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25th Test and Evaluation National Conference

“New Administration, New Opportunities”

Atlantic City, NJ

2-5 March 2009

Agenda

Monday, 2 March 2009

WORKSHOP I

MISSION-BASED TEST & EVALUATION (MBTE)

Presenters: Mr. Chris Wilcox, AEC

- Mr. Jack Sheehan, ORSA Corporation

PM Presenters:

- Mr. Jack Sheehan, ORSA Corporation

Tuesday, 3 March 2009

CONFERENCE KEYNOTE ADDRESS

Mr. Keith Williams, CEO, Underwriters Laboratories (UL)

DOT&E LOOKING AHEAD

Honorable Charles McQueary, Director, Operational Test & Evaluation (DOT&E)

ROUNDTABLE : REALITIES FACING THE WORLD OF DEFENSE AND HOMELAND SECURITY T&E

Moderator: Maj Gen Steve Sargeant, USAF, Commander AFOTEC

GAO ASSESSMENT OF DOD'S MAJOR WEAPON SYSTEMS ACQUISITION PORTFOLIO

Mr. Ronald Schwenn, US Government Accountability Office

SESSION A: MISSION CAPABILITY TESTING

- “*Evaluating the Mission – Translating Systems Performance to Unit Capabilities*”, Mr. David Thomas, Round Table Defense, LLC.
- “*System of Systems – Survivability, Lethality, Vulnerability Assessment*”, Mr. Jeffrey A. Smith and Ms. Beth Ward, U.S. Army Research Lab
- “*Structuring T&E for Validation of Complex Systems Capabilities and Exploration of Emergent Behaviors*”, Mr. Joseph Tribble, AVW Technologies
- “*Using IMPRINT to Translate Human Performance Into Mission Effectiveness to Focus Test and Evaluation*”, Ms. Diane Mitchell & Charneta Samms

SESSION B-NEW T&E POLICY AND POLICY IMPLEMENTATION

- “*New Test and Evaluation Master Plan Guidance*”, Ms. Darlene Mosser-Kerner, OUSD (AT&L)
- “*Walking the Line With Title 10: Implementation Strategies for Integrated Testing*”, Dr. Beth Wilson, Raytheon
- “*Systems Assurance Test and Evaluation in Defense Acquisition – Specification, Planning and Resourcing*”, Ms. Christine Hines, OUSD (AT&L)
- “*Automated GPS Simulation Test Process*”, 2nd LT Matthew Steele, Holloman AFB

SESSION C-T&E METHODOLOGY AND M&S

- “*How to Incorporate Modeling and Simulation into the System Acquisition Life Cycle*”, Mr. Derek Kropp, Navy Patuxent River
- “*Extending Test and Evaluation Modeling and Simulation Capabilities with Gaming Technology*”, Mr. Geoffrey Robinson, Ft. Hood
- “*Integrating the System Engineering “V” in a System of Systems*”, Mr. Jack Sheehan, ORSA Corporation

PRESENTATION OF THE 2009 WALTER W. HOLLIS AWARD FOR OUTSTANDING LIFETIME ACHIEVEMENT IN DEFENSE TEST & EVALUATION.

Guest Speaker: Mr. Winslow Wheeler, Director of the Straus Military Reform Project of the Center for Defense Information

Wednesday, 4 March 2009

SESSION IV: T&E POLICY & STUDIES

- “*Physics of Failure - the Critical Path to Saving \$M in T&E*”, Dr. W. Forrest Crain, Director, US AMSAA
- “*A Common Platform for DOD and DHS to Partner in the T&E Community*”, Dr. Richard Murrow, CEO, Air Academy Associates

SESSION VI: T&E WORKFORCE & RESOURCES

Session VI Chair: Mr. Charles Larson, SURVICE Engineering

- “*The DoD Strategic Plan for Test & Evaluation Resources*”, Mr. Jason Coker, OUSD (AT&L/TRMC)
- “*Today’s and Tomorrow’s DoD Test & Evaluation Acquisition Workforce*”, Ms. Darlene Mosser-Kerner, OUSD (AT&L)

SESSION D-RESOURCES, INSTRUMENTATION, AND TARGETS

Session VI Chair: Mr. Charles Larson, SURVICE Engineering

- “*Test and Training Enabling Architecture, TENA, An Important Component in Joint Mission Environment Test Capability Successes*”, Mr. Gene Hudgins, BAE Systems
- “*Joint Mission Environment Test Capability*”, Mr. Chip Ferguson, TRMC
- “*Evolving Threats – How They Impact T&E Testing and Infrastructure*”, Mr. Dick Dickson, TYBRIN Corporation
- “*Threat/Target Simulation for Live-Fire Events*”, Mr. Greg Van Splinter, NAWCWD

SESSION E- APPLICATION OF T&E/POLICY TO SPECIFIC SYSTEMS

- “*Challenges Facing T&E of Systems to Combat Nuclear and Radiological Smuggling*”, Mr. Stephen DeFrank, Jr., Mantech SRS, Inc.
- “*C-RAM Delivers on Promises and Saves Lives*”, Mr. James Bloodsworth, Army C-RAM Program Directorate

Thursday, 5 March 2009

MISSION-BASED TEST & EVALUATION STRATEGY:

- “*An Inter-Agency-Developed Process to Link Mission Capability With System Functional Requirements*”, Mr. Christopher Wilcox, ATEC
- “*Evaluating An Immersive Virtual World For Accelerating T&E*”, Mr. Redge Bartholomew, Rockwell Collins

FCS CAPABILITIES TO EMPOWER THE SOLDIER —WHAT IS AND WHAT WILL BE

Mr. Bud Irish, Vice President, SAIC

THE ANALYSIS OF ALTERNATIVES (AOA): A MISSION-ORIENTED, EVALUATION-BASED FRAMEWORK FOR DEFENSE TEST & EVALUATION

Mr. Vincent P. Roske, Jr., IDA

CONFERENCE SYNOPSIS: OUTBRIEFS OF BREAKOUT / WRITING SESSIONS

Improving T&E Efficiency and M&S – Dr. Paul Deitz, ARL and Dr. Mark Kiemele, Air Academy Associates

25TH ANNUAL TEST & EVALUATION NATIONAL CONFERENCE: “New Administration, New Opportunities”

WHAT YOU DON'T WANT TO MISS AT THIS CONFERENCE:

- ▶ Internationally known civilian and military authorities presenting their views on Defense and Homeland Security T&E issues
- ▶ Outstanding Tutorials
- ▶ Presentation of the 2009 Hollis Award and Tester of the Year Awards
- ▶ Viewpoints from the Media/ TV/ Authors Informative Displays from Vendors in T&E-related fields
- ▶ Multiple Breakout Sessions to Address Specific Pacing Issues
- ▶ Panel Discussions Assessing New Policy and Issues
- ▶ Over 70 presenters addressing Test Facilities, Congressional Actions, Study Results, Specific T&E Applications to Defense and Homeland Security



MARCH 2-5, 2009

WWW.NDIA.ORG/MEETINGS/9910

SHERATON ATLANTIC CITY ▶ ATLANTIC CITY, NJ

EVENT #9910

CONFERENCE ANNOUNCEMENT

This 25th Annual National Test & Evaluation Conference is sponsored by the NDIA T&E Division and supported by the Office of the Under Secretary of Defense (AT&L) and the Director, Operational Test & Evaluation (DOT&E) in cooperation with ASTM.

The conference will feature nationally known leaders in the field of National Defense and Homeland Security, military leaders from the combat zones, senior industry leaders, authorities on the conference topics from academia and policy study houses, Congressional leaders, as well as a host of individuals charged with conducting test and evaluation on an ongoing basis.

The timing of this conference also permits meaningful discussion on recent legislative actions and Defense Acquisition policy initiatives as well as the results, implications and implementation of such recent studies as the Defense Science Board Study on Test & Evaluation, DAPA and recommendations. While a new Administration offers a unique window of opportunity to invite new ideas and changes in approaches to T&E, it is also vital that approaches that have been demonstrated to be responsive and effective not be sacrificed on the altar of novelty or simply “change for the sake of change.” This conference will feature open discussion and debate addressing what’s working and should be retained and what’s not and suggestions for change to correct these deficiencies.

The full scope of issues related to and impacted by defense and homeland security test and evaluation will be addressed at this event, with emphasis on emerging technologies. Topics will include acquisition and T&E policy and procedures, related studies, T&E infrastructure issues, implications of BRAC on the T&E community, modeling and simulation in support of T&E, training and upgrading the T&E workforce, T&E in support of rapid deployment, pressing T&E environmental issues, novel T&E concepts, T&E encroachment issues, implications of feedback from the combat zones, test design approaches, and a host of other related topics.

Representatives of the U.S. and international communities, including government, industry, academia and other nonprofit institutions are invited to participate.

CONFERENCE ATTIRE

Conference attire is business for civilians and Class A uniform for military. In addition, your identification badge, received upon conference check-in, must be worn at all times.

NDIA T&E EXECUTIVE BOARD:

Mr. Joe Andrese, *APG NDIA Chapter*

Mr. Dennis Bely, *ARL*

Dr. Keith Bradley, *LLNL*

Mr. Britt Bray, *DRC Corporation*

Mr. Sam Campagna, *NDIA*

RADM David Crocker, USN (Ret), *Hard Charger Solutions*

Dr. Paul Deitz, *HRED, ARL*

Mr. Dick Dickson, *Tybrin Corporation*

Mr. Russ Hauck, *Simulation Information Systems*

Dr. Anne Hillegas, *ARA Corporation*

Mr. John Illgen, *Northrop Grumman Corporation*

RADM Charles “Bert” Johnston, USN (Ret), *Wyle Labs*

Dr. Mark Kiemele, *Air Academy Associates*

Mr. Chuck Larson, *SURVICE Engineering*

Mr. James O’Bryon, *The O’Bryon Group, T&E Division Chair*

Mr. Brendan Rhatigan, *Lockheed Martin Corporation*

Dr. Ernest Seglie, *DOT&E, OSD*

Mr. Jack Sheehan, *ARL*

Dr. Lowell Tonnessen, *IDA*

Dr. Juan Vitali, *JPEOCBD*

Mr. William Yeakel, *ORSA Corporation*

AWARD INFORMATION

WALTER W. HOLLIS HONORS BANQUET

The Walter W. Hollis Award is presented annually in recognition of lifetime contributions and achievement in the area of defense Test & Evaluation. The award is presented in the name of Walter W. Hollis who is recognized for his dedicated and long-standing service and contributions in the field of Test & Evaluation.

Previous Recipients of this award:

Dr. Paul H. Deitz, Acting Director HRED, ARL, APG, MD (2008)
Mr. James F. O'Bryon, Former DOT&E / LFT (2007)
RADM Charles "Bert" Johnston, USN (Ret), Wyle Laboratories (2006)
Hon Thomas Christie, DOT&E, OSD (2005)
Dr. Marion Williams, HQ AFOTEC (2004)
Mr. James Fasig, Aberdeen Test Center (2003)
Mr. G. Thomas Castino, Underwriters Laboratories, Inc. (2002)
Hon Philip Coyle, III, DOT&E, OSD (2001)
Mr. Walter Hollis, Department of the Army (2000)

TESTER OF THE YEAR AWARDS

These awards, presented to outstanding individuals in the field of Test & Evaluation, offer OSD and each Military Service Test & Evaluation Department the opportunity to select three award recipients for recognition as the Tester of the Year in specific categories. The three categories recognized are: Military, Civilian, and Contractor. Recipients will be recognized at the conference Awards Luncheon on Wednesday, March 4.

2008 TESTER OF THE YEAR AWARDEES

MAJ Theotis Clemons, USA
 Army Military Tester of the Year, 2008

Mr. W. Scott Walton
 Army Civilian Tester of the Year, 2008

Mr. Timothy J. Conway
 Army Contractor Tester of the Year, 2008

Col Eileen A. Bjorkman, USAF
 OSD Military Tester of the Year, 2008

Mr. William J. Kralik
 OSD Civilian Tester of the Year, 2008

Mr. Thomas G. Kane
 OSD Contractor Tester of the Year, 2008

Capt James D. Conley, USAF
 USAF Military Tester of the Year, 2008

Mr. Kenneth E. Bandy
 USAF Civilian Tester of the Year, 2008

Mr. Blair L. Bozek
 USAF Contractor Tester of the Year, 2008

LT Leonard L. Adams, Jr., USN
 Navy Military Tester of the Year, 2008

Mr. Kevin M. Ransford
 Navy Civilian Tester of the Year, 2008

Dr. Jay R. Smith
 Navy Contractor Tester of the Year, 2008

Maj Garrett L. Benson, USMC
 Marine Corps Military Tester of the Year, 2008

Mr. John Lee
 Marine Corps Civilian Tester of the Year, 2008

Mr. Donald C. Mueller
 Marine Corps Contractor Tester of the Year, 2008

Joint Electronic Protection Air Combat Joint T&E Team
 OSD Special Category Tester of the Year, 2008

MONDAY, MARCH 2, 2009

11:00 AM - 5:00 PM CONFERENCE REGISTRATION

TUTORIAL SESSIONS

| | WORKSHOP I-(CROWN BALLROOM 4) | WORKSHOP II-(CROWN BALLROOM 5) |
|---------|--|---|
| 1:30 PM | MISSION-BASED TEST & EVALUATION (MBTE) Presenters: Mr. Chris Wilcox, <i>AEC</i> Mr. Britt Bray, <i>DRC Corporation</i> Mr. Jack Sheehan, <i>ORSA Corporation</i> | THE SECRET TO SURVIVING & THRIVING IN A DOWN-TURN ECONOMY Presenter: Dr. Mark J. Kiemele, <i>President and Co-founder, Air Academy Associates</i> |
| 3:00 PM | AFTERNOON BREAK | AFTERNOON BREAK |
| 3:15 PM | MISSION-BASED TEST & EVALUATION (MBTE) CONTINUED Presenters: Mr. Chris Wilcox, <i>AEC</i> Mr. Britt Bray, <i>DRC Corporation</i> Mr. Jack Sheehan, <i>ORSA Corporation</i> | THE SECRET TO SURVIVING & THRIVING IN A DOWN-TURN ECONOMY CONTINUED Presenter: Dr. Mark J. Kiemele, <i>President and Co-founder, Air Academy Associates</i> |

TUTORIAL FEE \$50

TUTORIAL DESCRIPTIONS

WORKSHOP I

Moderator: Dr. Paul Deitz, *Acting Director, HRED ARL*

MISSION-BASED TEST & EVALUATION (MBTE)

Topics to be covered include a synopsis of MBTE Efforts, Accomplishments of the AEC MB T&E Program and Logic and Approach for Bottom-Up MBTE Execution Strategy.

We now note that OSD P&R has developed a process utilizing MB Tasks/ Conditions/ Standards (T/C/S) "criteria" or a kind of "use case construct". Sets of T/C/S are used as surrogates for fully developed missions (or even vignettes), but are directly relatable to the materiel readiness and human skill sets most relevant to the mission(s) contemplated. Furthermore, OSD's P&R Office has a roll up process by means of which the statuses of both materiel and people capabilities can be related to particular mission sets. Our aim is to collect the details of these current practices, and then emulate/apply them as possible to both MB T&E and MB Technology Assessment (TA).

MISSION-BASED TEST & EVALUATION (MBTE) CONTINUED

Conclusion to MBTE Presentation as well as a Working & Writing Session to permit time for Q&A, discussion and drafting of a paper addressing issues arising from this tutorial including recommendations for implementation of the MBTE concept.

WORKSHOP II

Moderator: Mr. William Yeakel, *ORSA Corporation*

THE SECRET TO SURVIVING & THRIVING IN A DOWN-TURN ECONOMY

A leading question in today's marketplace is what's the best investment a company can make? This workshop will introduce the participant to a methodology that can be used to systematically generate breakthrough improvement and deliver double-digit return on investment. If your Six Sigma or Lean Six Sigma (LSS) initiative has fallen short of the value you were expecting and needs a shot in the arm to rejuvenate it, or if you are a newcomer to LSS or Design for Six Sigma (DFSS), this workshop is for you. This session will provide you with an overview of the necessary methodologies, infrastructure, and approach that have proven to be valuable breakthrough performance generators for a variety of companies. Companies no longer can afford to depend on the epiphanies of a select creative few to achieve innovative breakthroughs. Although there are no magic formulas or silver bullets, this session will give you the basics of reliable, predictable, and repeatable breakthroughs by providing you a systematic approach to gaining order-of-magnitude return on investment.

THE SECRET TO SURVIVING & THRIVING IN A DOWN-TURN ECONOMY CONTINUED

Conclusion to discussions of LSS and DFSS and their applications as well as a Working & Writing Session to permit time for Q&A, discussion and drafting of a paper addressing issues arising from this tutorial including recommendations for implementation of these applications to DoD's and DHS's missions.

5:00 PM - 6:00 PM EVENING RECEPTION IN DISPLAY AREA-(PEARL BALLROOM)

6:00 PM CONFERENCE ADJOURNED FOR THE DAY & DISPLAY AREA CLOSED

TUESDAY, MARCH 3, 2009

7:00 AM - 5:00 PM **CONFERENCE REGISTRATION**

7:00 AM - 8:00 AM **CONTINENTAL BREAKFAST IN DISPLAY AREA**

8:00 AM **CALL TO ORDER AND REMARKS-(CROWN BALLROOM 3, 4 & 5)**

▶ Mr. Sam Campagna, *Director, Operations, NDIA*

8:05 AM **TRIBUTE TO OUR NATION AND WARFIGHTERS, NATIONAL ANTHEM**

8:10 AM **WELCOME AND CONFERENCE INTRODUCTORY REMARKS**

▶ Mr. James O'Bryon, *Chairman, NDIA T&E Division; The O'Bryon Group*

SESSION I

Session I Chair: Mr. James O'Bryon, *Chairman, NDIA T&E Division*

8:15 AM **CONFERENCE KEYNOTE ADDRESS**

▶ Mr. Keith Williams, *CEO, Underwriters Laboratories (UL)*

The UL seal is one of the most recognizable trademarks in the world. Since 1894, the UL has been at the forefront of testing and testing policy to assure that systems not only work effectively but also that they will be reliable and safe to operate over the long haul. It's an honor to have this leader of the world's most prominent and respected T&E organization with us at this Silver Anniversary of NDIA's T&E Division.

9:00 AM **DOT&E LOOKING AHEAD**

▶ Honorable Charles McQueary, *Director, Operational Test & Evaluation (DOT&E)*

9:30 AM **PERSPECTIVES FROM A FORMER TEST PILOT AND FORMER D, OT&E**

▶ Honorable John "Jack" Krings, *President, Krings Corporation, Former DOT&E*

10:00 AM **MORNING BREAK & NETWORKING IN DISPLAY AREA**

SESSION II

Session II Chair: RADM Charles "Bert" Johnston, USN (Ret), *Wyle Labs*

10:30 AM **ROUNDTABLE: REALITIES FACING THE WORLD OF DEFENSE AND HOMELAND SECURITY T&E**

Moderator: Maj Gen Steve Sargeant, USAF, *Commander AFOTEC*

MG Roger Nadeau, USA, *Commander ATEC*

RDML David "Decoy" Dunaway, USN, *Commander, OPTEVFOR*

Col David Reeves, USMC, *Director, MCOTEA*

Mr. George Ryan, *Director, OT&E, DHS*

11:45 AM - 1:15 PM **LUNCHEON AND SPECIAL GUEST SPEAKER-(CROWN BALLROOM 1 & 2)**

▶ Mr. Vago Muradian, *Editor, Defense News and TV Host of CBS's "This Week in Defense News"*

TEST & EVALUATION
AGENDA: MARCH 03, 2009

SESSION III

Session III Chair: Mr. Jack Sheehan, *ORSA Corporation*

1:30 PM GAO ASSESSMENT OF DOD'S MAJOR WEAPON SYSTEMS ACQUISITION PORTFOLIO

► Mr. Ronald Schwenn, *US Government Accountability Office*

2:00 PM NDIA ICOTE ANNUAL REPORT

► Mr. Larry Graviss, *ICOTE Chair, President, Eagle Engineering*

2:30 PM AFTERNOON BREAK & NETWORKING IN DISPLAY AREA

3:00 PM - 5:30 PM CONCURRENT FOCUS AND WORKING DRAFT SESSIONS

Each Breakout Session will consist of both oral presentations and collaboration between presenters and audience to draft the recommendations and issues raised during each session for presentation to the plenary session Thursday morning. The Session host and presenters will be responsible for pulling these issues together for later presentation.

| | SESSION A-(STEEL PIER) MISSION CAPABILITY TESTING SESSION <i>Chair: Mr. Britt Bray, DRC Corporation</i> | SESSION B-(CROWN BALLROOM 4) NEW T&E POLICY AND POLICY IMPLEMENTATION <i>Chair: Mr. Robert Wojciechowski, APG</i> | SESSION C-(CROWN BALLROOM 5) T&E METHODOLOGY AND M&S <i>Chair: Dr. Mark Kiemele, Air Academy Associates</i> |
|----------------|---|--|---|
| 3:00 PM | Evaluating the Mission – Translating Systems Performance to Unit Capabilities Mr. David Thomas, <i>RoundTable Defense, LLC.</i> | New Test and Evaluation Master Plan Guidance Ms. Darlene Mosser-Kerner, <i>OUSD (AT&L)</i> | Early Decision Analysis Guiding System Reliability Growth Dr. Patricia Jacobs, <i>Naval Postgraduate School</i> |
| 3:30 PM | System of Systems – Survivability, Lethality, Vulnerability Assessment Ms. Beth Ward, <i>U.S. Army Research Lab</i> | ITAA GEAI-STD-0009 – New Best Practices Standard for Reliability Assessment and Verification Mr. Enzo Long, <i>DOT&E, OSD</i> | How to Incorporate Modeling and Simulation into the System Acquisition Life Cycle Dr. Derek Kropp, <i>Navy Patuxent River</i> |
| 4:00 PM | Structuring T&E for Validation of Complex Systems Capabilities and Exploration of Emergent Behaviors Mr. Joseph Tribble, <i>AVW Technologies</i> | Walking the Line With Title 10: Implementation Strategies for Integrated Testing Dr. Beth Wilson, <i>Raytheon</i> | Extending Test and Evaluation Modeling and Simulation Capabilities with Gaming Technology Mr. Geoffrey Robinson, <i>Ft. Hood</i> |
| 4:30 PM | Using IMPRINT to Translate Human Performance Into Mission Effectiveness to Focus Test and Evaluation Ms. Diane Mitchell & Charneta Samms | Systems Assurance Test and Evaluation in Defense Acquisition – Specification, Planning and Resourcing Ms. Christine Hines, <i>OUSD (AT&L)</i> | Integrating the System Engineering “V” in a System of Systems Mr. Jack Sheehan, <i>ORSA Corporation</i> |
| 5:00 PM | | Automated GPS Simulation Test Process 2 nd LT Matthew Steele, <i>Holloman AFB</i> | Applying the SCORE Framework to Evaluate Advanced Military Technologies Mr. Craig Schlenoff, <i>NIST</i> |

5:30 PM AFTERNOON SESSION COMPLETE

6:30 PM - 8:30PM **WALTER W. HOLLIS HONORS BANQUET-(CROWN BALLROOM 1 & 2)**

PRESENTATION OF THE 2009 WALTER W. HOLLIS AWARD FOR OUTSTANDING LIFETIME ACHIEVEMENT IN DEFENSE TEST & EVALUATION.

The Walter W. Hollis Award is presented annually in recognition of lifetime contributions and achievement in the area of defense Test & Evaluation. The award is presented in the name of Walter W. Hollis who is recognized for his dedicated and long-standing service in the field of Test & Evaluation.

Recipient: Dr. Ernest Seglie, *Science Advisor to the Director, Operational Test & Evaluation, OSD*

Dr. Seglie received his B.S. at The Cooper Union and his Ph.D. in Physics from the University of Massachusetts. After teaching and research assignments at Rensselaer Polytechnic Institute and Yale University he joined the Institute for Defense Analyses. He led the IDA analysis for the Joint Test TASVAL, Tactical Aircraft Survivability Evaluation, which was the largest field test conducted up to that time. He was project leader for IDA's support of the Sgt. York Operational Test, the first test overseen by the then just established Office of Director, Operational Test and Evaluation (DOT&E). He received the Andrew Goodpaster Award for Excellence in Research from IDA. He became the first Science Advisor to DOT&E in 1988 and his efforts have been rewarded with the Civilian Service Medal, the Secretary of Defense Medal for Meritorious Service (twice) and the rank of Meritorious Senior Professional, conferred on him in 2003 by President Bush.



Dr. Ernest Seglie
Science Advisor to the Director,
Operational Test & Evaluation, OSD

GUEST SPEAKER

Mr. Winslow Wheeler, *Director of the Straus Military Reform Project of the Center for Defense Information*

“Mr. Winslow Wheeler is widely known in defense circles for working on national security issues for members of the US Senate and the GAO. In the Senate, Wheeler advised Senators Jacob K. Javits (R-NY), Nancy L. Kassebaum (R-KS), David Pryor (D-AK) and Pete V. Domenici (R-NM). He was the first and, according to Senate records the last, Senate staffer to work simultaneously on the personal staffs of a Republican and a Democrat. He has also appeared as a guest on defense matters for C-SPAN, NPR, PBS, 60 Minutes, Armed Forces Journal, Barron's, the Washington Post, the Politico and a number of other media outlets.

He has also published on a wide range of defense topics. In 2002, while working on the Republican staff of the Senate Budget Committee, he authored an essay under the pseudonym “Spartacus,” addressing Congress' reaction to the September 11, 2001 terrorist attacks. He has authored two books: “The Wastrels of Defense” and “Military Reform” and released a new anthology, “America's Defense Meltdown”.

*The cost of this Honors Banquet is included in the registration fee. Guests of conference registrants are welcome for an additional fee of \$75.



WEDNESDAY, MARCH 4, 2009

7:00 AM - 5:00 PM **CONFERENCE REGISTRATION**

7:00 AM - 8:00 AM **CONTINENTAL BREAKFAST IN DISPLAY AREA**

8:00 AM **CALL TO ORDER AND REMARKS-(CROWN BALLROOM 3, 4 & 5)**

▶ Mr. Sam Campagna, *Director, Operations, NDIA*

SESSION IV: T&E POLICY & STUDIES

Session IV Chair: Dr. Paul Deitz, *Acting Director, ARL HRED*

8:05 AM **PHYSICS OF FAILURE - THE CRITICAL PATH TO SAVING \$M IN T&E**

▶ Dr. W. Forrest Crain, *Director, US AMSAA*

8:35 AM **A COMMON PLATFORM FOR DOD AND DHS TO PARTNER IN THE T&E COMMUNITY**

▶ Dr. Richard Murrow, *CEO, Air Academy Associates*

9:05 AM **PREVAILING DEVELOPMENTAL TEST AND EVALUATION (DT&E) CHALLENGES**

▶ Mr. Thomas Berard, *Air Force Flight Test Center, Edwards AFB*

9:35 AM **IMPLEMENTATION OF THE RECENT DEVELOPMENTAL TEST & EVALUATION DEFENSE SCIENCE BOARD RESULTS**

▶ Mr. Christopher DiPetto, *OUSD (AT&L)*

10:00 AM **MORNING BREAK & NETWORKING IN DISPLAY AREA**

SESSION V: T&E POLICY & STUDIES CONTINUED

Session V Chair: VADM Joseph W. Dyer, *USN (Ret), iRobot Corporation*

10:30 AM **PANEL DISCUSSION: THE MOVING POLICY TRAIN: IMPLICATIONS**

Panelists: Dr. Steven Hutchison, *DISA TEMC*
Mr. James Ruma, *GDLS*
Mr. Brian Simmons, *ATEC*
Dr. Robert Soule, *IDA*

11:15 AM **DISCUSSION: ACQUISITION AND T&E: COLLABORATING FOR THE WARFIGHTER**

This discussion will enable a fresh examination of the relative roles of the senior Pentagon proponents and the role of the independent oversight functions in the Pentagon established by Congress 25 years ago. This debate will include written questions submitted from the audience to the participants.

Mr. Christopher Dipetto, *OUSD(AT&L)*
Dr. Ernest Seglie, *DOT&E, OSD*

11:45 AM **ANNUAL TESTER OF THE YEAR AWARDS LUNCHEON-(CROWN BALLROOM 1 & 2)**

This awards event is a highlight of our annual conference as it provides the opportunity to recognize outstanding achievement in test and evaluation by members of our armed forces, DoD civilians and DoD contractors. Furthermore, what makes these awards particularly noteworthy is that the selections are made by the peers of those being recognized. Congratulations to all who are being recognized this year!

SESSION VI: T&E WORKFORCE & RESOURCES

Session VI Chair: Mr. Charles Larson, *SURVICE Engineering*

1:15 PM THE DOD STRATEGIC PLAN FOR TEST & EVALUATION RESOURCES

► Mr. Jason Coker, *OUSD (AT&L/TRMC)*

1:45 PM TODAY'S AND TOMORROW'S DoD TEST & EVALUATION ACQUISITION WORKFORCE

► Ms. Darlene Mosser-Kerner, *OUSD (AT&L)*

2:15 PM AFTERNOON BREAK & NETWORKING IN DISPLAY AREA

2:45 PM - 5:15 PM CONCURRENT FOCUS AND WORKING DRAFT SESSIONS

Each Breakout Session will consist of both oral presentations and collaboration between presenters and audience to draft the recommendations and issues raised during each session for presentation to the plenary session Thursday morning. The Session host and presenters will be responsible for pulling these issues together for later presentation.

| | SESSION D-(CROWN BALLROOM 4) RESOURCES, INSTRUMENTATION, AND TARGETS <i>Chair: Mr. Charles Larson, SURVICE Engineering</i> | SESSION E-(CROWN BALLROOM 5) APPLICATION OF T&E/POLICY TO SPECIFIC SYSTEMS <i>Chair: RADM Charles "Bert" Johnston, USN (Ret), Wyle Labs</i> |
|----------------|--|---|
| 2:45 PM | Test and Training Enabling Architecture, TENA, An Important Component in Joint Mission Environment Test Capability Successes Mr. Gene Hudgins, <i>BAE Systems</i> | Reliability Growth Planning and Implementation of the ASA (ALT) Reliability Test Threshold Dr. J. Brian Hall, <i>Army Evaluation Command</i> |
| 3:15 PM | Joint Mission Environment Test Capability Mr. Chip Ferguson, <i>TRMC</i> | Challenges Facing T&E of Systems to Combat Nuclear and Radiological Smuggling Mr. Stephen DeFrank, Jr., <i>Mantech SRS, Inc.</i> |
| 3:45 PM | The Department of Homeland Security Leverages DoD Assets for Test & Evaluation Mr. Kerry Wilson, <i>DHS Counter-MANPADS Program</i> | Application of Legislative Language and DoD Directives to Life Fire Test & Evaluation Mr. James O'Bryon, <i>The O'Bryon Group</i> |
| 4:15 PM | Evolving Threats – How They Impact T&E Testing and Infrastructure Mr. Dick Dickson, <i>TYBRIN Corporation</i> | C-RAM Delivers on Promises and Saves Lives Mr. James Bloodsworth, <i>Army C-RAM Program Directorate</i> |
| 4:45 PM | Threat/Target Simulation for Live-Fire Events Mr. Greg Van Splinter, <i>NAWCWD</i> | Integrated Display and Keyboard Video Mouse Control (KNV) of Multiple Computers: A New Paradigm Mr. Robert Marcus, <i>RGB Spectrum</i> |

5:15 PM CONFERENCE ADJOURNS FOR THE DAY AND DISPLAY AREA CLOSED

THURSDAY, MARCH 5, 2009

7:00 AM - 12:00 PM **CONFERENCE REGISTRATION**

7:00 AM - 8:00 AM **CONTINENTAL BREAKFAST IN DISPLAY AREA**

8:00 AM **CALL TO ORDER AND REMARKS-(CROWN BALLROOM 3, 4 & 5)**

▶ Mr. Sam Campagna, *Director, Operations, NDIA*

SESSION VII

Session VII Chair: Mr. William Yeakel, *ORSA Corporation*

8:05 AM **MISSION-BASED TEST & EVALUATION STRATEGY:**

AN INTER-AGENCY-DEVELOPED PROCESS TO LINK MISSION CAPABILITY WITH SYSTEM FUNCTIONAL REQUIREMENTS

▶ Mr. Christopher Wilcox, *ATEC*

8:35 AM **EVALUATING AN IMMERSIVE VIRTUAL WORLD FOR ACCELERATING T&E**

▶ Mr. Redge Bartholomew, *Rockwell Collins*

9:00 AM **FCS CAPABILITIES TO EMPOWER THE SOLDIER—WHAT IS AND WHAT WILL BE**

▶ Mr. Bud Irish, Vice President, *SAIC*

9:25 AM **THE ANALYSIS OF ALTERNATIVES (AOA): A MISSION-ORIENTED, EVALUATION-BASED FRAMEWORK FOR DEFENSE TEST & EVALUATION**

▶ Mr. Vincent P. Roske, Jr., *IDA*

9:50 AM **T&E PANEL DISCUSSION: EARLY INVOLVEMENT**

Panel Chair: Dr. Ernest Seglie, *DOT&E*
Mr. David Hamilton, *AF/TE*
Dr. James Streilein, *ATEC*
Dr. Stephen Whitehead, *OPTEVFOR*

10:25 AM **MORNING BREAK & NETWORKING IN DISPLAY AREA**

10:50 AM **CONFERENCE SYNOPSIS: OUTBRIEFS OF BREAKOUT / WRITING SESSIONS**

(Input from the audience will also be entertained during this session.)

- ▶ New T&E Policy and Policy Implementation – Mr. David Duma, *DOT&E* and Mr. Robert Wojciechowski, *APG*
- ▶ Mission-Based Test & Evaluation – Mr. Britt Bray, *DRC* and Mr. Jack Sheehan, *ORSA Corporation*
- ▶ Improving T&E Efficiency and M&S – Dr. Paul Deitz, *ARL* and Dr. Mark Kiemele, *Air Academy Associates*
- ▶ System-Specific T&E Issues – Dr. Anne Hillegas, *ARA Corporation* and RADM Charles “Bert” Johnston, *Wyle Labs*
- ▶ Resources, Instrumentation and Targets, Mr. Dick Dickson, *Tybrin* and Mr. Charles Larson, *SURVICE Engineering*

11:50 AM **CLOSING REMARKS**

▶ Mr. James O’Byron, *Chairman, NDIA T&E Division, The O’Byron Group*

12:00 PM **CONFERENCE ADJOURNS**

SECONDARY AUTHORS

| ABSTRACT ID | ABSTRACT TITLE | ADDITIONAL AUTHORS |
|-------------|---|--|
| 7773 | Applying the SCORE Framework to Evaluate Advanced Military Technologies | Mr. Brian Weiss |
| 7796 | System of Systems - Survivability, Lethality, Vulnerability Assessment | Dr. Jeffrey Smith |
| 7817 | Extending Test and Evaluation Modeling and Simulation Capabilities with Gaming Technology | Mr. Robert Bowen Mr. Kevin Van Antwerp Mr. Patrick Heney Mr. Dale Waldrep |
| 7828 | GAO Assessment of DOD's Major Weapon Systems Acquisition Portfolio | Mr. Michael Sullivan |
| 7842 | ITAA GEIA-STD-0009--New Best Practices Standard for Reliability Assessment and Verification | Dr. Michael Cushing |
| 7847 | Walking the Line with Title 10: Implementation Strategies for Integrated Testing | Ms. Darlene Mosser-Kerner |
| 7854 | The DoD Strategic Plan for Test and Evaluation Resources | Mr. Chris Paust |
| 7855 | Early Decision Analysis Guiding System Reliability Growth | Dr. Donald Gaver Dr. Ernest Seglie |

NATIONAL DEFENSE INDUSTRIAL
ASSOCIATION
2111 WILSON BOULEVARD, SUITE 400
ARLINGTON, VA 22201-3061
(703) 247-2566
(703) 522-1885 FAX
WWW.NDIA.ORG

**25TH ANNUAL
TEST & EVALUATION
NATIONAL CONFERENCE**



MARCH 2-5, 2009
SHERATON ATLANTIC CITY
ATLANTIC CITY, NEW JERSEY

TO REGISTER, VISIT:
WWW.NDIA.ORG/MEETINGS/9910

THANK YOU TO OUR PROMOTIONAL PARTNER



ALION
SCIENCE AND TECHNOLOGY

THANK YOU FOR ATTENDING!

**WE LOOK FORWARD TO
SEEING YOU NEXT YEAR**

**FEBRUARY 20-25, 2010
SAN DIEGO, CALIFORNIA**

Evaluating an Immersive Virtual World for Accelerating T&E

NDIA 25th Annual Test &
Evaluation National
Conference

Redge Bartholomew

***Rockwell
Collins***

Development Scale Problem

- In large, distributed, complex programs, T&E can be a discovery process rather than a confirmation
 - Many MSLOC, several supplier tiers, many regional facilities
 - Communication, coordinating/synchronizing supplier actions, deploying & clarifying information are problematic
 - Iterations of test-analyze-fix from conflicting interpretations of requirements, designs, interfaces
- Collocation optimizes development but is unlikely; using conventional media as a substitute fails
- Medium that simulates collocation might mitigate problems
- Internal evaluation focused on 25 regional facilities

Immersive Virtual Collaboration

- Immersive virtual world simulates collocation
 - Includes integrated audio & visual animation, data & object persistence, common view, integrated development tools
- Could provide enough fidelity to collocation for effective collaboration & synchronizing suppliers
 - Strangers meet in online games & social worlds, form teams, strategize, execute plans, coordinate actions
- Could reduce number of errors that escape implementation phase into T&E
- Integrated modeling & simulation tools could provide environment for initial T&E

Sun's MPK20 – Project Wonderland

- Operation can be confined within firewall to resolve third party storage, data/access control, identity masking, etc.
- Animation of configurable avatars, stereo VOIP, IM
 - Keyboard steers avatar through prefabricated concourse, conference room, offices, lab
 - Users logged onto same server see, hear each other
 - 3-D objects can be assembled and animated
- Provides collaboration via 3rd party applications launched into in-world 2-D windows
 - Participants jointly develop artifacts by explicitly sharing control of launched applications

MPK20 – Project Wonderland



Code Window, 3rd person view

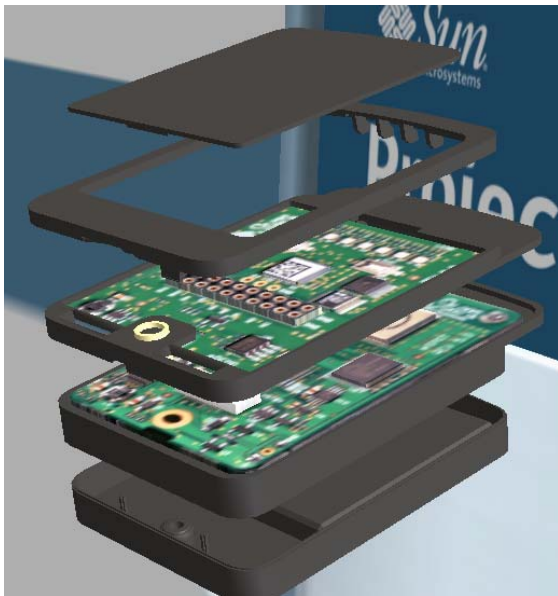
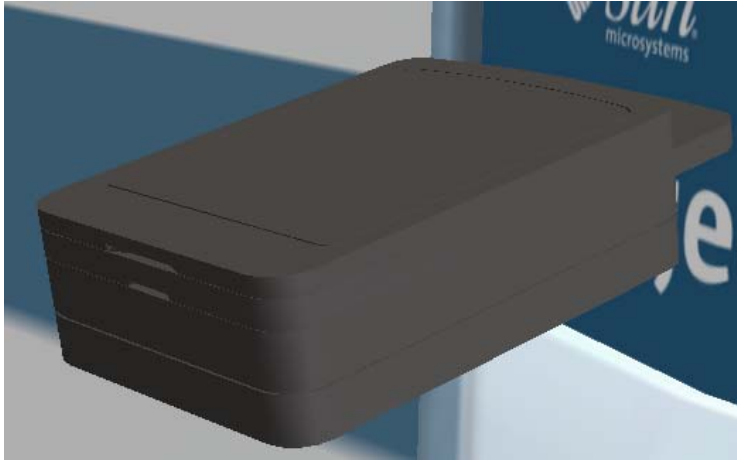


First Person View

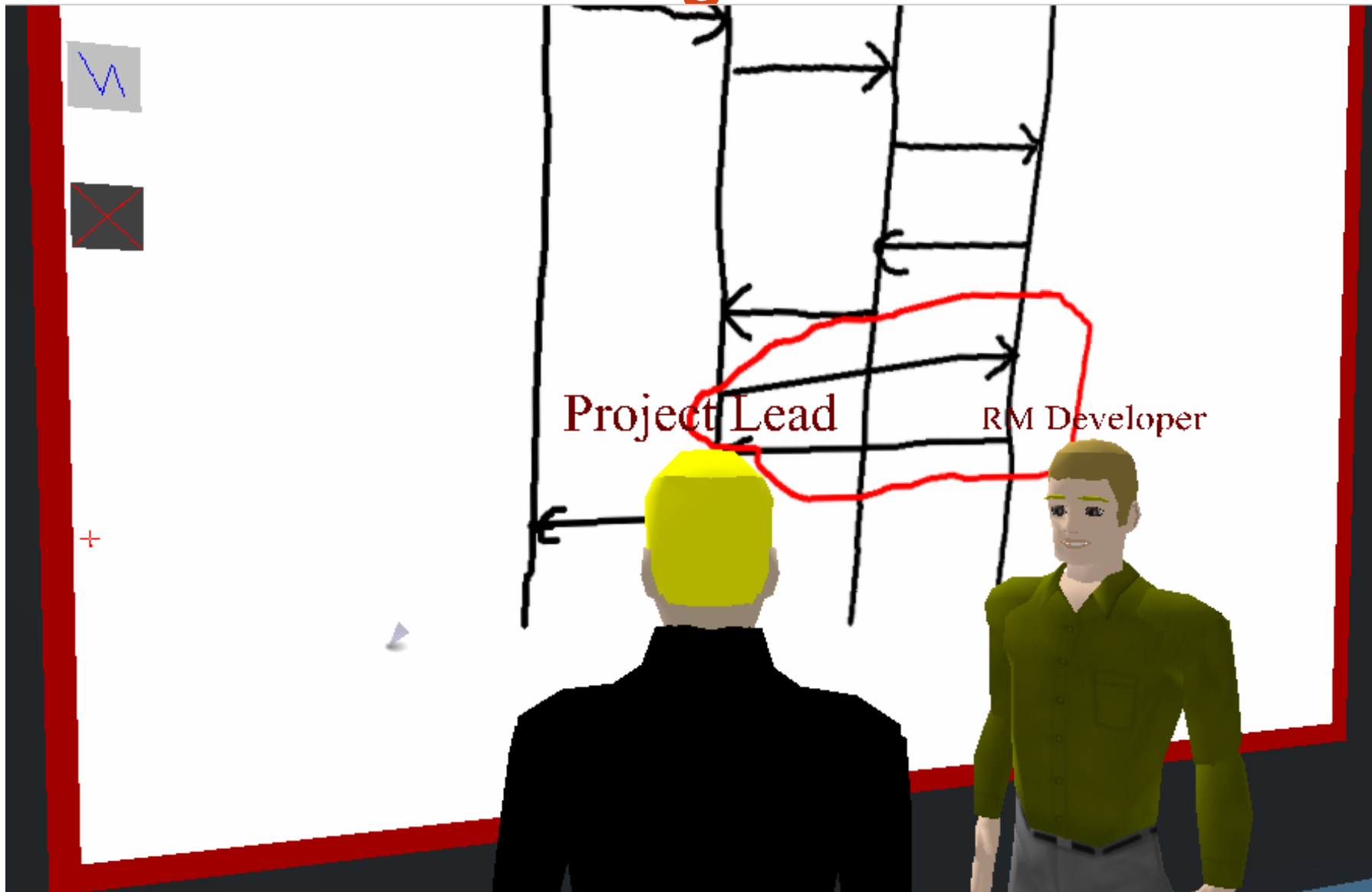
```
String stateClassName = in.readUTF();  
  
try {  
    Class c1 = Class.forName( stateClassName, true, classLoader );  
    // System.out.println("Got class "+c1 );  
    Constructor construct = c1.getConstructor(  
        new Class[] {  
            com.sun.j3d.utils.scenegraph.io.retained.SymbolTableData.class,  
            com.sun.j3d.utils.scenegraph.io.retained.Controller.class } );  
    // System.out.println("Got constructor "+construct );  
    state = (SceneGraphObjectState)construct.newInstance(  
        new Object[] { null, this } );  
    System.out.println("Got state instance "+state);  
} catch (ClassNotFoundException e) {  
    throw new java.io.IOException( "Error Loading State Class "+stateClassName+  
        " "+e.getMessage() );  
} catch (NoSuchMethodException ex) {  
    throw new java.io.IOException( "1 Broken State class for "+  
        stateClassName+" "+ex.getMessage() );  
}
```

Gary

Object animation



Collaborative design



Code inspection



Subjective Assessment ...

