 16), Acquirers Requirements(SP 5/16/26)

Decomposition - Small Changes in a System Engineering Standard Drive Many Other Changes



Life Cycle, Processes and Standards

Project Plan

Life Cycle Phase Definition

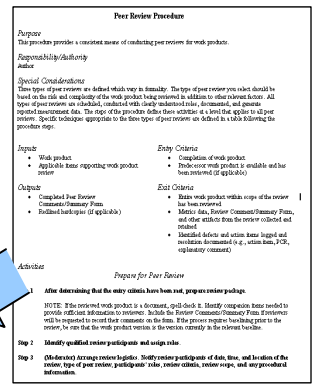
Product Design

Inputs	Entry Criteria	Activities	Exit Criteria	Outputs
Requirements Existing system/product documentation	Requirement is defined RTM through Requirements Phase updated	**Determine Technical Solution** 1. Using the DAR procedure (TSS_CMMI -PRC-.DAR), evaluate and select the technical solutions in accordance with the PMP. 2. Using the DAR Procedure, decide whether to make, buy, or re use products/product components. 3. Update the project plan and WBS, if appropriate. **High-level Design** 1. Develop architecture. Partition product capabilities (environment, product, and interface requirements) into components and update the RTM. 2. Collect and an alyze existing system/product documentation. 3. Develop and maintain the high -level design including interfaces. 4. Peer Review the high -level design using the Peer Review Procedure (TSS_CMMI -PRC-.PEER_REVIEW). 5. Review the high -level design with stakeholders, as needed. **Detailed Design** 1. Decompose high -level design into the lowest level product components. 2. Allocate requirements to the lowest level product component, and update the RTM. 3. Define and maintain the control flow of components. 4. Define and maintain the phys ical structure of components and their relationships. 5. Design inter -component interfaces, user/system interfaces, database, and software/hardware interfaces. 6. Design algorithms and error handling. 7. Perform required data modeling of data and critical computer resource optimization. 8. Complete design documentation. 9. Peer review design components using the Peer Review Procedure. 10. Execute the Baseline Procedure (TSS_CMMI -PRC-.BASELINE). 11. Review the final design with relevant stakeholders. 12. Update development folders. 13. Update requirements, operational concepts, and scenarios with information learned during design.	Design documentation has been baselined	Design documentation Updated RTM Updated Requirements Specifications, operational concepts and scenarios

Design Specification

Template

Forms



Procedures

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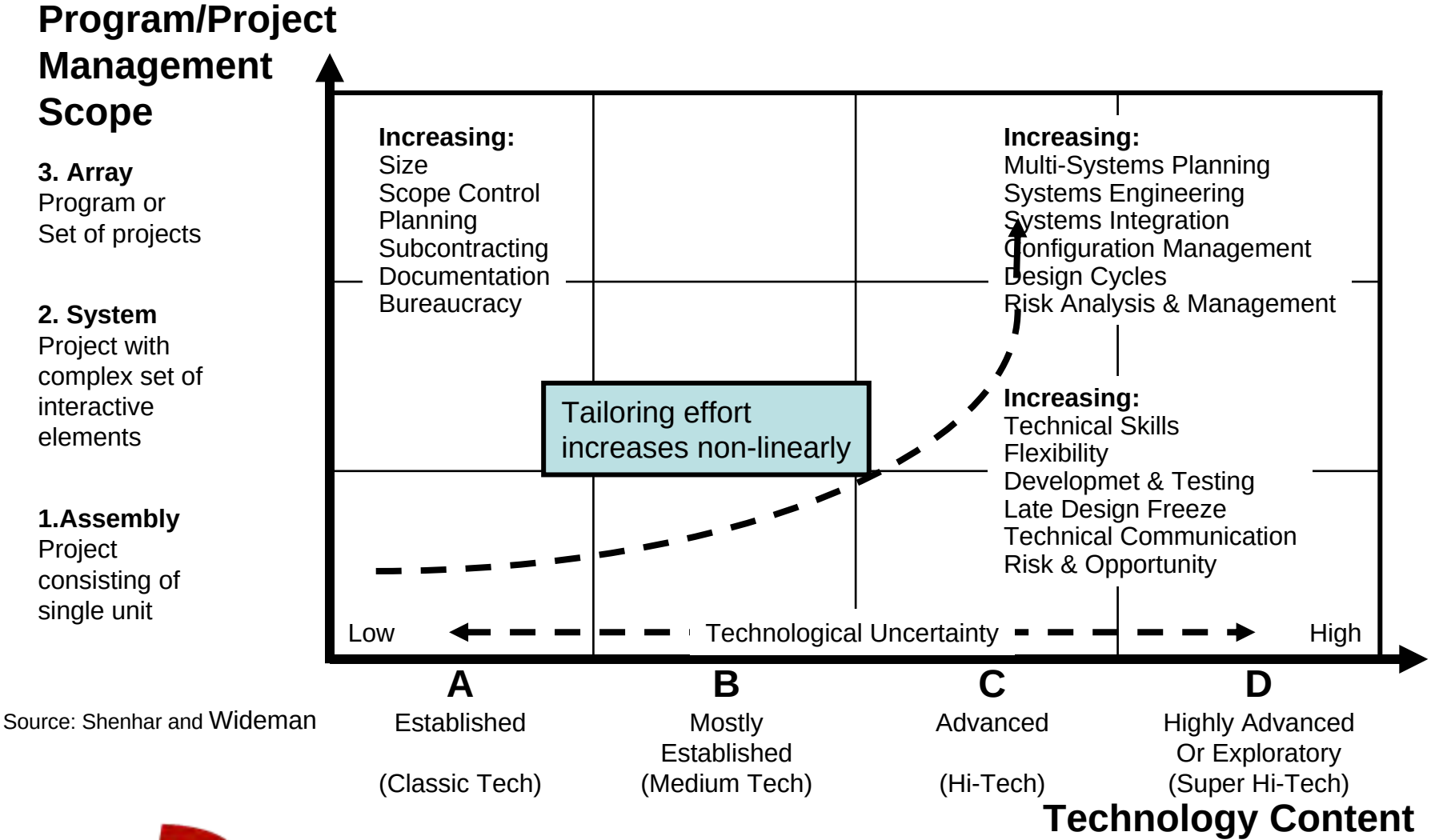
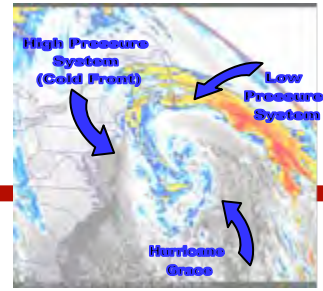
Tailoring Effort Increases Non-Linearly with Program and Technology Complexity



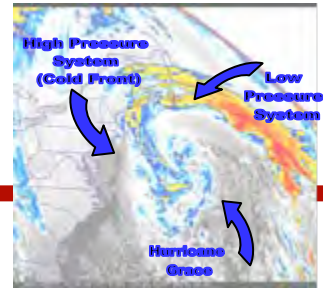
Source: Shenhar and Wideman

What We Determined: Devil in the Details



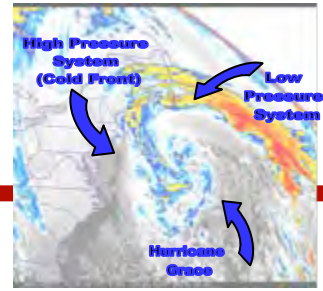
- State of Practice
  - Some on-going research in the area of automated rules-based test engines
  - Existence of a limited set of reasonably mature automated tailoring tools
    - Significant manual-tuning required dealing with most problems
    - Limited number of “universal” tailoring rules
    - Output often compatible with Microsoft tools
      - WBS and Project Plans automatically generated
  - OSPs nominally contain a substantial body of knowledge and data
    - Many different formats and types of artifacts

What We Determined: Devil in the Details



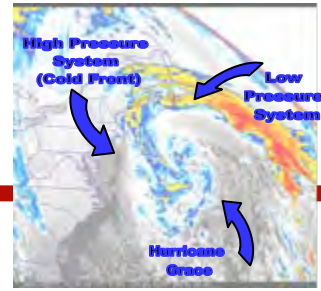
- Technically
  - In general, standard processes are not engineered/architected for tailoring
    - Makes automation difficult
  - Organizational assets are expanding, costly to maintain, and are becoming more difficult to tailor to projects
    - Difficult for an OSP to cover every case and be lean
  - Tailoring rules difficult to establish
    - Numerous attributes drive the process tailoring decisions
    - Strong demand for the establishment of robust tailoring rules

What We Determined: Devil in the Details



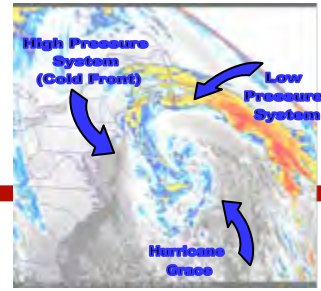
- Technically (Con't)
  - Multiple frameworks (e.g. CMMI, ISO, ITIL, etc) are not scalable or easily customizable
    - Different frameworks need different data elements
- Organizationally
  - Corporate committed, projects involved
- Human element
  - Natural tendency to tailor the OSP based on least resistance
    - Information from similar programs
    - Reliance on local process improvement teams
  - Difficult to demonstrate to program managers the ROI
  - Lack of consistency in process definition for most process areas

Road Ahead



- The problem is real
  - The problem is not going away and will grow in importance with time
- In the short run, tailoring responsibility will nominally rest with the process engineering teams
  - Key focus will be the development of tailoring rules and guidelines
  - Rules-based engine research will continue
- In the longer term:
  - Organizations will use process architectures to design and populate their process asset libraries
  - Intelligent agents/rules-based test engines will become more prevalent

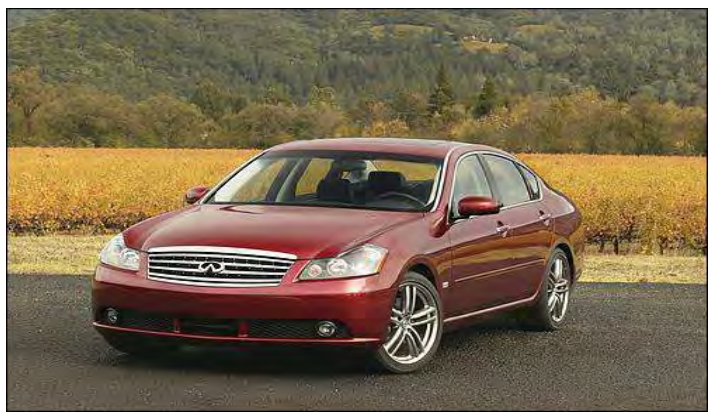
Road Ahead



- Utopia Perspective
  - What could we do differently if we started over?
- Secret of success may be a shift of focus from assets to process execution information
- Approach
  - Define a common set of software and system engineering processes for the organization
  - Map the common set of processes to the organizations lifecycles
  - Apply processes/lifecycles on programs and collect data
  - Store process execution information in the PAL
  - Improve processes based on results and establish tailoring rules

Road Ahead: Example - Service-Oriented Architecture & Asset Management

- Service-Oriented Architecture is an approach to building IT systems out of common parts
  - Represents a breakthrough in the way we build IT systems
    - Composed of reusable components, called services
    - Service is a building block that performs a distinct function
  - Evolution of client/server architecture
    - Functions of user I/F, application logic and data management are separated and decomposed still further
- Why Now
  - Internet and World Wide Web →
  - Business/Quality Focused →
  - Standardization (common parts) →
  - Vender Market →



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Questions?

References

- Brown, J.S., Duguid, P., "Organizational Learning and Communities-of-Practice: Toward a Unified View of Working, Learning, and Innovation." *Organization Science*, 2 (1), 1991, pp. 40-57
- Busak, Mike, “Achieving CMMI ® Compliance through Automated Process Management”, White Paper, SELECT Business Solutions, 2004
- Cockburn, A., "Selecting A Project's Methodology." IEEE Software, 14 (4), 2000, pp. 64-71.
- Dybå, T., "Improvisation in Small Software Organizations." *IEEE Software*, 17 (5), 2000, pp. 82-87
- Cockburn, A, Presentation at SSCI, March 2006

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References

- Fischer, G., Ostwald, J., "Knowledge Management: Problems, Promises, Realities, and Challenges." *IEEE Intelligent Systems*, 16 (1), 2001, pp. 60-72
- Henninger, Scott, “Turning Development Standards Into Repositories of Experiences, Department of Computer Science and Engineering, University of Nebraska, NE
- Henninger, Scott, “Tools Supporting the Creation and Evolution of Software Development Knowledge, Department of Computer Science and Engineering, University of Nebraska, NE
- ANSI/EIA Standard 632, Processes for Engineering a System, January 1999

References

- ISO/IEC Standard 15288, Systems Engineering – System Life Cycle Processes, 2002
- EIA Standard 731.1, Systems Engineering Capability Model, August 2002
- IEEE 1220 Standard, IEEE Standard for Application and Management of the Systems Engineering Process
- Naval Systems Engineering Systems Guide, October 2004
- INCOSE Systems Engineering Handbook, Version 3, June 2006

Recommended Reading

Buckman, Robert H. *Building a Knowledge-Driven Organization.* McGraw-Hill, New York, NY, 2004.

Chao, Pierre A. "Alternative Futures for the Defense Industry." Center for Strategic & International Studies, Chantilly, VA, April 2005.

Chesbrough, Henry William. *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business School Publishing Corporation, Boston, MA 2003.

Drucker, Peter. *Managing in the Next Society*. Truman Talley Books, New York, 2003.

Gladwell, Malcolm. *The Tipping Point.* Little, Brown and Company. New York*, 2002*

Malone, Thomas. *The Future of Work: How the New Order of Business Will Shape Your Organization, Your Management Style and Your Life.* Harvard Business School Publishing, Boston, MA, 2004.
See http://ccs.mit.edu/futureofwork/

Wladawsky-Berger, Irving. "The Future of IT in an On-Demand World." IBM Server Group, Keynote address at OSBC 2005.
Archived at http://www.itconversations.com/shows/detail495.html

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Measuring the Impact of RD and REQM CMMI Process Areas

Aldo Dagnino
Director of Manufacturing Solutions

THE POWER TO KNOW.®

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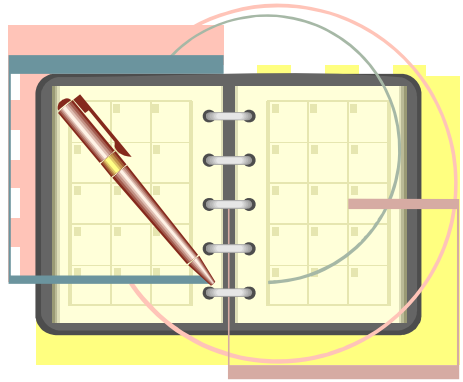
Agenda



- Introduction
- CMMI Appraisal Results
- Methodology to Measure economic Benefits
- Conclusions

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Why do Defects Occur?

- **Poorly defined requirements - approx 55%**
- **Poor design - approx 25%**
- **Coding issues - approx 15%**
- **Other - approx 5%**

- Poor specification, scoping, and communication of release requirements is the **number 1 failure point** in making quality , customer-centric software

Patton, R. (2001), Software Testing, SAMS Publishers, USA

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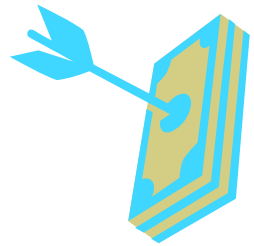
Business Objective Guide to CMMI Appraisal



- Reduce the effort and cost of defect removal activities after system verification by 30% in Manufacturing Solutions Department
- The above business objective guided the scoping of the CMMI internal SAS appraisal.
  - The CMMI appraisal was focused on CMMI Level 2 process areas
  - After conducting the appraisal, it became evident that a primary source of defect generation were the RD and REQM process areas

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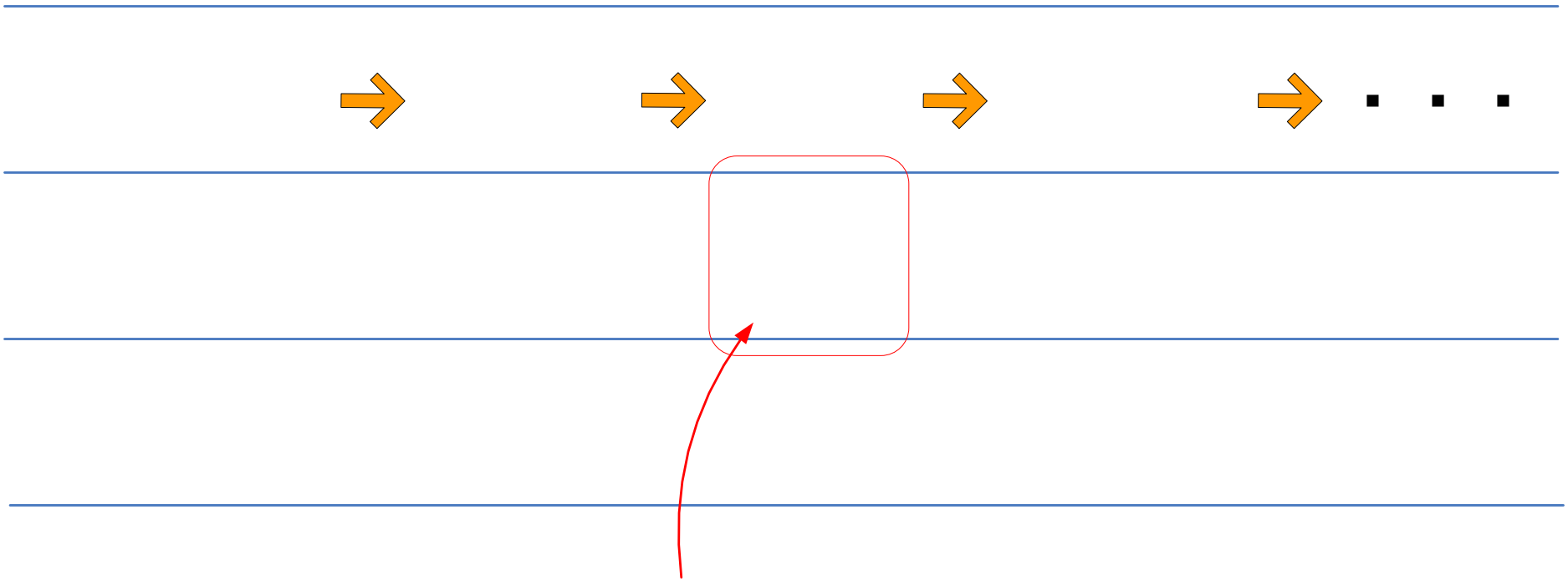
Chronology of Events



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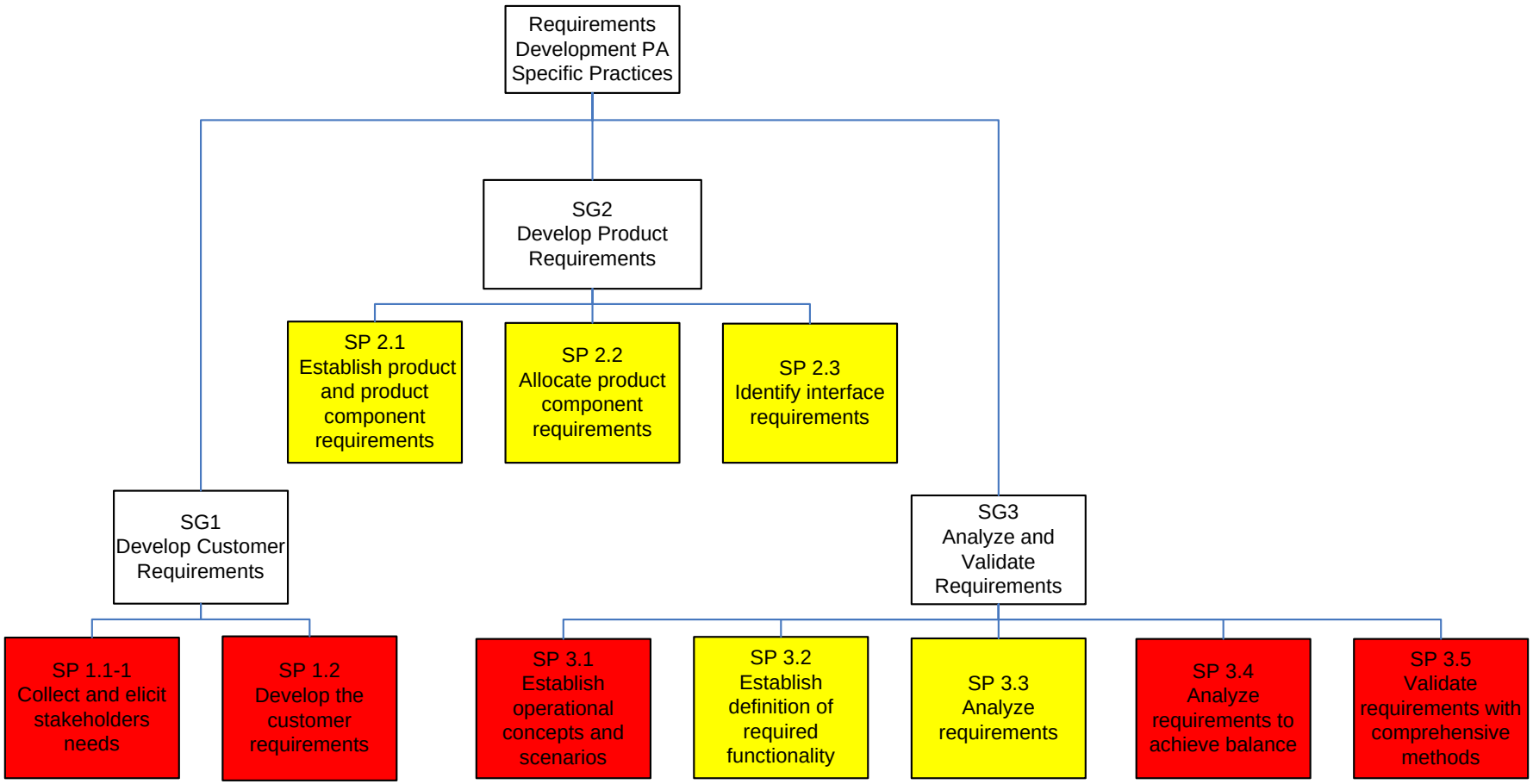
RD Specific Goals/Practices - Appraisal Results



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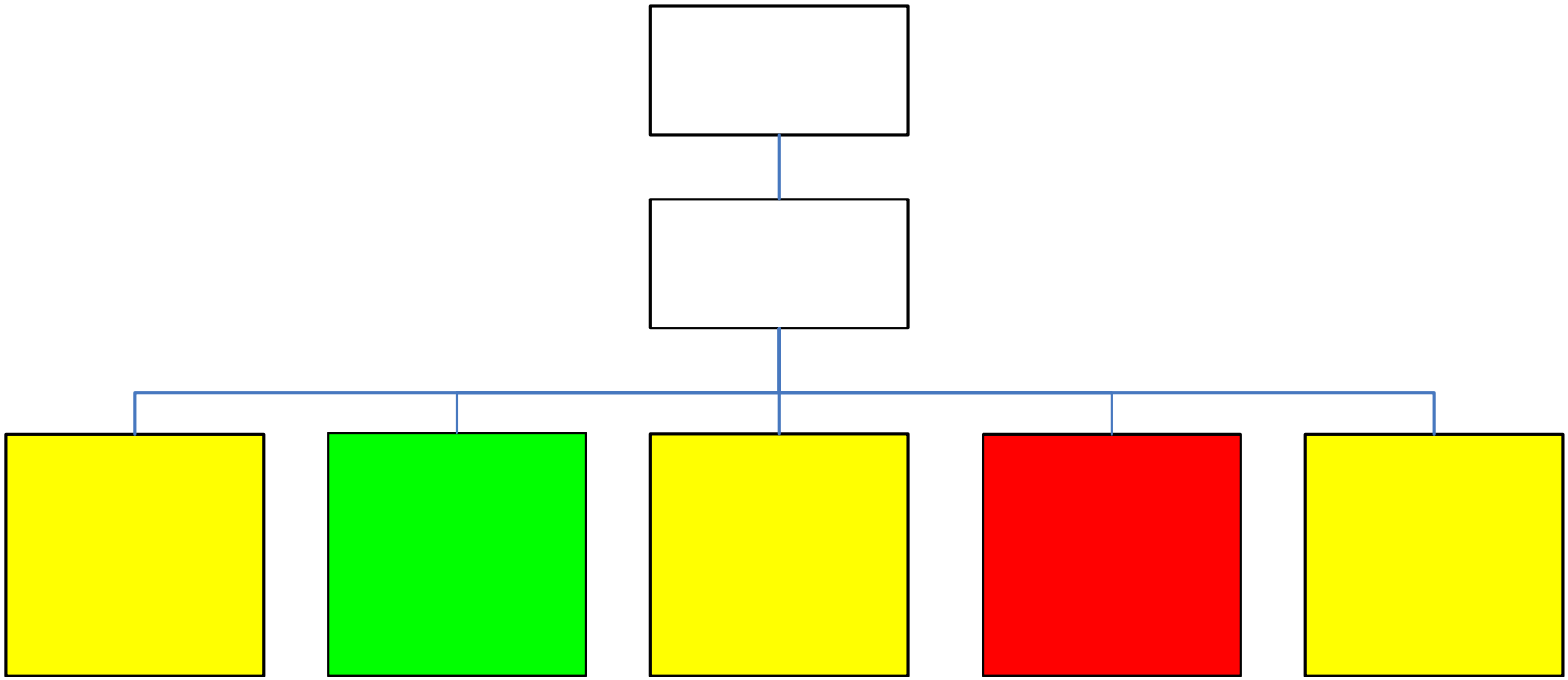
REQM Specific Goals/Practices – Appraisal Results



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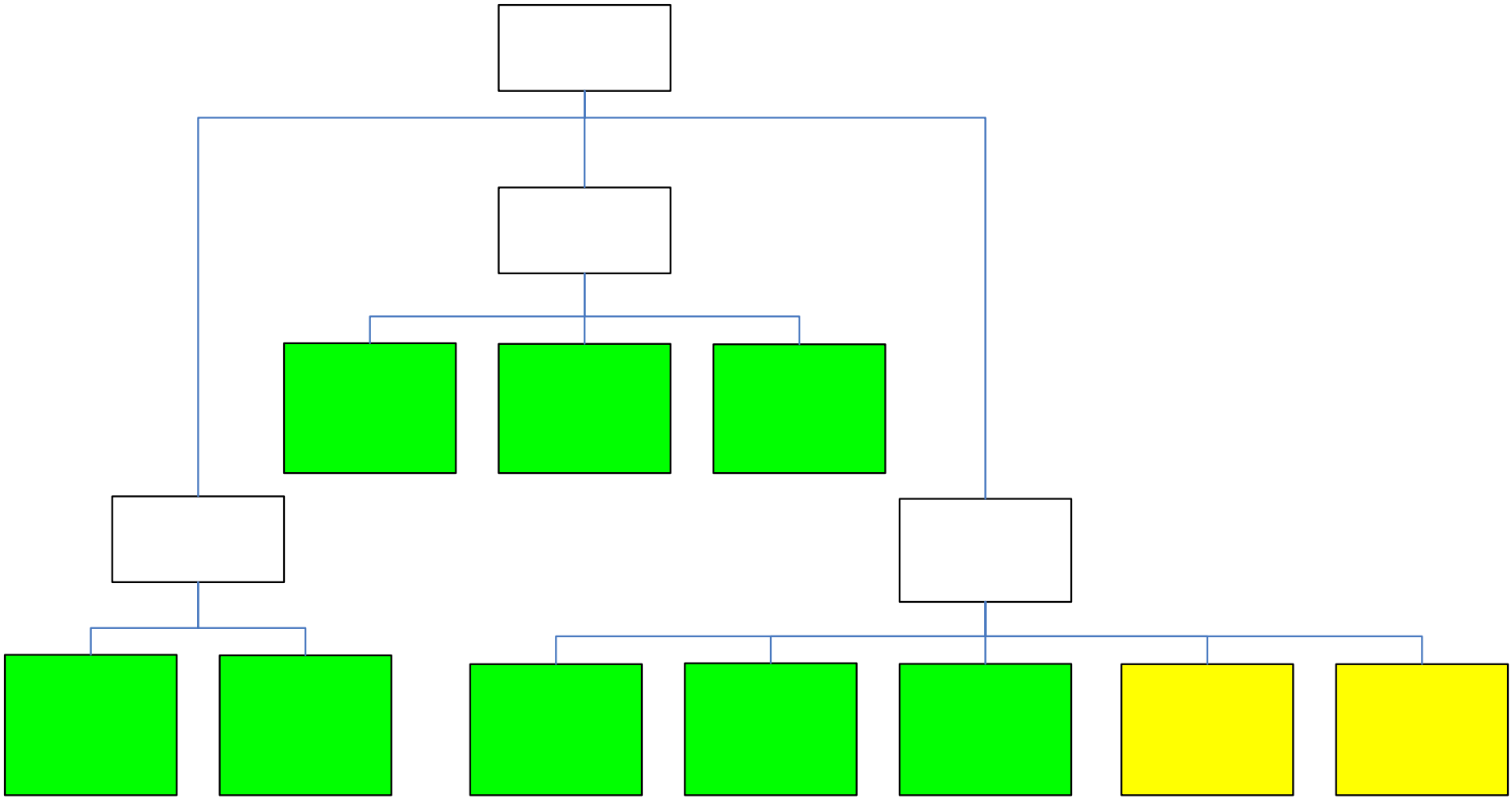
RD Specific Goals/Practices – Enhanced Process



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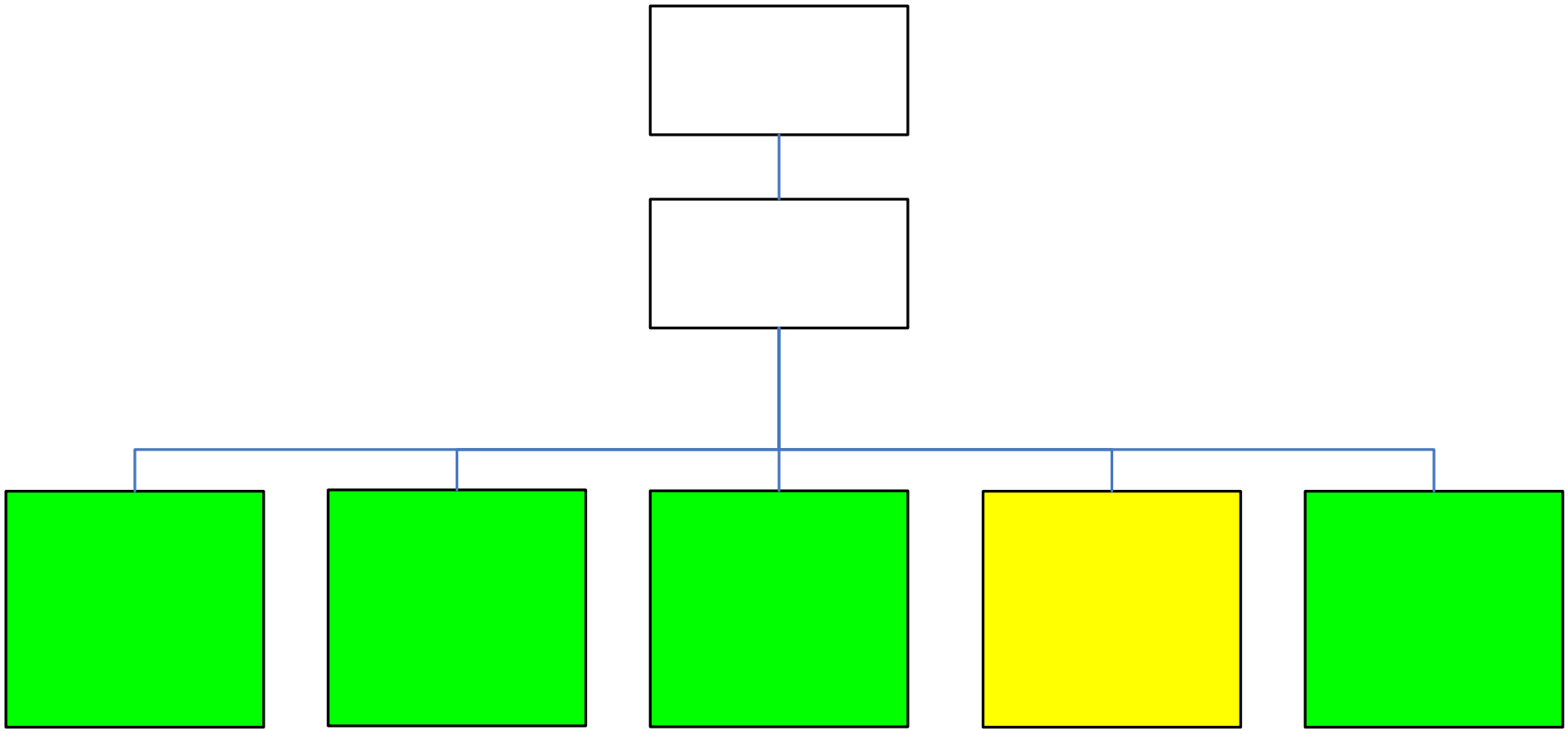
REQM Specific Goals/Practices – Enhanced Process



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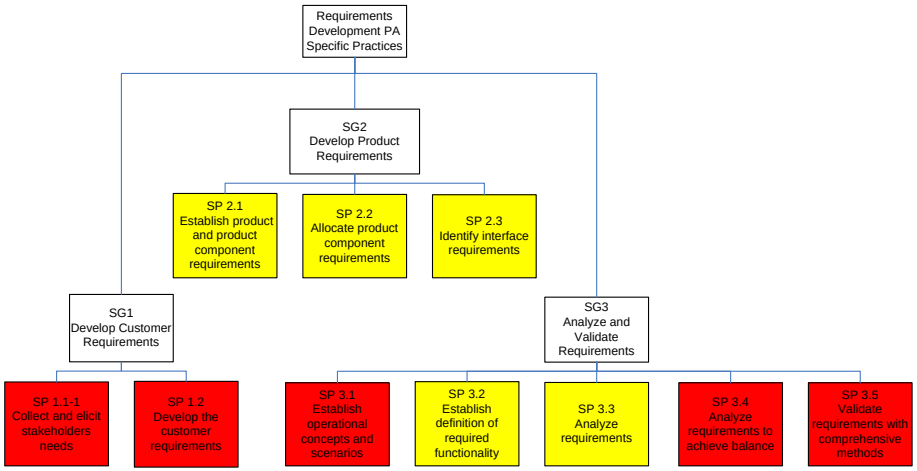
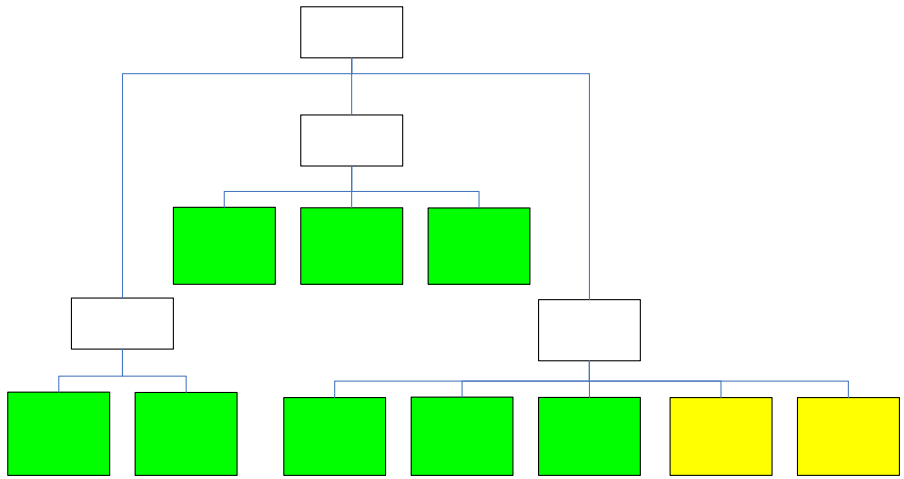
RD - Before and After





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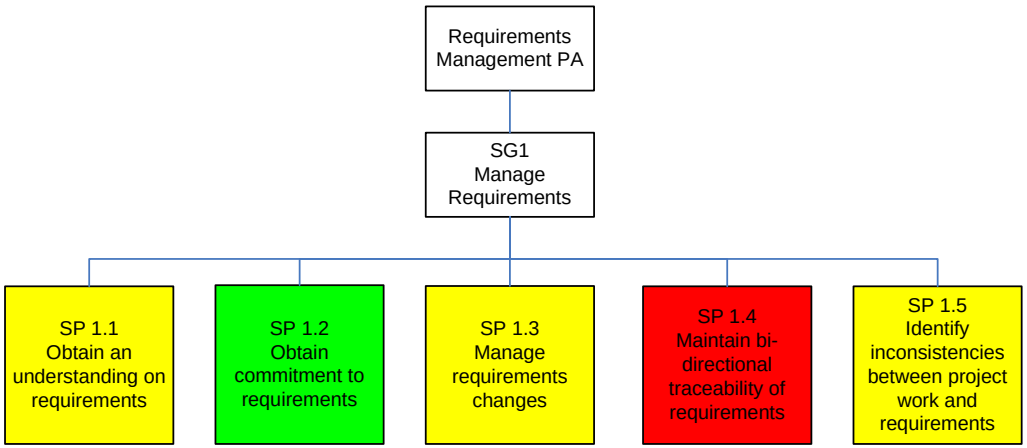
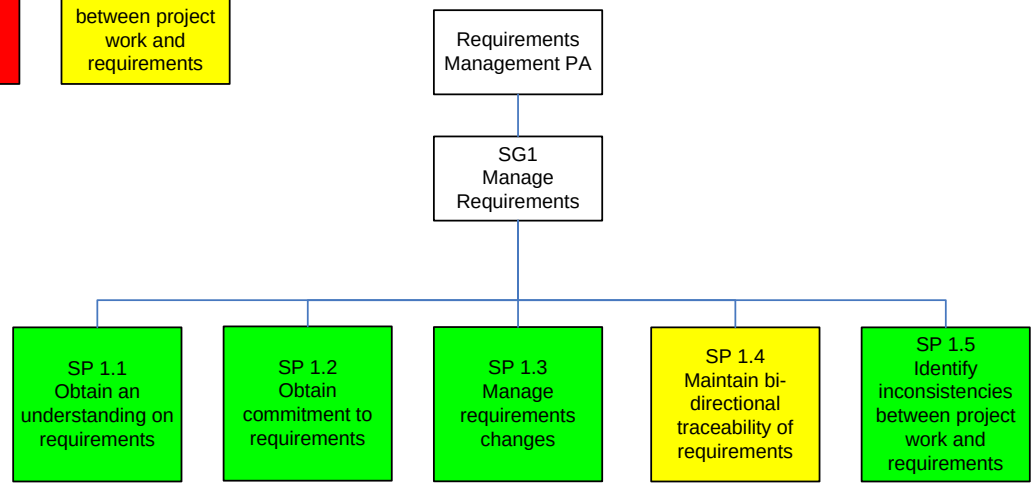
REQM - Before and After





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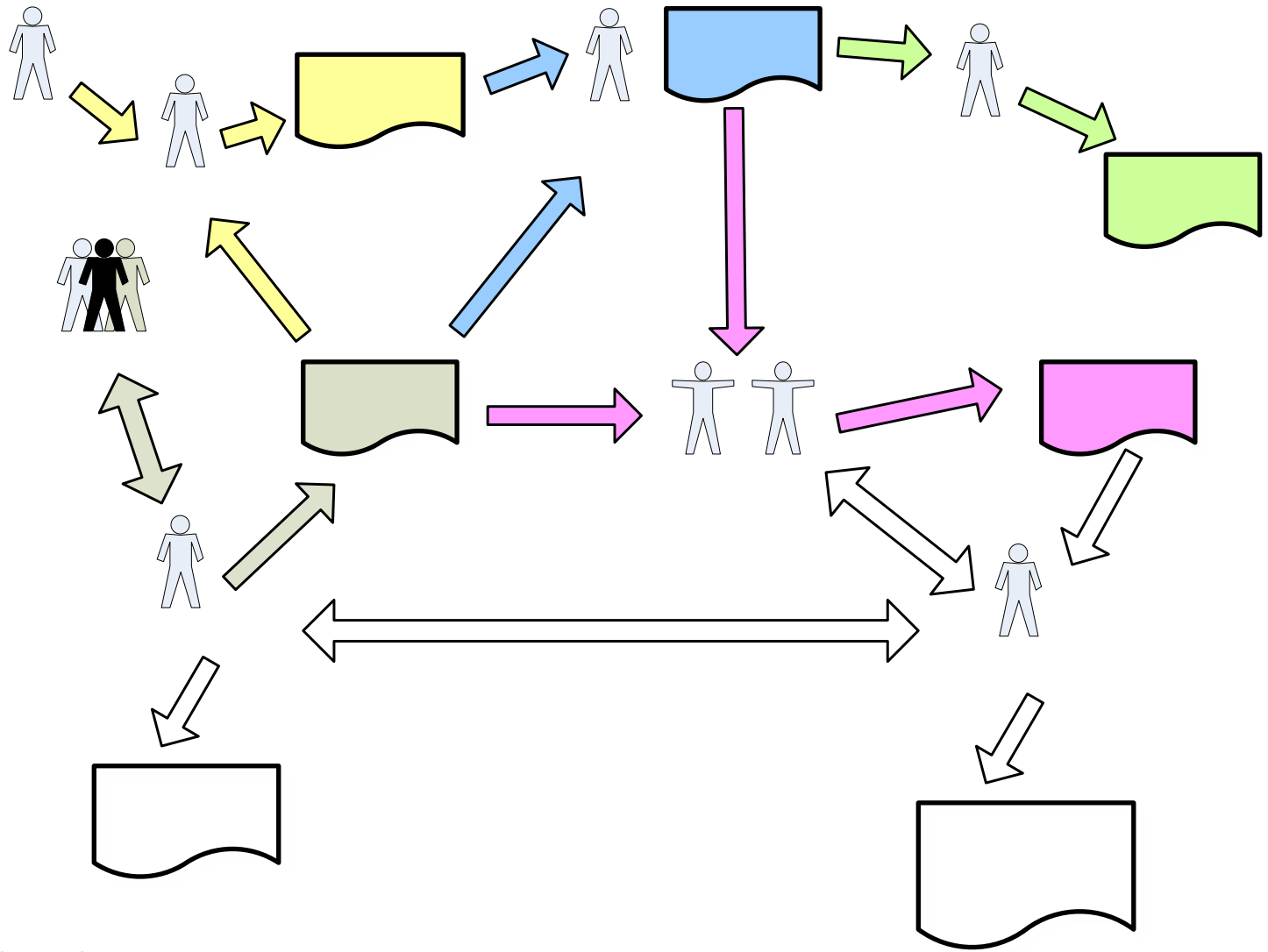
New RE Process



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MA Process Area

- Measurement Objective
  - To measure the defect removal effort in hours spent by software developers to fix defects identified, documented, and categorized in the SAS DEFECTS system
- Measures
  - # of defects in each category associated with RD and REQM
  - Actual development time associated with fixing each defect. Time includes developers' time and also subsequent tester's time to review the fixes
  - Cumulative time that accounts for all defect types across the whole project.

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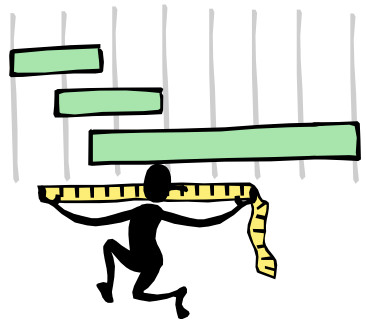
MA Process Area



- Measurement Data Collection
  - Defects are identified by test team and documented in the DEFECTS database
  - Defect types are defined in a collaborative fashion between testers and developers
  - Time associated with defect removal will be recorded by developers in time-sheet database
  - Time associated with reviewing defect removal by testers will be recorded in time-sheet database
- Analysis of Measurement Data
  - Measurement data will be analyzed using the RE Economic Benefit Calculation explained later

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MA Process Area

- Reporting of Measurement Data
  - Three primary reports will be generated
    - Histogram that presents the number of defects within their types at time t1 and at time t2
    - Cumulative defect removal time graphics for each defect type for time t1 and time t2
    - Histogram of total time and cost for all defect removal for time t1 and time t2

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Defect Types Associated with Requirements Development

- Market Requirements Document (MRD)
  - Requirement not documented in MRD
  - Requirement not properly specified in MRD
  - Requirement creep in MRD
  - Development misunderstood requirement in MRD
- Product Requirements Specification (PRS)
  - Requirement not documented in PRS
  - Requirement not properly specified in PRS

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Defect Types Associated with Requirements Management

- Change in requirement not documented in MRD
- Change in requirement not documented in PRS
- Change in requirement not properly documented in MRD
- Change in requirement not properly documented in PRS

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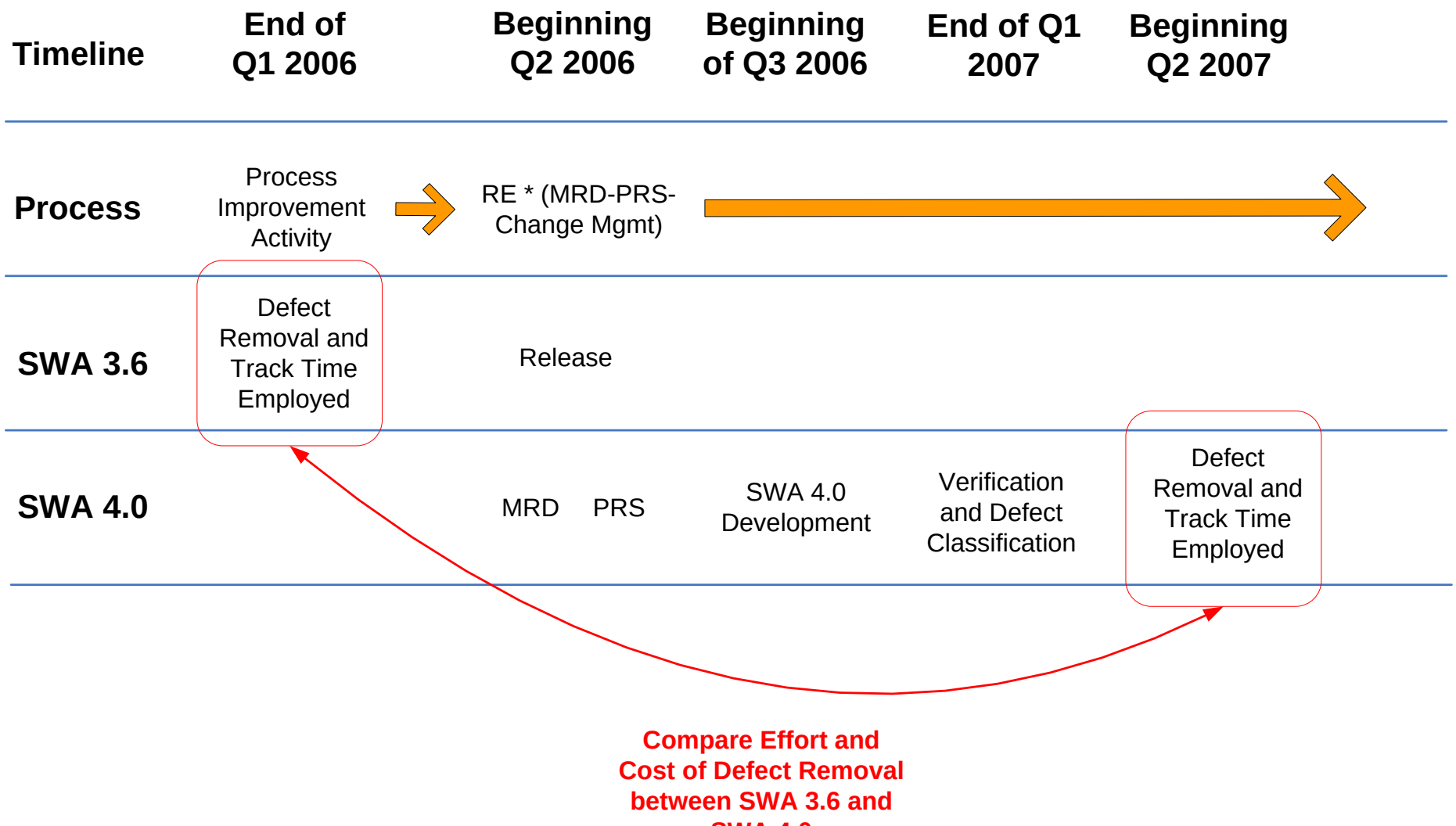
Compare Defect Removal Effort and Cost



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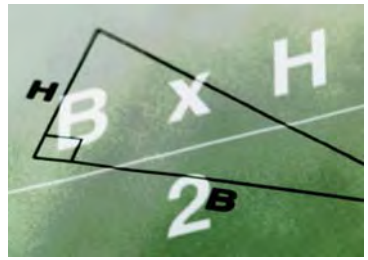
RE Economic Benefit Calculation



$t_{1\,(k)}$ = time to fix defects of type “k” at time t_1

$t_{2\,(k)}$ = time to fix defects of type “k” at time t_2

$t_{1\,(k,i)}$ = time to fix defect of type “k” at time t_1 and at occurrence i

$t_{2\,(k,j)}$ = time to fix defect of type “k” at time t_2 and at occurrence j

C = hourly average cost of development

T_Δ = time differential between fixing all defect types at time 1 and at time 2

$$t_{1\,(k)} = \sum_{I=1}^{n} [\, t_{1\,(k,i)} \,]$$

$$t_{2\,(k)} = \sum_{j=1}^{m} [\, t_{2\,(k,j)} \,]$$

$$T_\Delta = \sum_{k=1}^{s} [t_{(1,k)} - t_{(2,k)}]$$

Expected Economic Benefit = $T_\Delta * C$

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Conclusions

- Having a quantitative business objective guiding the internal CMMI appraisal and process improvement activity is essential
- Use the Measurement and Analysis PA as a basis for measurement
- Start “small”
- Find “high impact” area that shows a “large” benefit

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Untethered Activities – the Real Reason for Schedule Slips

NDIA CMMI Technology Conference

Thursday, November 16th

Rolf W. Reitzig

cognence inc
Improving Software Economics

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Schedule Mismanagement Statistics

- The average project runs 189% over budget and overshoots its schedule by 222%[1]
- More than 72% of IT projects fail to deliver expected results[1]
- The completion rate of IT projects lasting a year or more is only 51%[2]

1: The CHAOS Studies, The Standish Group International, Inc., Dennis, MA, 1994-2002

2: The Hackett Group, Atlanta, GA, 2002

What Causes Schedule Misses?

- Senior Management Mandate?
- Scope Changes?
- Poor Estimation?
- Poor Planning/Untethered Activities?

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Senior Management Mandate?

- In the absence of credible planning data and schedules, management will set targets for teams to meet
- There are some managers that believe that stretch goals are a good way to motivate teams
- Other times, mandates reflect other business problems
  - Competitors have announced a competing product launch, therefore we have to match them
  - Executives making commitments to customers for delivery dates – ***the Bat Phone!***

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Scope Changes?

- Too often, projects are asked to "suck up" unplanned scope changes
  - "Our competitor just announced this feature – we have to have it in the next release!"
  - "I know I didn't tell you about this critical piece of functionality, but I need it anyway!"
- "Death by a thousand cuts"
  - Numerous "small" requirements/scope changes eventually add up to real work

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Poor Estimation?

- To help themselves, project teams attempt to adopt elaborate estimation techniques and tools to improve their project planning and management performance.
  - COCOMO
  - Wide Band Delphi
  - Parametric Tools
- But, this typically doesn't help!!!??!!!
- ***How can you estimate activities that aren't in your plan?***

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CMMI Improves Estimation Techniques

- CMMI Specific Practices
  - Project Planning
    - SP 1.1 – Establish a top-level work breakdown structure (WBS) to estimate the scope of the project
    - SP 1.2 – Establish and maintain estimates of the attributes of the work products and tasks
    - SP 1.3 – Define the project life-cycle phases upon which to scope the planning effort
    - SP 1.4 – Estimate the project effort and cost for the work products and tasks based on estimation rationale
  - Integrated Project Management
    - SP 1.2 – Use the organizational process assets and measurement repository for estimating and planning the project's activities

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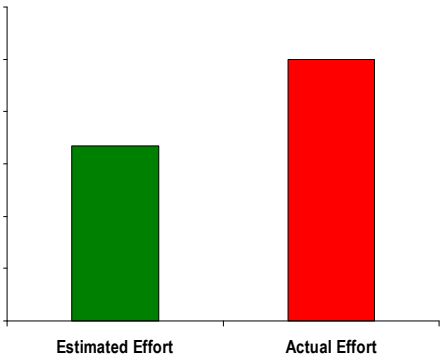
Actual versus Estimated Effort

- If we add up the effort for many software projects, we'd find that more actual effort is expended than estimated
- Where is this extra effort coming from?
  - Poor estimation?
  - Scope changes?
  - Unplanned activities?
- **Are you even estimating and tracking all the effort associated with the project???**



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Are Better Estimation Techniques Really The Answer?

- The project team needs to present management with credible schedules and data-driven plans
- Need the right "recipe" for developing systems
  - How much of the estimated effort should you allocate to:
    - Requirements Development?
    - Configuration Management?
    - Process & Product Quality Assurance?
    - Etc.?
  - Are you even thinking about your projects in this fashion?
- Once you know all the activities (the process) that go into building your systems, you can implement better estimation

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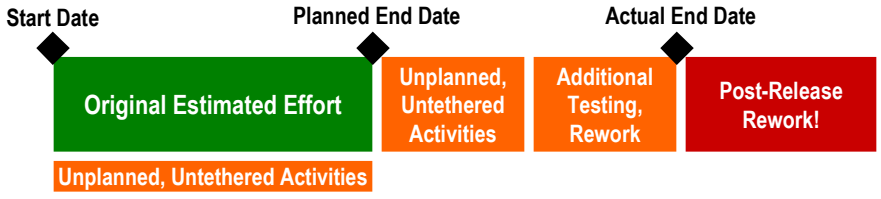
Poor Planning/Untethered Activities?

