



Engineering Quality Software

10 Recommendations for Improved Software Quality Management

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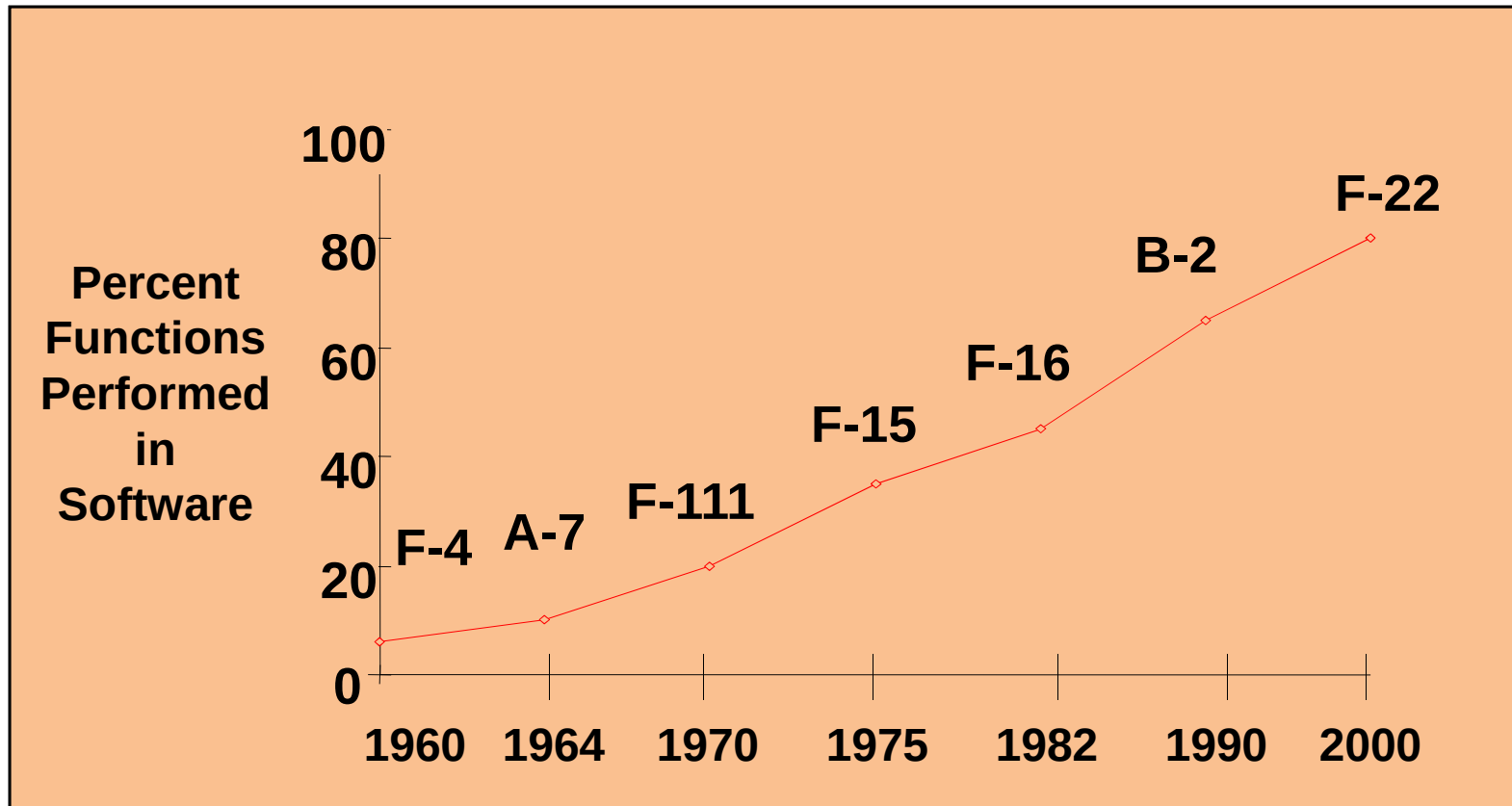
Outline