- ... based on internal proof-of-concept evaluation and Software Engineering Research Center project
- Promotes informal communication & coordination well beyond IM, tele/video-conferencing ...
 - ... if it is frequently used by nearly everyone
- Integrated tools improve common understanding, increase accuracy of understanding ...
 - ... for requirements, designs, interfaces, status conveyed by modeling/simulation tools, code editors, code coverage tools
- Scalability yet to be evaluated ...
 - ... number of developers, facilities, time zones

Emerging Operational Concept

- Central system assembly & test area with library
- Radial hallways contain offices/labs for analysts, developers, end-users, acquisition team
- Developers analyze, design, code in windows visible to all authorized participants
- Library contains artifacts accessed via integrated tools – e.g., modeling, requirements management
 - Hold artifact reviews in library alcoves
 - Hold program reviews in library auditorium
- Projects spin-off worlds from baseline as need dictates – e.g., unique tools, access restrictions



25th Annual NDIA National T&E Conference Atlantic City NJ

Counter-Rocket, Artillery, Mortar (C-RAM) Delivers on Promises and Saves Lives

**Jim Bloodsworth
PD C-RAM
Test Branch Chief
Jim.Bloodsworth@us.army.mil
256-774-6899**



Counter-Rocket, Artillery, Mortar (C-RAM) Delivers on Promises and Saves Lives



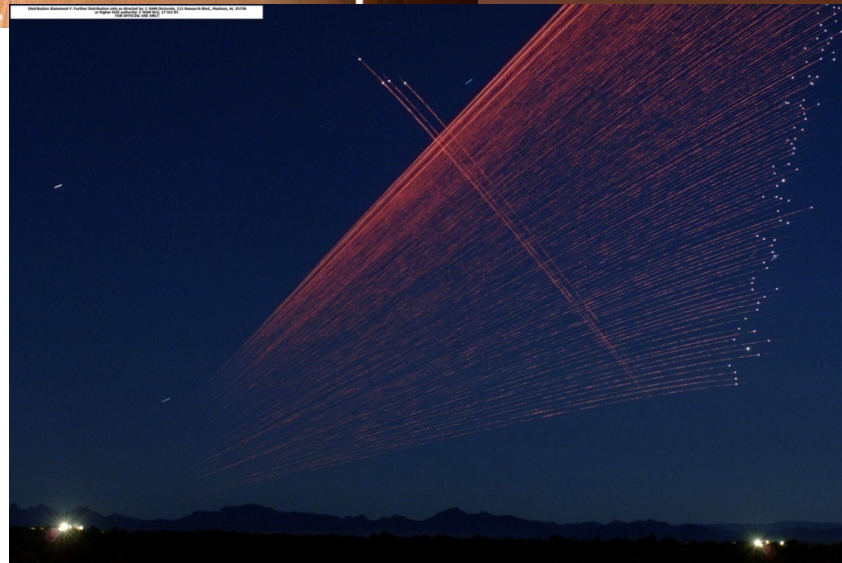
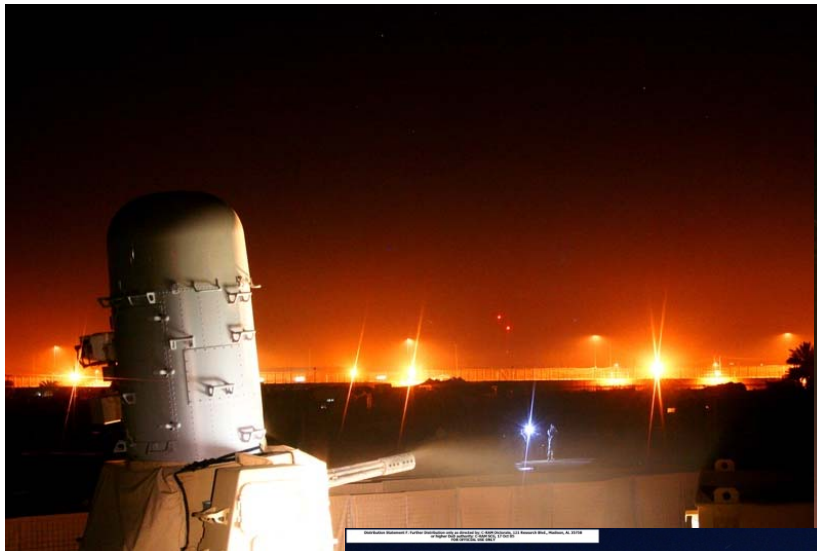


Counter-Rocket, Artillery, Mortar (C-RAM) Delivers on Promises and Saves Lives





Counter-Rocket, Artillery, Mortar (C-RAM) Delivers on Promises and Saves Lives





Operational Environment



- Indirect fire is and will remain a staple of combat
- Weapons of choice for conventional & irregular foes, worldwide:
 - Mortars
 - Rapidly employed and used, acceptably accurate, difficult to locate
 - Rockets (all calibers and types)
 - Remote or delayed firing options, difficult to locate
 - Some possible use of lighter artillery (75mm-105mm)
 - More accurate, easier to move, easier to locate
- Present and future threats will exploit vulnerabilities of US/Coalition fixed sites, especially large bases, by indirect fire attacks





Current Operational Requirement



HQDA Validated OIF Operational Needs Statements (ONS)

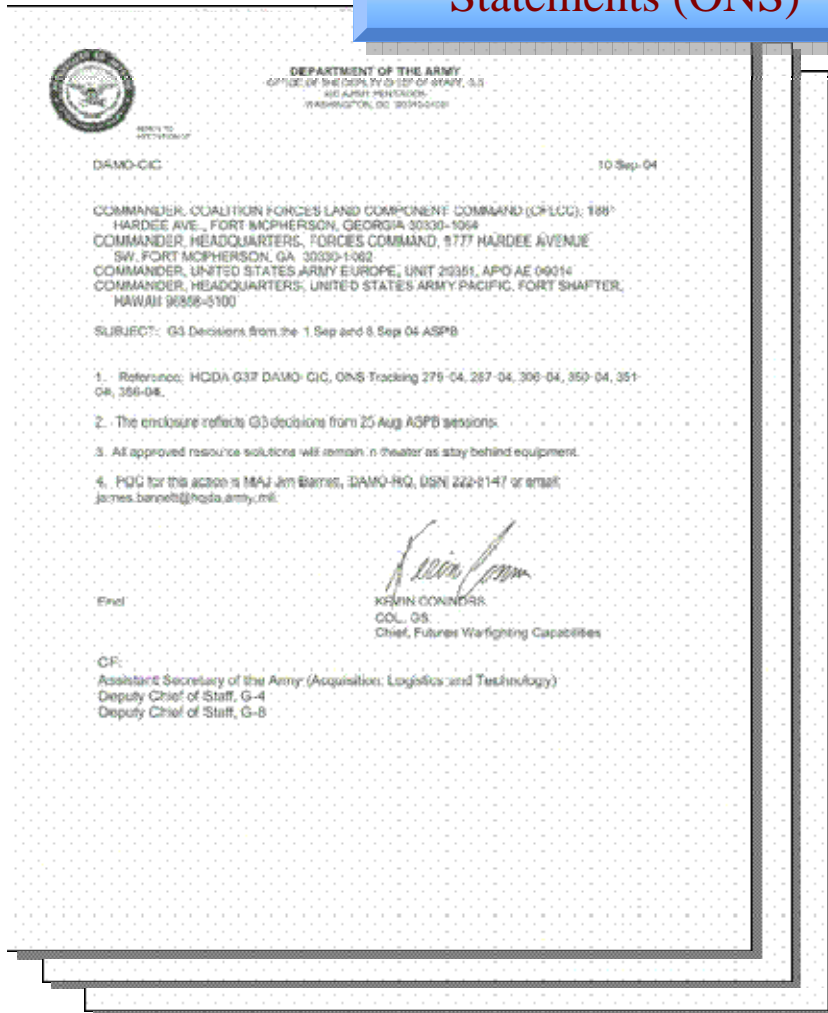
Operational requirement for Integrated Force Protection based on Theater needs:

✓ 10 Sep 04 Army Strategic Planning Board Validated Theater ONS 306-04 for a Counter Rocket and Mortar Intercept and Destroy Capability



➤ Supports a Mar 05 HQDA G3-validated Theater ONS (260-4) for Sensor Interoperability to Digital Battle Command Systems

➤ Supports a Aug 05 HQDA G3-validated Theater ONS (05-466) for an Integrated Base Defense Security System capability





C-RAM Requirement / Background



- **C-RAM Requirement**

- Jun 2004 – Theater submitted Operational Need Statement (ONS 306-04) for a system to destroy Mortar rounds
- Sep 2004 – The ASPB validated theater ONS and directed ABO fund C-RAM Proof-of-Principle Test
- Jan 2005 – Results of C-RAM POP test briefed to VCSA, SecNav, and Dep SecDef

- **C-RAM Capability**

- Feb 2005 – Sense and Warn capability validated and initial fielding begins
- Apr 2005 – Intercept capability validated and initial fielding begins
- Jul 2005 – IOC of Sense, Warn, and Respond capability at FOB 1
- Sep 05 – C-RAM supported successful attack of 2 insurgent mortar teams – 11 KIA, 5 captured
- Mar 06 – FOC declared at FOB 1 and first combat intercept (first ever for a Phalanx system)

- **FMS and Lease Cases approved 2QFY06**

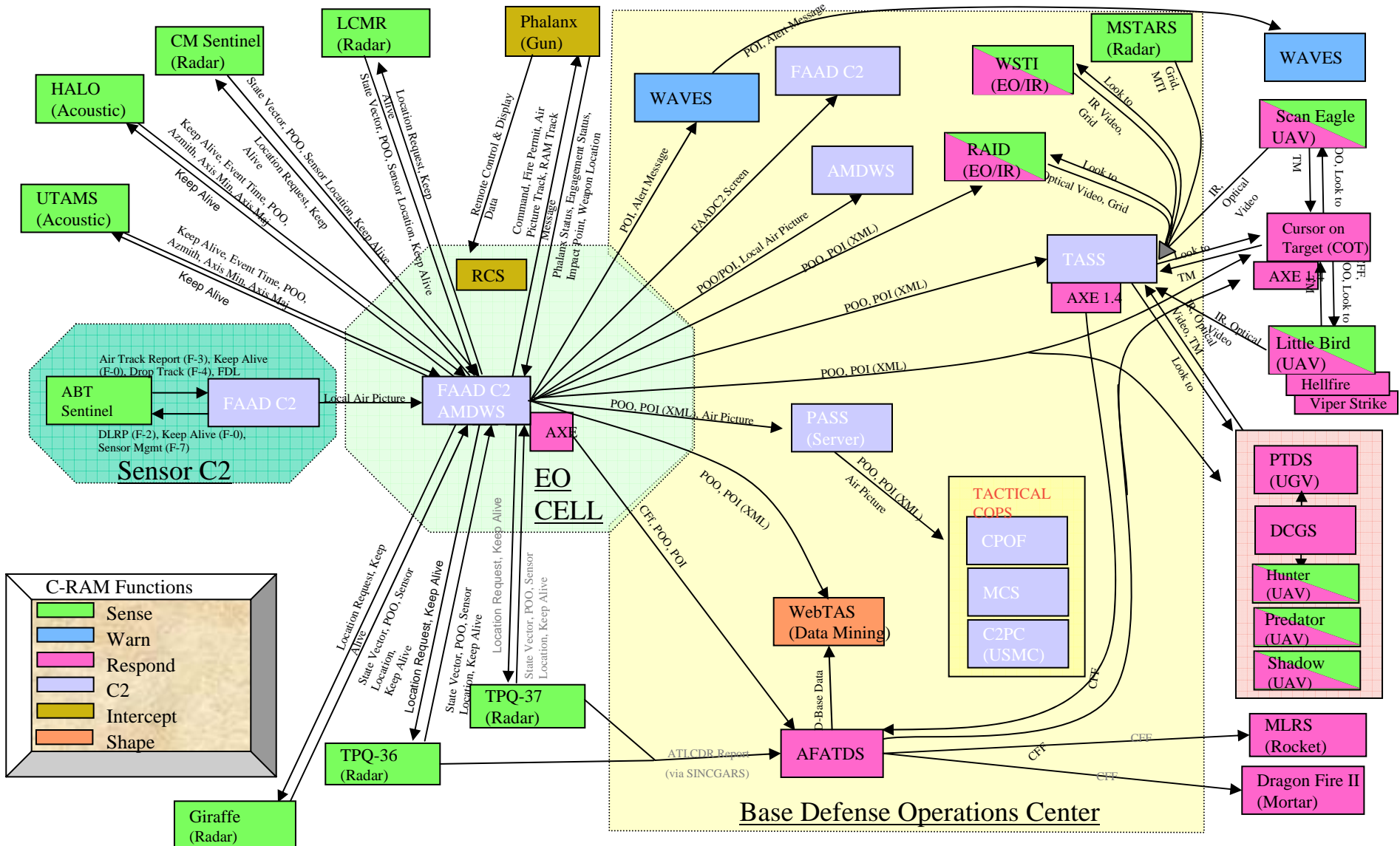
- May 06 – First Coalition FOB fielded

- **IBDSoS funded 2QFY06 and fieldings begin in support of C-RAM Enhanced Response capabilities and ONS 05-466**

C-RAM Sense and Warn capability fielded to 15 FOBs, 3 of which have Intercept capability, and IBDSoS is installed at 10 FOBs



C-RAM / Unit Protection Architecture





Lessons Learned

System-of-Systems Integration



- **Lesson Learned: System-of-Systems (SoS) PM must retain and execute integration responsibility for the SoS**
 - **SoS PM must conduct all trades in selection of component systems**
 - Avoids corporate biases
 - **All DoD Program of Record (POR) systems should be assessed**
 - Avoids service biases
 - **SoS PM must ensure support of the component system's PM for any necessary modifications**
 - SoS PM must assess risk and cost for these modifications
 - **When a suitable system is not available, selection of an S&T initiative or a COTS item may be appropriate**
 - SoS PM must ensure any S&T or COTS item has been adequately tested and is supportable

**The Government Stakeholders Must be Bound to “Specified Time”
to Avoid Schedule Slips and Cost Increases**



Lessons Learned

SoS Capability Development



- **Lesson Learned: To ensure requirements are met, work with independent test agency throughout system development**
 - **C-RAM Program Office successfully integrated Army, Air Force, USMC, and Navy Program of Record (POR) systems into the C-RAM SoS and fielded a SoS that meets requirement just 6 months after funding**
 - Required working closely with Army Test and Evaluation Command (ATEC) in all tests, beginning with the very first proof-of-principle test in Nov 04
 - ATEC has been a partner in the C-RAM program
 - » They supported development of all test and data collection plans to ensure adequate data would be available to prepare a Capabilities and Limitations report
 - » No modifications were fielded without an ATEC Capabilities and Limitations Report

C-RAM SoS Capability Development Approach Enabled Accelerated Fielding and Continuous Improvement of a Force Multiplier in a Combat Zone



Lessons Learned

SoS Capability Development



- **Lesson Learned: To reduce risk and ensure supportability, fund component system PORs to implement all changes to their systems.**
 - **Multiple changes were required in the C-RAM's POR component systems**
 - All such changes were agreed to between the C-RAM and POR PMs; developed by the POR PMs; funded by C-RAM; and then jointly tested
 - When there were conflicts between the POR system's requirements and C-RAM requirements, the Combat Developer helped define courses of action

C-RAM SoS Capability Development Approach Enabled Accelerated Fielding and Continuous Improvement of a Force Multiplier in a Combat Zone



Lessons Learned Training



- **Lesson Learned. SoS PMs need to focus on Collective Training**
 - **Development of CONOPs, TTPs, and crew drills**
 - PM C-RAM provided Fires Center of Excellence (COE) tactical equipment to enable development of these essential operational procedures
 - **Individual Training**
 - Provided equipment to Fires COE and trained-the-trainers to enable individual training
 - Supported annual Mobile Training Team visits to theater to assess training and identify requirements for changes in both training and CONOPS/TTP
 - **Collective Training**
 - Provided Fires COE tactical suite of equipment to support collective training of deploying C-RAM units and supported conduct of their Mission Readiness Exercises
 - Fielded C-RAM equipment to Army and USMC Combat Training Centers (CTCs) to enable training of units rotating to theater
 - Developed stimulation capability to support on-site unit training to maintain proficiency and to train for new threats
 - **Warfighter Feedback**
 - PM C-RAM conducts weekly Secure VTCs with theater to provide Warfighter a direct link to C-RAM staff, the combat developer, and PMs of other component systems

Close Coordination with Combat Developer Has Ensured C-RAM Units are Prepared for Combat, and Identified Additional Changes Required in C-RAM



Lessons Learned

Responsive Support for the Warfighter

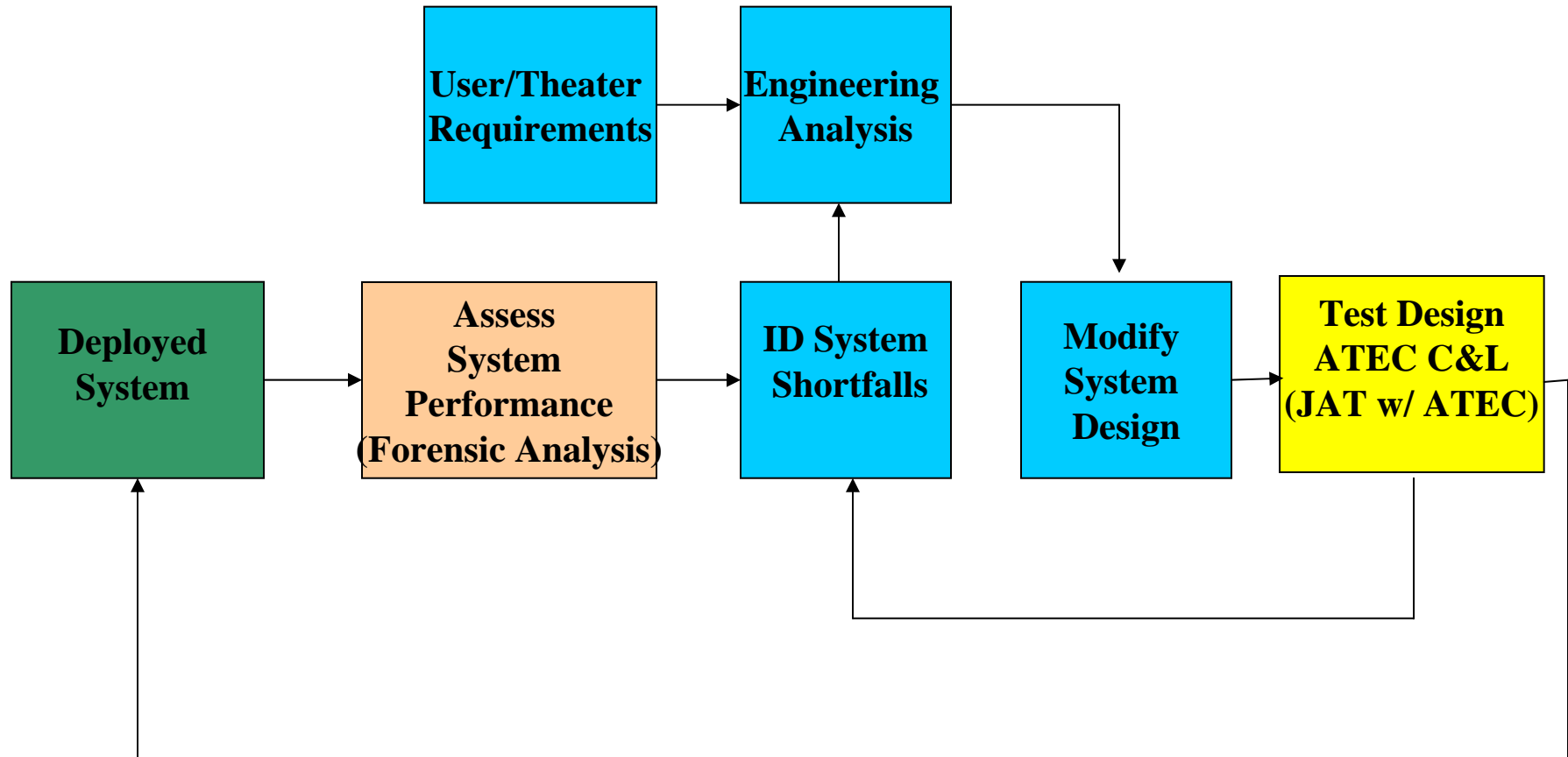


- **Lesson Learned. PMs must plan for and be prepared to support urgent Warfighter changes**
 - “No plan survives first contact”
 - **C-RAM provides a personal PM representative on MNC-I staff to coordinate and respond to:**
 - Multiple changes in fielding locations and priorities
 - Requirement to relocate / reinstall C-RAM capability from one FOB to another
 - Changes in threat tactics
 - Expansion of capabilities to support tracking of insurgent crews by integration and cuing of EO/IR sensors
 - Additional available sensors at FOBs by integrating them (UTAMS, Shadow)
- **Lesson Learned. PMs need to include collection and analysis of data on system performance concurrent with their fielding to enable rapid identification and localization of performance issues**
 - **C-RAM provides Warfighter:**
 - 24/7 forensics analysis team to analyze ALL events - successes and failures
 - Analysis is normally completed within 24 hours for major events
 - Secure commercial SATCOM links back to C-RAM Program Office in Huntsville to enable immediate transmission of all classified forensics data

PM's and TRADOC Should be Funded to do this in Peace-Time

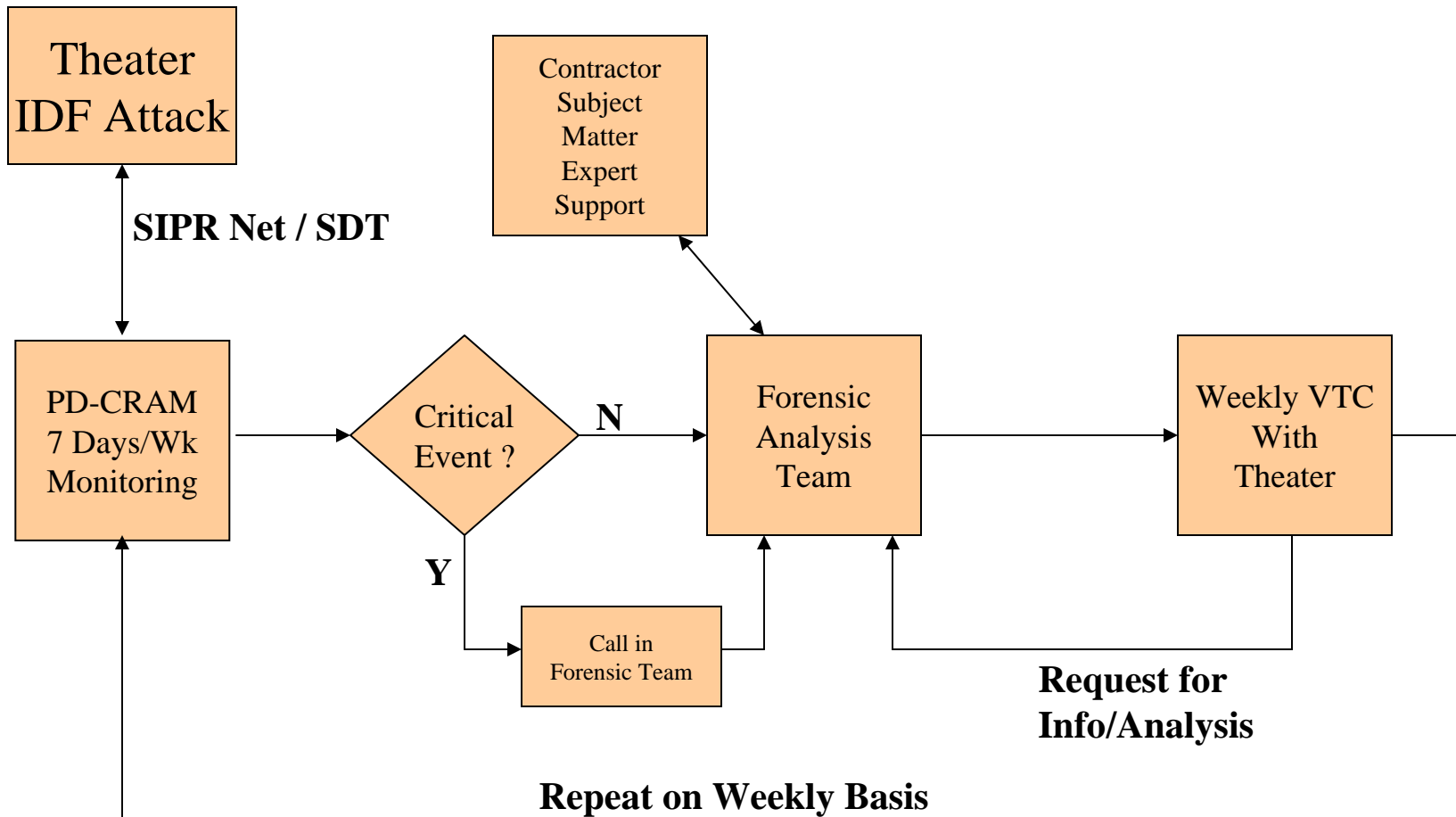


Systems Engineering with Embedded Forensics Process (U)





Forensic Data Process (U)





SUMMARY



- **Through judicious out-of-the-box thinking from the gitgo, PD C-RAM has taken a real-time, current warfighter threat and turned it into a long-term solution that addresses not only today's tactical theater of operations, but many diverse ones in the future.**
- **The Counter-Rocket, Artillery, Mortar Program: continuing to deliver on its promises and saving warfighter lives TODAY.**

The DoD Strategic Plan for Test and Evaluation Resources



Mr. Jason Coker
Mr. Christopher Paust
March 4, 2009

Test Resource Management Center
1225 South Clark Street, Arlington VA
22202



Outline



- TRMC Background
- TRMC Mission & Roles
- Organizational Structure
- Strategic Planning Purpose
- Strategic Plan Publication Date
Realignment
- Strategic Plan Development Process
 - Influence on CTEIP, T&E S&T,
Service/Agency Investments
 - Working Groups and the Reliance Process
- Summary



TRMC Background

- The December 2000 Defense Science Board's review of DoD's major range and test facilities identified a number of issues regarding inadequate funding, management, and support of these test ranges and facilities
- To address these issues, Congress, via the 2003 NDAA, directed:
 - the Services to fully fund the DoD Test Range institutional cost
 - the SecDef to establish a DoD-level resource management organization
- DoD Directive (DoDD) 5105.71 established the TRMC as a DoD field activity under the authority, direction, and control of the USD(AT&L)



TRMC Mission, Vision, and Goal

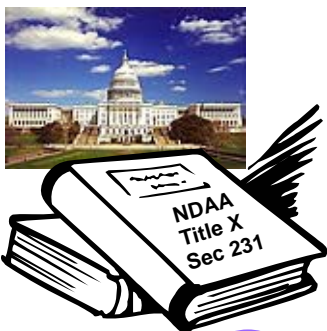
DoDD 5105.71



- **Mission:** "Plan for and assess the adequacy of the... MRTFB...[and] to provide adequate testing in support of development, acquisition, fielding, and sustainment of defense systems; and, maintain awareness of other T&E facilities and resources, within and outside the Department, and their impacts on DoD requirements."
- **Vision:** The DoD T&E ranges and facilities will be fully capable of supporting the Department with quality products and services in a responsive and affordable manner.
- **Goal:** Robust and flexible T&E capabilities to support the Warfighter.



Roles and Missions of the TRMC



**NDAA FY03
Established
TRMC**

- DoD Field Activity
 - Direct Report to USD(AT&L)
- ☆☆☆ SES Director

**Oversee DoD
T&E Budgets:**

- MRTFB
- Other DoD T&E Facilities

**Biennial 10-Year
Strategic Plan**

**Administer T&E
Investment
Programs:**

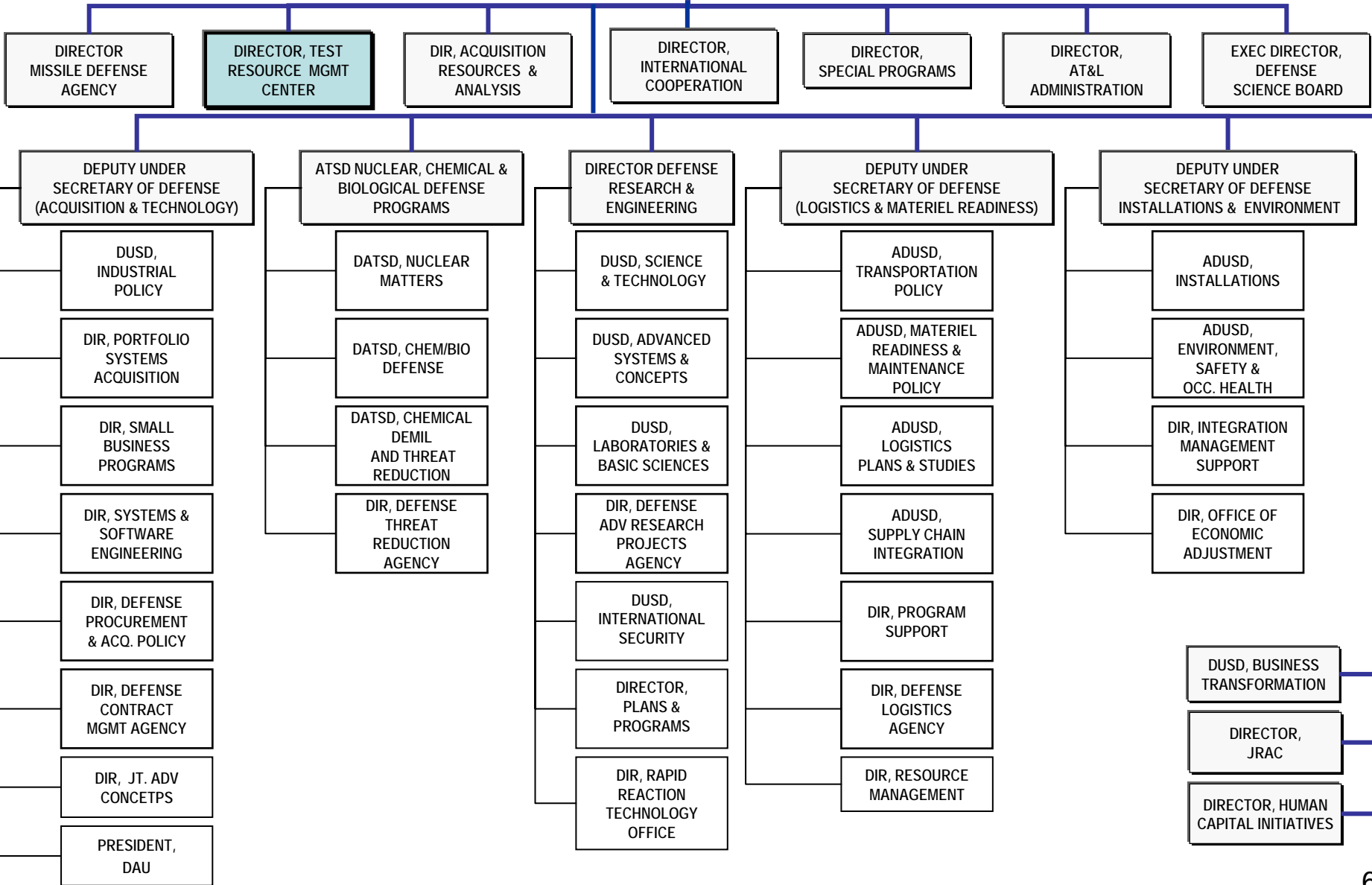
- CTEIP
- T&E / S&T

**Annual T&E
Budget
Certification:**

- Military
Departments &
Defense
Agencies

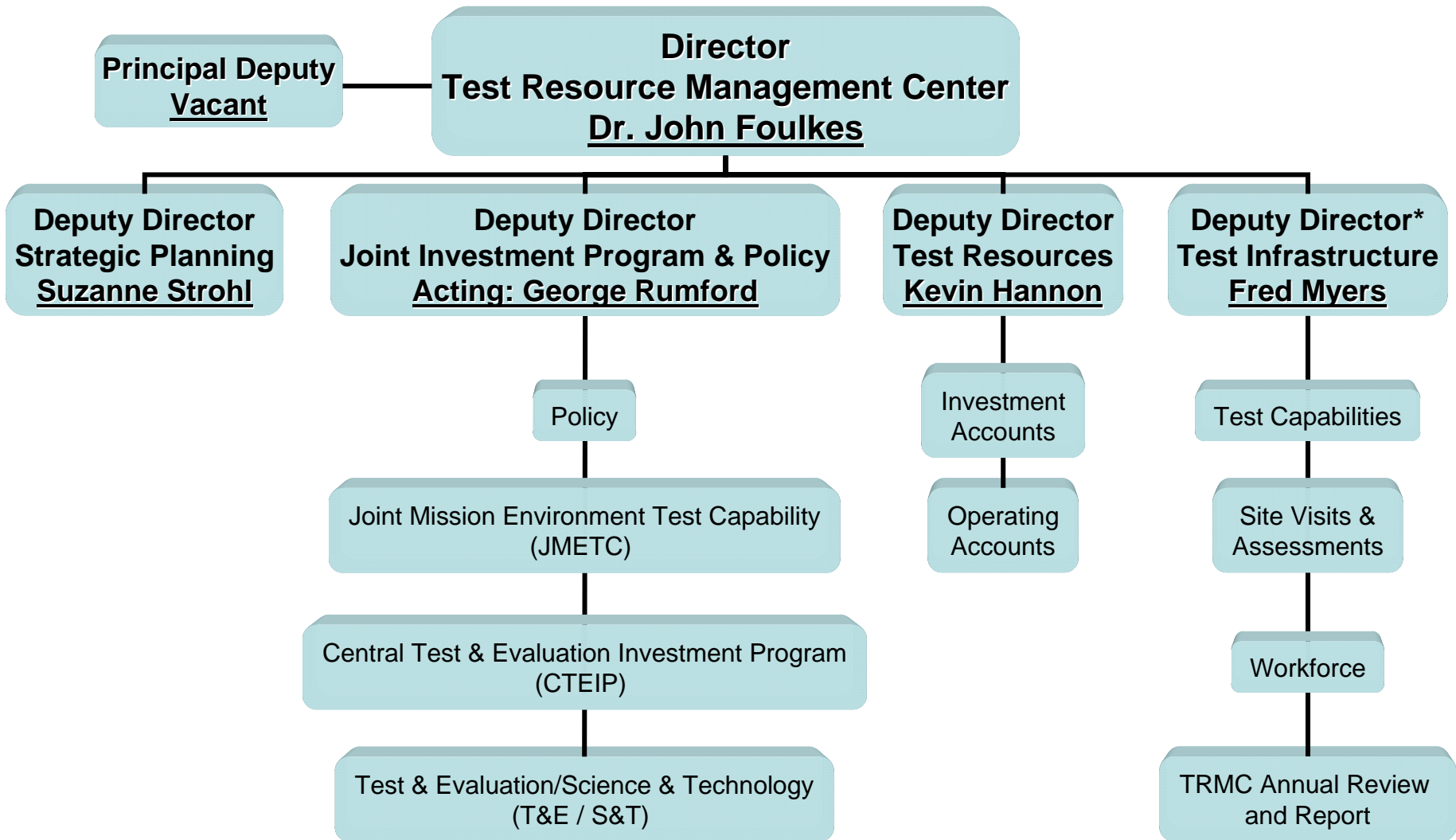


UNDER SECRETARY OF DEFENSE (ACQUISITION, TECHNOLOGY AND LOGISTICS)





TRMC Organization





Strategic Planning Purpose



- Provides a vision of the capabilities and investments needed to support the testing of future weapons systems
- Provides guidance for the planning, programming, budgeting and execution of T&E resources
 - Influences Services T&E POM Investments through the DoD T&E Budget Certification process
- The strategic plan must eventually consider all available T&E capabilities:
 - DoD T&E (MRTFB)
 - Governmental non-DoD
 - Commercial
 - International



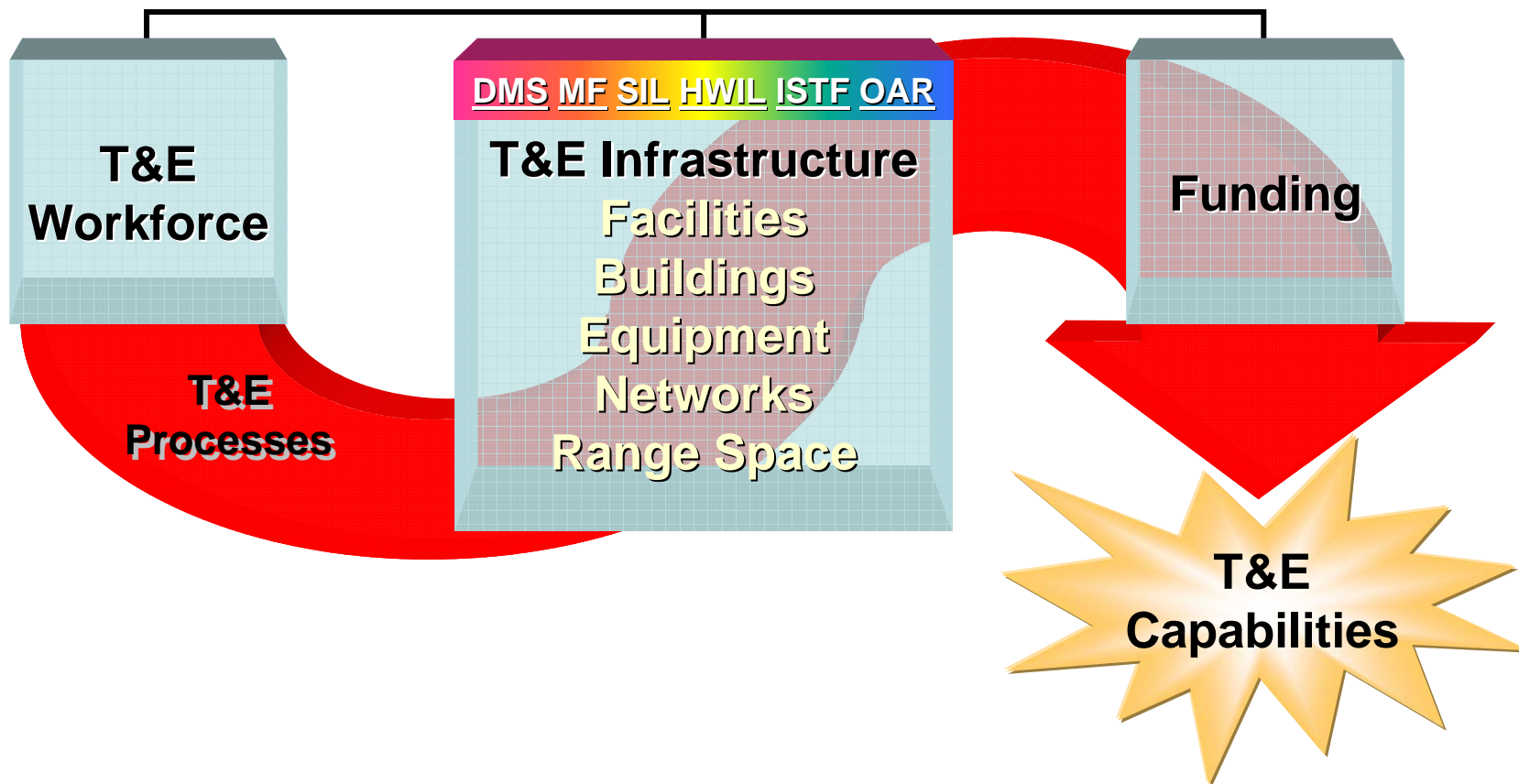
Strategic Planning Purpose (con't)



- Near-term plans will focus on MRTFB and migrate to addressing the broader spectrum of T&E
- Drive the Services Needs and Solutions Reliance process
- Guides TRMC Science and Technology (S&T) and Central Test and Evaluation Investment Program (CTEIP) investments to support DoD T&E Strategic Plan gaps



Strategic Planning Looks at ALL T&E Resources



T&E Resources: A collective term that encompasses the requisite **Workforce**, **Infrastructure** and **Funding** resulting in a **T&E Capability**, by means of the **T&E Processes**



Major Range and Test Facilities Base (MRTFB)



DEPARTMENT OF DEFENSE Major Range and Test Facilities Base (MRTFB)

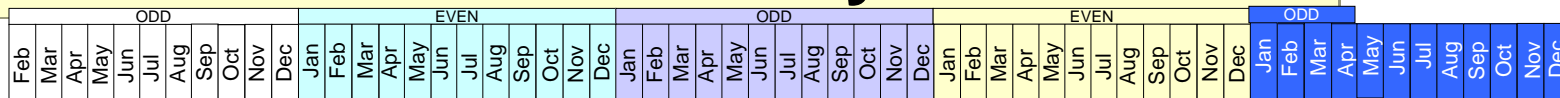
TEST FACILITIES

- USAF - Air Force
- USN - Navy
- USA - Army
- DoD





DoD Strategic Plan for T&E Resources and the PPBE Cycle



TRMC Budget Cert

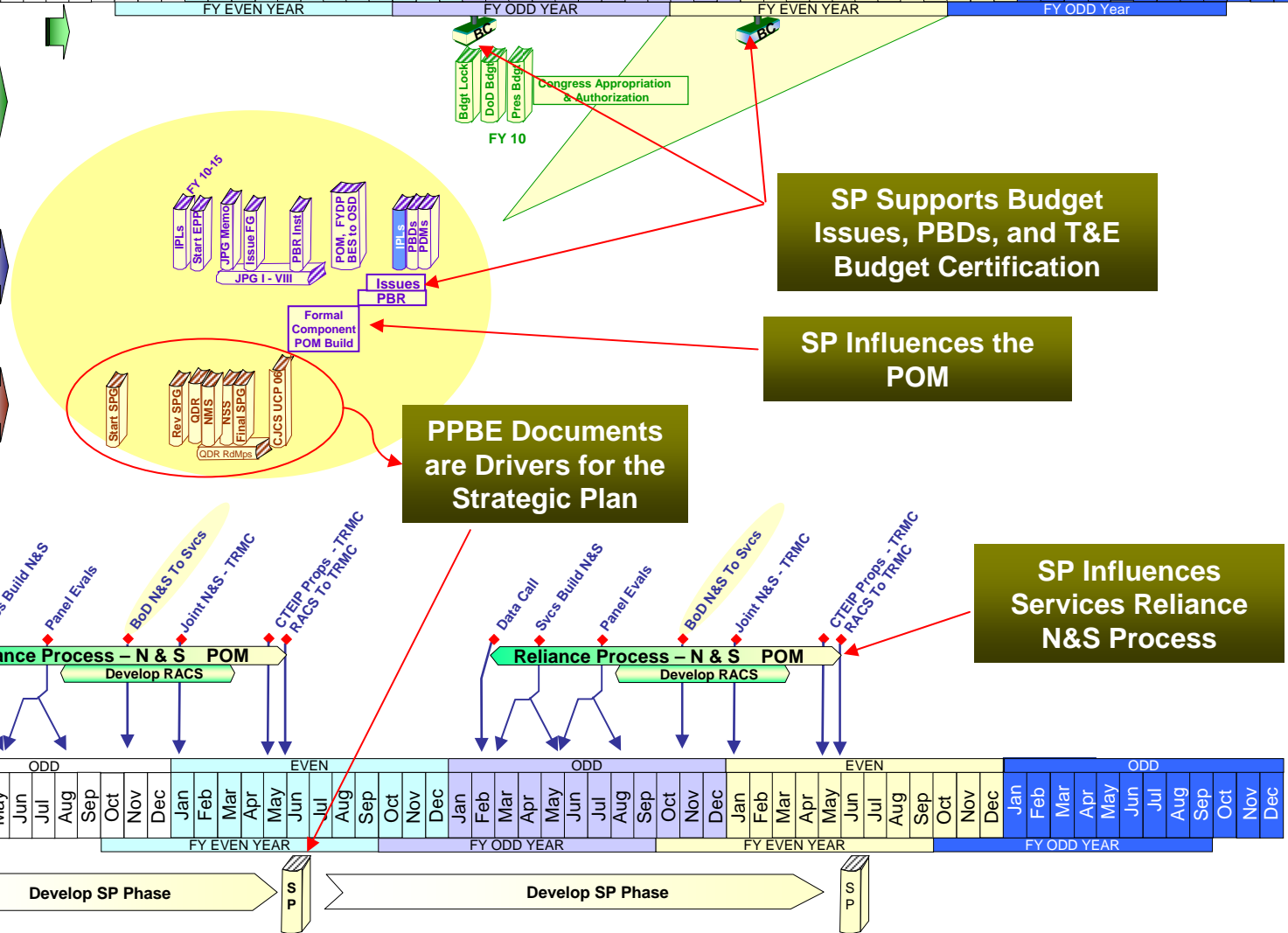
Budgeting

Programming

Planning

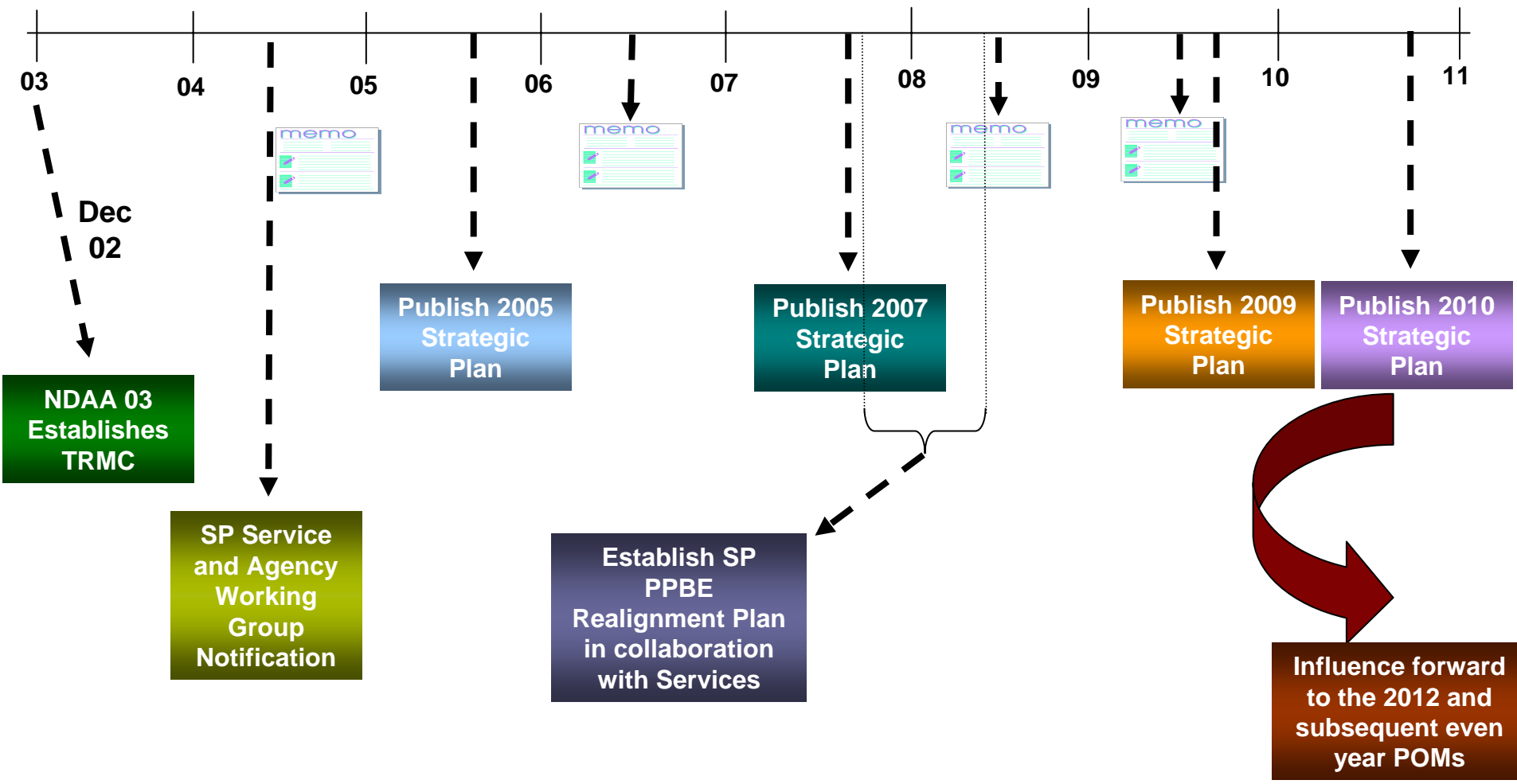
Field

DoD Strategic Plan





Realignment of the Biennial Strategic Plan





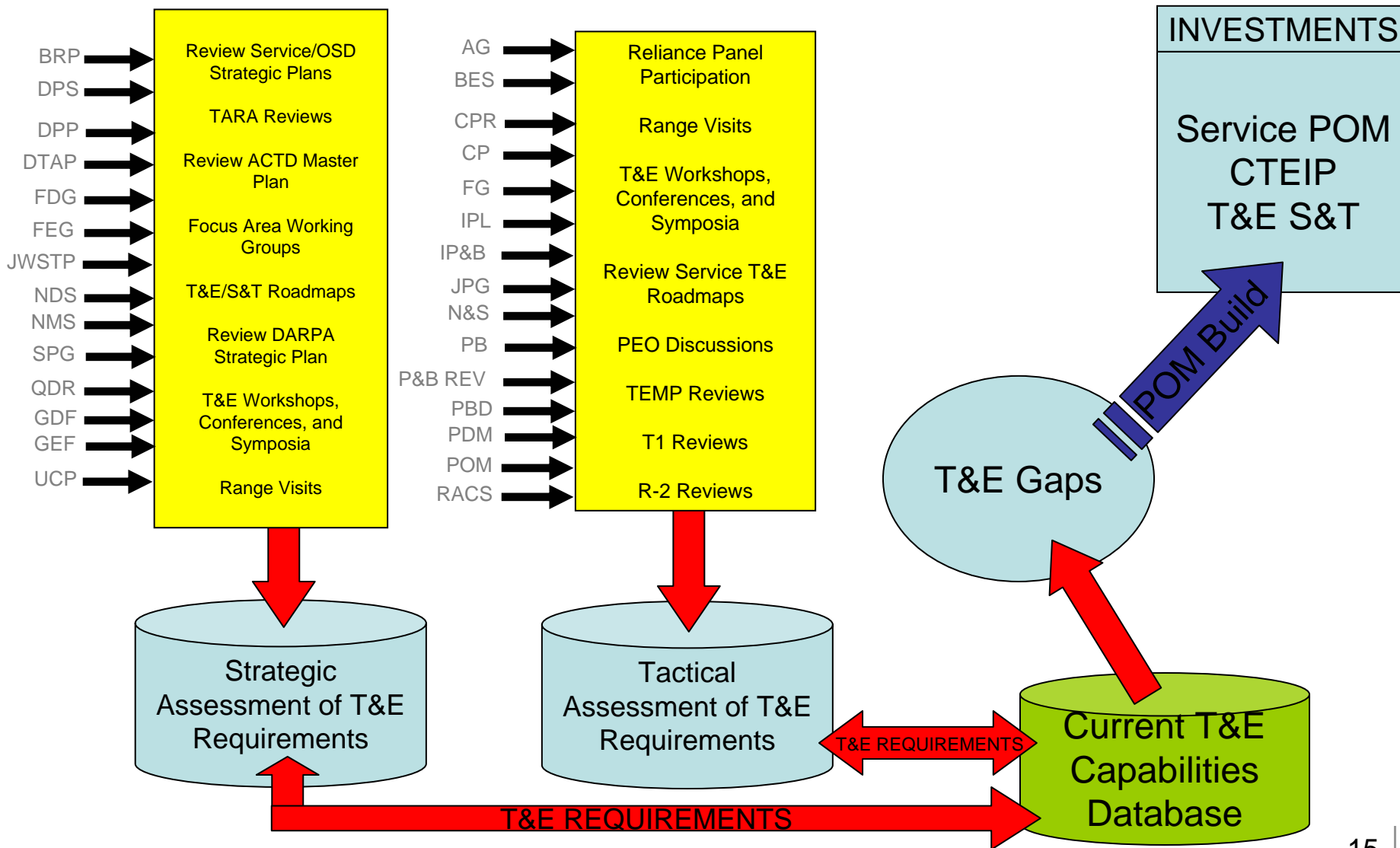
Advantages for Realignment



- Supports OSD, Services, and Agencies PPBES and POM processes
- Supports Services and Agencies Reliance Needs and Solutions Process
 - Established MOA
- Brings a purple flavor to the process
- Provides a top down perspective to the historically bottoms up process
- Synergy through aligned investments