- **Untethered activities are those that must be performed, but are never planned or scheduled**
- Since these untethered activities must be completed, others are short-sheeted or delayed to get the job done
- The end result is a delayed schedule, or worse, a poor quality system that required expensive rework and thus, more delay



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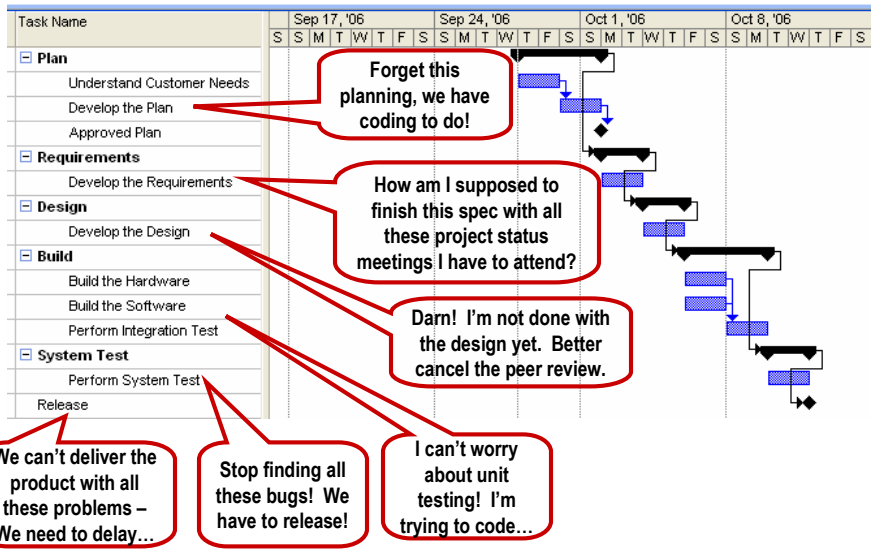
Typical (somewhat simplified) CMMI ML 1 WBS



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Example

- A project utilizing iterative/agile techniques used story cards to plan and scope the work for a 2 month iteration
  - Cards were to represent 1 day of effort and a specific deliverable
  - Employees were instructed that they could not perform work without a card
- By the end of the iteration, the card count "exploded" by 50% and the schedule slipped by 1 month, although no new functionality was authorized
- Much of the card explosion was due to necessary but untethered activities such as configuration management, builds, system administration, test computer installation/configuration, etc.
- **Very little was due to poor estimation of the product development work!**

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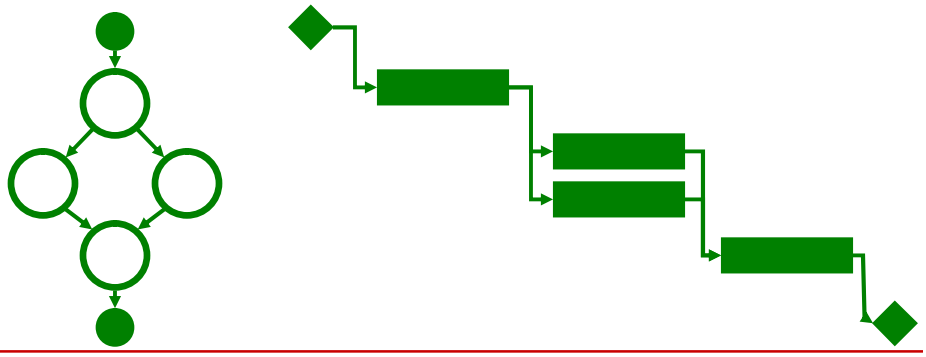
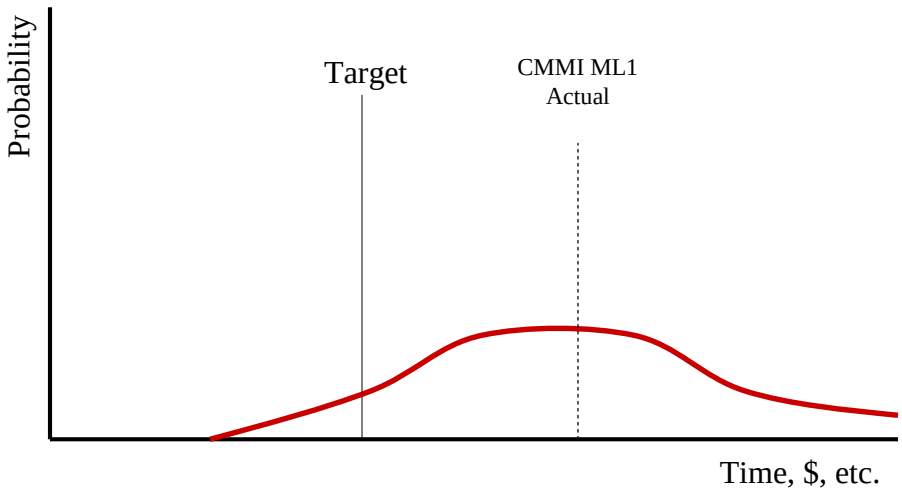
How Can You Tell?

- Look at schedules
- Ask people if everything they do shows up on a schedule and whether they track time against it
- Do schedules map to processes?

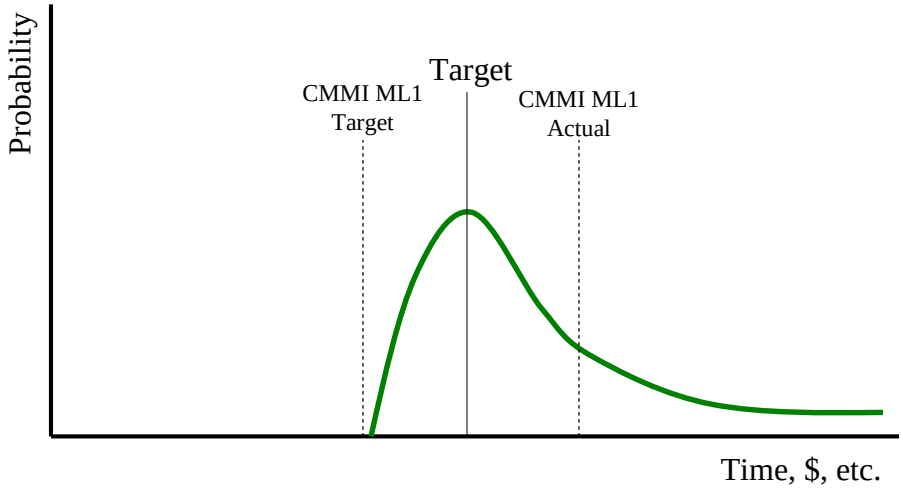


Benefits of Using the CMMI – Maturity Level 1



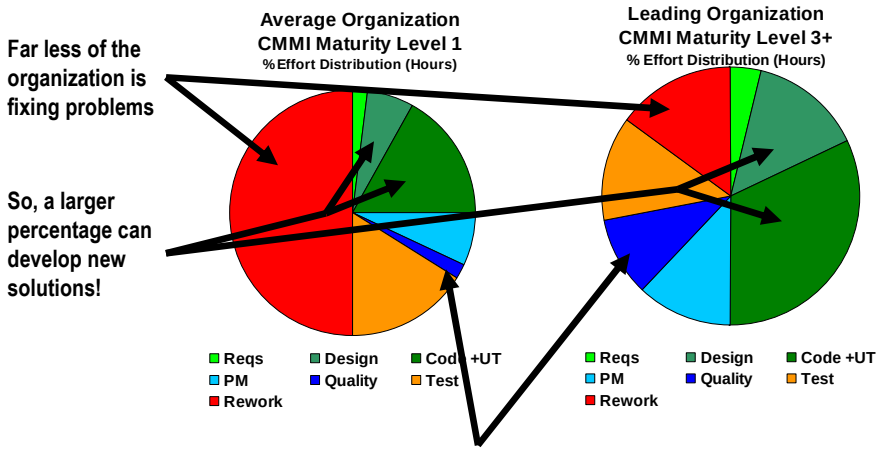
Source: The Capability Maturity Model – Guidelines for Improving the Software Process

Benefits of Using the CMMI – Maturity Level 3



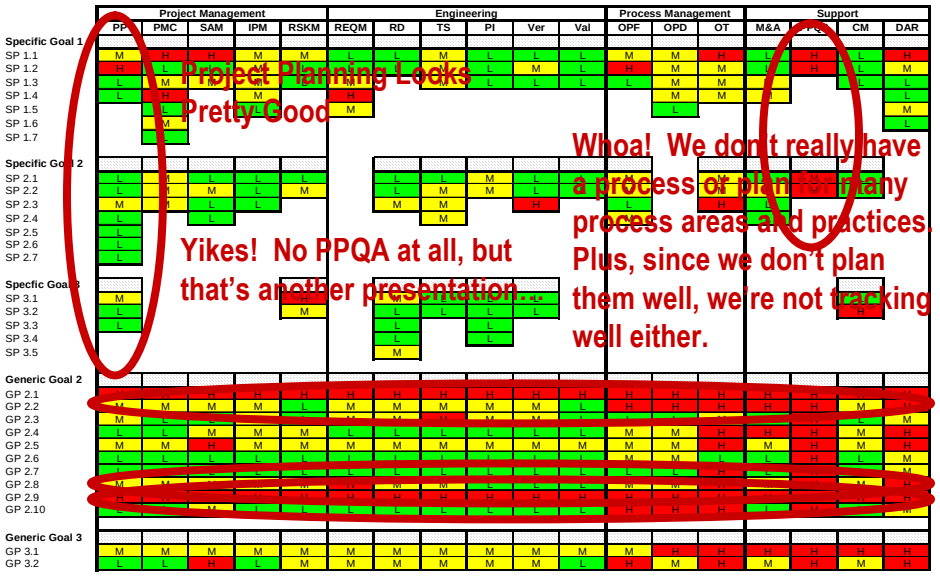
Source: The Capability Maturity Model – Guidelines for Improving the Software Process

Making the Transition



- ✓ Organizations with mature development process infrastructures ***plan*** for more requirements, design, code reviews and other quality activities (PPQA) to reduce testing/rework later
- ✓ Resources focused where they need to be – new releases/innovation!

CMMI/SCAMPI Helps



CMMI Focuses on Project Management First

- Maturity Level 2
  - Project Management Process Area
  - Project Monitoring & Control
  - Supplier Agreement Management
  - Measurement & Analysis
  - Requirements Management
  - *Although M&A and RM are not PM process areas, some would argue managing scope and measuring are project management responsibilities*
- Clearly, the CMMI believes better Project Management is a key enabler to better performance!
- So, is better estimation ***really*** the key?

How Does CMMI Address Untethered Activities?

- Generic Practices
  - GP 2.2 - Establish and maintain the plan for performing the process
  - GP 2.3 - Provide adequate resources for performing the process, developing the work products, and providing the services of the process
  - GP 2.4 - Assign responsibility and authority for performing the process, developing the work products, and providing the services of the process
  - GP 2.7 - Identify and involve the relevant stakeholders of the process as planned
  - GP 2.8 - Monitor and control the process against the plan for performing the process and take appropriate corrective action
- Only four specific practices at ML 2 related to estimation, and one more at ML 3
- **There are 45 generic practices at ML 3 related to planning and addressing untethered activities, and another 30 related to tracking!**

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How Can We Eliminate Untethered Activities?

- Stop senior management mandates and allow project teams to develop, defend, and negotiate schedules
- Develop standard WBS templates based on organizational processes that account for all the activities projects should undertake
- Ensure project schedules/plans account for all activities
  - No untethered activities!
  - Ensure quality activities are clearly called out – reviews, audits, CM, etc.
  - Provide placeholders for requirements changes, risk management activities
- Implement an activity-based time reporting/cost accounting system

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Summary

- Many people attempt to establish elaborate estimation techniques to fix schedule problems
- The real issue (initially) is not the estimation technique
- Rather, incorporating all the activities that will be executed in plans and schedules is key – ***eliminate untethered activities***!
- Better planning also helps to combat senior management mandates and unplanned scope changes

If you aren't estimating and tracking all effort associated with a project, you're shooting in the dark

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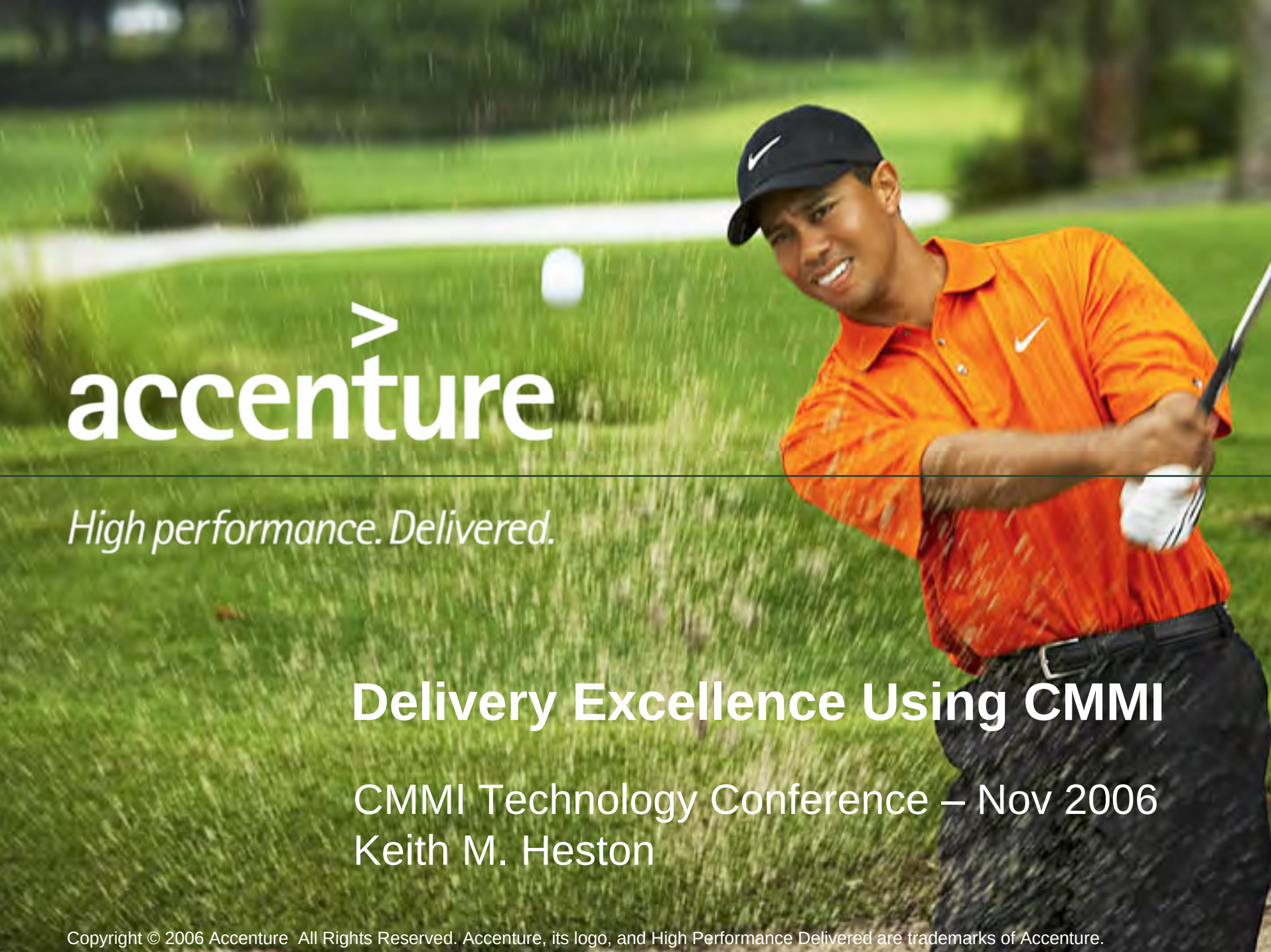

Delivery Excellence Using CMMI

CMMI Technology Conference – Nov 2006

Keith M. Heston

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Purpose & Agenda

A common mistake in improvement programs is to be model-centric rather than business-objective-centric.

Instead:

- Balance internal and external tools/techniques, one of which can be CMMI
- Make sure your business goals are the focus
- Understand when CMMI adds value and when you need something else (instead of or in addition to)

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Context
What is Accenture?

Accenture is a global management consulting, technology services, and outsourcing company.

- US $15.5 billion net revenues for FY05
- Over 133,000 employees in 48 countries
- Accenture serves approximately 2,500 clients that span the full range of industries around the world
- We serve 87 of the *Fortune* Global 100, two-thirds of the *Fortune* Global 500 and government agencies in 26 countries
- Of our top 100 clients in fiscal 2005, 96 have been clients for at least five years and 83 have been clients for at least 10 years
- Ranked No. 1 in "Computer & Data Services" industry category in *Fortune's* 2005 list of America's most admired companies
- *InformationWeek* ranked Accenture as the #1 leading Outsourcer

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Delivery Excellence
Holistic Approach to Quality

Delivery Excellence is about focusing on total performance, having the right systems, measurements, and processes in place.

- From a quality model perspective, you need to balance internal and external definitions of quality and tools/techniques
- **Internal:** proprietary best practices help differentiate you and build unique strengths
  - Methods
  - Tools
  - Metrics
  - Architectures
  - Stakeholder Management
  - Continuous Improvement
  - Quality Assurance

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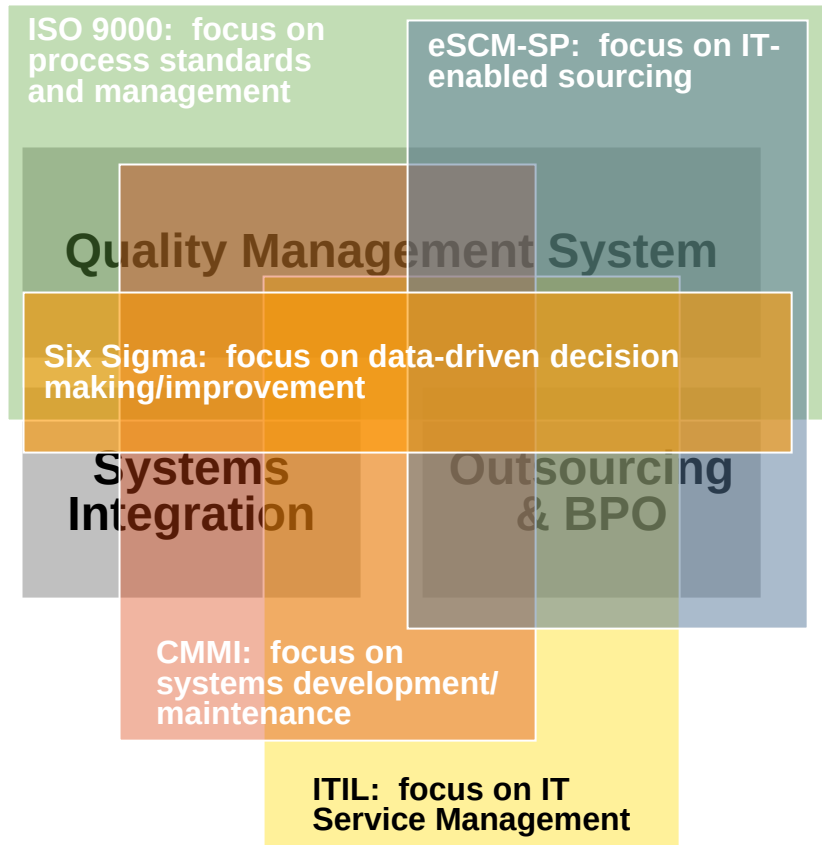
Delivery Excellence
Holistic Approach to Quality

It is important to balance internal and external definitions of 'best practice.'

- **External:** industry quality models provide an objective view into best practices and a common yardstick to compare companies
  - Industry standards frequently overlap, but have different 'sweet spots'



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Delivery Excellence
Case in Point: CMMI

CMMI has some impressive benefits:

- **Cost:** 4.5 percent decline in overhead and up to 33 percent decrease in the cost to fix defects
- **Schedule:** 30 percent increase in productivity, 50 percent reduction in release time, increase of milestones met from 50 percent to 95 percent
- **Quality:** reduction in defects found from 6.6 to 2.1 per thousand lines of code (KLOC)
- **Customer Satisfaction:** increase in client satisfaction scores and award fees
- **Return on Investment:** 5:1 to 13:1 ROI

From CMU/SEI-2003-SR-009 Demonstrating the Impact and Benefits of CMMI®: An Update and Preliminary Results.

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Delivery Excellence
Case in Point: CMMI

But…many organizations make the mistake of seeing CMMI as a silver bullet that will magically solve problems.

Common pitfalls:

- Setting wrong or incomplete goals
- Believing CMMI will fix all or most of your problems
- Focusing your improvement program on CMMI by itself

From CMU/SEI-2003-SR-009 Demonstrating the Impact and Benefits of CMMI®: An Update and Preliminary Results.

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Delivery Excellence
Goal Setting

What is the goal of your improvement program?
Hint: it probably isn't achieving CMMI Level X.

- Do not confuse CMMI goals with your business goals
- What are your business goals? Some examples:
  - Increase customer satisfaction
  - Reduce delivery time
  - Increase productivity
- How can CMMI help you with your goals?
  - **No:** Customer satisfaction is low because our call center is understaffed and keeps them on hold too long
  - **Maybe:** Customer satisfaction is low because our system upgrades take too long and have lots of bugs

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Delivery Excellence
Goal Setting

What is the goal of your improvement program?
Hint: it probably isn't achieving CMMI Level X.

- How do we know when we've achieved success?
  Which of these is more successful:
  - We are CMMI Level 3 but customer satisfaction hasn't changed
  - Customer satisfaction has improved 40% but we 'failed' our CMMI appraisal
- **Common mistake:** defining success based on CMMI Level rather than achievement of business goals

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Delivery Excellence
CMMI isn't everything

CMMI, like all quality models, has a 'sweet spot' where it provides the most value. Your business problems probably aren't that narrow.

- CMMI has some excellent content, such as:
  - Project management
  - Systems development/maintenance
- What about other problems related to your business goals?
  - Customer relationship management
  - Human performance
  - Outsourcing
  - Infrastructure management
  - Security management

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Delivery Excellence
CMMI isn't everything

CMMI, like all quality models, has a 'sweet spot' where it provides the most value. Your business problems probably aren't that narrow.

- Make sure to supplement your improvement program with other quality frameworks that have different 'sweet spots'
  - People Capability Maturity Model (P-CMM®)
  - eSourcing Capability Model for Service Providers (eSCM-SP) or for Client Organizations (eSCM-CL)
  - Information Technology Infrastructure Library (ITIL®)
  - ISO® 9000
  - (Lean) Six Sigma
  - ISO 17799/27001
  - …

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Delivery Excellence
CMMI isn't everything

CMMI has good process improvement content and principles, but doesn't cover all aspects of process improvement.

- CMMI has some excellent content and principles to help structure an improvement program
  - Sponsorship
  - Training
  - Measurements
  - Documentation
  - Verification
- **But don't forget:**
  - Communications program
  - Human performance
  - People change management
  - Tool and technology improvements
  - Organizational re-engineering

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Delivery Excellence
Conclusions

CMMI can be a valuable and important part of your delivery excellence program, but make sure you stay focused on the right issues.

- Focus first on business strategy and objectives
- Decide which quality frameworks will best help with those
  - Internal, proprietary methods and frameworks
  - Industry standards: CMMI, ITIL, eSCM-SP, Six Sigma, etc.
- Define your improvement program
  - Business case
  - Program plan + milestones
  - Define ‘success’ and identify metrics that will help you measure success

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Delivery Excellence
Conclusions

CMMI can be a valuable and important part of your delivery excellence program, but make sure you stay focused on the right issues.

- Make sure your improvement program has all the elements, including:
  - Program Management
  - Sponsorship
  - Process, Technology, and People Change Management
    - Training
    - Communications
    - Tools
    - Process and Organization re-engineering

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Resolving CMMI Issues

CMMI Technology Conference
16 November 2006

Dr. Karen J. Richter

Summary Issues

- Programs execute at lower maturity levels than their organizations have achieved and advertised
- High-maturity practices are not consistently applied at the project level after contract award
- New projects do not always incorporate the organization's CMMI-appraised processes
- Content of Appraisal Disclosure Statements (ADS) is lacking
- Appraisal sampling procedures do not ensure adequate coverage of the organizational unit
- Appraiser quality not always consistent– training, etc.
- Lack of agreement on what constitutes Levels 4 and 5
- Need to converge to a single representation
- Inadequate training and education for acquirers
- Should CMMI be used for source selection?

Program Execution

- Issue
  - Programs execute at lower maturity levels than their organizations have achieved and advertised
- Resolution
  - Defense Contract Management Command (DCMA) has begun data collection on program performance

Project Implementation of Appraised Processes

- Issues
  - High-maturity practices are not consistently applied at the project level after contract award
  - New projects do not always incorporate the organization's CMMI-appraised processes
- Resolution for v. 1.2
  - Eliminated "level for life"—now a 3 year limit
  - Added a specific goal and two specific practices to the Organizational Process Focus (OPF) process area (PA) of the model to stress deployment of processes to projects
  - Added words to a specific practice in Integrated Project Management (IPM) PA to emphasize having a defined process at project start-up

Appraisal Disclosure Statement (ADS)

- Issue
  - Content of Appraisal Disclosure Statement (ADS) is lacking
- Resolution for v. 1.2
  - Much more detail disclosed in v. 1.2 ADS than previous versions
    - Organizational unit, focus and non-focus projects, application domains
  - Lead Appraisers must certify that focus and non-focus projects are truly representative
  - Lead Appraisers must certify that level 4 and 5 appraised subprocesses map to organization's business objectives
  - All appraisals performed after 28 Nov 2006 must report with v. 1.2 of the ADS, regardless of model or method used
  - DoD contractor's ADS will be posted on a .mil web site

Sampling

- Issue
  - Appraisal sampling procedures do not ensure adequate coverage of the organizational unit
- Resolution for v. 1.2
  - New sampling rules and disclosure in Appraisal Disclosure Statement (ADS)
    - Organizational Scope: name, type, location
    - Organizational Unit Coverage: size, application domain, geographical breadth, project type expressed in percentages of total organizational unit

Appraiser Training

- Issue
  - Appraiser quality not always consistent– training, etc.
- Resolution for v. 1.2
  - Upgrade face-to-face training with focus on integrity
    - Sessions held at this conference
  - Certification of high-maturity appraisers in place
    - Workshop on high maturity training determined the requirements for which the lead appraisers have to provide evidence in order to do high maturity appraisals
      - —Previous courses, oral questions, etc

Levels 4 and 5

- Issue
  - Lack of agreement on what constitutes Levels 4 and 5
- Resolution for v. 1.2
  - Body of Knowledge on high maturity will be developed and available by October 2007
    - What constitutes high maturity behavior?

Addressing Acquisition

- Issues
  - Inadequate training and education for acquirers
  - Should CMMI be used for source selection?
- Resolutions for v. 1.2
  - Completion of Guidebook for Program Managers
    - *Understanding and Leveraging Your Contractor's CMMI Efforts: A Guidebook for Acquirers*
    - Due out after the first of the year—February 2007
  - Development of the CMMI for Acquisition Constellation (CMMI-ACQ)
    - Initial draft model developed by General Motors and the SEI
    - Involvement of broad acquisition stakeholder community through pilots and as key reviewers
    - CMMI-ACQ model and training to be available by end of April 2007

Summary Issues—Addressed in V. 1.2

- ✓ Programs execute at lower maturity levels than their organizations have achieved and advertised
- ✓ High-maturity practices are not consistently applied at the project level after contract award
- ✓ New projects do not always incorporate the organization's CMMI-appraised processes
- ✓ Content of Appraisal Disclosure Statements (ADS) is lacking
- ✓ Appraisal sampling procedures do not ensure adequate coverage of the organizational unit
- ✓ Appraiser quality not always consistent– training, etc.
- ✓ Lack of agreement on what constitutes Levels 4 and 5
- ➢ Need to converge to a single representation
- ✓ Inadequate training and education for acquirers
- ✓ Should CMMI be used for source selection?

Outstanding Issues

- Need to converge to a single representation

- Issues addressed in v. 1.2 product suite still need to be monitored to ensure improvement goals are really being met
  - Integrity of appraisals
  - Quality of the product suite
  - Education of acquirers
  - Opportunities for streamlining where appropriate

Moving Forward

- Ensure constellations don't become stovepipes
- Monitor outstanding issues—DCMA continues to investigate
  - Programs execute at lower maturity levels than their organizations have achieved and advertised
- Continue to address
  - Lack of agreement on what constitutes Levels 4 and 5
  - Need to converge to a single representation

Additional Improvement Opportunities

- Lean the Model
  - Convene 6-sigma team to analyze
  - Eliminate cumbersome material included for legacy reasons
  - Move forward from legacy representation approach to focus on measuring process capability with translation to organizational maturity
- Next Generation Process Improvement (PI)
  - Develop a strategy for how we will take PI to the next level
  - Do we need something else with CMMI for high maturity?

Questions/Comments?

Why Choose Between ISO, CMMI, ITIL and Six Sigma? Why not Leverage All!

Lemis O. Altan

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Improving Software Economics

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A Few Questions

- ISO, CMMI, ITIL, Six Sigma. How many of you have wondered which model or which standard to choose from?
- How many of you have heard of or participated in conversations/discussions on which is better?
- How many of you wondered how all these models, standards might fit together and you might actually use them all in your organization?

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Session Objectives

- Review of ISO 9001:2000, CMMI, ITIL and Six Sigma
- Present the relationships among them
- Discuss the areas where each would be applicable in your organization

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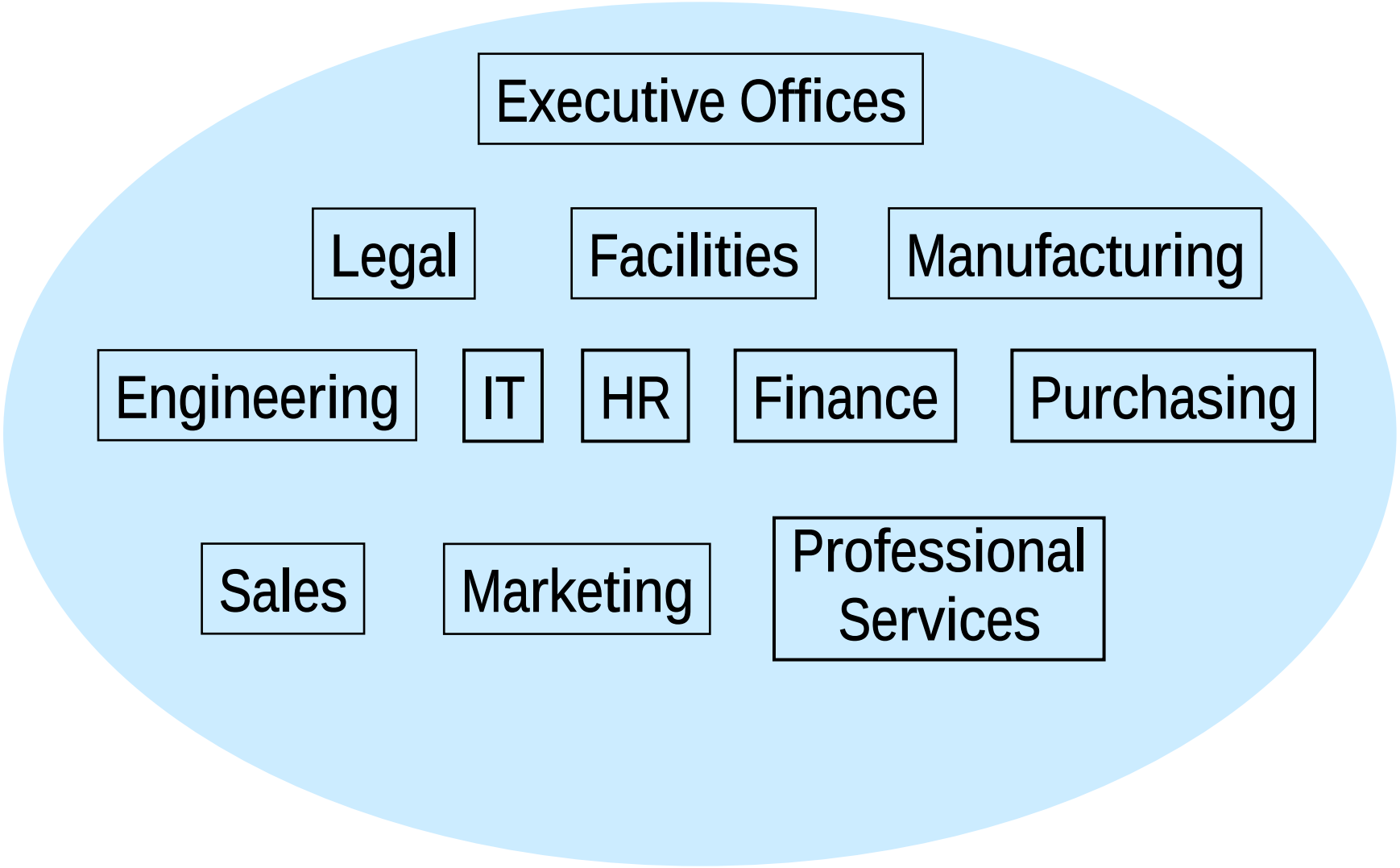
Typical Organizational Structure



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Motives for Process Improvement

- Internal drivers to improve product quality and reduce cost
- External drivers to achieve a certification or rating for marketing purposes

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ISO 9001:2000 Standard

- Applies to all organizations that develop products or provide services
- Equally applicable to small, medium, and large organizations
- Less prescriptive than the 1994 version
- Provides an organization with more flexibility in documenting its Quality Management System (QMS)
- Enables each individual organization to develop the minimum amount of documentation needed in order to demonstrate the effective planning, operation and control of its processes, and the implementation and continuous improvement of the effectiveness of its Quality Management System

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ISO 9001:2000 Requirements

- Systemic
  - Establish quality system
  - Document quality system
- Management
  - Support quality
  - Satisfy customers
  - Establish a quality policy
  - Carry out quality planning
  - Control quality system
  - Perform management reviews
- Resource
  - Provide quality resources
  - Provide quality personnel
  - Provide infrastructure
  - Provide quality environment
- Realization
  - Control realization planning
  - Control customer processes
  - Control product development
  - Control purchasing function
  - Control operational activities
  - Control monitoring devices
- Remedial
  - Perform remedial processes
  - Monitor and measure quality
  - Control nonconforming products
  - Analyze quality information
  - Make quality improvement

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ISO 9001:2000 Requirements

Quality management system
Quality manual
Human resources
Resource management
Competence, awareness and training
Infrastructure
Work environment
Meet customer requirements
Customer communication
Identify customer requirements
Plan, design and development
Design and development verification
Design and development validation
Carry out design and development
Monitoring and measurement of process and product
Internal audits
Control of design and development changes
Control of monitoring and measuring devices
Control of documents and records
Improvement
Verify purchased products

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Capability Maturity Model Integration (CMMI®)

- A framework consisting of best practices that address product development and maintenance
- V1.1 emphasizes systems and software engineering and the integration necessary to build and maintain the total product
- Applicable to any size engineering organization
- Much more descriptive then ISO – Specific Practices
- Tells you **what** to do, not **how** to do it
- Has several bodies of knowledge
- Two representations:
  - Continuous, Staged
- Assure consistency with ISO/IEC 15504

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CMMI Continuous Representation

CATEGORY	PROCESS AREA (V1.1)
Process Management	• Organizational Process Focus (OPF) • Organizational Process Definition (OPD) • Organizational Training (OT) • Organizational Process Performance (OPP) • Organizational Innovation and Deployment (OID)
Project Management	• Project Planning (PP) • Project Monitoring and Control (PMC) • Supplier Agreement Management (SAM) • Integrated Project Management (IPM) • Risk Management (RISKM) • Integrated Teaming (IT) • Integrated Supplier Management (ISM) • Quantitative Project Management (QPM)
Engineering	• Requirements Management (REQM) • Requirements Development (RD) • Technical Solution (TS) • Product Integration (PI) • Verification (VER) • Validation (VAL)
Support	• Configuration Management (CM) • Process and Product Quality Assurance (PPQA) • Measurement and Analysis (MA) • Organizational Environment for Integration (OEI) • Decision Analysis and Resolution (DAR) • Causal Analysis & Resolution (CAR)

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ISO 9001:2000 and CMMI V1.1 Overlap

Quality management system - OPF , GGs
Quality manual - OPD, GG
Human resources
Resource management - PMC
Competence, awareness and training - OT
Infrastructure - OEI
Work environment - OEI
Meet customer requirements – REQM, VAL
Customer communication - PMC
Identify customer requirements - RD
Plan design and development - PP
Design and development verification – VER
Design and development validation - VAL
Carry out design and development - TS
Monitoring and measurement of process and product - MA
Internal audits - PPQA
Control of design and development changes - CM
Control of monitoring and measuring devices
Control of documents & records - PPQA
Improvement – OPP CAR
Verify purchased products – SAM

OPF, OPD, OT

OPP, OID

PP, PMC, IPM

IT, RISKM

SAM, ISM

QPM

RD, REQM

TS, PI, VER, VAL

CM, PPQA, MA

OEI, DAR, CAR

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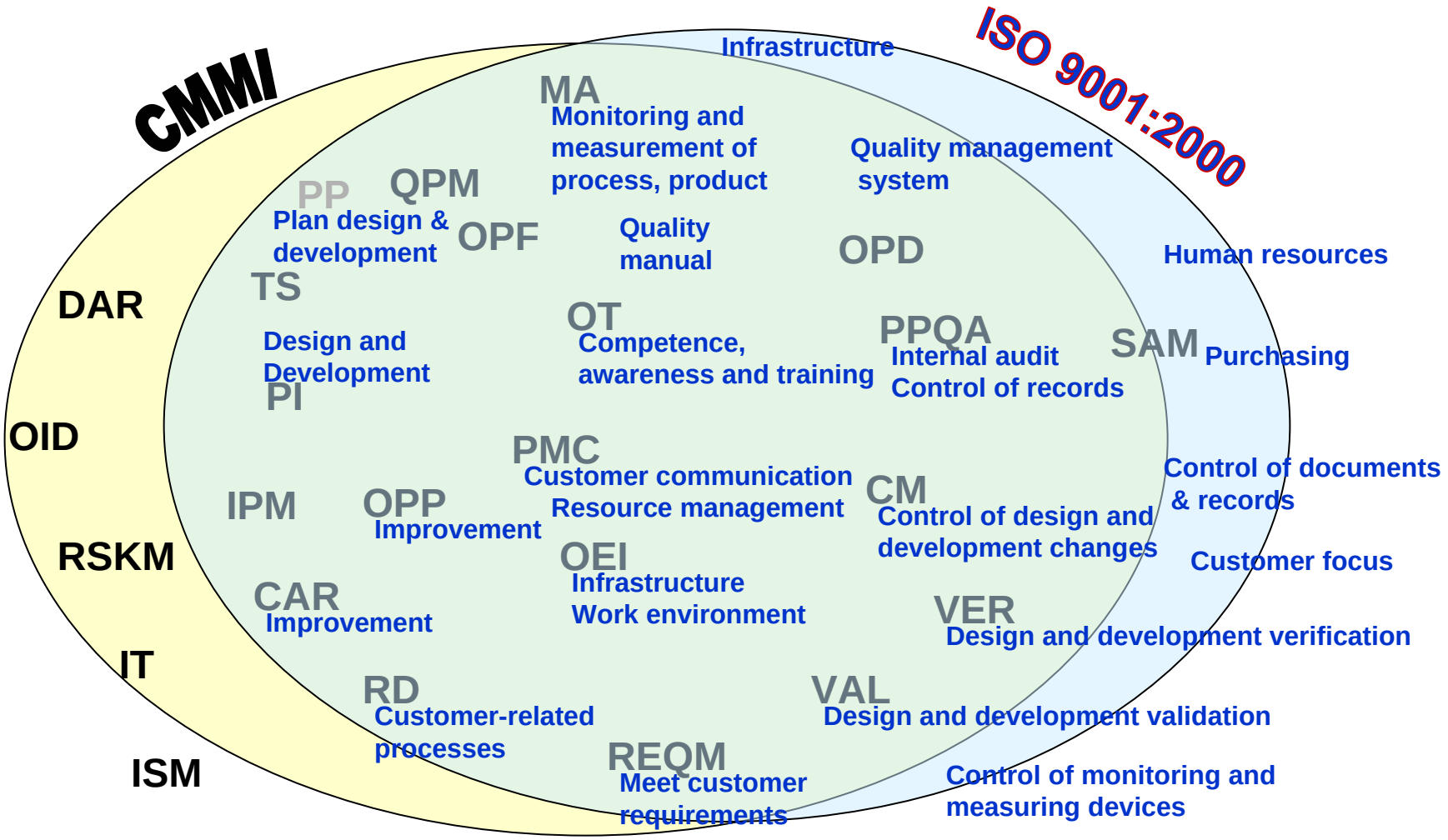
ISO 9001:2000 and CMMI V1.1 Overlap



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ISO 9001:2000 and CMMI Summary

- Considerable overlap

- ISO has a broad perspective and is more general
- CMMI provides more detail on what is required for engineering best practices

- ISO is applicable to all types and sizes of organizations
- CMMI is applicable to the Engineering function, IT application development function, Professional Services development function and any other organization that is planning and managing projects.

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Information Technology Infrastructure Library (ITIL)

- Premise:
  - IT plays a critical role in support of the business goals and requirements
  - IT provides essential services to the organization supporting the business
- Set of integrated, best practices focused on the management of IT service processes
- Promotes quality and efficiency in the use of Information Technology
- Meets ISO 9001 standards
- Considered "public domain" because it is a Crown Copyright
- Focuses on IT Service Management - IT Service Support and IT Service Delivery (48 modules)
- ITIL instructs **how** to do it

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ITIL Service Management Focus -1

IT Service Support

- **Configuration Management** - physical and logical perspective of the IT infrastructure and the IT services being provided
- **Change Management** - standard methods and procedures for effective managing of all changes
- **Release Management** - testing, verification, and release of changes to the IT environment
- **Incident Management** - the day-to-day process that restores normal acceptable service with a minimal impact on business
- **Problem Management** - the diagnosis of the root causes of incidents in an effort to proactively eliminate and manage them
- **Service Desk (Function)** - a function not a process. This provides a central point of contact between users and IT

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ITIL Services Management Focus -2

IT Service Delivery

- **Availability Management** - optimizing IT infrastructure capabilities, services, and support to minimize service outages and providing sustained levels of service to meet business requirements
- **IT Service Continuity** - managing an organization's capability to provide the necessary level of service following an interruption of service
- **Capacity Management** - enabling an organization to tactically manage resources and strategically plan for future resource requirements
- **Service Level Management** - maintaining and improving the level of service to the organization
- **Financial Management for IT Services** - managing the costs associated with providing the organization with the resources needed to meet requirements

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CMMI V1.1 and ITIL Touch Points

CATEGORY	PROCESS AREA
Project Mgt.	• PP – Problem Mgt., Change Mgt., SW Control and Distribution, Computer Network Operations, Capacity Mgt., Security Mgt., Contingency Planning, Planning and Control • PMC – Problem Mgt., Change Mgt., Contingency Planning, Planning and Control, Business IT Alignment • IPM – Customer Relationship Mgt., Service Level Mgt., Planning and Control, Business IT Alignment • RISKM – Change Mgt. , Contingency Planning, Planning and Control • IT – Service Level Mgt., Planning and Control
Engineering	• REQM – Help Desk, Incident Mgt., Problem Mgt., Change Mgt., Customer Relationship Mgt., Service Level Mgt., Availability Mgt., Contingency Planning, Business IT Alignment • RD – Customer Relationship Mgt., Service Level Mgt., Availability Mgt., Business IT Alignment • TS – SW Control and Distribution, Computer Network Operations • PI – Help Desk, Incident Mgt., Problem Mgt., Change Mgt., Contingency Planning, Planning and Control • VAL – Customer Relationship Mgt,, Service Level Mgt., Capacity Mgt. , Business IT Alignment
Support	• CM – Help Desk Incident Mgt., Problem Mgt., Change Mgt., Configuration Mgt., SW Control and Distribution, Computer Network Operations, Security Mgt. • MA – Problem Mgt.

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CMMI V1.1 Process Areas with No ITIL Touch Points

- Organizational:
  - OPF, OPD, OT, OPP, OID
- Project Management:
  - SAM, ISM, QPM
- Engineering:
  - VER
- Support:
  - PPQA, DAR, CAR, OEI

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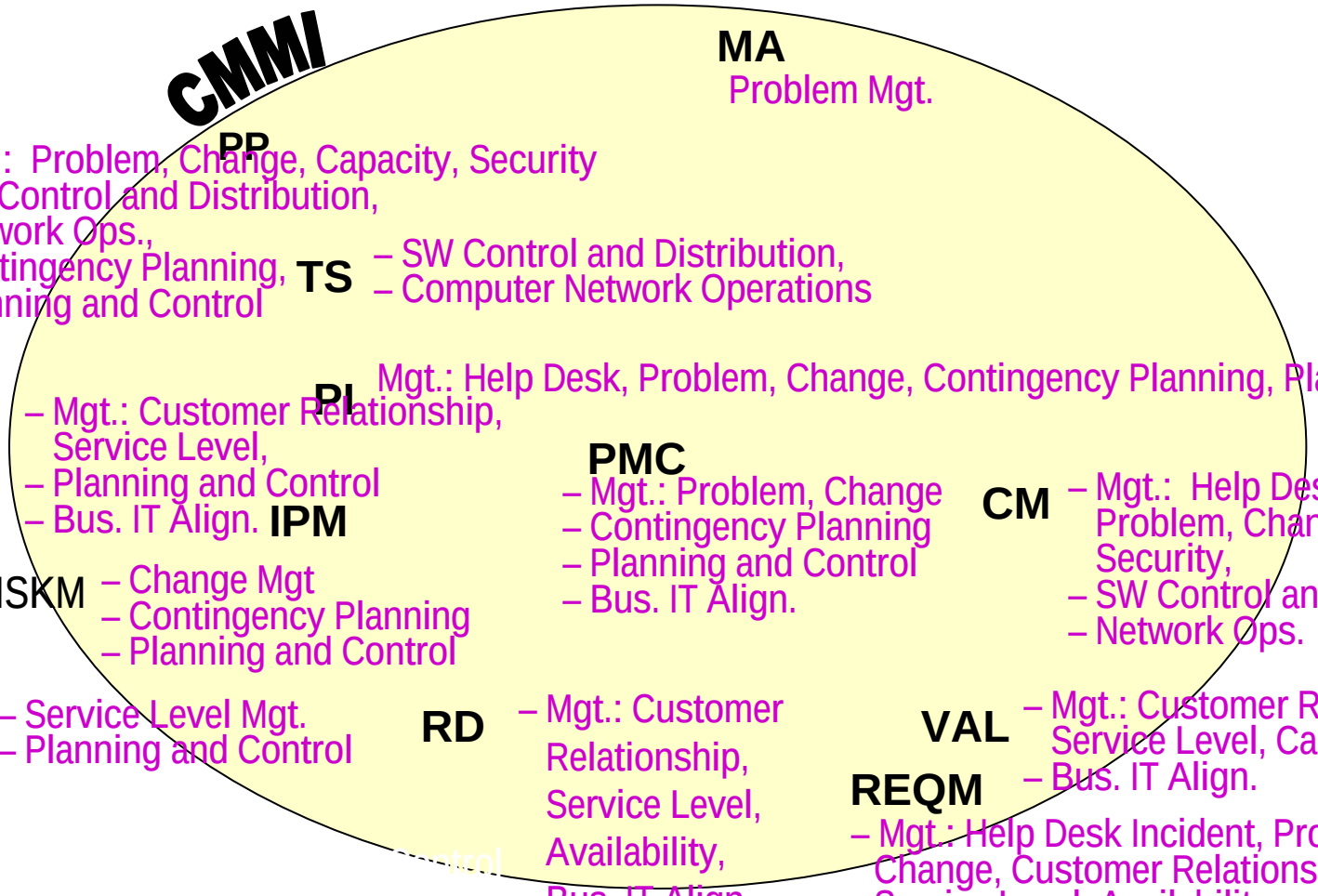
CMMI V1.1 and ITIL Touch Points



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ISO 9001:2000 , CMMI Overlap and ITIL Touch Points

Quality management system	OPF , GGs	
Quality manual	OPD, GG	
Human resources		
Resource management	PMC	– Mgt.: Problem, Change, Contingency Planning, Planning and Control,
Competence, awareness and training	OT	Business IT Alignment (Bus. IT Align.)
Infrastructure	OEI	
Work environment	OEI	
Meet customer requirements	REQM	– Mgt.: Help Desk, Problem, Change, Customer Relationship,
Customer communication	PMC	Service Level, Availability, Contingency Planning, Bus. IT Align.
Identify customer requirements	RD	– Mgt.: Customer Relationship, Service Level, Availability, Bus. IT Align.
Plan design and development	PP	– Mgt.: Problem, Change, Capacity, Security, SW Control and Distribution,
Design and development verification	VER	Network Ops., Contingency Planning, Planning and Control
Design and development validation	VAL	– Mgt,: Customer Relationship, Service Level, Capacity, Bus. IT Align.
Carry out design and development	TS	– Software Control and Distribution, Computer Network Operations
Monitoring and measurement of process and product	MA	– Problem Mgt.
Internal audits	PPQA	
Control of design and development changes	CM	– Mgt.: Help Desk, Incident, Problem, Change, Configuration,
Control of monitoring and measuring devices		Security, SW Control and Distribution, Network Ops.
Control of documents & records	PPQA	
Improvement	OPP, CAR	
Verify purchased products	SAM	

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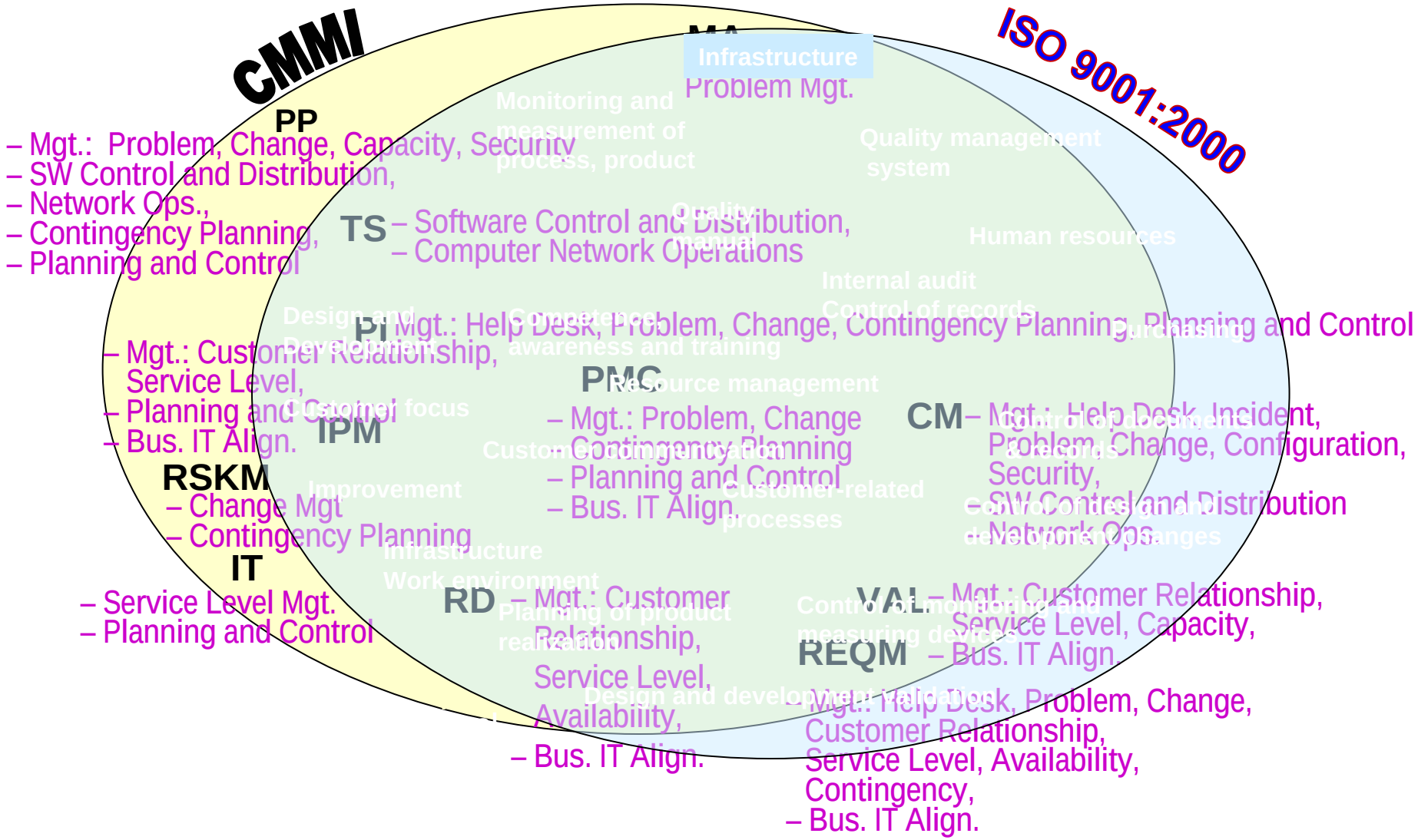
CMMI V1.1 and ITIL Touch Points



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ISO 9001:2000, CMMI V1.1, and ITIL Summary

- Considerable overlap

- ISO has a broad perspective and is more general
- CMMI instructs **what** is required for development best practices
- ITIL provides more detail on the "**how** to" of a process

- ISO is applicable to all types and all sizes of organizations
- CMMI is applicable to the Engineering function, IT application development function, Professional Services development function and any other organization that is planning and managing projects.
- ITIL is applicable to IT function, and IT Professional Services

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Six Sigma

Has been described as:

- "A highly technical method used by engineers and statisticians to fine-tune products and processes"
- A goal of near-perfection in meeting customer requirements.
- A sweeping "culture change" effort to position a company for greater customer satisfaction profitability and competitiveness

SIX SIGMA: "A comprehensive *system* for achieving, sustaining and maximizing business success. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis and diligent attention to managing, improving, and reinventing business processes." - *Six Sigma Way*, © 2000, Peter S. Pande, Robert P. Neuman, Roland R. Cavanaugh

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Six Sigma

- Is a *flexible* system for improved business leadership and performance
- Builds on many of the ideas and best practices of the past
- Is about action, not theory
- Applicable to all types and all sizes of organizations
- Could be applied to any process
- Assumes existing processes
- Consists of six themes:
  - Focus on the Customer
  - Data- and Fact-Driven Management
  - Process Focus, Management, and Improvement
  - Proactive Management
  - Boundaryless Collaboration
  - Drive to perfection; Lack of Tolerance for Failure