- Software Trends & Motivation
- What is Software Quality?
- Why is Software Quality Important?
- Software Quality Framework
- Ten Focus Recommendations
- Summary

Software Trends

- More complex systems
 - More functionality
 - More diverse, larger teams
- Heterogeneous architectures
- Parallel programming
 - Assure correctness and performance

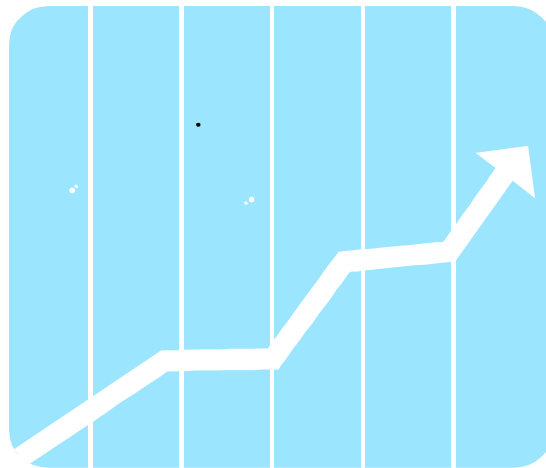
Weapon System Software Dependence



Ref: Crouching Dragon, Hidden Software

Increasing Code Size

Manufacturer	System	Code Size
Lockheed Martin/Boeing	F-22 Raptor	~1.7M LOC
Lockheed Martin	F-35 Joint Strike Fighter	~5.7M LOC
Boeing	787 Dreamliner	~ 6.5M LOC



Ref: This Car runs on code

DoD Software Challenges - 1994

- **Lack of Consistent Attention to Software Process**
- **Poor Requirements Definition – lack of user involvement**
- Inadequate Software Process Management & Control By Contractors
 - No “Team” of Vendors and users; little SME participation
- Ineffective Subcontractor Management
- **Software Architectures Ignored**
- **Poorly Defined and Controlled Interfaces (HW, Comm, Software)**
- Assumption That Software Upgrades Can “Fix” Hardware Deficiencies
- **Focus on Innovation Rather than Cost and Risk**
- Limited or No Tailoring of Military Specifications Based on Continuing Cost-Benefit Evaluations

Ref: Report of the DSB Task Force on Acquiring Defense Software Commercially

NDIA Top SWE Issues - 2006

- **The impact of system requirements upon software is not consistently quantified and managed in development or sustainment.**
- Fundamental system engineering decisions are made without full participation of software engineering.
- Software life-cycle planning and management by acquirers and suppliers is ineffective.
- **The quantity and quality of software engineering expertise is insufficient to meet the demands of government and the defense industry.**
- **Traditional software verification techniques are costly and ineffective for dealing with the scale and complexity of modern systems.**
- There is a failure to assure correct, predictable, safe, secure execution of complex software in distributed environments.
- Inadequate attention is given to total lifecycle issues for COTS/NDI impacts on lifecycle cost and risk.

Ref: NDIA Top 7 SWE Issues Report

Standish Group Report

	Year 1994	Year 1996	Year 1998	Year 2000	Year 2002	Year 2004	Year 2006	Year 2009
Successful	16%	27%	26%	28%	34%	29%	35%	32%
Challenged	31%	40%	28%	23%	15%	53%	19%	44%
Failed	53%	33%	46%	49%	51%	18%	46%	24%
Challenged+ Failed	84%	73%	74%	72%	66%	71%	67%	68%



Quality Improvement
Opportunities

Ref: The Rise and Fall of Chaos Report Figures

What is Software Quality?

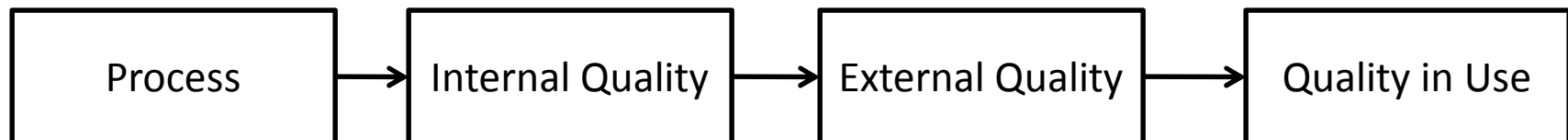
IEEE defines as ...