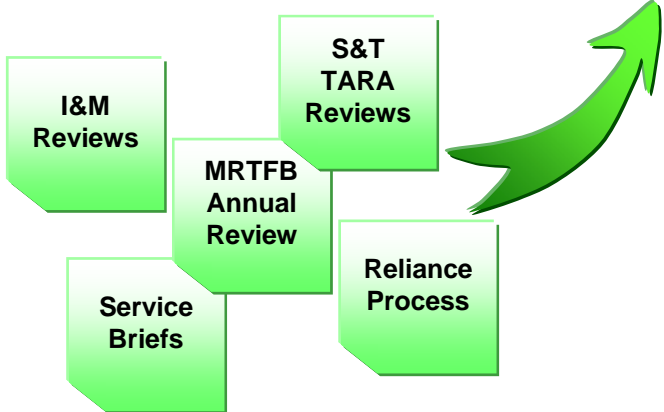
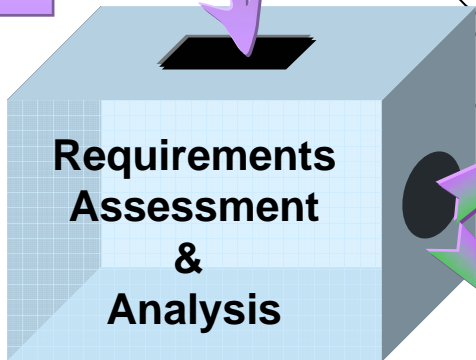
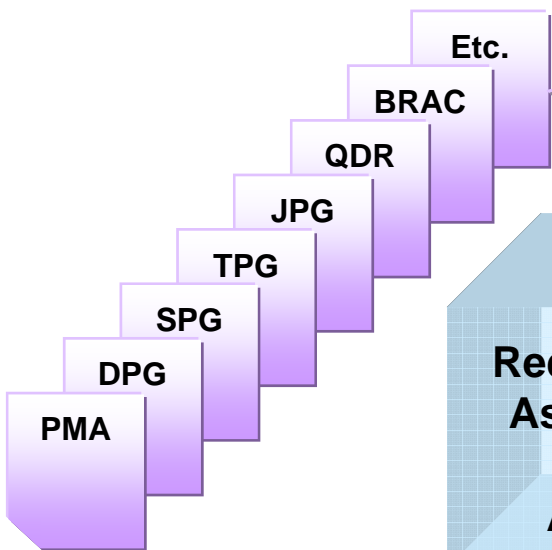
The Strategic Planning Process





Building the Strategic Plan

Top-Down Inputs



Bottom-up Inputs

Focus Areas

1. Directed Energy
2. Nuclear Weapons Effects
3. Hypersonics
4. Distributed Test/Cyber/IO
5. Urban Environments
6. Unmanned & Autonomous Systems/Maritime Surveillance
7. IED Defeat
8. Biometrics
9. Space

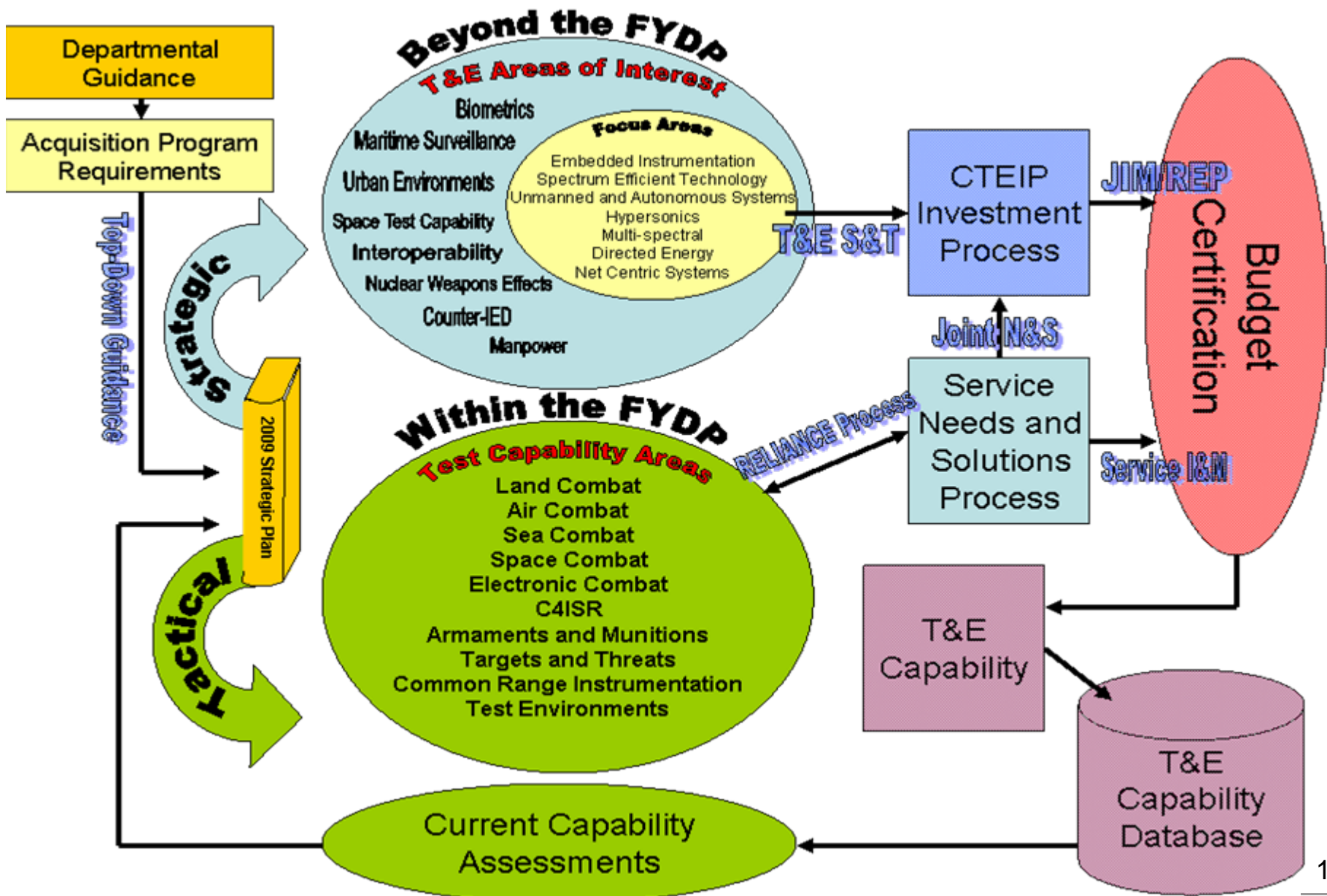
1. Air Combat
2. Land Combat
3. Sea Combat
4. Electronic Combat
5. Space Combat
6. C4ISR
7. Armaments and Munitions
8. Targets and Threat
9. Test Environments
10. Common Range Instrumentation

Test Capability Areas



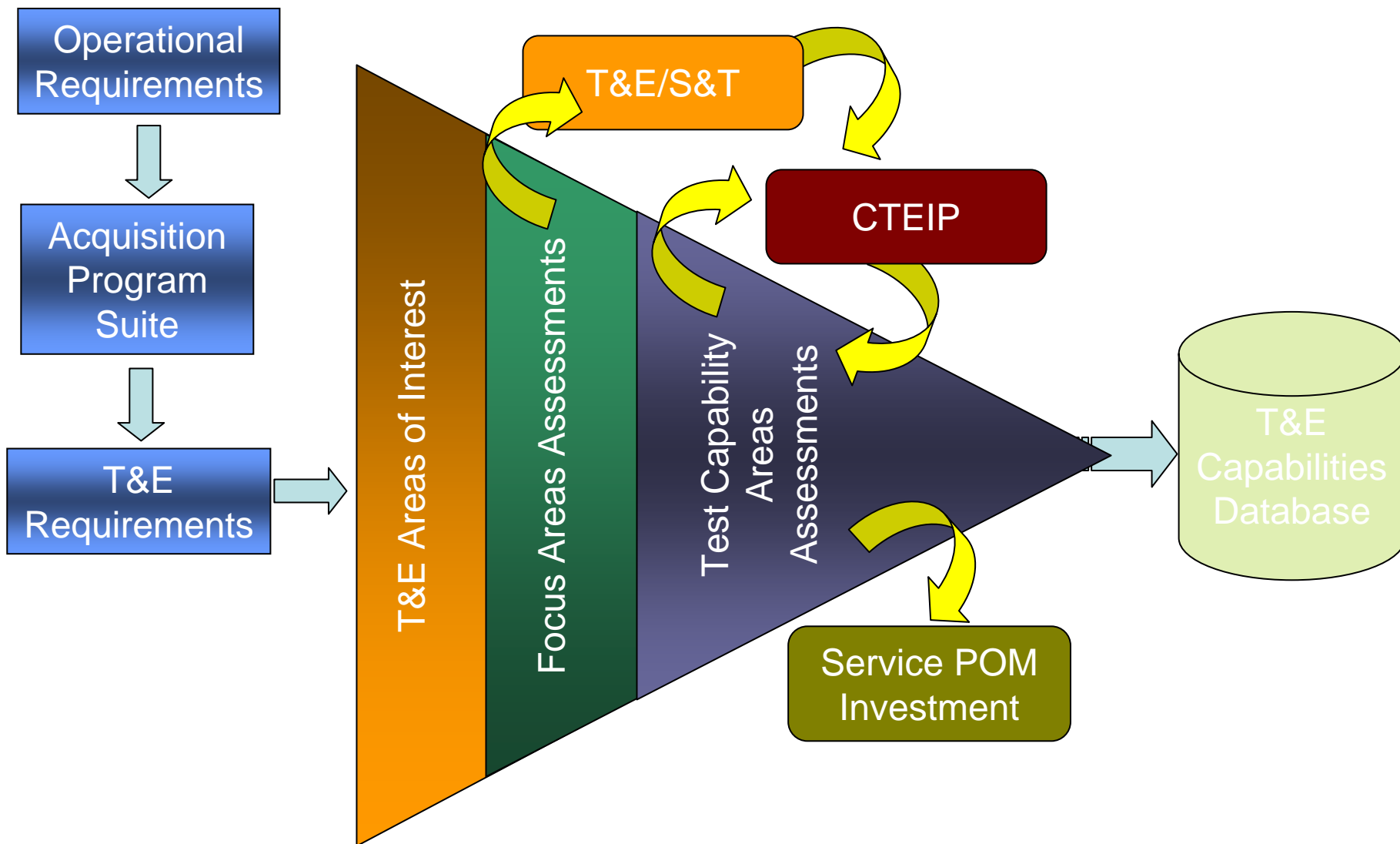


Strategic Planning Interrelation and Roles



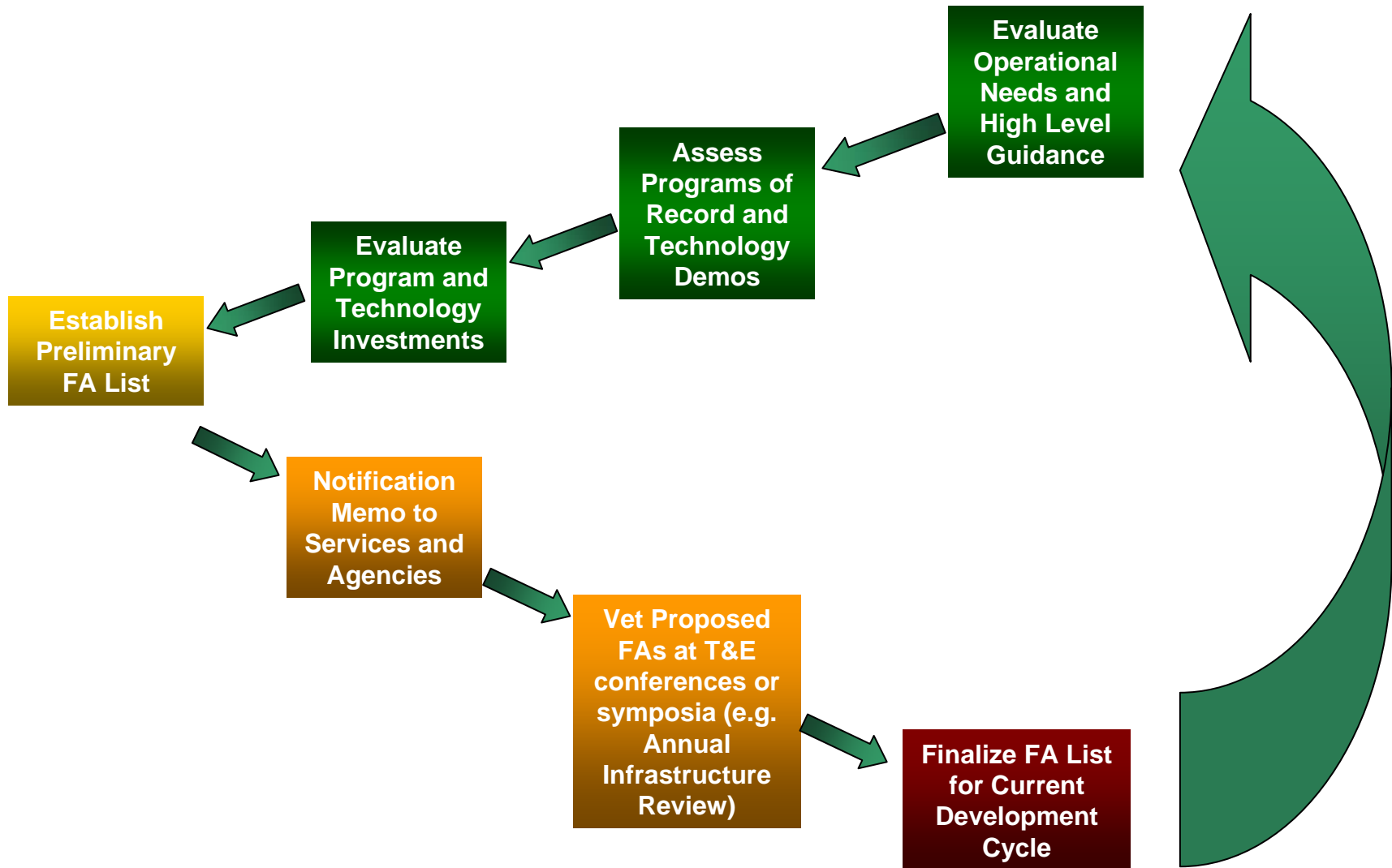


T&E Investments and the Strategic Planning Process





Strategic Plan Focus Area Selection Process





Strategic Planning Focus Area Working Groups



- Focus Area Working Group Composition
 - TRMC Lead
 - Lead POC from each Service/Agency Headquarters
 - Service/Agency Subject Matter Experts for each Technical Area (Action Officer)
 - Multiple Supporting Members
- Headquarters POCs Serve as Final Authority
- Action Officers
 - Serves as principal POC between TRMC and their Service/Agency
 - Reviews and vets focus area development throughout their respective Service/Agency
 - Participates in meetings as established by the TRMC Focus Area leads



Summary



- Strategic Plan provides fundamental support to the TRMC mission
- Foundational document for DoD T&E resources
- Must be collaboratively developed with the Services and Agencies it influences
- Influence's T&E S&T, CTEIP, and Service/Agency investments



Questions?



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Physics of Failure - The Critical Path to Saving \$M in T & E

Dr. W. Forrest Crain
410-278-6614
DSN 298-6614

- Cost of Failure
- Background
- Test & Evaluation Environment
- Problem Statement & Benefits
- What AMSAA is doing with Physics of Failure
- What AMSAA is doing with the Reliability Scorecard
- Physics-of-Failure Successes
- Challenges
- Summary

| Type of Business | Lost Revenue per Hour |
|---------------------------------|-----------------------|
| Retail Brokerages | \$6,450,000 |
| Credit Card Sales Authorization | \$2,600,000 |
| Home Shopping Channels | \$113,750 |
| Catalog Sales Centers | \$90,000 |
| Airline Reservation Centers | \$89,500 |
| Cellular Service Activations | \$41,000 |
| Package Shipping Services | \$28,250 |
| Online Network Connect Fees | \$22,250 |
| ATM Service Fees | \$14,500 |
| Supermarkets | \$10,000 |

continued
→

source: "Ready when chips, lines are down; Firm offers clients work space in crises," Margaret Webb Pressler, Washington Post, Washington, Dec. 18, 1999, pg. E1 & U of MD CALCE Center

LAPTOP LAWSUIT*

Major corporation agreed to \$2.1 Billion Settlement for selling allegedly defective laptops.

AN AUTOMOTIVE RECALL

Dear ___ Customer, This notice is sent to you in accordance with the requirements of the National Traffic and Motor Safety Act. ___ has decided that a defect which relates to motor vehicle safety exists in certain _____ vehicles. ... Windshield wiper motors may fail after a year or more... as a result of *cracked solder joints* on the *controller circuit board*.

MISSION FAILURE AND/OR LOSS OF LIFE



*Wall Street Journal, 1 Nov 99 pg.1

PoF – A Comprehensive Engineering Based Reliability Approach



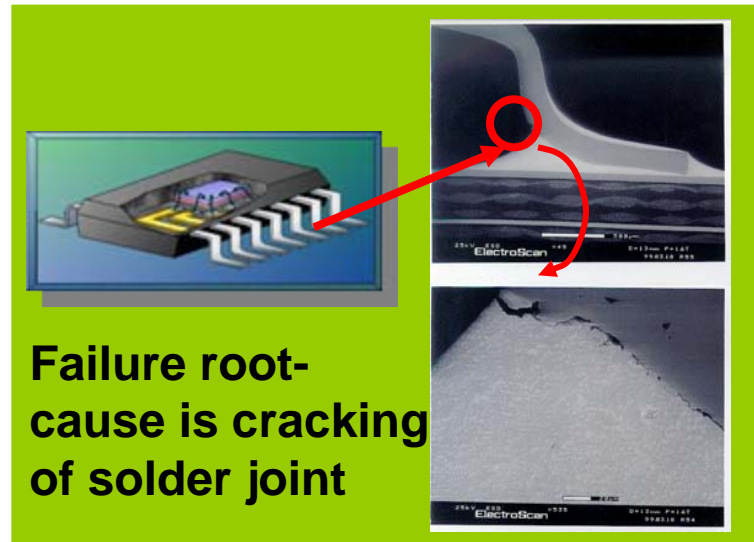
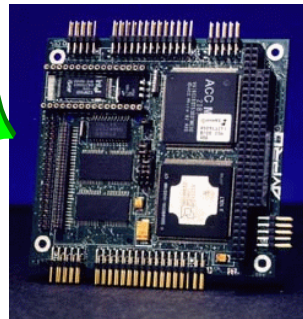
Stress (e.g., vibration) is propagated from the system level to a failure site



- Also termed “Physics of Failure” (PoF), “Predictive Technology”, “Predictive Engineering”, “Physics of Reliability” and models the root causes of failure that include fatigue, fracture, corrosion, and wear.
- Industry, academy, and government develop failure models and CAD tools that address specific materials, failure sites, and design architectures.

Benefits

- Influence design early
- Eliminate failures prior to test
- Increased chance of passing test
- Enhanced fielded reliability
- Improved prognostics
- Decreased O&S costs



- ❑ May not be enough time in schedule for desired test
- ❑ Funding may be insufficient
- ❑ Test asset availability limited; assets may be expensive, scarce, or needed for the war effort
- ❑ T&E IPT process highly competitive as proponents for each element's evaluation push to ensure that their data requirements will be met
- ❑ Testers and evaluators in a difficult position – under pressure to make do...
- ❑ Need to include new approaches that leverage test activities to provide more information

Need to get the most from every test!

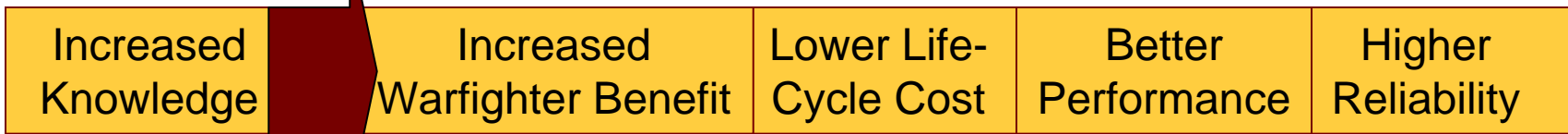
- ❑ Problem Statement: The Army requires Physics of Failure (PoF) throughout the materiel acquisition life cycle to mitigate current cost, schedule, and performance issues.

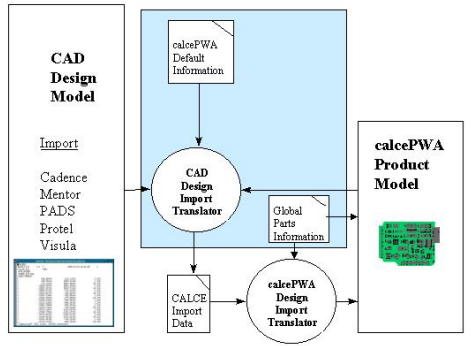
- ❑ Benefits
 - PoF, relying on physics-based analysis, provides Testers, Evaluators, and Program Managers the ability to field highly-reliable materiel.
 - PoF ensures that Testers, Evaluators, and Program Managers get the most out of every test.

- Supporting T&E and acquisition communities with Physics-of-Failure (PoF) analysis
 - System-level dynamics models, component finite element models, fatigue-life models
 - Reveals the underlying physics of the hardware in its mission environment
 - Outputs include:
 - ✓ Forces acting on a system
 - ✓ Displacements of components
 - ✓ Accelerations
 - ✓ Stress levels
 - ✓ Weak points of the design
 - What can the Army do with these new insights?
 - Work with ATEC, PMs, RDECs, & contractors to fix the components responsible for poor system reliability
 - Make meaningful and helpful suggestions for corrective action approaches
 - Encourage contractors to use the best analysis tools
 - Provide peer-level review of contractor designs and suggestions
 - Reap the benefits of increased customer knowledge

PoF enables the Army to...

- ✓ *Anticipate & understand test performance*
- ✓ *Not be surprised by test performance*

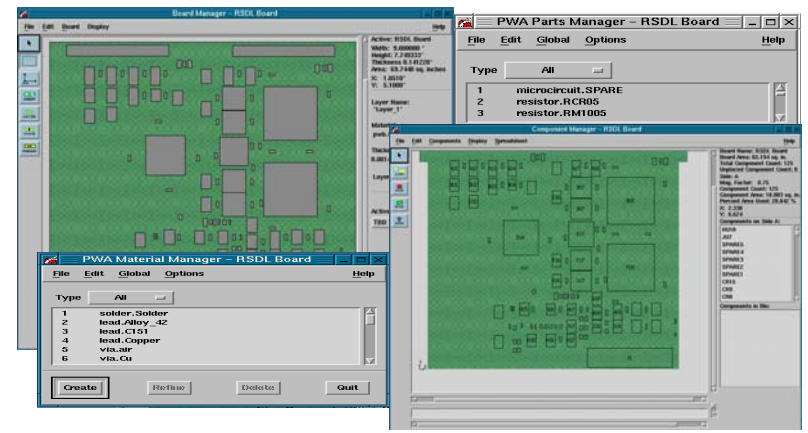




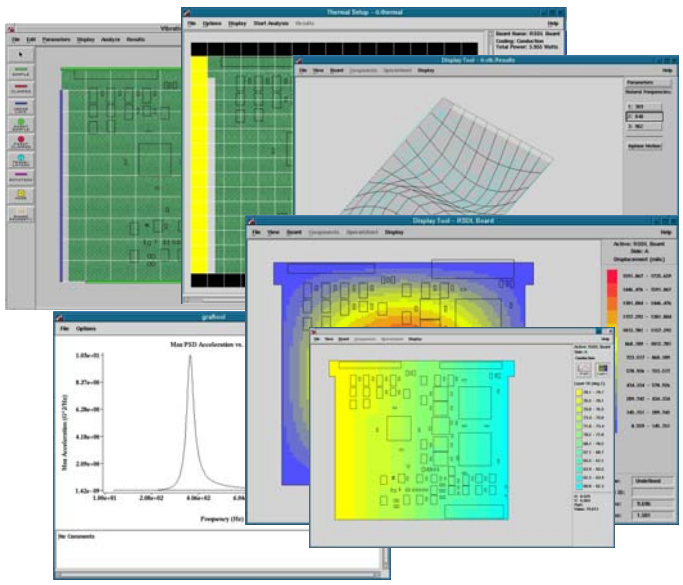
Support for importing CAD design files



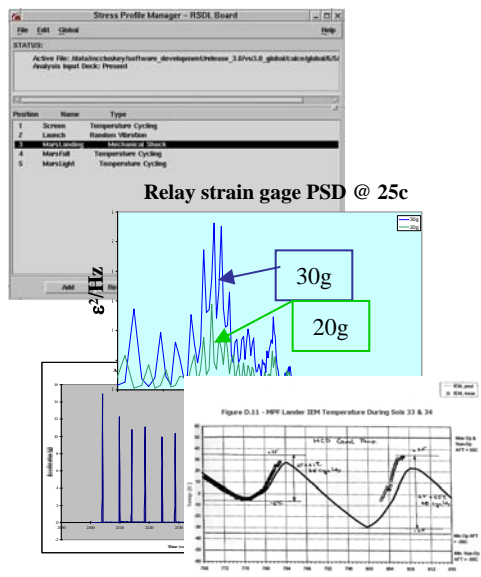
Toolbox



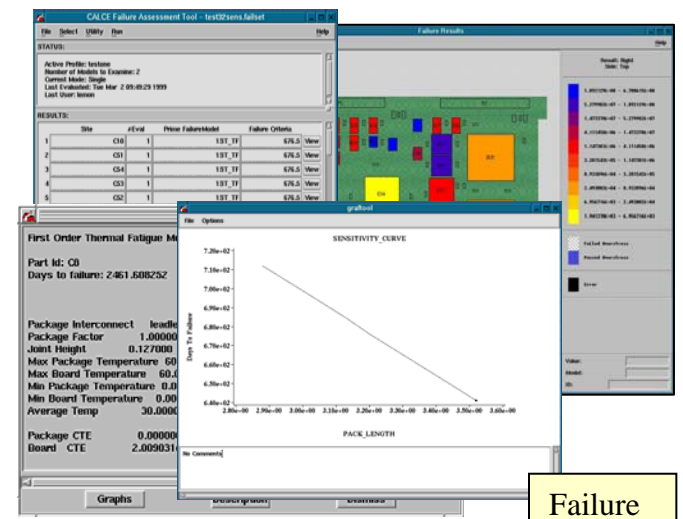
Product Modeling and Databases



Load Transformation



Environment Characterization



Failure Risk Assessment & Sensitivity Analysis

One example element from the Reliability Analysis Scorecard Category

| | | |
|----------|---|--------|
| ELEMENT | Critical loads and stresses are characterized; life cycle environment and operation duty cycle stresses are characterized | |
| CRITERIA | Clearly define estimates of life-cycle user and environmental loads, update periodically, verify with measurements on pre-production systems/products. The developer must characterize the critical loads and stresses. Validate with additional testing and data collection. | Green |
| | Estimate life-cycle user environmental loads from "like-systems" in similar operational environments. Measurements not verified on actual system through testing and data collection. | Yellow |
| | Life-cycle user environmental loads and duty cycle stresses are not defined. | Red |

- ❑ 8 Scorecard Categories
 - Reliability requirements and planning
 - Training and development
 - Reliability analysis
 - Reliability testing
 - Supply chain management
 - Failure tracking and reporting
 - Verification and validation
 - Reliability improvements

- ❑ For each Scorecard Category there are several elements with associated rating criteria

Identify weak performers early using this structured and analytic approach

➔ **Encourages use of Physics-of-Failure analysis**

Sign In

User Name:

Password:


[Request an Account](#)
[Benefit of Membership](#)
[Forgot My Password or Login](#)

Community Explorer

- Reliability and Maintainability
 - Maintainability
 - Reliability
 - Policy and Guidance
 - Related Websites
 - Tools**
 - Training Center


AMSAA Reliability Program Scorecard
 Tools & Forms

Ranking



#8 of 36 items
[How is ranking calculated?](#)

User Reviews



Assess reliability before testing

Long Description

This MS Excel-based tool may be used to qualitatively score the elements of a Reliability Program.

The covered elements are:

1. Reliability Requirements and Planning
2. Training and Development
3. Reliability Analysis
4. Reliability Testing
5. Supply Chain Management
6. Failure Tracking and Reporting
7. Verification and Validation

Surveillance System

\$1.2M Saved



- Analysis showed commercial circuit card OK

Power Supply

Reliability Improved

- Significant failures reduced with minimal cost fix



Tri-Service Radio

\$27M Cost Avoidance

- Identified weak link in design



Mobile Bridge

\$1.5M Savings

- Reduced testing



Army Vehicle

\$500K

- Reduced testing through M&S

Cost Avoidance



New Missile System

- PoF analysis on Plastic Ball Grid Array



Tactical Receiver

- Reliability design enhancements incorporated



Evaluate New Technologies

- ❑ Lead-free electronics
- ❑ Counterfeit parts
- ❑ No Fault Finds
- ❑ Still a lack of routine application of electronics Physics-of-Failure analysis early in the development process
- ❑ Continued use of MIL-HDBK-217 instead of rigorous engineering practices

- ❑ PoF, relying on physics-based analysis, provides Testers, Evaluators, and Program Managers the ability to field highly-reliable materiel.

- ❑ PoF ensures that Testers, Evaluators, and Program Managers get the most out of every test.

- ❑ PoF analysis tools can significantly contribute today.



ManTech

International Corporation®

Leading the Convergence of National Security and TechnologySM



Systems Engineering
and Integration



Information
Technology



Intelligence Analysis
and Mission
Operations



Global Integrated
Logistics Systems
and Support

NDIA 25th Annual T&E National Conference

Challenges Facing T&E Of Systems To Combat Rad/Nuc Smuggling

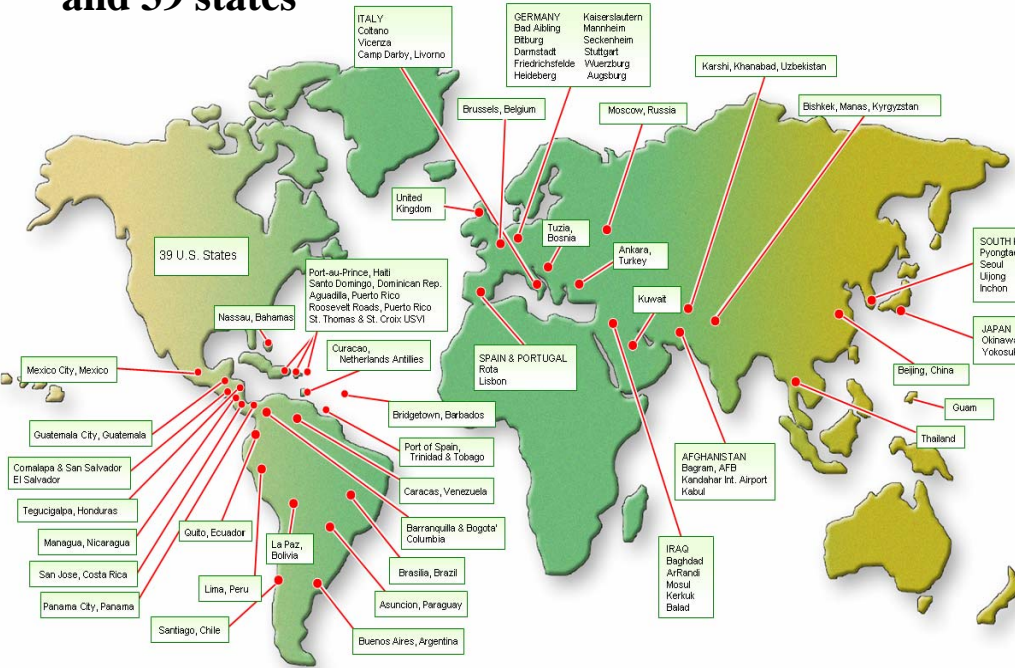
Stephen M. DeFrank Jr.
Senior Test Engineer
ManTech SRS Technologies Inc.
stephen.defrank@mantech.com
703-907-3645

March 4, 2009



Who is ManTech?

- **The ManTech culture is based on programmatic and technical excellence, mission support, quality, trust, integrity and ethics**
- **7,000+ highly skilled employees**
 - 75% with security clearances
 - Approximately 50% cleared Top Secret and above
- **180 locations world wide with operations in 42 countries and 39 states**



- **The ManTech Impact:**
 - A culture that emphasizes practical implementation program management and systems engineering processes
 - We create added value through quality, innovation, and partnership
 - World class engineers and technical specialists
 - Unique experience in transforming leading edge concepts and technologies into operationally effective systems
- **Operational Conflict of Interest (OCI) Free**
 - We provide our customers with the right information at the right time to make informed programmatic and technical decisions
 - We don't make things, we provide the environment to make them better
 - Our people are our only product



Our core competencies cross many domains and are attentive to our customer's technical and programmatic support needs

Homeland Security
WMD Detection
POE Security

Unattended Aircraft Systems
Electro-optics and lasers
Radar and Signal Processing

Aircraft protection
C4ISR
Information Technology

DOMAINS

- **Program Management/Systems Acquisition**
 - Acquisition strategy development
 - Program planning and control/EVM
 - Budget and financial management support
 - Milestone and technical reviews
- **Systems Engineering and Integration**
 - Complex system of systems engineering
 - Enterprise architecture
 - CONOPS
 - Requirements analysis and management
 - Design/development oversight and review
 - Modeling, Simulation and Analysis
 - Test and evaluation/IV&V
- **Total Life-Cycle Sustainment**
 - Life-cycle assessment/business case analysis
 - ILSPs
 - Design for sustainment
 - Reliability, supportability, maintainability

- **Environmental Planning Services**
 - NEPA planning, compliance, and assessment
 - EIS, EA, environmental studies
 - Endangered species act
- **Mission Assurance/Specialty Engineering**
 - System safety
 - Reliability and quality engineering
 - Software assurance
 - Software IV&V
 - Risk management
- **Test & Evaluation**
 - Test Planning
 - Test Execution
 - Analysis and Reporting
- **Program Protection/System Assurance**
Cyber Security
 - Operational environment
 - Critical information

SERVICES

Background

- End of the Cold War Era has given way to the War on Terrorism
- Has Caused a Shift in Focus From Nuclear Deterrence To Nuclear Detection
- April 15, 2005 President Established the Domestic Nuclear Detection Office (DNDO) – Under DHS
- ManTech SRS Selected as Systems Engineering Support Program





DNDO Mission & Scope of SESP

- **Mission of DNDO**

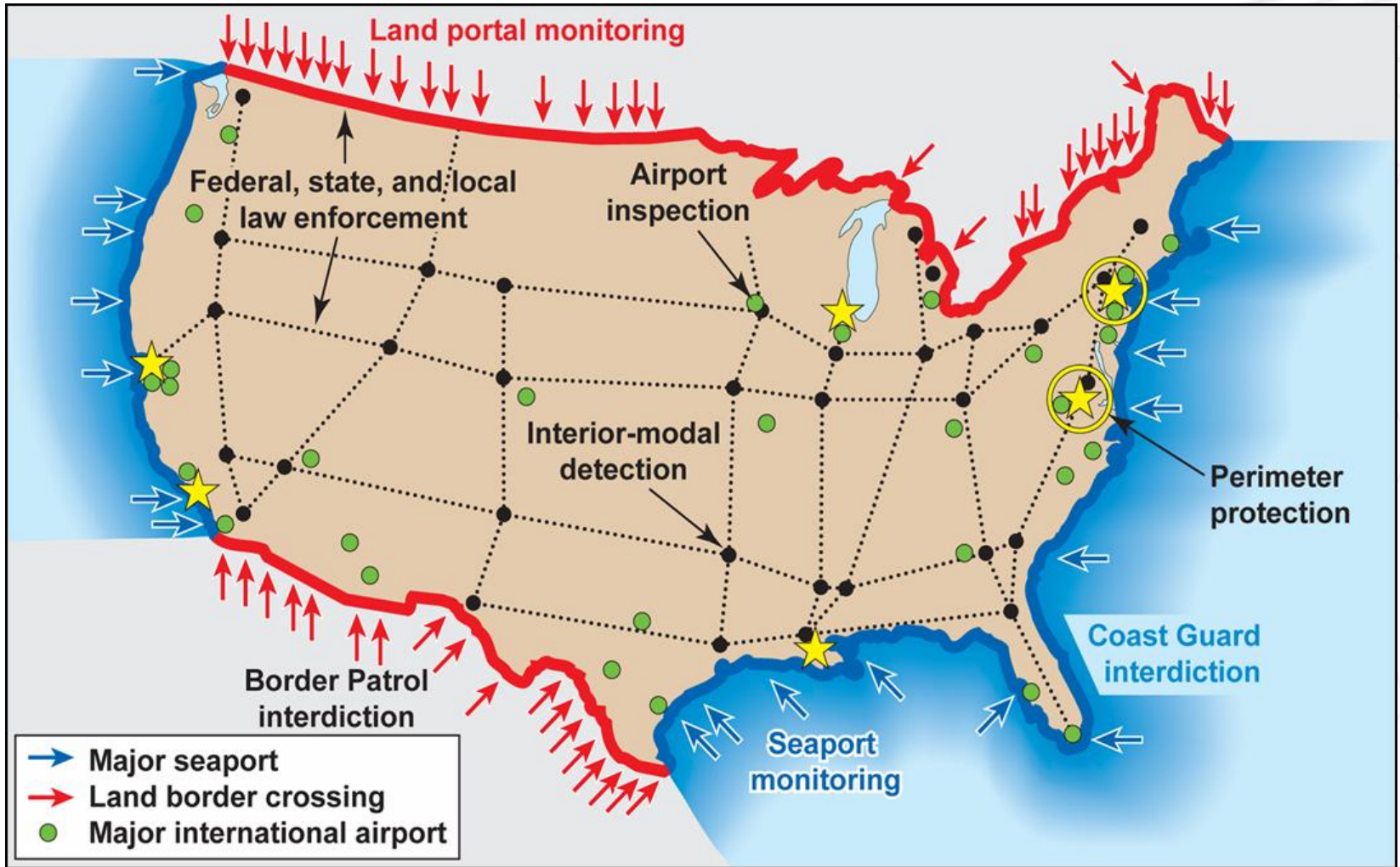
- DNDO is a jointly-staffed, national office founded on April 15, 2005, to improve the Nation's capability to detect and report unauthorized attempts to import, possess, store, develop, or transport nuclear or radiological material for use against the Nation, and to further enhance this capability over time

- **Scope of the SESP**

- Provide systems engineering support for:
 - Global nuclear detection and reporting architecture
 - User needs and requirements development
 - Program Management and Acquisition support
 - Systems Engineering Process Development
 - Detection System design, integration and test



DNDO Mission Challenge



DNDO Challenges Executing Rad/Nuc Testing

| Challenge | Solution |
|--|--|
| <ul style="list-style-type: none"> • No T&E Rad/Nuc Executing Agent | <ul style="list-style-type: none"> • Combined Test Team |
| <ul style="list-style-type: none"> • Field systems quickly | <ul style="list-style-type: none"> • Rapid-cycle test framework |
| <ul style="list-style-type: none"> • Lack of detection system standards | <ul style="list-style-type: none"> • Standards Program "GRaDER" |
| <ul style="list-style-type: none"> • Access to high fidelity sources | <ul style="list-style-type: none"> • RNCTEC Facility • Rail Test Center • Maritime Test Bed |
| <ul style="list-style-type: none"> • Operationally relevant testing | |
| <ul style="list-style-type: none"> • Threats in operational environment | |



No T&E Rad/Nuc Executing Agent

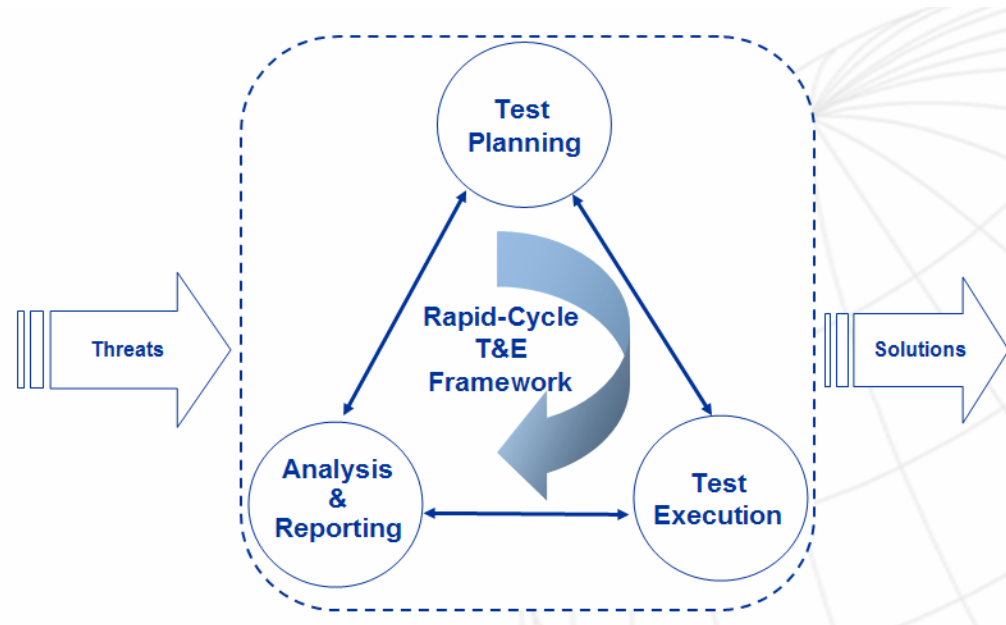
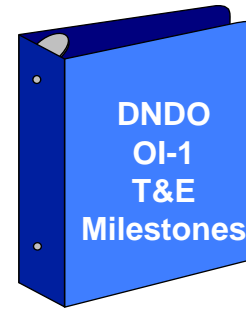
- **DNDO has created a Combined Test Team to meet the Rad/Nuc T&E challenge**
- **Combined Test Team:**
 - **DHS Organizations (DNDO, FEMA and CBP)**
 - **National Institute of Standards (NIST)**
 - **John Hopkins University/Applied Physics Lab (JHU/APL)**
 - **DOE Labs (Savannah River, Los Alamos, Pacific NW Lab))**
 - **Nevada Test Site (NTS)**
 - **Industry (ManTech)**



Field Solutions Quickly

Test Documentation (DNDO OI-1)

- **Test Planning Phase**
 - Test Management Plan
 - Test & Evaluation Master Plans (TEMPS)
 - Test Plans
 - Analysis Plans
 - Data Collection & Validation Plans
- **Test Execution Phase**
 - Test Procedures
 - Real Time Data Validation
- **Test Reporting Phase**
 - Data Analysis
 - Reporting (Tech/Peer Reviews)

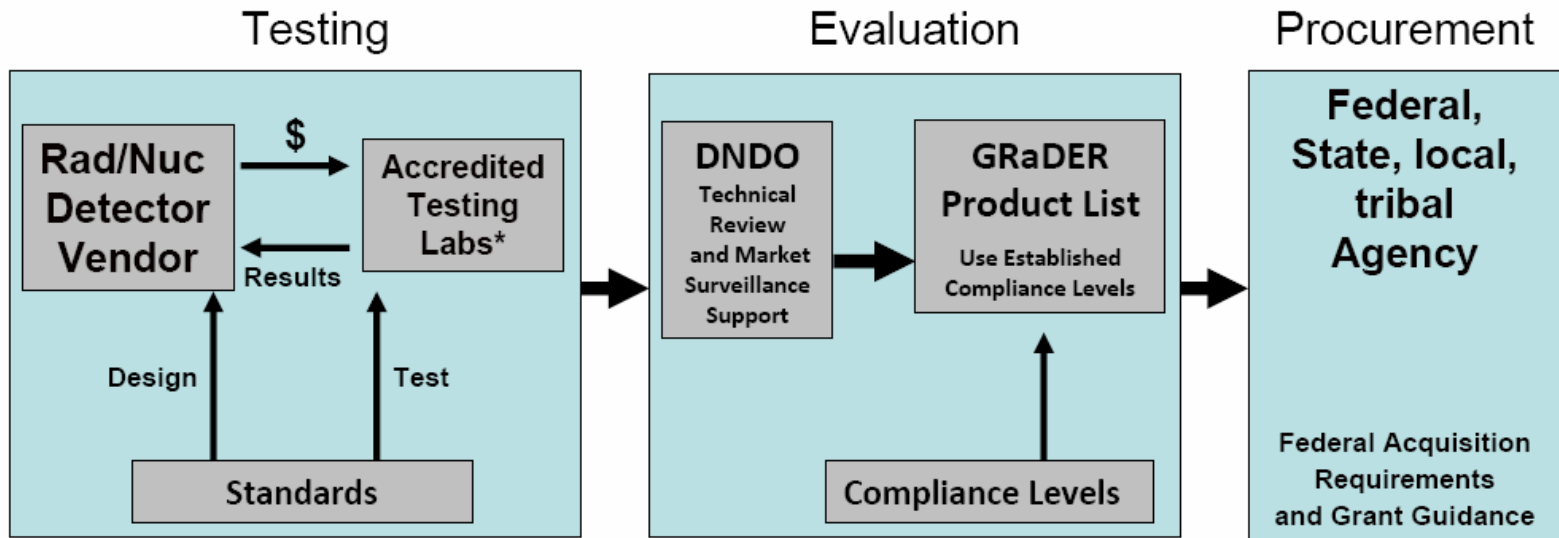


CONTINUOUS EVALUATION OF TEST EXECUTION RESULTS AGAINST EACH PHASE TO INCREASE EFFICIENCY AND EFFECTIVENESS

Lack of Detection System Standards—GRaDER Program

Mission for Graduated Radiological/Nuclear Detector Evaluation & Reporting Program

- Identify radiation detection products that satisfy standards and DHS Mission



Objectives:

- Provide infrastructure for the collection of high integrity test data
- Standardize instrument testing and presentation of test results to assure valid comparisons and easily interpreted results



Operationally Relevant Testing

- **Radiation/Nuclear Countermeasures T&E Complex**
 - Location: Nevada Test Site
 - Capabilities: Test with high fidelity threat sources
- **Maritime Test Bed**
 - Location: Savannah Rivers National Lab
 - Capabilities: Test small maritime craft in operational like conditions
- **Rail Test Center**
 - Location: Tacoma, WA
 - Capabilities: Test intermodal rail without impeding flow of commerce

These Test Facilities Will Allow the Use of High Fidelity Targets in Operationally Relevant Locations Without Disrupting the Flow of Commerce



Successful DNDO Test Campaigns

- **Advanced Spectroscopic Portal (ASP) Test Campaign (Jan-Feb 07 & Jul-Aug 08)**

- Purpose: DNDO test to support the DHS Secretarial certification for ASP Deployment and to support algorithm development
- Description: Test of ASP prototype systems alongside currently deployed PVT system against high fidelity threat objects in various configurations.



- **ASP New York Container Terminal (NYCT) Test Campaign (Jan-Feb 07)**

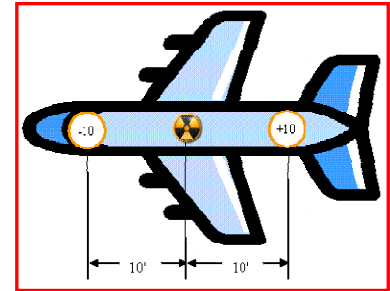
- Purpose: DNDO test to support the DHS Secretarial certification for ASP Deployment and to support algorithm development
- Description: Test of three ASP prototype systems in a stream of commerce at NYCT



Successful DNDO Test Campaigns (continued)

• International General Aviation (IGA) Test Campaign (Feb - Jun 08)

- Purpose: DNDO test to support the IGA radiation detection program
- Description: A test of the operational performance of the currently deployed GR 135 radiation detectors and possible alternatives in standard operating procedures and technologies against three sizes of aircraft



• Human Portable Radiation Detector System Test Campaign (Jan - Feb 08)

- Purpose: To assess the radiological/nuclear performance of HPRDS and COTS systems
- Description: Test of over 20 COTS/HPRDS handheld, backpack, and mobile detection systems in experimental non-operationally relevant scenarios to gather instrument performance independent of the user



Successful DNDO Test Campaigns (continued)

- **Anole Test Campaign (Jan-Feb 2006)**



- Purpose: Testing of Portable and Mobile Radiation detectors to support State and Local law enforcement procurement decisions
- Description: Tested over 30 COTS/GOTS handheld, backpack, and mobile detection systems in three operationally relevant scenarios which included screening, sweeping and portal/chokepoint operations



- **Bobcat Test Campaign (Jul-Aug 2006)**



- Purpose: Testing of Personal Radiation Detectors (PRDS) to support State and Local law enforcement procurement decisions
- Description: Tested over 30 PRDS in four operationally relevant scenarios, which included, pedestrian sweeping, screening, portal/chokepoint operations, and mobile sweeping



- **Crawdad Test Campaign (Jul-Aug 2008)**



- Purpose: Testing of Boat Mounted Radiation Detectors to support State and Local law enforcement procurement decisions and determine requirements for future systems
- Description: Tested 11 COTS & GOTS detectors in four operationally relevant scenarios at the Savannah River National Labs L-Lake



Summary

- Major national concern is potential Rad/Nuc terrorist attack
- DHS/DNDO is charged with improving nation's capability to detect and report such terrorist attempts
- DNDO is meeting the T&E challenges through formation of a combined test team and establishing rapid-cycle test framework
- The DNDO GRaDER program will evaluate detection systems and begin to standardize the radiation detection industry
- DNDO has established test facilities for various venues that has begun to make operational testing possible

Proven T&E processes coupled with advanced test ranges will help DNDO ensure operationally effective and suitable systems are deployed



Evolving Threats

“How they Impact T&E Testing and Infrastructure”

By

Mr. Dick Dickson

***GPS Based Range Instrumentation and Equipment IPT Lead
TYBRIN Corporation***

Presented at

**NATIONAL DEFENSE INDUSTRIAL ASSOCIATION
National Test & Evaluation Conference**

**March 2009
Atlantic City, NJ**

Background

If their economy is destroyed, they will be busy with their own affairs rather than enslaving the weak peoples. It is very important to concentrate on hitting the U.S. economy through all possible means.