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Elements of Six Sigma in CMMI V1.1

LEVEL	FOCUS	PROCESS AREA
5 Optimizing	Continuous process improvement	• Causal Analysis & Resolution SSA • Organizational Innovation and Deployment SSI
4 Quantitatively Managed	Quantitative management	• Quantitative Project Management SSC SSM • Organizational Process Performance SSA
3 Defined	Process standardization	• Organizational Process Focus SSI • Organizational Process Definition SSD • Organizational Training SSI • Integrated Project Management SSC SSD • Decision Analysis and Resolution SSA • Requirements Development SSA SSD
2 Managed	Basic project management	• Requirements Management SSA SSD • Project Planning SSD • Project Monitoring and Control SSC • Measurement and Analysis SSM
1 Initial		

Six Sigma Control
SSC

Six Sigma Improve
SSI

Six Sigma Analyze
SSA

Six Sigma Measure
SSM

Six Sigma Define
SSD

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ISO 9001:2000, CMMI, ITIL and Six Sigma Summary

- Considerable overlap

- ISO has a broad perspective and is more general
- CMMI instruct **what** is required for engineering best practices
- ITIL provides more detail on the "**how** to" steps of the IT best process
- Six Sigma's broad perspective could be applicable to any process

- ISO is applicable to all types and all sizes of organizations
- CMMI is applicable to the Engineering function, IT application development function, Professional Services development function and any other organization that is planning and managing projects.
- ITIL is applicable to IT function and IT Professional Services function
- Six Sigma is applicable to any organizational function

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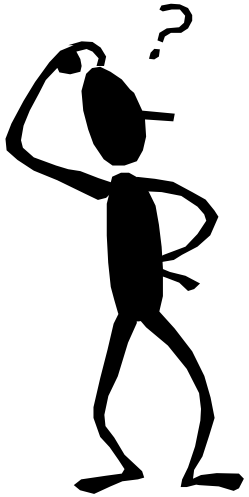
Questions and Comments



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“The Role of CMMI® in Facilitating Program Performance in Large Scale Systems”

Dev Banerjee
Director – Systems Engineering
Integrated Defense Systems
The Boeing Company
St. Louis, MO

CMMI® Technology Conference
and User Group
November 13-16, 2006
Hyatt Regency Tech Center
Denver, CO

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BOEING
Forever New Frontiers

2016 VISION

People working together as a global enterprise for aerospace leadership

Strategies

Run healthy core businesses
Leverage strengths into new products and services
Open new frontiers

Core competencies

Detailed customer knowledge and focus
Large-scale systems integration
Lean enterprise

Values

Leadership
Integrity
Quality
Customer satisfaction
People working together
A diverse and involved team
Good corporate citizenship
Enhancing shareholder value

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Topics

- **Boeing Progress on CMMI**
  - 11 sites at Maturity Level 5
  - Continuing effort to deploy CMMI across all programs
  - Moving to “common”
- **Current Limitations of CMMI**
  - Industry Issues
  - Program Issues
- **Boeing Approach and Initiatives**
  - Corporate Initiatives
  - Key Focus Areas – Integrated Defense Systems
  - Program Management Best Practices
  - Strengthen Systems Engineering
- **Summary**

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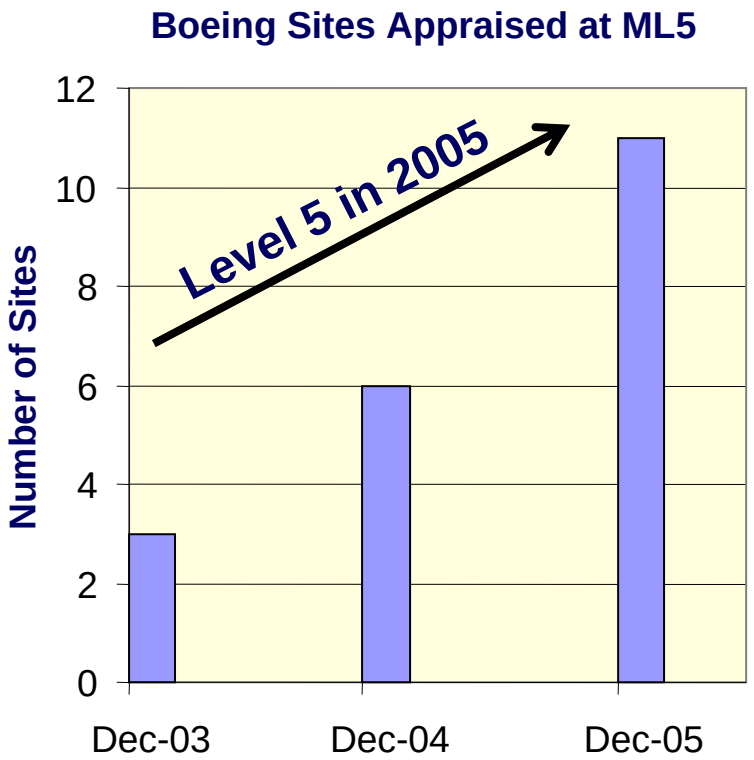
Boeing is Committed to CMMI

Programs at 11 major Boeing sites supporting all Business Units have been appraised at Maturity Level 5



Major Programs Appraised:

- B-1B
- C-17
- F/A-18 E/F
- F-22
- V-22
- Satellite Systems
- Mission Planning
- International Space Station
- Delta
- GPS

All Major Boeing Sites at Maturity Level 5

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Continue to Deploy CMMI Across All Businesses and Programs

- Business Units and Sites continue to expand deployment of CMMI-based processes
- Goals include:
  - Increase the number of programs and projects
  - Increase the penetration into the Engineering population
- Expand use of CMMI processes from main business programs into supporting Engineering activities and functions:
  - Modeling and Simulation
  - Engineering Laboratories
  - Ground Support Equipment

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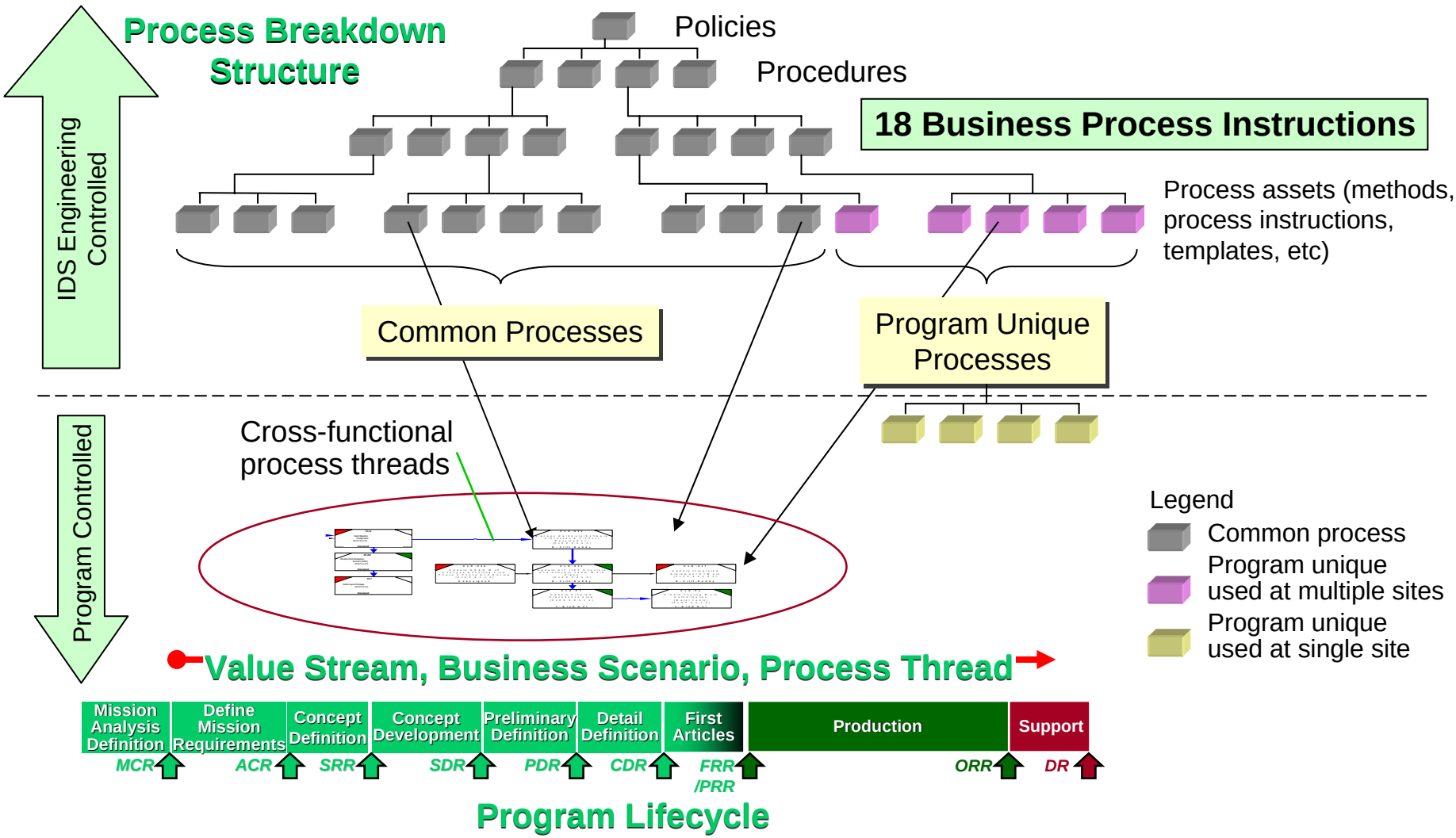
Move to Common Processes Consistent With CMMI Process Areas



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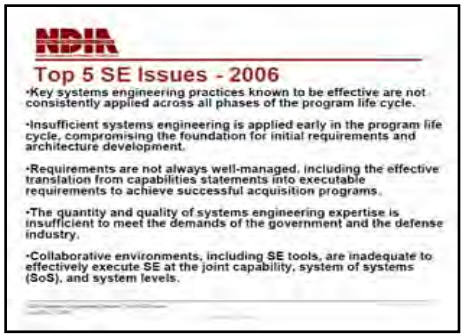
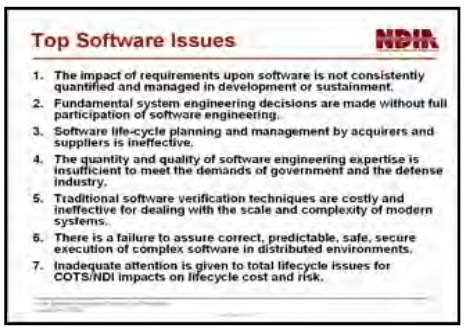
Industry Issues

Industry Issues:

- Top 5 System Engineering Issues



- Top Software Engineering Issues



Typical Program Issues:*

- Requirements instability
- Weak baseline management
- Weak risk management
- Weak supplier management
- Inadequate specifications
- Poor project management
- Management change control

* Issues developed during joint Government/Boeing Systems Engineering Interchange meeting and from list of top reasons projects fail from the Project Management Institute

Boeing Recognizes the Limitations of CMMI-based Process Implementation

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Approach to Integration of Broad-based Initiatives

- **Boeing Corporate – Growth and Productivity Initiatives**
  - Internal Services Productivity
  - Lean+
  - Global Sourcing
  - Development Product Excellence
- **Boeing Integrated Defense Systems – Key Focus Areas**
  - Supplier Management and Quality
  - Program Management Best Practices
  - Strengthen Systems Engineering
  - Cost Reduction

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Strong/Robust SE Support of Program Management Best Practices (PMBP) Required for Successful Program Performance

SE Activities Supporting PMBP

- *Requirements Definition*
- *Proposal Risk Management*
- *Establish Baseline*

- *Supplier Management*

- *Product-Focused, consistent with WBS*

- *Performance and Operational Measure*
- *Standard Review Format*

- *Integration of Risk, Opportunity, Issues Management Process*

- *IPT, Customer, Teammates, Key Suppliers Involved in Independent Reviews*

- *Trade Studies*
- *Requirements Mgmt*
- *Technical Performance Measures*
- *Affordability*
- *Baseline Management*
- *Integrated Planning*
- *Integrated Scheduling*
- *Allocation/Traceability of Requirements*
- *Integration of Program Baseline*
- *Interface Definition Management*
- *Integrated Software Development*
- *System Integration, V & V*

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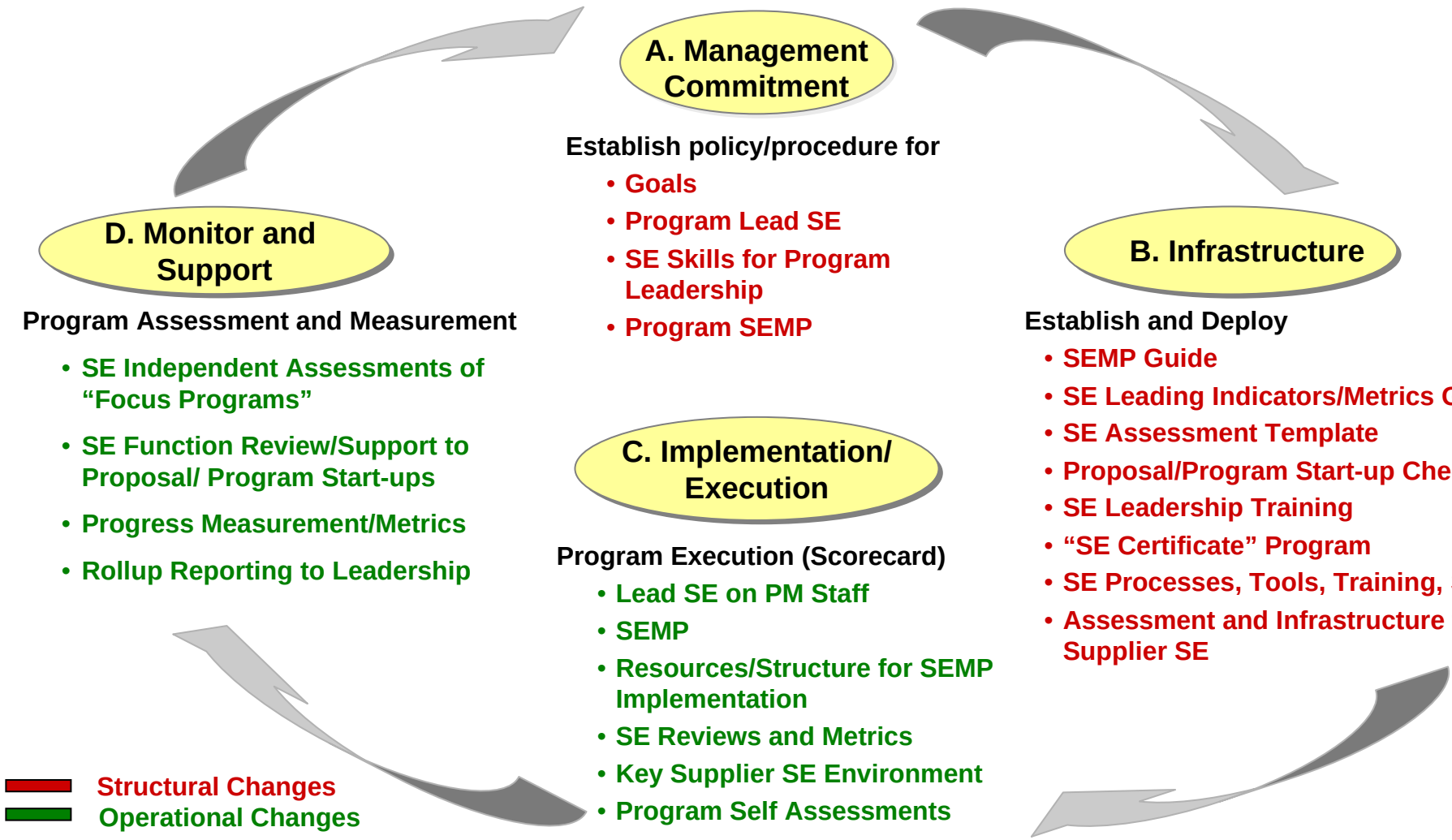
Process to Strengthen Systems Engineering



Closed Loop Process to Strengthen SE at Boeing

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Summary

Vision 2016

Program Management Best Practices

Supplier Management and Quality

Strengthen Systems Engineering

Lean +

Global Sourcing

Development Process Excellence

- Project Planning
- Project Monitoring & Control
- Supplier Agreement Management
- Integrated Project Management + IPPD
- Risk Management
- Quantitative Project Management

- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

- Configuration Management
- Process & Product Quality Assurance
- Measurement & Analysis
- Decision Analysis & Resolution
- Causal Analysis & Resolution

- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation & Deployment

CMMI Supports the Boeing Vision

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DoD Systems and Software Engineering

Taking it to the Next Level

CMMI Technology Conference Executive Panel

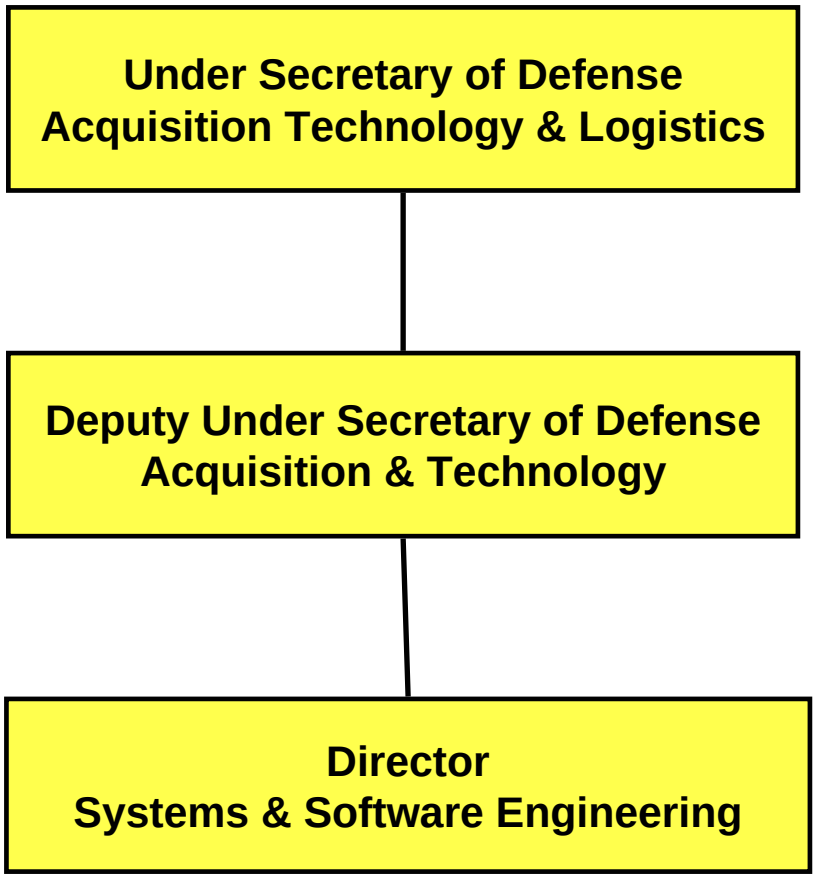
14 November 2006

Mark D. Schaeffer

Director, Systems and Software Engineering

Office of the Deputy Under Secretary of Defense (A&T)

Recent Acquisition & Technology Reorganization



as of June 1, 2006

Systems Engineering is well positioned in DoD

Systems and Software Engineering Mission Statement

- Shape acquisition solutions and promote early technical planning
- Promote the application of sound systems and software engineering, developmental test and evaluation, and related technical disciplines across the Department's acquisition community and programs
- Raise awareness of the importance of effective systems engineering and drive the state-of-the-practice into program planning and execution
- Establish policy, guidance, best practices, education, and training in collaboration with academia, industry, and government communities
- Provide technical insight to program managers and leadership to support decision making

Evolving System Engineering Challenges

Systems Engineering Revitalization Effort

- Issued Department-wide Systems Engineering (SE) policy
- Issued guidance on SE, T&E, and SE Plans (SEPs)
- Instituted system-level assessments in support of DAB, OIPT, DAES, and in support of programs
- Established SE Forum to ensure senior-level focus within DoD
- Integrating DT&E with SE policy and assessment functions--focused on effective, early engagement of both
- Instituting a renewed emphasis on modeling and simulation in acquistion
- Working with Defense Acquisition University to revise curricula (SPRDE, T&E, PQM, LOG, PM, ACQ, FM, CONT)
- Leveraging close working relationships with industry and academia

Top 10 Emerging Systemic Issues

1. Management	• IPT roles, responsibilities, authority, poor communication • Inexperienced staff, lack of technical expertise
2. Requirements	• Creep/stability • Tangible, measurable, testable
3. Systems Engineering	• Lack of a rigorous approach, technical expertise • Process compliance
4. Staffing	• Inadequate Government program office staff
5. Reliability	• Ambitious growth curves, unrealistic requirements • Inadequate “test time” for statistical calculations
6. Acquisition Strategy	• Competing budget priorities, schedule-driven • Contracting issues, poor technical assumptions
7. Schedule	• Realism, compression
8. Test Planning	• Breadth, depth, resources
9. Software	• Architecture, design/development discipline • Staffing/skill levels, organizational competency (process)
10. Maintainability/Logistics	• Sustainment costs not fully considered (short-sighted) • Supportability considerations traded

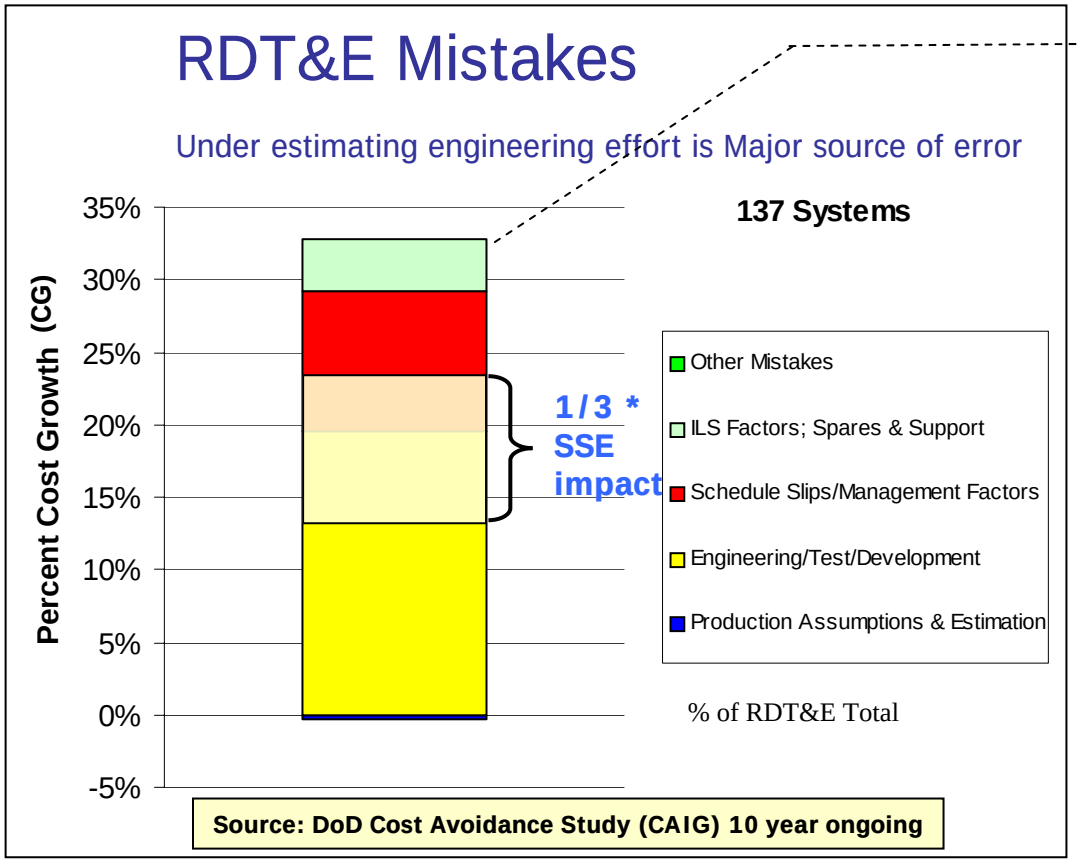
Major contributors to poor program performance

Necessary but not sufficient

now

“Take SE to the Next Level”

Systems and Software Engineering in Programs Reduces Costly Mistakes



33% historical RDT&E **Cost Growth**

Applied to

$222.8B RDT&E FYDP**

Yields a Potential → $73.52B **RDT&E Cost Growth FYDP**

* SSE positive impact on just 1/3 of RDT&E mistakes (11%)

Yields a Potential → $24.51B **RDT&E Cost Avoidance FYDP**

****SAR data for MAIS and MDAP programs under OSD Systems Engineering Oversight**

Initiatives For Strategic and Tactical Acquisition Excellence

STRATEGIC
"Big A"

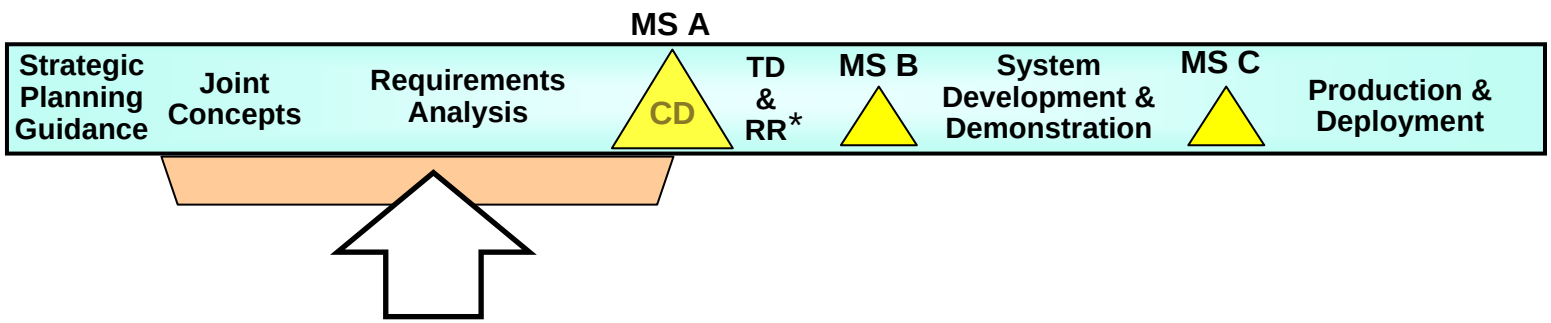
"Little A"
TACTICAL

OBJECTIVES	INITIATIVES
Making Decisions that Balance the Trade-Space • Affordable, Feasible Investments	• Portfolio Management • Tri-Chair Concept Decision / Time-Defined Acquisition • Evaluation of Alternatives • Synchronize Existing Processes • Tri-Chair Investment Balance Reviews
Starting Programs Right • Improved, Up-Front Planning • Awareness of Risk / Improved Source Selection • More Responsive Acquisition Solutions	• Risk-Based Source Selection • Small Business Innovative Research • Acquisition of Services Policy • Systems Engineering Excellence • Award Fee and Incentives
Process efficiency • Tailored, agile, transparent	• DAB / OIPT Process Optimization • Common Data / DAMIR • Restructured DAES
Program Stability • No Downstream Surprises • Issue Awareness	• Program Baseline Assurance • Capital Accounts

Improving the Full Range of Acquisition Execution

Make Decisions that Balance the Trade Space Early Lifecycle Planning

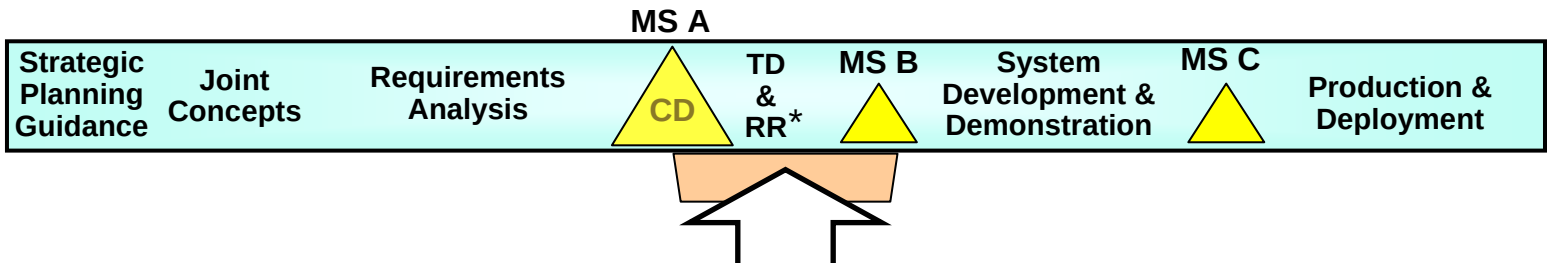
- Early lifecycle involvement of Systems Engineering:
  - Inform evaluation of alternatives with technical insights
  - Ensure solutions balance requirements with technical feasibility
  - Ensure solutions can be validated and verified
- Appropriate resourcing (personnel/funding) required



*Technology Development and Risk Reduction

Starting Programs Right
Shaping Systems Acquisition Solutions

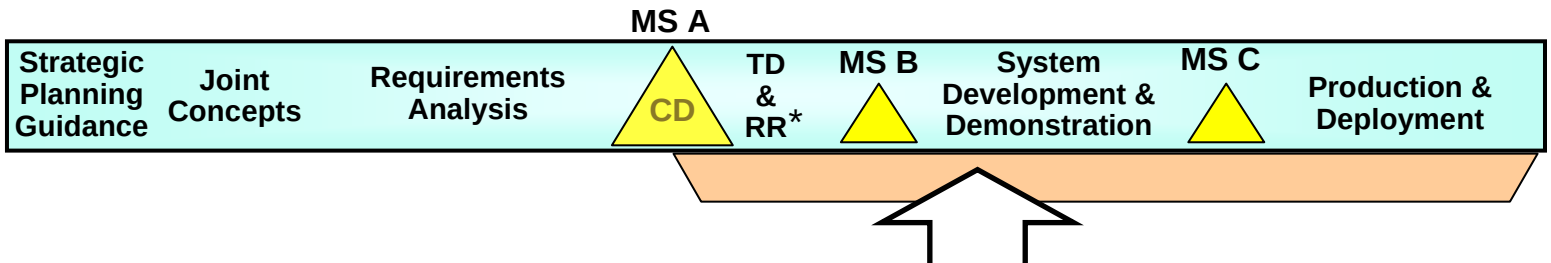
- System Level
  - Application of System Engineering principles contributes to successful program execution
  - Leverage System Engineering relationship to cost, schedule, and performance
  - Ensure enabling disciplines are in concert with technical planning
- Ensuring program and milestone reviews are informed by technical planning, verification and validation, and complementary business rules



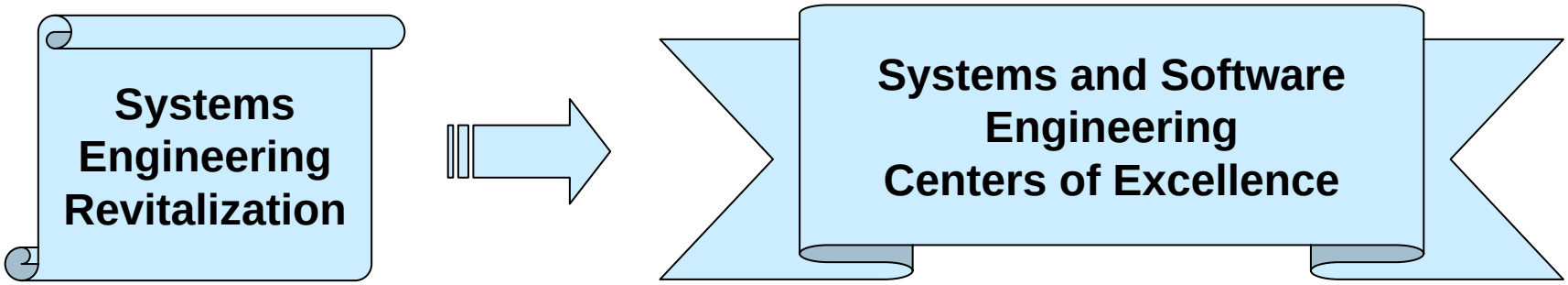
Starting Programs Right
Shaping System-of-Systems Acquisition Solutions

➢ System-of-Systems Level

- Needs will be satisfied by groupings of legacy systems, new programs, and technologies
- Presents additional integration and management issues
- Success depends heavily upon software interfaces
- Broad context and knowledge of system interrelationships and CONOPS are critical to decision-making
- Sound SE practices enable the integration of these SoS solutions



Vision for Systems Engineering and Software



- **Competencies Improved**
- **Delivered Product Suite**
  - Courseware
  - Policy/Guidance
  - Program Support methods
- **Elevated Stature**
- **Raised Awareness**
- **Positive Influence**

- **World class leadership**
- **Broaden to Software Engineering, System Assurance, Complex Systems-of- Systems, Test & Evaluation**
- **Responsive and agile, technical discipline to shape acquisition solutions**
- **Ensure appropriate human capital needs are met**

. . . the Technical Foundation that Enables Acquisition Excellence

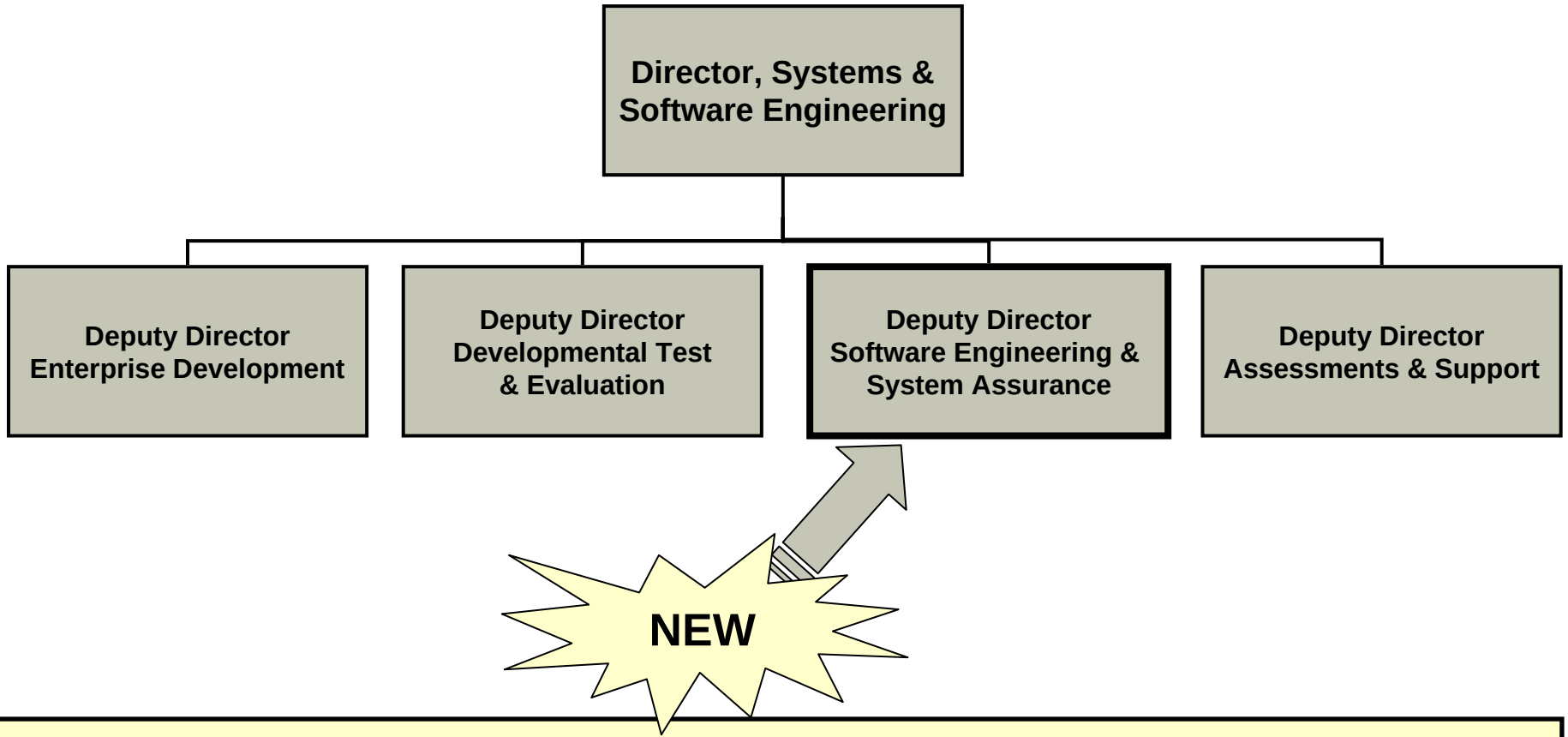
Why the Focus on Software…

- Research investment has been static or declining
  - DARPA computer science R&D funding 50% ↓ (’01 - ’04, universities)
- Requirements growth 10X (% functionality) ’60s -’00s
- Need vs. skilled/clearable workforce - gaps increasing
- President’s Information Technology Advisory Committee Report, February 2005
  - Identifies SW as “major vulnerability”
  - Recommends priority attention: “Secure Software Engineering and Software Assurance” and “Metrics, Benchmarks, and Best Practices”
- Cost, schedule and performance issues

Software is an increasingly, important factor

Systems and Software Engineering

An Organizational Construct



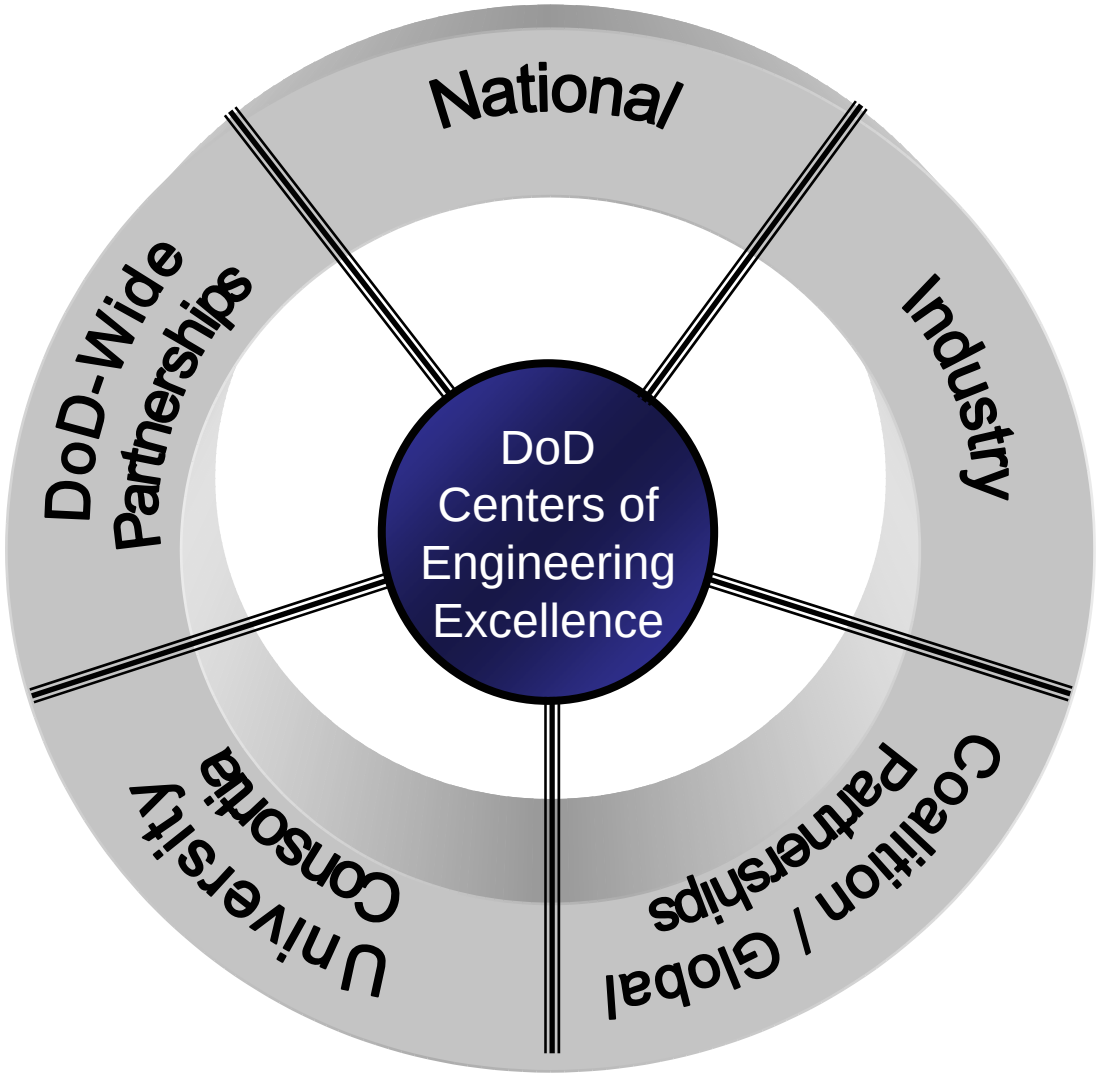
Management Visibility – Best Practices – Acquisition Excellence

DoD Software Center of Excellence Organizational Tenets

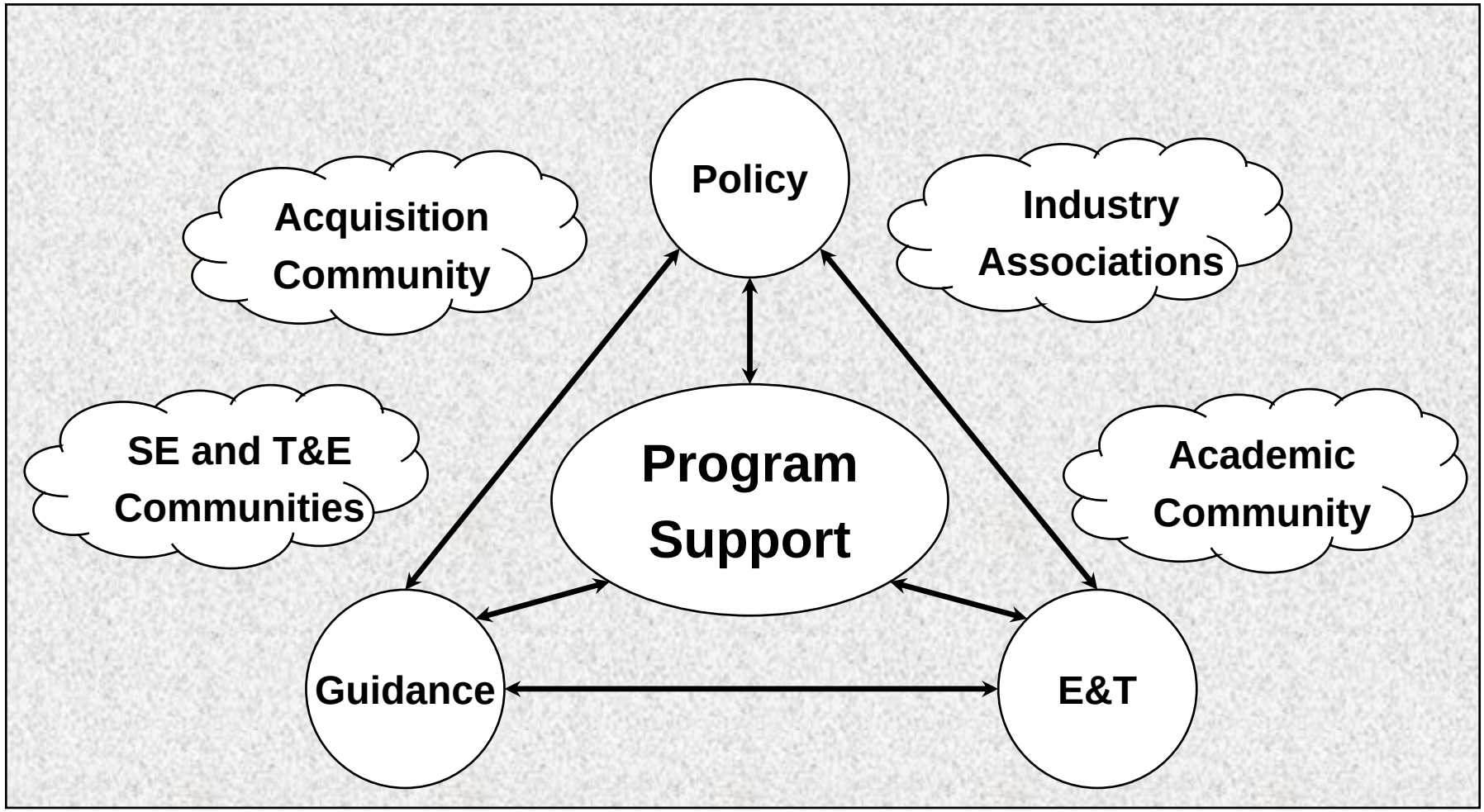
- Support Acquisition Success
  - Ensure effective and efficient software solutions across the acquisition spectrum of systems, SoS and capability portfolios
- Improve the State-of-the-Practice of Software Engineering
  - Advocate and lead software initiatives to improve the state-of-the-practices through transition of tools, techniques, etc.
- Provide Leadership, Outreach and Advocacy
  - Implement at Department and National levels, a strategic plan for meeting Defense software requirements
- Foster Software Resources to meet DoD needs
  - Enable the US and global capability to meet Department software needs, in an assured and responsive manner

Promote World-Class Leadership for Defense Software Engineering

How do we get there?



Systems Engineering Revitalization Framework



Driving Technical Excellence into Programs!

Systems Engineering Policy

- Policy Memorandum (February 2004) and Policy Addendum (October 2004)
  - Programs shall apply robust SE approach and develop a SE plan
  - Each PEO shall have a lead or chief systems engineer
  - Event-driven technical reviews with entry criteria and independent SMEs unless waived by MDA
  - OSD shall review program SEPs for ACAT ID and IAM programs
  - Defense Systems shall establish a SE Forum

Systems Engineering Guidance

- Establish Defense Acquisition Guidebook System Engineering Baseline
- Developed the following guides:
  - Reliability, Availability, and Maintainability
  - Integrated Master Plan and Integrated Master Schedule Preparation and Use
  - Systems Engineering Plans
  - Risk Management for DoD Acquisition
  - CMMI version 1.2
- In development:
  - Update Defense Acquisition Guidebook
  - Contracting for SE Guide
  - CMMI Guide for Acquirers
  - System Assurance Guide
  - Systems-of-Systems System Engineering Guide

Systems Engineering Education, Training, & Outreach

- Updated /Developed Systems Engineering curriculum
- Reviewed and modified enabling disciplines curriculum
  - Acquisition Program Management, Contract Management, Finance, Logistics
- Continuous learning, on-line courses:
  - Developed: Reliability and Maintainability, Technical Reviews, System Safety, Modeling and Simulation, Technical Planning
  - In development: Corrosion Prevention and Control, Modular Open Systems Approach, Trade Studies
- Established new, strengthened certification requirements for DoD systems engineers
  - New Systems Engineering career path provides for broader experience and training for selected positions
- Engaging universities:
  Stevens Institute of Technology, University of Southern California, Stanford, Southern Methodist, George Mason, Service Academies and Naval Postgraduate School, Air Force Institute of Technology Center for Systems Engineering

Driving Technical Rigor Back into Programs
"Portfolio Challenge"

- Systems and Software Engineering have been tasked to:
  - Review program's SE Plan (SEP) and T&E Master Plan (TEMP)
  - Conduct program support reviews
- Portfolio of major acquisition (ACAT ID and IAM) programs, supporting 10 Domain Areas:
  - Business Systems
  - Communication Systems
  - C2ISR Systems
  - Fixed Wing Aircraft
  - Unmanned Systems
  - Rotary Wing Aircraft
  - Land Systems
  - Ships
  - Munitions
  - Missiles

Software

Systems Engineering and T&E Support to Over 150 Major Programs in 10 Domain Areas

DoD Software Performance: What We're Seeing*

- Software systemic issues are significant contributors to poor program execution
  - Software requirements not well defined, traceable, testable
  - Immature architectures, COTS integration, interoperability, obsolescence (electronics/hardware refresh)
  - Software development processes not institutionalized, planning documents missing or incomplete, reuse strategies inconsistent
  - Software test/evaluation lacking rigor and breadth
  - Schedule realism (compressed, overlapping)
  - Lessons learned not incorporated into successive builds
  - Software risks/metrics not well defined, managed

*Based on ~40 program reviews to date

Other Challenges

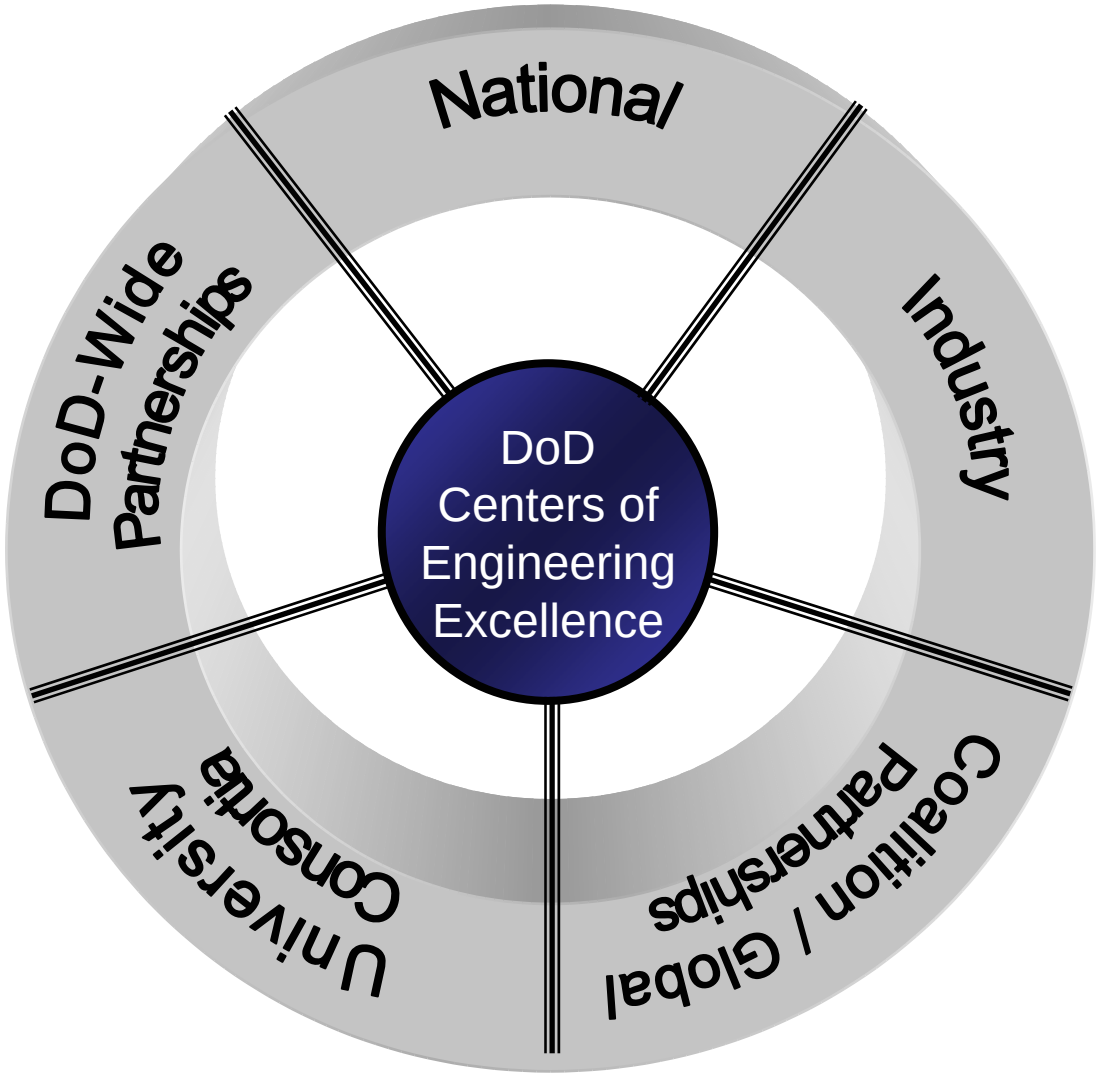
- Implementing a DoD vision and strategy for software and systems assurance
- Component and Industry adoption and effective implementation of sound SE practices as early as possible in the system life cycle
- SE support to Acquisition Initiatives stemming from the QDR
- Retention and development of technical acumen in an aging and shrinking acquisition workforce
- Meeting all requests for technical support to programs
- Continue to evolve “high visibility” initiatives:
  - Energy
  - CMMI
  - System-of-Systems
  - Modeling & Simulation
  - Defense Safety Oversight Council

Global Acquisition

- Benefits of leveraging reliable non-US sources
  - Price, performance, and schedule benefits
  - Increase interoperability with allies and coalition partners
  - International competition spurs US innovation and efficiencies
  - Mutually beneficial industrial linkages enhance access to global markets
- US is committed to effective systems engineering and best value
- Norway has demonstrated it is committed to being a Global Supplier by:
  - Formation of the National Center of Expertice in Systems Engineering
  - Securing significant Joint Strike Fighter work this past year with best value products

Much is Left to do…Vector is Correct

How do we get there?



Systems Engineering Revitalization

- Policy
  - No new policies in 2006
- Guidance
  - Continues to be refined
- Education and Training
  - E&T portfolio refreshed and growing
- Program Support
  - Gaining momentum; yielding systemic insights

Defining User Requirements

Balancing Key Programmatic Elements

Element	Systems Engineering	Test & Evaluation	Risk Management	Exit Criteria	Acquisition Strategy
Focus Areas	Requirements	V&V Traceability	Risk ID	Mission Systems	Mission Capability
	Organization & Staffing	Test Resources	Risk Analysis	Support	Resources & Management
	Technical Reviews	Test Articles	Risk Mitigation Planning	Manufacturing	Technical Process
	Technical Baseline	Evaluation	Risk Tracking	R & M	Technical Product
	Linkage w/ Other Program Mgmt & Controls	Linkage w/ Other Program Mgmt & Controls	Evidence of Effectiveness	Net Centric	Enterprise Environment
Product	SEP	TEMP	RM Plan	Phase Exit Criteria	ASR/APB

Examples

NORTHROP GRUMMAN

DEFINING THE FUTURE

What CMMI Does for Our Industry
- And What It Doesn't

CMMI Technology and User Conference
Denver, Colorado

November 14, 2006

Roger Fujii
Vice President, Communications and Systems Technologies,
Defense Mission Systems Division
Northrop Grumman Mission Systems

Northrop Grumman Mission Systems & CMMI

- **Strong and continued commitment to CMMI**
  - 56 SCAMPI appraisals (39 external) conducted since 8/02
    - 163 projects appraised (115 external)
    - 19 organizational appraisals (67 projects) on PARS Site
      - 14 are Level 5
      - 5 are Level 3
    - NGMS organizations regularly reappraise within 3 years
- **NGMS is committed to using our processes**
  - Require all organizations to formally confirm their intent to use NGMS processes prior to proposal release
  - Every project undergoes post award process review within 30 days of start up
  - Process status is a part of every internal program review

We invest in CMMI because we've found it's worth the effort.