- (1) The degree to which a system, component, or process **meets specified requirements;**
- (2) The degree to which a system, component, or process **meets customer or user needs or expectations.**

Ref: IEEE Std 610.12-1990

Quality Perspectives

- **Process Quality (CMMI)**
- **Product Quality (ISO/IEC 2500x)**
 - Internal Quality Attributes
 - External Quality Attributes
 - Quality in Use (Customer's View)

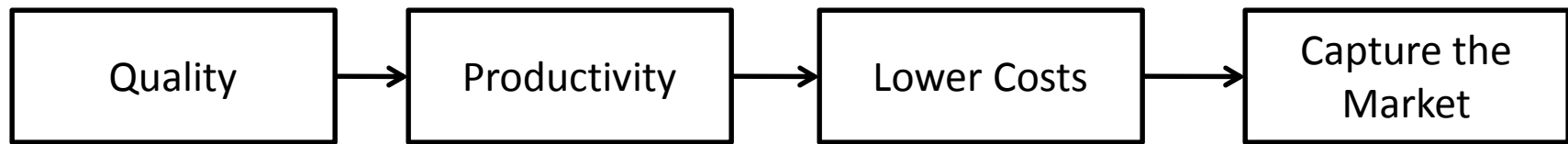


Why is Software Quality Important?

- Military
 - Affects ability to deliver and sustain superior capability
 - Quality focus needed for to improve stewardship and productivity
- Industry
 - Affects competitive advantage, reputation and market share

Quality can Make or Break You

Deming's Quality Chain Reaction

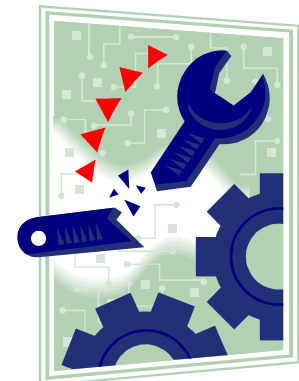


Ref: Out of the Crisis

Quality Problems at Toyota

- Reputation for producing high-quality vehicles
 - Toyota Production System based on “The Toyota Way”
 - 4-P Model: Problem Solving, People/Partners, Process, Philosophy
- Software quality problems
 - Hybrid Anti-lock braking software: 2010
 - Toyota Sai, MY 2010 Toyota Prius, MY 2010 Lexus HS 250h
 - Sudden stall and shut down – recalled 160,000 cars : 2005
 - Recalled 160,000 of 2004 /2005 Prius hybrids