The young men [of the Jihad] need to seek out the nodes of the American economy and strike the enemy's nodes.

Osama bin Laden

Background

- In early FY07, the Electronic Warfare Directorate, known as the 412th Electronic Warfare Group, at the Air Force Flight Test Center (AFFTC), Edwards AFB, commissioned a study on evolving threats.
- The resulting report, “Survey of Evolving Threats & Enduring Challenges” was delivered in October 2008.
 - 303 page draft report delivered – still needs some refinement and more information added on certain topics.
 - Evolving threats covered new areas out to 10-15 years and enduring challenges focused on existing known threats and their continued evolution.
- This study looked at both U.S. and foreign systems/threats.
- This study was completed by Cubic Applications Inc., Threat Technologies Division in conjunction with TYBRIN Corporation.

Background

- The focus of the study was two fold.
- It looked at existing and new evolving threats and how they could potentially impact T&E facilities security.
 - How a facility is planned and trained to confront these potential threats (disaster preparedness plans, etc.).
 - External and potential internal threats (insider).
- It also looked at how these evolving threats could potentially impact T&E testing (indoor, outdoor) and T&E infrastructure in the future.
 - Related to the type of T&E testing that might be required as the U.S. develops new weapon systems and counter measures to confront these evolving threats.
 - Support testing related to the Foreign Material Exploitation Program (FMEP).

Evolving Threats Study

- The study looked at a broad spectrum of both existing threats and new evolving threats.
- A threat description was provided for each threat examined.
 - What It Is and the Expected Effects
 - When Available.
 - Employment Method.
 - **Ease of Employment.**
 - **Credibility of Threat.**
 - Lethality and Range.
 - Likely Targets.
 - Typical Defense.

Evolving Threats Study

- The threat descriptions provided ratings for the “Ease of Employment” and “Credibility of Threat”.
- Ease of Employment ratings.
 - **Difficult**: Little or no potential for use due to one or more factors, such as lack of expertise, materials, or deliver system being readily available.
 - **Moderate**: Possible, but one or more factors may make it unlikely at the present.
 - **Unknown**: Ease of employment unknown.
 - **Easy**: Relatively easy to employ due to readily available technology and materials.

Evolving Threats Study

- Credibility of threat ratings.
 - **Low**: Difficult to employ
 - **Moderate**: May be difficult to employ at present, but more likely as technology develops or other factors come into play.
 - **Unknown**: Credibility of the threat is unknown.
 - **High**: Likely to be employed.

Evolving Threats Study

- The study also provided risk factors for each threat examined.
 - Potential impact on DoD-cognizant areas.
 - Likelihood to be used against critical support infrastructure.
 - Near term.
 - Long term.
 - Assessed Risk.
 - Near term.
 - Long term.

Evolving Threats Study

- The risk factors identified for each threat provided ratings for the “Likelihood To Be Used” and “Assessed Risk”.
 - Likelihood To Be Used Against Critical Structures (both near term and long term risks).
 - **Low**: Little or no potential for loss of a given critical infrastructure segment, denials or disruption of service of same.
 - **Moderate**: May cause loss of a critical infrastructure segment, or denial/significant disruption of same.
 - **Unknown**: Unknown impact.
 - **High**: Likely to cause loss of one or more critical infrastructure segments, significant denial/disruption of service of same.

Evolving Threats Study

- Risk factor ratings cont...
 - Assessed Risk (both near term and long term risks).
 - **Low**: Little or no potential risk for the time period indicated.
 - **Moderate**: Moderate potential risk for time period indicated.
 - **Unknown**: Unknown risk.
 - **High**: High potential risk for time period indicated.
- For each threat examined, additional information was provided.
 - **Threat Environment**: Detailed description of the threat itself and how, when and where it might be used.
 - **Key Judgments**: Brief description of the threat's applicability to T&E.
 - **Observations**: Additional information if necessary.
 - **Recommendations**: Information on how to address each threat, types of testing that may be necessary, further studies needed, etc.

Evolving Threats Study

- Threat Description Table Example:

Table 18-1. Threat Description: Thermobaric Materials

| | | |
|------------------------------|--|---|
| What It Is | Enhanced blast and thermal explosive (similar to fuel-air explosives); burn temperature of 2,000°C, but blast effects are more serious than thermal. | |
| When Available | Now | From Russia, Bulgaria, Poland, Czech Republic, and China. |
| Employment Method | Same as any other explosive. | |
| Ease of Employment | Easy | Easily blended and transported; delivered like any other munitions. |
| Credibility of Threat | High | Cheap, simple process to produce, easy to employ. |
| Lethality and Range | More energetic and far greater radii of effects (impulse) than conventional explosives; flash intensity and duration can cause temporary blindness. | |
| Likely Targets | Especially effective within closed spaces, e.g. buildings and caves. | |
| Typical Defense | Barriers, distance, shock absorption. | |

Evolving Threats Study

- Risk Factors Table Example

Table 18-2. Risk Factors: Thermobaric Materials

| Potential Impact on DoD-Cognizant Areas | | | |
|---|---|-----------------|--|
| | Personnel affected, but in relatively small area, e.g. buildings and blocks; structures and materiel destroyed or severely damaged. | | |
| Likelihood To Be Used Against Critical Support Infrastructure | | | |
| | Near-Term: | Moderate | Simple technology, materials, and little knowledge needed. |
| | Long-Term: | High | High, especially if terrorist attacks on U.S. soil accelerate after U.S. begins drawdown of U.S. forces from Iraq. |
| Assessed Risk | | | |
| | Near-Term: | Low | |
| | Long-Term: | High | |
| <ul style="list-style-type: none"> Thermobaric materials are of greatest utility in destroying structures from within. Could be used against DoD structures, personnel, and other parts of the national security infrastructure. | | | |

Evolving Threats Study

- Threats examined by this study and their projected impacts.

| Potential Impact On Security | Potential Impact on T&E Infrastructure | Potential Impact on Both Security & T&E Infrastructure | No Expected Impact |
|--------------------------------------|--|--|--|
| Biological Agents | Chemical Warfare Agents | Toxic Industrial Chemicals or Materials | Interhalogen Oxidizers (IHO) |
| Metal Embrittlement Materials | Improvised Explosives | Improvised Explosive Devices (IED) | Vehicle-Borne Improvised Explosive Devices (VBIED) |
| Platter Charges | Explosively Formed Projectiles (EFP) | Energetic/Reactive Materials | Thermobaric Materials |
| High-Energy-Density Materials (HEDM) | Hafnium Bombs and Isomer Grenades | Information Operations/Cyber Attacks | Power Disruption Ordnance |
| General Nuclear Devices and Weapons | Fourth Generation Nuclear Weapons | Radiological Dispersal Devices (RDD) and "Dirty" Bombs | General Radio Frequency Weapons (RFW) |

Evolving Threats Study

- Threats examined by this study and their projected impacts.

| Potential Impact On Security | Potential Impact on T&E Infrastructure | Potential Impact on Both Security & T&E Infrastructure | No Expected Impact |
|------------------------------|--|--|--|
| Charged Aerosol | Active Denial System (ADS) | Short-Pulse Radars | Foreign RFW Programs |
| Hypersonic Guns | Electromagnetic Rail Guns | Electrothermal Chemical Guns (ETC) | Electric Coil Guns |
| Acoustic Guns | Metal Storm | Laser Weapons | Dynamic Pulse Detonation (DPD)/Plasma Acoustic Shield System |
| Particle Beams | Weather Modifications | Asymmetric Warfare | Unrestricted Warfare |
| Strategic Indirect Warfare | Political Warfare | Economic Warfare | Anti-Satellite Weapons (ASAT) |

Evolving Threats Study

Appendices

- The report also contains eleven different appendices.
 - **Appendix A: Bibliography** – A detailed 10 page list of all the sources of information used to compile this report.
 - **Appendix B: Glossary** – A list of all the unique Terms/Acronyms used in the report and their definition.
 - **Appendix C: Threat Environments & Municipalities** – This appendix contains 5 pages of information that correlates information from Table C-1 of the original document to when they become viable and whether or not they may effect DoD and T&E functions.
 - **Appendix D: Correlation of Adversary Categories of Concern Goals, Attack Approaches, Evolving Threats, and DoD T&E Missions:** Five pages of documentation regarding the categories of concern, attack goals, attack approach, and weapons of choice versus DoD T&E missions.

Evolving Threats Study

Appendices

- The report also contains eleven different appendices (cont...)
 - **Appendix E: Evolving Threats versus Critical Infrastructures** – A detailed 7 page report that lists the pros and cons of various styles of attack versus the targets of choice, delivery means, likelihood of target choice versus effect, and most likely/least likely conflict spectrum.
 - **Appendix F: Weapons of Information Operations & Cyber Warfare** – A three page detailed report of how cyber warfare affects the U.S. and specifically T&E ranges.
 - **Appendix G: Uranium Enrichment, critical Mass, and Potential Sources of Special Nuclear Material** – This appendix contains 6 pages of information about the percent of uranium enrichment, who has it (especially the Highly Enriched Uranium (HEU)), and the availability of this material for weapon programs underway around the world.
 - **Appendix H: Foreign RFW Program Summary:** This appendix contains 15 pages on the state of foreign radio frequency weapons programs with regards to who has them, how far along they are in the development and deployment, and to what extent they pose a threat to the U.S.

Evolving Threats Study

Appendices

- The report also contains eleven different appendices (cont...)
 - **Appendix I: Radio Frequency Weapon Technology** – This appendix contains 13 pages of information on the types of technology being looked at by the various nations around the world for creating radio frequency based weapons.
 - **Appendix J: Understanding Radio Frequency Weapons (RFWs)** – This appendix contains 16 pages of information that explain why RFWs are so important; why the threat is so great; details on specific RFWs known to exist; how they interact with their intended target; and which types of targets are most vulnerable to this evolving threat.
 - **Appendix K: Vulnerability Mitigation Program Lessons Learned** – This appendix contains 6 pages of information on nuclear induced Electromagnetic Pulse (EMP) effects; current protection levels; and where we need to focus on protection for future generations of nuclear induced EMP.

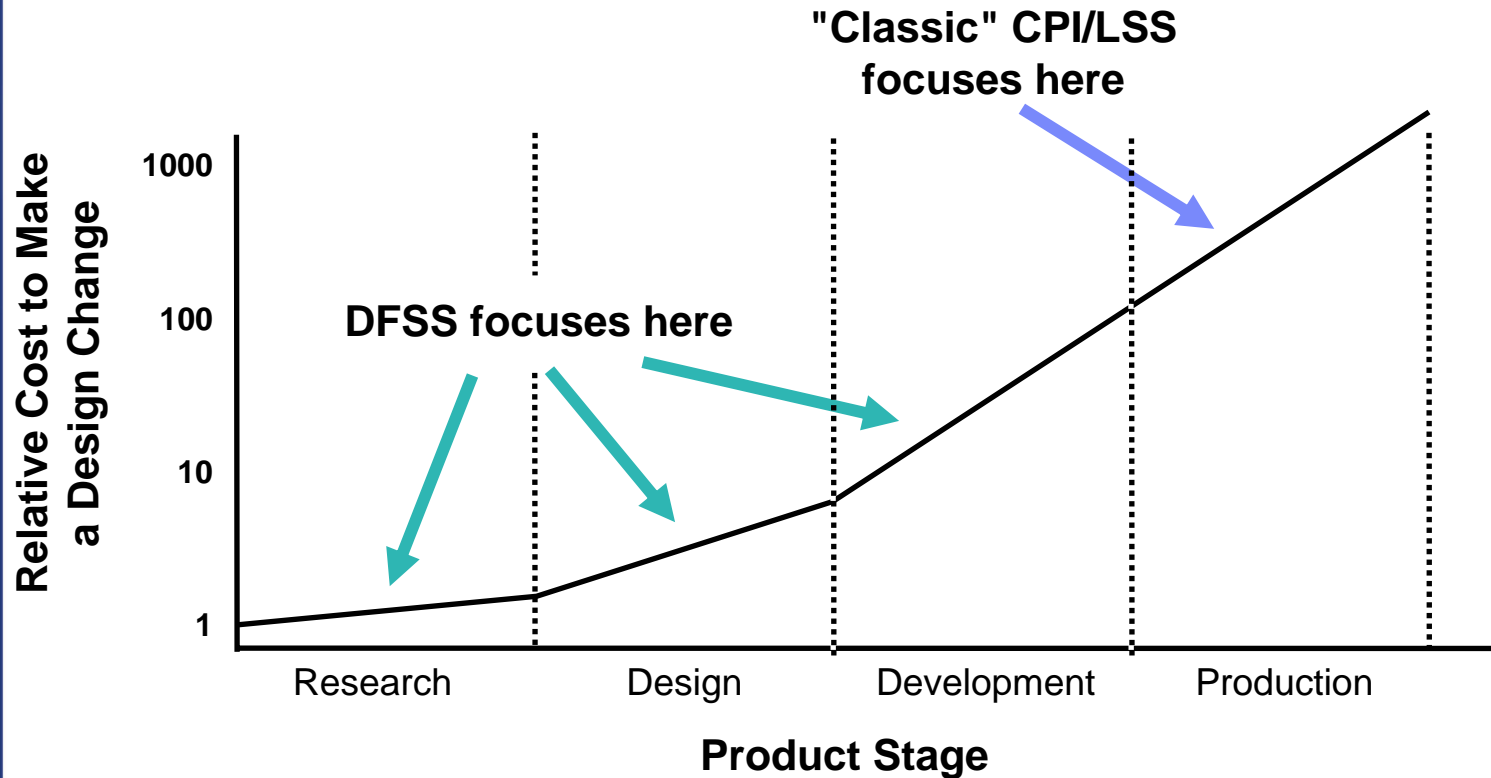
Summary

- *“Survey of Evolving Threats and Enduring challenges”*
 - Currently in a draft state.
 - Final report due out later this year.
 - Contains classified supplements.
- Comprehensive report on existing and new threats.
- Provides detailed information on each threat addressed.
- Provides an analysis on how each threat potentially impacts T&E.
 - Facility security concerns.
 - Potential T&E infrastructure shortfalls.

Major Conference Themes/Issues wrt Improving T&E Efficiency and M&S

- OT&E should be validation testing, not discovery testing
- Mission Based Test and Evaluation
- Integrated Testing
- Eliminate failures prior to test
- Unreliability is a design issue
- Put the “E” back into T & E
- First 15% of investment will determine or dictate the remaining 85% of LCC.
- Want exit criteria from one phase to another
- Need to predict performance before we build or test

Design for Breakthrough Improvement (DFBI*)



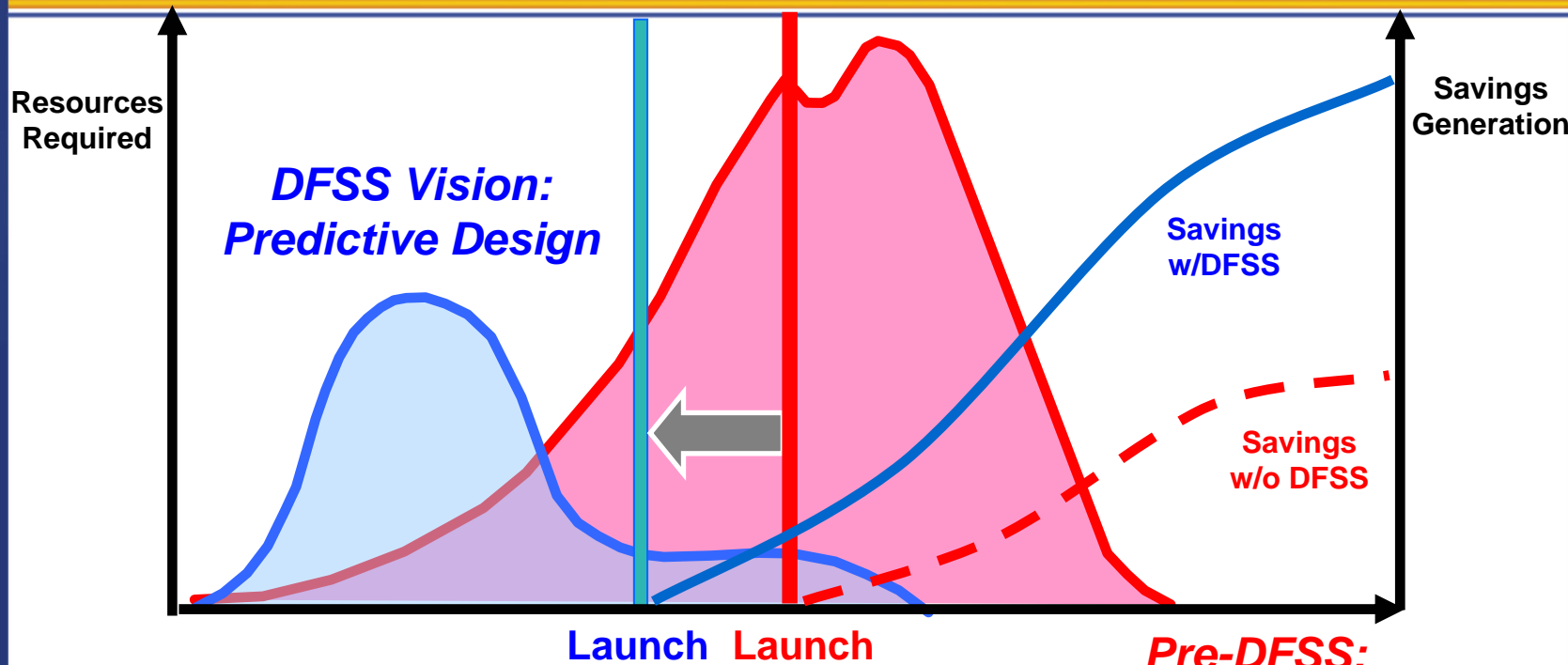
- Gain knowledge when costs are lowest
- Design in quality right from the start

*also known as Design for Six Sigma (DFSS)

DFBI or DFSS Goals

- ***Reduce Cycle Time in the Design and Development Process***
- ***Reduce the total resources and cost over the life cycle***
- ***Reduce the Cost of Poor Quality***
- ***Improve Predictability of QCD (Quality, Cost, Delivery)***

The Benefits



- Early problem identification; solution when costs low
- Faster market entry: earlier revenue stream, longer patent coverage
- Lower total development cost
- Robust product at market entry: delighted customers
- Resources available for next game-changer

- Unhappy customers and employees
- Unplanned resource drain
- Skyrocketing costs
- Next product compromised

- **Upfront investment is most effective and efficient**
- **Show customers “high quality” products right from the start**

The Vision



From

- Evolving design requirements
- Extensive design rework
- Product performance assessed by “build and test”
- Performance and producibility problems fixed after product in use
- Quality “tested in”

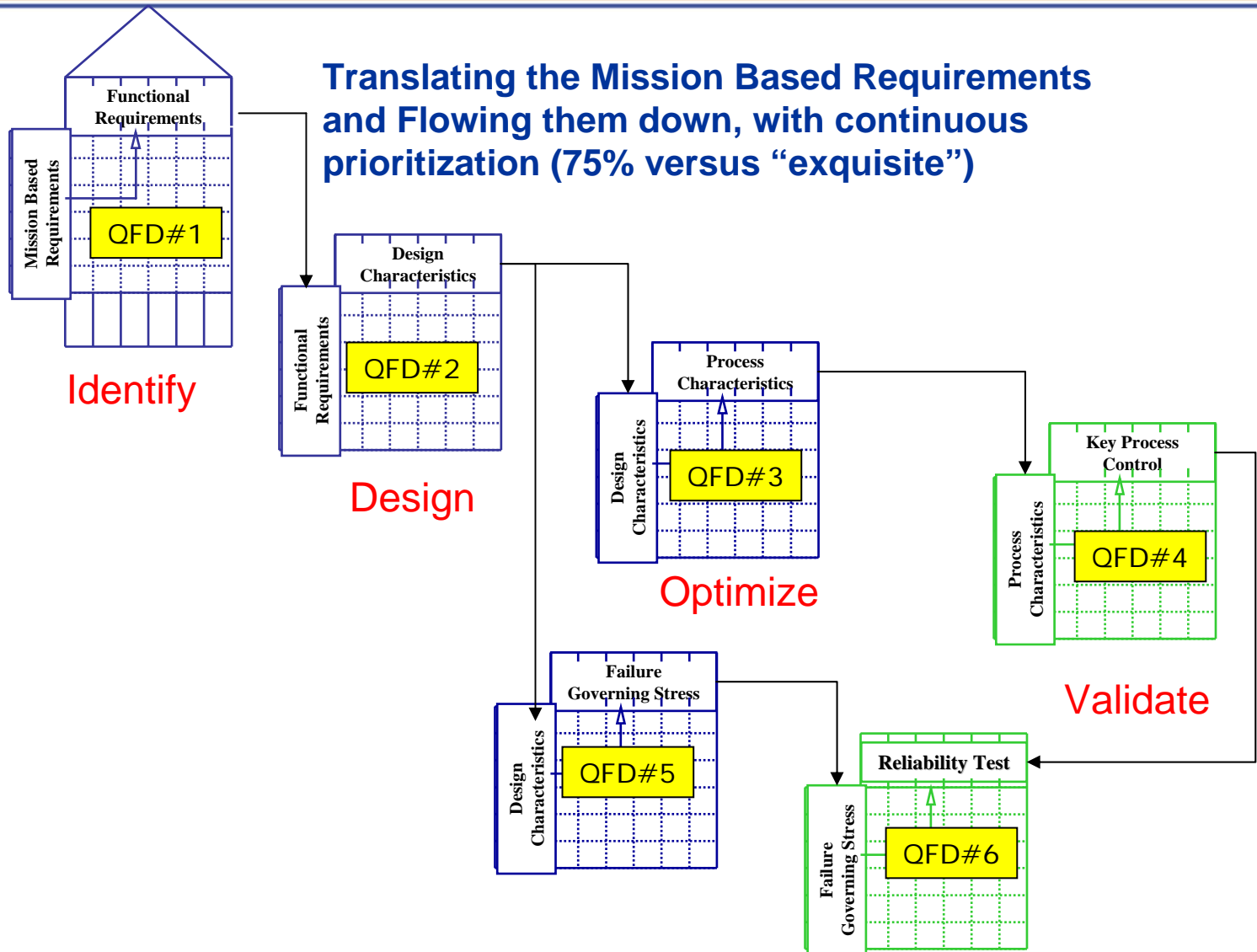


To

- Disciplined CTC flowdown
- Controlled design parameters
- Product performance modeled and simulated
- Designed for robust performance and producibility
- Quality “designed in”

- Lean Six Sigma (DMAIC) fixes known problems.
- ***DFBI or DFSS prevents unknown problems from occurring.***

Quality Function Deployment (QFD)





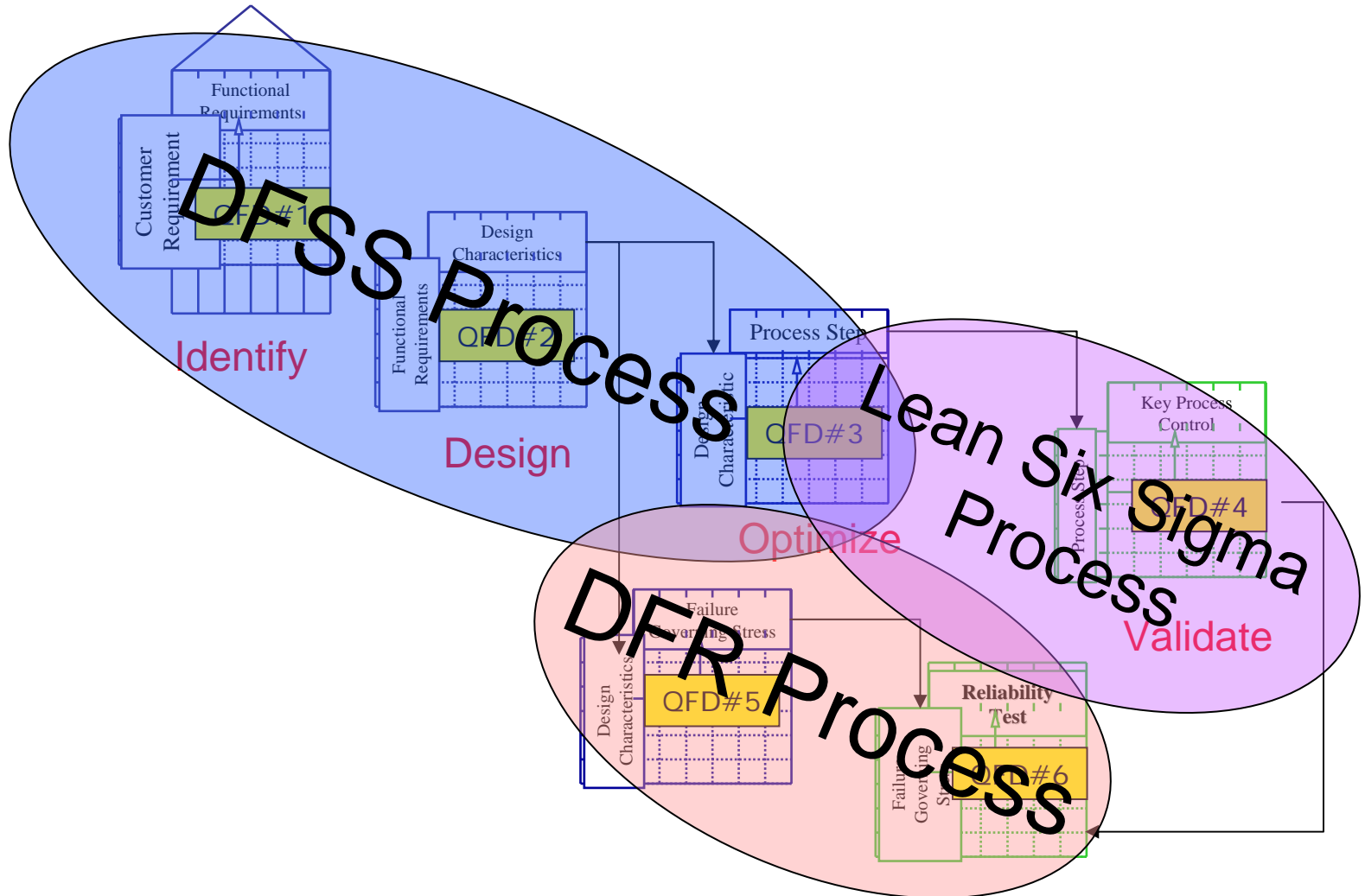
Background – MBT&E Overview

Mission-Based Test and Evaluation

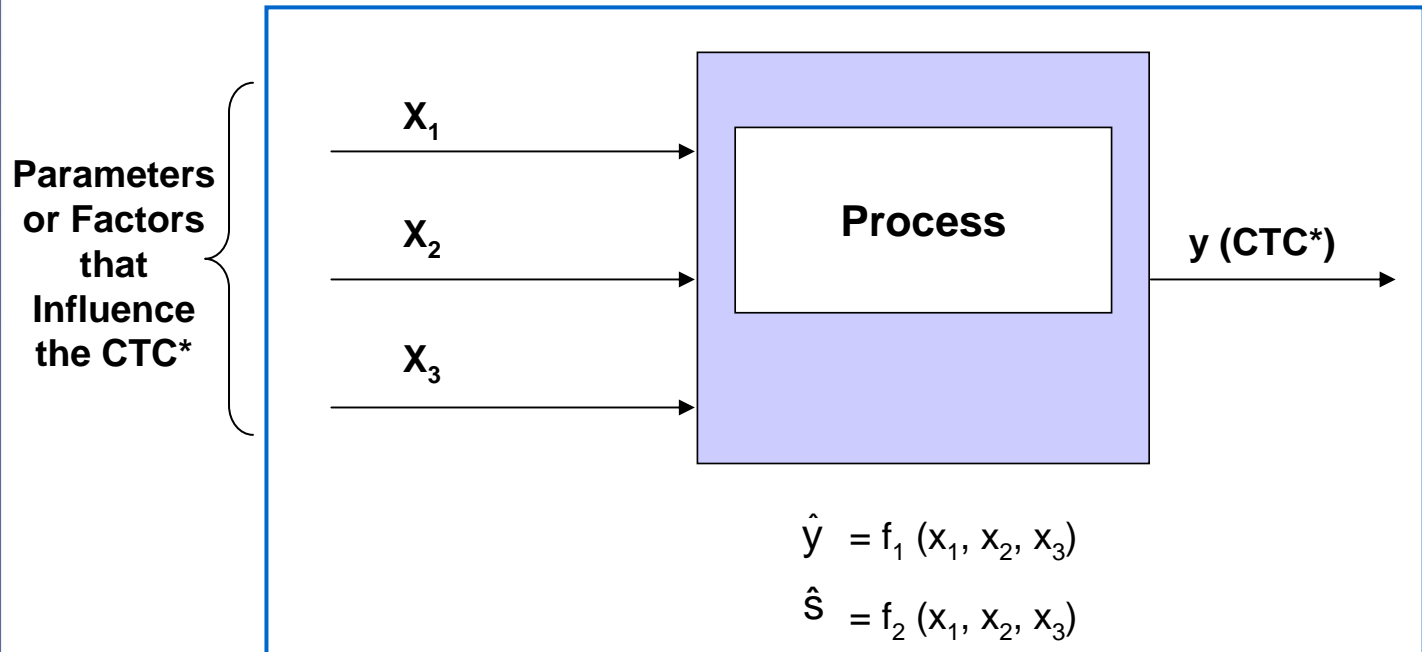
is a methodology that focuses T&E on the mission task **capabilities** provided to the warfighter. It provides a framework and procedure to:

- **link capabilities to the attributes** of the materiel system-of-systems;
- develop evaluation measures that **assess capabilities and attributes**;
- and link the evaluation measures to all **available data sources**.

Linking DFSS, LSS, and DFR in the QFD Flowdown



Transfer Function: The Bridge to Innovation



Where does the transfer function come from?

- **Exact transfer Function**
- **Approximations**
 - **DOE (also known as Multi-Variate Testing)**
 - **Historical Data Analysis**
 - **Simulation**

* **Critical to Customer (or Functional) Performance Measure**

“Integrated testing is the collaborative planning and collaborative execution of test phases and events to provide shared data in support of independent analysis, evaluation and reporting by all stakeholders, particularly developmental (both contractor and government) and operational test and evaluation communities.”

“Integrated testing is the collaborative planning and collaborative execution of test phases and events to provide shared data in support of ***independent*** analysis, ***evaluation*** and reporting by all stakeholders, particularly developmental (both contractor and government) and operational test and evaluation communities.”

What Makes DOE so Powerful? (Orthogonality: both vertical and horizontal balance)

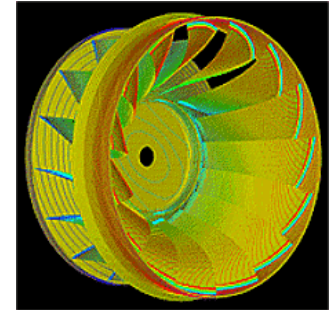
A Full Factorial Design for 3 Factors A, B, and C, Each at 2 levels:

| Run | A | B | C | AB | AC | BC | ABC |
|-----|---|---|---|----|----|----|-----|
| 1 | - | - | - | + | + | + | - |
| 2 | - | - | + | + | - | - | + |
| 3 | - | + | - | - | + | - | + |
| 4 | - | + | + | - | - | + | - |
| 5 | + | - | - | - | - | + | + |
| 6 | + | - | + | - | + | - | - |
| 7 | + | + | - | + | - | - | - |
| 8 | + | + | + | + | + | + | + |

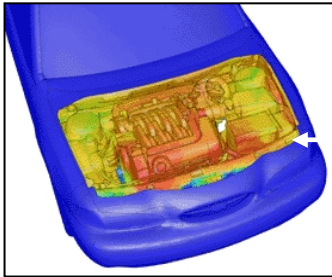
Applications of Modeling and Simulation

Power

Simulation of stress and vibrations of turbine assembly for use in nuclear power generation



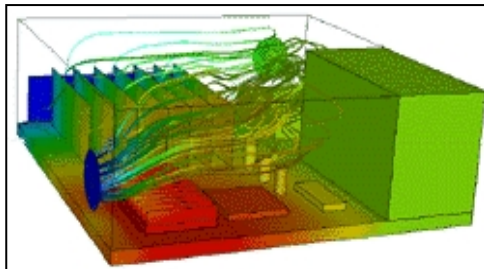
Automotive



Simulation of underhood thermal cooling for decrease in engine space and increase in cabin space and comfort

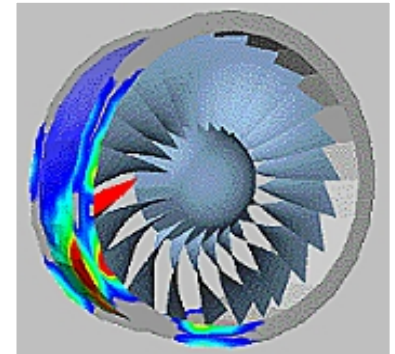
Evaluation of dual bird-strike on aircraft engine nacelle for turbine blade containment studies

Electronics



Evaluation of cooling air flow behavior inside a computer system chassis

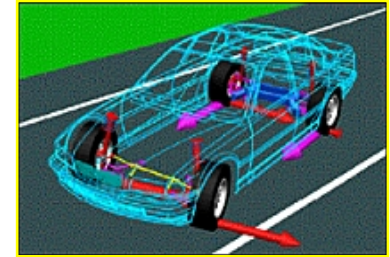
Aerospace



Examples of Computer Aided Engineering (CAE) and Simulation Software

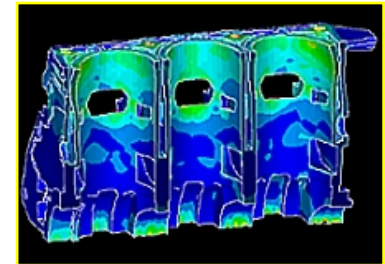
Mechanical motion: Multibody kinetics and dynamics

ADAMS®
DADS



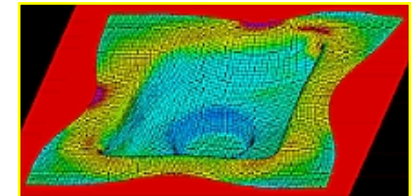
Implicit Finite Element Analysis: Linear and nonlinear statics, dynamic response

MSC.Nastran™, MSC.Marc™
ANSYS®
Pro MECHANICA
ABAQUS® Standard and Explicit
ADINA



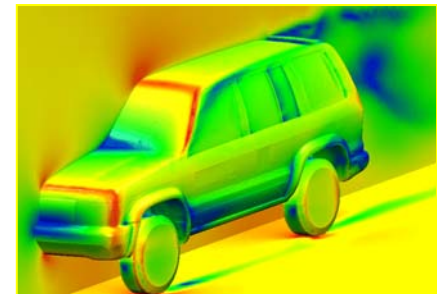
Explicit Finite Element Analysis : Impact simulation, metal forming

LS-DYNA
RADIOSS
PAM-CRASH®, PAM-STAMP



General Computational Fluid Dynamics: Internal and external flow simulation

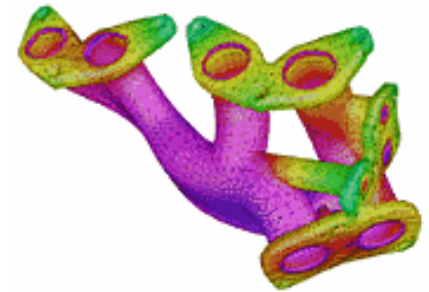
STAR-CD
CFX-4, CFX-5
FLUENT®, FIDAP™
PowerFLOW®



Examples of High Fidelity Simulation Models

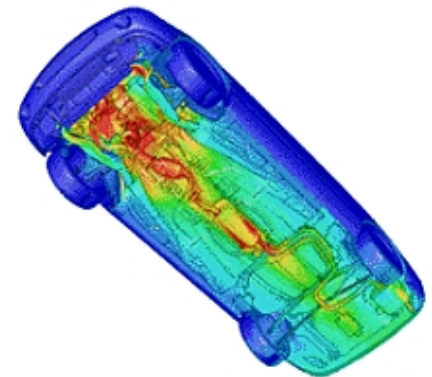
Preprocessing: Finite Element Analysis and Computational Fluid Dynamics mesh generation

ICEM-CFD
Gridgen
Altair® HyperMesh®
I-deas®
MSC.Patran
TrueGrid®
GridPro
FEMB
ANSA

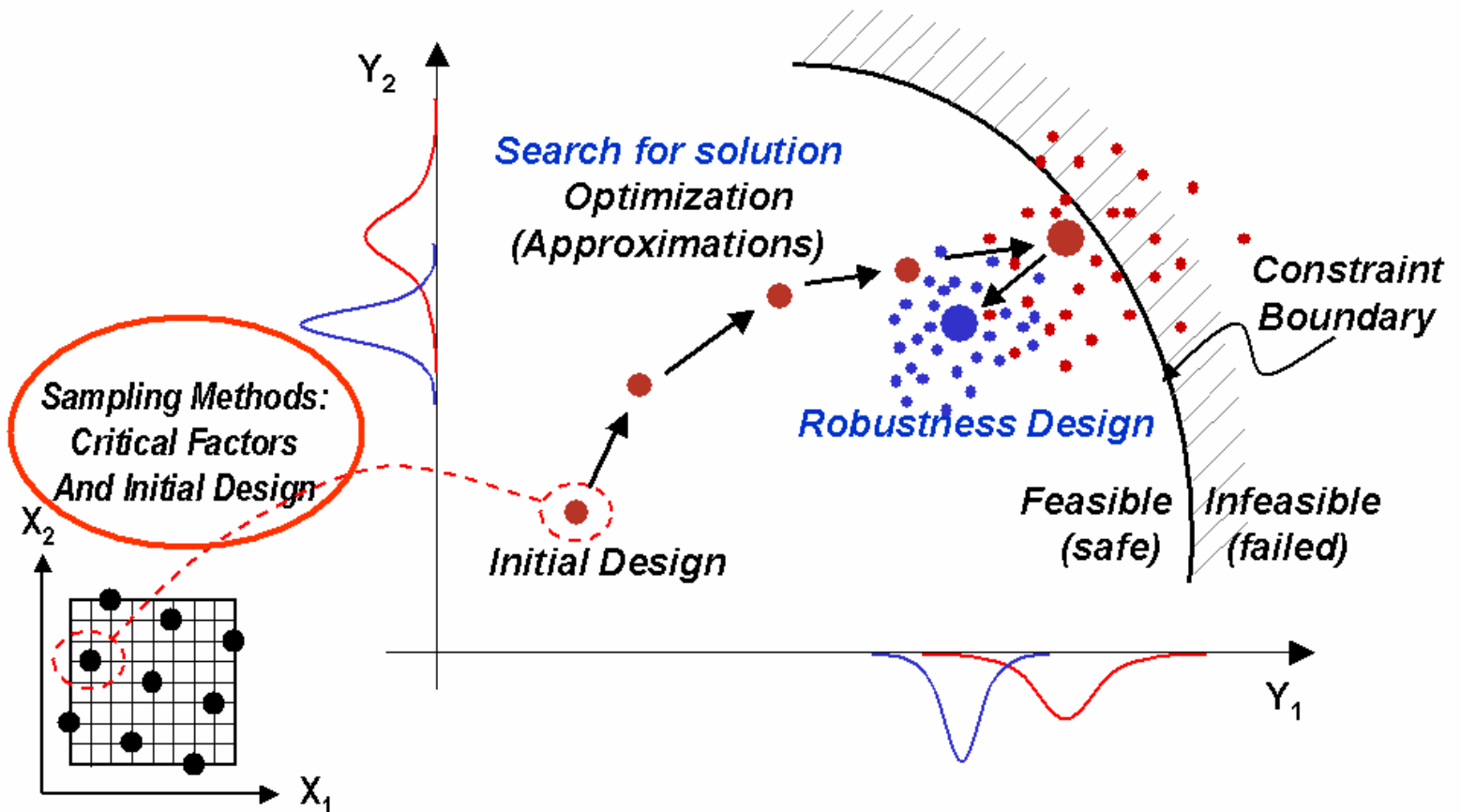


Postprocessing: Finite Element Analysis and Computational Fluid Dynamics results visualization

Altair® HyperMesh®
I-deas
MSC.Patran
FEMB
EnSight
FIELDVIEW
ICEM CFD Visual3 2.0 (PVS)
COVISE



Making Use of Iterative Simulation and Modeling for Optimizing the Design



Knowledge Based Principles*

- Develop a Product Development System Built Upon Knowledge
- Focus on Knowledge Generation to Streamline the Product Development Process, Rather Than Strict Adherence to Pre-determined Timelines
- Move from schedule-driven acquisition to knowledge-driven acquisition
- Promote Technical Competency Over Procedural Compliance
- Develop Innovation–Driven Project Leaders/Program Managers
- Support and Reward Technical Excellence, Systematic Innovation and Competency

* These principles are based on the key findings of the Research and Technology Executive Council, as presented in its September 2006 article entitled “*Establishing a Lean R&D Organization.*”

Joint Mission Environment Test Capability (JMETC)



**Mr. Bruce Bailey
Principal Deputy PM
Joint Mission Environment Test Capability
Test Resource Management Center**

4 March, 2009



The JMETC Mission



JMETC provides the DoD T&E Community the resident distributed test *expertise* and the persistent modern *network infrastructure* needed for the connection and use of distributed live, virtual, and constructive resources to augment the DT&E and OT&E of joint systems and systems-of-system.



JMETC Distributed Test Infrastructure Product Lines



- **Persistent connectivity**
- **Middleware**
- **Standard interface definitions and software algorithms**
- **Distributed test support tools**
- **Data management solutions**
- **Reuse repository**



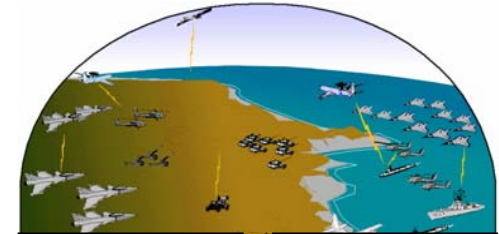
JMETC Enables Distributed Testing



Systems Under Test

Integrated Test Resources

Joint Operational Scenarios



Virtual Prototype

TENA * Standard Interface Definitions

TENA Common Middleware

Hardware in the Loop Lab

TENA Standard Interface Definitions

TENA Common Middleware

Installed Systems Test Facility

TENA Standard Interface Definitions

TENA Common Middleware

Range

TENA Standard Interface Definitions

TENA Common Middleware

Environment Generator

TENA Standard Interface Definitions

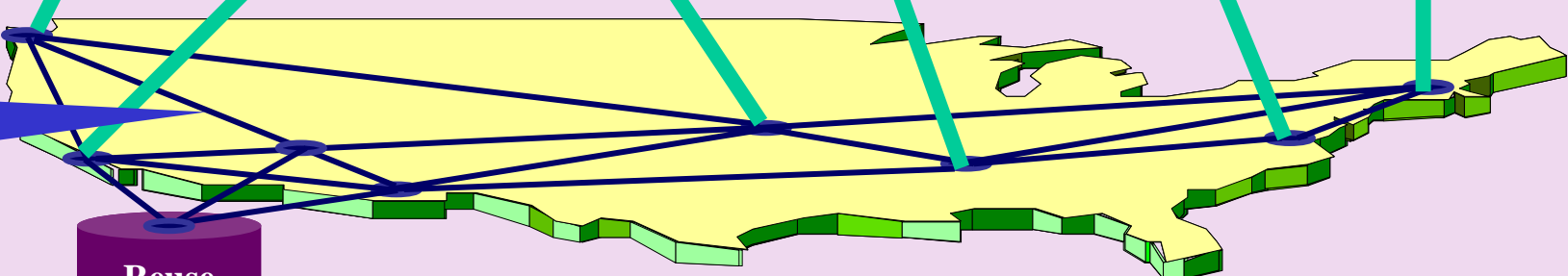
TENA Common Middleware

Threat Systems

TENA Standard Interface Definitions

TENA Common Middleware

JMETC VPN on SDREN



Reuse Repository

Distributed Test Support Tools

Data Management Solutions

JMETC Infrastructure

Customer Support

* TENA: Test and Training Enabling Architecture



JMETC...



1. Reduces Technical Risk
2. Saves Time
3. Reduces Costs

- **People**: Experienced and highly skilled expertise forward deployed for distributed test planning and operations
- **Network**: Modern, tested, and reliable network capability already in place
- **Practices**: Integration and interoperability of test resources is proven practice *plus* a quarterly User's Group to capture technical requirements
- **Data Exchange**: Methodologies and solutions have already been tested, proven, and put in practice
- **R&D + S&T**: JMETC actively captures customer needs and requirements on a continuous basis and programs basic and applied research projects to improve distributed test capabilities for the Department
- **Lessons Learned**: JMETC is the T&E Communities' enterprise-level focal point for collecting and maintaining "lessons learned" as well as implementing resource "reuse" for improving the DoD's distributed test capability
- **Tools**: JMETC maintains a comprehensive suite of distributed test tools...in fact, the same tools used by the Joint Interoperability Test Command (JITC) for net-ready KPP "interoperability" certification"



JMETC Leadership & Governance



JMETC Chain of Command

Honorable John Young
USD (AT&L)



Dr. John B. Foulkes
Director, Test Resource Management Center (TRMC)

Vacant
Principle Deputy, TRMC
Deputy Director, JIPP



Chip Ferguson
JMETC Program Manager



George Rumford
Senior Technical Advisor

JMETC Governance

Testing in a Joint Environment Roadmap Senior Steering Group

- Senior DoD Leaders
- Charter signed 26 Oct 07



JMETC Advisory Group

- Service/Agency reps
- Regularly held meetings to discuss/review plans, common issues, needed studies, etc.