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What CMMI Is Intended to Do?

- **Provide a model of Development best practices**
  - Soon to be expanded to include Acquisition and Services
- **Provide a framework for our organizational processes**
  - Provide an outline for achieving organizational maturity through exploitation and repetition of those practices
  - Provide informational examples of practices and documentation
- **Provide a means for organizations to measure themselves using a standard method (SCAMPI)**
- **Provide a means to roughly compare achievements against other similar organizations (Maturity Levels)**

CMMI provides a map.
Organizations provide the start and end points.
Then they create the directions
through organizational practices.

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What CMMI Does for NGMS?

- **Common model for understanding how to execute in complex development environments**
  - Software and systems engineers now have an integrated model upon which to build an approach
  - Repeatable understanding of execution from project to project and from project managers to executives
- **Executive management has reference points to manage quantitatively and repeatedly**
  - Measures are understood both by developers and reviewers
  - Estimates are based upon similar work and scope
  - Can easily compare similar programs
- **Personnel can migrate to the next project, even in a different division, and know what to expect and how they are expected to perform**
  - Start up is easier and more predictable

The real payoff from CMMI is measurable results!

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What CMMI Doesn't Do!

- **CMMI (and Organizational Process) doesn't mean that projects will automatically use them**
  - New managers or those joining from other organizations may not be convinced yet
  - NGMS reviews early and often to ensure process use
- **CMMI doesn't specify efficient and effective practices – it defines what to expect**
  - Organizations have to **create** their own **effective practices**
  - NGMS uses Six Sigma to measure process effectiveness
    - **745 Six Sigma** projects since 2001 have improved our processes and saved an estimated $130M
- **CMMI can't guarantee error-free performance**
  - Early detection of problems and effective responses are key to minimizing impacts
  - Even the best estimates based upon poorly understood requirements can't be accurate.

CMMI ratings are not silver bullets.
You still must work to gain the benefits!

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Project Management Maturity

- **Project Planning is where it all starts**
  - Repeatable and executable to eliminate surprises
- **Estimating what it really will require**
  - We focus on accuracy in estimation as a basis for determining the feasibility of achieving the desired results
  - Include factors to cover historical variations
- **Understanding your risks and how to mitigate them makes all the difference**
  - Puts the project and the executives on the same page
  - Gives the customer a view of development risks that they normally can't get

It all starts with an executable plan

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Striving for Repeatable Execution

- **Organizations carry techniques from one project to another – especially within core business areas**
  - Organizational Training defines skill and process training for the organization and the project
- **Process adherence emphasizes repeatability**
  - Organizational Process Focus minimizes unnecessary variants (when used with reason)
  - Project Planning is the means to create it
  - Quantitative Management and Project Monitoring and control are often used to ensure compliance
- **Enforcing use of organizational practices**
  - Key to success from the outset
  - Start up kits provide the templates and direction starting with capture teams

Discipline drives out chaos!

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Building the right thing, the right way!

- **First you have to know what to build**
  - Requirements Development & Requirements Management
  - Then you have to build it right
    - Technical Solution & Product Integration
  - And ensure it is built right and you built the right thing
    - Validation and Verification
- **But you fail if you don't build it on time and within budget**
  - Project Planning
  - Project Management & Control
  - Quantitative Management
- **And the initial estimate is made before the requirements are agreed upon (There is lots of room for underestimation)**

Customer trust gained by repeated success - PRICELESS!

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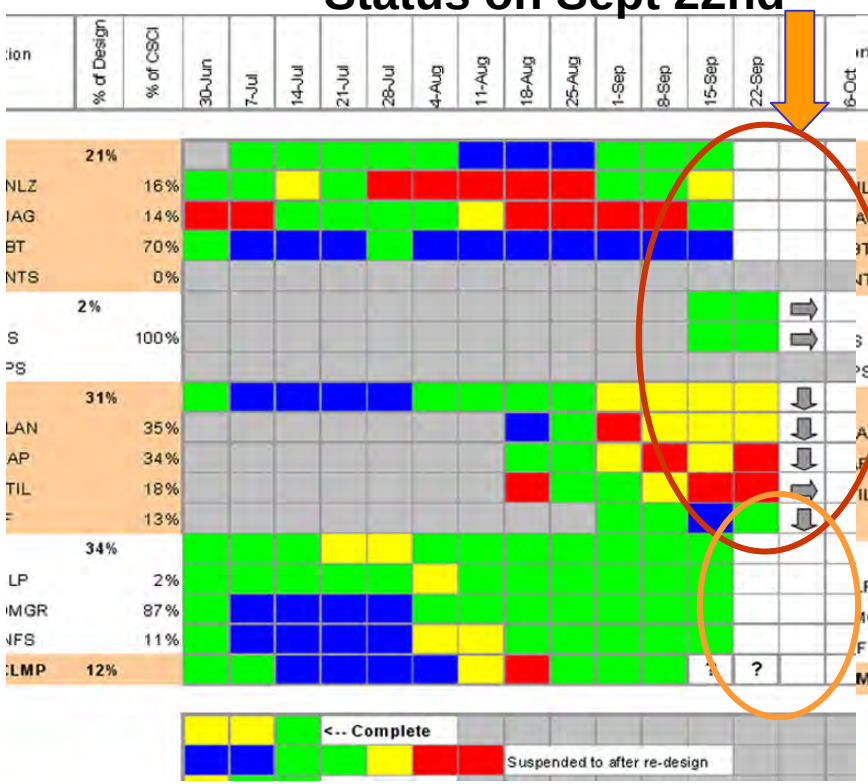
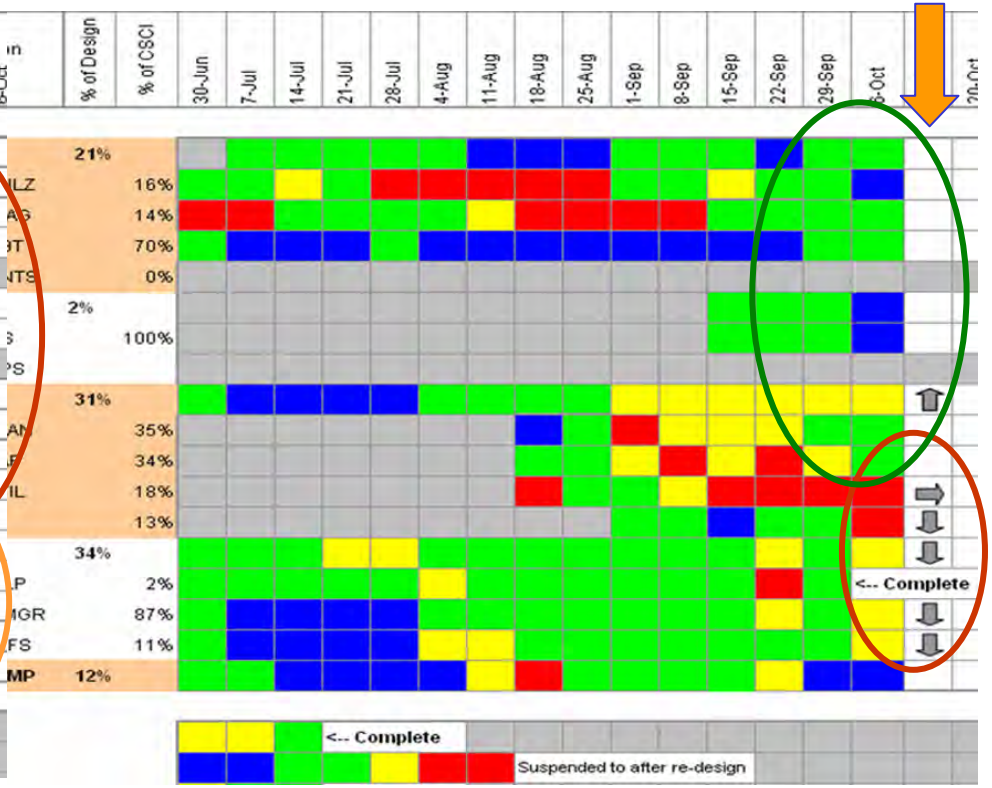
Using “Inch-Pebble” Planning and Monitoring

Status on Sept 22nd



Status on Oct 6th



Monitoring in detail helps get the effort directed to where it will do the most good & having a VP & GM interested doesn’t hurt either.

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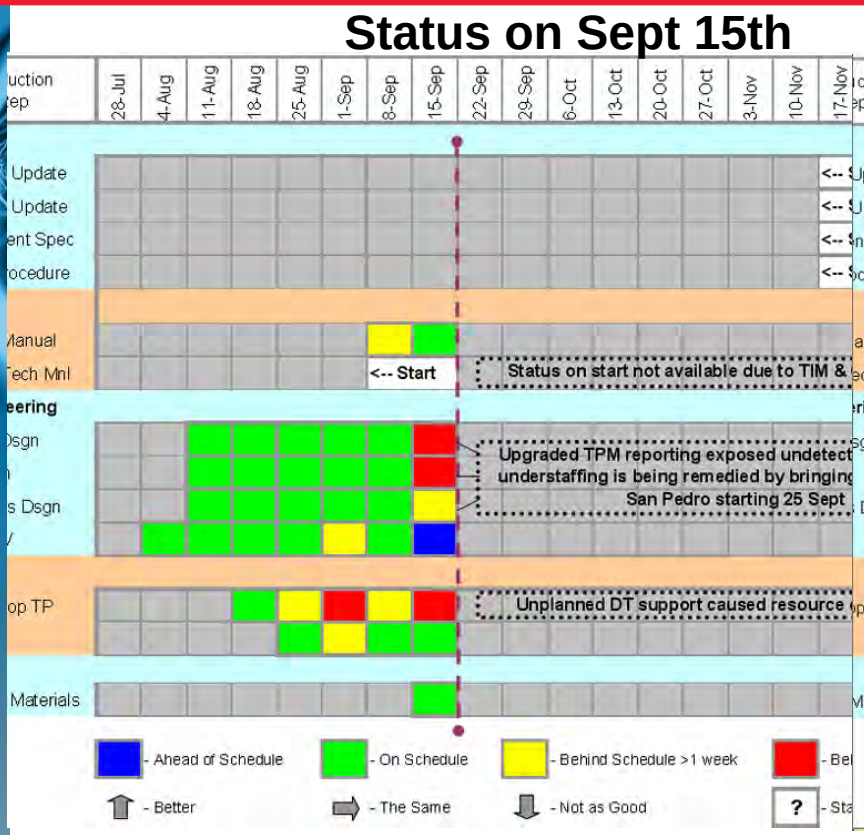
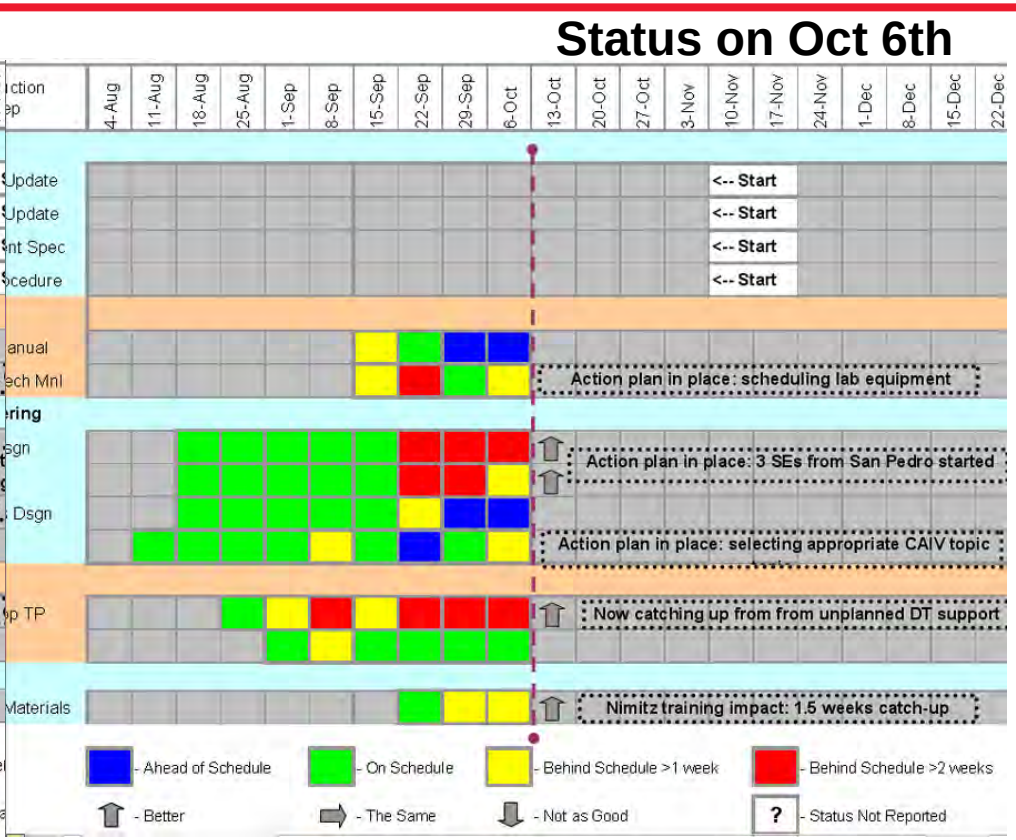
Mitigation to Manage Schedule & Performance





Any program can experience delays in sub tasks. Keeping the minor delays from spreading makes for program success.

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Results That Impress Executives

- **During the last 4 years:**
  - Projects started using NGMS mature processes haven't experienced pervasive problems
  - When & if problems do occur (and they will regardless of process)
    - Problems are identified before causing severe damage
    - Action is taken quickly to return the projects to effective performance
    - Requirements Development that uncovers misunderstandings is the biggest cause of variations
- **Since CMMI was adopted:**
  - Customer funding problems are the #1 reason for appearing on the problem projects list
  - Most projects that are reported for performance problems predate CMMI organizational adoption

Executives don't like surprises

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A Development Organization's ROI in CMMI

- **An organization's life blood is winning new projects**
  - Estimation validity gains support from executive management to pursue aggressively and price competitively
  - Repeatable performance is key to support both when bidding and during development
- **Risk isn't just a dirty word in Government**
  - Executives view Proposal Risk, Program Risk, & Execution Risk equally
  - Identification and mitigation of risk using proven and trusted process is key to gaining executive support
- **Individuals trained on mature programs migrate easily to new starts**
  - Takes one more risk out of start up

We invest in CMMI because is pays off!

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Carnegie Mellon
Software Engineering Institute

CMMI® Current State and Future Plans

Bob Rassa
Industry CMMI Co-Chair
Raytheon

Clyde Chittister
Chief Operating Officer
Software Engineering Institute

13 November 2006

CMMI is registered by the US Patent & Trademark Office by Carnegie Mellon University

Topics

- **Current Status**
- Appraisal Results
- Transition Status
- Product Suite V1.2 Improvements
- Summary

Current Status

- Version 1.2 was released on August 25, 2006.
- Version 1.2 upgrade training is available online.
- New policies announced and implemented for version 1.2 appraisals.
- CMMI adoption continues to grow worldwide.

Topics

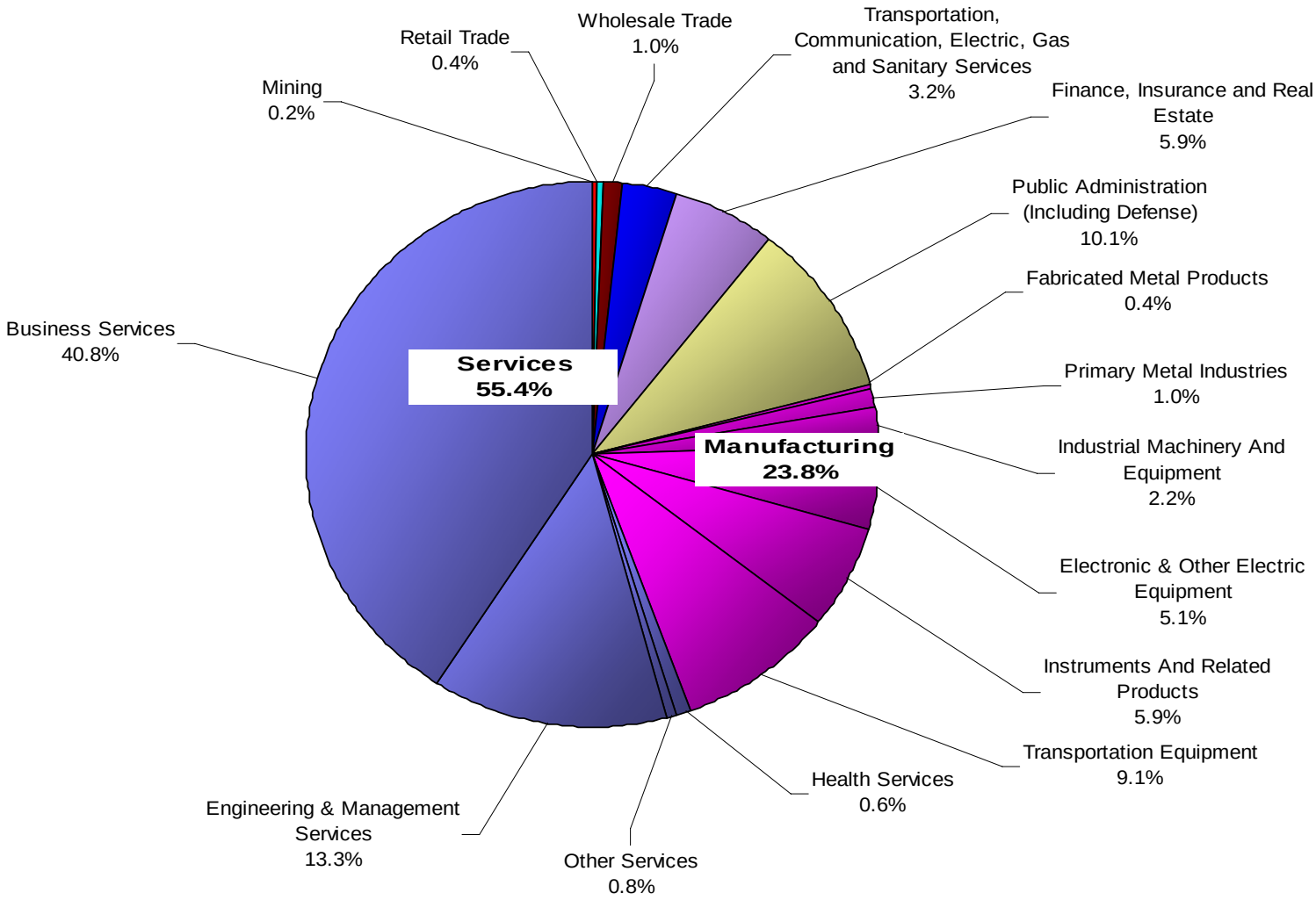
- Current Status
- **Appraisal Results**
- Transition Status
- Product Suite V1.2 Improvements
- Summary

Appraisal Synopsis as of 6/30/06

- **Based on SCAMPI v1.1 Class A appraisals conducted since April 2002 release through June 2006 and reported to the SEI by July 2006.**
  - **1,581 appraisals**
  - **1,377 organizations**
  - **840 participating companies**
  - **109 reappraised organizations**
  - **6,001 projects**
  - **63.8% non-USA organizations**
- *** Organizations previously appraised against CMMI v1.0 and who have not reappraised against v1.1 are not included in this report.**
- **Please visit http://www.sei.cmu.edu/appraisal-program/profile/about.html, for additional information or to find answers to questions you may have about this briefing.**

Organizational Type

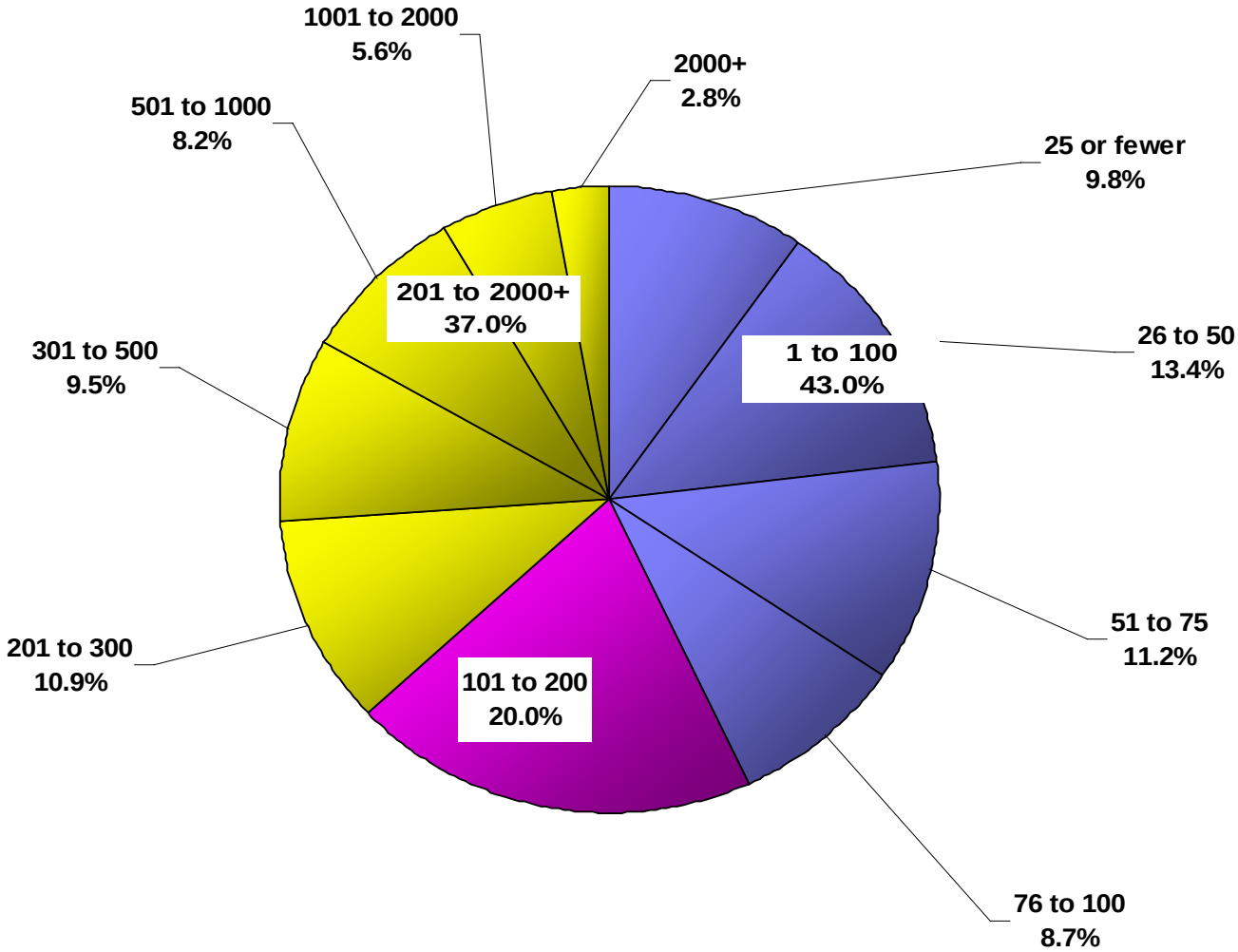
Based on Primary Standard Industrial Classification (SIC) Code



Based on 505 organizations reporting SIC code. For more information visit: http://www.osha.gov/oshstats/sicser.html

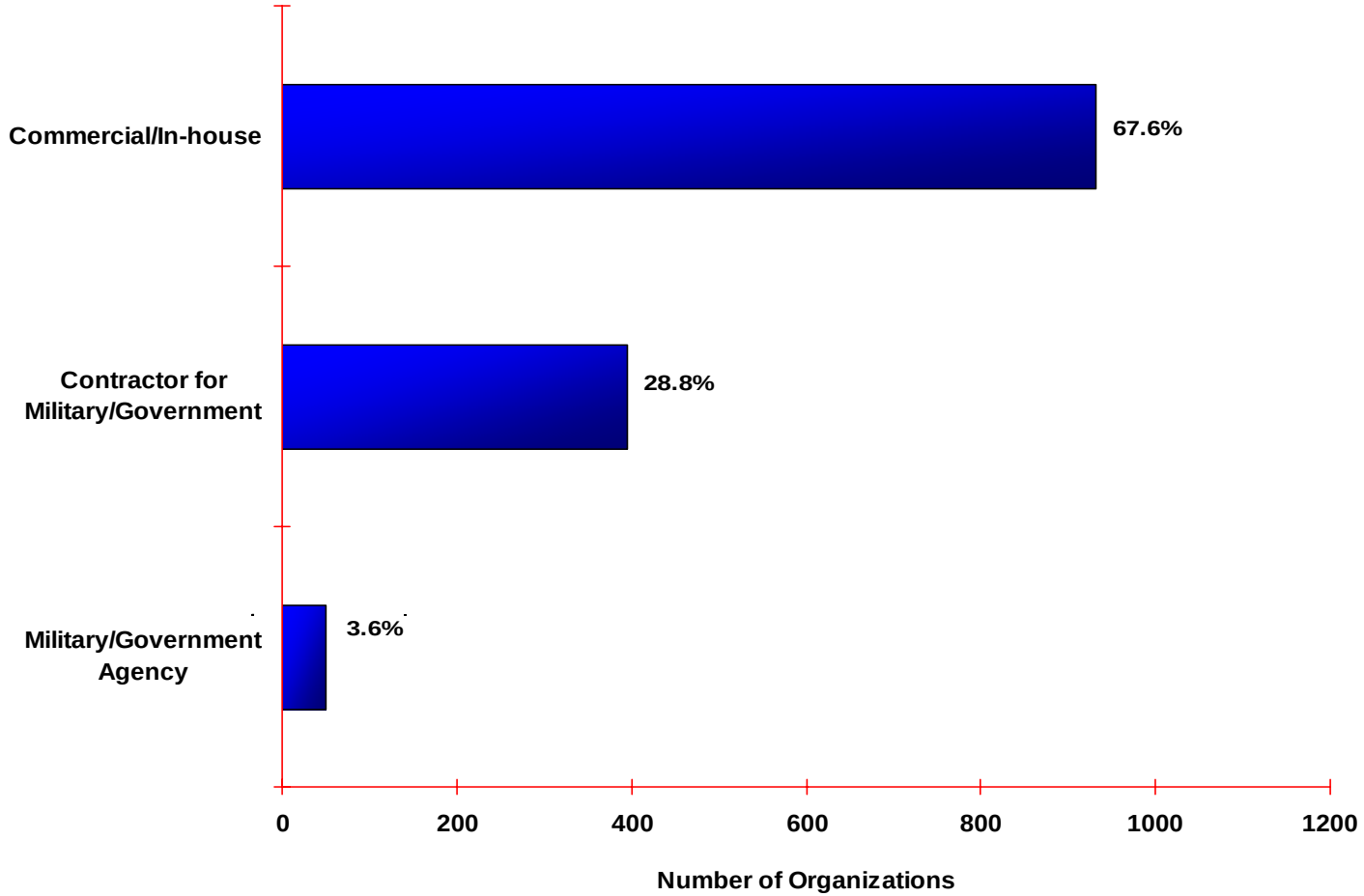
Organizational Size

Based on total employees within area of appraised organization



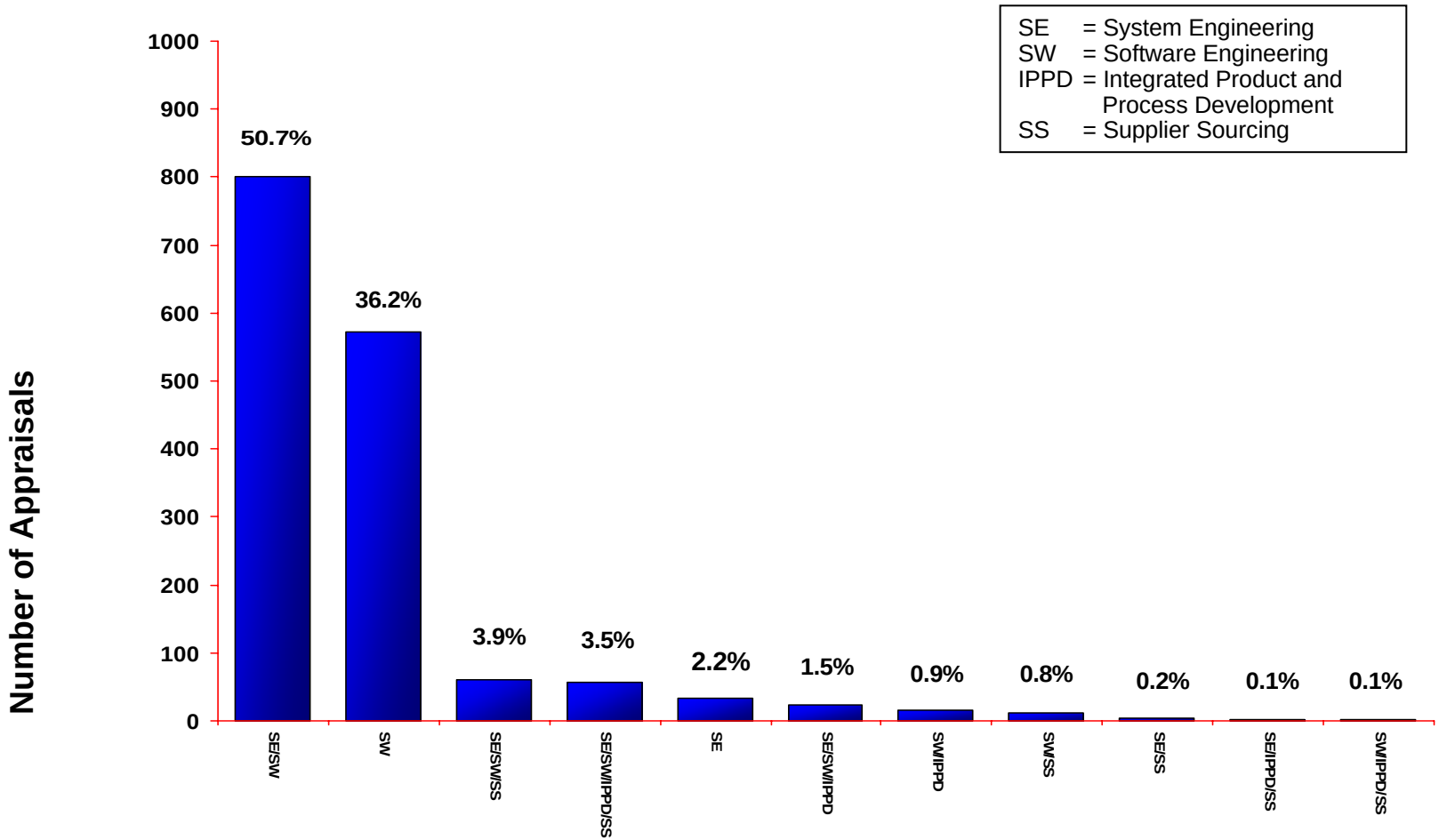
Based on 1,348 organizations reporting size data

Reporting Organizational Types



Based on 1377 organizations

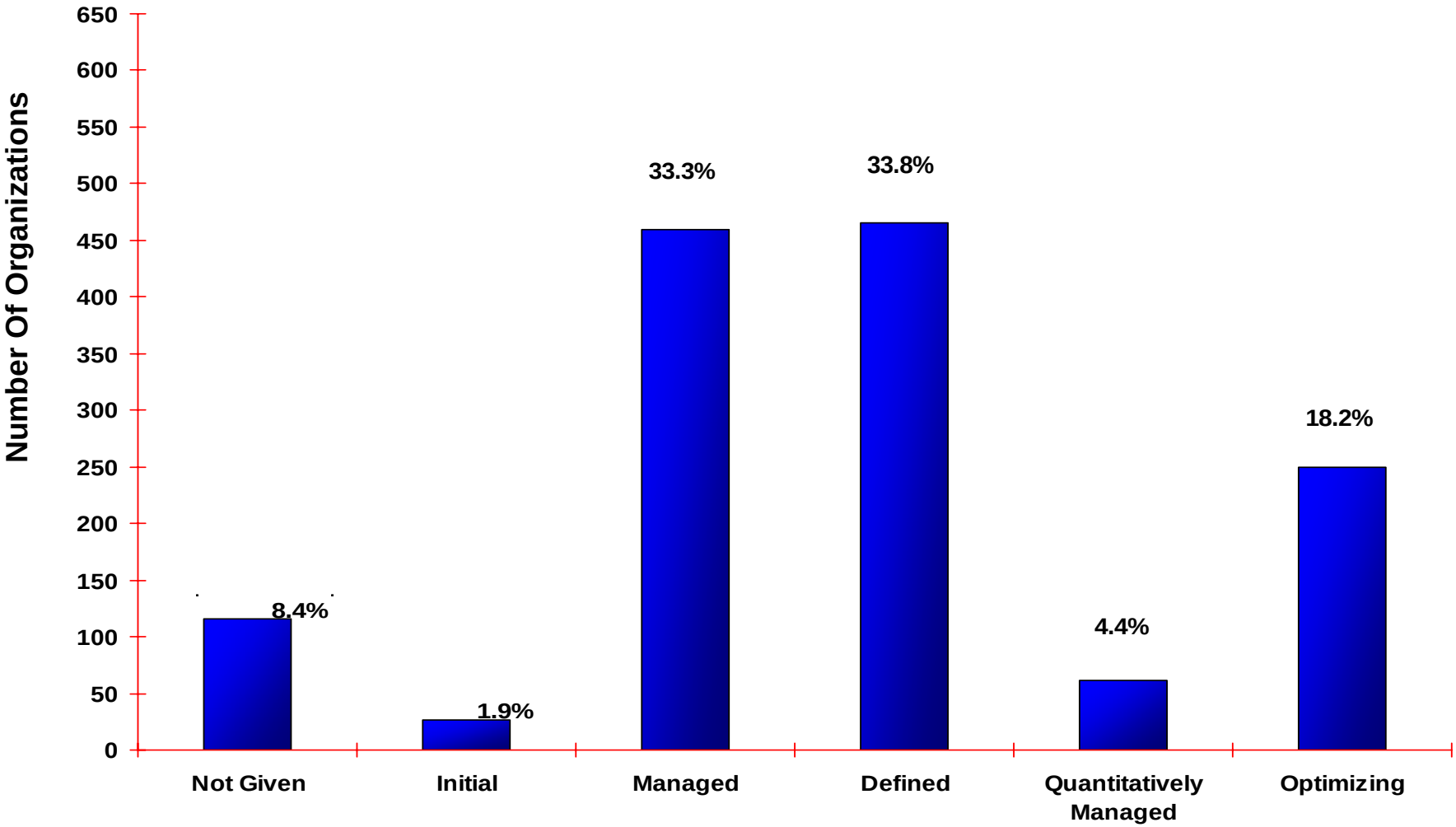
Disciplines Selected for Appraisals



Based on 1,581 appraisals

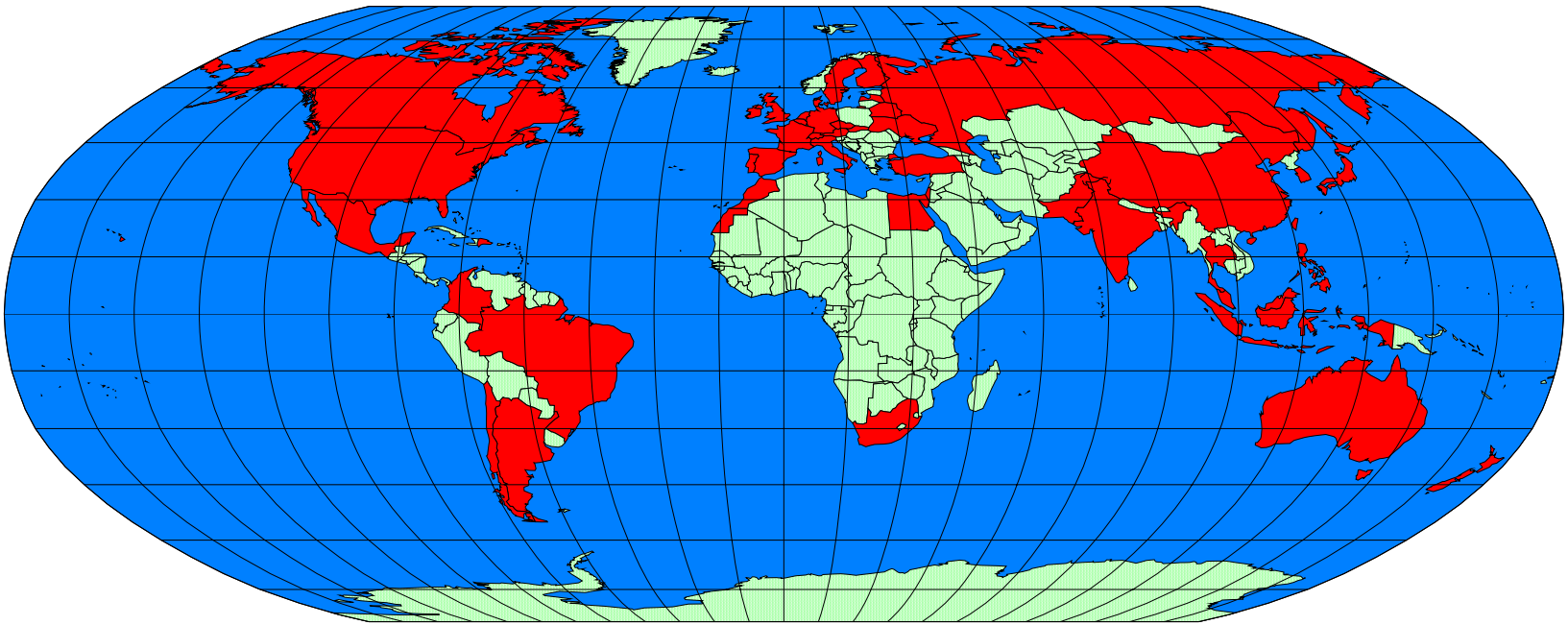
For more information about Allowable Models & Combinations, visit: http://www.sei.cmu.edu/cmmi/background/aspec.html

Maturity Profile by All Reporting Organizations



Based on most recent appraisal of 1,377 organizations

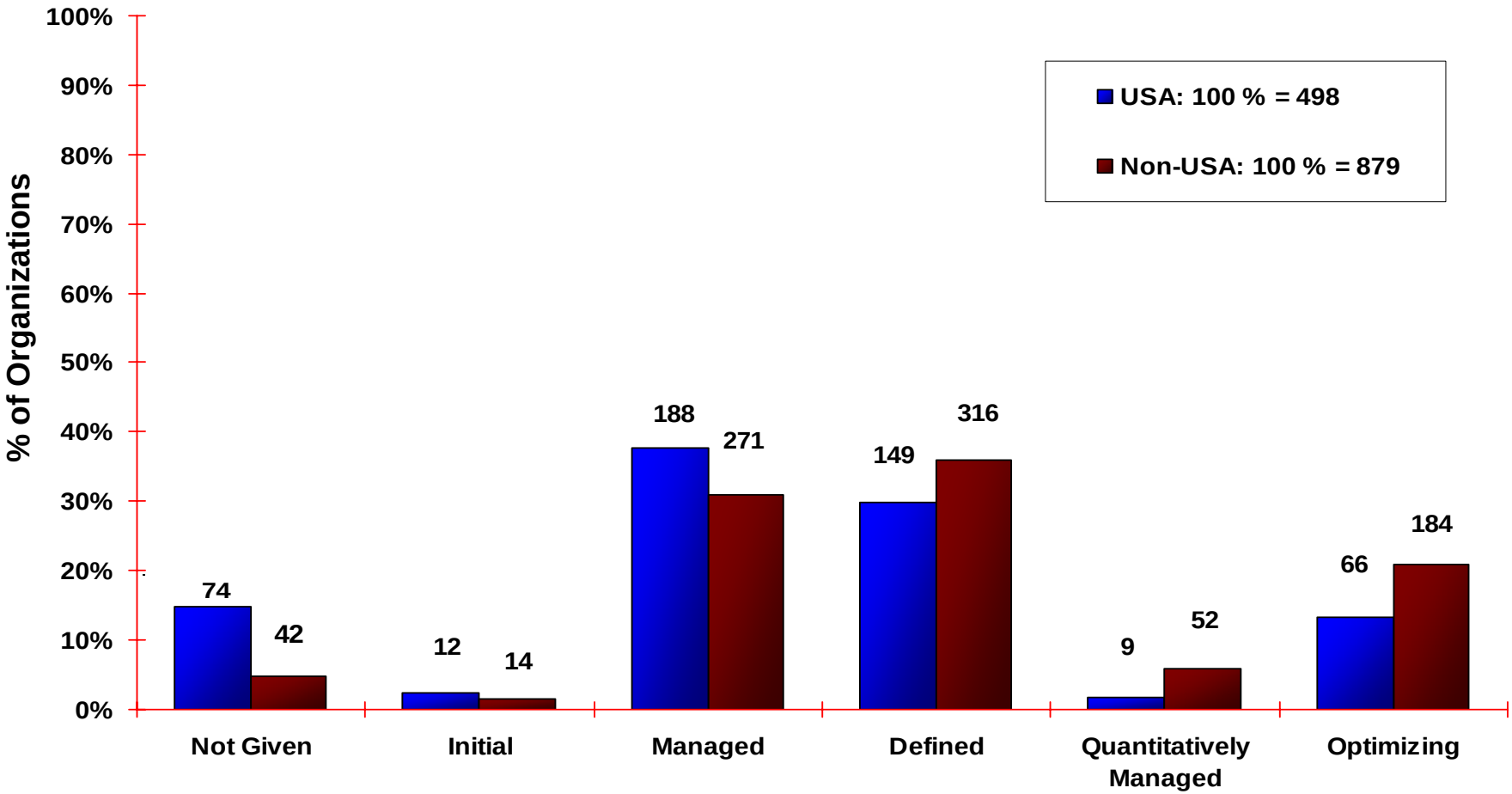
Countries Where Appraisals Have Been Performed and Reported to the SEI



Argentina	Australia	Austria	Bahrain	Belarus	Belgium	Brazil	Canada
Chile	China	Colombia	Czech Republic	Denmark	Dominican Republic	Egypt	Finland
France	Germany	Hong Kong	India	Indonesia	Ireland	Israel	Italy
Japan	Korea, Republic of	Latvia	Malaysia	Mauritius	Mexico	Morocco	Netherlands
New Zealand	Pakistan	Philippines	Portugal	Russia	Singapore	Slovakia	South Africa
Spain	Sweden	Switzerland	Taiwan	Thailand	Turkey	Ukraine	United Kingdom
United States	Vietnam						

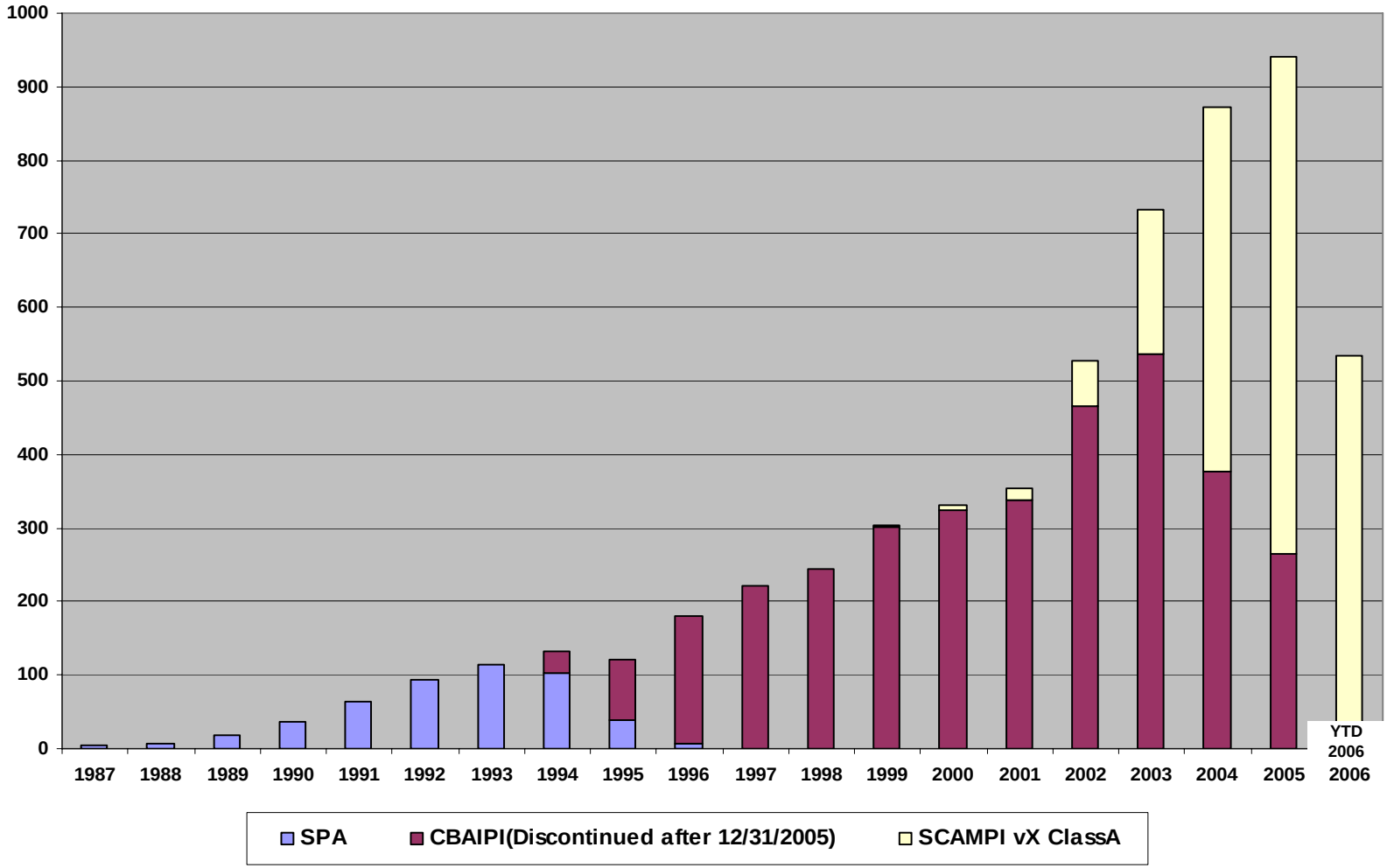
Red country name: New additions with this reporting

Maturity Profile by All Reporting USA and Non-USA Organizations



Based on 498 USA organizations and 879 Non-USA organizations

Number of Appraisals Conducted by Year, as of 10/31/06



Appraisal Results Summary

- 1,581 SCAMPI A appraisals have been reported to the SEI in 52 months; 744 of these were reported in the last 12 months.
- We believe that there are a significant number of non-SCAMPI appraisals being conducted.
- Commercial/In-House, Government/Military, and Government/Military Contractor organizations reporting appraisals are increasing at a stable and consistent rate.
- Comparing early reports of the SW-CMM maturity profile with early CMMI data reflects a more mature CMMI profile.
- CMMI adoption continues to grow worldwide.