Ref: This Car Runs on Code



The Quest for Software Quality

Process

Tailored, Defined, Measurable & Repeatable



**Quality
Software**

Technology

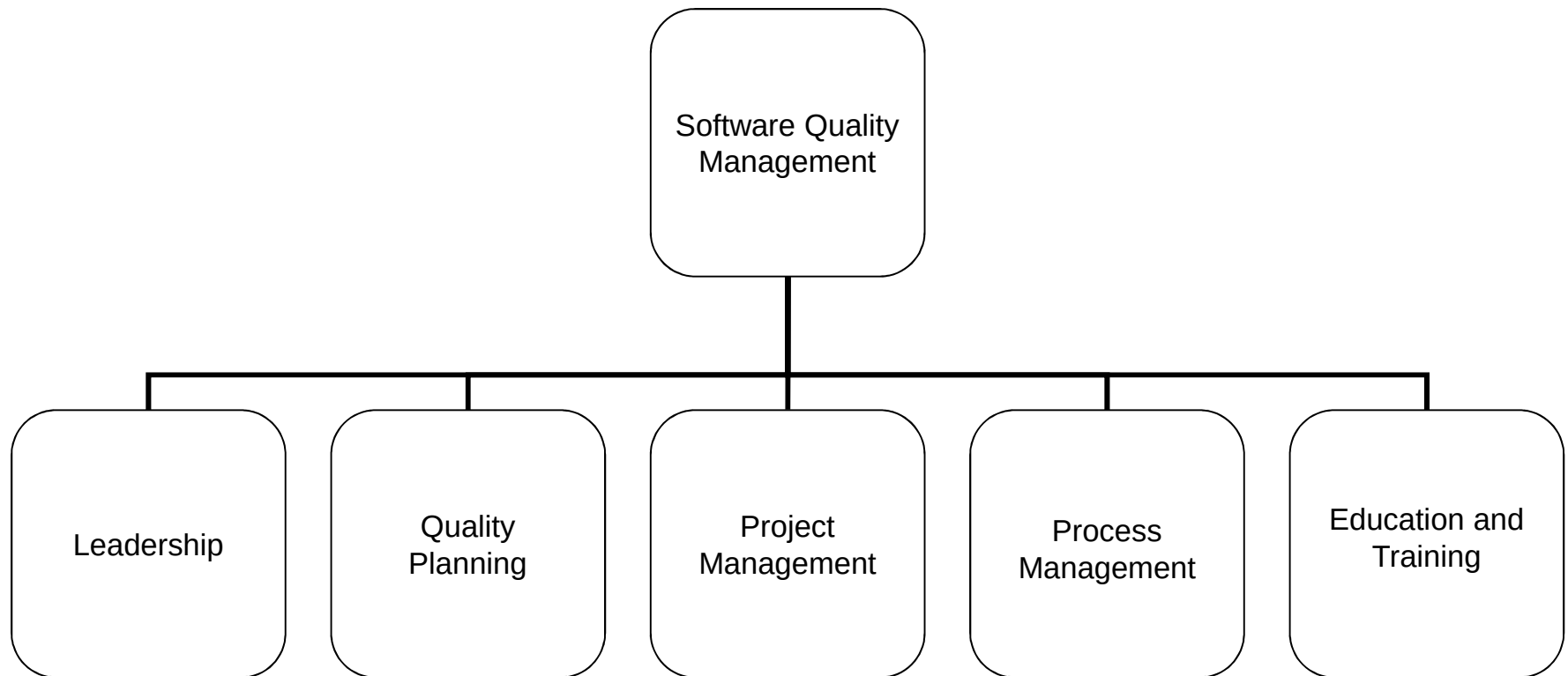
Effective Technology Insertion

People

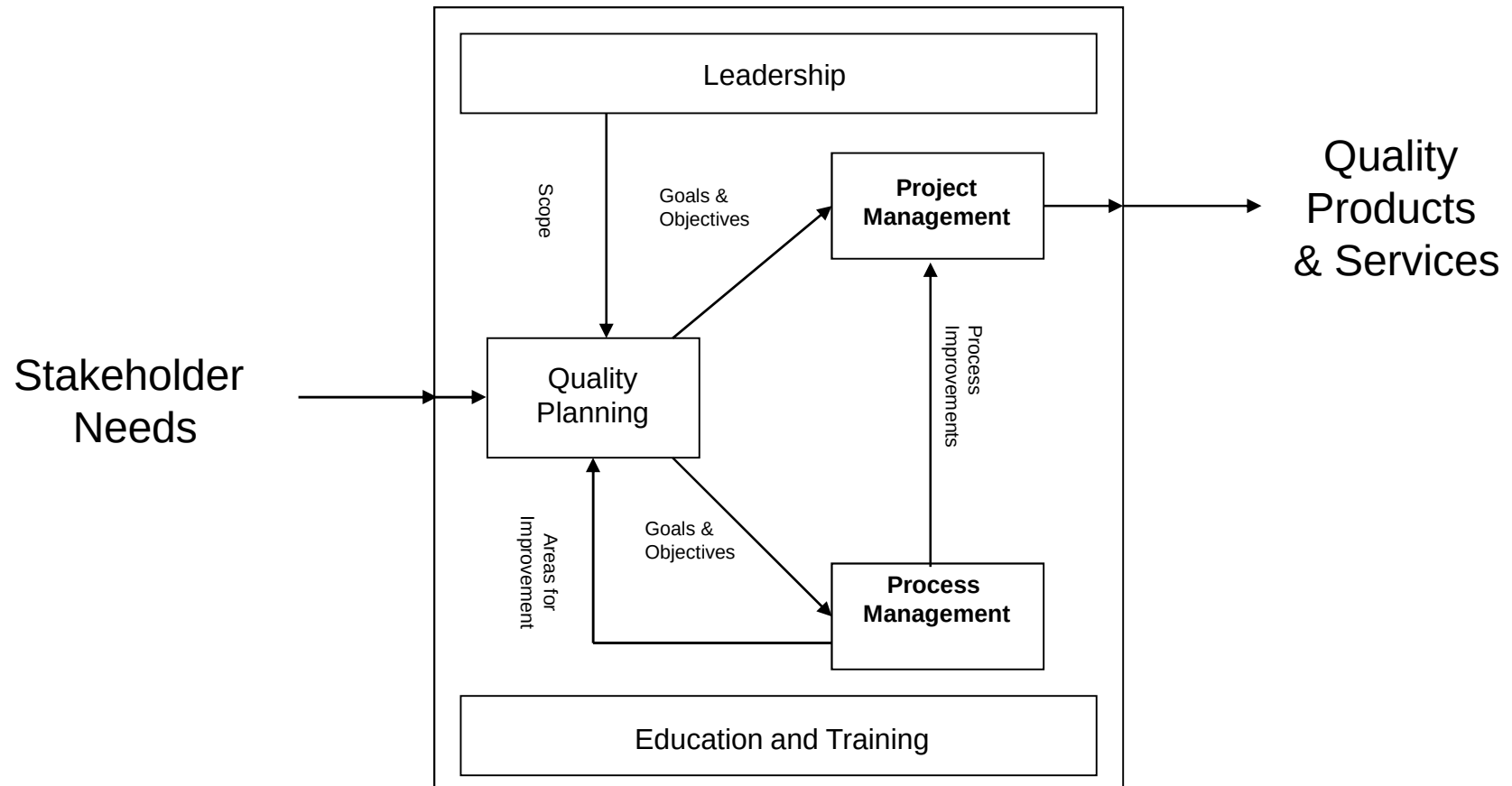
Technical and Process Training,
Process Discipline

Result : Predictable Cost, Schedule and Performance

Software Quality Components



Software Quality Framework



Ten Focus Recommendations

1. Focus on a **common software quality definition**
2. Focus on **software quality planning**
3. Focus on developing “quality” **people**
4. Focus on quality **assessments**
5. Focus on **requirements**
6. Focus on creating an **effective SQA group**
7. Focus on **risk mitigation**
8. Focus on **defect prevention**
9. Focus on **software quality metrics**
10. Focus on **teamwork**





#1 – Common Quality Definition

- Issue:
 - Software quality means different things to different people
 - Resolve competing priorities
- Recommendation:
 - Achieve consensus on quality definition
 - Create organizational software quality policy

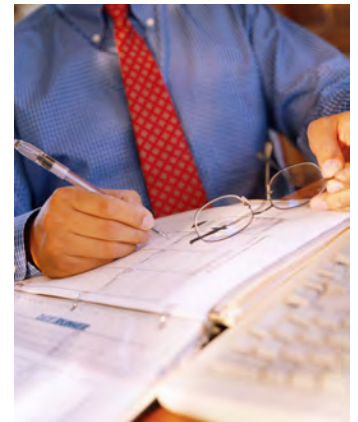


Reach for the same quality goal



#2 – Software Quality Planning

- Issue:
 - Lack of appreciation of planning for quality initiatives
- Recommendation:
 - V&V focuses on the quality of products
 - IEEE Std 1059
 - QA focuses on the quality of processes
 - IEEE Std 730