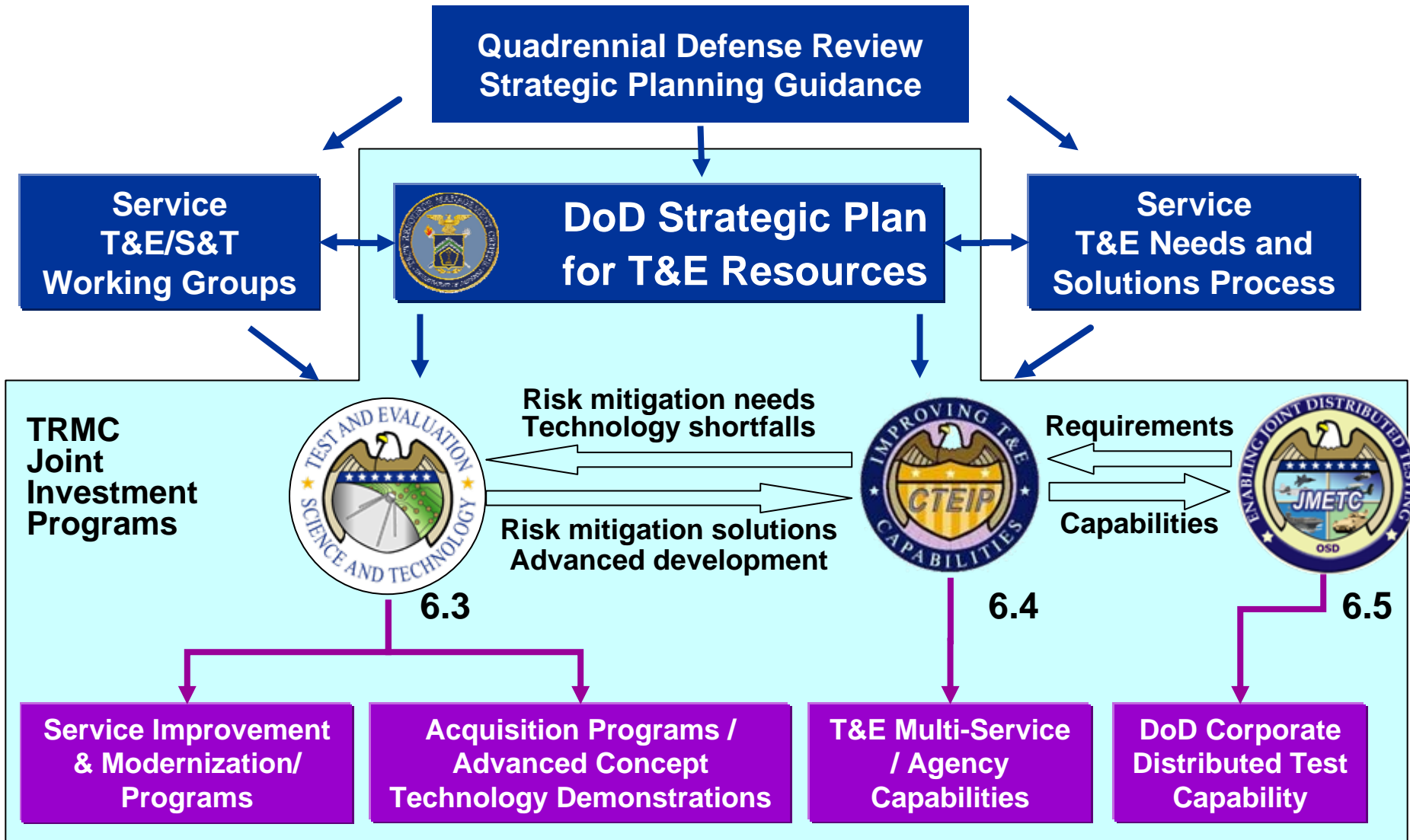
JMETC Users Group

- Technical representatives of customers and test resource owners
- Six meetings held to date
- 265 participants at last meeting



Relationship within TRMC

Synergy through Aligned Investment





TRMC Investment Programs Overview



T&E/S&T



- Established in FY2002
- Develops technologies required to test future warfighting capabilities
- 6.3 RDT&E funds
- ~\$95M / year
- 7 current focus areas
 - Directed Energy
 - Hypersonics
 - **Netcentric Systems**
 - Unmanned Systems
 - Multi-Spectral Sensors
 - Non-intrusive Instruments
 - Spectrum Efficiencies

CTEIP



- Established in FY1991
- Develops or improves test capabilities that have multi-Service utility
- 6.4 RDT&E funds
- ~\$140M / year
- 52 current projects
 - 27 projects developing core Joint capabilities
 - 2 projects improving interoperability test cap.
 - 9 projects improving threat representations used in testing
 - 16 projects addressing near-term OT shortfalls

JMETC

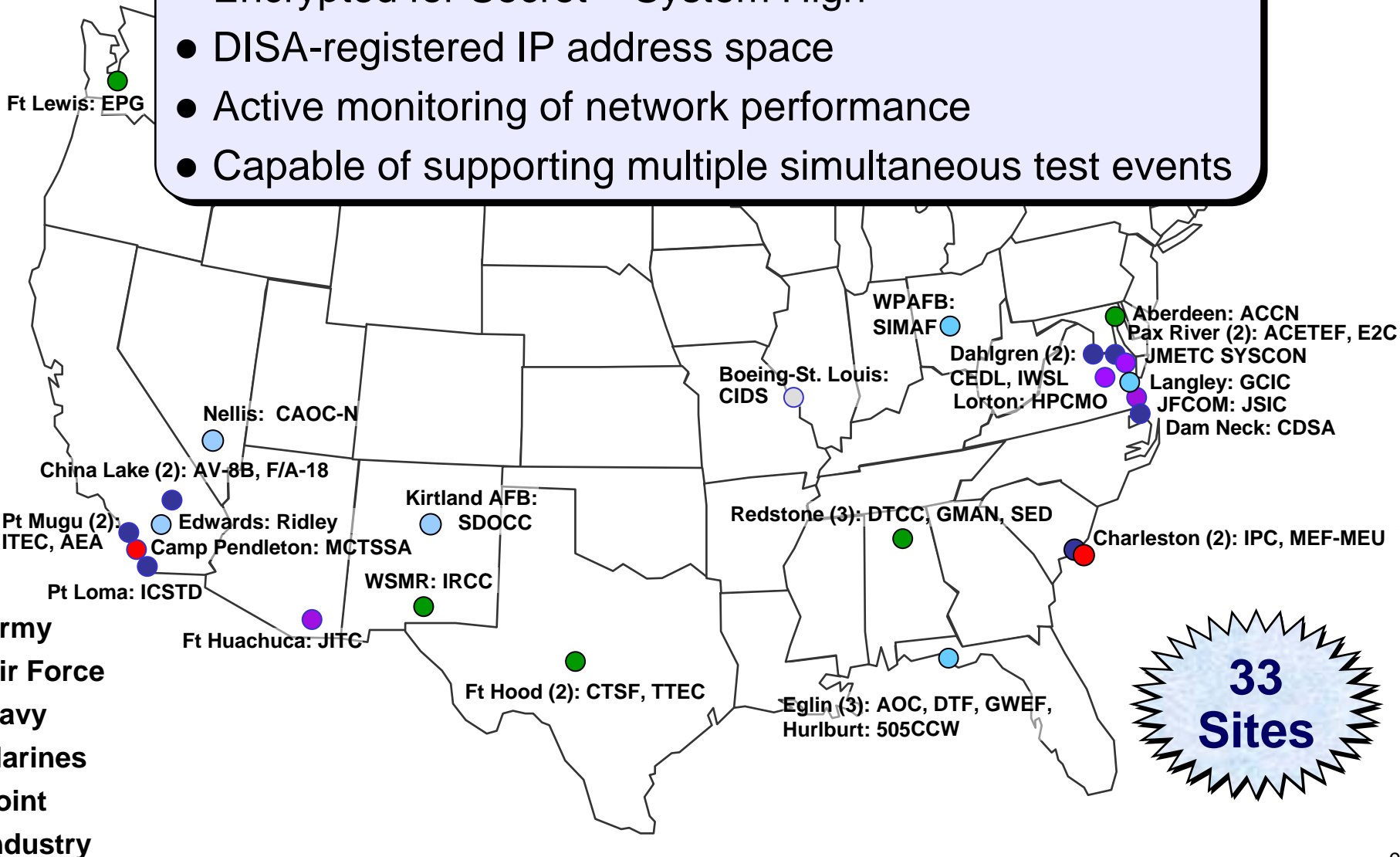


- Established in FY2007
- Provides corporate infrastructure for distributed Joint testing
- 6.5 RDT&E funds
- ~\$10M / year
- 33 current sites
 - Expanding to 42 sites
- Maintains
 - Network connections
 - Security agreements
 - Integration software
 - Interface definitions
 - Distributed test tools
 - Reuse repository



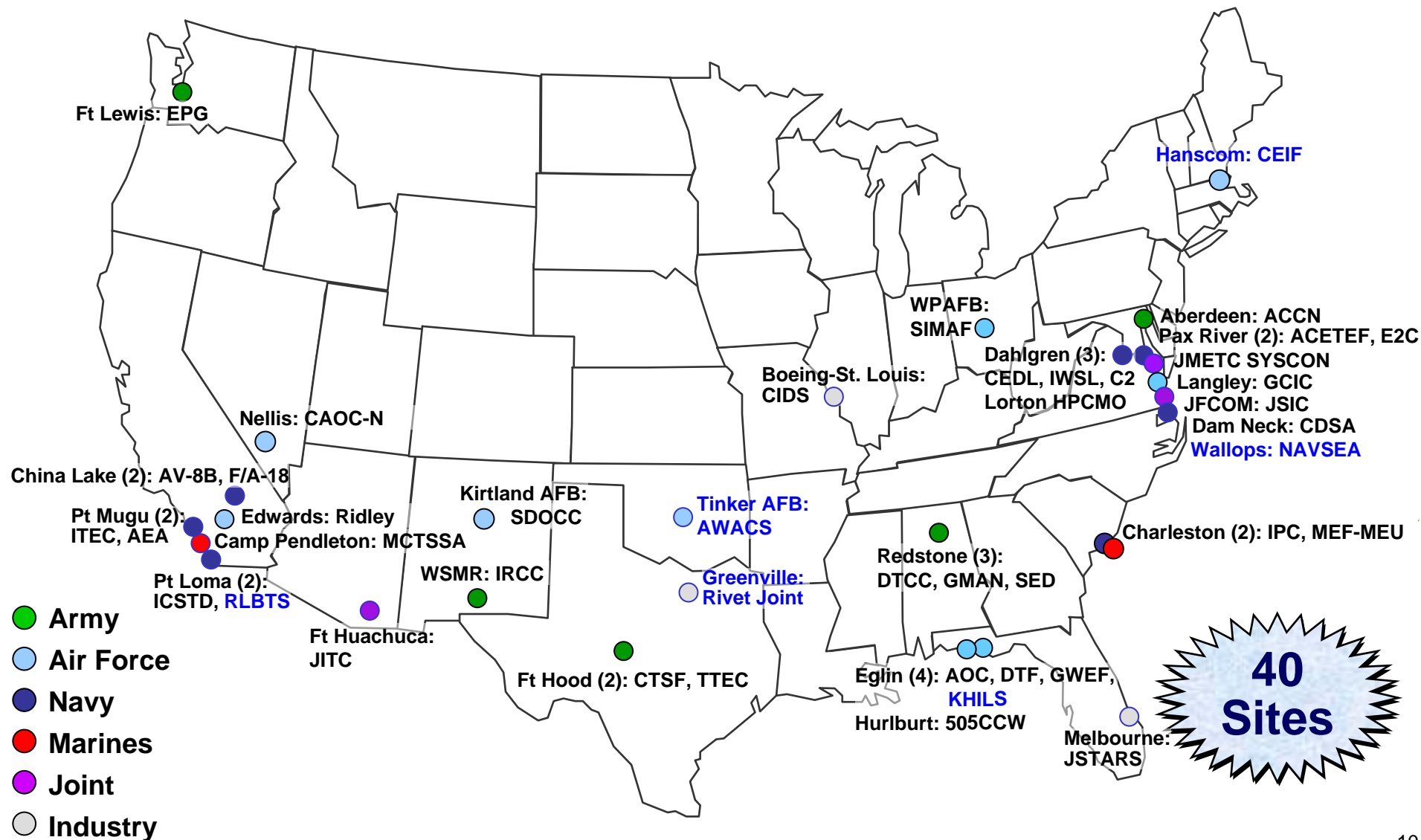
Current JMETC Connectivity

- Dedicated, trusted VPN on SDREN (part of the GIG)
- Encrypted for Secret – System High
- DISA-registered IP address space
- Active monitoring of network performance
- Capable of supporting multiple simultaneous test events



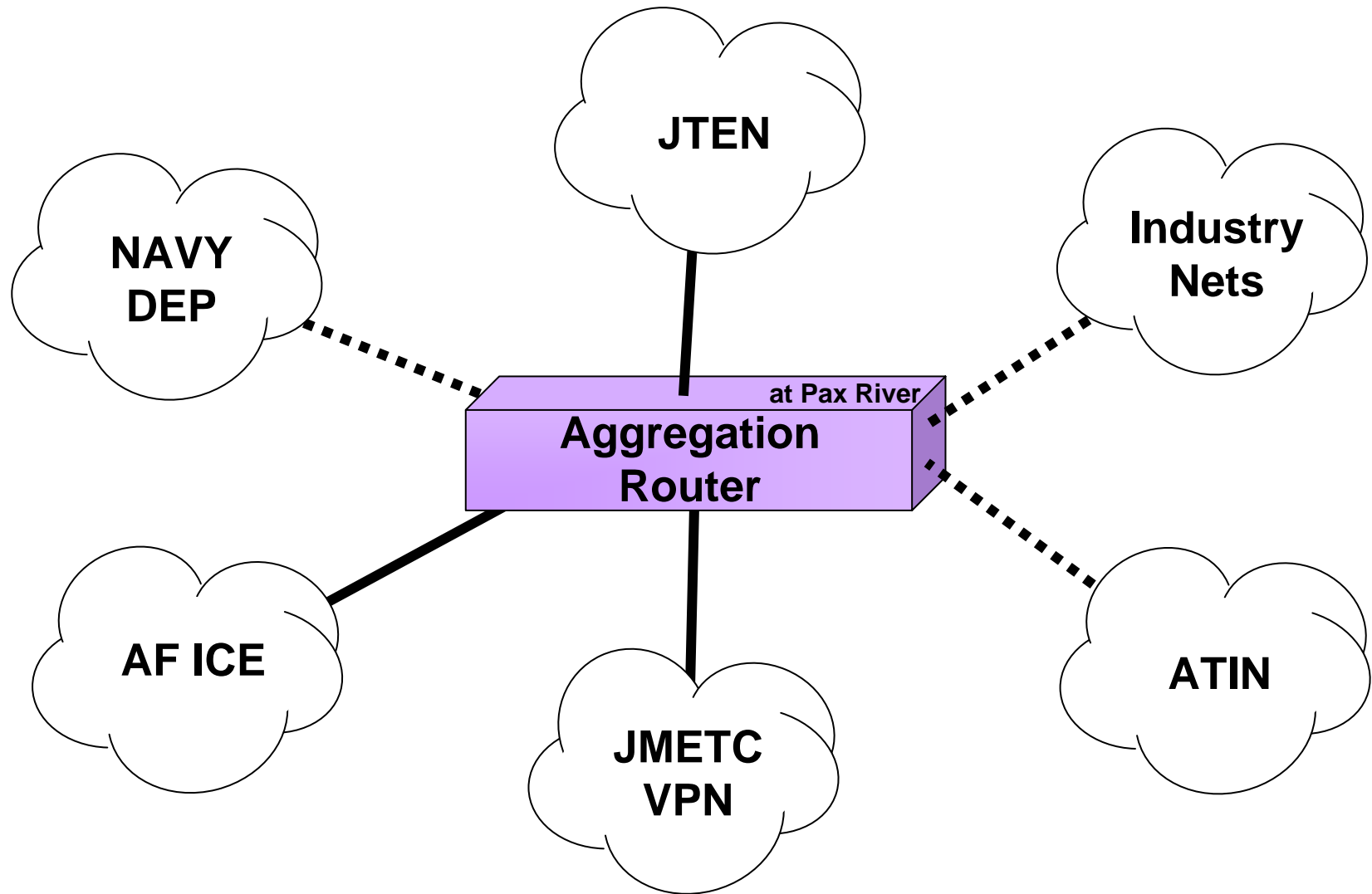


Planned JMETC Connectivity





Network Aggregation Bridging Networks





Joint Mission Environment Test Capability (JMETC) FY08 Accomplishments



JMETC FY08 Customers

- Future Combat System (FCS) Combined Test Office
- Joint T&E Methodology (JTEM) JT&E
- InterTEC
- Single Integrated Air Picture (SIAP) JPO
- Air Force Datalink Studies

JMETC FY08 Accomplishments

- Expanded network from 8 sites to 32 sites
- Supported multiple tests simultaneously
- Realized reuse from persistent agreements
 - 51 times avoided the cost of re-doing site connection paperwork
- Characterized JMETC network performance (latency, throughput, etc.) in detail
- Enhanced the JMETC toolbox with test tools for OTH-G and USMTF message protocols

Insight Gained by the DoD

- Timeliness of C2 processes
 - Joint Fires
 - Joint Close Air Support
 - Combat ID
- Airspace deconfliction studies
- Battlespace management between Army and Air Force
- Link-16 implementation differences between Navy and Air Force
- Improvements to Combat Airborne Networking gained from using FAST over Link-16
- Operational Test Assessment of the Capability Test Methodology
- Suitability of FCS test resources to support FCS Milestone C decision
- Suitability of test strategy for SIAP integration software



FY09 JMETC Support Schedule



| Customer | Event | Dates |
|----------------------|---|---------------------------------|
| Air Force | Persistent Fire 01 | October 08 – December 09 |
| OSD/TRMC | CTEIP TENA R6 | October 08 – February 09 |
| Air Force | JEFX 09-02 | October 08 – February 09 |
| Air Force | JEFX 09-03 | February 09 – April 09 |
| Joint Program | Single Integrated Air Picture (SIAP) | October 08 – June 09 |
| OSD/TRMC | InterTEC Tools Development | FY09 – Periodic |
| Navy | Joint Surface Warfare JCTD | October 08 – February 09 |

Discussions for possible future teaming:

Gerald R. Ford Class (CVN-21)

Multi-mission Maritime Aircraft (MMA)

Future Combat System

Joint Strike Fighter (JSF)

Net-Enabled Command Capability



Example: Single Integrated Air Picture

Single Integrated Air Picture (SIAP)

- Real time, fire control quality
- Exploit the full range of our weapons
- Reduce the risk of fratricide and counter emerging threats

Special Interest Program

Congressional Item of Interest

AWACS:
2 Known Friendly
2 Known Hostile
1 Known Cruise Missile

E-2:
2 Known Friendly
2 Known Hostile
1 Known Cruise Missile



JLENS



HOSTILE

AEGIS:
2 Known Friendly
2 Known Hostile
1 Known Cruise Missile



CVN (SSDs)



Patriot Launcher



USMC Sensors

CAC2S:
2 Known Friendly
2 Known Hostile
1 Known Cruise Missile



Patriot Radar

Sentinel

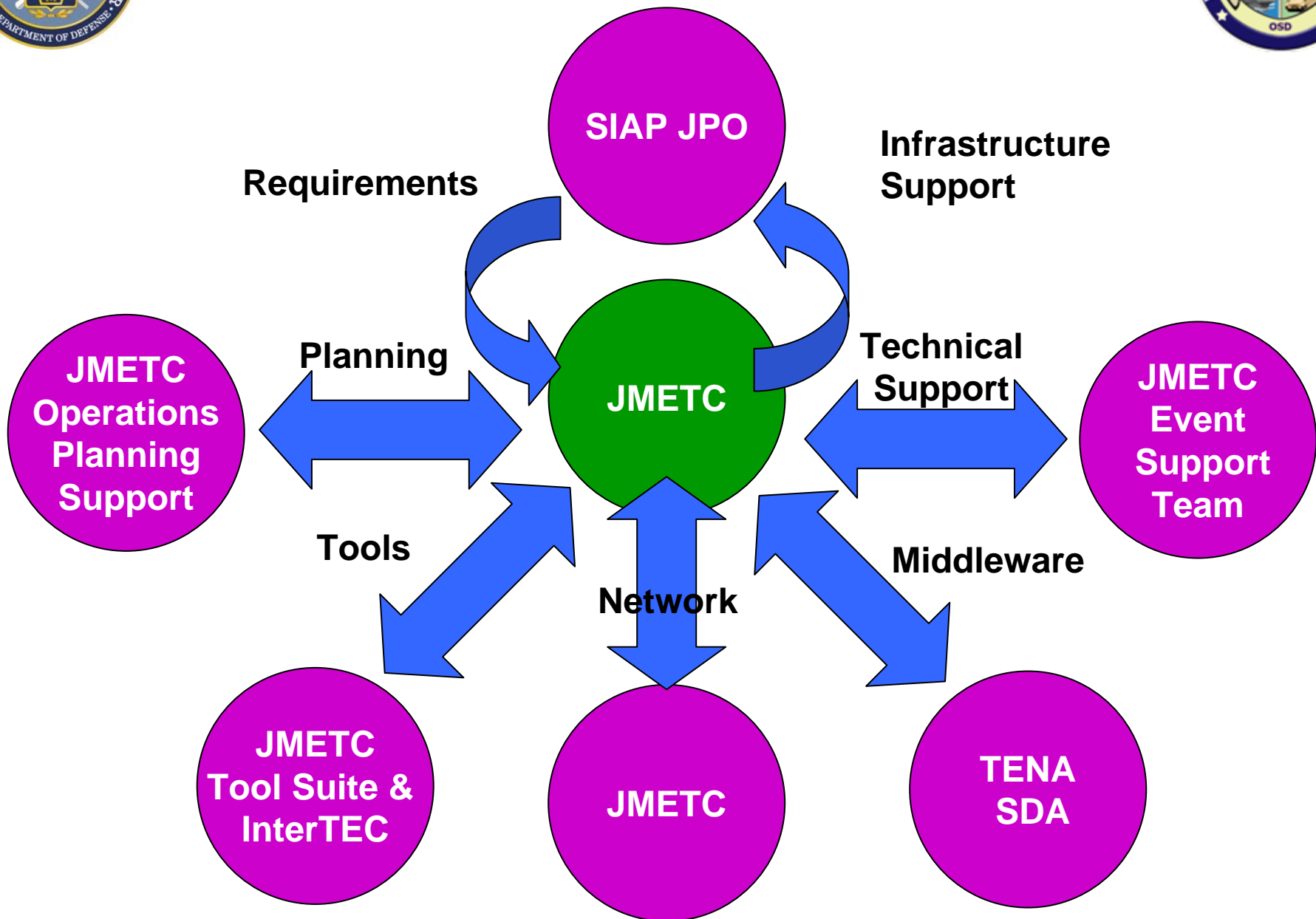
IBCS:
2 Known Friendly
2 Known Hostile
1 Known Cruise Missile



BCS

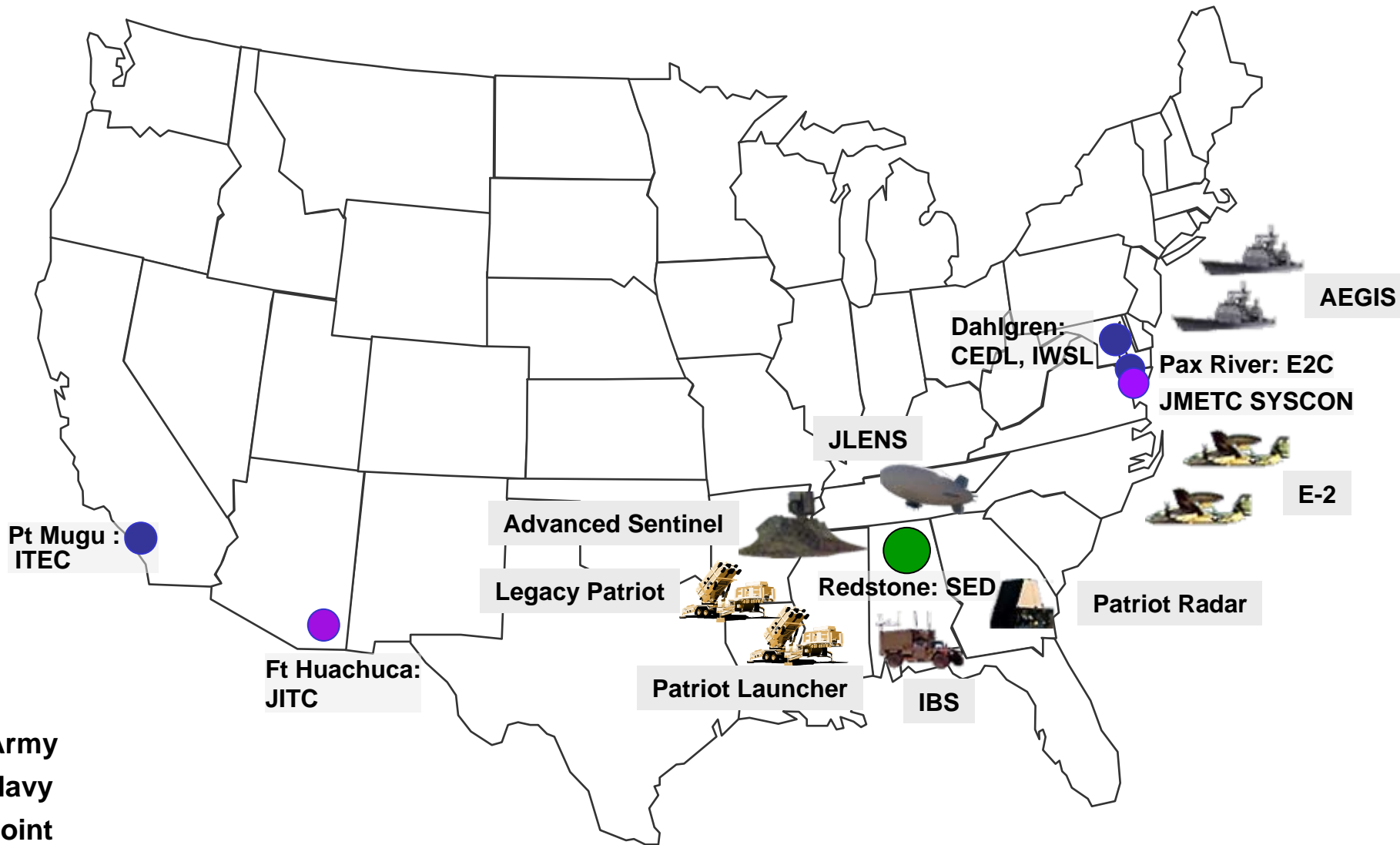


JMETC SIAP Support





JMETC VPN Sites Support to SIAP Joint Combined HWIL Event (JCHE) 5





JMETC SIAP Support



- JMETC provides persistent support to the JPO throughout entire JCHE-5 schedule
- JMETC distributed and Joint testing expertise enables tailor-made test recommendations to SIAP
- **Payoff Example:** JMETC involvement enabled early integration testing of Wrap-Around Simulation Program (WASP) Real-Time Data Distribution System (DDS)
 - “Idea-to-Execution” in just two weeks
 - Tactical simulation traffic over the JMETC VPN five months before scheduled distributed site integration testing
 - **Issues discovered and resolved much earlier in test schedule**



JMETC Positive Impact

JEFX 09-01: Persistent Fire



Global Cyberspace Integration Center Perspective

JMETC-AF partnership accelerated WWF acquisition timeline

- Extended limited budget resources to obtain best bang for the buck: able to move rapidly from concept path to OT
- Reduced certification and accreditation issues that hamper developmental activities
- Afforded greater opportunities to inject direct warfighter input without cost of reestablishing network infrastructure
- Greater access to simulation network capabilities increased number of test cases with single event



JMETC Initiatives



- **Streamlining the Network Accreditation process**
 - *Tiger Team: The DoD Information Assurance Certification and Accreditation Process (DIACAP)*
- **Cross-Domain Solutions**
 - **Unified Cross Domain Management Office (UCDMO)**
 - **Information Operations Range**
 - **Joint Improvised Explosive Device Defeat Organization**
- **West Coast Aggregation Router**
- **Mobile Node Capability (Transportable Node)**



Summary



- **JMETC supports the full spectrum of Joint testing, supporting many customers in many different Joint mission threads**
- **JMETC is being built based on customer requirements**
 - JMETC event support can be tailored to customer needs
- **JMETC is partnering with Service activities and leveraging existing capabilities**
- **JMETC is coordinating with JFCOM to bridge test and training capabilities**
- **JMETC Users Group provides an open forum to present emerging requirements as well as new technologies & capabilities**
 - **Next JMETC Users Group 24-26 March, San Destin, FL**



JMETC Program Points of Contact



JMETC Program Manager:

Chip Ferguson

chip.ferguson@osd.mil

703-604-0350 x138

JMETC Principal Deputy PM:

Bruce Bailey

bruce.bailey@osd.mil

703-604-0350 x144

JMETC Senior Technical Advisor:

George Rumford

george.rumford@osd.mil

703-601-5233

JMETC Lead Systems Engineer:

Ryan Norman

ryan.norman@osd.mil

703-604-0350 x146

JMETC Website: www.jmetc.org



Testing & Evaluation for Weapon System Security

March 3, 2009

**Office of the Under Secretary of Defense
Acquisition, Technology and Logistics
Systems and Software Engineering Directorate**



Agenda

- **Today's Threats, Vulnerabilities**
- **Acquisition Security Policies**
- **Streamlining Acquisition Security**
 - Security Disciplines
 - Program Protection Plan
 - Designing-In Protection
- **Implementing Protection**
 - System Component Protection Best Practices & Tools
 - Evaluation of Protection
- **Summary**



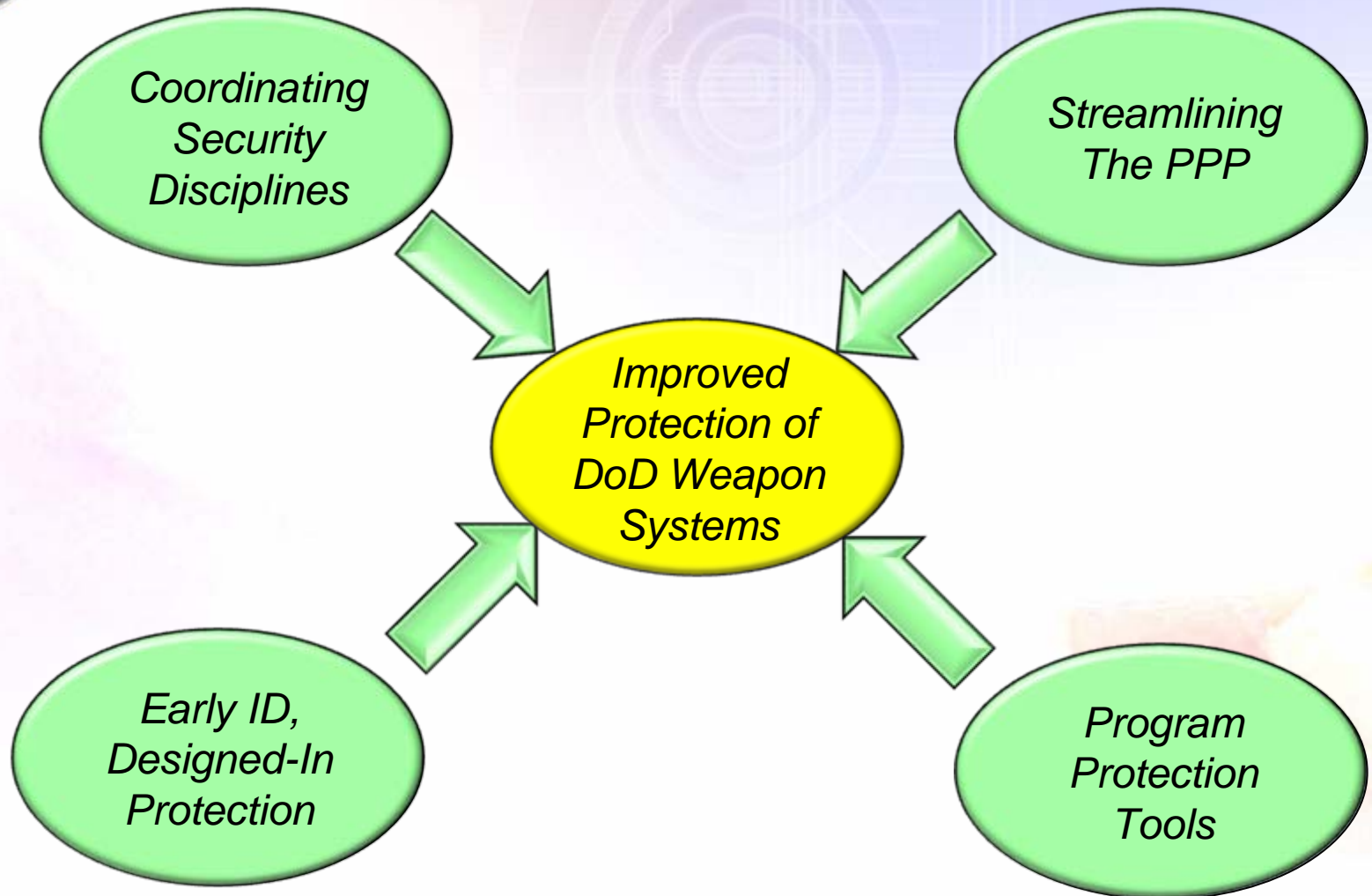
Today's Threats & Vulnerabilities

How are we verifying and validating that we are reducing the risk of these types of attacks in our systems?

- **Threats: Nation-state, terrorist, criminal, rogue developer who:**
 - Gain control of IT/NSS/Weapons through supply chain opportunities
 - Exploit vulnerabilities remotely
- **Vulnerabilities: All IT/NSS/Weapons (incl. systems, networks, applications)**
 - Intentionally implanted logic (e.g., back doors, logic bombs, spyware)
 - Commercial software and circuit cards with embedded “phone home” functionality
- **Consequences: Stolen critical data & technology; corruption, denial of critical warfighting functionality³**

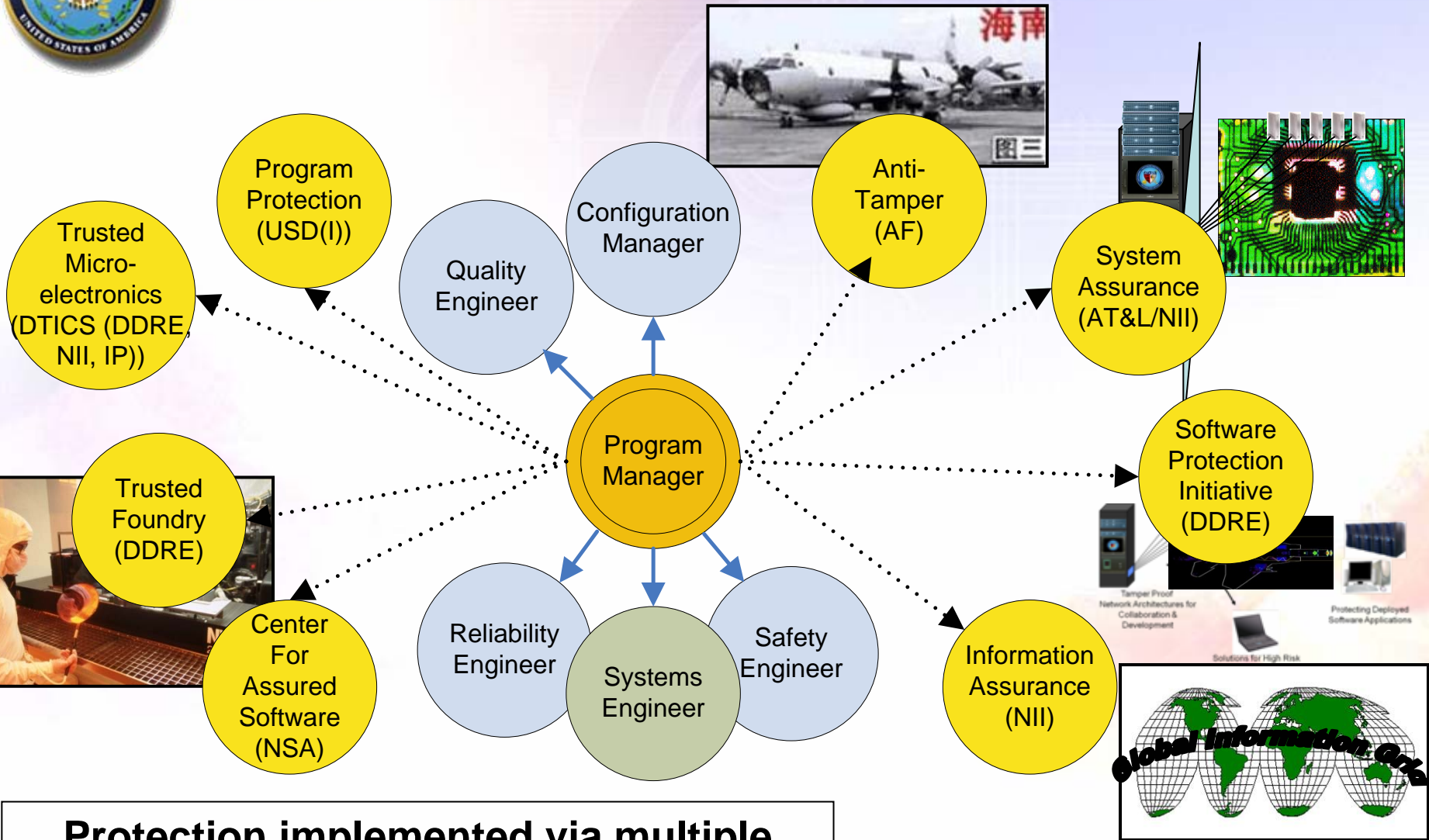


Improving DoD Program Protection

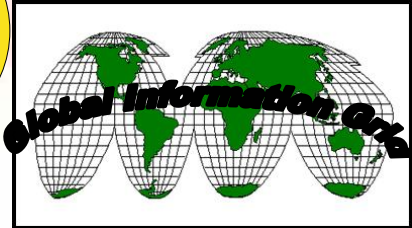




Numerous Security Disciplines



Protection implemented via multiple initiatives with multiple owners





Acquisition Security Policies

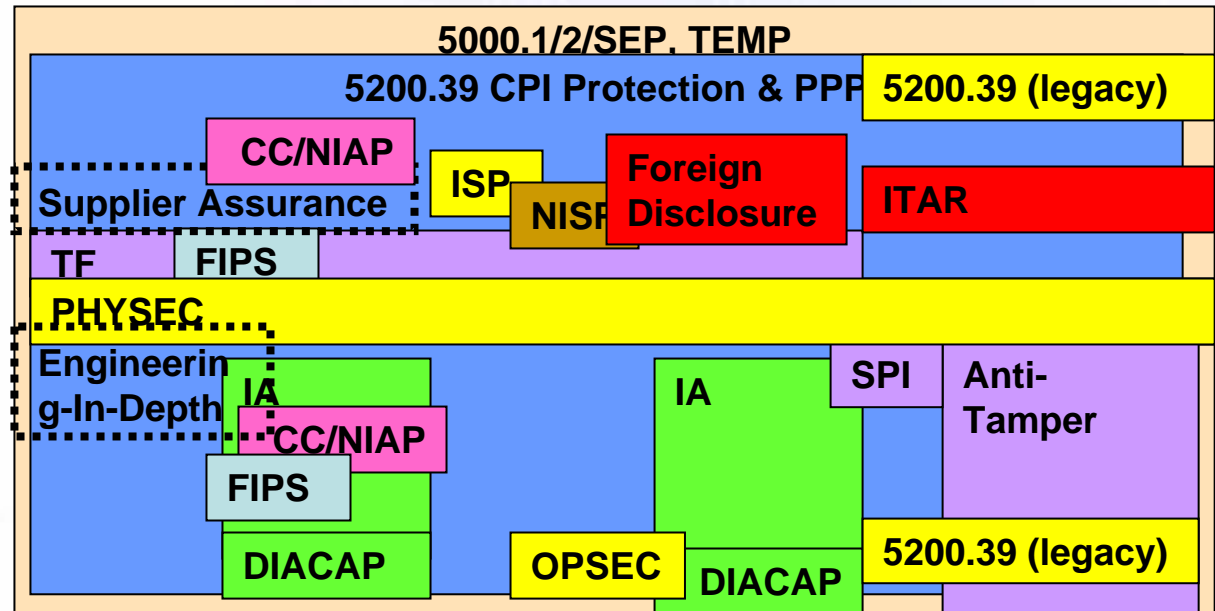
DODI 5200.39: integration point for policies, NOT replacement

NEW CPI Protection Countermeasures

Defense-In-Depth

Component Protection Sought

| | | |
|---------------------------|-------------------------|------------------------|
| Critical Functionality | Critical Information | Critical Technology |
| Custom | Classified | Software |
| COTS | Un- Classified | Hardware/ Firmware |



Policy Ownership

USD(I)

DoD - CIO/DSS

DoD - AT&L

DoD - AT&L/S&T

DoD - CIO/DISA

NSA/CC

Dept. of State

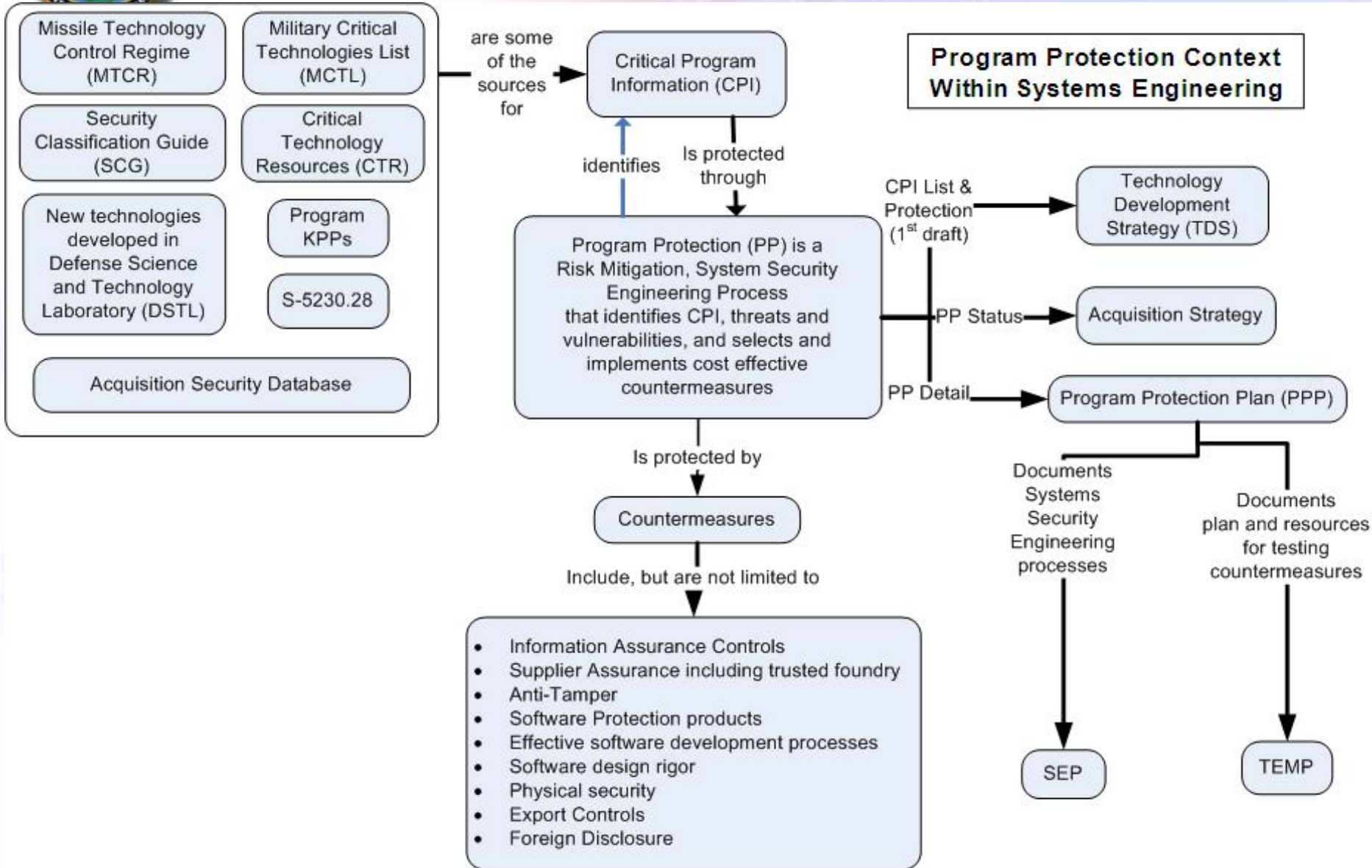
DoD - USD(I)

NIST

DoD Controlled
Development/Operation

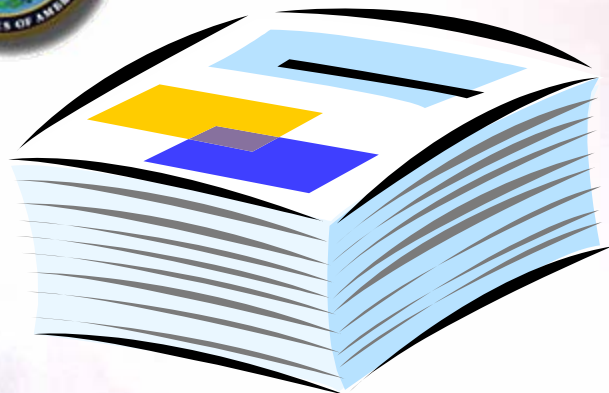


Systems Security Engineer Leads Integration of Security Resources





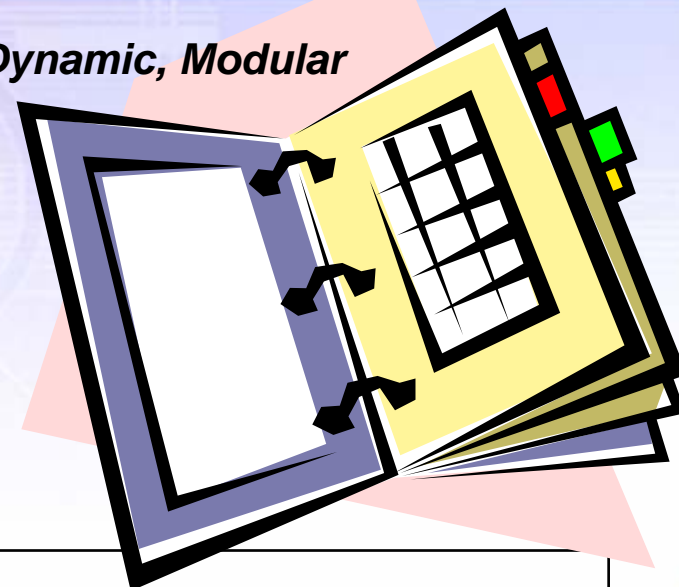
New PPP: Data Driven Format



Verbose, Static, Essay



Pithy, Dynamic, Modular



Critical Program Information (CPI)

| <i>Critical Program Information</i> | <i>Impact of Loss (Low, Med, Hi)</i> | <i>Reason (for each change in status)</i> | <i>List Locations (Lab(s), PMO, Contractor Name(s), Test Site(s))</i> | <i>Status Dates (watch, new, removed)</i> |
|-------------------------------------|--|--|---|---|
| GPS | | New: Critical warfighting component | PMO, Contractor X | New 6/2006 |
| Radar FPGA | | New: target for hackers | PMO, Prime, Subcontractor Z | Watch 6/2007 |
| Communication Card | | Watch: US lead in technology | N/A | New 4/1998 |
| | | Removed: No longer leading edge technology | | Removed 4/2007 |
| | | | | |

Example Format



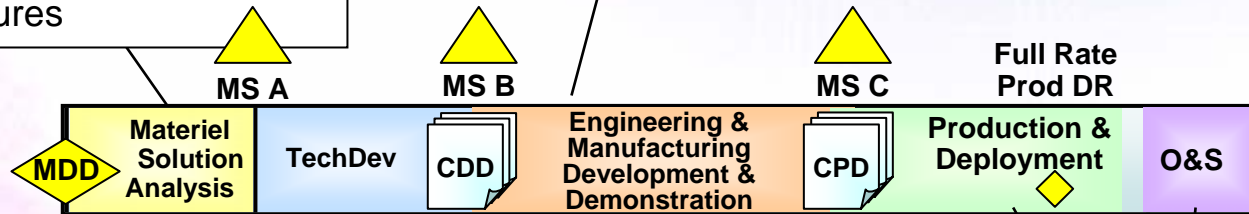
Early, Designed-In Program Protection

- Acquisition Strategy, **TDS**, RFP, SEP, and TEMP must be revised to include PPP relevant information
- **Milestone Decision Authority approves PPP in addition to PM**

Streamlined Program Protection Plan

- **One-stop shopping for documentation of acquisition program security (ISP, IAS, AT appendices)**
- **Living document, easy to update, maintain**
- **Improve over time based on feedback**

- Identify draft CPI, estimated protection duration and S&T Lab countermeasures



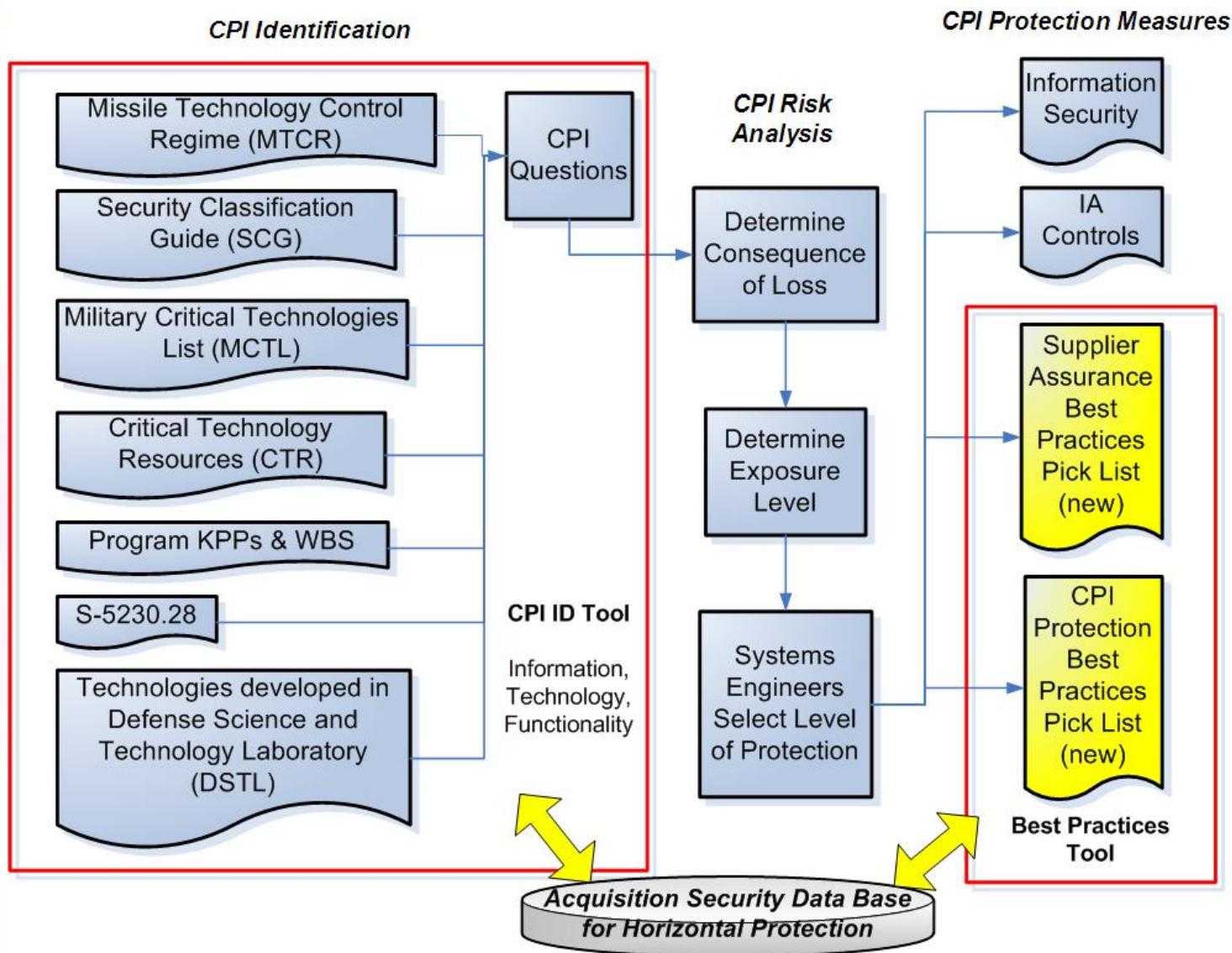
- Obtain threat assessments from Intel/CI, assess supplier risks
- Develop design strategy for CPI protection
- **Submit PPP to Acquisition Security Database (ASDB)**

- Contractor adds detail to Program Protection Plan
- Preliminary **verification and validation** that design meets assurance plans

- Enhance countermeasure information in Program Protection Plan (PPP)
- **Evaluate** that CPI Protection RFP requirements have been met



Program Protection Tools





Best Practice Format

DRAFT

- **Title:** Name of best practice
- **Requirement:** Sample requirement language for inclusion in RFP
- **Application:** Explanation of conditions under which best practice should be applied
- **Evaluation:** Recommended technique for evaluation for each life cycle phase
- **Metrics:** Criteria for successful implementation
- **Cost:** Rough estimate of cost (order of magnitude)
- **References:** sources of information and SMEs that contributed to development of this control
- **Background:** supporting anecdotes/evidence



Best Practice Example

Not Validated For Use – For Example Only

- **Title:** Code Static Analysis
- **Requirement:** Implement static code analysis tool for use during software development.
- **Application:** automated method of detecting and eliminating bugs early in the development cycle
- **Evaluation:** Analysis of code improvements and remaining types of weaknesses
- **Metric(s):** types of software problems eliminated
- **Cost:** \$250/user
- **References:** samate.nist.gov, DoD Labs
- **Background:** DoD labs and commercial vendors have static code analysis tools



CPI Protection Evaluation

What should the CPI Verification and Validation Strategy be?