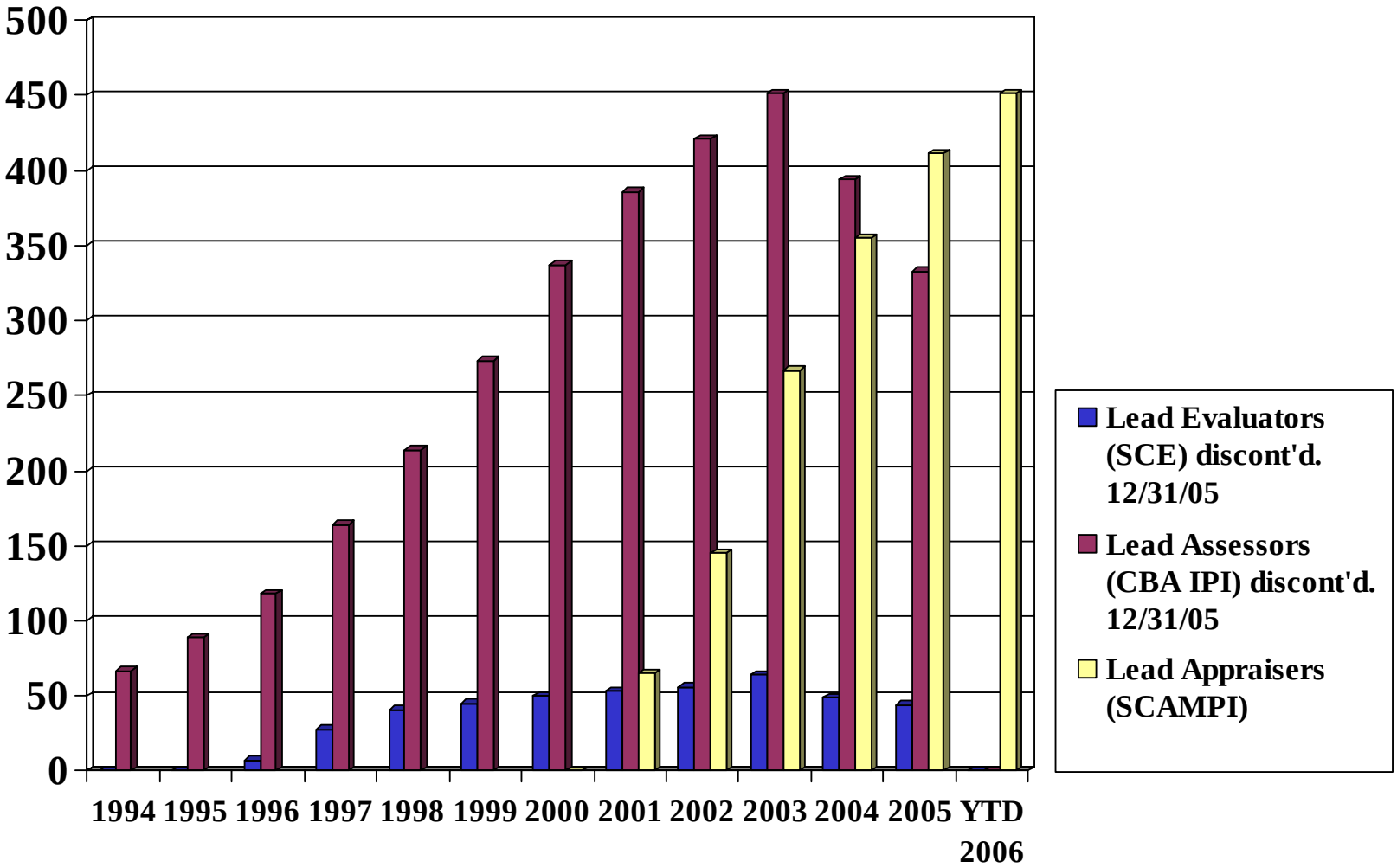
Topics

- Current Status
- Appraisal Results
- **Transition Status**
- Product Suite V1.2 Improvements
- Summary

CMMI Transition Status, 10/31/06

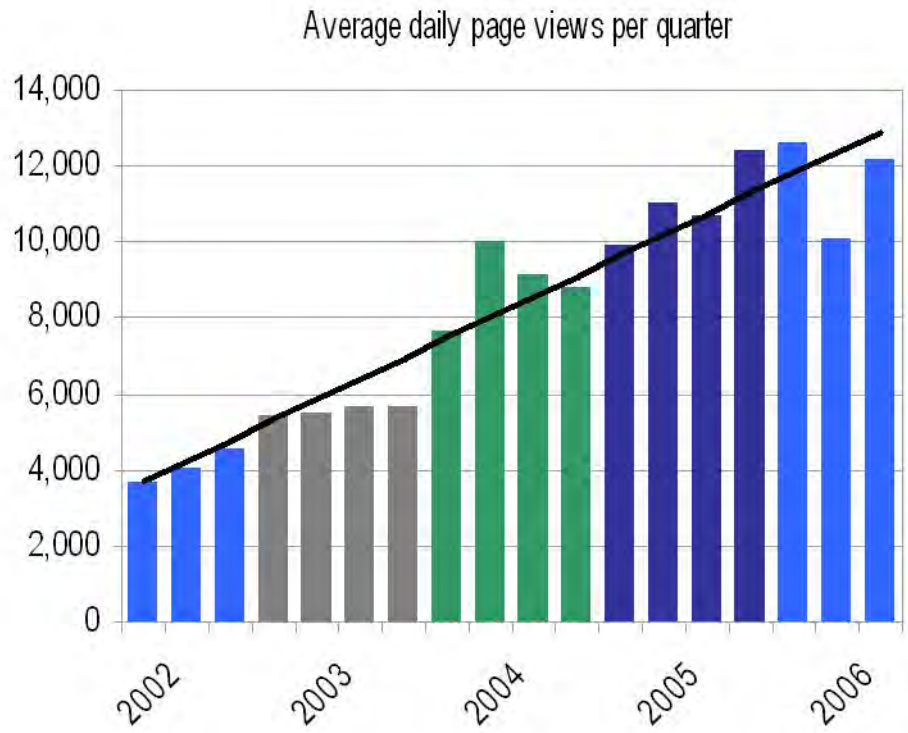
- **Training**
  - Introduction to CMMI – 58,178
  - Intermediate CMMI – 2,280
- **Authorized**
  - Introduction to CMMI v1.1 Instructors – 404
  - SCAMPI v1.1 Lead Appraisers – 451
- **Partners**
  - Introduction to CMMI Training Services – 238
  - SCAMPI Appraisal Services – 259

Number of Lead Appraisers Authorized (Cumulative), 10/31/06



CMMI Adoption Trends, Web Page Views, as of 9/30/06

- **CMMI Web pages views in September 2006**
  - **360K/month**
  - **Exceeded 24K views on 27 September 2006**
- **The following were the most downloaded files on the SEI Web site in September 2006:**
  - **CMMI-DEV, V1.2**
  - **CMMI V1.2 Overview Presentation**
  - **"CMMI V1.2 Model Changes" Presentation**
  - **"Extreme Programming (XP), Six Sigma, & CMMI: How They Can Work Together" Presentation**
  - **Comparison of Version 1.2 PAs to Version 1.1 PAs**



Performance Results Summary -1
as of 8/30/06

Improvements	Median	# of data points	Low	High
Cost	34%	29	3%	87%
Schedule	50%	22	2%	95%
Productivity	61%	20	11%	329%
Quality	48%	34	2%	132%
Customer Satisfaction	14%	7	-4%	55%
Return on Investment	4.0 : 1	22	1.7 : 1	27.7 : 1

30 Organizations with results expressed as changes over time

Performance Results Summary -2

- **For more information on CMMI performance results, see**
  - **An August 2006 SEI technical report titled Performance Results of CMMI-Based Process Improvement (CMU/SEI-2006-TR-004)**
    - **It is available on the SEI Web site at http://www.sei.cmu.edu/publications/documents/06.reports/06tr004.html.**
  - **The CMMI Performance Results Web site at http://www.sei.cmu.edu/cmmi/results.html**

Topics

- Current Status
- Appraisal Results
- Transition Status
- **Product Suite V1.2 Improvements**
  - **Identification of Issues**
  - Resolution of Issues in V1.2
  - Summary of V1.2 Changes
  - Next Steps
- Summary

Surfacing of Problems with Use of CMMI Ratings

- **Problems presented by OSD at the 2004 NDIA CMMI Technology Conference**
  - **When achieving a level replaces the focus on continuous improvement, we've lost sight of the goal**
  - **We created "level-mania" instead of continuous improvement**
- **NDIA Workshop and Summit on CMMI Use in DoD Programs, Sept 2005**
  - **Explored issues, and identified a set of recommendations**
- **Spring 2006 Government Review and Assessment**
  - **Validated Workshop findings**
  - **Refined and augmented issues, developed recommended actions**
  - **Reported to CMMI SG and Sponsors**
- **Ongoing: DCMA data call on CMMI implementation. Initial assessment confirms problems**

Issue Areas

- **Issue Area 1: High Maturity/Level 4 & 5**
  - Lack of agreement on what constitutes Levels 4 and 5
  - High-maturity practices are not consistently applied at the project level after contract award
- **Issue Area 2: Integrity of Appraisal Results**
  - Appraiser training, consistency, independence
  - Content of Appraisal Disclosure Statement (ADS) is not representative of CMMI appraisal data
  - Appraisal sampling inconsistent and influenced by appraised organization
- **Issue Area 3: Organizational Commitment**
  - Concern that new projects are not incorporating standard processes
- **Issue Area 4: CMMI Guidance for Acquirers**
  - Inadequate training and education for acquirers resulting in misrepresentation and misuse of CMMI

Topics

- Current Status
- Appraisal Results
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- **Product Suite V1.2 Improvements**
  - Identification of Issues
  - **Resolution of Issues in V1.2**
  - Summary of V1.2 Changes
  - Next Steps
- Summary

Issue Area Resolutions -a

- **Issue Area 1: High Maturity/Level 4 & 5**
  - **Initial certification of high-maturity appraisers**
    - **July 06 workshop on high maturity training determined the requirements lead appraisers have to have in order to do high maturity appraisals**
    - **Application review and oral exam**
  - **Body of Knowledge on leading appraisals will be available by October 2007**
  - **Lead Appraisers must certify that level 4 and 5 appraised subprocesses map to organization's business objectives**

Issue Area Resolutions -b

- **Issue Area 2: Integrity of Appraisal Results**
  - **CMMI v1.2 upgrade training, proctored exam, and face-to-face training**
  - **Eliminated “level for life”—now three-year limit**
  - **DCMA developed a survey related to CMMI appraisal ratings and program performance to begin to measure the problem**
  - **CMMI v1.2 updates to the ADS and to Sampling**

Issue Area Resolutions -c

- **Issue Area 2: Integrity of Appraisal Results - continued**
  - **Precise definition of the appraisal sampling**
    - **Organizational scope: name, type, location**
    - **Organizational Unit Coverage: size, application domain, geographical breadth, project type expressed in percentages of total organizational unit**
    - **Projects excluded and rationale**
  - **Lead Appraiser certification that focus and non-focus projects are representative of organization**
  - **Lead Appraisers must come from an organization other than the business unit being appraised**

Issue Area Resolution -d

- **Issue Area 2: Integrity of Appraisal Results - continued**
  - **v1.2 ADS requires improved level of detail**
    - **Provides details on appraisal sample**
      - **Organizational unit, projects, domains**
    - **Provides Lead Appraiser certifications**
      - **Project sampling is representative**
      - **Level 4/5 certifications are based upon practices that represent organizational business goals**
    - **All appraisals beginning after 1 November 2006 must use and fully populate ADS v1.2 (includes CMMI v1.1-based appraisals)**
    - **ADS for all DoD contractors will be posted (government Web site TBD) for Government acquirer review**

Issue Area Resolutions -e

- **Issue Area 3: Organizational Commitment**
  - **Added new goal and two practices to Operational Process Focus (OPF) PA to stress deployment of processes to projects.**
  - **Added text in Integrated Project Management (IPM) PA to emphasize having a defined process at project start-up**
  - **CMMI Guidebook for Acquirers will discuss need to address project level implementation with developers**

Issue Area Resolutions -f

- **Issue Area 4: CMMI Guidance for Acquirers**
  - **CMMI Guidebook for Acquirers**
    - **Will address how CMMI should be used by acquirers, how to interpret appraisal results, how to treat CMMI throughout the lifecycle**
    - **Due out after the first of the year**
  - **Development of the CMMI-Acquisition Constellation**

Topics

- Current Status
- Appraisal Results
- Transition Status
- **Product Suite V1.2 Improvements**
  - Identification of Issues
  - Resolution of Issues in V1.2
  - **Summary of V1.2 Changes**
  - Next Steps
- Summary

Reduced Model Complexity & Size

- Eliminated the concepts of advanced practices and common features
- Incorporated ISM into SAM; eliminated Supplier Sourcing (SS) addition
- Consolidated and simplified the IPPD material; eliminated two process areas (OEI, IT)
- Consolidated all definitions in the glossary
- Adopted a single book approach
- Reduced size 15%

Increased Model Coverage

- ***CMMI always covered hardware design, but the naming (CMMI-SE/SW/etc) didn't reflect this***
- **Added hardware amplifications**
- **Added two work environment practices (i.e., one in OPD and one in IPM)**
- **Added goal and two practices in OPF to emphasize importance of project startup**
- **Updated notes on service development and acquisition of critical product elements**
- **Updated name to CMMI for Development (CMMI-DEV) to reflect the expanded coverage**

Appraisal Method Changes to Improve Integrity

- **Method implementation clarifications**
  - interviews in “virtual” organizations
  - practice characterization rules
  - organizational unit sampling options
- **Appraisal Disclosure Statement (ADS) improvements**
  - improve usability for sponsor and government
  - require sponsor’s signature on the ADS
  - require all team members to show agreement on findings via signature
  - *Both v1.1 and v1.2 ADS reflect these changes now*
- **Appraisal team will have responsibility for determination of “applicability” for SAM; no other process area exceptions will be accepted for maturity level achievement**

Appraiser Qualification Changes to Improve Integrity

- **All v1.2 Lead Appraisers must do the following:**
  - **pass upgrade and refresher testing**
  - **attend "face-to-face" sessions on appraisal quality**
  - **pass an additional oral exam before conducting a high maturity (HiMat) appraisal**
- **All v1.2 Appraisal Team Members must accomplish upgrade training and be registered at SEI**
- **All v1.2 high maturity appraisals must be led by a certified high maturity Lead Appraiser**

CMMI Training v1.2

- **Introduction to CMMI**
  - Updated for v1.2
  - Phased in this fall
- **Intermediate Concepts of CMMI**
  - Updated for v1.2
  - Will better prepare students for SCAMPI training
- **CMMI Instructor training**
  - Updated to reflect v1.2 changes

"Delta" training from v1.1 to 1.2

- Available online for free
- More extensive upgrade course for fee
  - Appraisal Team Members
  - Lead Appraisers, instructors, candidates

Topics

- Current Status
- Appraisal Results
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- **Product Suite V1.2 Improvements**
  - Identification of Issues
  - Resolution of Issues in V1.2
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- Summary

CMMI V1.2 Schedule

• Version 1.2 CMMI Product Suite release	• August 25, 2006
• Update material available	• August 25, 2006
• Upgrade course available on-line	• August 25, 2006
• First Lead Appraiser “face to face”	• October 16, 2006
• V1.2 ADS required for all SCAMPIs (on-site starts)	• November 1, 2006
• Last v1.1 Intro training	• December 31, 2006
• First expiration of v1.1 appraisals (3 year validity)	• August 25, 2007
• Last v1.1 appraisal (on-site starts)	• August 31, 2007

CMMI "v2.0"

- **Sponsors and CMMI SG beginning discussions on CMMI v2.0**
- **Plan on series of focused NDIA/SEI Workshops in 2007 to dialog strategies on both models and appraisal methods**
  - **Need to see effects of v1.2 changes**
  - **Need to see how we can improve efficiency and reduce CMMI adoption costs**
  - **Need to determine if any better methods can be implemented**
  - **Need to continue the analysis of CMMI integrity**

Summary

- **CMMI has clearly reached far more users than ever envisioned.**
  - **We need to be sensitive to this as we move forward**
- **CMMI Adopters are reporting increased performance.**
- **CMMI v1.2 has made substantial improvements to address integrity issues:**
  - **Model**
  - **Appraisal Method**
  - **Appraisal Reporting**
  - ***We will continue to monitor the integrity-driven improvements for effectiveness, and react accordingly***
- **We welcome your feedback.**

SPAWAR
Systems Center Charleston

Practical Experiences and Lessons Learned in Implementing CMMI®

Michael T. Kutch, Jr.

Director Engineering Operations Code 09K

Department Head Code 70

Intelligence & Information Warfare Systems Department

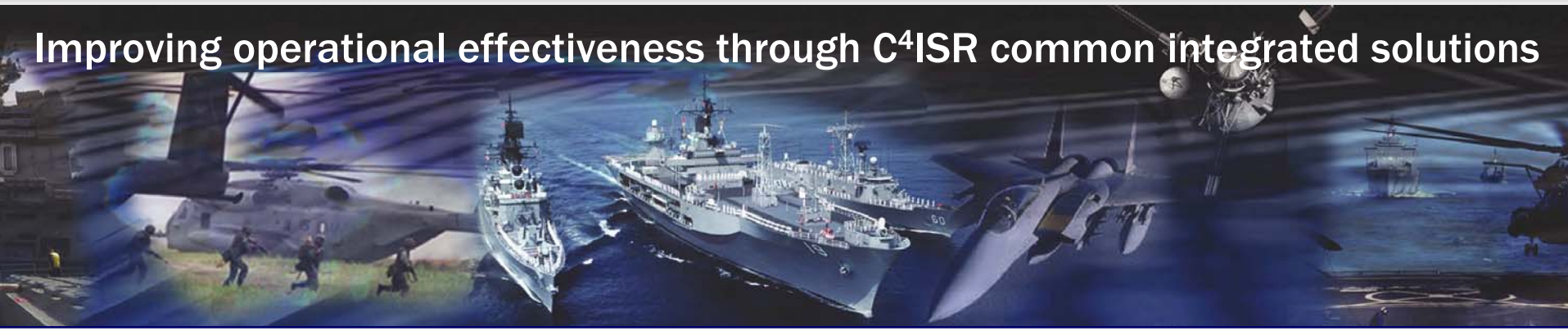
SPAWAR Systems Center Charleston (SSC-C)

Sandee Guidry

SEI Authorized CMMI Trainer
SEI Authorized SCAMPI Appraiser
Technical Software Services, Inc.

Engineering Process Office
SPAWAR Systems Center Charleston (SSC-C)

NDIA CMMI Conference, November 13, 2006 - NDIA 3762



SEI Partner
TECHSOFT
Technical Software Services, Inc.

SPAWAR
Systems Center Charleston

Presentation Outline

- Introduction to SPAWAR Systems Center Charleston
- Vision and Strategy
- Critical Success Factors
- Practical Experiences
- Success!
- Lessons Learned
- Going Forward
- Summary

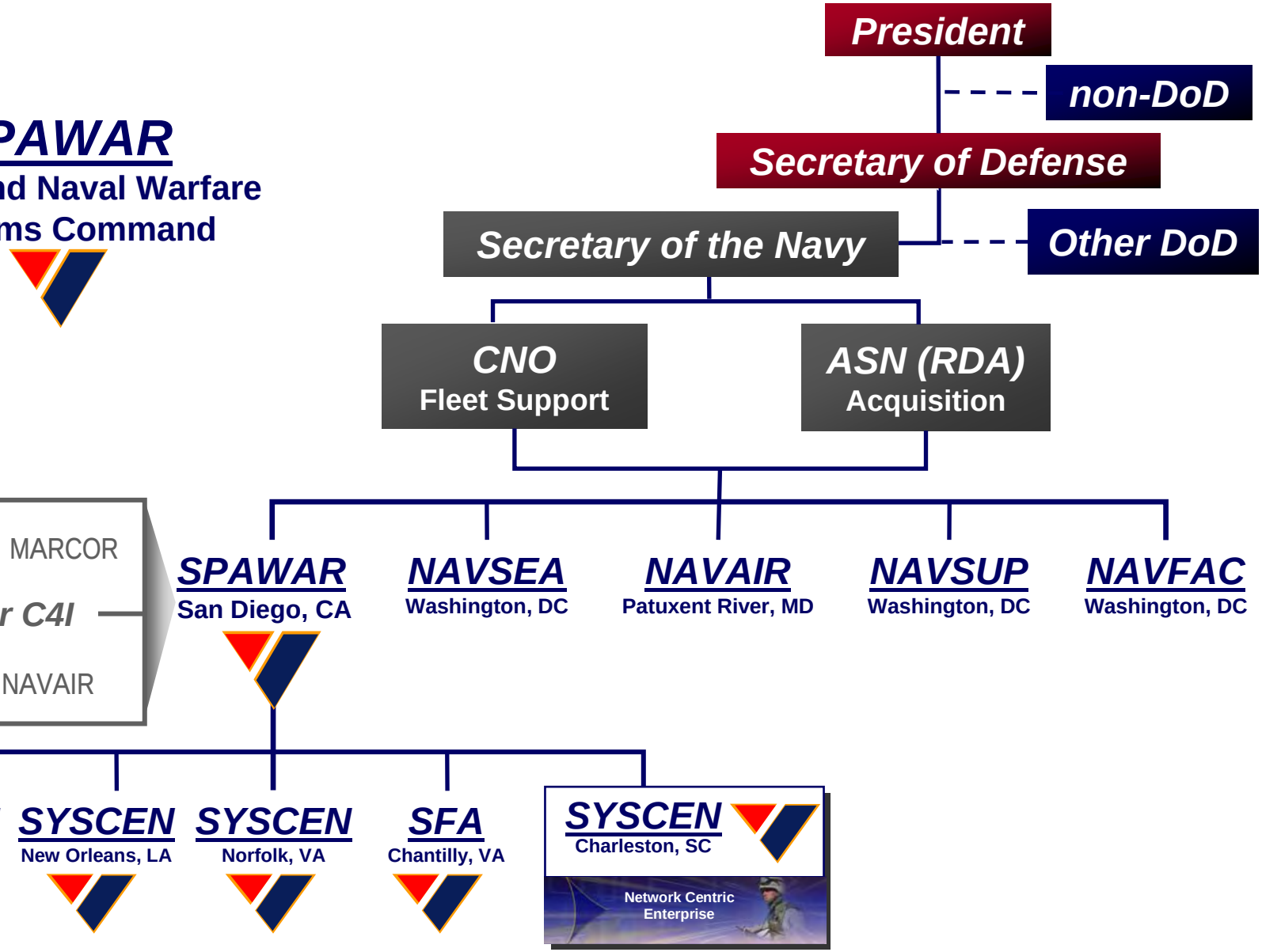
Introduction to SSC-Charleston

- Where we fit
- What we do
- What we are known for
- Who we are

Where We Fit

SPAWAR
Systems Center Charleston

SPAWAR
Space and Naval Warfare Systems Command



SEIPartner
TECHSOFT
Technical Software Services, Inc.

What We Do

Connecting the Warfighter

Mission- We enable knowledge superiority to Naval and Joint Warfighters through the development, acquisition, and life cycle support of effective, integrated C4ISR Information Technology, and Space capabilities.

Vision-
Fully Netted in Three

We are the
Principal C4I Acquisition Engineering & Integration Center on the East Coast
& Principal C4ISR ISEA for the Navy

Connecting the Warfighter to the resources needed to win GWOT

SPAWAR
Systems Center Charleston

What We're Known For

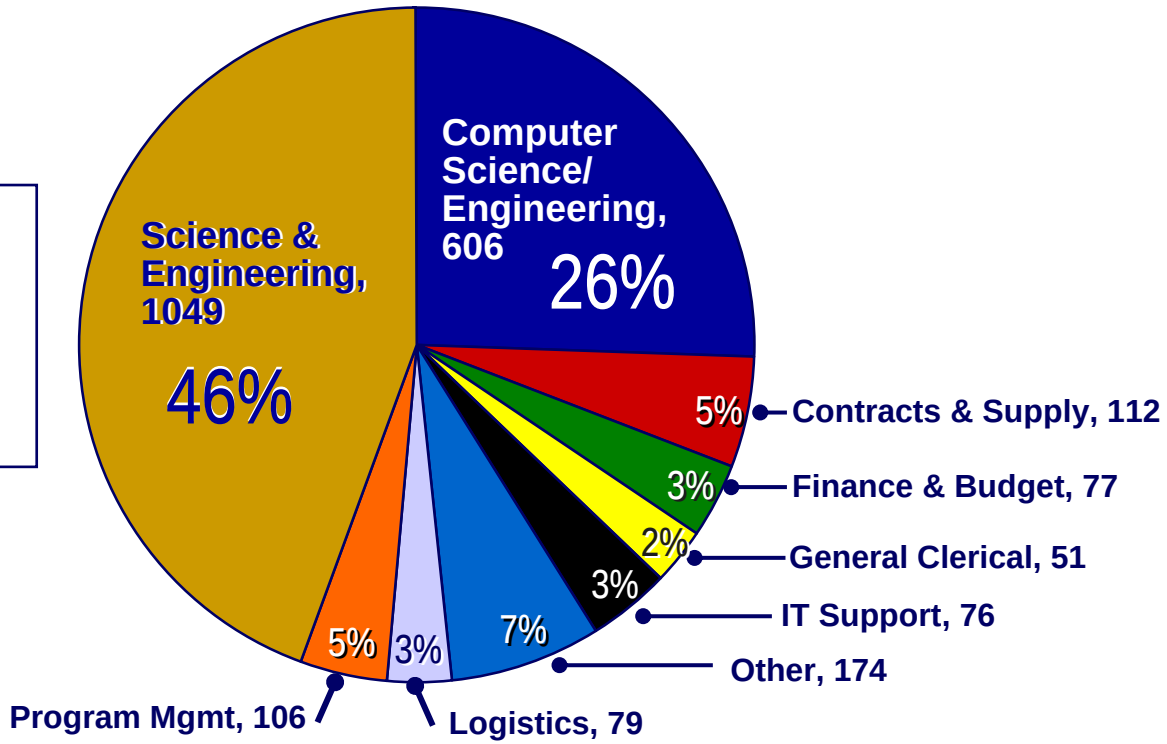
- **Developer of FORCEnet joint collaborative assessment tools** that promote netCentric interoperability and reduce system redundancy
- **Principal SPAWAR provider for Joint and Homeland Security** C4I solutions in a responsive manner
- **Navy's most efficient provider of critical engineering** and acquisition expertise for Navy/Joint commands and other federal agencies

- **Rapid integrator and deployer of interoperable technologies** to the Navy, Federal Government, and Joint Warfighter
- **Developer and employer of life-cycle logistic support solutions** in a web-enabled portal environment

Who We Are

A Large Systems & Software Engineering Organization

Over 70% of workforce is in an engineering or computer-related discipline



- The solutions to the global war on terror developed by SPAWAR result from good systems and software engineering.
- Systems engineering is our core competency.
- Total workforce of ~ 2,300 employees.

Vision

- **Vision**
  - Develop and Maintain a World Class Systems Engineering Organization
- **Strategy for Implementing CMMI®**
  - Research Best Methods (Case Studies)
  - Investigate Techniques and Models
  - Build Plan of Action
  - Implement Plan of Action

Research and Investigate

- Extensively researched industry and government organizations that have successfully used the CMM® and CMMI® to implement process improvement*
- Identified commonality among implementation approaches and lessons learned
- Identified Benefits of CMMI®
- Identified “Critical Success Factors”

*** Case Studies Included: Boeing-Integrated Defense Systems (IDS); U.S. Army Armaments Research, Development and Engineering (RDE) Centers; Lockheed Martin Corporation; Electronic Data Systems (EDS); Raytheon; Northrop Grumman – Mission Systems; Motorola – Global Software Group; General Dynamic Advanced Information Systems; SPAWAR Systems Center San Diego; Defense Finance and Accounting Service; Thales Training and Simulation; Jet Propulsion Laboratory; Bosch Automotive; Jacobs Sverdrup**

Benefits of Implementing CMMI®1

- Increased control of requirements, costs and schedule
- Increased ability to predict schedule and costs of product and product components
- Ability to remove defects early and efficiently from the work products
- Reduced rework leading to reduced development cycle time
- Increased predictability and control of product quality (the quality of a system is highly influenced by the quality of the process used to acquire, develop, and maintain it)

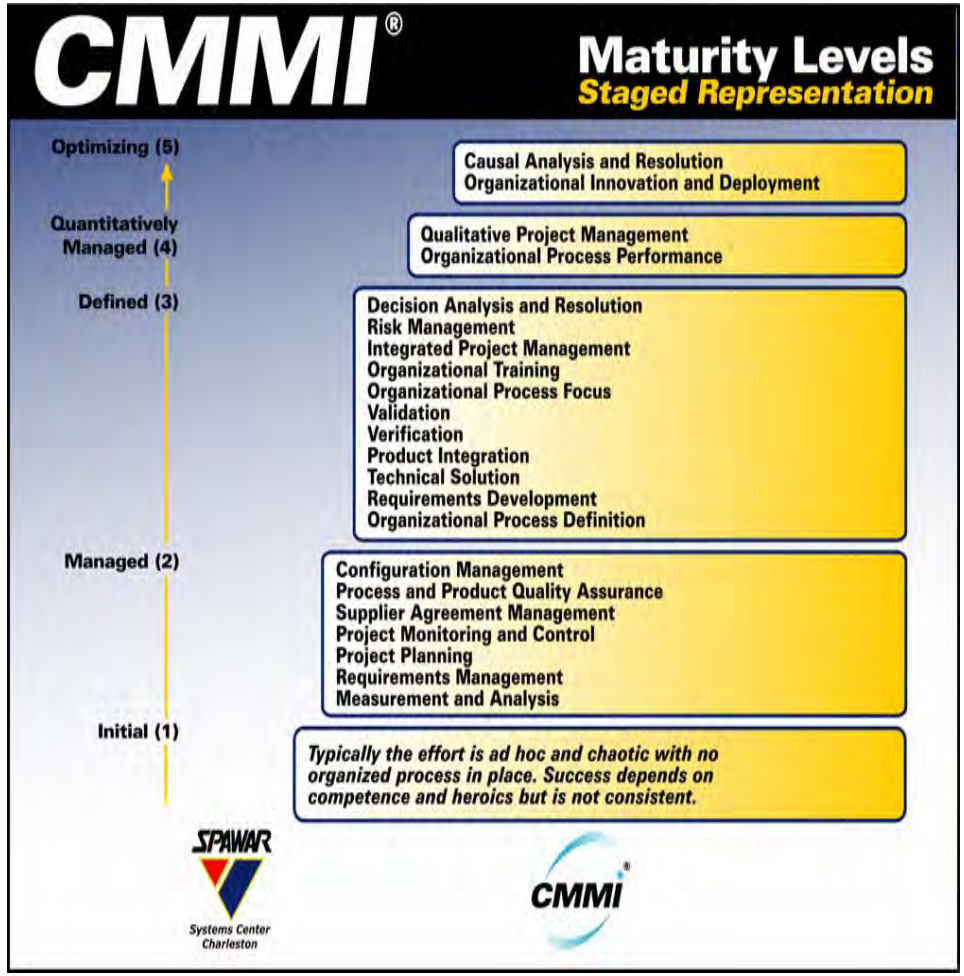
Benefits of Implementing CMMI®2

- Enhanced ability to make cost-benefit trade-offs of implementing new technologies and processes
- Increased capability to select and manage qualified suppliers
- Enhanced ability to make management decisions based on quantitative data
- More time available for top innovators to spend on problems and challenges requiring creative energy
- Enhanced communication and involvement of everyone in continuing process improvement efforts

CMMI®

SSC-Charleston chose to implement CMMI® because it provides a structured model for process improvement and is used to measure and improve an organization's ability to successfully manage complex systems engineering and software projects.

The model recognizes excellence in business practices, as measured against a set of demanding criteria.



Critical Success Factors

CRITICAL SUCCESS FACTORS FOR IMPLEMENTING CMMI®	
Command-wide Policy (Create vision that is urgent)	Assign Responsibilities (Strong Change Agents are essential)
Strategy and Plan (Include knowledge of why change is necessary and benefits)	Provide Training
Senior Management Support	Build Central Repository
Provide Resources and Funding (New Organizational Structure Usually Needed)	Measure and Communicate Progress

Practical Experiences

Applied the Critical Success Factors:

1. Ensure Policy Published at Highest Level
2. Obtain Approval for Process Improvement (PI) Plan
3. Obtain Resources (Funding) and Assign Responsibility for PI Initiative
4. Build Support for the PI Initiative
5. Plan and Provide Training
6. Build and Maintain Central Repository
7. Measure and Communicate Progress

1. Policy Published at Highest Level

Command-wide policy signed by our Technical Director, approved by the Board of Directors, and published December 2003.

- The policy directs the use of the best practices represented in the CMMI®-SE/SW model for all SSC-C systems and software engineering projects and tasks.
- The policy also directs the use of industry standards (ISO/IEC 15288 for Systems Engineering and ISO/IEC 12207 for Software Engineering).

2. Get Plan Approved

Process Improvement Plan and Schedule Approved February 2004.

- Plan included why changes were necessary
- Schedule included achievement of CMMI® Maturity Level 2 for Command in April 2005
- Schedule includes achievement of CMMI® Maturity Level 3 for Command in April 2007

Practical Experiences

Applied the Critical Success Factors:

1. Ensure Policy Published at Highest Level
2. Obtain Approval for Process Improvement (PI) Plan
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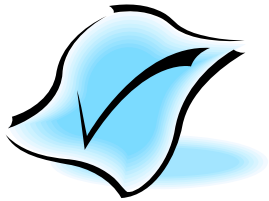
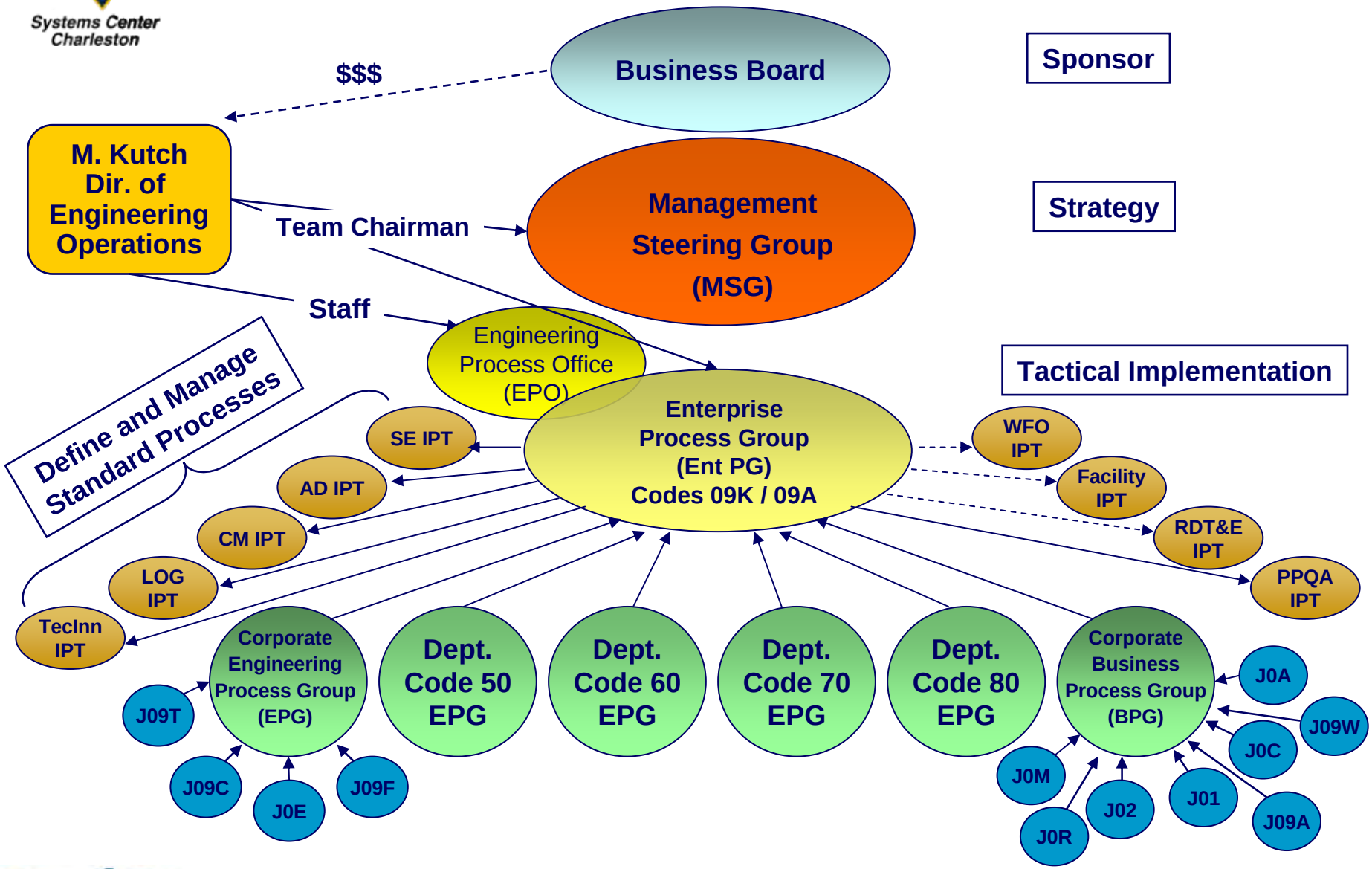
3. Resources and Responsibility



New Organizational Structure Established and Funded at the Command Level.

- Director of Engineering Operations (Code 09K)
- Engineering Process Office (EPO)
- Command and Departmental Engineering Process Groups (EPGs)
- Various Integrated Process Teams (IPTs)

New Organization for Implementation



Practical Experiences

Applied the Critical Success Factors:

1. Ensure Policy Published at Highest Level
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5. Plan and Provide Training
6. Build and Maintain Central Repository
7. Measure and Communicate Progress

4. Build Support for PI Initiative

Spread the word!

- Shared Early Successes in *The Chronicle*, SSC-C's site publication
- Built Senior Management Support
- Created a Newsletter Focusing on Systems & Software Engineering Process Improvement
  - Available in printed and electronic format
  - Published every 2-3 months
- Provided Extensive Mentoring and Coaching
- Communicate what is expected from SSC-C Projects

Spread the Word!

Systems and Software Engineering Newsletter

s²eNEWS

Systems and Software Engineering Newsletter

SPAWAR Systems Center Charleston

Volume 2, Issue 1 February 2006

The Benefits of CMMI®

SSC Charleston's Project Managers have pushed their teams to practice CMMI® and are reaping great benefits as a result. The Engineering Process Office sat down with them to discuss what they learned during their pursuit of Maturity Level 2. Article on Page 2.

KUTCH'S KORNER: CMMI® Makes SSC-C Work Smarter

In the past year, we've taken great steps toward making SPAWAR Systems Center Charleston a world-class engineering organization. We had six teams go to CMMI® Maturity Level 2, and their experience is the focus of this issue of the *s²eNEWS*. Granted, this effort required significant work, but SSC-C is seeing numerous benefits as a result of implementing CMMI. By jumping ahead, these teams have provided a roadmap we all can follow, allowing us to work smarter to achieve the same success.

The tangible, quantifiable benefits we've reaped by implementing CMMI have boosted SSC Charleston's reputation – both in the Command and the civilian world – as a quality engineering institution, and that's something we can all be proud of. In their interviews for the article you're about to read, SSC-C's projects were very

IN THIS ISSUE...

Kutch's Korner 1
The Benefits of CMMI 2
AP IPT Finishes Marine Corps Project 6
CICS Receives Official Certifications for SecureD Product 7

SEIPartner TECHSOFT Technical Software Services, Inc.

Practical Experiences

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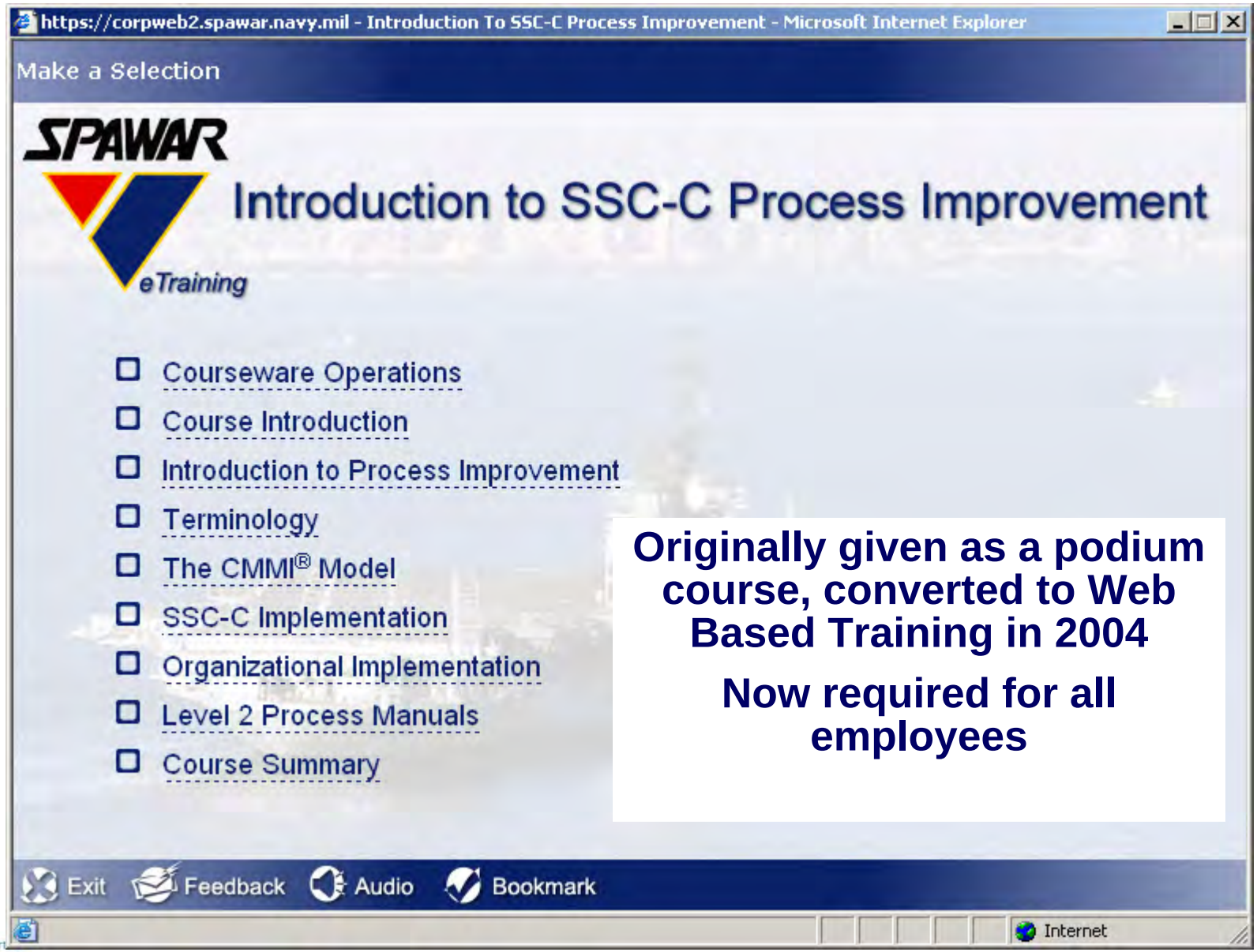
7. Measure and Communicate Progress

5. Plan and Provide Training

- **Intro to Process Improvement**
  - Formal Classroom Course Initially
  - Currently Provided via WBT
  - Now Mandatory for all employees
- **CMMI®**
  - SEI Intro to CMMI®
  - SSC-C Level 2 Processes
- **Systems Engineering Fundamentals Classes**

Intro to Process Improvement WBT



SEI's Intro to CMMI®

- **SEI's *Introduction to CMMI*® course teaches the full CMMI® model**
  - Students learn how the best practices build and relate across process areas
  - Learn the terminology and complete model
  - SEI-Authorized instructors are well-versed in our implementation to augment material with SSC-C specific content
  - Highlight SSC-C tools and resources
- **Over 300 employees trained**

Systems Engineering Fundamentals Classes

- **Teach the Systems Engineering process**
- **3-day on-site, classroom course**
  - Based on SMU SE Masters course
  - Customized to incorporate SSC-C SE process
  - Over 300 SSC-C engineers trained
- **1-day SE for Managers course added**

"Thought provoking, motivating, and challenging. Learning basic SE caused me to brainstorm many different applications of organized system processes. It motivated me to want to begin organizing its application. It also challenged me to apply GOOD SE practices in order to successfully be more efficient in the process.."

"It was extremely beneficial to have a professor with extensive knowledge of the subject matter and one who could apply it to the SPAWAR methods."

Student Feedback

Practical Experiences

Applied the Critical Success Factors:

1. Ensure Policy Published at Highest Level
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6. Build and Maintain Central Repository
7. Measure and Communicate Progress

6. Central Repository

Built and Continue to Populate Central Repository (CORPWEB/CMMI® intranet website).

- Policies & Process Manuals
- Standard Operating Procedures (SOPs)
- Sample Documentation and Templates
- Projects' Artifacts
- Artifacts from Teams – IPTs, EPGs
- Link to PI-WBT and other WBT courses
- Links to Reference materials and guidebooks
- Link to ePlan Builder (EBP) - Our CMMI Tool

Engineering Process Office Website

Systems Center Charleston

Address https://corpweb2.spawar.navy.mil/cmmi/standardprocesses/standardprocesses.aspx Go

SPAWAR Systems Center Charleston

SSC-Charleston Engineering Process Office

EPO Home | ePlan Builder | WBT Courses | eWBS | Contact EPO | CorpWeb

Navigation

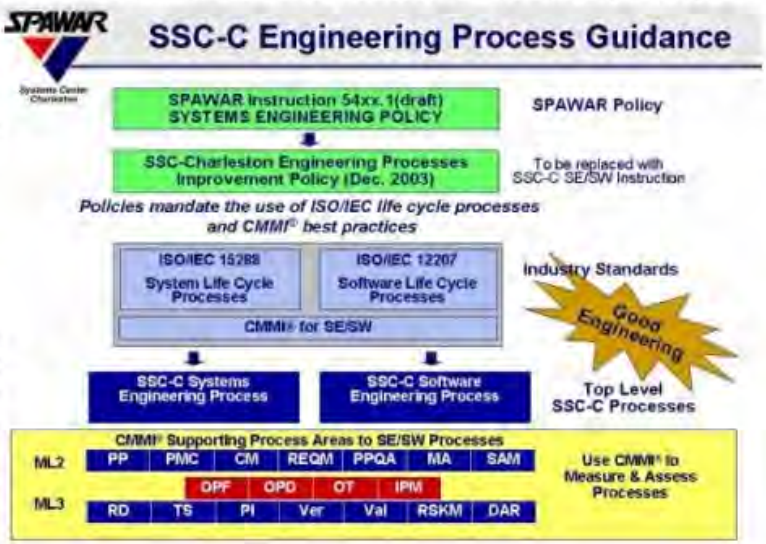
- Calendar
- SSC-C Standard Processes
  - Systems Engineering Process
  - Software Engineering Process
  - Life Cycles
  - Tailoring Criteria
- Process Areas
- Projects
- Process Improvement Teams
- Organizational Measurement Repository
- Training
- Innovation Program

SSC-C Standard Processes

Currently, the SSC-C Standard Processes contain policies, process manuals for CMMI®-SE/SW Level 2 and Level 3 process areas, and select SOPs. The standard processes for Systems Engineering and Software Engineering provide detailed procedures for accomplishing tasks within these respective disciplines. The 3 top-level standard engineering processes are:

- Systems Engineering
- Software Development
- Software Maintenance

These processes were derived from the ISO/IEC industry standards to address the typical engineering work performed by SSC-C. Additional SSC-C standard processes have been developed to further refine these top level engineering processes and to support the process areas of CMMI®. The graphic depicts the derivation of the SSC-C standard processes.



Related Links

- Process Improvement Communication Plan
- SSC-C Artifact Submittal Form

Internet

SPAWAR
Systems Center Charleston

Policies and Processes

A unique SSC-Charleston Policy and Process Manual addresses each of these Process Areas:

- Project Planning
- Project Monitoring and Control
- Configuration Management
- Process and Product Quality Assurance
- Measurement & Analysis
- Requirements Management
- Supplier Agreement Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation
- Risk Management
- Decision Analysis and Resolution Management
- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Integrated Project Management

Practical Experiences

Applied the Critical Success Factors:

1. Ensure Policy Published at Highest Level
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7. Measure and Communicate Progress

7. Measure and Communicate Progress[1]

Progress Measured Every 1- 4 Months

- Projects conducted Process Reviews and Document Reviews to measure progress and identify gaps using Apprasial tool
- EPO performed Class B/C appraisals of selected projects
- SEI performed Standard CMMI® Appraisal Method for Process Improvement (SCAMPI^{SM}) Class A's at the Project-level
- SEI performed Command-wide SCAMPI^{SM} Class A appraisal in April, 2005

7. Measure and Communicate Progress[2]

Recognize and Publicize Early Successes

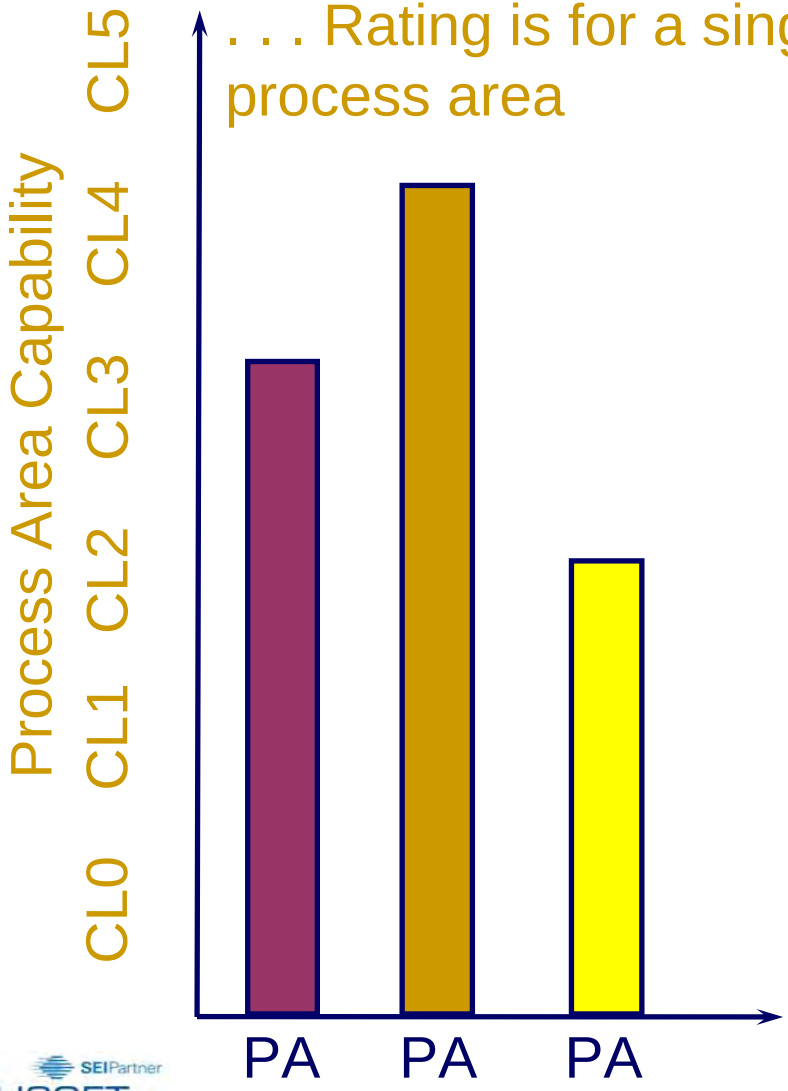
- 'Project-level' SCAMPIs provided early successes due to conducting the appraisal using the "continuous representation" of the model
  - Scope of appraisal looked at all 7 ML2 PAs and if the PAs were satisfied, i.e., achieved CL2, then the project achieved ML2 [equivalent staging]
  - Projects received CL2 for various PAs (e.g., CM, SAM, REQM, PP, PMC)
- Led to BIG success! - SSC-C became the first SPAWAR Systems Center to achieve CMMI® Maturity Level 2 (April 2005)

Capability verses Maturity Level

Systems Center Charleston

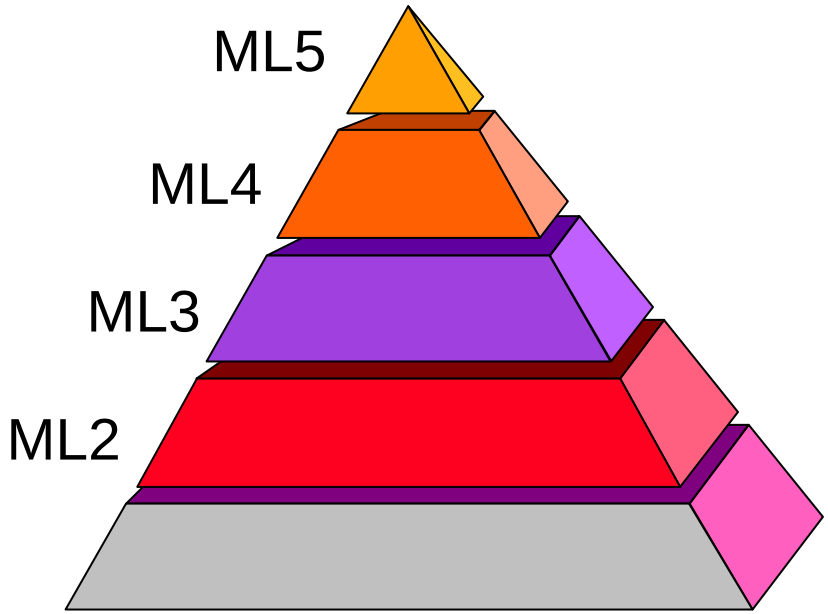
Continuous

. . . Rating is for a single process area



Staged

. . . Rating is for a specified set of process areas



Success!

First SPAWAR Systems Center to Achieve Command Level CMMI® Maturity Level 2

Also, First SPAWAR Systems Center to have a Program Achieve CMMI® Maturity Level 3 (July 2006)

Question?

What do these Critical Success Factors and the model itself have in common?

Answer!

"Both Institutionalize the PI/CMMI® Process"

Critical Success Factors	CMMI® Generic Practices
Ensure Policy Published at Highest Level	2.1 Establish an Organizational Policy
Get the Plan Approved	2.2 Plan the Process
Get Resources (Funding) and Assign Responsibility	2.3 Provide Resources
Get Resources (Funding) and Assign Responsibility	2.4 Assign Responsibility
Plan and Provide Training	2.5 Train People
Build and Maintain Central Repository	2.6 Manage Configurations
Get Resources (Funding) and Assign Responsibility	2.7 Identify and Involve Relevant Stakeholders
Measure and Communicate Progress	2.8 Monitor and Control the Process
Measure and Communicate Progress	2.9 Objectively Evaluate Adherence
Get Resources (Funding), Assign Responsibility and Communicate Progress	2.10 Review Status with Higher Level Management

Lessons Learned[1]

1. ***Do your homework*:** Researching what others have done to successfully implement process improvement and what challenges they encountered helped prepare us.
2. ***Formulate a good plan*:** Building a Plan based on the "Critical Success Factors" led to our success.
3. ***Policy needs to be Top-down:*** Having Command-level policy energized the PI initiative.
4. ***Train, train, train:*** Providing an understanding of what the CMMI® is all about, what SE is all about, and how to implement within a project is critical.

Lessons Learned[2]

5. ***Train some more*:** Train process owners (PPQA, CM, REQM, etc.) to be subject matter experts (SMEs).
6. ***Bite off small pieces*:** Approach change in small steps and use those experiences, successes and 'best practice' artifacts to ease the change for all Command personnel.
7. ***Ensure they know what's in it for them:*** Value added must be visible. Share benefits that others have experienced in implementing CMMI®.
8. ***Advertise successes early on:*** Publicize each positive outcome as progress is measured.

Lessons Learned[3]

9. ***Full-time SME to mentor and coach*:** Dedicated Engineering Process Office (EPO) maintained momentum and resolved issues.
10. ***Build a support system*:** Identify key "change agents" within the organization to overcome resistance to change (those most respected and energized).
11. ***Make sure the plan gets implemented:*** Promulgate realistic timeframes to all stakeholders (EPGs, IPTs, projects) and monitor schedules for continued successes in the PI Program.

Lessons Learned[4]

12. ***Establish organizational assets early:*** Developing Process Manuals, Naming Conventions, Formats/Style Guides, Templates and Tools provided value, consistency and 'starting points' for projects.
13. ***Communication is constantly needed*****:** Use multiple methods and channels for effective understanding, up to date status, and cross-communication among teams.

The rest of the story……..

Phase 2 - ML2 to ML3

The Second Wave – ML2 to ML3[1]

- Shift Focus of Process Improvement Strategy from "Implementing CMMI®" to "Executing Sound Systems Engineering"
- Educate Project Managers on What's Expected
- Improve Project's Planning and Documented Processes
- Provide additional CMMI® Training and WBTs
- Incorporate ISO, Lean Six Sigma (LSS) and Balanced Scorecard (BSC) Initiatives

The Second Wave – ML2 to ML3²

- Develop internal "self-assessment" process for measuring ongoing implementation of Maturity Level 2 processes
- Populate EPO/CMMI® Website with 'best examples'
- Implement Tailoring Guidelines
- Implement SSC-C Measurement Repository
- Implement ML2-to-ML3 Action Plans
- Continue to Measure and Communicate Progress
- Maintain Momentum and Commitment to Goals

SSC-C SE Revitalization Plan

SPAWAR Systems Center Charleston

Elements of SSC-C SE Revitalization

Policy / Guidance
- SSC-C SE Instruction
- SSC-C SE Process Manual
- SSC-C SW-Dev Process Manual
- SSC-C SW-Maint Process Manual
- EPO Website
- ePlan Builder

Training / Education
- Intro to PI WBT
- SE 101 WBT
- SE Fundamentals
- SE for Managers
- Project & Process Workshop
- Intro to Software Engr.
- Architecture Dev. WBT
- Certification/Degrees

Assessment & Support
- CMMI® Level 2
- CMMI® Level 3
- Balanced Scorecard
- Lean Six Sigma
- Integrated Product Teams
- IT Tools

Underway

Completed/Ongoing

SEI Partner
TECHSOFT
Technical Software Services, Inc.