Quality does not just happen, it has to be planned



#3 – Developing “Quality” People

- Issue:
 - Software is highly prone to human errors
 - Lack of “quality” development skills
- Recommendation:
 - Enable professionals to hone their craft
 - Encourage professional certifications
 - PMI PMP, IEEE CSDP, INCOSE CSEP, ASQ CSQE
 - Advance the discipline and practice



Create a culture of software professional excellence



#4 – Quality Assessments

- Issue:
 - Process and Product problems go unnoticed
- Recommendation:
 - CMMI/ISO 9000 Assessments
 - Capture organizational knowledge
 - Identify best practices, lessons learned



Know where you are, and where you need to be



#5 – Requirements

- Issue:
 - Unrealistic expectations – undefined scope
 - Poor requirements engineering
- Recommendation:
 - Effective communication is the key
 - Requirements management plan



Know your stakeholders



#6 – Effective SQA group

- Issue:
 - Lack of understanding of status of quality initiatives
- Recommendation:
 - Empower and embrace QA activities
 - Learn to effectively use walkthroughs, inspections, audits and reviews

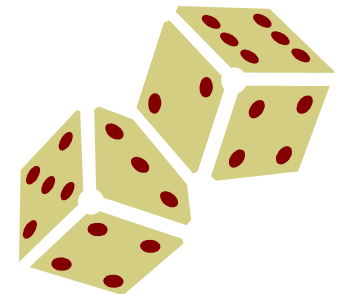


QA is your friend



#7 – Risk Mitigation

- Issue:
 - Problem areas not identified and acted on early enough
 - Don't prepare for contingencies
- Recommendation:
 - Ask “what if this happens”
 - Prioritize based on project objectives



Anticipate problems and develop ready solutions



#8 – Defect Prevention

- Issue:
 - Quality defined as detection of defects
 - Reactive focused – identify, correct
- Recommendation:
 - Adopt a proactive approach to quality
 - Prevention works better than detection
 - It's easier to do it right the first time
 - Start earlier, look upstream for improvements

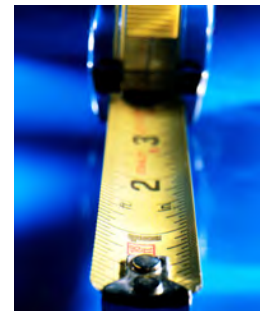


It's easier to do it right the first time



#9 –Software Quality Metrics

- Issue:
 - Limited indicators for process and product status
- Recommendation:
 - Tailored product and process measures should be used
 - Process – # of reviews, audits, inspections
 - Product – internal, external, quality in use
 - Project – earned value



That which gets measured, gets managed



#10 – Teamwork

- Issue:
 - Software is involved in increasingly diverse functions
- Recommendation:
 - Precisely define roles and responsibilities
 - Create "sweet" spot
 - Successfully integrate professional functional bodies of knowledge



It takes a "village" to deliver quality software

Summary

- Systems will continue to increase in complexity and software dependence
 - Increasing software functionality; larger, more diverse teams
- Quality must remain in the forefront
 - Primary factor in Superior Capability & Competitive Advantage
- Quality is a leadership choice
 - Everyone's job, but leader's responsibility
- Lifecycle Approach to Quality Management
 - Focus on prevention rather than detection
- Quality management systems must evolve
 - Even the best quality management systems can have challenges



Focus on QUALITY!

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For More Information

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Acronym List

- ASQ – American Society for Quality
- CSDP – Certified Software Development Professional
- CSEP – Certified Systems Engineering Professional
- CSQE – Certified Software Quality Engineer
- DSB – Defense Science Board
- IEEE – Institute of Electrical and Electronics Engineers
- IEC – International Electrotechnical Commission
- ISO – International Organization for Standardization
- MY – Model Year
- NDIA – National Defense Industrial Association
- SWE – Software Engineering
- PMI – Project Management Institute
- PMP – Project Management Professional