Forms of Evaluation:

- **Analysis**

- Pre-MS B analyze planned countermeasures for sufficiency versus threats and vulnerabilities

- **Testing**

- System Security Certification?
- OT&E attack scenarios?
- DT&E insider attack scenarios?
- Security vulnerability testing?
- Automated identification and removal of malicious code?

- **Monitoring**

- Survey public domain information
- Detect, record, act and report CPI loss, AT breaches



Summary

- **Program Protection strategy provides**
 - Overarching framework and process to integrate acquisition security policies and resources early in the life cycle
 - One-stop shopping for acquisition security documentation
 - Best practice tools to support implementation
- **Current Test and Evaluation resources are still fragmented across IA, Anti-Tamper, Software, etc. a comprehensive, integrated strategy for T&E of program protection is under development**

We welcome feedback on PP Streamlining and T&E

www.acq.osd.mil/sse/

Christine.hines.ctr@osd.mil

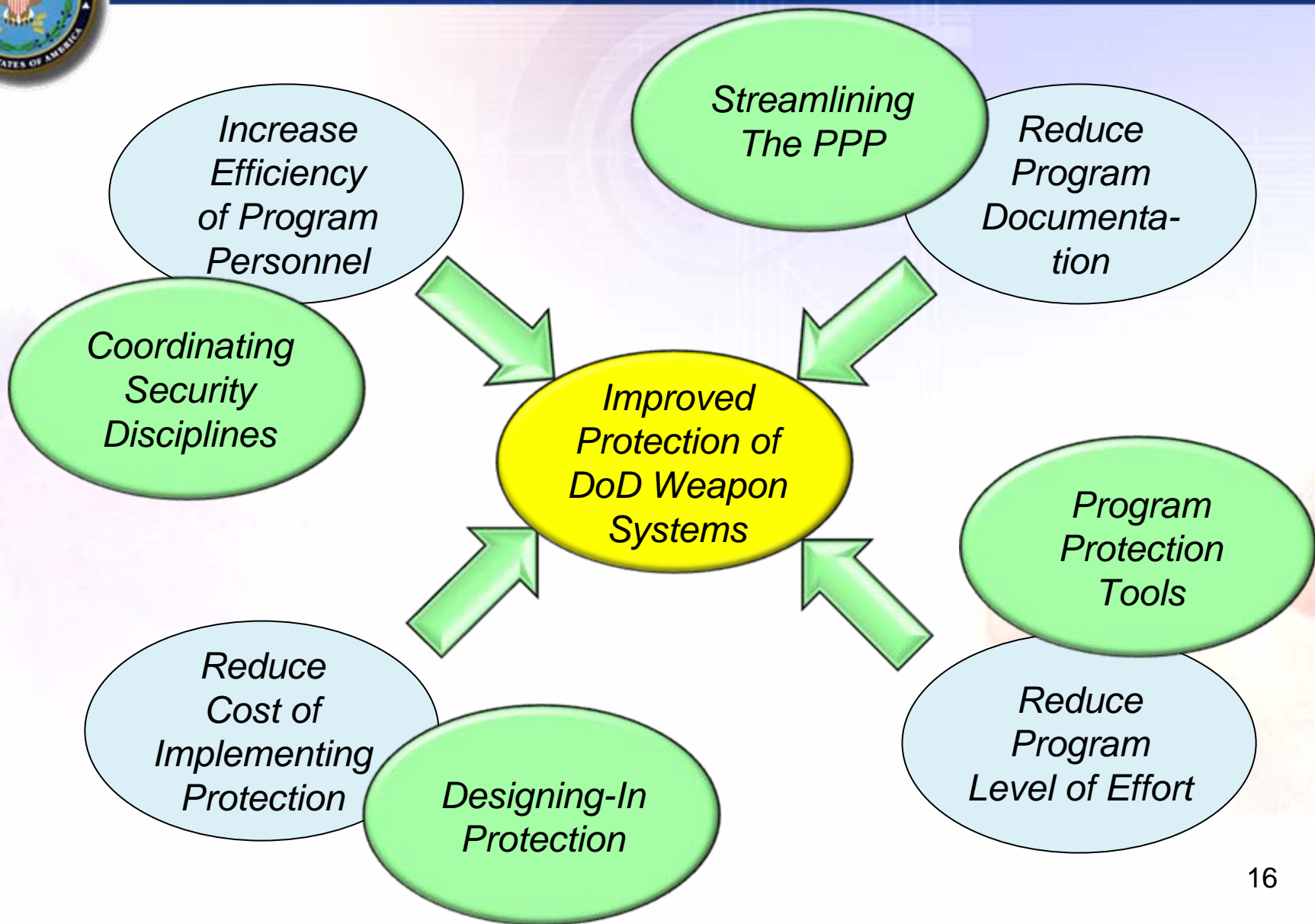
(703) 682-5309



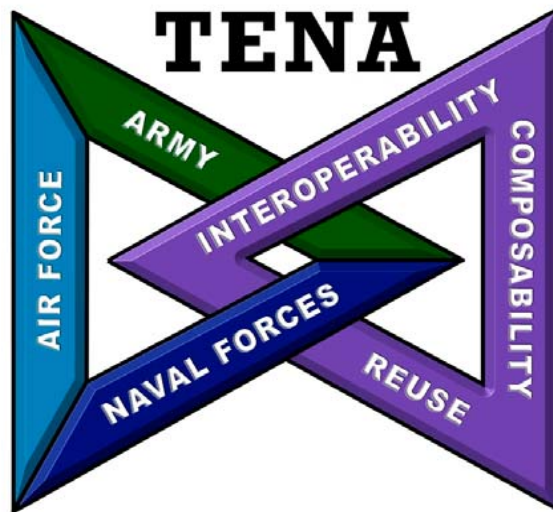
QUESTIONS?



Streamlining Program Protection



Test and Training Enabling Architecture (TENA), An Important Component in Joint Mission Environment Test Capability (JMETC)



Briefing for:
25th Annual NDIA T&E National Conference

March 4, 2009

Gene Hudgins, TENA SDA User Support Lead



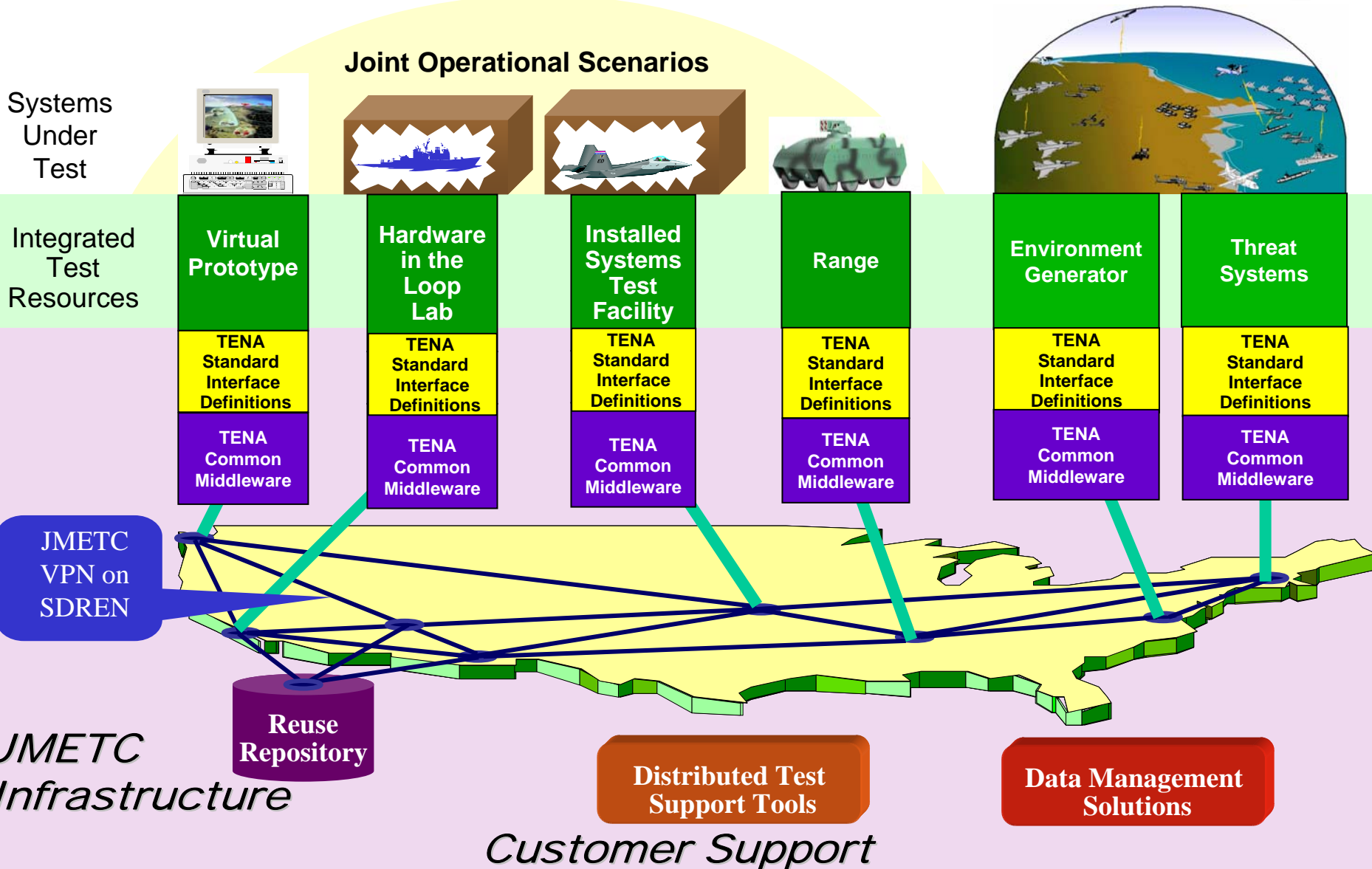
What is JMETC?



- **A corporate approach for linking distributed facilities**
 - Enables customers to efficiently evaluate their warfighting capabilities in a Joint context
 - Provides compatibility between test and training
- **A core, reusable, and easily reconfigurable infrastructure**
 - Consists of the following products:
 - Persistent connectivity
 - Middleware
 - Standard interface definitions and software algorithms
 - Distributed test support tools
 - Data management solutions
 - Reuse repository
- **Provides customer support team for JMETC products and distributed testing**



JMETC Enables Distributed Testing



JMETC Infrastructure

Customer Support



JMETC: Here and Now



- **Uses the Secure Defense Research & Engineering Network (SDREN) for connectivity**
 - 35 sites currently on-line
- **Uses Test & Training Enabling Architecture (TENA)**
 - Gateways to link to existing DIS and HLA simulations
- **Incorporates InterTEC test tools**
- **Uses the JNTC-sponsored Network Aggregator to link together other networks**
- **Being expanded based on customer requirements**
- **Holding JMETC Users Group meetings to discuss emerging requirements and technical solutions**
 - Seeking the “best of breed” solutions across the community



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JMETC Uses TENA to Integrate Sites

(Can gateway to existing DIS and HLA simulations)



- **TENA is:**

- Developed, upgraded, and sustained by CTEIP and JNTC
- Middleware that provides a single, universal data exchange solution
- Common for test and for training (core standard in JMETC and JNTC)
- Available for download at www.tena-sda.org for free

- **TENA provides:**

- Interoperability among range systems, hardware-in-the-loop laboratories, and simulations in a quick, cost-efficient manner
- A capability to rapidly and reliably develop LVC integrations
- A set of community-agreed object models that define the data elements used in LVC integrations – maximizes reuse from event to event
- An auto-code generator to drastically reduce TENA incorporation time

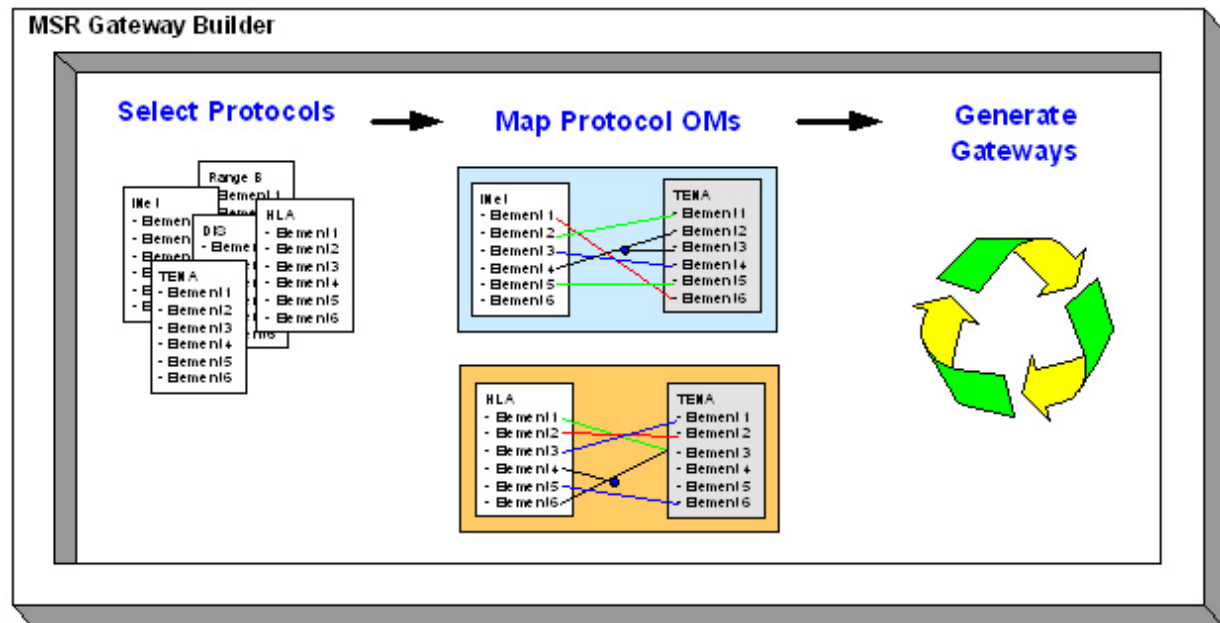
- **Next version of TENA (version 6.0) will:**

- Provide advanced data filtering (only data of interest sent over the wire)
- Improve fault tolerance and embedded diagnostics
- Currently being beta-tested for a formal release later this year



Gateway Builder

- **GWB is focused on integration of distributed live, virtual, and constructive (LVC) systems into a common synthetic battle space that comprises various simulation protocols, training ranges, live systems and platforms**
- **Gateway Builder streamlines integration process and reduces time and effort of creating gateways**
- **Gateway Builder is a flexible, extensible, graphically driven tool that automatically generates gateways to bridge simulation and live protocols**
- **Gateway Builder supports mappings between TENA, DIS, and HLA and message-based protocols using any object model**



Gateway Builder Simplified Block Diagram



TENA Overview



● Requirements

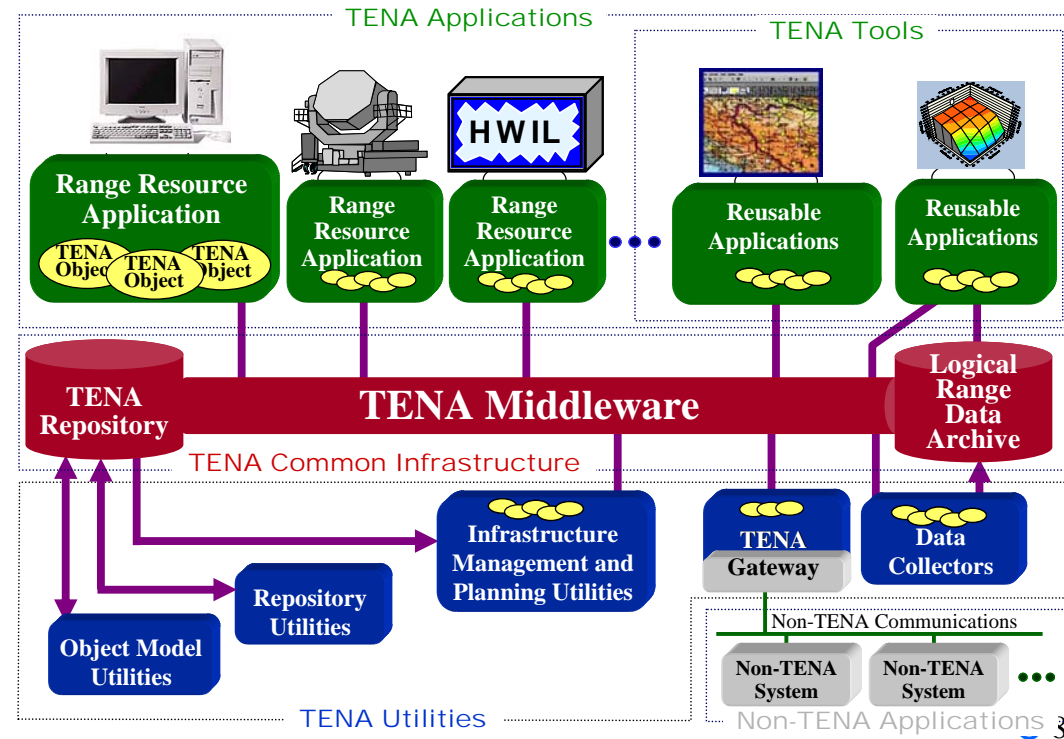
- **Interoperability**
- **Reuse**
- **Composability**
- Support Rapid Integration
- Gradual Deployment

● Supports

- Testers & Trainers
- Joint, Army, Navy, Air Force, Agencies
- Live, Virtual, Constructive
- Range, Laboratories, Simulations
- Real-Time & Non-Real-Time

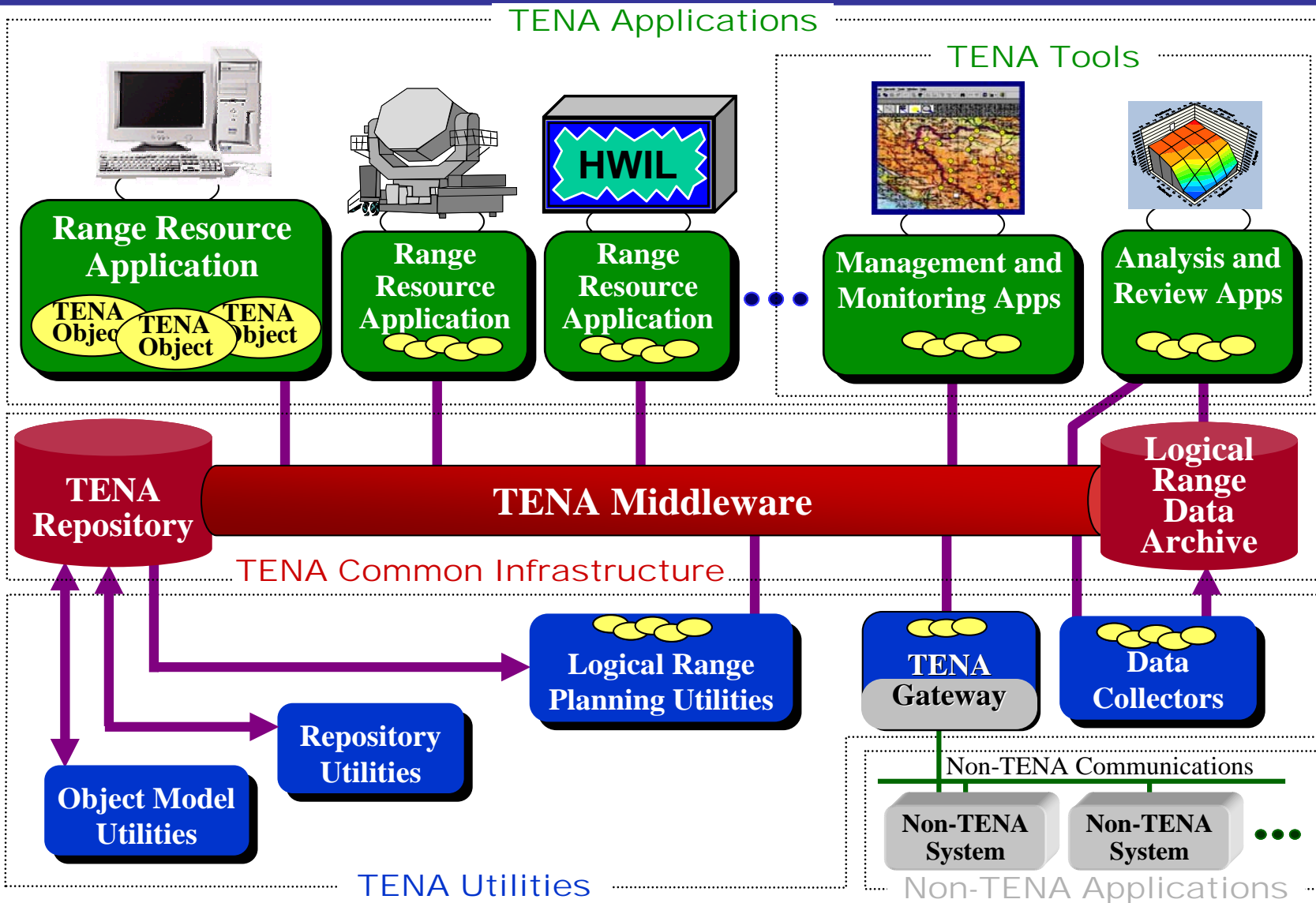
● Guiding Principles

- Provide middleware
- Use real software objects
- Maximize code generation
- Management by users (AMT)
- No license fee (GOTS)





TENA Architecture Overview





Key Release 6 Improvements and New Capabilities



New Middleware Capabilities

- Advanced Filtering
- OM Subsetting Support
- SDO State Processing Support
- Self-Reflection Option
- Object Reactivation
- Separate Inbound/Outbound ORBs

Metamodel and Model Improvements

- Fundamental Sized Type Aliases
- Const Qualifier
- Optional Attributes
- SDO Initializers
- Middleware Metadata
- Middleware IDs

New Event Management Capabilities

- Object Model Consistency Checking
- Remote Object Termination
- Execution Manager Fault Tolerance
- Embedded Diagnostics
- TENA Console

Usability Improvements

- Observer Pattern
(with Callback Aggregation)
- Local Methods Factory
Registration
- Code Installation Layout



Key Release 6 Improvements and New Capabilities



New Middleware Capabilities

- Advanced Filtering
- OM Sub
- Enhanced data distribution
- Optimized network usage
- Support
- Activation
- Separate Inbound/Outbound ORBs

Metamodel and Model Improvements

- Fundamental S
- Const O
- Better ways to define data
- Remove ambiguity
- Metadata
- Middleware IDs

New Event Management Capabilities

- Object Model
- Rem
- Improved reliability
- Enhanced troubleshooting
- Tolerance
- Diagnostics
- Console

Usability Improvements

- Observer Patt
- (with C
- Easy to use
- Harder to use wrong
- Installation Layout



Alaska Training Range Evolution Program (ATREP) use of TENA

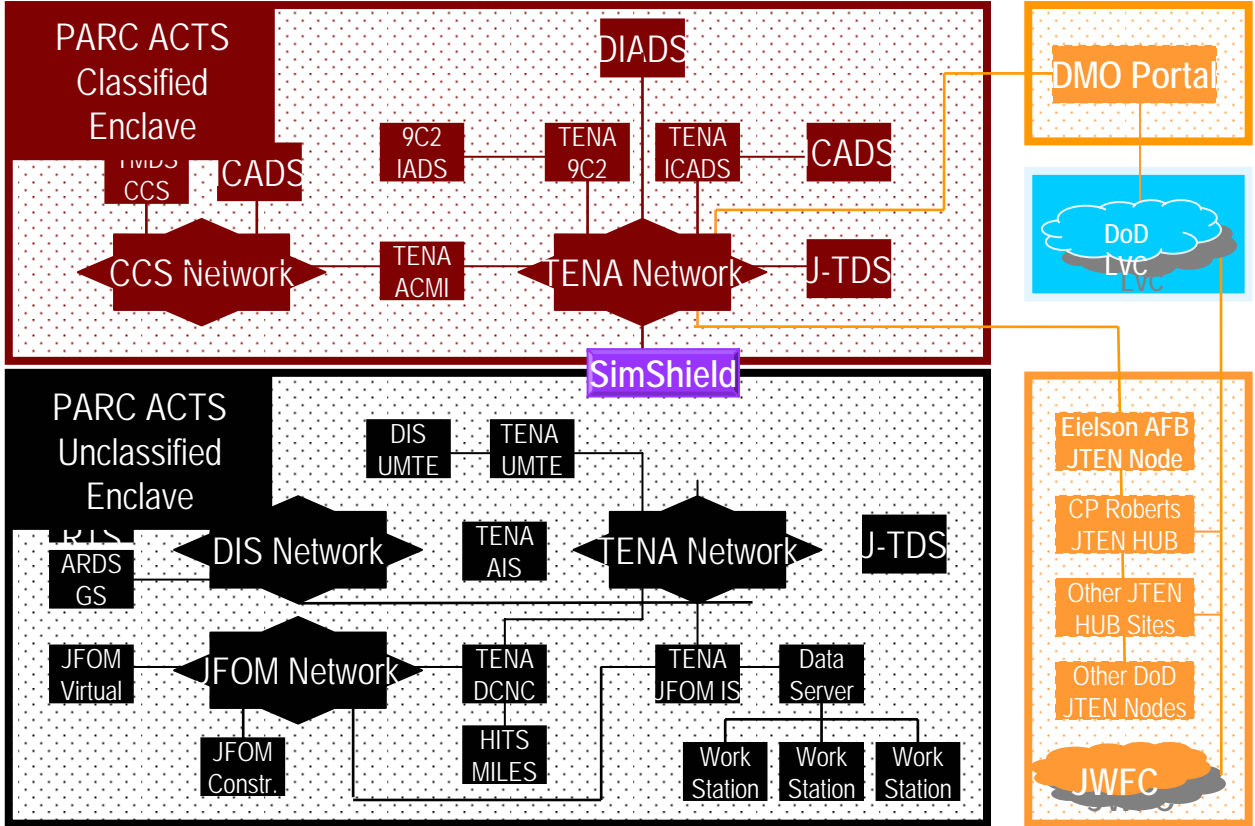
ATREP's intent is to enhance the existing Pacific Alaska Range Complex air and ground capabilities by providing a force-on-force (FOF) training capability that fully integrates and supports joint and coalition components for both air and ground training in live, virtual, and constructive (LVC) domains.

High Side

- TENA ICADS
- TENA ACMI
- TENA 9C2
- TENA DIADS
- TENA SimShield

Low Side

- TENA MOKKITS
- TENA MILES 2000
- TENA I-HITS
- TENA UMTE





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InterTEC Operational View-1

TENA-Based Integrated Test Tool Applications



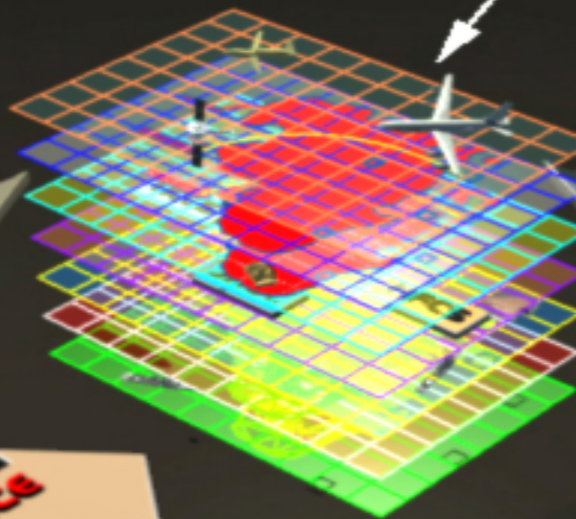
C4ISR Instrumentation & Analysis

20 Integrated Apps in Spiral 2

Test Control

- Planning
- Rehearsal
- Control
- Monitoring
- Reporting

Joint C4ISR Test Environment



C4ISR Test Control



Virtual Components

- HWIL Interfaces
- Message Generation



Live Components

- Range Interfaces
- Range Instrumentation



Constructive Components

- Simulation Interfaces

Synthetic Battlespace Environment



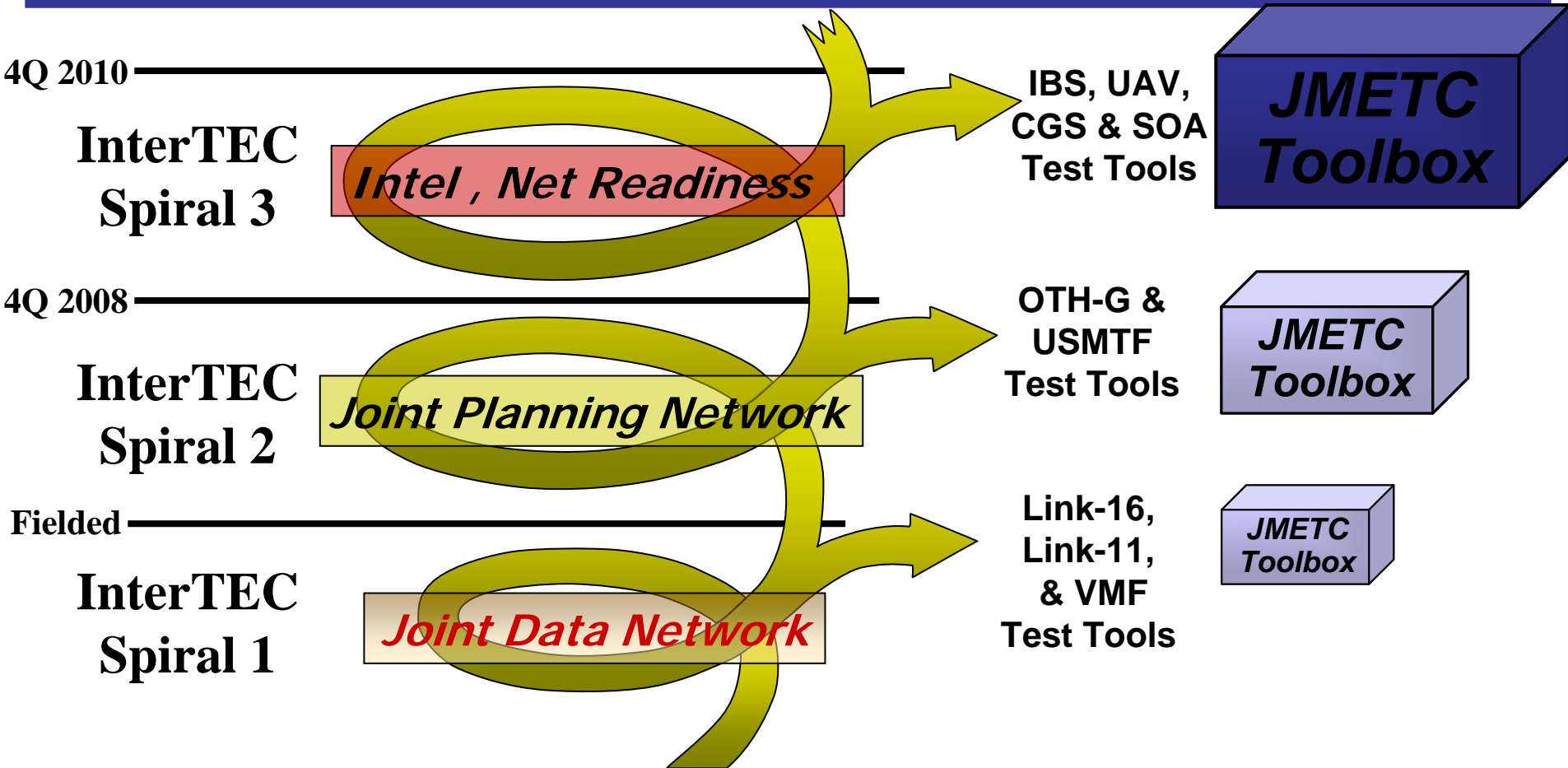
- Data Capture
- Stimulation
- Analysis
- Display

Distributed Test Suites





InterTEC Integration with JMETC Inextricably Intertwined



- JMETC supports InterTEC during their spiral development
- InterTEC expands JMETC toolbox with certified C4ISR Test Tools



TENA Integrated Development Environment (TIDE)



- **TIDE is a tool designed to assist developers in the creation, development, testing and deployment of TENA applications**
- **Initial Capabilities**
 - Catalog installed object models on a user's machine
 - Migrate user applications between object model versions
 - Migrate user applications between middleware versions
 - Browse and download object models available in the TENA Repository
 - Request object model distributions from the TENA Repository
- **TIDE 2.0 is the current version**
 - Available at <http://www.tena-sda.org/tide> web site



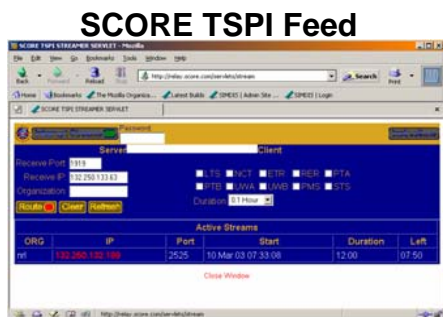
TENA Tools used by JMETC Interface Verification Tool (IVT)



- **Designed to support the integration testing of TENA applications**
 - TENA Standard OM's
 - JNTC and InterTEC LROM's
- **Provides real-time monitoring, logging and statistics gathering**
- **Operates in three different roles, either stand-alone or in combination:**
 - Data Subscriber Role
 - Data Publisher Role
 - DIS to TENA Gateway Role

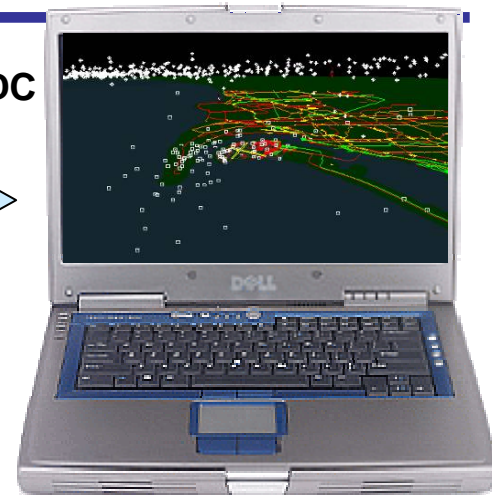


SIMDIS Use of TENA



Southern
California

NRL
Washington, DC

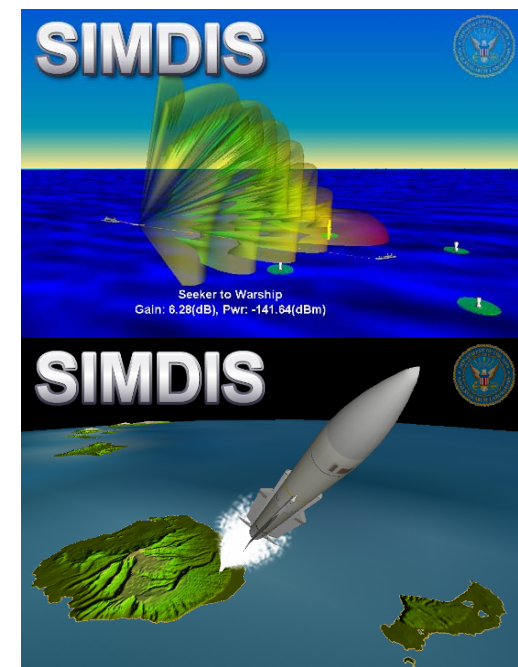


● Duration testing using SCORE TSPI data feed

- Four consecutive days
 - Win XP, Red Hat 9, Solaris 5.8
 - Processed **180,000+ entities**
- Two consecutive days
 - Win XP, Red Hat 9
 - Processed **53,000+ entities**

● Results and observations

- No issues with discovery latency
- No issues with update latency
- No issues with CPU usage
- No issues with memory usage





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JMETC Users Group Meetings



- Identify core infrastructure requirements and use cases
- Discuss available solutions, tools, and techniques
- Identify, investigate, & resolve issues
- Identify opportunities to collaborate
- Share lessons learned

Users Group #01

- 19-20 Jun 2007
- Dulles, VA
- ~140 participants
- Plenary session:
 - SIAP
 - JSF
 - FCS CTO
- Tracks:
 - User Requirements
 - Security
 - InterTEC Spiral 2
 - Networking

Users Group #02

- 11-15 Aug 2007
- San Diego, CA
- ~150 participants
- Plenary briefs:
 - InterTEC Spiral 2
 - AF-ICE
 - JFCOM J4
- Tracks:
 - User Requirements
 - Distrib. Test Tools
 - User Requirements
 - InterTEC Spiral 2
 - Networking

Users Group #03

- 29-30 Jan 2008
- Portsmouth, VA
- ~200 participants
- Plenary briefs:
 - InterTEC Spiral 2
 - AF-ICE
 - JFCOM J4
- Tracks:
 - User Requirements
 - Distrib. Test Tools
 - Object Models
 - Networking

Users Group #07

24-25 March
AMT 41 on 26 March
Ft Walton Beach, FL

Users Group #08

23-24 June
Portsmouth, VA

Users Group #04

- 20-21 May 2008
- Charleston, SC
- ~135 participants
- Plenary session:
 - InterTEC Spiral 2
 - SPAWAR Systems Center-Charleston
- Tracks:
 - User Requirements
 - Distrib. Test Tools
 - Service-Oriented Architecture (SOAs)
 - Networking

Users Group #05

- 9-10 Sep 2008
- Boston, MA
- ~176 participants
- Plenary session:
 - Dan Roth, AFFTC
 - Rick Cozby, FCS CTO
- Tracks:
 - User Requirements
 - Distrib. Test Tools
 - Service-Oriented Architecture (SOAs)
 - Networking

Users Group #06

16-17 Dec 2008
AMT 40
18 Dec 2008
Austin, TX



Standard Architecture Management Team Members

(as of AMT-40)



- Air Armament Center (AAC), Eglin AFB, FL
- Naval Undersea Warfare Center (NUWC)
- Redstone Technical Test Center (RTTC)
- Electronic Proving Ground (EPG)
- White Sands Missile Range (WSMR)
- Naval Air Warfare Center – Aircraft Division
- NAWC – Weapons Division
- P5 Combat Training System (P5CTS)
- Joint National Training Capability (JNTC)
- Pacific Missile Range Facility (PMRF)
- T&E/S&T Non-Intrusive Instrumentation
- Integrated Network Enhanced Telemetry (iNET)
- NAVSEA Warfare Center - Keyport
- Dugway Proving Ground (DPG)
- Joint Fires Integration & Interoperability Team (JFIIT)
- Common Range Integration Instrumentation Systems (CRIIS)
- Common Training Instrumentation Architecture (CTIA)
- Army Operational Test Command (OTC), Fort Hood, TX
- Interoperability Test and Evaluation Capability (InterTEC)
- Naval Aviation Training Systems Program Office (PMA-205)
- Air Force Flight Test Center (AFFTC), Edwards AFB, CA
- Aberdeen Test Center (ATC), Aberdeen Proving Ground, MD
- Alaska Training Range Evolution Plan (ATREP)



Advising AMT Members (as of AMT-40)



- **BMH Associates, Inc.**
- **Boeing**
- **Cubic Defense**
- **DRS**
- **Embedded Planet**
- **EMC**
- **MAK Technologies**
- **NetAcquire**
- **Science Applications International Corporation (SAIC)**
- **Scientific Research Corporation (SRC)**
- **Scientific Solutions, Inc. (SSI)**



Summary

- **JMETC** supports the full spectrum of Joint testing, supporting many customers in many different Joint mission threads
 - CVN-21, SIAP, FCS, JSF, MMA, NECC, DD1000, WWF
- **TENA** is the **CTEIP** architecture for future instrumentation, the **JNTC** architecture for Live integration and an enabling technology for **JMETC**
- **TENA** and **JMETC**:
 - Being built based on customer requirements
 - Partnering with Service activities and leveraging existing capabilities
 - Coordinating with **JFCOM** to bridge test and training capabilities
 - Provide a forum for users to develop and expand the architecture
 - **JMETC User Groups, TENA AMT Meetings**



Important Contact Information



- **TENA Website:** www.tena-sda.org
 - Download TENA Middleware
- **JMETC Website:** www.jmetc.org
- **TENA Feedback:** feedback@tena-sda.org
 - Provide technical feedback on TENA Architecture or Middleware
- **JMETC Feedback:** jmetc-feedback@jmetc.org
- **JMETC Program Office Contact**
 - E-mail: Telephone: (703) 604-0350 ext. 0

FUTURE COMBAT SYSTEMS



One Team-The Army/Defense/Industry

FCS Update & Testing

Bud Irish
SAIC Vice President
FCS Integrated Phases, Simulation
& Test Deputy IPT MGR

Army Leadership's View

“Future Combat Systems is the core of our modernization effort and will provide our Soldiers an unparalleled understanding of their operational environment, increased precision and lethality, and enhanced survivability.”

“We believe it’s affordable and we believe it’s an investment that we have to make.”

*The Honorable Pete Geren - Secretary of the Army
Senate Armed Services Committee
February 26, 2008*



**The Honorable Pete Geren
Secretary of the Army**

“We’re listening to our soldiers and commanders in the field, and we are giving them the capabilities they need – as fast as we can so that they can win in the current fight.”

*General George Casey, Jr. – Chief of Staff, U.S. Army
U.S. Army News Release
June 26, 2008*



**Gen. George W. Casey, Jr.
Chief of Staff, U.S. Army**

“Future Combat Systems is exactly the full-spectrum system that we need for our future.”

*General George Casey, Jr. – Chief of Staff, U.S. Army
Senate Armed Services Committee
February 26, 2008*

“Modernization is not an option.”

“FCS is more than a program, it is an Army imperative.”

*The Honorable Dean Poppo - Acting Assistant Secretary of
the Army for Acquisition, Logistics and Technology
February 2, 2008*



**The Honorable Dean Poppo
Acting ASAALT**

FCS – Army’s #1 Modernization Priority

Delivering a Versatile 21st Century Army



Non-Line of Sight Mortar (NLOS-M) XM1204



Infantry Combat Vehicle (ICV) XM1206



Mounted Combat System (MCS) XM1202



Non-Line of Sight Cannon (NLOS-C) XM1203



Armed Robotic Vehicle - Assault Light (ARV-A[L]) XM1219



Non-Line of Sight Launch System (NLOS-LS) XM 501



Medical Vehicle Treatment (MV-T) XM1208



Medical Vehicle Evacuation (MV-E) XM1207



Field Recovery and Maintenance Vehicle (FRMV) XM1205



MULE-T XM1217



MULE-C XM1218



Multifunctional Utility/Logistics and Equipment Countermine and Transport



Communicate
See
Understand
Act

Network



Class I Unmanned Air Vehicle (UAV) XM 156



Reconnaissance and Surveillance Vehicle (RSV) XM1201



Command and Control Vehicle (C2V) XM1209



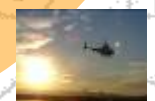
Tactical and Urban Unattended Ground Sensors



Class IV Unmanned Air Vehicle (UAV) XM 157



Small UGV (SUGV) XM1216



Recent Program Accomplishments

- ✓ Completed Non-Line-of-Sight Cannon P1 Prototype delivery and testing to support NLOS-C Milestone C
- ✓ Completed Spin Out 1 Tactical Field Test, Field Demonstration, Test and Evaluation, and Preliminary Limited User Test
- ✓ Completed all System and Platform Preliminary Design Reviews, including Class I and IV UAVs, MULE UGV, Manned Ground Vehicles and Network
- ✓ Completed Integrated Mission Test One
- ✓ System of Systems Common Operating Environment 2.0 Deliveries/Testing
- ✓ First successful Active Protection System (APS) End to End Test
- ✓ Airborne Standoff Minefield Detection System Captive Flight Test



Executing to Support Army Modernization

Combined Test Organization (CTO) Established 2004 - Charter

Charter Unit of Action Combined Test Organization

PURPOSE

The Combined Test Organization (CTO) has been established as a partnership between the Program Manager, Unit of Action (PM/UA), the Army Test and Evaluation Command (ATEC), the Lead System Integrator (LSI), and the Lead System Integrator (LSI). This partnership is designed to integrate the efforts of its members. The charter establishes the UA, CTO, and identifies the primary responsibilities of the CTO. The guiding principle of the CTO is to "plan together, test once, share the data".

MISSION

The CTO partnership exists to manage the integration of both the contractor and government efforts in the Army's UA Test program, while preserving the charter of the PM/UA and associated responsibilities and authorities, for operational test (OT) independence, and being responsive to the needs of the independent evaluation for the UA program.

CONCEPT OF OPERATION

The CTO functions as a three-way partnership, requiring agreement by all partners on major decisions. In the event that agreement cannot be reached within the CTO, the decision will be elevated to Commanding General, ATEC, the PM/UA, and the LSI. The CTO has the authority and responsibility for integration of UA technical platform integration, and field testing. The CTO will coordinate with ATEC, the PM, and the LSI to identify all test data requirements, and will manage the integration of technical and operational testing in accordance with guidance of the UA acquisition strategy and the acquisition program baseline. The CTO will document this plan in the Test and Evaluation Master Plan.

Tests may be executed by Army test organizations or by the LSI and its subcontractors at either government or contractor facilities. The CTO will select the appropriate test organization taking into consideration the Army's considerable investment in test and evaluation (T&E) infrastructure. System tests under CTO guidance include: Integrated Qualification Testing, Integrated Testbed Testing, Integrated Mission Testing, Technical Field Testing, Live Fire Testing, and some Specialty Testing. ATEC retains responsibility for all aspects of OT in accordance with DOD 5000.26 and Title 10 US Code, as the Army's Operational Test Agency. The Developmental Test Command retains its responsibility for providing Safety Reviews and Safety Certifications for UA, non-systems. Human use test approval considerations will reside with the test organization selected.

The CTO will manage, at the top level, the following UA T&E functions: test strategy development, test planning, design, and integration; test data reduction, test data management and reporting; test tool verification and validation; test resource and facilities upgrade, development, and utilization planning; Active management of base functional areas will coordinate on resource and data sharing to conduct "integrated testing" as appropriate, fully coordinated between the government and the LSI, along with its

Page 1

sub-contractor. The CTO will monitor and ensure these integration activities, and the data generated will be made available to the CTO and its partner organizations.