SSC-C Engineering Process Guidance

SPAWAR Systems Center Charleston

SPAWAR Instruction 54xx.1(draft) SYSTEMS ENGINEERING POLICY

SPAWAR Policy

SSC-Charleston Engineering Processes Improvement Policy (Dec. 2003)

To be replaced with SSC-C SE/SW Instruction

Policies mandate the use of ISO/IEC life cycle processes and CMMI® best practices

ISO/IEC 15288
System Life Cycle Processes

ISO/IEC 12207
Software Life Cycle Processes

CMMI® for SE/SW

Industry Standards

Good Engineering

SSC-C Systems Engineering Process

SSC-C Software Engineering Process

Top Level SSC-C Processes

CMMI® Supporting Process Areas to SE/SW Processes

ML2	PP	PMC	CM	REQM	PPQA	MA	SAM
ML3	OPF	OPD	OT	IPM			
	RD	TS	PI	Ver	Val	RSKM	DAR

Use CMMI® to Measure & Assess Processes

Classic System Engineering "Vee" Diagram Aligning SE with CMMI and Process Improvement

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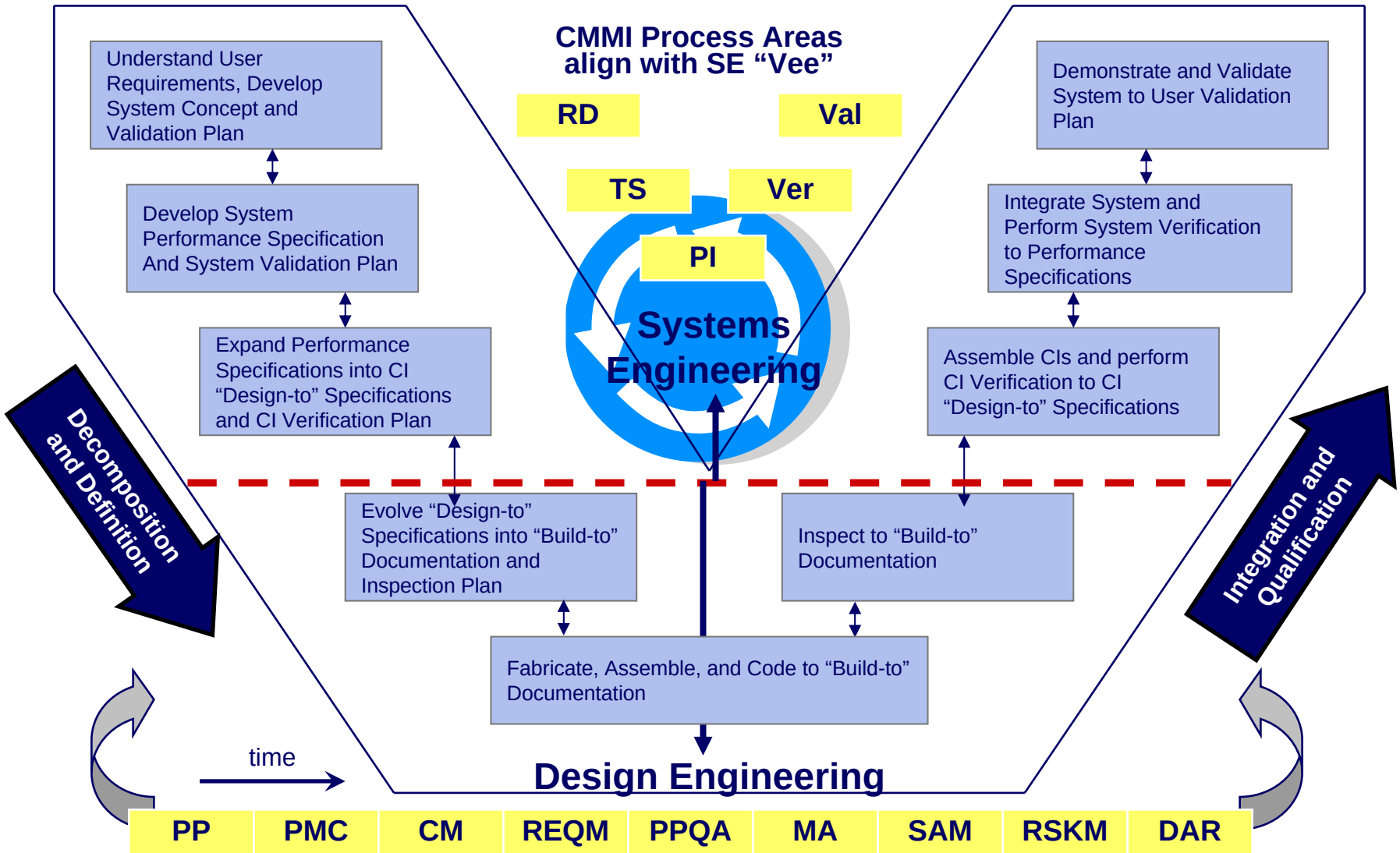

The Second Wave – ML2 to ML3

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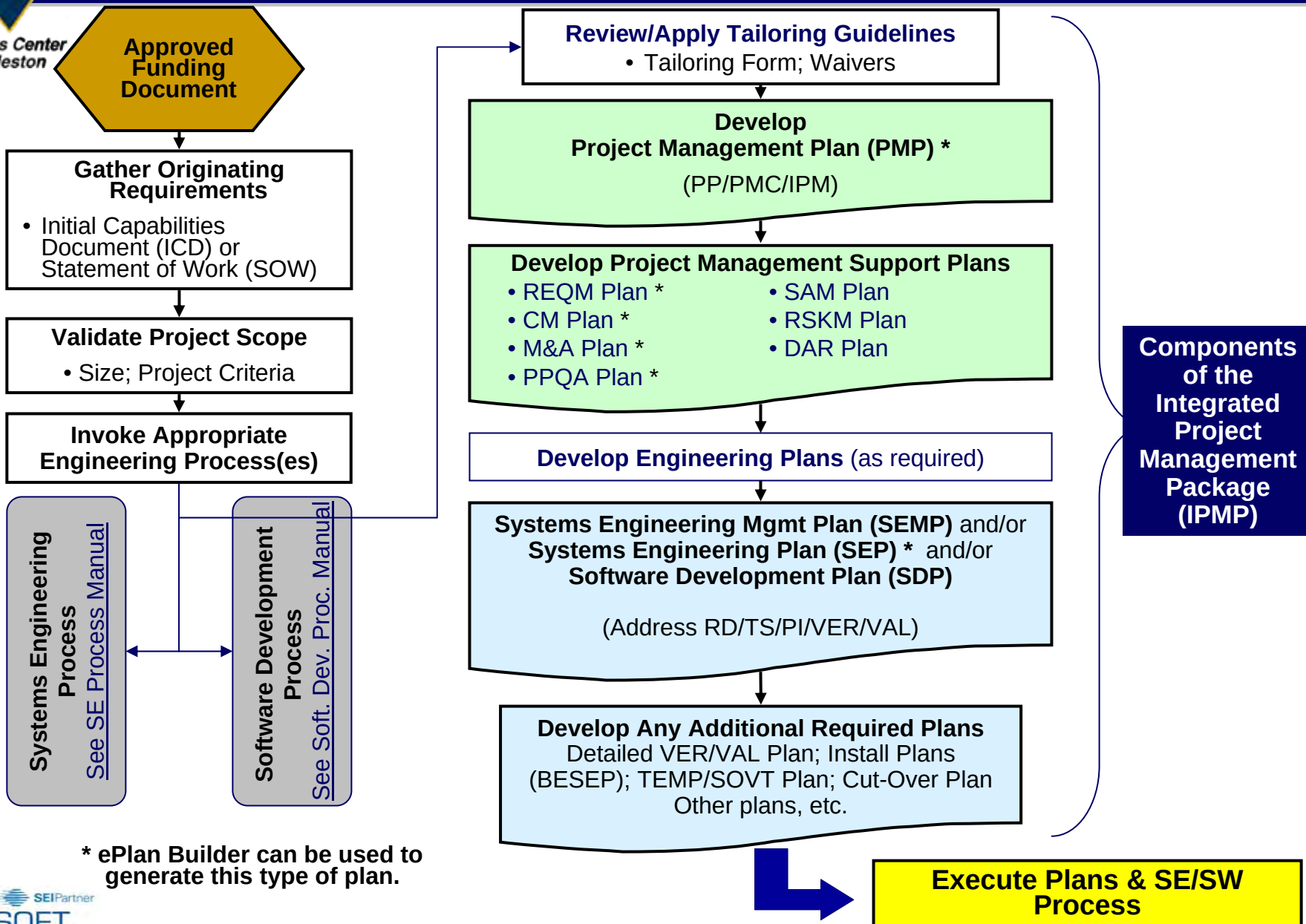
- Incorporate ISO, Lean Six Sigma (LSS) and Balanced Scorecard (BSC) Initiatives

What is expected from SSC-C projects?

- **Execute sound systems engineering**
  - Utilize the organizational processes, tools, guidance available
- **Sound systems engineering requires**
  - Proper Project Planning
  - Control over the project and process
    - Configuration Management, Requirements Management
    - Verification (Peer Reviews), Process Quality Assurance, …
  - Iterative and robust design and development methodology
    - Decomposition of Requirements, Analysis, Alternatives, …
  - Frequent interaction of senior management and customers (sponsor)

CMMI® provides a standard to assess progress against sound systems engineering practices

SSC-C Project Process - Planning



*** ePlan Builder can be used to generate this type of plan.**

Pitfalls in Developing Plans

- **Generating from scratch**
  - Author specific
  - What did I forget?
  - Time – “Re-inventing the wheel”
- **Copy from “good” example**
  - Is it good?
  - Cut and Paste errors – old project data
  - What did they forget or intentionally leave out?
  - Is my project really the same?
- **Document Outlines/Templates**
  - Provide placeholders; not explanation/examples
  - No validation
- **General issues with all above alternatives**
  - Consistency from Plan to Plan
  - Formatting
  - What belongs in this section?

ePlan Builder Tool

ePlan Builder tool

- An interactive, web-based application that leads the user through a structured interview process (like TurboTax®) to generate a CMMI®-compliant plan
- Includes standard, consistent text
  - Definitions
  - Acronyms
  - Roles and Responsibilities
- Generates an initial project-specific document

TurboTax® Usability

- **TurboTax® (and other income tax software)**
  - Simplifies the process for completing income tax returns
  - Uses an “interview” format with the user to collect information
  - Provides common defaults (that can be changed)
  - Branches to necessary sections based on input collected; skips unnecessary sections
  - Information entered once, but used in several places
  - Validates information for gaps and inconsistencies
  - Provides page/field specific help text
  - Automatically generates final forms

Apply Concept to Building Plans

- **Collect common project information once**
  - Ensures consistency from plan to plan
- **Acts as on-line template**
  - Ask questions, give choices, prompt for input
  - Application logic ensures full coverage of required sections (from standard process manuals)
  - Logic permits skipping / branching as appropriate
  - Provide on-line, section sensitive help
- **Standard content can be included in all plans**
- **Automatically generate initial draft of plan**

ePlan Builder Tool[1]

SPAWAR Systems Center Charleston

- Generates CMMI®-compliant (Maturity Level 3) Plans:
  - Project Management Plan (with WBS)
  - Configuration Management Plan
  - Quality Assurance Plan
  - Requirements Management Plan
  - Systems Engineering Plan (DoD SEP Format)
  - Measurement and Analysis Plan
  - Systems Engineering Management Plan (under development)
  - Verification Plan (under development)
  - Decision Analysis and Resolution Plan (under development)

ePlan Builder Tool²

SPAWAR Systems Center Charleston

- **Generates plan in Rich Text Format (rtf)**
  - For further editing and updating
- **Generates SSC-C compliant plan-specific standard lists for:**
  - Definitions
  - Acronyms
  - References
  - Roles/Responsibilities

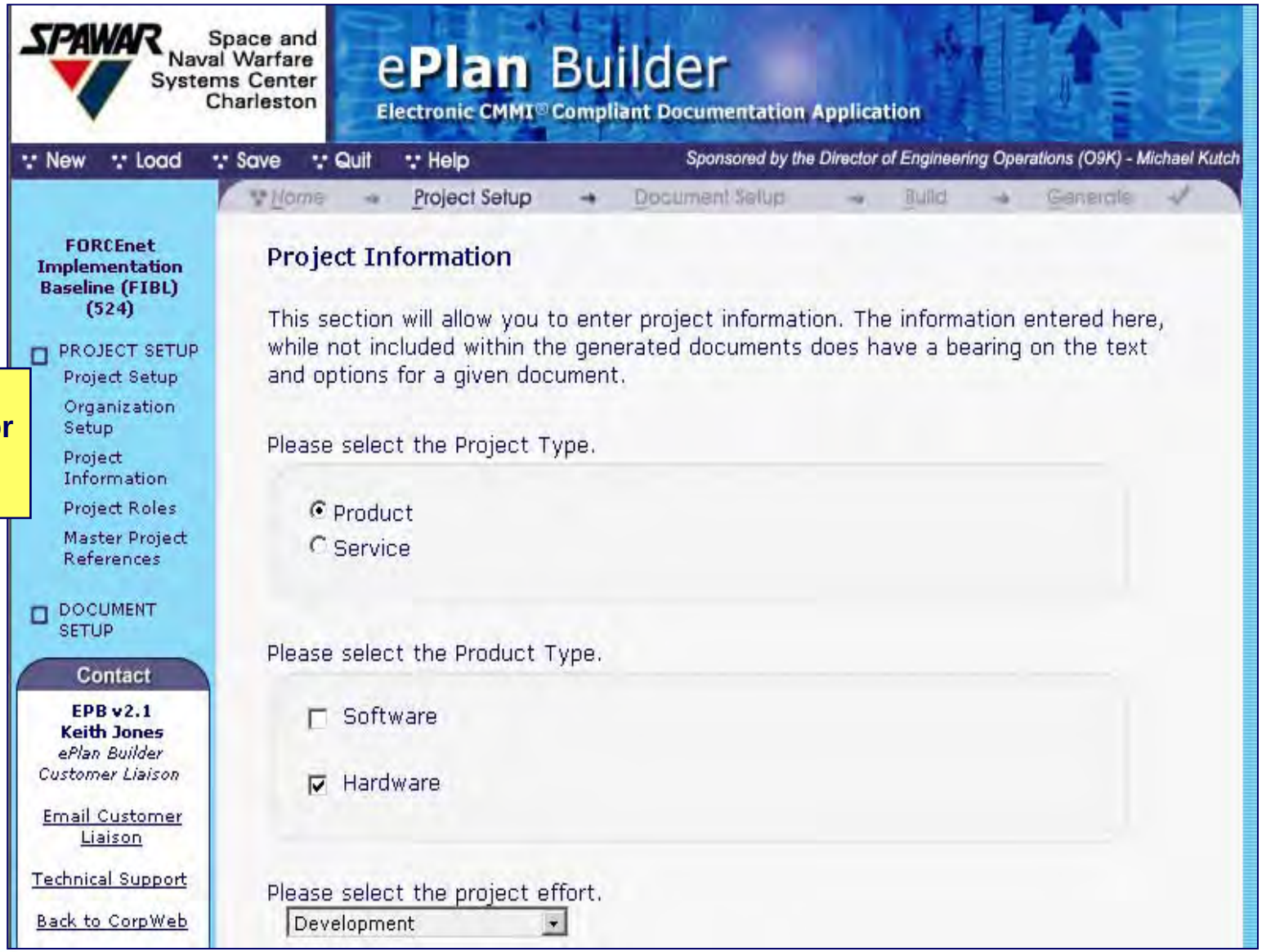
Project-specific content can also be added to these sections

ePlan Builder - Home

EPB – Project Setup

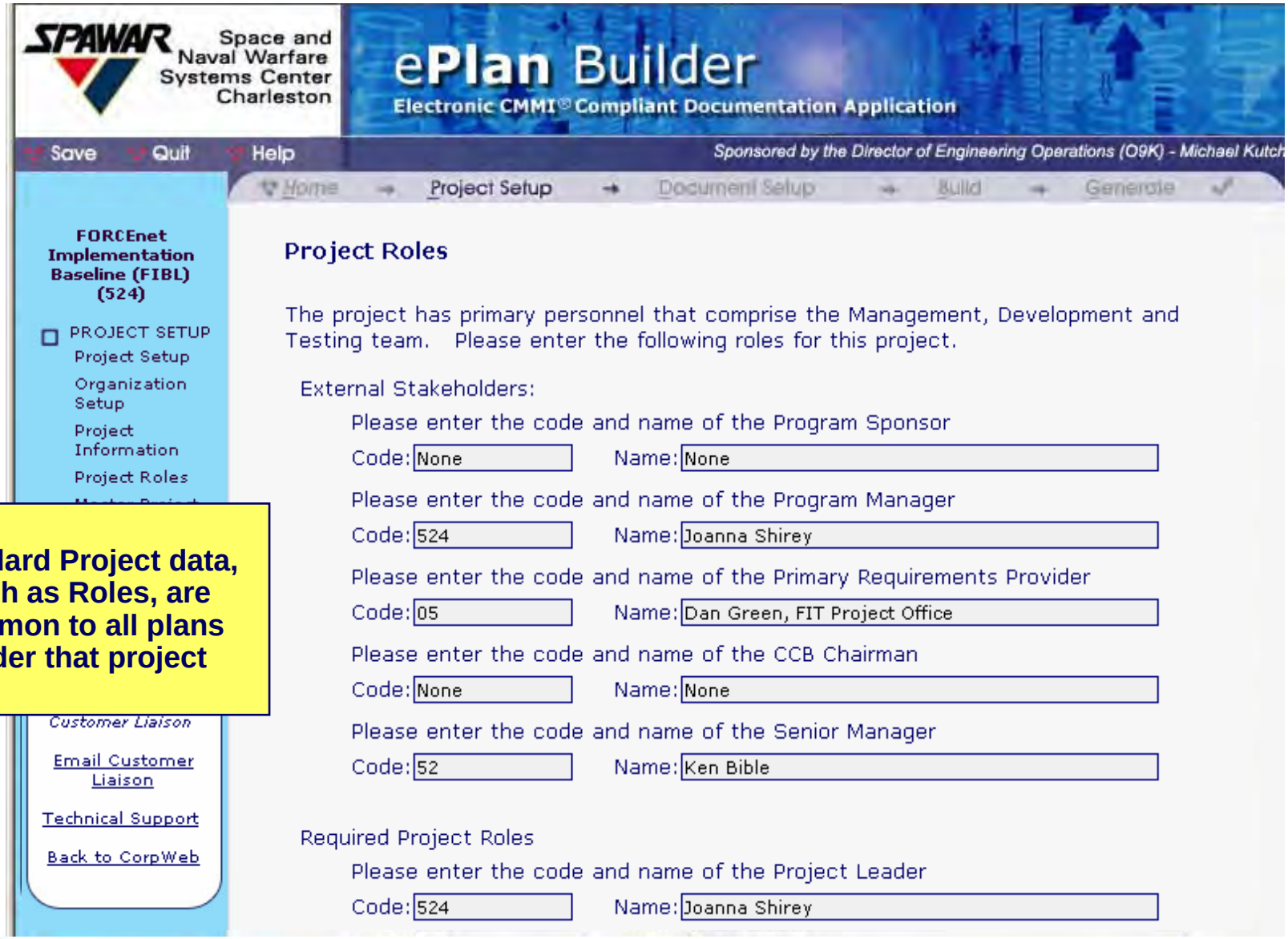
Systems Center Charleston

1 of 5 sections for Project Setup



EPB - Project Roles

Systems Center Charleston

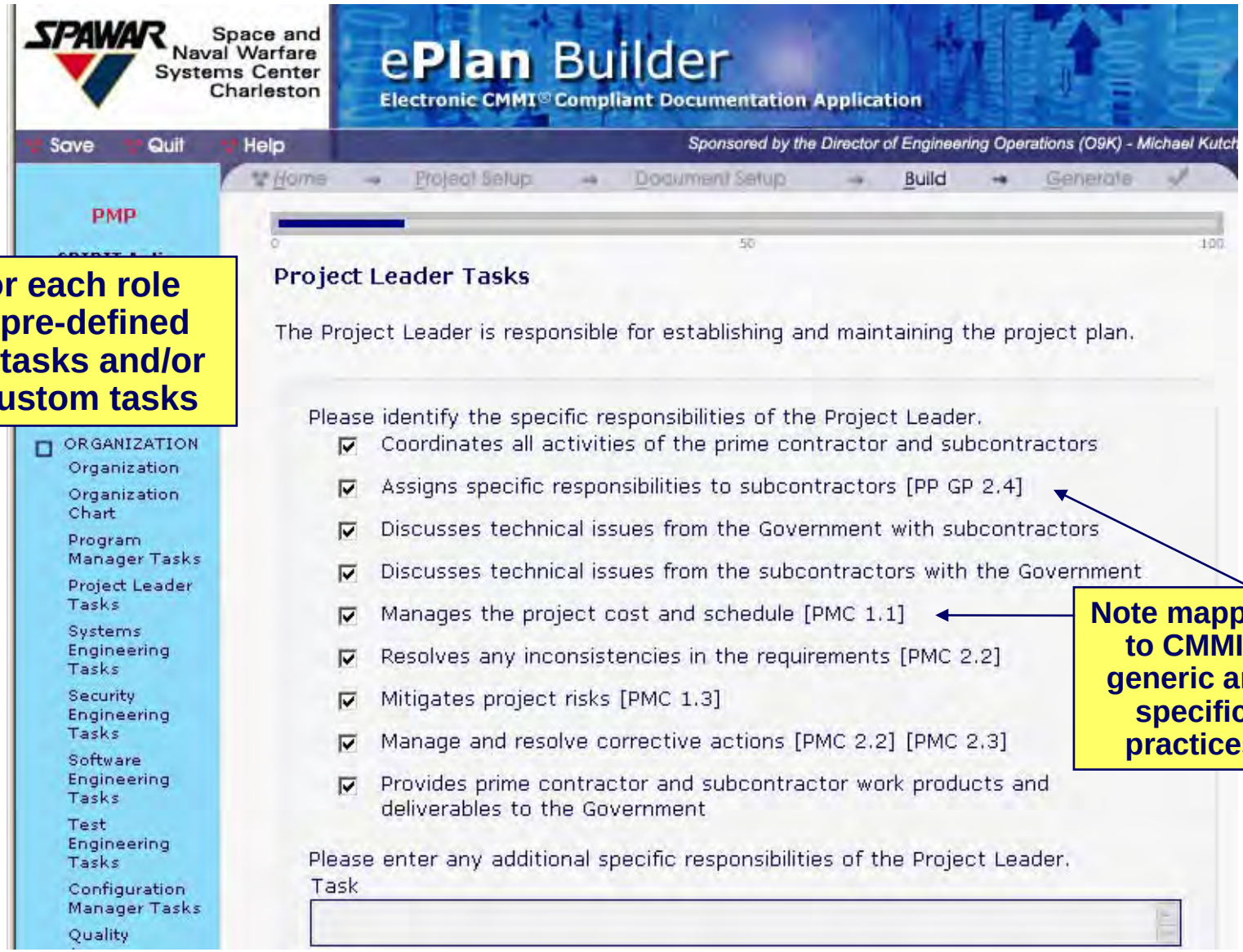


Standard Project data, such as Roles, are common to all plans under that project

EPB – Select Tasks for each Role

Systems Center Charleston

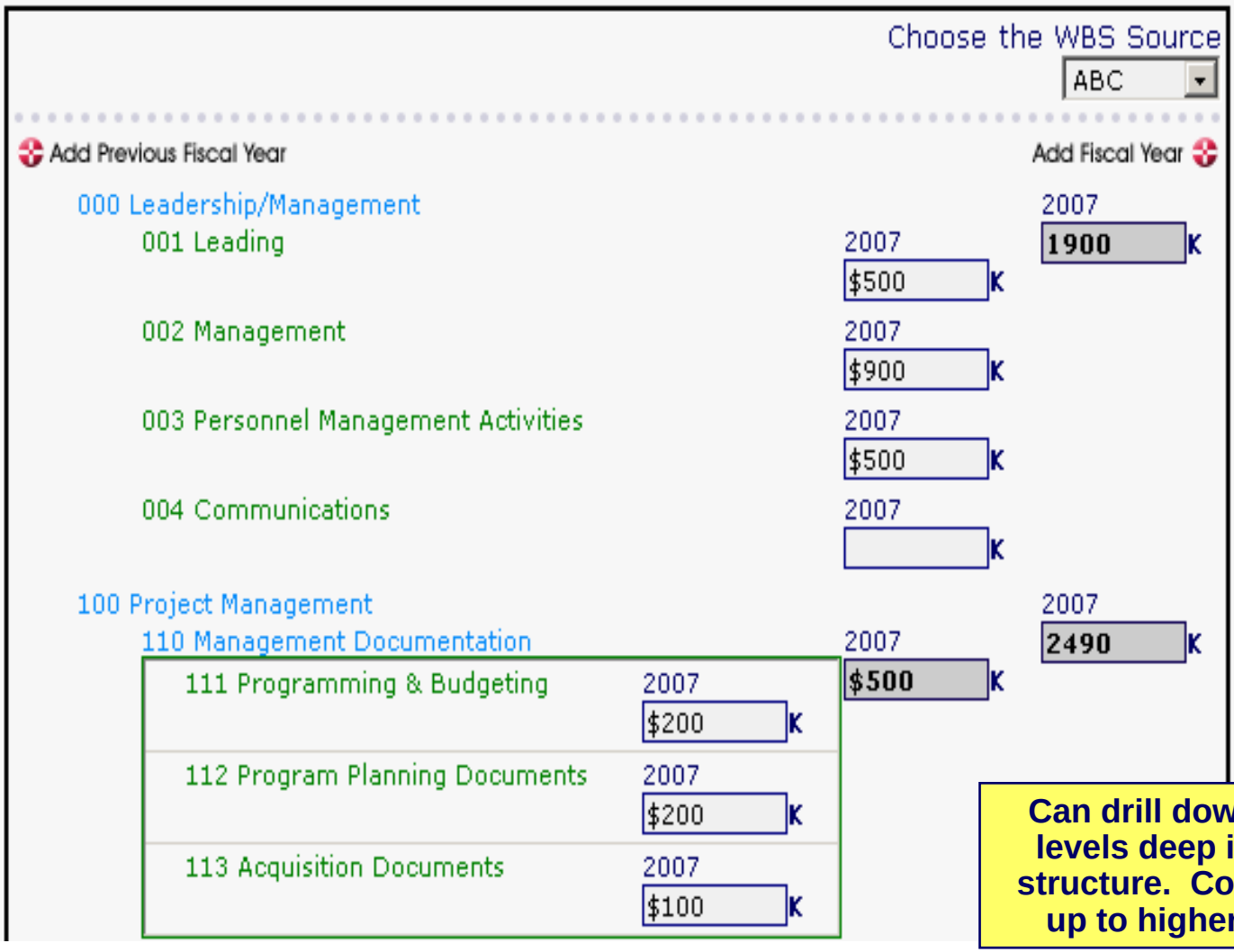
Tailor each role from pre-defined list of tasks and/or add custom tasks



Note mapping to CMMI® generic and specific practices

Work Breakdown Structure (WBS) in a Project Management Plan

SPAWAR Systems Center Charleston



Cost estimates entered using the SPAWAR global WBS or the SSC-C Activity Based Costing WBS

ePB accommodates multi-year projects

Can drill down three levels deep in WBS structure. Costs sum up to higher level.

Risk Identification in PMP

SPAWAR Systems Center Charleston

Risks

This page allows you to enter a list of known or expected risks. The severity of the risks and the mitigation approach for each should be identified. Please use the table below to identify the major risks associated with the project.

Click for more information about risks

Risk Category	Impact/Concern	Level	Mitigation Approach
Schedule	Products are required by the customer by 10/1/06	High	Be prepared to provide draft materials if development of
Quality	Will products be ready for 10/15/06 in a condition	Medium	Provide technical data to contractor in accordance with schedule with
Technical	Ability to get teh technical ata from the	High	Interact directly with the satellite manufacturer to obtain the technical

Add More Items

PMP may also reference a more comprehensive Risk Management Plan

Measurement & Analysis Plan[1]

SPAWAR Systems Center Charleston

Cost, Schedule, and Process Performance are standard categories of measures

Collection, Storage, and Analysis is defined for each Project measure

Cost is a measure within the Financial Performance category that measures the cost for activities, events, and products. The measure provides an easy-to understand view of the budget. Comparison of planned and actual cost data provides insight into significant and repetitive cost changes at the activity level.

While more detailed cost information provides more insight into the project's total cost, until the project personnel have achieved a certain level of proficiency in estimating costs, it is recommended that the cost data should be captured at a level commensurate with this level of experience.

Collection and Storage

Identify the level of detail for capturing cost data
Project Level

Please select how the Project Leader will report contract costs from the list below. If the Project Leader is not responsible for managing contracts, select "Project".
Project

Identify who will provide the actual cost data:
Project Leader

Identify the tool to be used to collect cost data:
BSA and PMACS

Identify how often the actual cost data will be collected:
Monthly

Analysis Procedures

Identify how often the cost data will be analyzed:
Monthly

Identify the cost alert threshold:
95%

Measurement & Analysis Plan²

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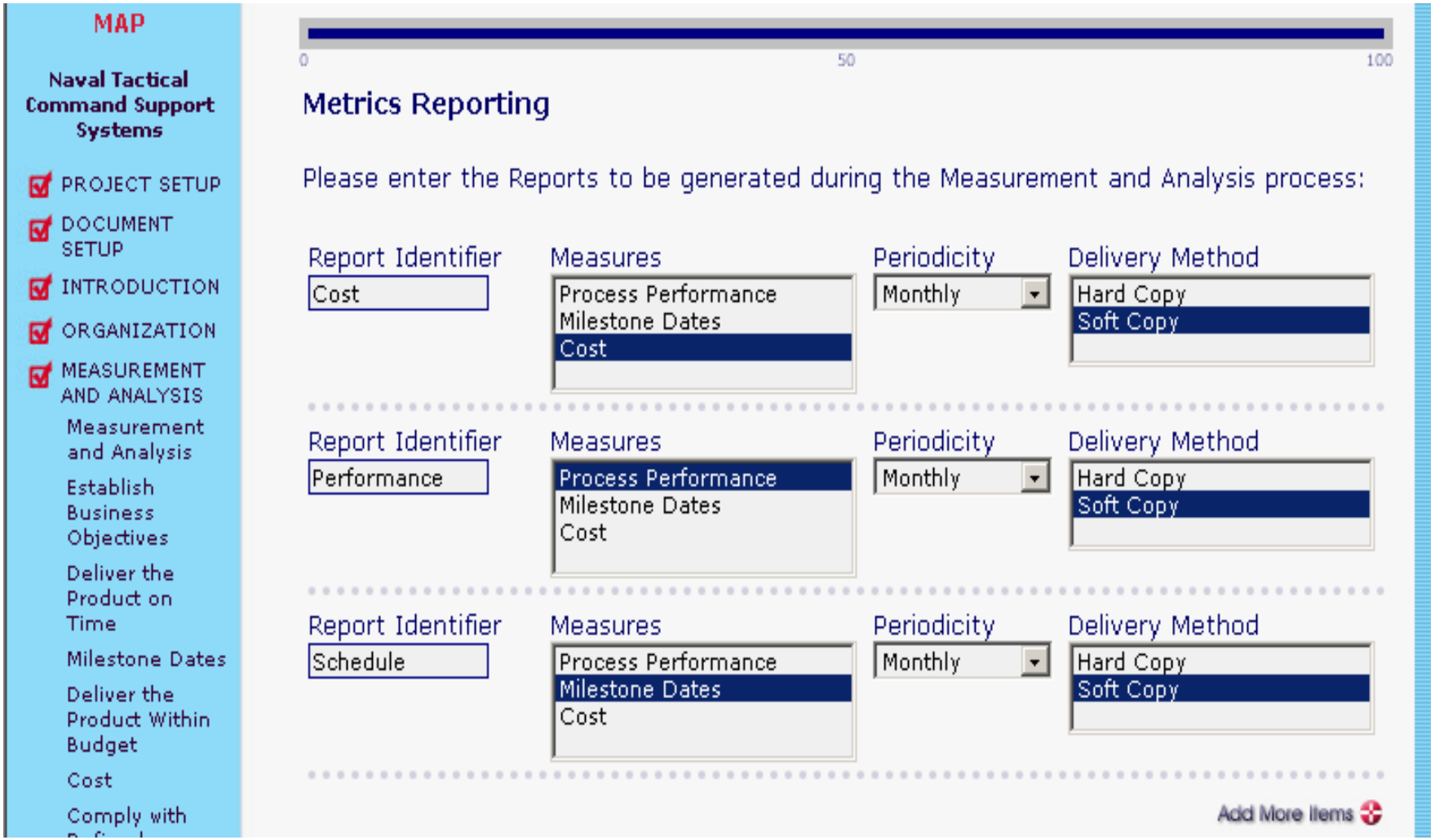
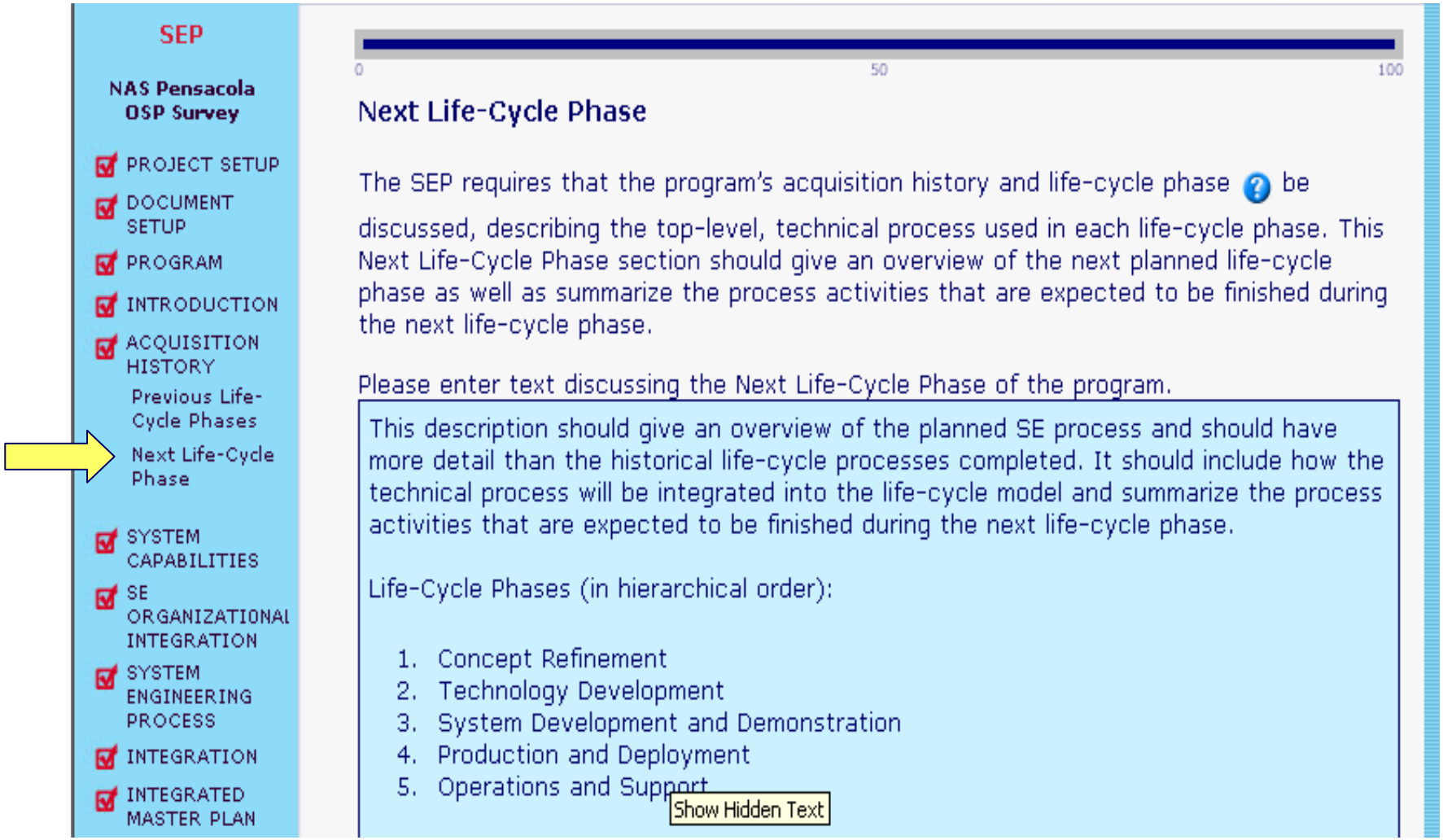


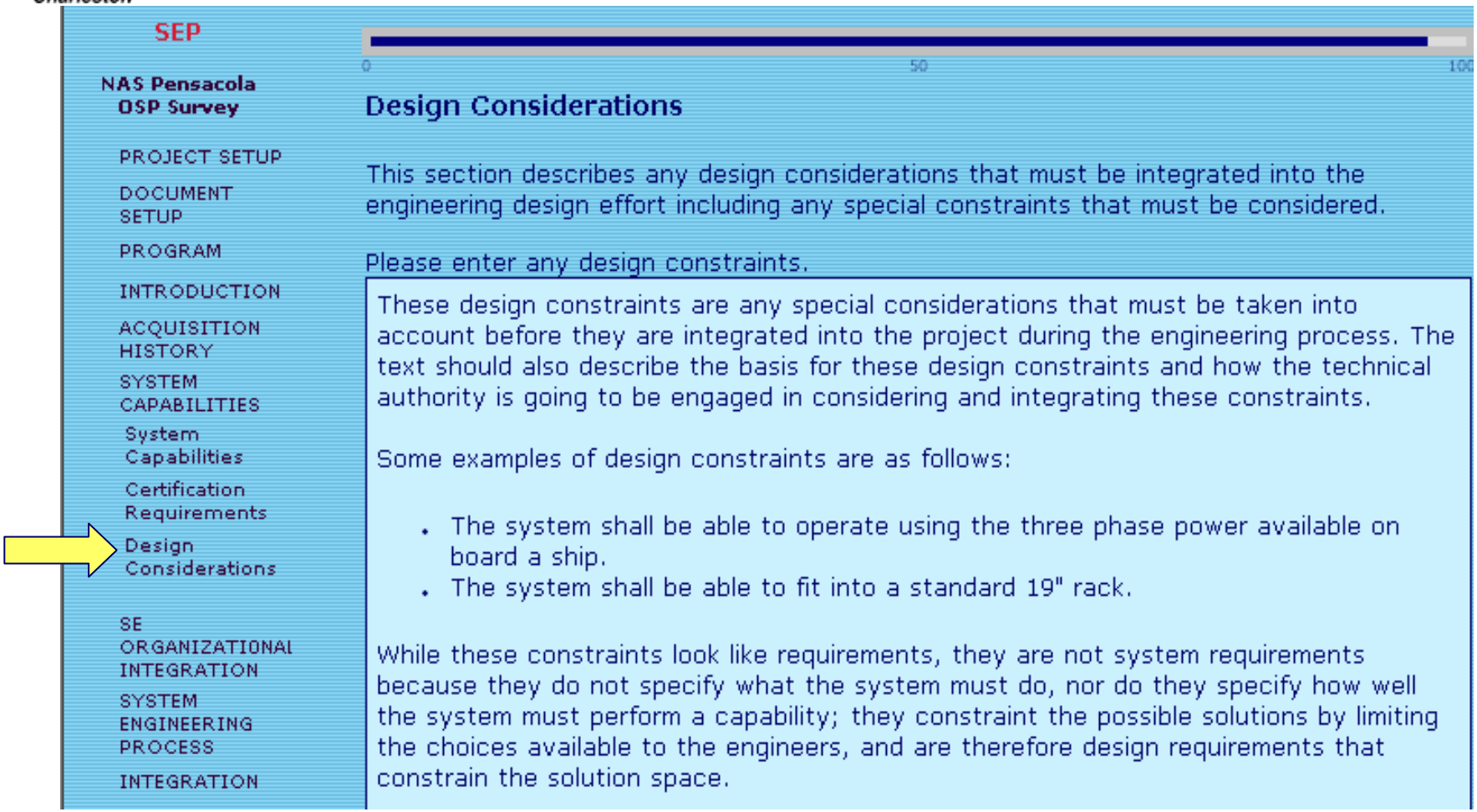
Systems Engineering Plan (SEP)[1]

SEP format follows the DoD SEP Preparation Guide



Systems Engineering Plan (SEP)[2]

Systems Center Charleston



The nature of the SEP requires more open input text fields, but EPB helps by providing elaborations and examples for the user

SEP – Planned Trade Studies

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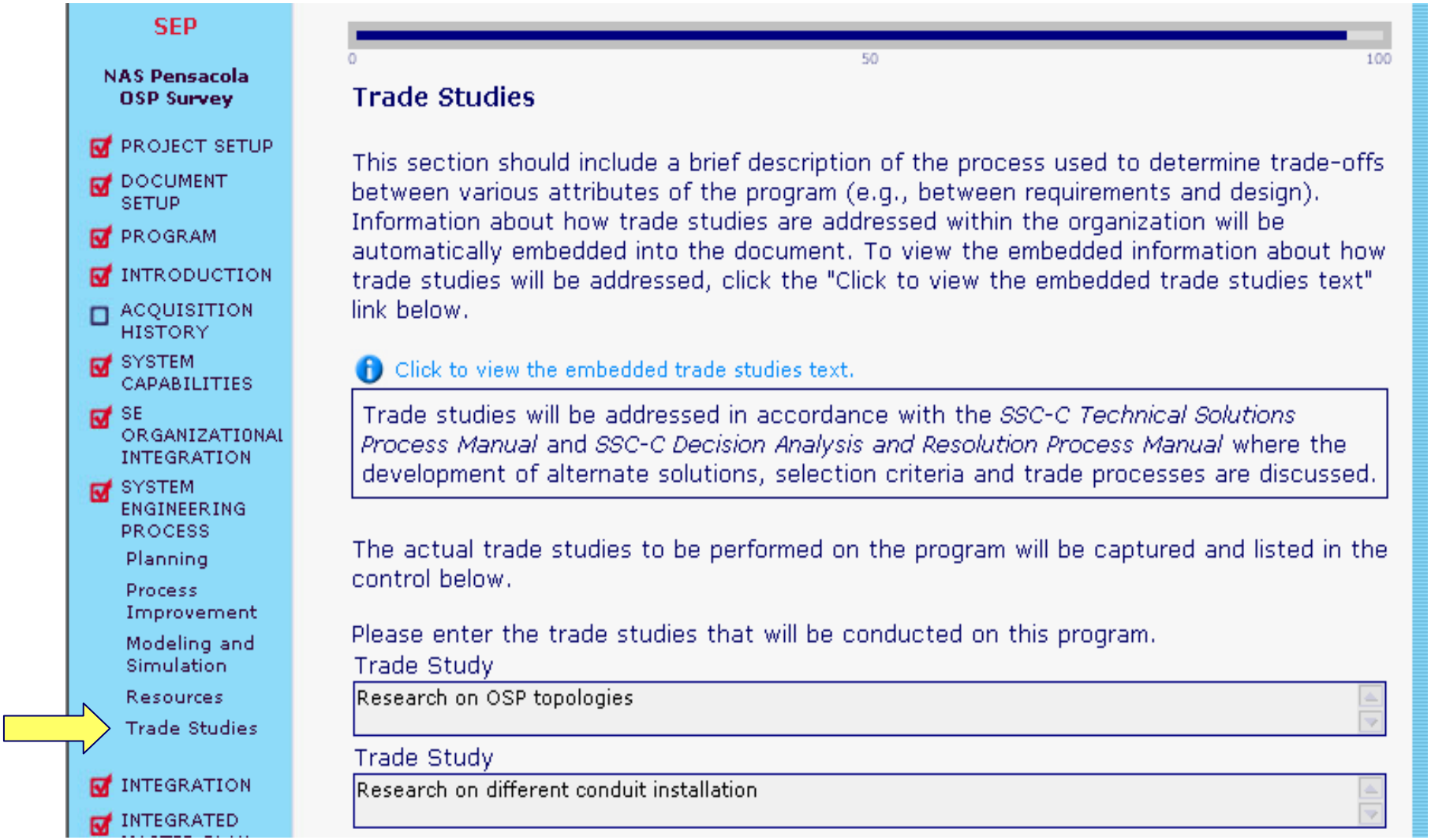

EPB Output – a Plan

Systems Center Charleston

N65236-593-PMP-0001-v1
August 18, 2006

Project Management Plan (PMP)

For

MARSOC West SCAMPI CER (593)

August 18, 2006

Prepared by:

Space and Naval Warfare Systems Center, Charleston
(SSC-C)
(593)
P. O. Box 190022
North Charleston, SC 29419-5542

Approved by: Mark Renaud (593) Date: August 23, 2006

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SEI Partner
TECHSOFT
Technical Software Services, Inc.

EPB Output – CMMI® Compliance Matrix

Compliance matrix cross references CMMI® practices with associated SSC-C Process Manual and Project-specific plan

N65236-593-PMP-0001-v1
August 18, 2006

PROJECT PLANNING

CMMI®-SE/SW Goal/Practice Number	CMMI®-SE/SW Level 2 Process Area Project Planning (PP)	SSC-C PP Process Manual Paragraph	593 PMP Paragraph
PP 1	Establish Estimates. Estimates of project planning parameters are established and maintained.	3.2	1.2.1
PP 1.1	Estimate the Scope of the Project. Establish and maintain a top-level work breakdown structure (WBS) to estimate the scope of the project.	3.2	1.2.1 3 Appendix A
PP 1.2	Establish Estimates of Project Attributes. Establish and document estimates of the attributes of the work products and tasks.	3.2	1.2.1 1.3
PP 1.3	Define Project Life Cycle. Define the project life cycle phases upon which to scope the planning effort.	3.2	1 1.2.1
PP 1.4	Determine estimates of Effort and Cost. Estimate the project effort and cost for the attributes of the work products and tasks based on estimation rationale.	3.2	1.3 1.2.1 Appendix A
PP 2	Develop a Project Plan. A project plan is established and maintained as the basis for managing the project.	3.3	1 1.2.1

EPB – Technical Specs

- **Architecture**
  - Web-based application, with supporting database
    - MS SQL Server® 2000 Relational Database Management System (RDBMS)
  - Web architecture: Active Server Page, MS .NET Framework® 1.1 (ASP.NET)
  - Programming Language: MS Visual Basic® .NET (VB.NET)
  - Scripting Language: HTML, Javascript
  - Master Page engine that uses only one Active Server Page (ASP) that dynamically retrieves required information (questions, client answers, document template text, etc.)
- **Development - Incremental life-cycle model**

The Second Wave – ML2 to ML3

- Shift Focus of Process Improvement Strategy from "Implementing CMMI®" to "Executing Sound Systems Engineering"
- Educate Project Managers on What's Expected
- Improve Project's Planning and Documented Processes
- Provide additional Training, Workshops and WBTs
- Incorporate ISO, Lean Six Sigma (LSS) and Balanced Scorecard (BSC) Initiatives

Provide Additional Training

- **All employees need a basic understanding of process improvement**
  - What is their process now?
  - How to add value by formalizing and improving their process (based on Organizational process)

- **All project teams need to fully understand the CMMI model (all processes, all levels)**
  - To understand all of the best practices and maturity levels
  - To comply/prepare for DoD and NAVY policy

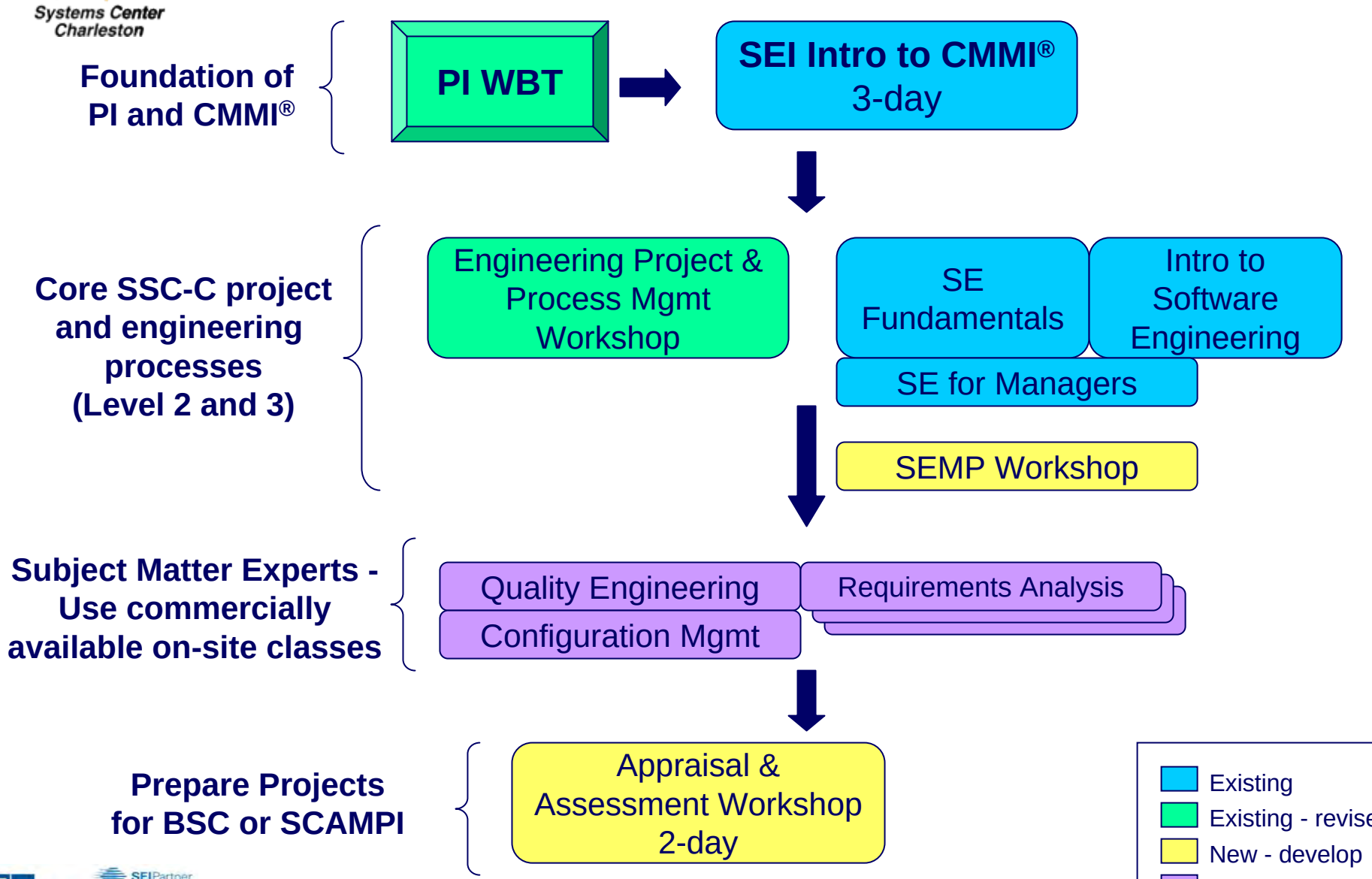
**** This accounts for some employees attending more than one course***

Provide Workshops

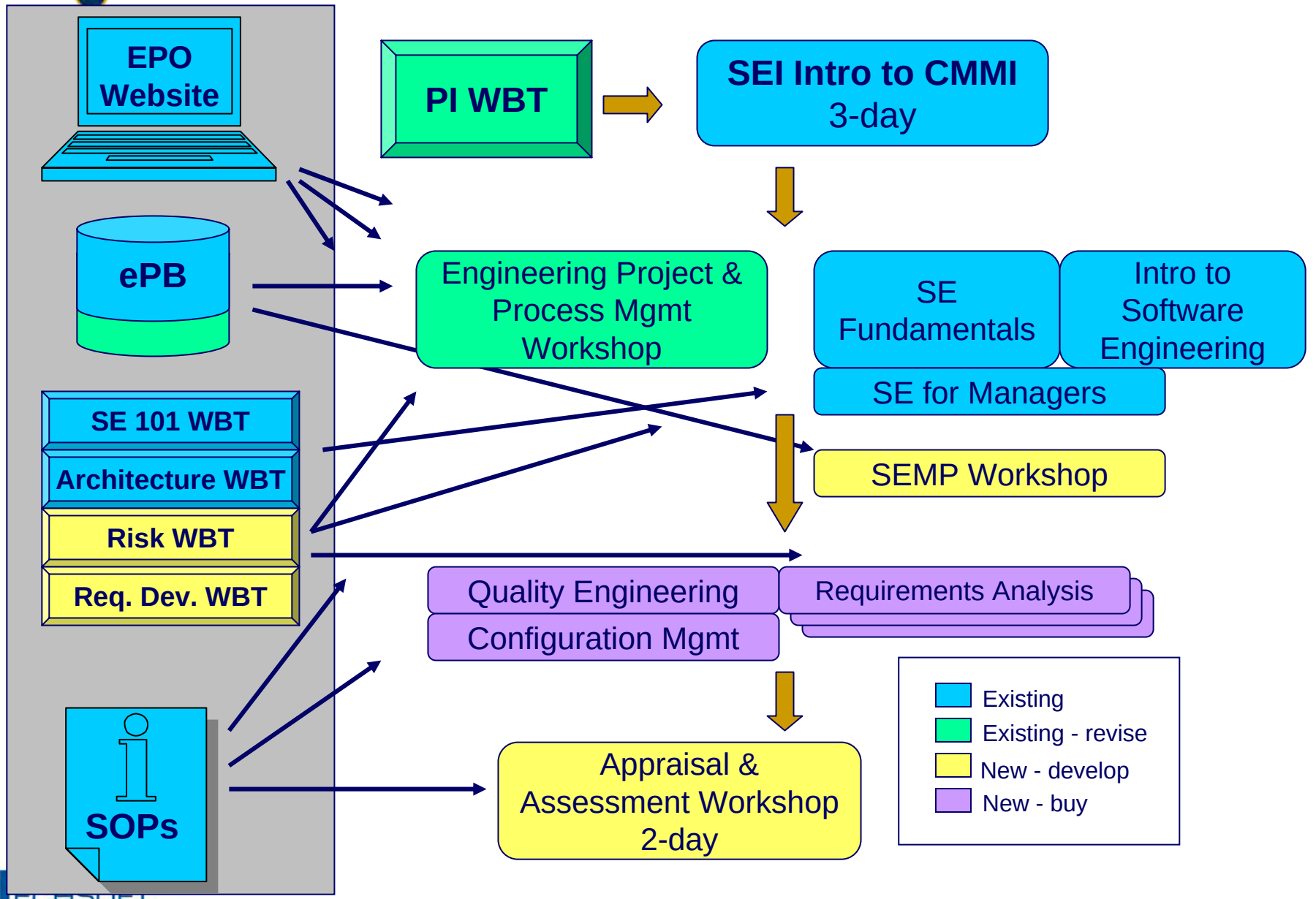
- **All project team members and supporting personnel need to know how to perform the standard processes and best practices required**
  - How to do good SE, CM, PPQA, Planning, Measurement, Risk, VER/VAL, etc.
- **To properly prepare for and complete an assessment or appraisal, key project team members need to map the project work products to the practices assessed.**

These needs can be depicted in a Training Architecture

Training Architecture

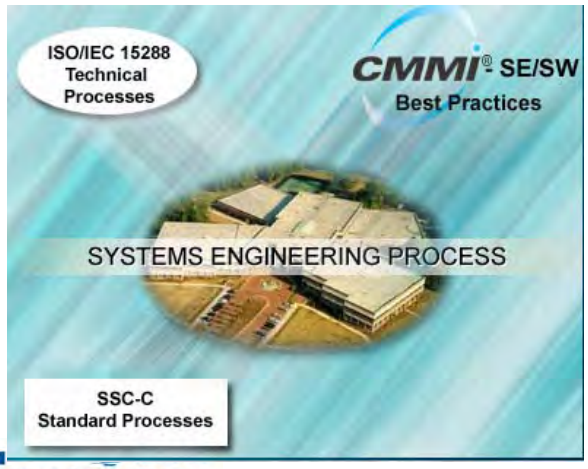


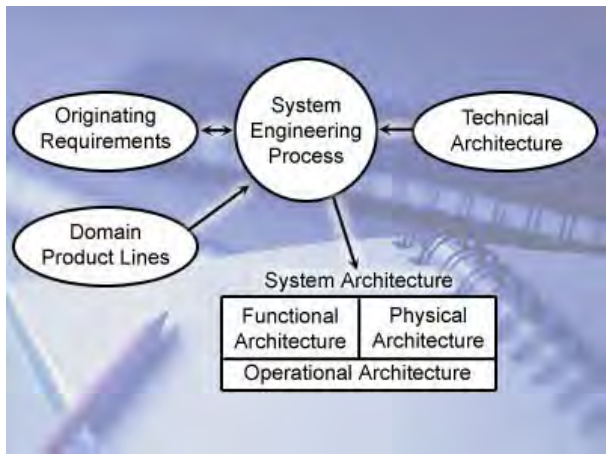
Training and Tools

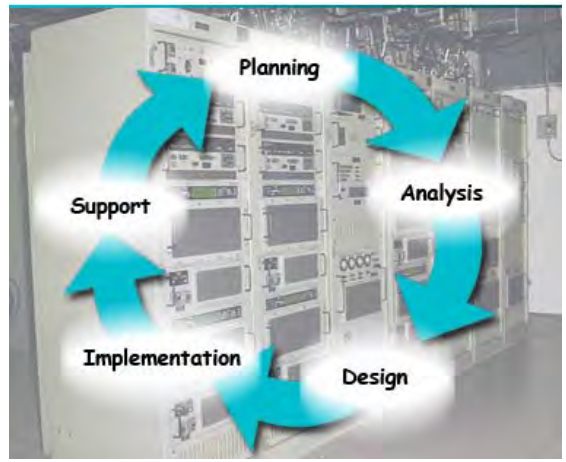


SE 101 Web-Based Training

- **Introduction to Systems Engineering WBT**
  - 10-module web based training
  - Closely aligned to SSC-C SE Process, SE Fundamentals Course, and ISO/IEC 15288
  - Includes hotlinks to referenced documentation
    - SSC-C Process manuals, policies, standards
  - Extensive branching for more detail