ORGANIZATION

The CTO structure is depicted in Figure 1. The CTO will primarily consist of individuals from the UA Program Management Office (PMO), the LSI, and ATEC. It is further supported by members of the US Army Training and Doctrine Command (TRADOC). The CTO is composed of management personnel into divisions. Integrated teams composed of PMO, LSI, and ATEC personnel will carry out these functions. A TEC OT mission, execution, and reporting will be in accordance with independently developed plans and in accordance with Title 10 US Code.

Lines of effort will be maintained at: Program Project Office (PPO), White Sands Missile Range (WSMR), the Electronic Proving Ground (EPG), and the Joint Interoperability Test Command (JITC), the Unit of Action Master Plan Lab (UAMPL), and Fort Belvoir (Operational Test Command) (OTC) and the Combat Technical Support Facility (CTSF).

The senior PM/UA representative functions as the CTO Director, representing the PM in all test activities performed by the PMO, and provides for day-to-day management of the CTO, acting as the sole "nominated partner" within the CTO. The other two CTO Divisions are supported by their parent organizations, and provide ATEC and LSI expertise and senior experience to the UA Test mission. The CTO Technical Director is a PM core position and has the leadership and overall responsibility for coordinating all technical integration activities of the Test Program and ensuring synchronization with POC software engineering processes. The CTO Director is the primary measurement team and has responsibility for managing all aspects of the UA test program. The Director ensures coordination of activities across the CTO partner organizations.

The UA PMO will program and budget for all T&E activities, and provide contract oversight. ATEC personnel will provide leadership for PMO LSI to participate in the CTO activities. LSI participation in the CTO is funded via the Other Transaction Agreement. Each organization represents its members to represent the joint capabilities, but leadership will reside over PM/UA issues with the PM or delegated via POC personnel.

DISTRIBUTED OPERATIONS

The main office of the CTO will be located at Aberdeen Proving Ground (APG), MD. Other CTO offices will be located at the National Center Supercomputing Center, West, MD, St. Louis, MO; Redstone Arsenal, AL; Ft. Monmouth, NJ; Fort Belvoir, IL; Ft. Belvoir, AZ; WSMR, NM; Ft. Belvoir, TX; Ft. Cavaz, KY, and other locations as requirements dictate.

ATEC will provide building space and basic services support (such as IT, telecommunications, and utilities) for the CTO main office at APG and other where ATEC is the primary systems element.

The LSI will provide building space and basic services support for offices located at LSI sites such as St. Louis, MO; Huntsville, AL; the MCR, and other locations as requirements dictate.

Page 2



Figure 1. CTO Structure

STAFFING

The PMO will primarily manage one PMO CTO personnel. These personnel will report to the CTO Director for organization, testing, and program management. A TRC will identify and staff PMO test ATRC personnel for the CTO. They will be responsible to the CTO Director for day-to-day guidance and administrative matters, but will remain under ATRC for rating and pay matters. The CTO Director will provide direct input to these personnel through ATRC personnel on the CTO. An exception of the ATRC Director Team (ART) will be made to work closely with the ATRC leadership to ensure that all staffed for ATRC positions within the CTO. The ATRC CTO team members may spend their individual requirements, however, for ATRC (that is the ATRC) must be ATRC.

Page 3

ISSUING DOCUMENTS

This charter will be revised on a periodic basis to incorporate changes to the UA program as well as required by use of the organization.

Signatures

Signature of Donald F. Schmitt, Program Manager, UA, Program Manager, Unit of Action.

Signature of James H. Smith, Program Manager, UA, Program Manager, Unit of Action.

Signature of Dennis H. Sullivan, The President and General Manager, The Boeing Corporation.

Page 4

Page 5

The mission of the CTO is to ensure the planning and execution of the Future Combat System (FCS) Test and Evaluation Program at minimum cost and duplication of effort to meet developmental and operational testing requirements.

Plan Together, Test Once, Share the Data

- **Equal Partnership between PMO, LSI and ATEC**
- **Synchronizing Developmental and Operational test planning**
- **Sharing test resources and support**
- **Collecting, sharing and assessing test data jointly**
- **Minimizing duplication of test support and time required to execute combined testing**
- **Preserving OT independence**
- **Reduce Program Risks wherever possible**

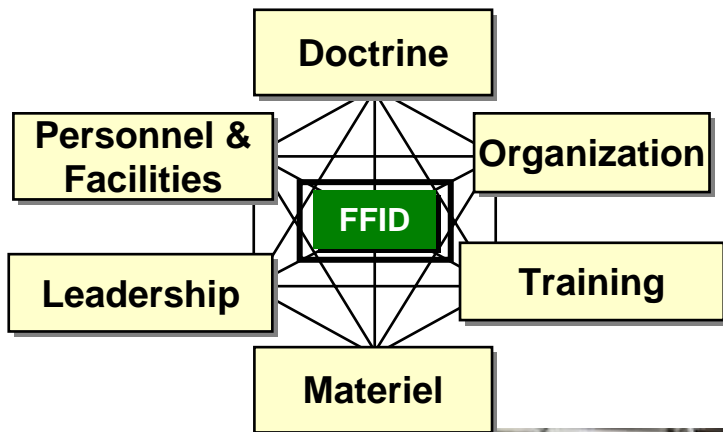
CTO Details of Operation

- **Manage all FCS T&E funding – except LSI allocated**
- **Manage all FCS Component, System Level, and System of System Level developmental and integration testing**
- **Approve all test plans for Gov and LSI testing**
- **Integrate, coordinate, and plan Combined Developmental and Operational Testing in accordance with the FCS TEMP**
- **Support Live Fire and Operational Testing**



New way of doing business... brings FCS to life.....

***Developing New Doctrine and Tactics,
Techniques & Procedures (TTPs)***



***Executing Network
Enabled
Operations***



***Real Soldiers and
Leaders...***

***Operating in live and
virtual events...***

To deliver real answers



***Conducting
Integrated Training***



Evaluating Material



..... Integrating capabilities for the current and future modular force!!

Army Evaluation Task Force (AETF) In Action



AETF P-LUT



SUGV on Point



UAS Image FBCB2



Emplacing U-UGS



Emplacing T-UGS



CL1 UAV in Overwatch



JEFX 08—Mission Accomplished



Integrated Mission Test – 1 (IMT1)



✓ Mission Test with Soldiers

- 45 Soldiers used a prototype Warfighter Machine Interface (WMI) and Battle Command System in a virtual-constructive relevant environment
- Soldier feedback on WMI design and cognitive assessment of the WMI
- First full scale system of systems (SoS) integration

✓ System of System Common Operating Environment (SOSCOE) Scalability and Discovery Test

- Large scale (100 platform) network emulation at the service layer
- Identified areas to reduce network load and improve robustness



✓ Common Operating Picture (COP) Dissemination Test

- First large scale (100 platform) COP emulation at the application layer
- Confirmed value of geographical dissemination on local COPs and identified areas for improvement



✓ SoS Simulation Framework Maturation Test

- Confirmed maturation of simulations and tools to support future SoS testing.



FCS Production Activities



Summary



- Program executing to achieve successful '09 DAB
- Platform and Network PDRs complete; supporting successful Systems of Systems Preliminary Design Review
- FCS providing capabilities to current force
 - IBCT TFT/FDT&E/LUT
- Supporting testing and technologies on track
- FCS Program is healthy and meeting commitments

Delivering a Versatile 21st Century Army



NAVAL AVIATION TECHNOLOGIES



How to Incorporate Modeling and Simulation into the System Acquisition Lifecycle

James N. Elele PhD



BATTLESPACE
modeling and simulation

How to Incorporate Modeling and Simulation into the System Acquisition Lifecycle

Presented By

Derek Kropp

25th Annual Test & Evaluation
National Conference (March 2-5, 2009)
National Defense Industry Association (NDIA)
Atlantic City, NJ

(For Dr. James N. Elele)

NAVAIR

Integrated Battlespace Simulation & Test (IBST) Dept. (5.4)
Battlespace Modeling & Simulation Division (5.4.2)
Battlespace Modeling & Simulation VV&A Support Branch
Patuxent River, MD

SUMMARY

- **DoD & Navy Regulations Mandating the Use Of M&S In Acquisition (DoD 5000.2-R)**
- **M&S Support in the System Lifecycle and Systems Engineering Technical Review Process**
- **M&S Support to Phases of System Lifecycle**
- **M&S Support to the System Lifecycle**
 - *Pre-system acquisition: Concept Refinement*
 - *Pre-system acquisition: Technology Development*
 - *System acquisition: Development/Demonstration*
 - *System acquisition: Production and Deployment*

DoD & NAVY REGULATIONS REQUIRING MODELING & SIMULATION USE FOR SYSTEM LIFECYCLE SUPPORT

Department of Defense

- DoD Directive 5000.1, "The Defense Acquisition System"
- DoD Instruction 5000.2, "Operation of the Defense Acquisition System"
- DoD Directive 5000.59
- DoD Acquisition Model and Simulation Master Plan
- DoD Guide to System of Systems (SoS) Engineering
- Army's Simulation Based Acquisition

Department of the Navy

- SECNAVINST 5000.2C – DON Acquisition Policy
- SECNAVINST 5200.38A – DoN M&S Management
- OPNAVINST 5200.34 – Navy M&S Management
- M&S VV&A Implementation Handbook, Volume I VV&A Framework
- M&S VV&A Implementation Handbook, Volume II VV&A: Adopt, Adapt & Improve (Draft)

NAVAIR

- NAVAIRINST 4355.19C - NAVAIR System Engineering Technical Review Requirements
- PEO Aircraft Carriers Instruction 5200.5
- NAVAIR M&S VV&A Guidelines (2009 Draft)

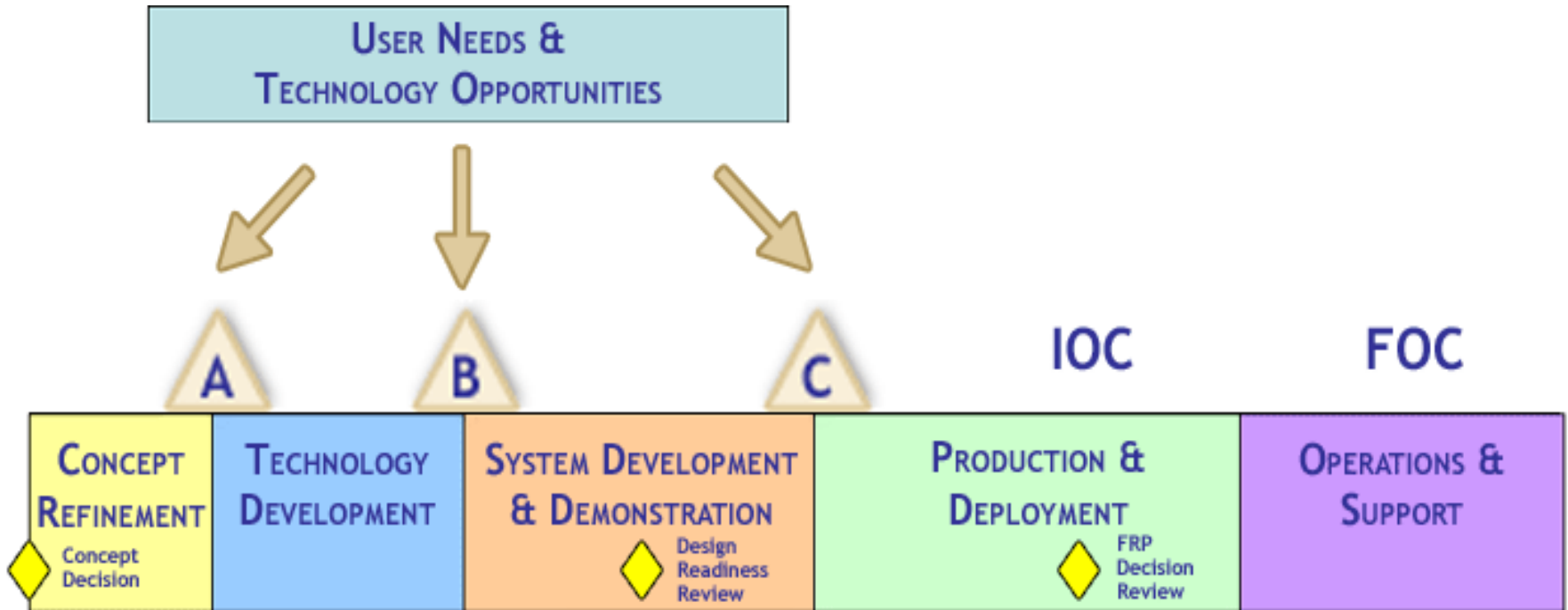
**DoD &
Department of
the Navy
Simulation
Support
Documents**

DoD REGULATION 5000.2-R

- Paragraph 3.4.4:
 - *Accredited* Models and Simulations (M&S) shall be applied, as appropriate, throughout the system lifecycle in support of various acquisition activities.
 - Note that:
 - M&S shall be applied
 - as appropriate,
 - throughout the system lifecycle

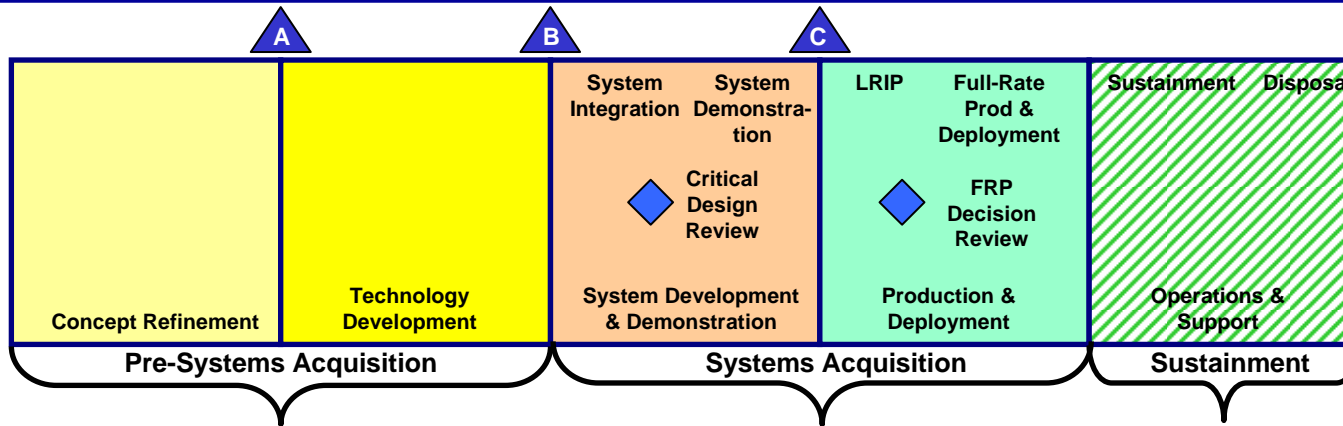
SYSTEM LIFECYCLE FRAMEWORK OVERVIEW

GOAL: To indicate how M&S may be used at each phase



M&S in the System Lifecycle and Systems Engineering

M&S Support In The Technical Review Process



Acquisition Processes and M&S

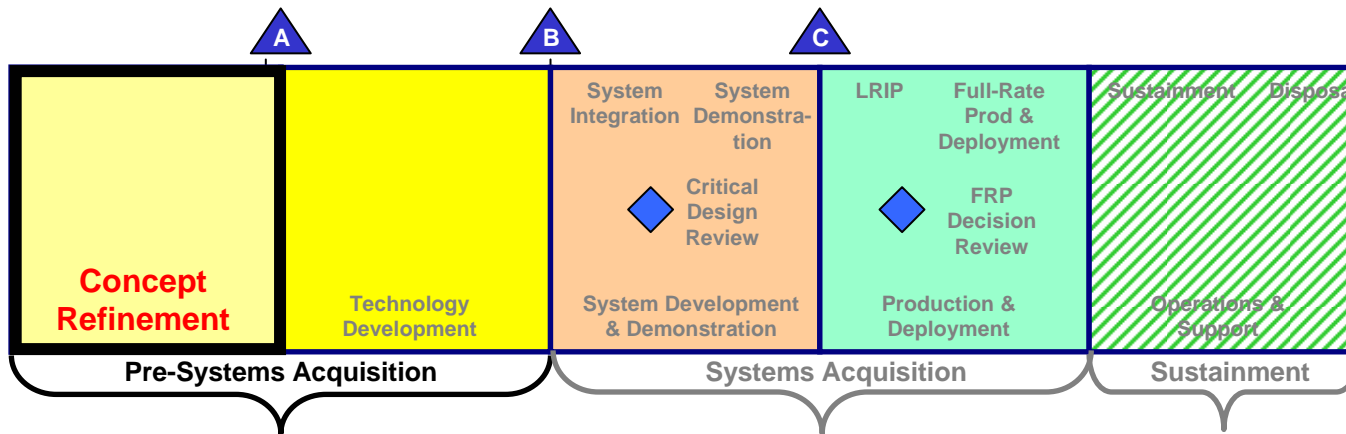
- DoD 5000.2-R, Mandatory Procedures for Major Defense, Acquisition Programs (MDAPS) and Major Automated Information System (MAIS)
 - *C3.9. MODELING AND SIMULATION (M&S):* “The PM shall identify and fund required M&S resources early in the acquisition lifecycle, so that M&S may be integrated with the T&E program.”
 - *Paragraph 3.4.4:* “PMs shall integrate the use of modeling and simulation within program planning activities, plan for life-cycle application, support, capitalizing on reuse of models and simulations, and integrate modeling and simulation across the functional areas.”
- Provides a logical start to the program
- Maximizes re-use of existing M&S providing economical testing methodology
- Presents technology opportunity

How to Incorporate M&S into System Lifecycle

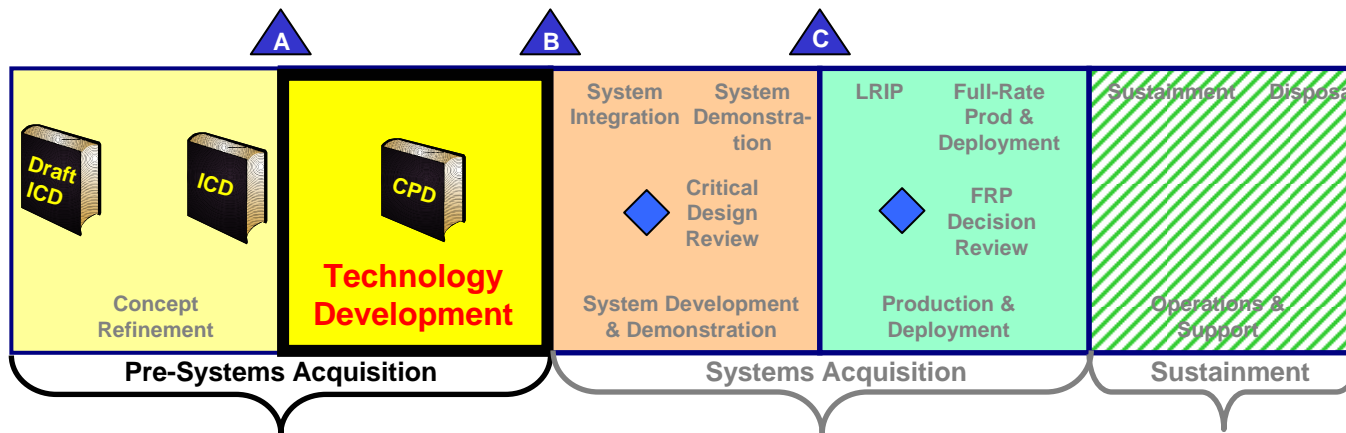
- **Identify applicable existing M&S**
- **Maximize re-use of available M&S**
- **Provide product growth for M&S to meet intended uses**
- **When possible, initiate creation of collaborative M&S environment of applicable M&S**

What is the Collaborative M&S Environment?

- Interactive environment populated with applicable M&S to the specific program
- Environment provides different levels of fidelity to match different phases of the acquisition process
- Ranges from desktop engineering models to HWIL training simulators
- Provides ready availability to M&S and/or applicable data and information to system designers, developers, testers, operators

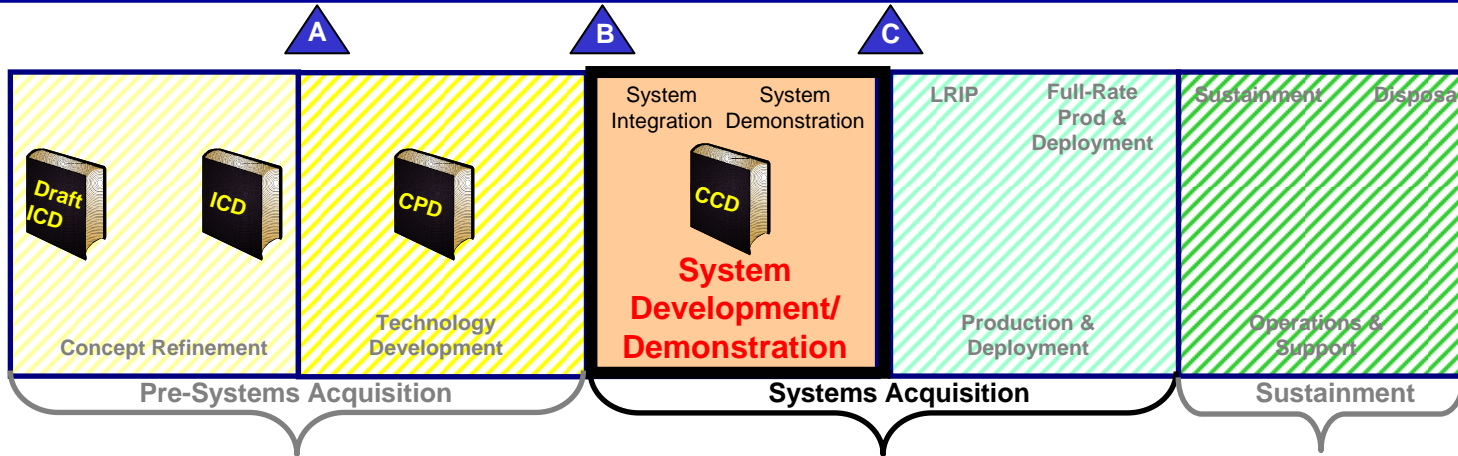


| | | |
|--|---------------------------------------|--|
| <p>Lifecycle Phase</p> <p>Pre-system Acquisition:</p> <p>Concept Refinement</p> <ul style="list-style-type: none"> • Technical framework definition • Analysis of alternatives • Capabilities definition • Rapid virtual prototyping • Concept exploration • Augmentation of the T&E process | <p>M&S Application Categories</p> | <ul style="list-style-type: none"> • Architecture Definition • Effectiveness Models • Engineering Models • Manufacturing Simulations • Assembly Simulations • Campaign Level Simulations • Engagement Level Simulations |
| <p>SETR Phase Venues</p> <ul style="list-style-type: none"> • Initial Technical Review • Alternative System Review | <p>M&S Used For</p> | <ul style="list-style-type: none"> • M&S modification requirements • Concept testing • Gap analysis • Planned capability assessments • Concept development input • Technology identification |
| | <p>Example M&S Products</p> | <ul style="list-style-type: none"> • Draft Initial Capabilities Document • Initial Capabilities Document • Plan for Analysis of Alternatives • Planned phased funding requirements |



| | | |
|--|--|---|
| <p>Lifecycle Phase Pre-system Acquisition: Technology Development</p> <ul style="list-style-type: none"> • Technological risk reduction • Technology integration into system • Technology analysis • Capability assessment • Lifecycle cost projection • Operational test integration planning • Virtual prototyping | <p>M&S Application Categories</p> <ul style="list-style-type: none"> • Architecture Definition • Effectiveness Models • Design and Specialty Engineering Models | <ul style="list-style-type: none"> • Manufacturing Simulations • Assembly Simulations • Supportability Models |
| <p>SETR Phase Venues</p> <ul style="list-style-type: none"> • Systems Readiness Review • Integrated Baseline Review | <p>M&S Used For</p> | <ul style="list-style-type: none"> • Risk reduction assessment • Technology selection • System integration analysis • Interoperability analysis |
| <p>Example M&S Products</p> | <ul style="list-style-type: none"> • Capabilities Development Document • Technology Development Strategy | <ul style="list-style-type: none"> • Inputs for System Readiness Review |

SYSTEMS ACQUISITION: SYSTEM DEVELOPMENT/DEMONSTRATION



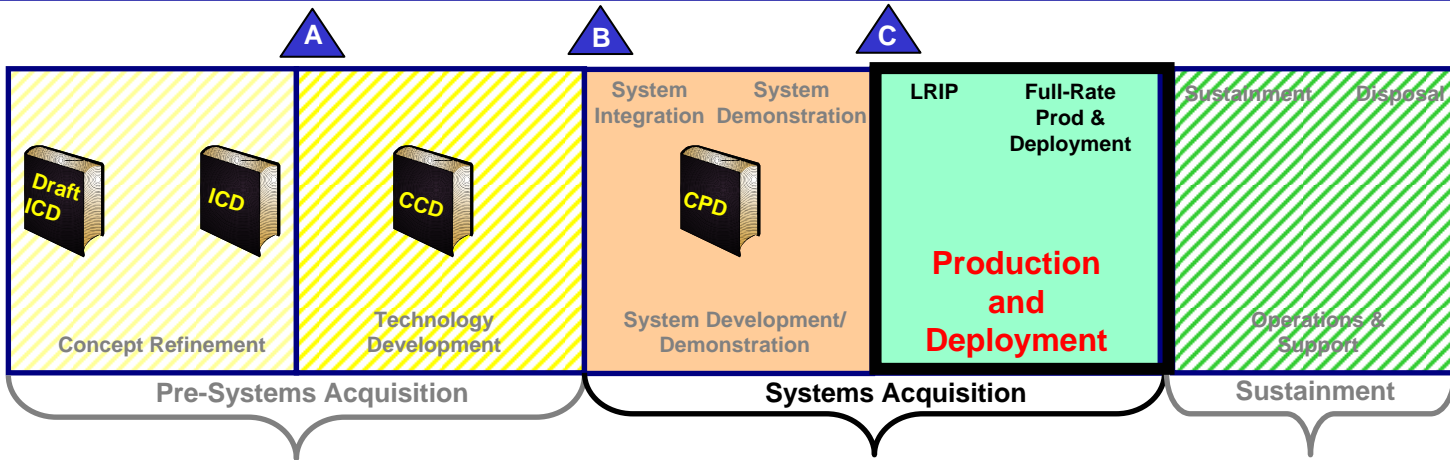
Lifecycle Phase
System Acquisition
Development/Demonstration

- Interface requirements definition
- Test and evaluation of technology under development
- Hardware prototype T&E process refinement
- Assessment of system in varying scenarios, mission space, and performance envelope

- Flight Readiness Review
- Operational Test Readiness Review
- System Verification Review/Production Readiness Review

| | | |
|----------------------------|--|--|
| M&S Application Categories | <ul style="list-style-type: none"> • System Demonstration Models • Effectiveness Models | <ul style="list-style-type: none"> • Supportability Models • HWIL/SWIL/MIL T&E |
| M&S Used For | <ul style="list-style-type: none"> • System integration of subsystems and components • Interoperability analysis | <ul style="list-style-type: none"> • Analysis for refining HW and SW • System integration risk reduction |
| Example Products | <ul style="list-style-type: none"> • Prototypes • Risk Mitigation Reports | <ul style="list-style-type: none"> • Capability Production Document |

- SETR Phase Venues
- Systems Functional Review
 - Preliminary Design Review
 - Critical Design Review
 - Test Readiness Review



Lifecycle Phase
System Acquisition:
Production and Deployment

- Detailed system design development
- System production and support process definition
- Manufacturing facility design
- Production flow definition
- Production bottleneck analysis and elimination
- Virtual training

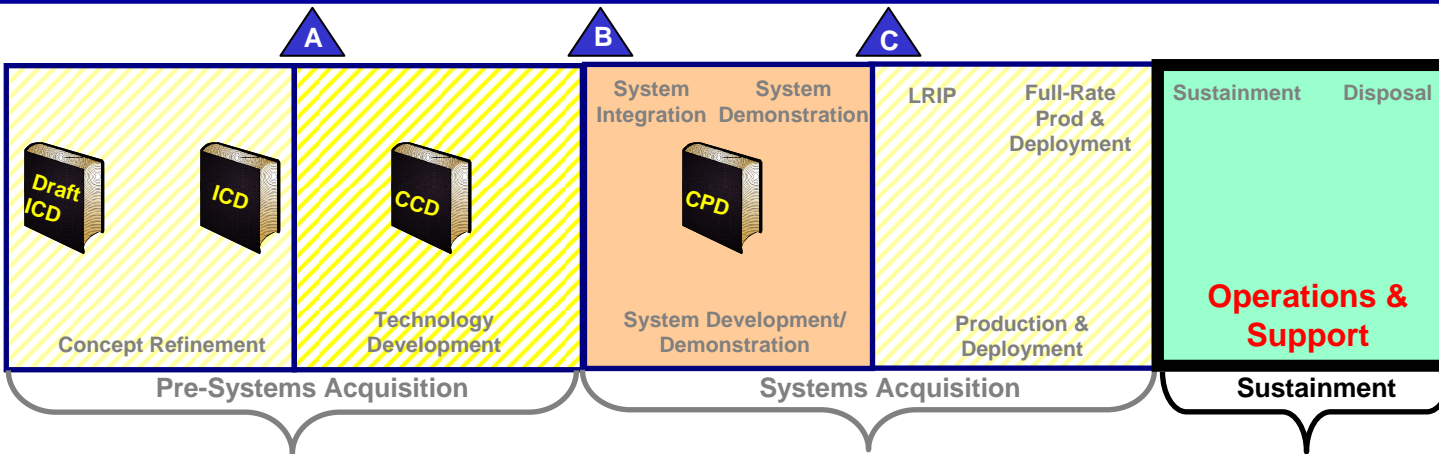
SETR Phase Venues

- Physical Configuration Audit

| | | |
|----------------------------|--|--|
| M&S Application Categories | <ul style="list-style-type: none"> • Manufacturing Simulations • Assembly Simulations | <ul style="list-style-type: none"> • Supportability Models • Training Simulations |
| M&S Used For | <ul style="list-style-type: none"> • Full manufacturing capability analysis • Production representative statistics | <ul style="list-style-type: none"> • Initial production recommendations • Support analysis |
| Example M&S Products | <ul style="list-style-type: none"> • Full-rate production estimates • Process Improvement Report | <ul style="list-style-type: none"> • System deployment plans • Operational capability • Quality Control |

M&S SUPPORT TO THE SYSTEM LIFECYCLE

SUSTAINMENT: OPERATIONS AND SUPPORT

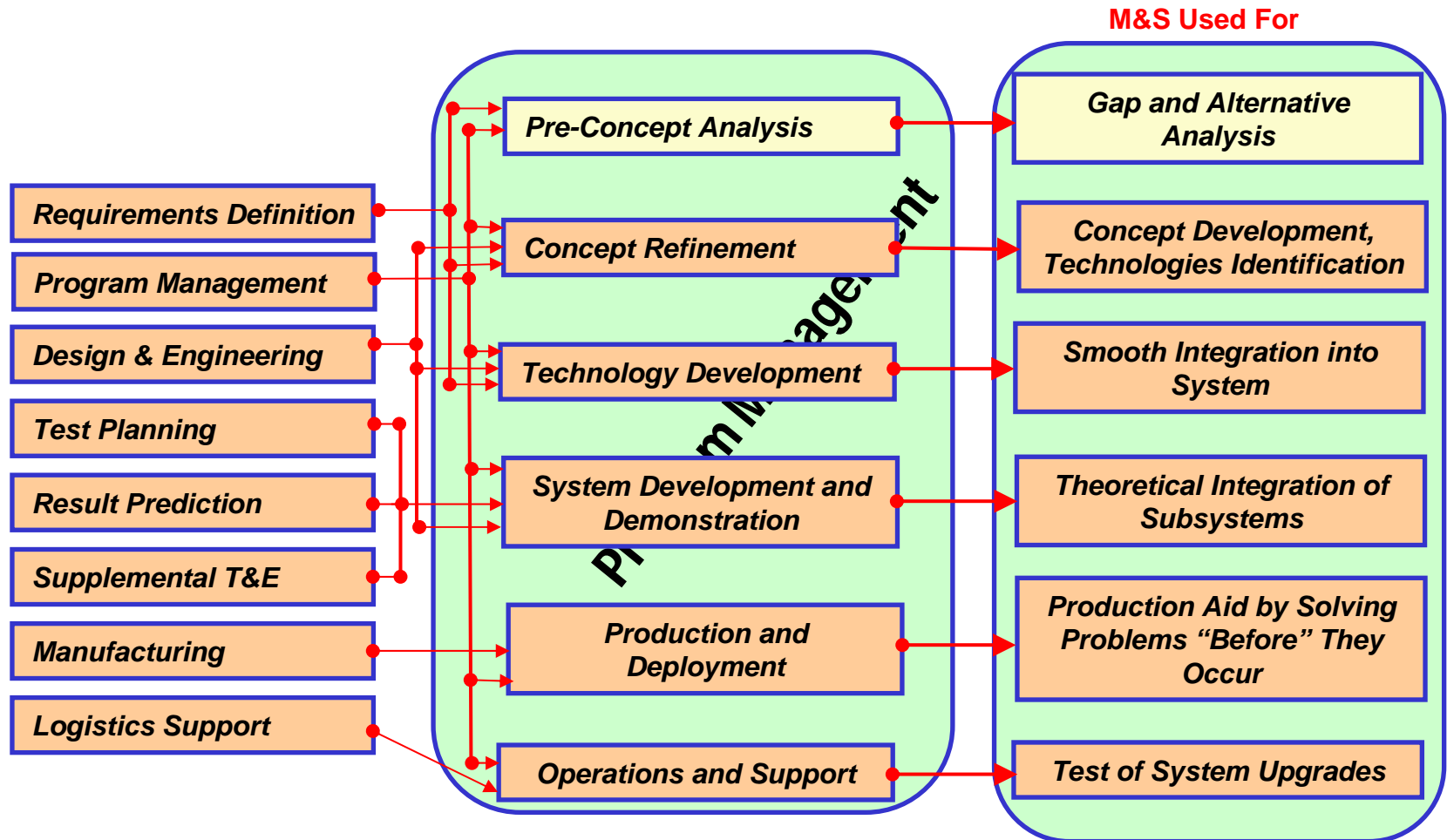


| |
|--|
| <p>Lifecycle Phase <u>Sustainment:</u> <u>Operation and Support</u></p> <ul style="list-style-type: none"> • Detailed system operational improvement • Future system improvement and support and process definition • Operational bottleneck analysis and elimination • Virtual training • Future requirements definition |
| <p>SETR Phase Venues</p> <ul style="list-style-type: none"> • Physical Configuration Audit |

| | | |
|--------------------------------|--|--|
| M&S Application Categories | <ul style="list-style-type: none"> • Simulations • Assembly Simulations | <ul style="list-style-type: none"> • Supportability Models • Training Simulations |
| <u>M&S Used For</u> | <ul style="list-style-type: none"> • Full manufacturing capability analysis • Production representative statistics | <ul style="list-style-type: none"> • Initial production recommendations • Support analysis |
| Example Products | <ul style="list-style-type: none"> • Full-rate production estimates | <ul style="list-style-type: none"> • System deployment plans • Operational capability |

REVIEW

- Acquisition activities span all phases of the system lifecycle
- M&S heavily supports all aspects of the system lifecycle
- M&S provides valuable input into the System Engineering Technical Review Process



ACKNOWLEDGMENT

- The material for this brief was derived from various sources:
 - DoD Publications
 - DAU course materials
 - DMSO documents
 - NMSO Lectures
 - NAVAIR Publications

Questions





25th Annual Test & Evaluation National Conference

Session D

Resources, Instrumentation, and
Targets Summary

Brief #1

TENA

- Test & Training Enabling Architecture (TENA) provides a standardized software interface for interfacing range instrumentation data outputs.
- Version 6.0 is scheduled for release soon.
 - Many new improvements
 - New middleware capability
 - Metamodel and model improvements
 - New event management
 - Usability Improvements

Brief #1

TENA (cont...)

- InterTEC – New CTEIP program to develop more tools for Joint Mission Environment Test Capability (JMETC).
- Interface Verification Tool
 - Used to verify and validate the new tools being developed for use with TENA and JMETC.

Brief #2

JMETC

- Joint Mission Environment Test Capability
- New means for linking distributed facilities
 - TENA is a part of JMETC
 - Allow joint mission environment testing

Brief #3

Evolving Threats – How They Impact T&E Testing & Infrastructure

- Outlined a study conducted by AFFTC's 412th Electronic Warfare Group.
 - Focused on new Evolving Threats and existing threats and how they may potentially impact T&E infrastructure and test capabilities.
 - Also looked at the potential impact to T&E facility security, disaster preparedness.
- Appeared to cover quite a bit of what DTRMC listed as focus areas for their strategic plan for T&E MRTFB ranges.
 - Directed Energy
 - Chem/Bio
 - Nuclear EMP Effects
 - IED and counter IED

Brief #4

Threat/Target Simulation for Live Fire

- Provided a comprehensive overview of NAWCWD's threat and target simulation capabilities
 - Types of targets available
 - Land/Air/Sea
 - Types of threat simulators (systems) available
 - Land/Air/Sea
 - Mockups (visual only)
 - Mockups (visual) with real RF emitters.
 - RF emitters only



25th Annual Test & Evaluation National Conference

Session VI
T&E Workforce & Resources
Summary

Brief #1

Today's and Tomorrow's DoD T&E Acquisition Workforce

- Observations:
 - Fairly wide disparity between the % of military in the T&E workforce between the Army, Navy, and Air Force.
 - A significant % of the workforce will be at the retirement age in the next 10 years.
 - Will result in a “brain drain” in the workforce.
 - Current economy situation may lesson the pending “brain drain”.

Brief #1

Cont...

- Observations (cont...)
 - Data used indicates the workforce has remained relatively stable over the last 4 years.
 - However, the contractor workforce was not included in this data.
 - What % of the total workforce does this account for?
 - Lack of contractor data may prove this to be inaccurate.
 - Contractor workforce is always the first to increase or decrease due to the ebb and flow in funding and workload.
 - Changes in DoDI 5000.02 will drive changes in the T&E workforce.

Brief #2

The DOD Strategic Plan for T&E Resources

- Defense Test Resource Management Center (DTRMC)
 - Oversees all aspects of MRTFB T&E facilities resources.
 - Coordinates operational budgets
 - Investments (CTEIP & I&M) for facility infrastructure.
 - Responsible for generating the high level strategic plan for T&E resources.
 - Several key infrastructure shortfall focus areas appear to be on “Evolving Threats” including:
 - Directed Energy test capability
 - Chem/Bio test capability
 - Nuclear EMP effects testing capability
 - IED and Counter IED testing capability
 - Coordinating with each Service to develop a viable and executable strategic plan to ensure maximum utilization of available resources.

NDIA T&E National Conference

Session B: New T&E Policy and Policy Implementation - March 5, 2009

Mr. David Duma

Mr. Robert Wojciechowski

Ms. Darlene Mosser-Kerner

Mr. Andy Long

Dr. Beth Wilson

Ms. Christine Hines

2nd Lt. Matthew Steele

Recommendations

- Use **new TEMP guidance and format** (Reliability, Integrated Testing, and Evaluation Framework)
- Adopt the **implementation framework** strategy for Integrated Testing: integrate the people, the planning, and the data; blend, harmonize
- Work with OUSD(AT&L) to develop an **overarching Critical Program Information (CPI) T&E strategy**
- Incorporate **LFT&E and survivability** as part of evaluation framework requirements (implied task)
- Include **contractors** in the T&E process (Title X does not prevent the use of contractor data or collaborative planning and execution)
- Ensure **T&E WIPTs** understand their duties extend beyond writing the TEMP; responsible for T&E execution and informing stakeholders
- Disseminate **new policies and definitions** (integrated testing, mission-oriented context)

Issues/Potential Future Conference Topics and Sessions

- Biggest barriers to integrated testing are cultural
- Additional changes to new TEMP guidance and format to address emerging issues (i.e., cyber, systems assurance)
- Appropriate level of detail in reliability section of the TEMP
- Defining and justifying contractor participation early (cost/benefit)
- Rapid programs: Schedule vs. rigorous T&E
- Sharing examples and lessons-learned (include PMs)



Secretary Gates' Recommendations for Improving Defense Acquisition As Submitted Jan. 27, 2009

- Avoid across-the-board adjustments.
- Pursue a "75 percent solution" vs. "exquisite" systems.
- Invest more in future-oriented (joint) programs.
- Freeze requirements at contract award, write contracts that provide incentive for "proper behavior."
- Seek increased competition and the use of prototypes.

Response of William Lynn to Senate Armed Services Committee Question on Acquisition Reform

- “Within the acquisition process, realism and stability can be fostered through greater emphasis on independent assessments of costs, technology readiness, and *testing maturity*, particularly during the early stages of programs.”
 - Mr. William Lynn, nominee for Deputy Secretary of defense (Prepared response to question submitted in advance of 15 Jan confirmation hearing)

- *“Facts are stubborn things; and whatever may be our wishes, our inclinations, or the dictates of our passion, they cannot alter the state of facts and evidence.”*

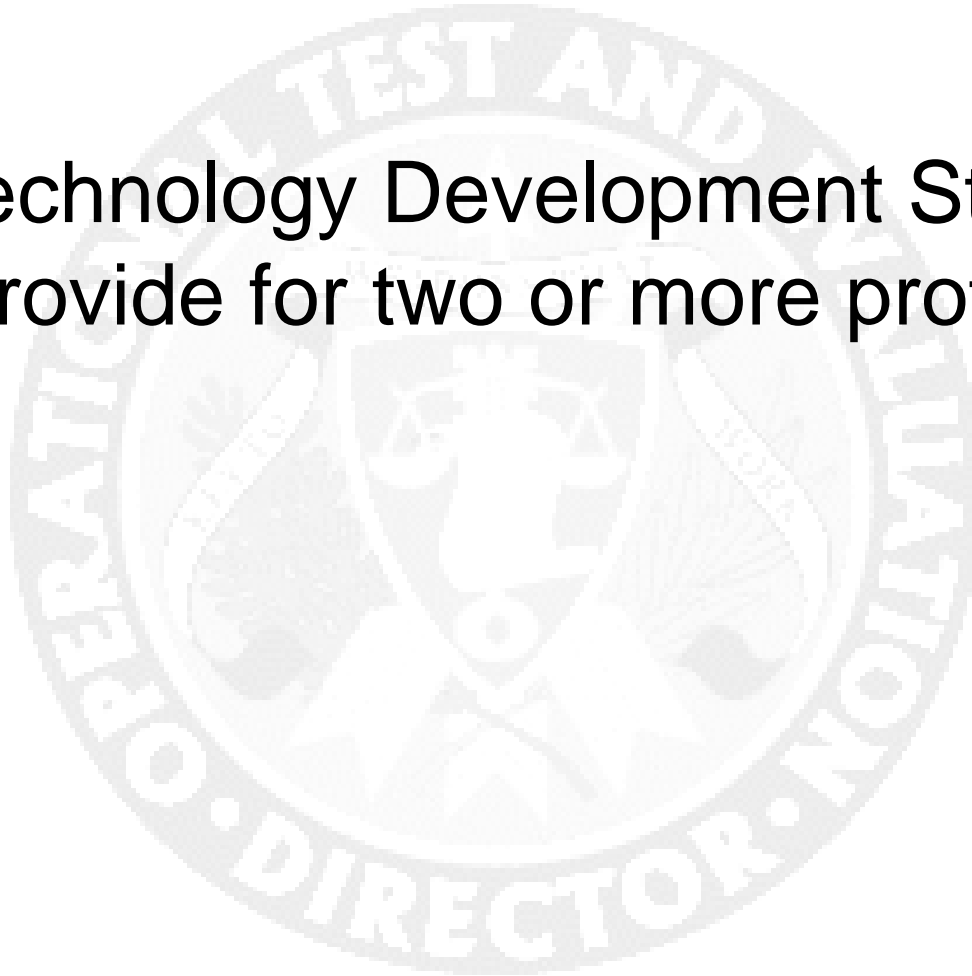
– John Adams

New Acquisition/T&E Policies in DoDI 5000.02

- The DUSD(A&T) shall conduct an independent Assessment of Operational Test Readiness (AOTR).
- The CAE shall consider the results of the AOTR.

New Acquisition/T&E Policies in DoDI 5000.02

- The Technology Development Strategy shall provide for two or more prototypes.

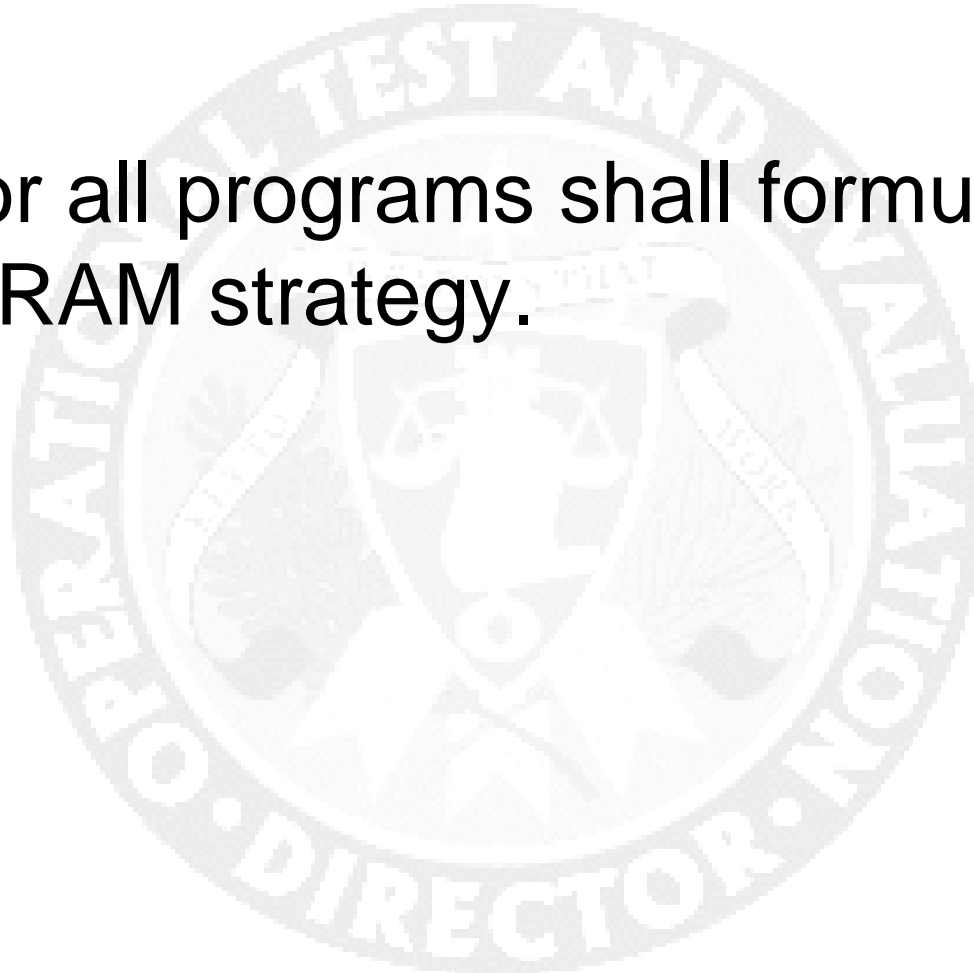


New Acquisition/T&E Policies in DoDI 5000.02

- DT and OT shall be integrated and seamless.
- Evaluations shall include a comparison with current mission capabilities . . . take into account all available and relevant data.
- T&E shall be conducted in a continuum of live, virtual, and constructive environments.
- T&E should assess improvements to mission capability.

New Acquisition/T&E Policies in DoDI 5000.02

- PMs for all programs shall formulate a viable RAM strategy.