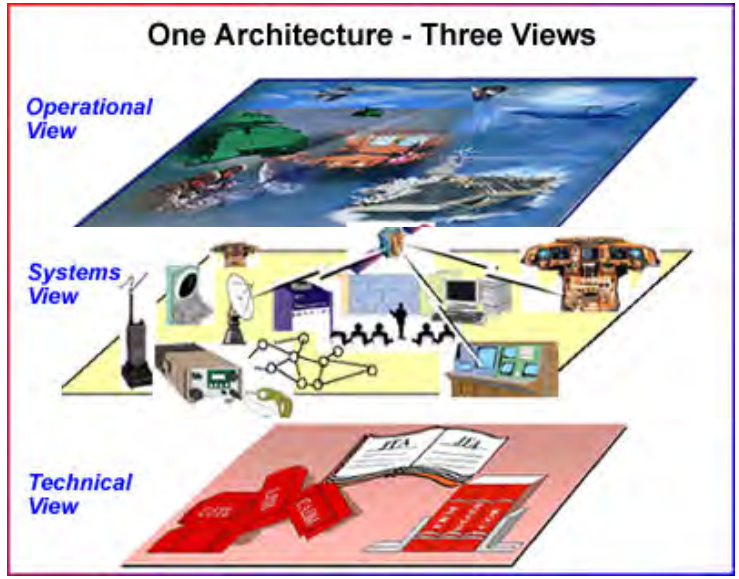






Topical WBTs

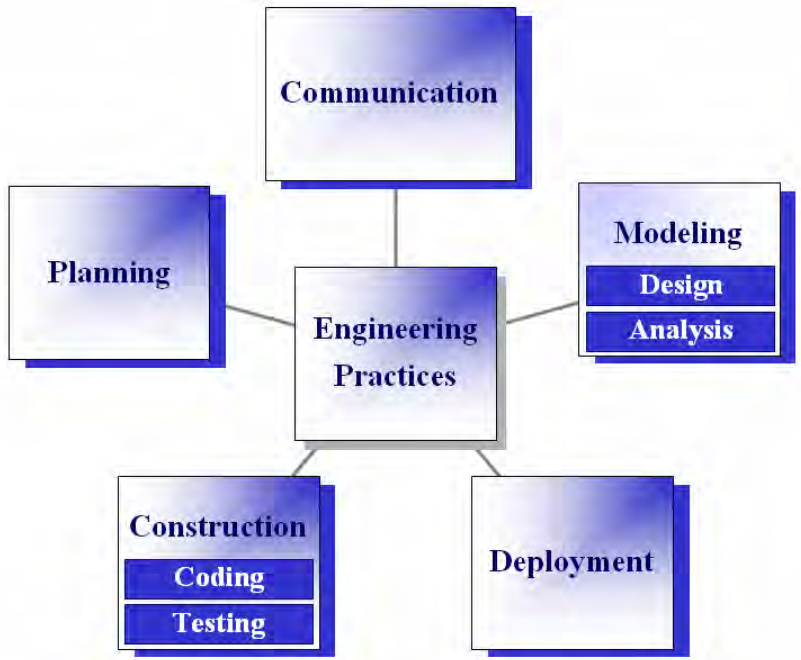
- **Developing web-based training courses in specific topics**
- **Architecture Development WBT - completed**
  - Introduction to Architecture Development and DoDAF
  - Designed to educate and promote value of system architecture to non-architects and new engineers
  - Tests for understanding
- **Risk Management WBT**
  - Risk identification
  - Analysis tools and techniques
  - Mitigation planning
  - Risk monitoring
- **Requirements Development**



Introduction to Software Engineering

- **Similar format to the Systems Engineering Fundamentals**
  - 3 days, primarily lecture
  - Aligned with the SSC-C Software Development Process Manual

- **Course Outline**
  - Intro to Software Engineering
  - Roles
  - Software Engineering Practices
  - Software Development Process
  - Software Maintenance
  - Managing Software Projects
  - Tailoring



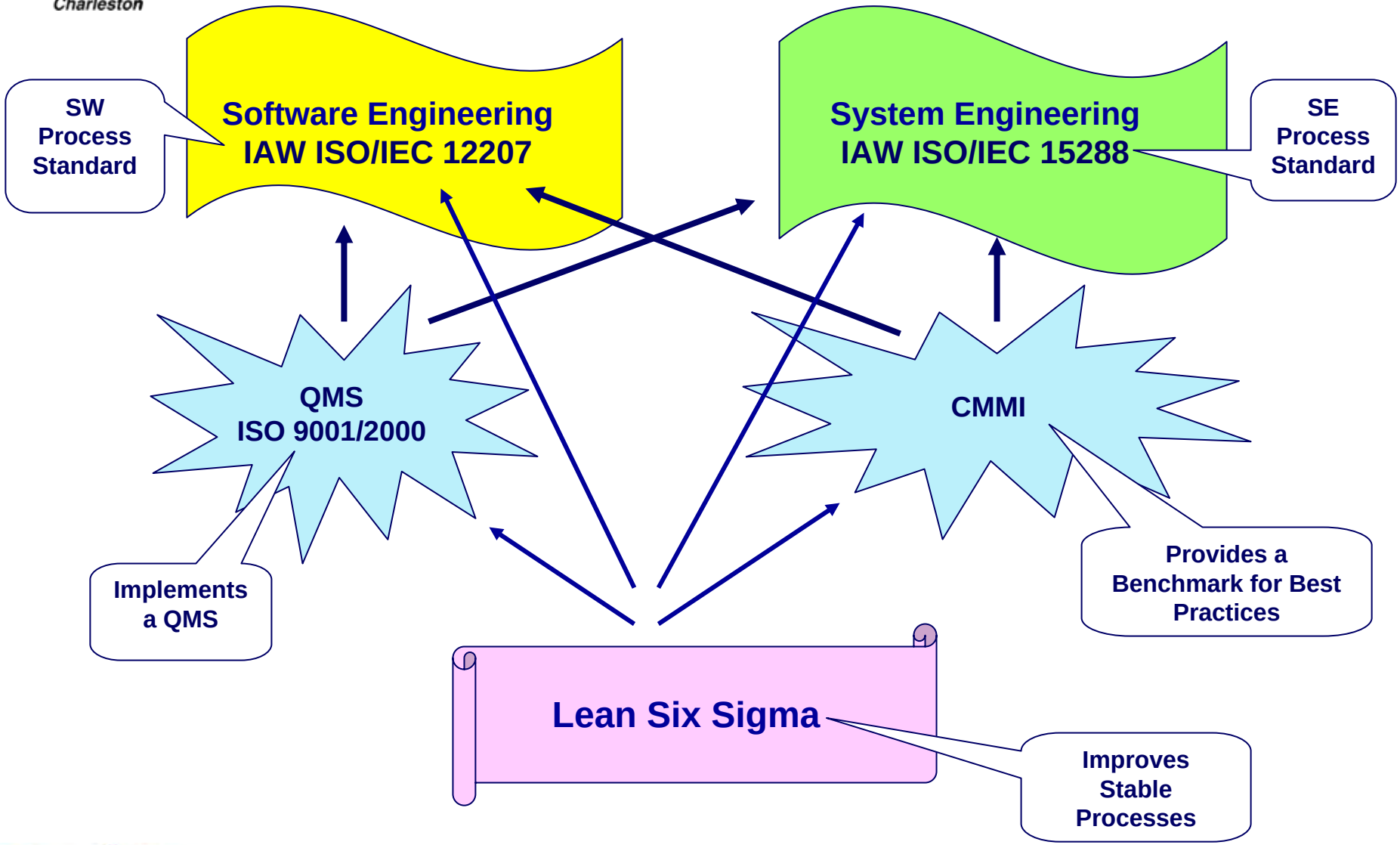
Engineering Project & Process Management Workshop

- **Multi-session workshop oriented "how to" class**
- **What is a good process? Is my process good?**
- **How to generate project plans**
  - What makes a good PMP, CM Plan, QA Plan…
  - How to use ePlan Builder
  - Hierarchy of plans (Based on level 2 or level 3 goals)
- **Configuration Mgmt**
  - Are my Configuration Items (CI's) and Change Control adequate?
- **PPQA**
  - How to execute a process review and work product review
- **Measurement and Analysis**
  - Are my measures measurable?
- **Requirements Management**
  - Traceability - simple to complex
- **Monitoring and Control using Reviews**

The Second Wave – ML2 to ML3

- Shift Focus of Process Improvement Strategy from "Implementing CMMI®" to "Executing Sound Systems Engineering"
- Educate Project Managers on What's Expected
- Improve Project's Planning and Documented Processes
- Provide additional Training, Workshops and WBTs
- Incorporate ISO, Lean Six Sigma (LSS) and Balanced Scorecard (BSC) Initiatives

A World Class Engineering Organization



ISO and LSS Initiatives

- ISO 9001/2000 is an internationally recognized standard for Quality Management Systems (QMS) Principles.
  - **ISO requires the Organization to focus upon organizational processes, the Customer, and continual improvement.**
  - **ISO requires documented processes and procedures that complement and supplement existing processes and procedures.**
  - **It is a common sense, documented system focusing on consistency, reliability, and improving the way businesses operate.**
  - **ISO provides elaboration of the CMMI QA best practices, giving you the detail to implement the Quality Management System**

- Lean Six Sigma is an Internationally recognized process improvement methodology that combines both Lean and Six Sigma.
  - **Lean minimizes waste and improves process flow.**
  - **Six Sigma improves process capability and eliminates process variation.**
  - **Lean Six Sigma is an aid in improving stable processes and process flow.**
  - **Lean Six Sigma is applied to stable, mature processes.**

ISO - CMMI Relationships

Systems Center Charleston

Hi-level view

ISO: **Quality Management System**

CMMI®:
OPF, OPD, PP, PPQA, CM, SAM;
GP 2.1, 2.2, 2.3, 2.6, 2.7, 2.8, 2.9, 3.1, 3.2

ISO: **Resource Management**
CMMI®:
PP, OT, OEI;
GP 2.3, 2.5

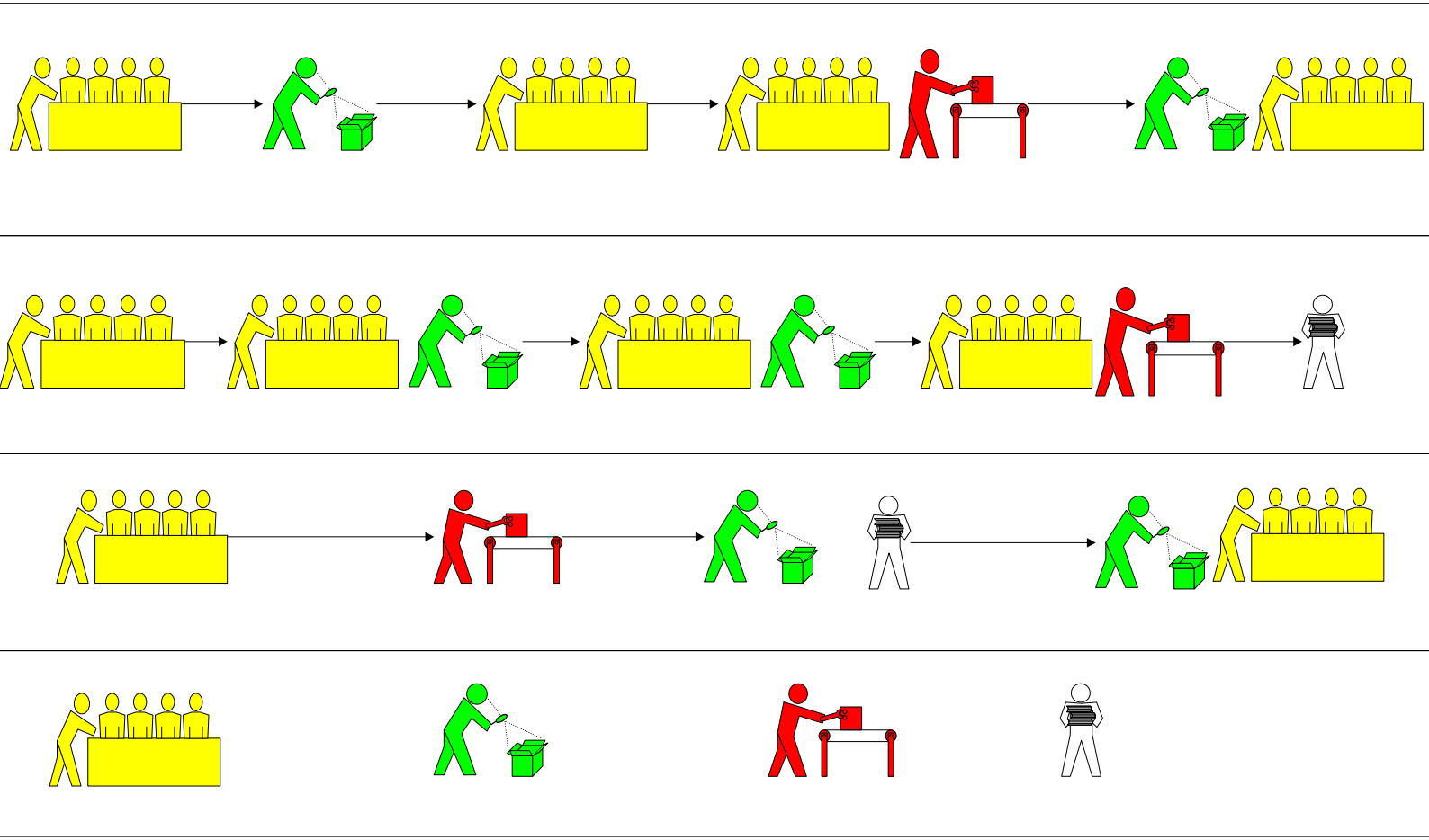
ISO: **Management Responsibility**
CMMI®:
OPF, OPD, RD, PMC, OPP, QPM;
GP 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.10, 3.1

ISO: **Product Realization**
CMMI®:
REQM, RD, TS, PI, MA, QPM, VER, VAL, OPD, PP, PMC, IPM, CM, SAM;
GP 2.1, 2.2, 2.3, 2.4, 2.6, 2.7, 2.8, 2.9, 2.10, 3.1

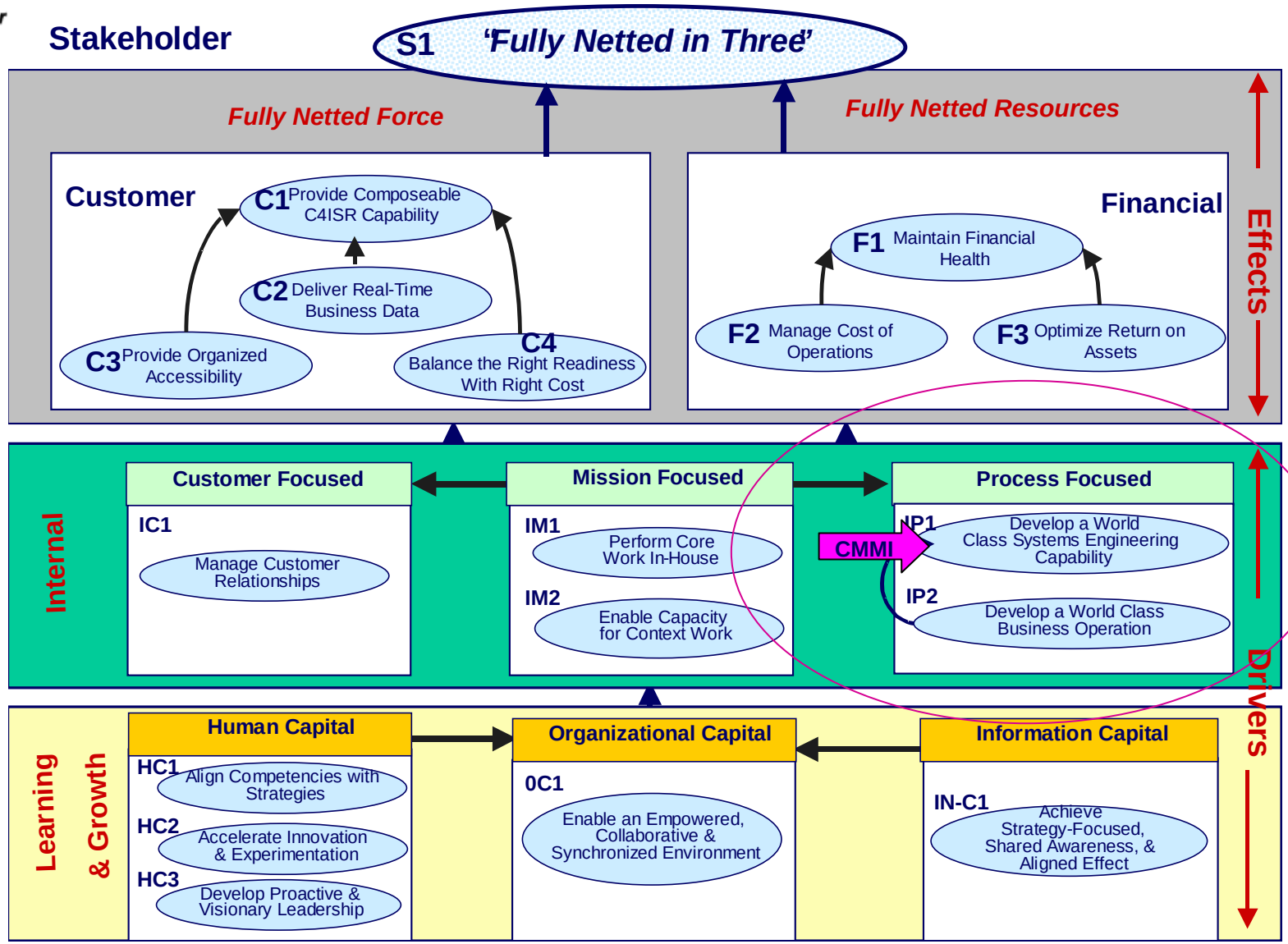
ISO: **Measurement, Analysis & Improvement**
CMMI®:
PMC, PPQA, MA, CM, REQM, RD, SAM, OPF, VER, VAL, OID, OPP, QPM, CAR;
GP 2.1, 2.2, 2.4, 2.6, 2.8, 2.9, 3.2

CMMI®, LSS and ISO Comparison

CMMI LSS ISO improvement framework comparison



Balanced Scorecard Strategy



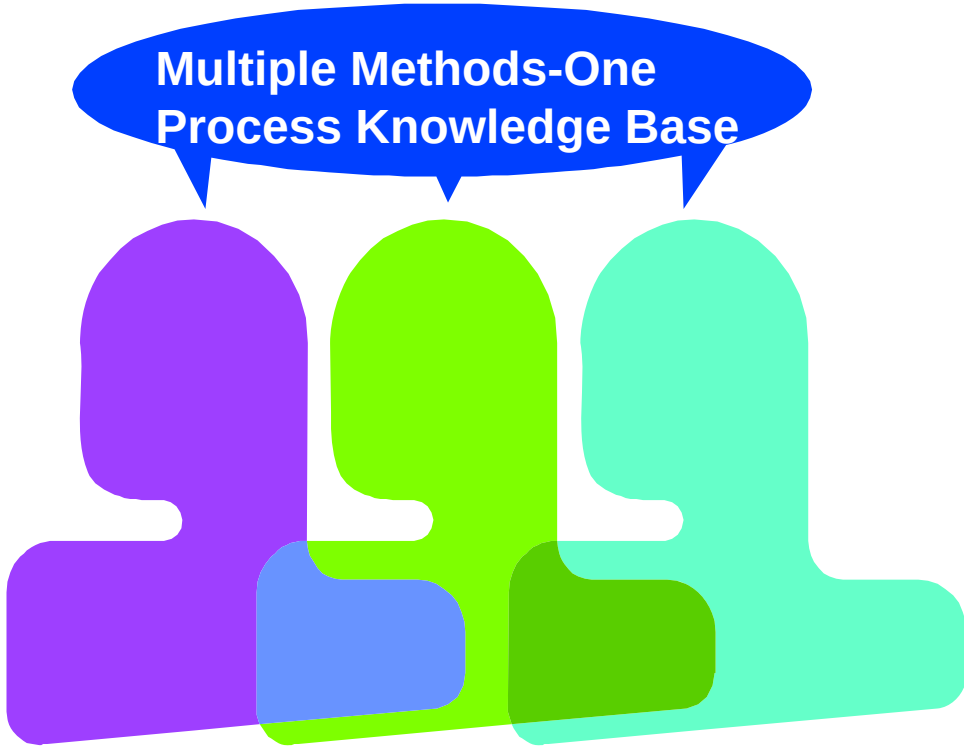
Balanced Scorecard Based on CMMI®

SPAWAR Systems Center Charleston

erspectives	Objective Headline	Objective Statement	Measure	Purpose
Customer (Internal)	IC1: Manage Customer Relationships	Construct and align our enterprise processes to insure maximum customer involvement.	On-line Customer Profile - Percent of customers for which we have current tasking and profiles that are enterprise wide accessible	To drive the customer focus thru all engineering and business processes
Mission	IM1: Perform Core Work In-House	Apply our limited government resources to the mission-critical and strategy-valued functions	Government Man-Hours on Core Work - Percent of government man-hours spent on core	To increase percentage of core government labor hours to total government man-hours
	IM2: Enable Capacity for Context Work	Maintain a sufficient level of contract capacity to support our outsourcing and out-tasking requirements.	Context Ceiling Capacity - Available contract ceiling with actual burn rate	Monitor available ceiling to ensure it exceeds expected work
Process	**IP1: Develop a World-Class Engineering Capability**	**Establish standard engineering processes that provide a qualitative competitive edge in the global market**	**A. Technical Maturity Assessments. Average ratings from assessments.** **B. Level Two/Three/Four Projects - Count the number of department projects self-assessed at Level 2/3/4.**	**Drive the level of implementation of common Systems Engineering practices at the Command**
	IP2: Develop a World-Class Business Operation	Establish standard business processes that complement our engineering processes and provide a competitive edge in the global market	A. Core business Processes Captured and Documented - Ratio of the business processes within the functional areas in Enterprise Process Management Architecture that are defined and documented with proper interfaces identified and controlled / facilitated	To promote standardization of processes and greater efficiency of overall business operations
			B. Core Business Process Improved - Dollars saved or costs avoided by the improvement of business operations processes, with their organizational interfaces accommodated by the Enterprise Process Management Architecture	To promote standardization of processes and greater efficiency of overall business operations

Incorporate ISO, LSS, BSC and CMMI®

- **Implementation**
  - Use all to complement each other
  - Promote consistent implementation from Command down
- **Benefits**
  - Objective evaluation and QA available to all projects, large or small
  - Cost sharing for QA or process reviews on an as-used basis
  - Central tracking of issues and lessons learned for sharing across division and department

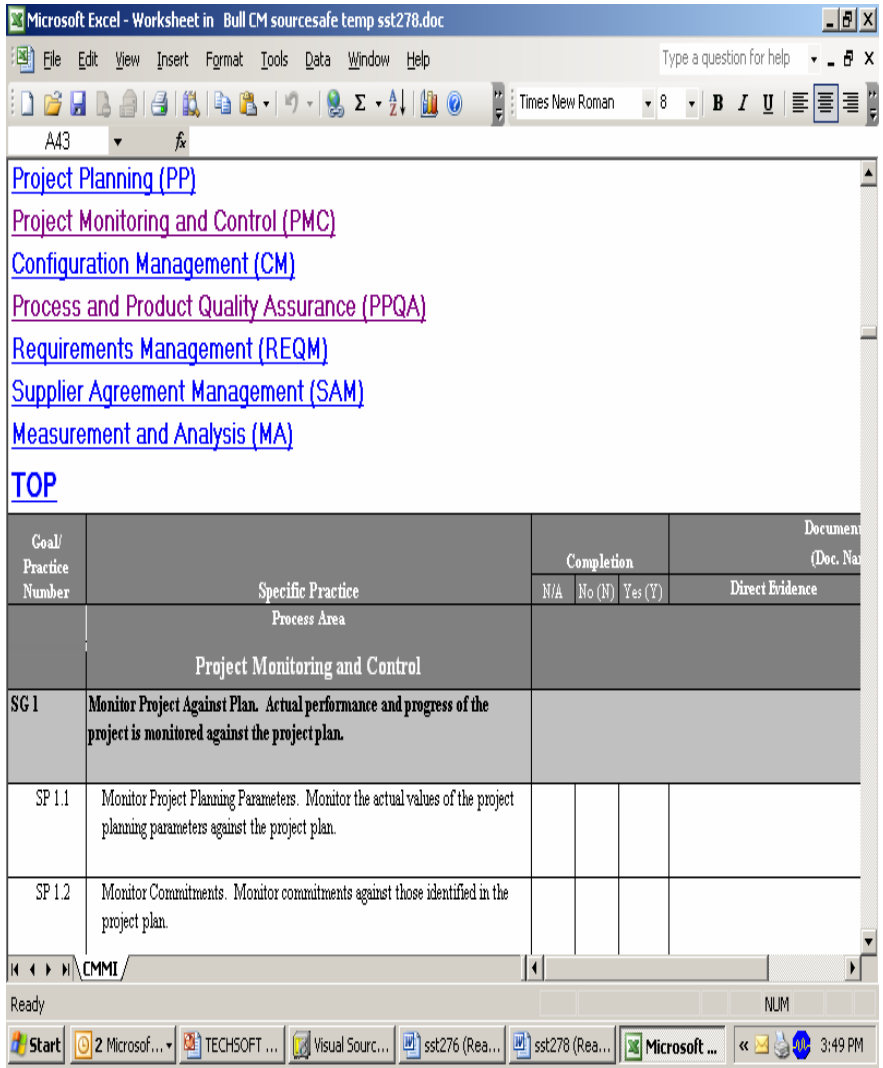


The Second Wave – ML2 to ML3

- Develop internal “self-assessment” process for measuring ongoing implementation of Maturity Level 2 processes
- Populate EPO/CMMI® Website with ‘best examples’
- Implement Tailoring Guidelines
- Implement SSC-C Measurement Repository
- Implement ML2-to-ML3 Action Plans
- Continue to Measure and Communicate Progress
- Maintain Momentum and Commitment to Goals

Internal "Self-Assessment" Process

- Good starting point for project to understand what's required
- Teaches difference between Direct and Indirect evidence and the need for both
- Serves as the BSC Measure of project's progress towards ML2/ML3/ML4
- Artifacts are reviewed for compliance



Populate Website with 'Best Practices'

- Improved/formalized process to populate EPO/CMMI® Website with 'best examples'
  - EPO submittal form to submit via email
  - Direct and timely response that artifact was received
  - Process for SME to evaluate artifact and recommend posting, holding for future date, not posting
  - Process for project to submit artifact with Do Not Post notice
  - Process to notify when submittal is posted or reason for not posting

Improved Content and Usability of Website

- Gave Website a “Facelift”
- Populated it with many “Good Samples” of ML2 and ML3 Plans and SOPs for projects to use
- Helps Institutionalize GP 3.2 for all Process Areas
  - ***Collect work products, measures, measurement results, and improvement information derived from planning and performing the process to support the future use and improvement of the organization’s processes and process assets.***

The Second Wave – ML2 to ML3

- Develop internal “self-assessment” process for measuring ongoing implementation of Maturity Level 2 processes
- Populate EPO/CMMI® Website with ‘best examples’
- Implement Tailoring Guidelines
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- Implement ML2-to-ML3 Action Plans
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Tailoring Guidelines

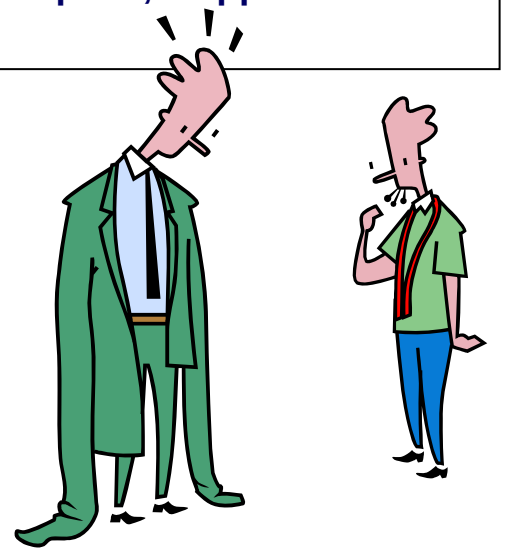
Excerpts from the *"SSC-C Developing Project Processes SOP"…..*

In order to initiate the Tailoring Process, a Project/Task Leader follows the guidance provided in the SSC-C Tailoring Guidelines and the SSC-C Integrated Project Management Process Manual to establish and manage a project according to an integrated and defined process that is tailored from the organization's set of standard processes. The SSC-C Tailoring Guidelines can be found on the EPO website.

There are six activities within the Tailoring Process, described in detail in the SSC-C Tailoring Guidelines:

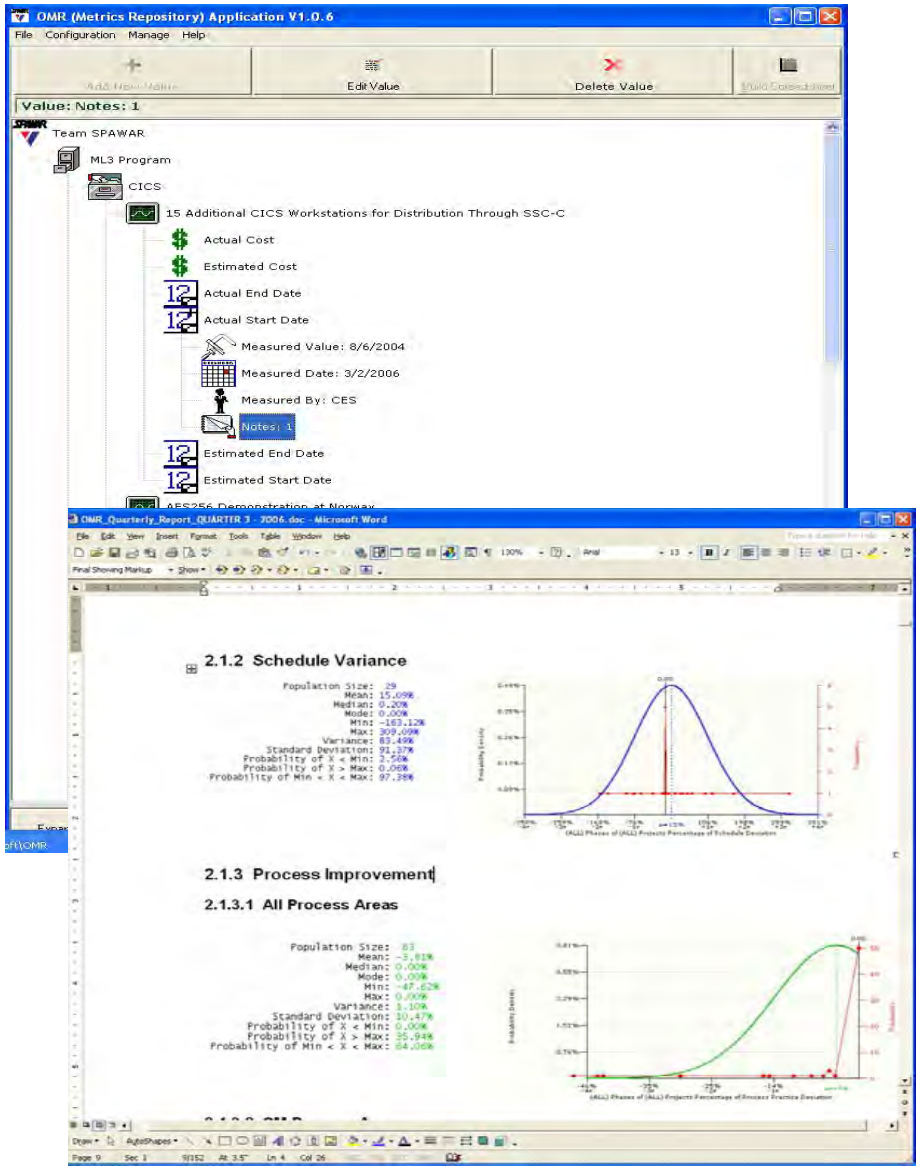
- Establish the project profile
- Select project processes from the SSC-C Set of Standard Processes
- Complete the Tailoring Form
- Complete Waiver Request, if applicable
- Complete Peer Reviews of Tailoring Forms and Waiver Request, if applicable
- Department Head reviews Waiver Request

The results of the completed Tailoring activities are used in conjunction with the SSC-C Integrated Project Management Process Manual to establish the Project's Defined Process. The basis for establishing the SSC-C Project's defined process is SSC-C's standard processes. The SSC-C Systems Engineering Process Manual, SSC-C Software Development Process Manual, and the SSC-C Software Maintenance Process Manual provide the detailed activities and tasks needed to successfully implement the process requirements provided in the SSC-C Level 2/3 Process Manuals.



Measurement Repository

- Built SSC-C Measurement Repository (OMR) for projects to use for managing their projects
  - Capturing standardized cost, schedule, and process performance
- Implementation included hands on training in reporting and using OMR
- Laying groundwork for higher maturity



ML2 to ML3 Action Plans

- PI Plan to address ML2 findings and ML3 actions
- Lessons learned from SCAMPIs
- Incorporate Tailoring Guidelines
- Provide metrics to OMR
- What's ML3 all about?
  - Peer Reviews
  - SEMPs
  - DAR Plan
  - RSKM Plan

The Second Wave – ML2 to ML3

- Develop internal “self-assessment” process for measuring ongoing implementation of Maturity Level 2 processes
- Populate EPO/CMMI® Website with ‘best examples’
- Implement Tailoring Guidelines
- Implement SSC-C Measurement Repository
- Implement ML2-to-ML3 Action Plans
- Continue to Measure and Communicate Progress
- Maintain Momentum and Commitment to Goals

Measure and Communicate Progress

- Continuing similar approach to Maturity Level 3
- Successful ML3 Program (with 4 projects) in July 2006
- Another project achieved CL3 in 16 Process Areas
- 4 more projects with planned SCAMPIs in 2006
- Continuing to use Continuous Representation and Equivalent Staging for early successes
- S2E Newsletter is a great means of communicating status and success

Maintain Momentum/Commitment to Goals

- **2007**
  - Conduct interim Maturity Level 3 appraisals on projects
  - Correct findings and strengthen institutionalization
  - Conduct Command Maturity Level 3 appraisal in April 2007
  - Incorporate new version of CMMI model (V1.2)
  - Incorporate IPPD (Integrated Product and Process Development)
  - Mentor projects to Maturity Level 3
- **2008 - 2009**
  - Begin Maturity Level 4/5 implementation
  - Establish/Refine/Compose organizational and project measures
  - Increase collection of project, process, and organizational measurement data
  - Conduct interim Maturity Level 4 appraisals on projects

Summary[1]

- Decided on Approach – use CMMI® for Process Improvement and Measuring Progress
- Using extensive research, determined the 'Critical Success Factors for Implementing CMMI®'
- Built Plan of Action
- Advertised Early Successes
- Implemented Plan Successfully for Phase 1
- First SPAWAR Systems Center to achieve CMMI® Maturity Level 2 in April 2005

Summary²

- Following Plan for Phase 2 – CMMI® Maturity Level 3
- Focus on System Engineering Excellence
- Continue to apply "Lessons Learned"
  - Findings from SCAMPIs
    - Peer Reviews, Effectiveness of DAR, Senior Management Involvement, PPQA
  - Feedback from using the SSC-C Organizational Assets
  - Feedback for using the SSC-C Organizational Measurement Repository
  - Feedback from ePlan Builder (MR Process in place)

Summary[3]

- Leveraging from the first program in SPAWAR Systems Center to achieve CMMI® Maturity Level 3
  - Interviews and pictures in S2E Newsletter
  - Sample ML3 Documents on Website
  - Findings from SCAMPI
- Continuing to prepare for the Command Maturity Level 3 appraisal in April 2007
- Laying groundwork for higher maturity

Summary[4]

Systems Center Charleston

- **Aggressive SE Program**
- **Industry Standards**
  - Systems Engineering
  - Software Engineering
- **Best Practices**

CMMI LEAN SIX SIGMA ISO 9001

- **Automated Tools**
  - ePlanBuilder
  - eWBS
- **Training – 1,600+**
  - SE Fundamentals - 305
  - Web-Based Training courses
    - SSC-C PI; Intro to SE; Arch. Dev.

corpweb2.spawar.navy.mil/cmmi/

- **Successes**
  - April 2005 Command Achieved CMMI® Maturity Level 2 as certified by Software Engineering Institute
  - July 2006 first program to achieve CMMI® Maturity Level 3
  - 1st SPAWAR Systems Center to achieve these levels
- **Goals**
  - World-Class SE Program
  - Support Command Balanced Scorecard
  - April 2007, Command to achieve CMMI® Level 3

SPAWAR
Systems Center Charleston

Thank you !

Any Questions ?

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Phone: 843-218-5706

Sandee Guidry
Technical Software Services, Inc.
Email: sdguidry@techsoft.com
Phone: 850-469-0086

Achieving the Vision

CMMI Technology Conference
Luncheon Keynote Address

November 14, 2006

Mark D. Schaeffer
Director, Systems and Software Engineering
Office of the Under Secretary of Defense (AT&L)

CMMI Vision*

The initial vision for CMMI was to integrate the competing maturity models and provide a framework for more consistent process improvement

- Cause integration of the functional disciplines within organizations and across programs
- Increase systems engineering and software process maturity as organizations migrate from the sun-setting CMMs to CMMI

Build on and improve the significant work done on CMM-like models

* Extract: 2004, 2005 CMMI Conference Keynotes

Have We Lost Sight of the Goal?*

- The end goal of CMMI is to provide a model for continuous process improvement to achieve:
  - Reduced cycle times
  - Meet cost and schedule targets
  - Improved quality
  - Common Systems Engineering and Software model

When achieving a level replaces the focus on continuous improvement, we've lost sight of the goal

* Extract: 2004, 2005 CMMI Conference Keynotes

How We Got Where We Are*

- CMMI Sponsors opted to pursue staged and continuous models to preserve legacy
  - SW-CMM, staged
  - SECM, continuous
- Acquiring organizations do not have full understanding of how CMMI is intended to be used
  - What a specific level at the enterprise level actually means to an acquisition program
  - That the process and people evaluated to obtain a level are not necessarily applied to their program
  - Achievement of a specific level may or may not have meaning to any given acquisition program

* Extract: 2004, 2005 CMMI Conference Keynotes

Efforts to Define the Problem

- NDIA report to DoD - CMMI issues, Feb 2005
- NDIA Workshop on CMMI Use in DoD Programs, Sept 2005
  - Explored issues, and identified a set of recommendations
- Spring ‘06 Government Review and Assessment
  - Validated Workshop findings
  - Refined and augmented issues, developed recommended actions
  - Directly influenced CMMI v1.2
- Ongoing: DCMA data call

Summary of CMMI Problems
DoD Sponsor Report 2006

- Programs execute at lower maturity levels than their organizations have achieved and advertised
- High-maturity practices are not consistently applied at the project level after contract award
- How to ensure new projects will incorporate CMMI processes
- Appraisal sampling procedures – how to ensure adequate coverage of the organizational unit
- Appraiser quality – training, consistency
- Lack of agreement on what constitutes Levels 4 and 5
- Need to converge to a single representation
- Content of appraisal disclosure statements is lacking
- Inadequate training and education for acquirers
- Should CMMI be used for source selection

What is the resolution of these issues?

CMMI Government Assessment: Spring 2006: 8 Major Issues for Resolution

1. High Maturity
   - Lack of consistency and agreement on what constitutes levels 4 and 5
2. Integrity
   - If certified, how can programs be performing at a lower level?
3. Organizational Commitment
   - Commitment and ability to implement processes on new projects
4. Acquirer Education
   - Misunderstanding and misuse of CMMI by Acquirers

CMMI Government Assessment: Spring 2006: 8 Major Issues for Resolution

5. Two representations
   - Staged and Continuous representations
6. Model Complexity and Size
   - Balancing content (700 pages) with ease of use
7. New Constellation Strategy
   - Impacts of the new architecture on original goal
8. Intended usage of CMMI
   - Current application of CMMI against original and future goals

Improvements Implemented in CMMI v1.2

- "Level for Life" - **ELIMINATED**
- Organizational Commitment
  - Added new goal and 2 practices to CMMI v1.2 to address commitment to processes at project start-up
- Appraisal Sampling
  - Developed new sampling rules
  - Precise definition of sample size and organizational coverage
- Appraisal Disclosure Statement (ADS)
  - Added specific sampling information to enhance transparency
  - DoD Contractor ADSs will be posted for Government acquirer access

Improvements Implemented in CMMI v1.2

- High maturity appraisers
  - Established certification requirements for appraisers
  - Oral exams being given to all high maturity appraisers
  - High maturity training course under development – Oct 07 release
- Guidebook for Acquirers
  - Provide concise information to acquirers on supplier use of CMMI
  - Expected release January 2007
- Appraisal Integrity
  - Lead Appraiser cannot be from the appraised business unit
  - Lead Appraiser certification of sample, and appropriateness of Level 4/5 practices
  - SEI is conducting appraisal audits

Remaining Opportunities …and some Questions

- Revisit Levels 4 and 5
  - Do we need something else to define high maturity?
- Lean the Model and the Appraisal Method
  - Eliminate cumbersome material included for legacy reasons
  - Eliminate staged representation?
- Evaluate Constellation strategy
  - Will Constellations result in stovepipes? Do they make sense?
- Assess next generation process improvement
  - Should CMMI be used for source selection?
  - Given worldwide adoption, is the CMMI Governance Structure appropriate?

Need your ideas and participation

Moving Forward

- Evaluate changes to the CMMI v1.2 product suite to ensure improvement goals are really being met
- Monitor constellation evolution
  - Pilot CMMI-ACQ model
  - Assess implementation
- Continue to capture the right knowledge in the CMMI Guidebook for Acquirers
- Leverage DCMA for actual performance monitoring

Reinforce the basics

- Continue focus on refining what CMMI was intended to achieve
  - Does the current product suite allow us to achieve those objectives?
- Make sure that v1.2 changes bring value added to the user
  - Assess the value of each change
- Ensure changes facilitate achievement of the CMMI objectives

The Department is committed to ensuring CMMI has integrity, and is responsive to next generation process improvement needs

Questions?

What We Learned Along the Way

Where We Were:

Slides from My 2004 Luncheon Address

What We Have Accomplished, And What's Left To Do

NDIA Workshop and Summit on CMMI Use in Acquisition

- Held on September 7 & 8, 2005
- Issues Discussed
  - Background on how organizations approach CMMI appraisals and why
  - Use of Appraisal Disclosure Statement by acquiring organizations
  - Formal guide to CMMI Usage for DoD
  - Training for DoD Acquisition Organizations in the use of CMMI for DoD
  - Government lack of understanding of need for mature SE content and practice
  - Specifying or requiring CMMI in RFPs

CMMI Revitalization

- DoD has invested heavily in the CMMI project as an important Systems and Software Engineering (SSE) initiative
- Problems have surfaced with CMMI
- This briefing will describe these problems, actions being taken, and future plans:
  - Where We Were
    - *Slides from My 2004 Luncheon Address*
  - What We Learned along the Way
    - *Workshops, Assessments, Data Calls*
  - What We Accomplished and What's Left to Do
    - *Resolution of Some Issues for v. 1.2*
    - *Moving Forward*

DCMA Survey and Data Collection*

- Survey conducted in response to OUSD (AT&L) request:
  - "How well do suppliers maintain their CMMI/CMM assessed levels during contract execution?"
- Data collected on 30 Programs (first in a quarterly collection process)
- ACAT Levels reported
  - ACAT – IAC – 1 program
  - ACAT IC – 8 programs
  - ACAT ID – 18 programs
  - ACAT II – 3 programs
- Claimed maturity levels (MLs)
  - 7 CMM ML3
  - 1 CMM ML4
  - 10 CMMI ML3
  - 2 CMMI ML4
  - 10 CMMI ML5

*** Excerpt from DCMA initial findings briefing, 3 Nov 06**

Initial DCMA data reveals…

- Programs are adhering to organizational processes
  - 77% of programs find the supplier performs their defined processes with minor non-compliance
  - The majority of programs do tailor 0-10% of their processes
- Reasons for process non-adherance
  - Primary reason is schedule
  - Cost, resources, and customer impacts are also causes
- There does not appear to be a link between higher maturity levels and program performance
  - No correlation between maturity levels and CPI/SPI

Issue Area 1: High Maturity/Level 4 & 5

- Issues:
  - Lack of agreement on what constitutes Levels 4 and 5
  - High-maturity practices are not consistently applied at the project level after contract award
- Resolution:
  - Certification of high-maturity appraisers is now in place
    - July 06 workshop on high maturity training determined the requirements for which the lead appraisers have to provide evidence in order to do high maturity appraisals
    - Previous courses, oral questions, etc.
  - Body of Knowledge on high maturity will be developed and available by October 2007
  - Lead Appraisers must certify that level 4 and 5 appraised subprocesses map to organization's business objectives

Issue Area 2: Integrity – Programs Execute at Lower Levels than Achieved and Advertised

- Findings that lead to Integrity Issue:
  - Issues with appraiser quality – training, consistency, independence
  - Content of Appraisal Disclosure Statements (ADS) lacking
  - Appraisal sampling inconsistent, and influenced by appraised organization
- Resolutions:
  - CMMI v1.2 training upgrade: face-to-face training with focus on integrity
  - Eliminated “level for life”— now 3 year limit
  - DCMA developing a survey related to CMMI appraisal ratings and program performance to begin to measure the problem
  - CMMI v1.2 updates to the ADS (separate chart)
  - CMMI v1.2 updates to Sampling (separate chart)

Issue Area 2: Integrity - continued

- Issue
  - Appraisal sampling inconsistent, and influenced by appraised organization
  - Appraisal sampling representation of the organizational unit
- Resolutions:
  - Precise definition of the sample
    - Organizational scope: name, type, location
    - Organizational Unit Coverage: size, application domain, geographical breadth, project type expressed in percentages of total organizational unit
    - Projects excluded and rationale
  - Lead Appraiser certification that focus and non-focus projects are representative of organization
  - Lead Appraisers must come from an organization other than the business unit being appraised

Issue Area 2: Integrity - continued

- Issue:
  - Content of Appraisal Disclosure Statement (ADS) is not representative of CMMI appraisal data

- Resolution: v1.2 ADS requires improved level of detail
  - Provides details on appraisal sample
    - Organizational unit, projects, domains
  - Provides Lead Appraiser certifications
    - Project sampling is representative
    - Level 4/5 certifications are based upon practices that represent organizational business goals
  - All appraisals performed after 28 Nov 2006 must use ADS v1.2 (includes CMMI v1.1 appraisals)
  - DoD contractor ADS's will be posted (website tbd) for Government acquirer review

Issue Area 3: Organizational Commitment

- Issue:
  - How to ensure new projects will incorporate CMMI processes
- Solution:
  - Added new goal and two practices to Operational Process Focus (OPF) PA to stress deployment of processes to projects.
  - Added text in Integrated Project Management (IPM) PA to emphasize having a defined process at project start-up
  - CMMI Guidebook for Acquirers will discuss need to address project level implementation with developers

Issue Area 4: CMMI Guidance for Acquirers

- Issues
  - Inadequate training and education for acquirers resulting in misrepresentation and misuse of CMMI
- Solution
  - *CMMI Guidebook for Acquirers*
    - Due out after the first of the year
    - Will address how CMMI should be used by acquirers, how to interpret appraisal results, how to treat CMMI throughout the lifecycle
  - Development of the CMMI-Acquisition Constellation

CMMI TECHNOLOGY CONFERENCE & USER GROUP

AN ENTERPRISE APPROACH TO PROCESS IMPROVEMENT

VADM WALLY MASSENBURG

COMMANDER,
NAVAL AIR SYSTEMS COMMAND

14 NOVEMBER 2006

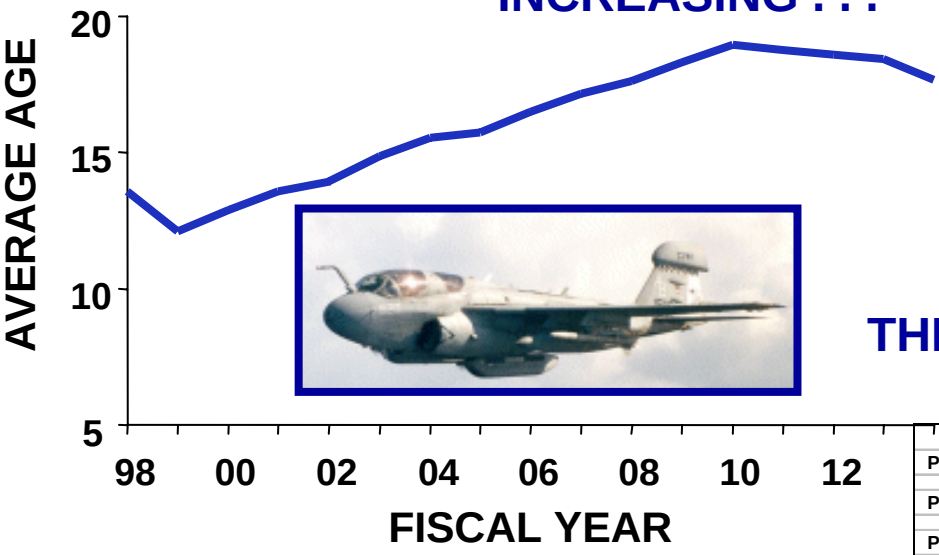
OUTLINE

- **OUR ENTERPRISE JOURNEY**
- **AIR*SPEED* SUCCESS STORIES**
- **NAVY ENTERPRISE: THE WAY AHEAD**

OUR ENTERPRISE JOURNEY

THE DILEMMA

20-YEAR-OLD AIRCRAFT ARE COSTLY TO MAINTAIN . . .
MAINTENANCE MAN-HOURS PER FLIGHT HOUR
INCREASING . . .



. . . AND WE CAN'T AFFORD TO BUY THE NUMBER OF NEW AIRCRAFT WE NEED

	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11
PB98	71	125	144	150	164								
PB99	71	119	143	154	164								
PB00		105	140	163	183	187	201						
PB01			128	130	173	177	187						
PB02				88	92	115	119	143	155				
PB03					90	85	105	147	193				
PB04						100	100	133	191	254	302		
PB05							111	134	183	238	283		
PB06								128	170	195	242	248	242

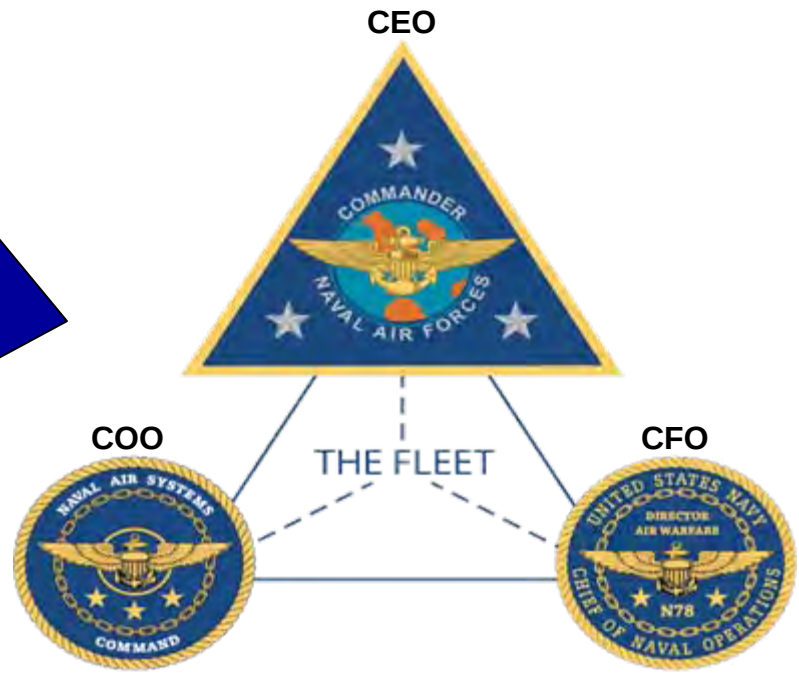
THE PROBLEM:

WE NEED TO BUY AN AVERAGE OF 190 NEW AIRCRAFT EACH YEAR TO MAINTAIN OUR AVERAGE AIRCRAFT AGE

NAVAL AVIATION ENTERPRISE LEAN SIX SIGMA (LSS) JOURNEY

- **THE YEAR IS FY01 . . .**
  - CURRENT READINESS . . . $1B DEFICIT
  - FUTURE READINESS . . . NEED MORE AIRCRAFT
- **CNO EXECUTIVE BOARD DIRECTION . . . DECEMBER 2000**
  - SINGLE PROCESS OWNER FOR NAVAL AVIATION
  - FIX CURRENT READINESS
  - AFFORD FUTURE READINESS

CONCLUSION
WE NEEDED TO CHANGE OUR BEHAVIOR TO ACHIEVE DIFFERENT OUTCOMES . . .



NAVAL AVIATION ENTERPRISE

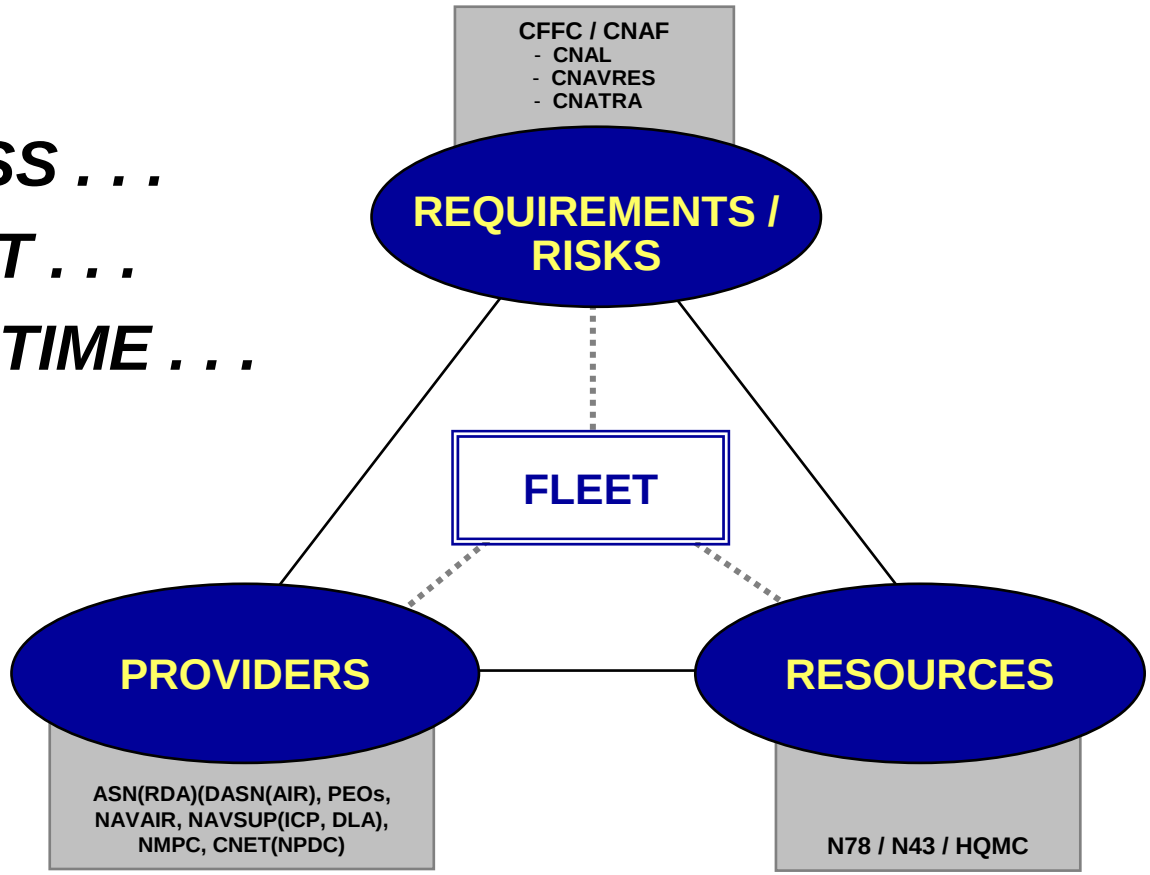
NAVAL AVIATION VISION

RIGHT FORCE . . .

RIGHT READINESS . . .

RIGHT COST . . .

RIGHT TIME . . .



. . . TODAY, AND IN THE FUTURE

ENTERPRISE PRINCIPLES

- APPLY A *PROCESS* PERSPECTIVE
- UTILIZE A SET OF CONSISTENT, INTEGRATED, AND HIERARCHICAL *METRICS*
- ENSURE FULL AND CONSISTENT *TRANSPARENCY* OF DATA AND INFORMATION THROUGHOUT
- ESTABLISH AND MAINTAIN PROCESS *DISCIPLINE* THROUGHOUT
- ESTABLISH AND MAINTAIN *ACCOUNTABILITY* FOR ACTIONS AND RESULTS THROUGHOUT
- APPLY AN *INTEGRATED GOVERNANCE* STRUCTURE

A DELIBERATE, DISCIPLINED PROCESS TO ACHIEVE AVIATION UNITS READY FOR TASKING AT THE RIGHT COST . . . TODAY AND IN THE FUTURE

OPERATING AS AN ENTERPRISE

- **SINGLE PROCESS OWNER**
- **SINGLE FLEET-DRIVEN METRIC:**
  AIRCRAFT AND CARRIERS READY FOR TASKING AT REDUCED COST **(CONTINUING TO MATURE)**
- **VALUES – WHAT WE BELIEVE**
  - ***FLEET READINESS***
  - ***"COST-WISE" (LESS $s)***
  - ***TIME ON WING (LESS STUFF)***
  - ***SPEED (LESS TIME IN MAINTENANCE)***
  - ***PEOPLE (CONTINUOUS IMPROVEMENT)***
- **THREE MAIN FOCUS AREAS:**
  - **READINESS: TODAY, TOMORROW, AND FUTURE**
  - **TOTAL FORCE READINESS**
  - **COST MANAGEMENT**

APPROACH

NEED TO DEFINE:

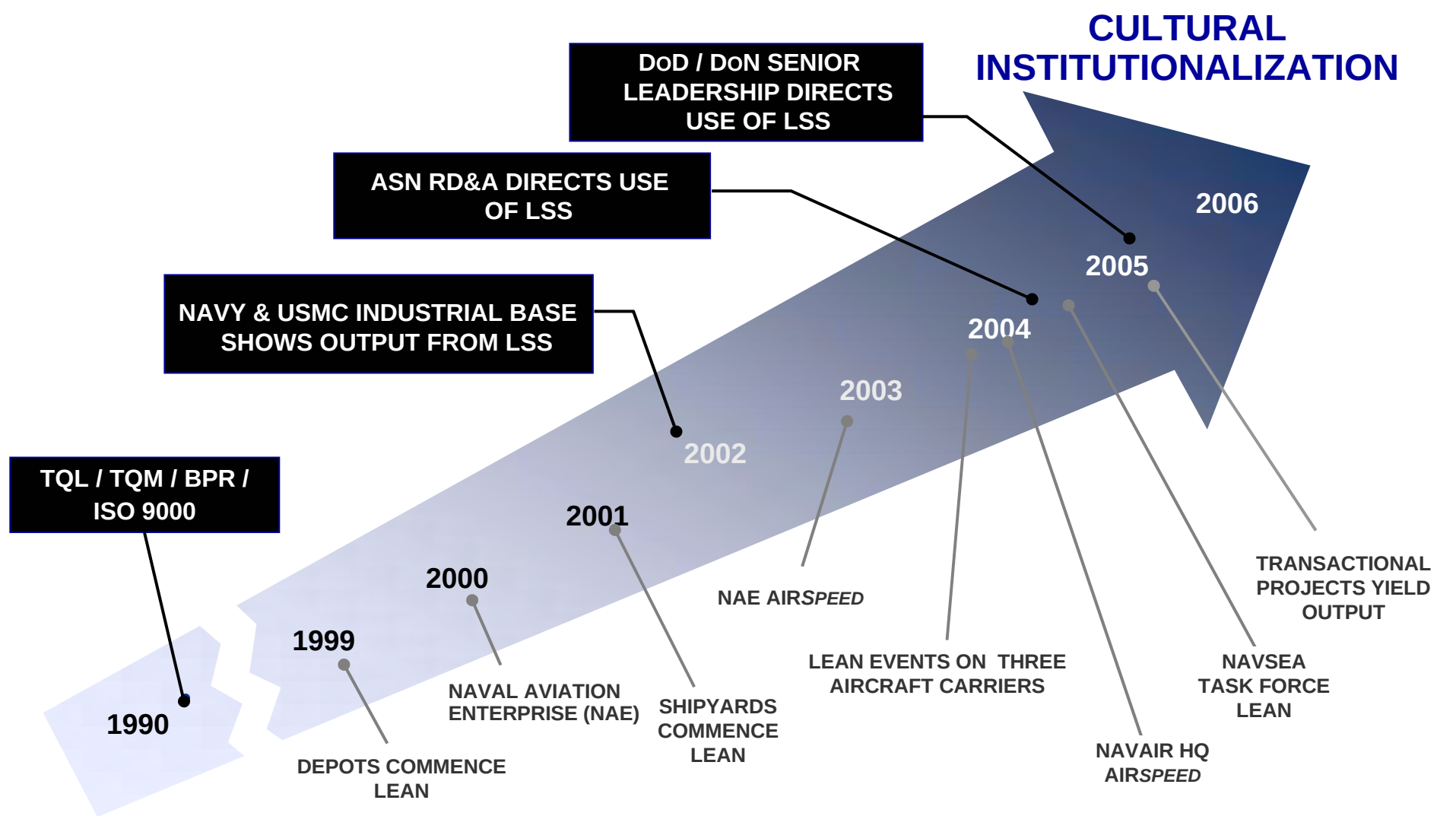
- DESIRED OUTPUT FIRST, **THEN . . . . . .**

- POLICIES / PROCESSES
  NEEDED TO OBTAIN OUTCOME; LASTLY. . . . . .

- BEHAVIORAL CONSTRUCTS / CONOPS
  TO ACHIEVE COST-WISE & RESPONSIVE OUTCOMES. . . . . .

A BEHAVIORAL MODEL FOR THE GREATER GOOD

DoN LEAN SIX SIGMA (LSS) JOURNEY



STRIVING FOR: "LSS – BUSINESS AS USUAL"

NAVAL AVIATION ENTERPRISE AIR*SPEED* LEAN, SIX SIGMA, TOC

FOUR PROGRAMS: ONE GOAL, ONE METRIC

1999	2003	2004	2005
DEPOT	ENTERPRISE	NAVAIR	NAVICP
• DEPOT PRODUCTION PROCESSES • LED BY DEPOT CO's / AIR-6.0 • ROLLOUT TO 3 SITES	• FLEET-WIDE REPAIR SITES AND PROCESSES • LED BY O-6 ESC • O-I-D + SUPPLY CHAIN • LINKS TO NAVRIIP • ROLLOUT TO 59 SITES	• CORPORATE / COMPETENCY PROCESSES AND OTHER PRODUCTIVITY INITIATIVES • LED BY CCBU / EDB GUIDANCE • ENABLED BY CORE TEAM • LINKS WITH ENTERPRISE & DEPOT AIR*SPEED*	• CORPORATE / COMPETENCY PROCESSES AND OTHER PRODUCTIVITY INITIATIVES • LED BY NAVSUP GUIDANCE • ENABLED BY DEPLOYMENT TEAM • LINKS WITH ENTERPRISE & DEPOT AIR*SPEED*

SINGLE, FLEET-DRIVEN METRIC

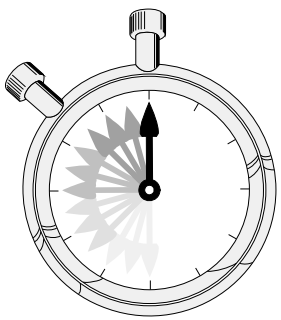
"AIRCRAFT AND CARRIERS READY FOR TASKING AT REDUCED COST . . .

TODAY AND IN THE FUTURE"

PROCESS IMPROVEMENT

- EQUIPMENT / FACILITIES
- PEOPLE
- SUPPLIERS
- PRODUCTS
- TECHNOLOGY
- FINANCING

CLASSIC
"ADD RESOURCES" APPROACH



- PROCESSES
- METHODS
- CULTURE
- METRICS
- BEHAVIOR
- STRATEGY

CYCLE-TIME APPROACH – PROCESS, PROCESS, PROCESS

NAVAIR AIR*SPEED*
INVESTMENT AND COST DATA SUMMARY – FY06

LABOR / TRAINING / TOOLS DATA FORECAST FOR FY06 – TYPE I / II SAVINGS DATA THRU 01 JUL 06

INVESTMENT

- **GEORGE GROUP CONTRACT** (NAVAIR ELEMENTS ONLY): **$ 12.30M**
- **AIR*SPEED* TOOLS** (INCLUDES TRAINING FACILITIES / *POWER STEERING / MINITAB / IGRAFX SOFTWARE*): **$ 0.89M**
- **BLACK BELT / GREEN BELT – LABOR / TRAVEL:** **$ 15.80M**

TOTAL $ 28.99M

NAVAIR AIR*SPEED* VALIDATED SAVINGS

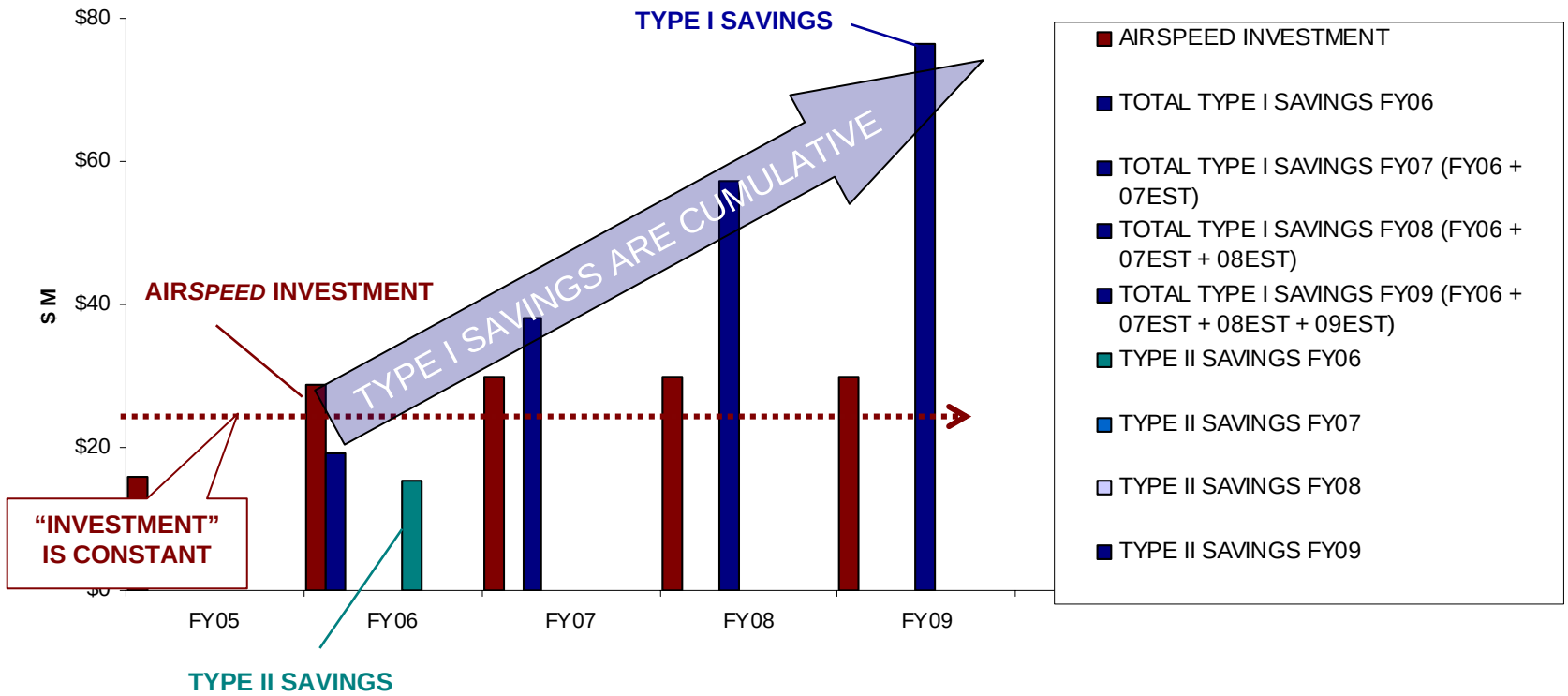
- **TYPE I** **$19.1M**
- **TYPE II** **$15.3M**

TOTAL $34.4M

AS OF 01 JUL 06: RETURN ON INVESTMENT (ROI) = 1.2

AIR*SPEED* INVESTMENT AND RETURN ($M)

- **FY07-09 INVESTMENT IN PEOPLE / TOOLS / TRAINING IS "EXAMPLE BASELINED" ~$30M –** (FY05-06 ACTUAL BUDGET)
- **TYPE I SAVINGS ARE CUMULATIVE OVER THE FYDP . . . IF $19.1M IS SAVED IN AS A RESULT OF A PROJECT COMPLETED IN FY06, THEN IT IS ALSO SAVED FY07 THRU FY09 . . . SAVINGS ESTIMATES FOR FY07-09 ARE BASELINED AT $19.1M TO SHOW CUMULATIVE POWER OF AIR*SPEED* . . . FY09** [FY06-$19.1M + FY07-$19.1M(EST) + FY08-$19.1M(EST) + FY09-$19.1M(EST) = $76.4M]
- **TYPE II SAVINGS ARE NOT CUMULATIVE OVER THE FYDP . . . VARY YEAR-TO-YEAR BASED ON PROJECT SELECTION**
- **EXPECTATION IS THAT BASELINED SAVINGS INCREASE . . . AIR*SPEED* IS SELF SUFFICIENT IN OUT YEARS**



ACHIEVE ENTERPRISE COST EFFICIENCIES

AIR*SPEED* PRINCIPLES OF OPERATION:

- PLACE THE RIGHT INVENTORY AT THE RIGHT SPOT
- TRADE SPEED FOR WIP
- OPTIMIZE MATERIAL / LABOR CONSUMPTION
- DRIVE VARIANCE OUT OF THE ENTERPRISE
  - THEORY OF CONSTRAINTS
  - LEAN MANUFACTURING
  - SIX SIGMA

SHIFT REFLEX BEHAVIOR FROM "BUY MORE STUFF AND PEOPLE" TO "BUY MORE SPEED"

WHAT WE'VE LEARNED

. . . "*OR WHAT I WISH I'D KNOWN FROM THE START*"

- **A TOTAL ENTERPRISE APPROACH IS REQUIRED FOR BEST RESULTS**
- **CHANGE REQUIRES COMMITMENT / WILLINGNESS TO DRIVE**
- **THROWING MONEY AT BROKEN PROCESSES IS PRETTY CLOSE TO A CRIME**
- **ESTABLISHING THE RIGHT METRICS (OUTPUT / CUSTOMER) IS ESSENTIAL**
- **NOT EVERYTHING CAN BE FIXED INTERNALLY—OUTSIDERS CAN IDENTIFY, DRIVE AND ACCELERATE CULTURAL CHANGE—NEED HELP IN MANAGING PROCESS AND DISCIPLINE IN EXECUTION**

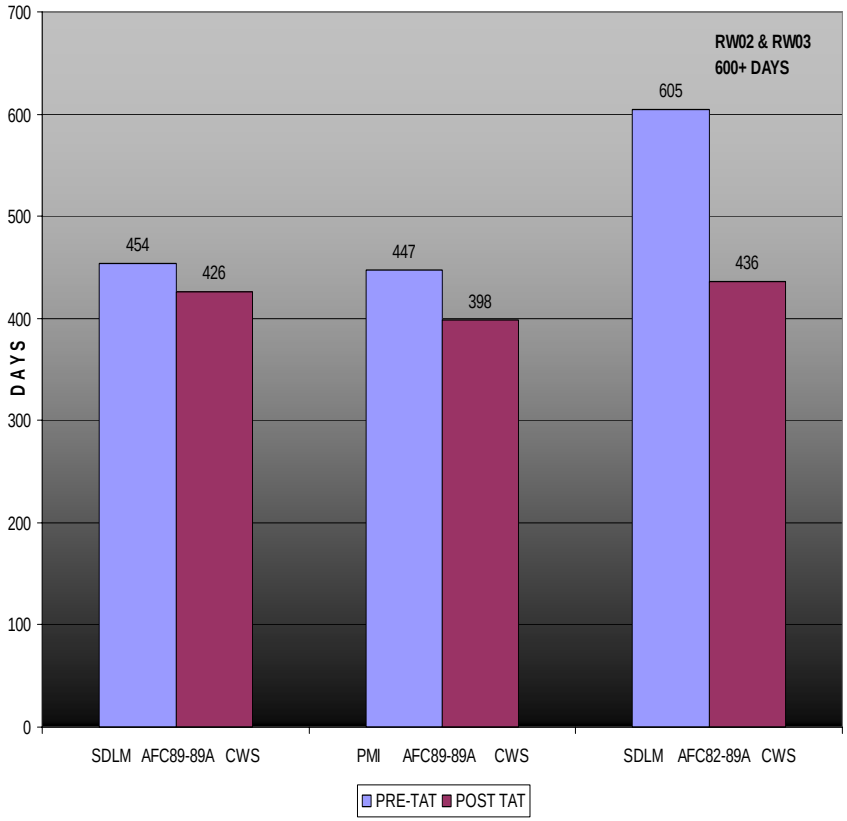
PROCESS DIMENSION:	**AS MEASURED BY:**
• PROCESS *SPEED:*	INVENTORY ON HAND
• PROCESS *QUALITY:*	FIRST-PASS YIELD
• PROCESS *EFFECTIVENESS:*	TURNAROUND TIME
• PROCESS *EFFICIENCY:*	COST PER UNIT

AIR*SPEED* SUCCESS STORIES

EA-6B PMI-1 WITH MODS

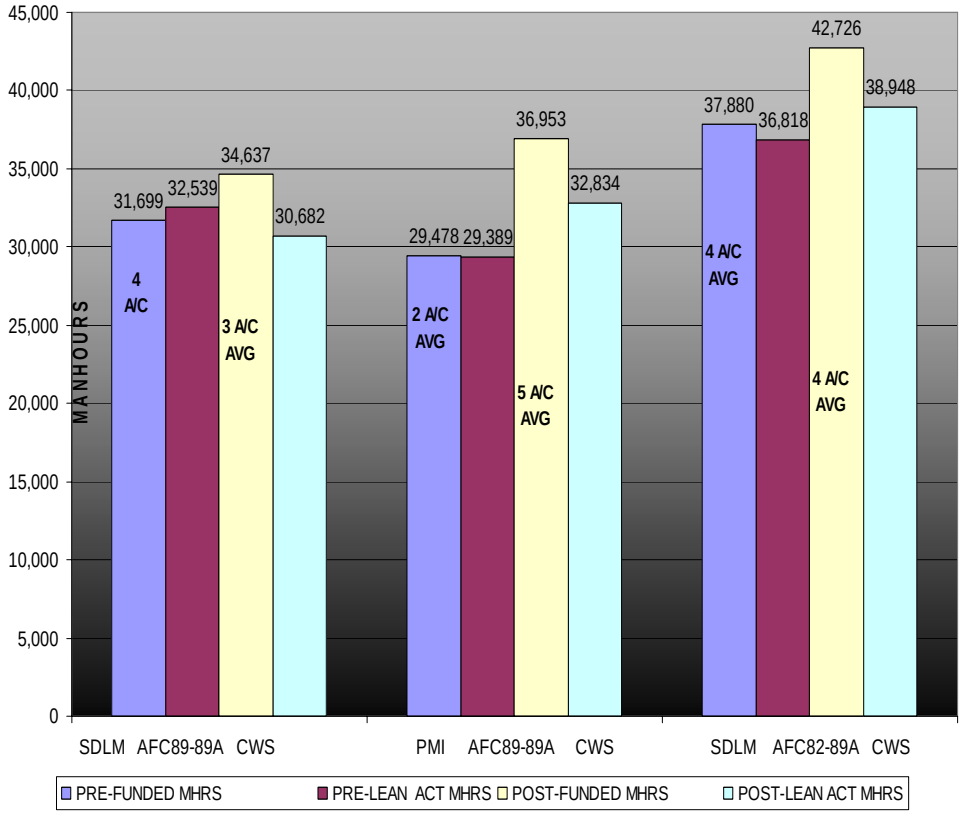
CYCLE-TIME REDUCTION

EA6B
PRE/POST LEAN
TAT



FUNDED vs. ACTUAL LABOR HOURS

EA6B
PRE/POST LEAN
MANHOURS



AIR*SPEED* IMPROVEMENTS TO P-3 *ORION* AIRCRAFT MAINTENANCE & REPAIR, NAVAIR DEPOT JAX

SBT LEAD: RICK THEILACKER

AIR*SPEED* CHAMPION: BILL UPDEGRAFF

DEPOT AIR*SPEED* INITIATIVE

- BECOME "DEPOT OF CHOICE" BY REDUCING WIP AND CYCLE TIME, IMPROVING ON-TIME DELIVERY AND IMPROVING QUALITY
- 5S ENTIRE FACILITY AND CREATE SINGLE-PIECE FLOW MOVING-LINES UTILIZING CELLULAR WORK CENTER DESIGN
- FACILITIES IMPROVEMENTS – FACILITIES PAINTING, LIGHTING, ELECTRICAL SERVICE UPGRADE, ROOF REPAIR, ARTISAN BREAK AREA, OFFICE SPACE
- 100% OF WORKFORCE TRAINED IN AIR*SPEED*

AIR*SPEED* ACCOMPLISHMENTS

PAST SUCCESS

- DEFINING WORK CELLS BY TRADE
- SETTING UP QTS SPOT FOR FUELED A/C
- DEFINING SHORED AND NON-SHORED SIDES OF HANGAR FOR EASE OF A/C MOVES

NEXT…

- OPERATIONAL MATURITY MATRIX ASSESSMENTS
- STANDARD WORK PACKAGES
- KITTING
- KAN BAN FOR MINI-SHOPS

Area of Improvement	FY04 Pre-AIR*Speed*	FY06 Post-AIR*Speed*
On Time Delivery	43%	87%
WIP	11	8

HOSHIN GOALS

SAFETY	• HIGHEST SAFETY OF ALL GOVERNMENT INDUSTRIAL FACILITIES • ZERO AVIATION MISHAPS
QUALITY	• HIGHEST QUALITY OF ANY MRO FACILITY
CUSTOMER	• ON-TIME DELIVERY TO OUR CUSTOMER
FINANCIAL	• TOTAL COST REDUCTION
PROCESS	• CONTINUOUS PROCESS IMPROVEMENT THRU AIR*SPEED*
PEOPLE	• OPERATIONAL MATURITY LEVEL 3.0 • EMPLOYER OF CHOICE • TRAINING, EMPOWERMENT AND INVOLVEMENT

AIR*SPEED* ACTIVITIES

Apr-04	Lean Deployment Commenced
May-04	Fuel Leaks - Quick Turn Spot, Hazmat Carts
Jun-04	Foam Install - Quick Turn Spot, Hardware Cage
Oct-04	G3 Metal Tank Repairs - Metals Cell established
Dec-04	Flow Infrastructure - Induction Scheduling, REI/TEI Process, Kitting
Jan-05	Disassembly - Disassembly Cell established, Kitting continued, Metals/NDI Process
Mar-05	Assembly - Assembly Cell established, G2 Sheet Metal, Minishop
Apr-05	Assembly / Finals - Kitting Design
Apr-06	AIRSpeed Champion assigned

ENGINE REPAIR CONSOLIDATION AND PRODUCT ENTERPRISE TEAMS (PET)

F404 ENGINE I-LEVEL CONSOLIDATION

- **EFFORT BEGAN EARLY '04**
- **IDENTIFIED EXCESS CAPACITY (57%)**
- **SIGNIFICANT SAVING PROJECTED**
  - 9-5 SITES (FY05)
  - 5-3 SITES (FY06)
  - $161M SAVINGS THROUGH FY11
- **SPOTLIGHTED THE POTENTIAL OF PROCESS IMPROVEMENT ACTIVITIES**
  - AIR*SPEED*, LEAN, TOC, SIX SIGMA
- **NAE-WIDE APPROACH**
- **NOV 04: NAE PROCESS LAUNCHED**

THE PET PROCESS BRINGS:

- **STANDARD PROCESSES & METRICS**
- **PRIORITIZATION OF WORK AND INVESTMENT**

TO MAXIMIZE

  - RELIABILITY, CYCLE TIME, INVENTORY, COST, AND SAFETY
- **INTEGRATION OF OTHER TOOLS**
  - (AIR*SPEED*, BLACK BELTS, ETC.)
- **FOUNDATION FOR NAE-LEVEL PRIORITIZATION**

A NEW WAY OF DOING BUSINESS

PARDON OUR DUST WHILE WE GROW!

SBT LEAD: JOHN CRUMPLY

AIR*SPEED* CHAMPION: CHRIS KOPP

FUTURE F-18 INNER WING SHOP, NAVAIR DEPOT JAX (GREENFIELD PROJECT)

CHALLENGE

- HANGAR 122 DEMOLITION 83K SQ FT
  - CURRENT WING SHOP 29K SQ FT
  - FLIGHT LINE 34K SQ FT
  - PAINT BOOTH 20 SQ FT
- FUTURE F/A-18 WING WORKLOAD?

OPPORTUNITY

- MFG BB EVENT RECOVERED 13K SQ FT
- LEAN EVENTS RECOVERED 10K+ SQ FT
- A/C KITTING EVENTS
- A/C WIP REDUCTION
- REMOVED AIRCRAFT ASKARS (WIP REDUCTION)

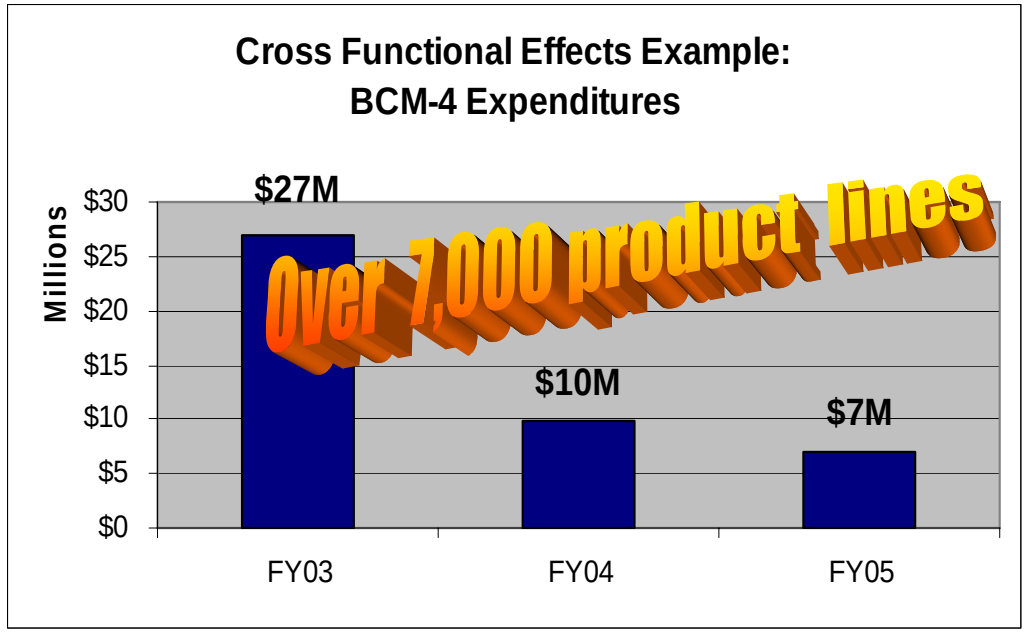
RESULTS: RECOVERED OVER 23K SQ FT

GOODNESS: FOOTPRINT REDUCTION RESULTING FROM PREVIOUS AIR*SPEED* EVENTS IS ALLOWING US TO ABSORB LOSS OF HANGAR 122 WITHOUT NEW CONSTRUCTION

CURRENT READINESS CFT SUCCESS

F404 I-Level Consolidation

- Effort began early '04
- Identified excess capacity (57%)
- Significant saving projected
  - 9-5 Sites (FY05)
  - 5-3 Sites (FY06)
  - $161M savings through FY11
- Spotlighted the potential of process improvement activities
  - AIRSpeed, LEAN, TOC, SIX SIGMA
- NAE wide approach implemented Fall '04



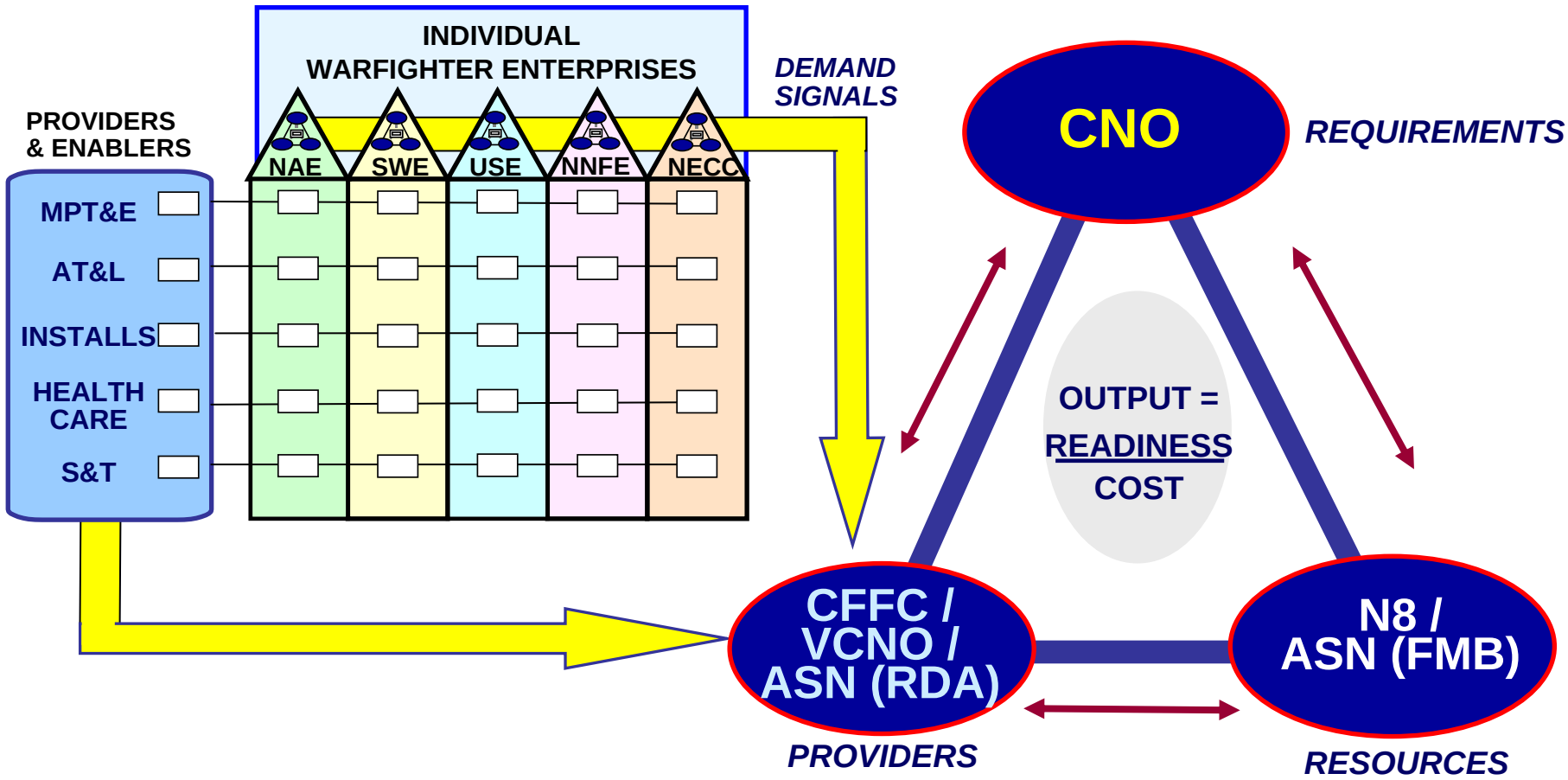
- **EFFICIENCIES: FY05-EXECUTED FHP TO 6+2 DESPITE INITIAL $122M SHORTFALL**
- **GENERATED ADDITIONAL $160M BY UNDERSPENDING TO PLAN TO COVER ADDITIONAL GNFPP HOURS, 2ND FUEL INCREASE, DEPOT NNOR, PACFLT SHIP OPERATIONS**

CULTURE CHANGE: CROSS-FUNCTIONAL DELIVERY OF COST-WISE READINESS

- **FUTURE READINESS: BOUGHT 111 AIRCRAFT VICE 100 IN FY05 . . . CHALLENGE IS TO BUY RIGHT NUMBER OF AIRCRAFT . . .**

NAVY ENTERPRISE:
THE WAY AHEAD

NAVY ENTERPRISE



PRODUCTIVITY DRIVERS:

- PRIORITIES
- BEHAVIORAL CHANGES
- SINGLE PROCESSES / OWNERS
- COMMON METRICS
- INTEGRATED CAPABILITIES
- TRANSPARENCY OF INFORMATION

DESIRED NAVY ENTERPRISE OUTPUT

- ✓ READINESS OVER COST TODAY
- ✓ READINESS OVER COST TOMORROW
- ✓ READINESS OVER COST IN THE FUTURE

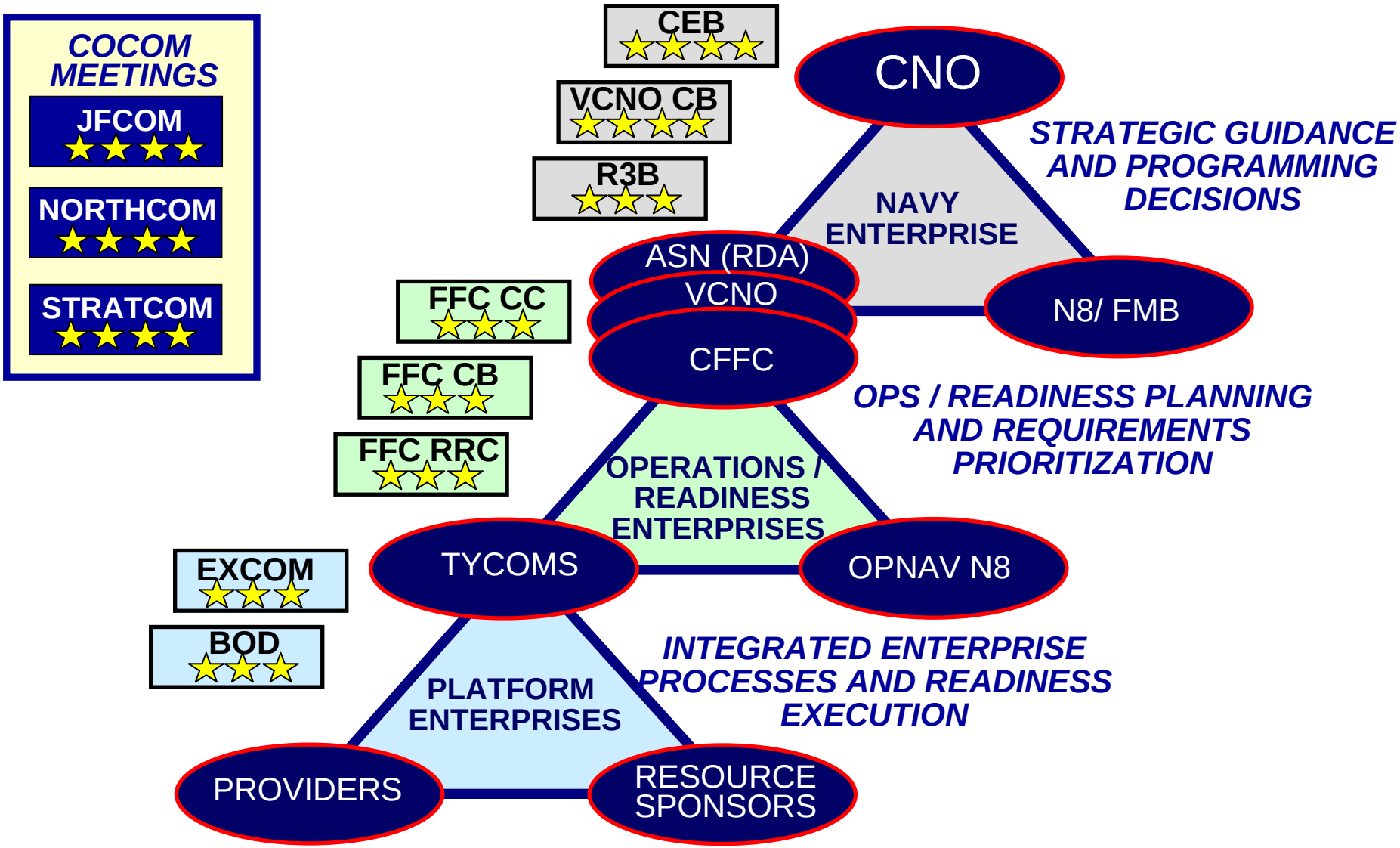
ACHIEVED THROUGH BEHAVIORAL MODEL (INTERDEPENDENT CONCEPT OF OPERATIONS):

- **NAVY ENTERPRISE (GOVERNANCE BOARD):**
  - SENIOR NAVY STRATEGIC DECISION FORUM FOCUSED ON IMPROVING PRODUCTIVITY FOR CURRENT AND FUTURE READINESS THROUGH INTEGRATION OF SUPPORTED WARFIGHTER ENTERPRISES
- **WARFIGHTER ENTERPRISES (FIVE SUPPORTED TEAMS; LED BY "SUPER TYCOMs"):**
  - COLLABORATIVE TEAMS FOCUSED ON DELIVERING WARFIGHTING CAPABILITY TO NAVY COMPONENTS AND COMBATANT COMMANDERS; AND INCREASING PRODUCTIVITY ACROSS THEIR DOMAIN AT REDUCED COST
- **PROVIDERS / ENABLERS (SUPPORTING ELEMENTS; WITH DESIGNATED LEADS):**
  - OPERATE AS PROVIDERS / ENABLERS TO MANAGE VALUE STREAMS (PEOPLE, DOLLARS, AND STUFF), SUPPORTING TYCOM-LED WARFIGHTER ENTERPRISES, WITH LINKED AND COMMON PROCESSES / METRICS
- **DOMAIN: DOLLARS, PEOPLE, & STUFF ASSOCIATED WITH EACH WARFIGHTER ENTERPRISE**
- **DEMAND SIGNAL: DERIVED FROM THE WARFIGHTER ENTERPRISES (I.E., READINESS REQUIRED AND NO MORE)**
- **ENTITLEMENTS: WHAT'S NEEDED, WHEN, HOW MUCH, AND NO MORE**
- **OUTPUT: READINESS OVER COST**

CRITICAL NAVY ENTERPRISE PROCESSES AND BEHAVIORS

- **IDENTIFY DOMAINS AND ASSIGN SINGLE PROCESS OWNERS**
- **ASSEMBLE THE RIGHT ENTERPRISE TEAMS AND GAIN COMMITMENT**
- **OPERATE IN SUPPORT OF A SINGLE FLEET-DRIVEN METRIC *(WHAT THE ENTERPRISE VALUES)***
  - ***AGREEMENT ON SCOPE, OUTPUTS, AND LINKED METRICS***
  - ***TRANSPARENCY OF DATA TO PROMOTE TRUST AND MONITOR PERFORMANCE***
  - ***SHARED KNOWLEDGE ON ISSUES AND KEY PROBLEMS AFFECTING THE DOMAIN***
  - ***RECOGNIZE, NURTURE AND RESPECT TECHNICAL AUTHORITY***
  - ***IDENTIFIED ENTITLEMENTS (WHAT'S NEEDED, WHEN, HOW MUCH, AND NO MORE)***
- **AGREE ON DESIRED OUTPUT (E.G., READINESS OVER COST), WITH FOCUS / TRADE-SPACE INVOLVING CURRENT AND FUTURE READINESS**
- **OPERATE WITH DISCIPLINE, GOVERNANCE, AND A REGULAR (TIMELY) DRUMBEAT**
- **BASELINE EVERY DOLLAR, ALL THE PEOPLE, ALL THE STUFF, AND ALL THE CAPABILITY WITHIN THE DOMAIN, WITH ASSIGNED ACCOUNTABILITY FOR OUTCOMES**
- **ESTABLISH ENTITLEMENTS; CONTINUALLY MEASURE GAPS-TO-ENTITLEMENT**
- **REMOVE BARRIERS TO PRODUCTIVITY**

NAVY ENTERPRISE CONSTRUCT



HOW SENIOR LEADERSHIP CAN HELP:
AREAS OF EMPHASIS

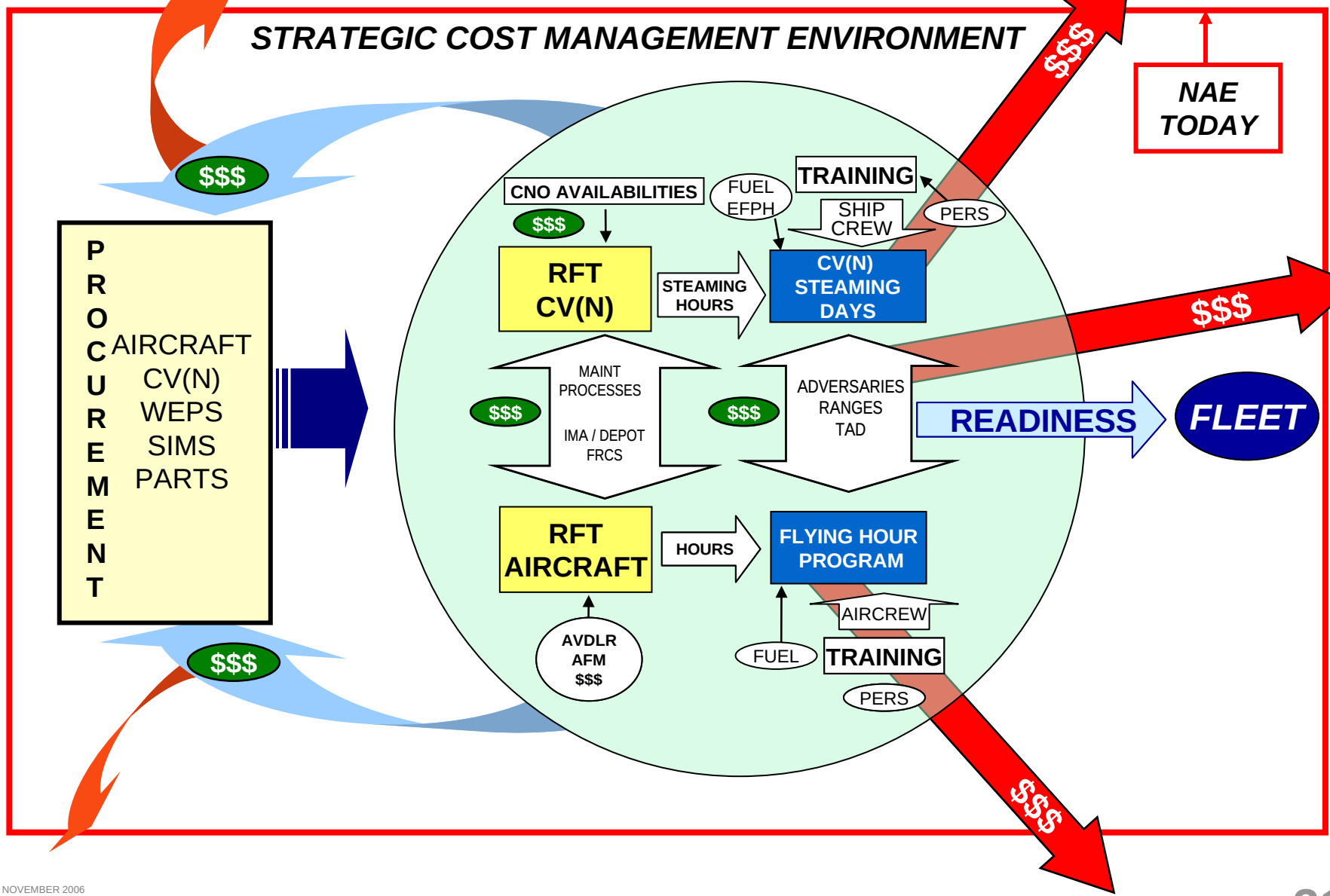
- **COMMIT TO THE CHANGE – MAKE IT LAST THROUGH LEADERSHIP TURNOVER**
  - INCLUDE IN PERFORMANCE EVALUATIONS / FITNESS REPORTS (FITREPs)
  - INCENTIVIZE GROUP PERFORMANCE GOALS FOR SENIOR LEADERSHIP
  - INCLUDE PRODUCTIVITY IMPROVEMENT TRAINING IN LEADERSHIP DEVELOPMENT PROGRAMS
- **PARTICIPATE IN THE EFFORT**
  - PROVIDE EXECUTIVE SPONSORSHIP FOR PROJECTS
  - GET TRAINED AS A GREEN BELT
  - DEMAND DATA AND METRICS . . . STAMP OUT OBFUSCATION
- **PROVIDE RESOURCES – VISION WITHOUT MONEY EQUALS HALLUCINATION**
  - PROVIDE STABLE FUNDING TO ENSURE SUCCESS
  - DEMAND VALIDATED RETURN ON INVESTMENT

LEADERSHIP COMMITMENT AND ACCOUNTABILITY MAKE CULTURAL CHANGE A REALITY

THE FLEET
NAVAL AVIATION ENTERPRISE
LEADERSHIP
QUESTIONS?
NAVAL AVIATION VISION
2020

BACKUP

NAE "SYSTEM" SCM



NAVAIR SOFTWARE PRODUCTIVITY IMPROVEMENT EXAMPLES

(COMPARISONS OF TEAM'S SW-CMM LEVEL 1 PERFORMANCE VERSUS SW-CMM LEVEL 4 PERFORMANCE)

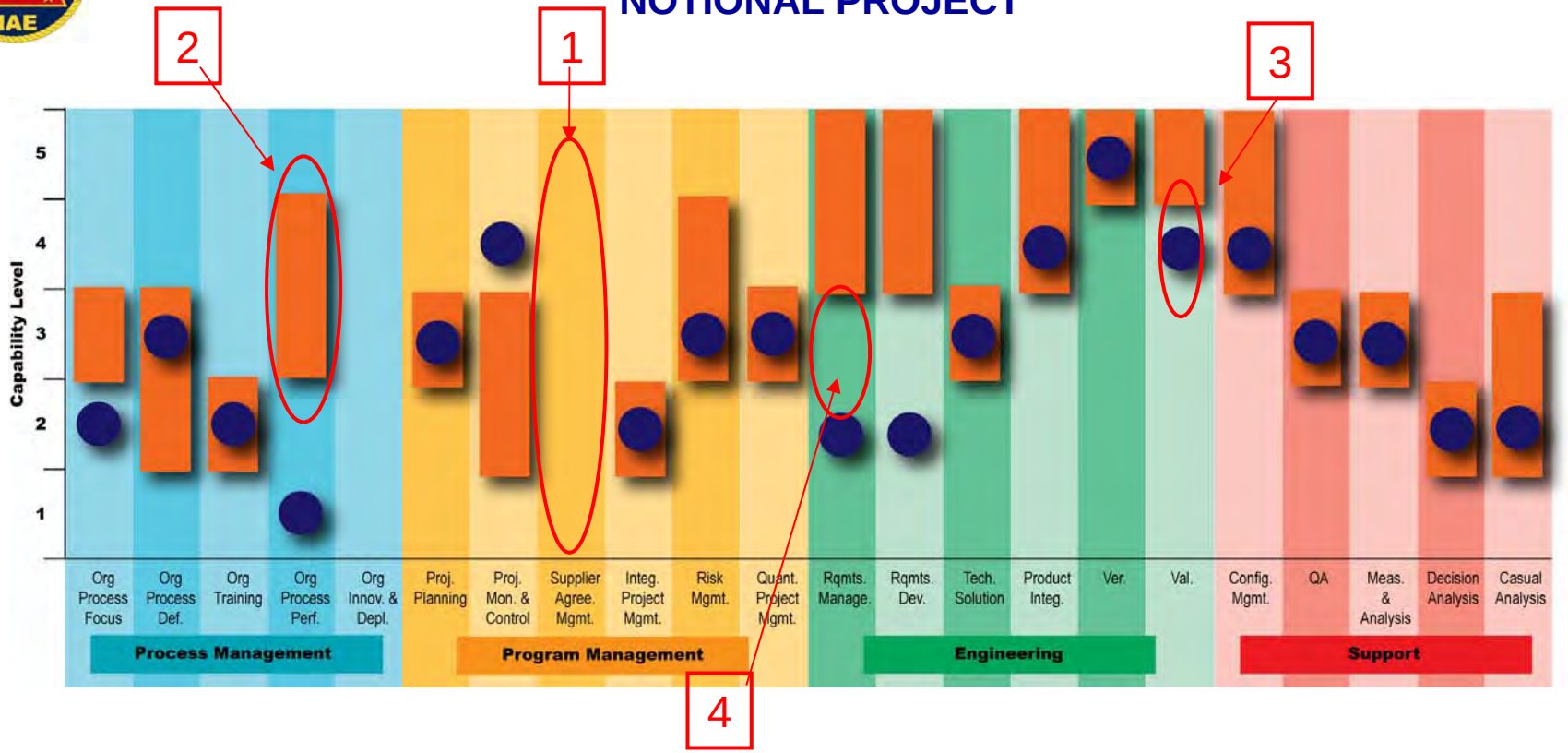
SSA	Productivity (MH/SLOC)	Cost ($/SLOC)	Quality Increase (Defects/KSLOC @OTRR)
P-3 (Design Only)	46%	35%	78%
AV-8B	37%	56%	46%
F/A-18	34%	68%	45%

NOTES:

- ABOVE DATA IS PROVIDED TO SHOW GAINS REALIZED BY NAVAIR ORGANIZATIONS THAT HAVE IMPROVED THEIR PROCESSES BY MEANS OF CARNEGIE-MELLON SOFTWARE ENGINEERING INSTITUTE CAPABILITY MATURITY MODELS.
- DATA IS BASED ON ACTUAL OFP COSTS UP TO OTRR FOR F/A-18 AND AV-8. P-3 DATA IS BASED ON ACTUAL DESIGN COSTS.
- DATA ***SHOULD NOT*** BE USED TO COMPARE ONE ORGANIZATION AGAINST ANOTHER, SINCE VARIATIONS IN SOFTWARE COMPLEXITIES AND REQUIREMENTS WOULD MAKE SUCH COMPARISONS INVALID; FOR EXAMPLE:
  - REAL-TIME EMBEDDED APPLICATIONS VS. DESKTOP MISSION SUPPORT APPLICATION;
  - LEGACY SOFTWARE DEVELOPMENT (ASSEMBLY LANGUAGE) VS. NEW LANGUAGE DEVELOPMENT (C++ OBJECT-ORIENTED).

BUSINESS-BASED CMMI APPROACH

NOTIONAL PROJECT



- **ADOPTING CONTINUOUS REPRESENTATION OF CMMI MODEL**
- **FOUR STEP PROCESS:**
  - **1) DETERMINE WHICH CMMI PROCESS AREAS ARE GERMANE TO THE PROJECT TEAM**
  - **2) DETERMINE PROCESS CAPABILITY LEVELS NEEDED TO DELIVER REQUIRED FLEET PRODUCTS (AND NO MORE)**
  - **3) ASSESS PROJECT TEAM'S CURRENT CAPABILITY LEVEL IN EACH PROCESS**
  - **4) PERFORM BUSINESS CASE ANALYSIS TO DETERMINE BEST INVESTMENT AREAS**
- **WILL DETERMINE CMMI MATURITY VIA EQUIVALENT STAGING AT MAT LEVEL**