Definition of Integrated Testing in Defense Acquisition Guidebook

- *“Integrated testing is the collaborative planning and collaborative execution of test phases and events to provide shared data in support of independent analysis, evaluation and reporting by all stakeholders, particularly the developmental (both contractor and government) and operational test and evaluation communities.”*

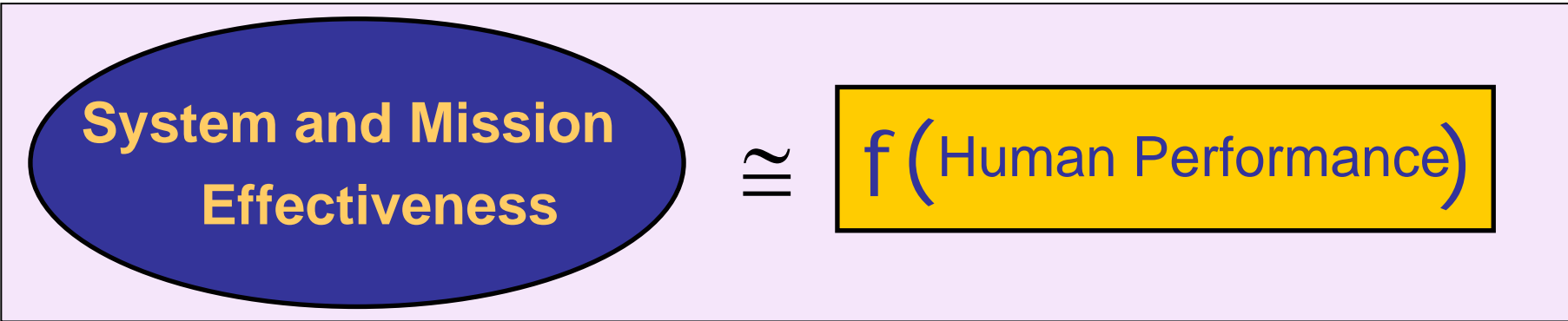


TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Using IMPRINT to Translate Human Performance into System and Mission Effectiveness

Diane Kuhl Mitchell and Charneta Samms

March 3, 2009



The Defense Acquisition Management Framework *

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Human performance is challenging to predict

Many Variables

Concept System

Too Dangerous

Field Study Not Feasible

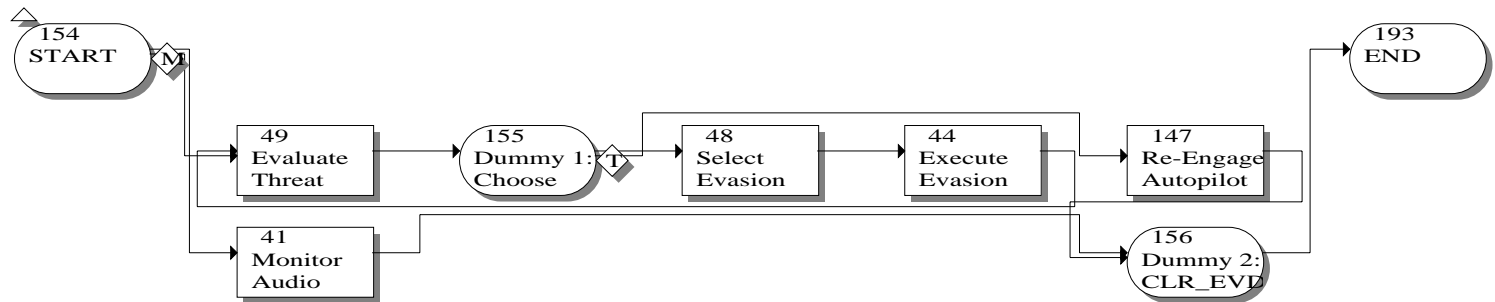
System Performance $\cong f(\text{human performance})$

INPUTS

- Time and accuracy of each task
- Consequences of "poor" performance

Gathered from such sources as existing data, algorithms, and estimates from SMEs

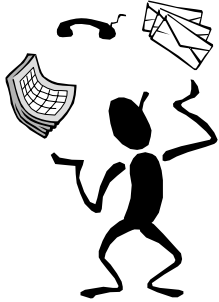
MODEL



OUTPUTS

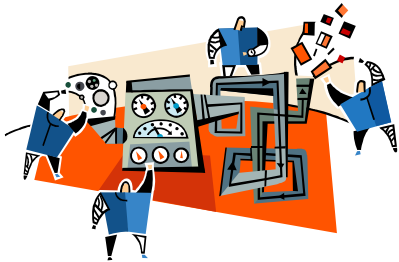
Measures of effectiveness

Not descriptive models, but predictive models



Is the human overloaded with tasks?

Will training improve human and system performance?

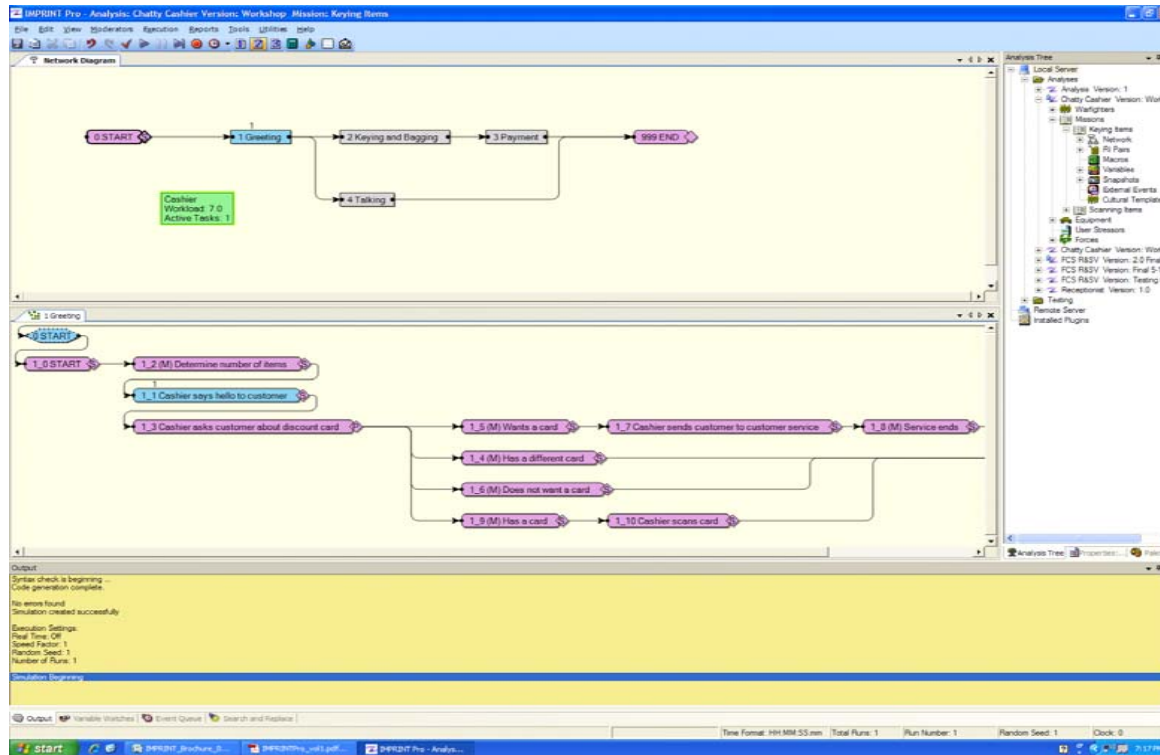


How to allocate tasks between human(s) and automation?

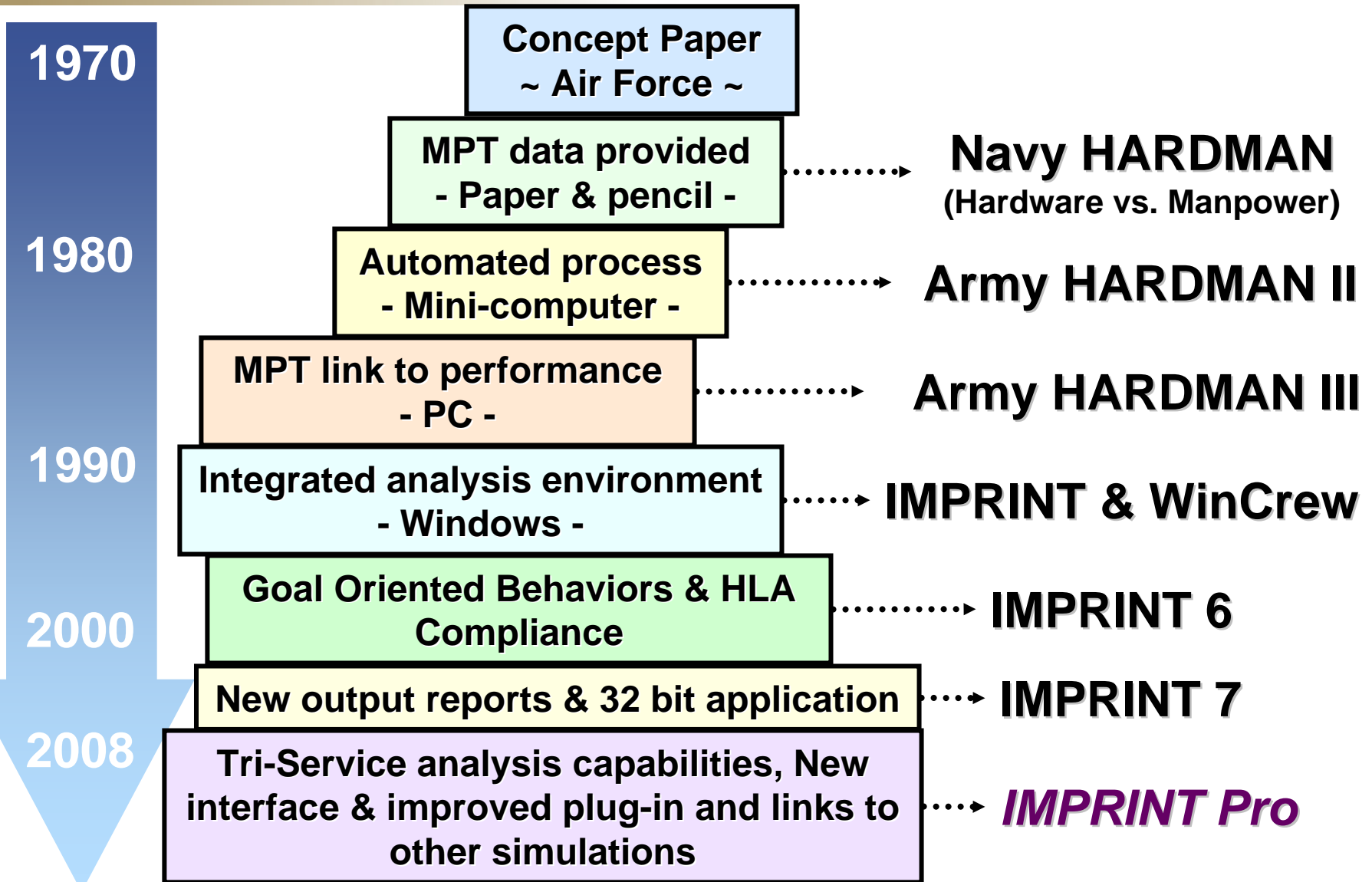
What are the performance tradeoffs with different system designs or levels of operator experience?

IMPRINT is...

- a Human System Integration tool
- a dynamic, stochastic discrete event network modeling tool

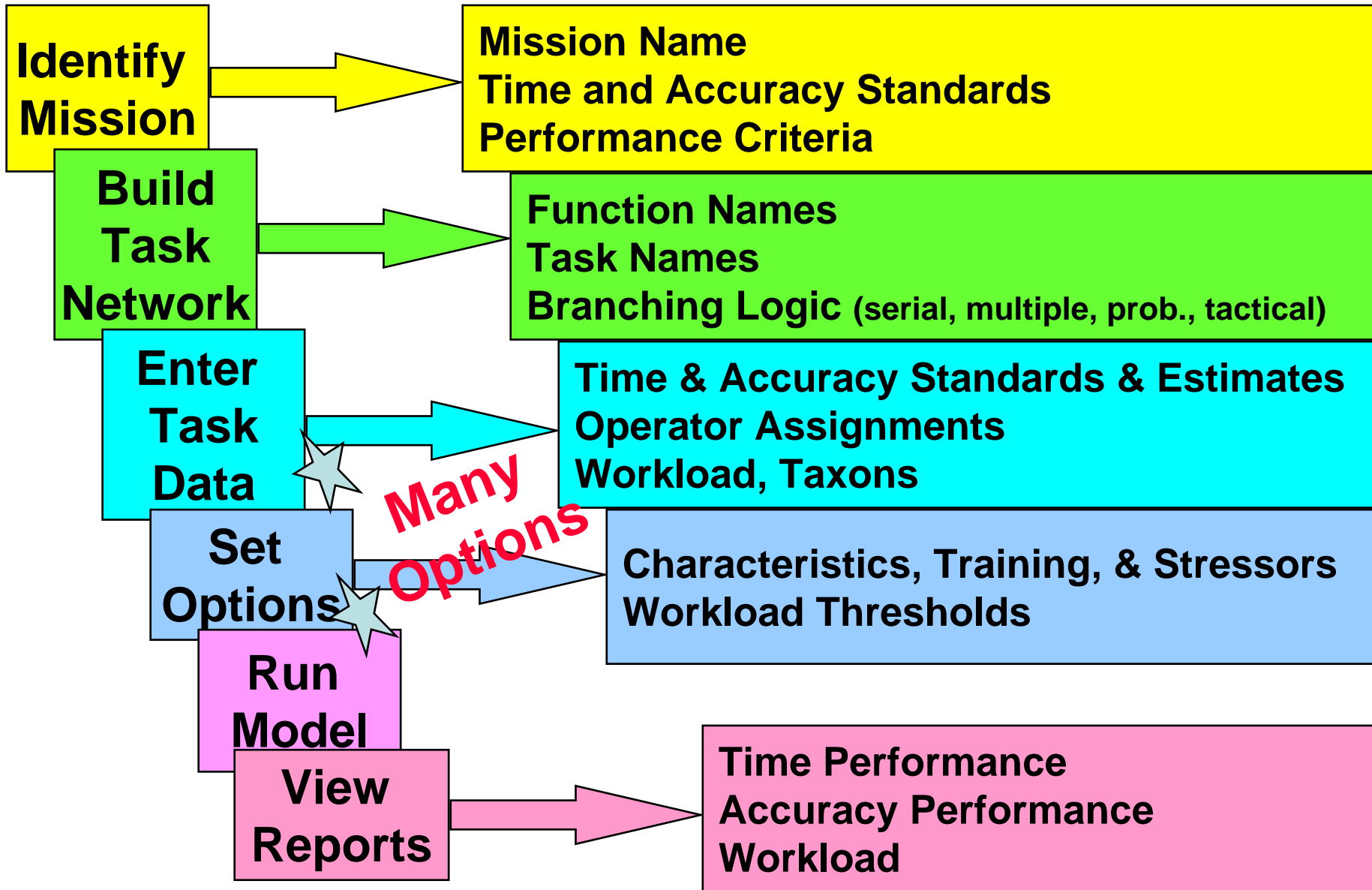


<http://www.arl.army.mil/IMPRINT>

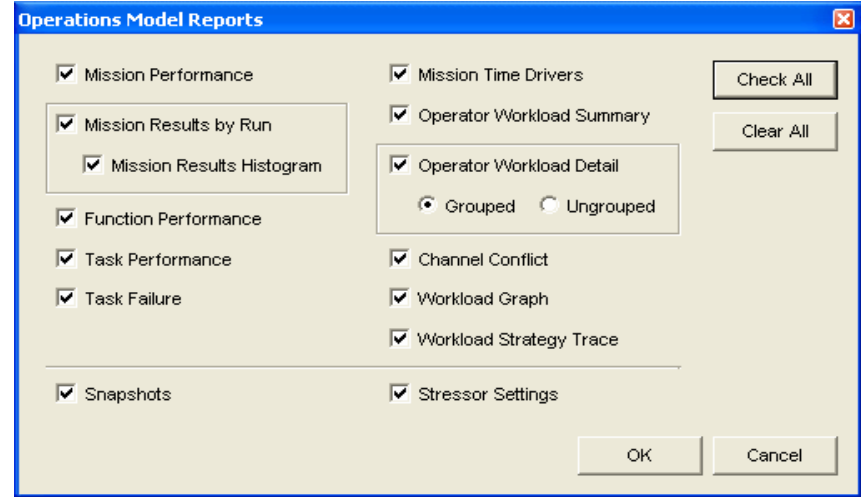


- Set realistic system requirements
- Identify future manpower & personnel constraints
- Evaluate operator & crew workload
- Test alternate system-crew function allocations
- Assess required maintenance manhours
- Assess performance during extreme conditions
- Examine performance as a function of personnel characteristics and training frequency & recency
- Identify areas to focus test and evaluation resources
- Quantify human system integration risks in mission performance terms to support milestone review
- Represent humans in federated simulations

IMPRINT is a trade-off analysis tool



- **Mission Performance**
 - Predicted time & success rate of mission
- **Function Performance**
 - Predicted time & success rate of individual functions



| ID | Function | Times Performed | Standard | Minimum | Maximum | Mean | Std. Dev. | Met |
|--------|--|-----------------|----------|-------------|-------------|-------------|-------------|------|
| 117 | (P3) Maintain local SA and scan for enemy | 1 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |
| 103 | (C3) Conduct video | 3 | 00:00:00 | 00:10:00 | 00:10:00 | 00:10:00 | 00:00:00 | 0.00 |
| 106 | (D3) Conduct Area Reconnaissance | 1 | 00:00:00 | 00:17:39.66 | 00:17:39.66 | 00:17:39.66 | 00:00:00 | 0.00 |
| 118 | (V3) Maintain local SA and scan for enemy | 1 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |
| 105 | (D3) Get reconnaissance pictures or video | 2 | 00:00:00 | 00:00:02.87 | 00:00:09.87 | 00:00:06.37 | 00:00:04.86 | 0.00 |
| 108 | (U3) Maintain local SA and scan for enemy | 1 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |
| 167 | (S3) Miss while dismounted | 5 | 00:00:00 | 00:21:30.00 | 02:40:00.00 | 01:12:06.00 | 01:02:59.30 | 0.00 |
| 107 | (U3) Control Mount Mounted Sensor | 2 | 00:00:00 | 00:03:04.20 | 00:20:52.00 | 03:12:28.00 | 00:11:44.45 | 0.00 |
| 108 | (U3) Conduct Area Reconnaissance | 3 | 00:00:00 | 00:02:26.68 | 00:18:11.61 | 00:07:48.10 | 00:08:59.89 | 0.00 |
| 108_8 | (U3) Get reconnaissance pictures or video | 13 | 00:00:00 | 00:00:01.87 | 00:01:12.74 | 00:00:34.23 | 00:00:23.74 | 0.00 |
| 11 | (G3) W3 Move Tactical/Health | 5 | 00:00:00 | 00:29:00.00 | 02:00:00.00 | 00:47:12.00 | 00:40:41.79 | 0.00 |
| 166 | Occupancy DP 1 | 1 | 00:00:00 | 00:40:00.00 | 00:40:00.00 | 00:40:00.00 | 00:00:00.00 | 0.00 |
| 13 | (U3) Engage Threat | 0 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |
| 154_3 | Actions on Contact_BTR60 - Part 2 | 1 | 00:00:00 | 00:30:00.00 | 00:30:00.00 | 00:30:00.00 | 00:00:00.00 | 0.00 |
| 114 | (P3) Control Movement of Platoon | 1 | 00:00:00 | 00:00:04.00 | 00:00:04.00 | 00:00:04.00 | 00:00:00.00 | 0.00 |
| 119 | (S3) Maintain local SA and scan for enemy | 1 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |
| 168 | (S4) Miss while dismounted | 5 | 00:00:00 | 00:21:30.00 | 02:40:00.00 | 01:12:06.00 | 01:02:59.30 | 0.00 |
| 169 | (P3) Mission Communication | 0 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |
| 169 | Occupancy DP 2 and Set Screens | 1 | 00:00:00 | 01:00:00.00 | 01:00:00.00 | 01:00:00.00 | 00:00:00.00 | 0.00 |
| 172 | (P3) Miss while dismounted | 1 | 00:00:00 | 01:14:00.00 | 01:14:00.00 | 01:14:00.00 | 00:00:00.00 | 0.00 |
| 173 | (P3) Mount Up | 2 | 00:00:00 | 00:01:00.00 | 00:01:00.00 | 00:01:00.00 | 00:00:00.00 | 0.00 |
| 174 | (P3) Mount Up | 1 | 00:00:00 | 00:12:00.00 | 00:12:00.00 | 00:12:00.00 | 00:00:00.00 | 0.00 |
| 130 | (V3) Observe OBJ using observation plan | 4 | 00:00:00 | 00:30:00.00 | 00:42:49.99 | 00:33:50.00 | 00:06:15.55 | 0.00 |
| 122 | (S3) Dismount and conceal vehicle | 5 | 00:00:00 | 00:11:00.00 | 02:02:30.00 | 00:33:18.00 | 00:49:51.86 | 0.00 |
| 123 | (S3) Mount Up | 5 | 00:00:00 | 00:01:00.00 | 00:01:00.00 | 00:01:00.00 | 00:00:00.00 | 0.00 |
| 124 | (S3) Observe OBJ using observation plan | 4 | 00:00:00 | 00:30:00.00 | 00:42:49.99 | 00:33:26.50 | 00:06:15.55 | 0.00 |
| 125 | (S4) Maintain local SA and scan for enemy | 1 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |
| 126 | (S4) Dismount and conceal vehicle | 5 | 00:00:00 | 00:11:00.00 | 02:02:30.00 | 00:33:18.00 | 00:49:51.86 | 0.00 |
| 127 | (S4) Mount Up | 5 | 00:00:00 | 00:01:00.00 | 00:01:00.00 | 00:01:00.00 | 00:00:00.00 | 0.00 |
| 175 | Enemy Contact - Technical Providing Reinforcements | 1 | 00:00:00 | 00:48:00.00 | 00:48:00.00 | 00:48:00.00 | 00:00:00.00 | 0.00 |
| 128 | (S4) Observe OBJ using observation plan | 4 | 00:00:00 | 00:30:00.00 | 00:42:49.99 | 00:33:26.50 | 00:06:15.55 | 0.00 |
| 162 | First Mounted OP | 1 | 00:00:00 | 00:41:00.00 | 00:41:00.00 | 00:41:00.00 | 00:00:00.00 | 0.00 |
| 163 | Second Mounted OP | 1 | 00:00:00 | 00:20:00.00 | 01:20:00.00 | 01:20:00.00 | 00:00:00.00 | 0.00 |
| 154 | Actions on Contact_BTR60 | 1 | 00:00:00 | 01:26:30.00 | 01:26:30.00 | 01:26:30.00 | 00:00:00.00 | 0.00 |
| 155 | (V3) Observe OBJ using observation plan | 1 | 00:00:00 | 00:17:06.90 | 00:17:06.90 | 00:17:06.90 | 00:00:00.00 | 0.00 |
| 156 | (V3) Get reconnaissance pictures or video | 1 | 00:00:00 | 00:03:02.87 | 00:01:17.81 | 00:02:27.87 | 00:00:01.15 | 0.00 |
| 156 | (P3) Conduct Area Reconnaissance | 2 | 00:00:00 | 00:17:19.06 | 00:06:55.40 | 03:13.46 | 04:09:06.97 | 0.00 |
| 156_11 | (P3) Get reconnaissance pictures or video | 3 | 00:00:00 | 00:00:02.87 | 00:00:04.47 | 00:00:22.89 | 00:00:19.27 | 0.00 |
| 157 | (S3) Conduct Area Reconnaissance | 1 | 00:00:00 | 00:19:47.14 | 00:19:47.14 | 00:19:47.14 | 00:00:00.00 | 0.00 |
| 157_11 | (S3) Get reconnaissance pictures or video | 4 | 00:00:00 | 00:00:10.87 | 00:00:02.47 | 00:00:29.48 | 00:00:19.14 | 0.00 |
| 158 | (S4) Conduct Area Reconnaissance | 1 | 00:00:00 | 00:17:46.63 | 00:17:46.63 | 00:17:46.63 | 00:00:00.00 | 0.00 |
| 158_3 | (S4) Get reconnaissance pictures or video | 0 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |
| 177 | (U3) Engage Threat | 1 | 00:00:10 | 00:16:57 | 00:16:57 | 00:16:57 | 00:00:00.00 | 0.00 |
| 157 | (P3) Mount UGV/UAV/air | 3 | 00:00:00 | 00:24:87 | 00:08:42 | 00:38:39 | 00:09:32 | 0.00 |
| 89 | Internal Control (all) | 1 | 00:00:00 | 00:02:21 | 00:02:21 | 00:02:21 | 00:00:00.00 | 0.00 |
| 74 | (D3) Maintain local SA and scan for enemy | 1 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |
| 87 | (P3) Mission Communication | 0 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 00:00:00 | 0.00 |

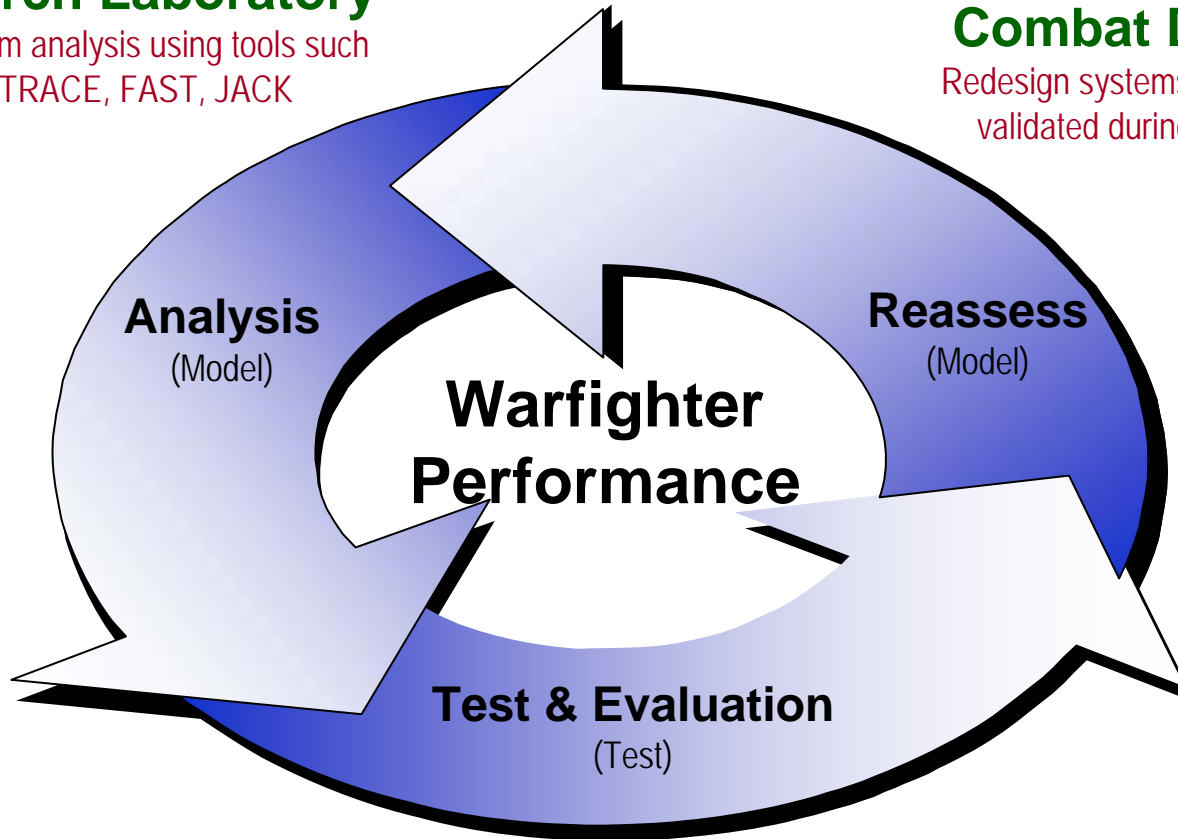
- **Task Performance**
 - Predicted time & success rate of individual tasks
- **Operator Workload**
 - Workload over time for each operator
 - Tasks performed over time and associated workload

Army Research Laboratory

Conduct human system analysis using tools such as IMPRINT, C3TRACE, FAST, JACK

Program Managers, Combat Developers

Redesign systems to overcome issues validated during test & evaluation

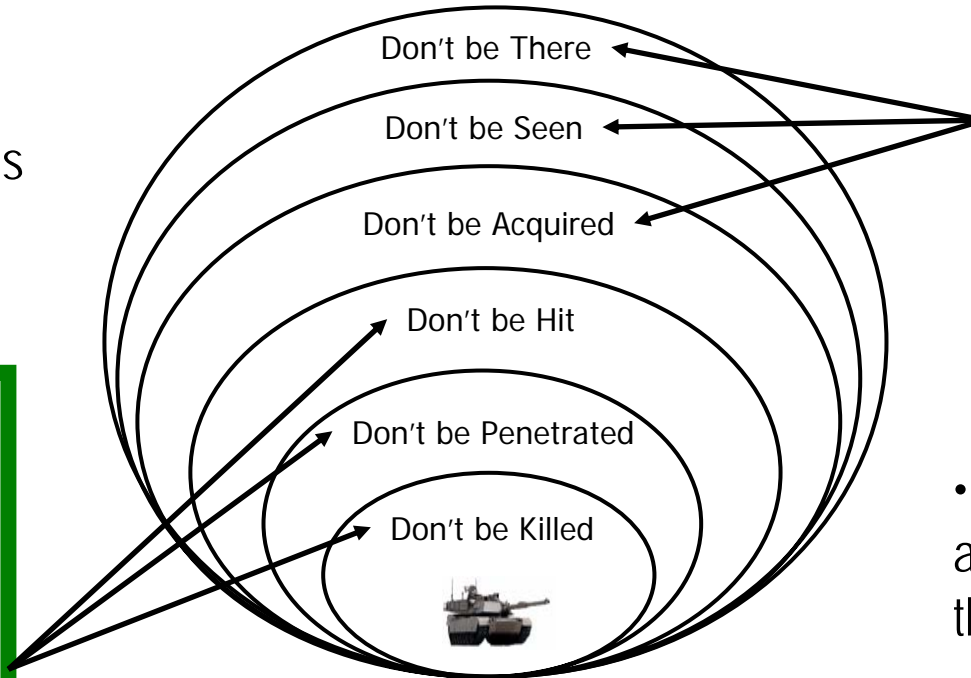


Army Test and Evaluation Center, Army Research Laboratory

Implement issues found during analysis into test plans

- Rely on heavy armor and artillery to protect the forces
- Heavy, large systems are difficult to deploy rapidly

Survivability Onion



NEED TO REDUCE CREW SIZE TO SUPPORT SMALLER, LIGHTER VEHICLE

- Rely on situation awareness to protect the forces
- Lighter, smaller systems are easier to deploy rapidly

- Identified functions to be completed - knowledge elicitation
- Set up experimental conditions to model based on varying function allocations
- Built models
- Validated models by walking-through with Soldiers
- Completed runs and prepared results

Four Conditions

- **Gunner-Driver and Commander**
- **Commander-Driver and Gunner**
- **Commander-Gunner and Driver**
- **Commander, Driver and Gunner**

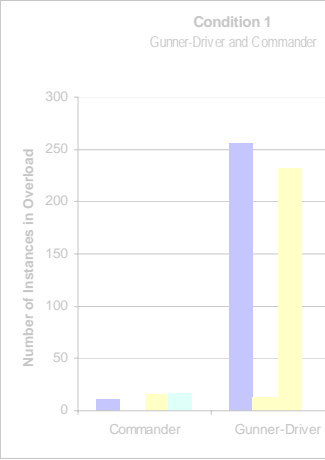
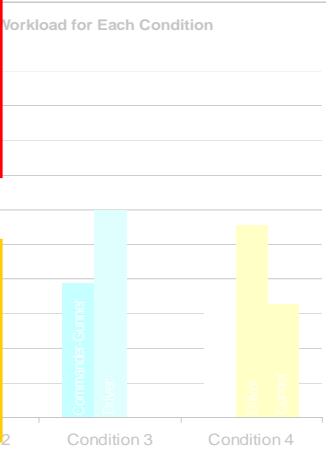
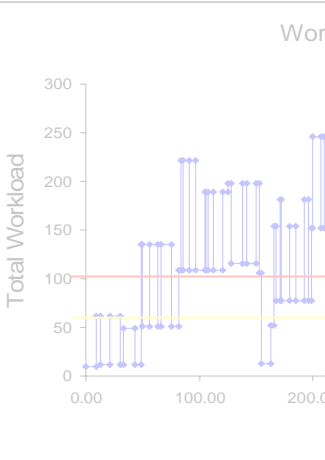
| Function Name | Condition 1 | Condition 2 | Condition 3 | Condition 4 |
|----------------|----------------------------|----------------------------|----------------------------|----------------------------|
| | GD and C | CD and G | CG and D | C and G and D |
| | <i>Function allocation</i> | <i>Function allocation</i> | <i>Function allocation</i> | <i>Function allocation</i> |
| Drive | GD | CD | D | D |
| Hindrance | GD | CD | D | D |
| Remediate | GD | CD | D | D |
| Engage | GD ^(C) | G ^(CD) | CG | G ^(C) |
| Local Security | C | G | CG | C and G |
| External Com | C | CD | CG | C |
| Crew Commo | GD & C | CD & G | CG & D | C & G & D |

Commander - Driver and Gunner
Highest workload of all conditions

Gunner - Driver and Commander
No shooting on the move

Commander - Gunner and Driver
Best two crewmember function allocation; single vehicle commander

Commander, Driver and Gunner
Two crewmembers scanning; allows hunter-killer philosophy



| Condition | Function allocation |
|-------------|---------------------|
| Condition 1 | D |
| Condition 2 | D |
| Condition 3 | D |
| Condition 4 | G |
| | C and G |
| | C |
| | C & G & D |

**2 Soldier crew
considered HIGH RISK**

- Changed the crewmember requirement for Operational and Organizational (O&O) Concept Document and the Operational Requirements Document (ORD)
- Role of third crewmember changed to gunner in prime contractor design concept.

3



PL/VC
O2
19A



Crew Chief
E5
19K20



DR
E4
19K10



ARV-Assault (L)
M240 7.62MM
Javelin (2)

XM36 120MM
M2 50 CAL
GMR
WiN-T
CC

3



PSG/VC
E7
19K40



Crew Chief
E5
19K20



DR
E4
19K10



CL I UAV Ch
CL 1 UAS LCU C

XM36 120MM
M2 50 CAL
GMR 8
CC

3



VC
E6
19K30



Crew Chief
E5
19K20



DR
E4
19K10

XM36 120MM
MK 19 40MM
GMR 8
CC

Original analysis

Provides BLOS support to Infantry Platoons

| Response | Visual | Auditory | Manual | Verbal |
|----------|--|---|---|---|
| Visual | HIGH CONFLICT (.7-.9) Directly competing resources (e.g. two search functions; less if functions adjacent or on same display areas) | | | |
| Auditory | LOW CONFLICT (.2-.4) Noncompeting resources (e.g., search and listening). | HIGH CONFLICT (.7-.9) Highly competitive resources; some time-sharing if discriminability between inputs is high | | |
| Manual | LOW CONFLICT (.1-.3) Noncompeting resources. | LOW CONFLICT (.1-.3) Noncompeting resources. | HIGH CONFLICT (.7-.9) Competing resources such as two tracking functions or discrete choice functions have shown high-dual decrements. | |
| Verbal | LOW CONFLICT (.1-.3) Noncompeting resources. | MEDIUM CONFLICT (.4-.6) More interference if task requires voiced output. | LOW CONFLICT (.2-.4) Noncompeting resources (e.g., tracking and voice input). | HIGH CONFLICT (1.0) Requires complete serial output; e.g. giving two messages or voice commands. |

* North, R. A., and Riley, V. (1989). "W/INDEX: A Predictive Model of Operator Workload." Applications of Human Performance Models to System Design, G. McMillan et al., eds. (Plenum Press, New York, NY).

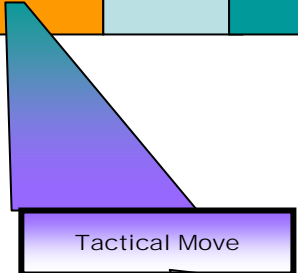
| | | Continuous Functions | | | | | | | | | Discrete Functions | | | | | | | |
|---------|------------|----------------------|----------------|----------------|-----------------|--------------------------|-------------|-------------|------------------------|------------------------|---------------------------------|-------------------------------|-------------------------------|--------------------------------|------|-------------------------|---------------|--------------------|
| Vehicle | Position | Driving | Monitor Driver | Local Security | Battle Tracking | Monitor Vehicle Intercom | Monitor UAV | Monitor ARV | Monitor Platoon TacNet | Monitor Company TacNet | Communicate on Vehicle Intercom | Communicate on Platoon TacNet | Communicate on Company TacNet | LOS Engagement Threat Detected | BDA | Provide BLOS Capability | Intervene ARV | Intervene with UAV |
| PL MCS | PL | | P | | P | P | | | P | P | 70% | | 70% | | 10% | 10% | | |
| | Crew Chief | | | P | | | | P | | | | 70% | | 10% | | | 100% | |
| | Driver | P | | | | | | | | | | | | | | | | |
| PSG MCS | PSGT | | P | | P | P | | | P | | 70% | 70% | | | 10% | 10% | | |
| | Crew Chief | | | P | | | | P | | | | | | 10% | | | | 100% |
| | Driver | P | | | | | | | | | | | | | | | | |
| MCS | VC | | P | | P | P | | | | | 70% | | | | 100% | 100% | | |
| | Crew Chief | | | P | | | | | | | | | | 100% | | | | |
| | Driver | P | | | | | | | | | | | | | | | | |



- Crew chief (Gunner) has two primary functions
 - Local Security
 - ARV monitoring
- Both visual search tasks
 - 90% penalty in accuracy on one of the two concurrent functions
 - If local security than 9 out 10 targets might be missed
 - 9 out of 10 times MCS potentially hit and destroyed
- HRED experiment* looking at concurrent performance of a gunner's and robotic operator's tasks in a simulated MCS environment supports that local security will be the function degraded.

* Chen, J. Y. C., & Terrence, P. I. (2007). Effects of Tactile Alerts on Concurrent Performance of the Gunner's and Robotic Operator's Tasks in a Simulated Mounted Environment (Tech. Rep. ARL-TR-4227). APG, MD: U.S. Army Research Laboratory.

| | | | | | | | | |
|-------------------------------|--------|---------------|---------------|--------|---------------|----------------------|--------|---------------|
| Mounted Supported by Dismount | | | Urban/Mout | | | Defensive Operations | | |
| Tactical Move | Attack | Hasty Defense | Tactical Move | Attack | Hasty Defense | Tactical Move | Defend | Counterattack |



Platforms Library of blocks

MCS PLT

ICV PLT

Co HQ

ICV PLT

- Three tanks in future concept platoon
 - 2 of the 3 vehicles have gunners monitoring robotic systems
 - 2 of the 3 vehicles have gunners potentially missing 9 out of 10 threats
 - 10% survivability
- Tank platoon mission is to provide fires for an infantry platoon
- Infantry platoon has reduced protection
- All vehicles may not arrive at attack start point
- Company mission may be degraded

- **IMPRINT Tool**
 - No cost to government employees and government contractors.
 - Email IMPRINT-INFO@arl.army.mil

- **Analytical support**
 - Assistance with structuring analysis.
 - Analyses completed for customers.
 - Email diane.k.mitchell@us.army.mil

**THANK
YOU**



“Today’s and Tomorrow’s T&E Acquisition Workforce”

**NDIA - 25th Annual T&E National Conference
“New Administration, New Opportunities”**

March 4, 2009

Ms. Darlene Mosser-Kerner
Assistant DD, DT&E Policy and Guidance
Engineering & Test Policy & Guidance
OUSD(AT&L)/Systems & Software
Engineering

MANNED FLIGHT SIMULATOR FACILITY AT PATUXENT RIVER



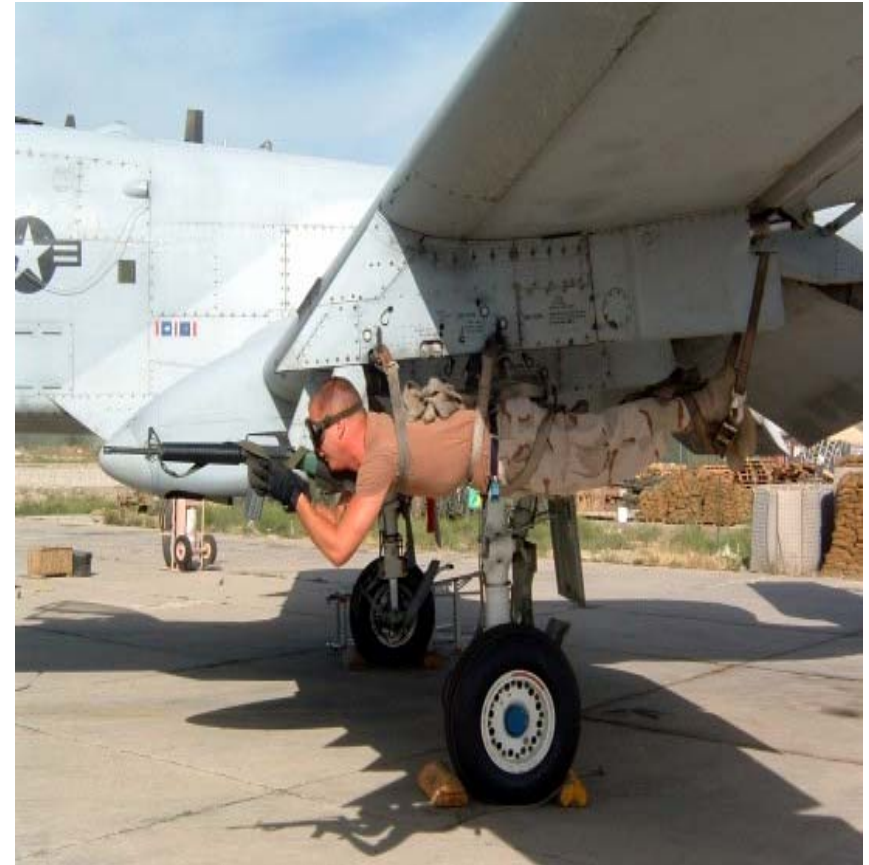
C-17 FLARE EVALUATION (GERMANY)



“Today’s and Tomorrow’s T&E Acquisition Workforce”

DEVELOPMENTAL TEST & EVALUATION

- **One of seven mission critical acquisition career fields**
- **Workforce size, composition, education, retention, recruitment, and assignment is critical to ensuring accurate and complete support to acquisition decision-makers**
- **Workforce has to be resourced to meet the challenges of more complex and interdependent systems**
- **Potential reduced DoD funding will impact the T&E support efforts and require planning for and obtaining multiple use T&E data early and often through product/system development**



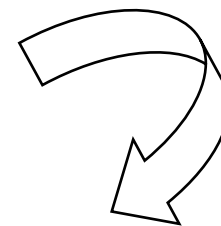
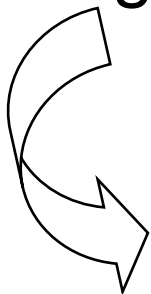
T&E Community must be flexible and adaptable



T&E Mission Challenge

DEVELOPMENTAL TEST & EVALUATION

- 319 Programs on the CY 09 OSD T&E Oversight List



224 of the Programs are
under DT&E Oversight



DEVELOPMENTAL TEST & EVALUATION

NUMBERS

COMPOSITION

AGE

WHAT DOES TODAY'S T&E ACQUISITION WORKFORCE LOOK LIKE

RETENTION

CERTIFICATION



T&E IS A TEAM PLAYER

DEVELOPMENTAL TEST & EVALUATION

PROGRAM SPONSOR

BUDGET

SCHEDULE



T&E FEELS LIKE EVERYONE IS AFTER THEM WHEN THEY HAVE THE BALL



AT&L Acquisition Workforce

DEVELOPMENTAL TEST & EVALUATION

Human Capital Fact Sheet

| Defense Acquisition Workforce Acquisition, Technology, and Logistics ¹ | Civilian (Civ) AT&L Workforce | Military (Mil) AT&L Workforce | Total AT&L Workforce (Civ + Mil) |
|--|-------------------------------------|-------------------------------------|---|
| Size & Composition | | | |
| FY08 Workforce Size | 110,934 | 14,945 | 125,879 |
| FY13 Planned/Budgeted Size | 112,949 | 15,899 | 128,848 |
| Change in size 2005-2008 | -7% | -3% | -7% |
| Civilian/Military Composition | 88% | 12% | - |
| Educational Attainment | | | |
| Bachelor's Degree or Higher | 77% | 81% | 77% |
| Graduate Degree | 26% | 43% | 28% |
| Certification (Cert) | | | |
| Level I or Higher | 73% | 61% | 72% |
| Level II or Higher | 63% | 41% | 61% |
| Level III | 38% | 19% | 36% |
| Position Cert Requirement Met | 62% | 45% | 60% |
| Planning Considerations | | | |
| % Baby Boomer/Traditional Generations | 68% | 17% | 62% |
| Average Age | 46.7 | 36.3 | 45.5 |
| | | - | - |
| Average Years of Service | 17.8 | 13.3 | 17.3 |
| | | | |
| | | | |



T&E Workforce as part of the AT&L Workforce

DEVELOPMENTAL TEST & EVALUATION

| Human Capital Fact Sheet | | | | |
|--|---|---|--|--------------------------------------|
| Defense Acquisition Workforce Test and Evaluation¹ | Civilian (Civ) T&E Workforce | Military (Mil) T&E Workforce | Total T&E Workforce (Civ + Mil) | Defense Acquisition Workforce |
| Size & Composition | | | | |
| FY08 Workforce Size | 5,608 | 1,812 | 7,420 | 125,879 |
| FY13 Planned/Budgeted Size | 5,630 | 1,834 | 7,464 | 127,539 |
| Change in size 2005-2008 | -4% | 14% | 0% | -7% |
| Civilian/Military Composition | 76% | 24% | - | 88% / 12% |
| Educational Attainment | | | | |
| Bachelor's Degree or Higher | 95% | 91% | 94% | 77% |
| Graduate Degree | 30% | 43% | 33% | 28% |
| Certification (Cert) | | | | |
| Level I or Higher | 76% | 49% | 69% | 72% |
| Level II or Higher | 68% | 24% | 57% | 61% |
| Level III | 52% | 8% | 41% | 36% |
| Position Cert Requirement Met | 67% | 29% | 58% | 60% |
| Planning Considerations | | | | |
| % Baby Boomer/Traditional Generations | 58% | 10% | 46% | 62% |
| Average Age | 43.8 | 34.6 | 41.5 | 45.7 |
| | | - | - | |
| Average Years of Service | 15.4 | 11.5 | 14.5 | 17.3 |
| | | - | - | - |
| | | - | - | - |
| | | - | - | - |



AT&L Headcount by Component (As of End of FY2008)

DEVELOPMENTAL TEST & EVALUATION

| Count and Composition (FY08) | | | | | | |
|--|----------------|---------------|----------------|---------------|--------------|--------------|
| Acquisition, Technology, and Logistics | | | | | | |
| Service/Agency | FY08 | FY08 (%) | Civ | Mil | Civ (%) | Mil (%) |
| Army | 40,269 | 32.0% | 38,689 | 1,580 | 96.1% | 3.9% |
| Navy | 43,066 | 34.2% | 38,579 | 4,487 | 89.6% | 10.4% |
| Air Force | 24,827 | 19.7% | 16,067 | 8,760 | 64.7% | 35.3% |
| DCMA | 7,334 | 5.8% | 7,334 | 0 | 100.0% | 0.0% |
| DLA | 3,927 | 3.1% | 3,927 | 0 | 100.0% | 0.0% |
| Other Defense | 6,456 | 5.1% | 6,338 | 118 | 98.2% | 1.8% |
| Total | 125,879 | 100.0% | 110,934 | 14,945 | 88.1% | 11.9% |



T&E Count & Composition

DEVELOPMENTAL TEST & EVALUATION

| Count and Composition (FY08) | | | | | | |
|------------------------------|--------------|---------------|--------------|--------------|--------------|--------------|
| Test and Evaluation | | | | | | |
| Service/Agency | FY08 | FY08 (%) | Civ | Mil | Civ (%) | Mil (%) |
| Army | 2,135 | 28.8% | 2,117 | 18 | 99.2% | 0.8% |
| Navy | 2,476 | 33.4% | 2,034 | 442 | 82.1% | 17.9% |
| Air Force | 2,622 | 35.3% | 1,276 | 1,346 | 48.7% | 51.3% |
| DCMA | 31 | 0.4% | 31 | 0 | 100.0% | 0.0% |
| DLA | 1 | 0.0% | 1 | 0 | 100.0% | 0.0% |
| Other Defense | 155 | 2.1% | 149 | 6 | 96.1% | 3.9% |
| Total | 7,420 | 100.0% | 5,608 | 1,812 | 75.6% | 24.4% |



AT&L Career Field Count & Composition

DEVELOPMENTAL TEST & EVALUATION

| Count and Composition Acquisition, Technology, and Logistics | | | | | | |
|---|----------------|---------------|----------------|---------------|--------------|--------------|
| Service/Agency | FY08 | FY08 (%) | Civ | Mil | Civ (%) | Mil (%) |
| Auditing | 3,638 | 2.9% | 3,638 | 0 | 100.0% | 0.0% |
| BCEFM | 7,085 | 5.6% | 6,840 | 245 | 96.5% | 3.5% |
| CON | 25,680 | 20.4% | 21,773 | 3,907 | 84.8% | 15.2% |
| FE | 4,920 | 3.9% | 4,919 | 1 | 100.0% | 0.0% |
| Property | 451 | 0.4% | 451 | 0 | 100.0% | 0.0% |
| IT | 3,934 | 3.1% | 3,579 | 355 | 91.0% | 9.0% |
| LCL | 13,361 | 10.6% | 12,415 | 946 | 92.9% | 7.1% |
| PQM | 9,138 | 7.3% | 8,445 | 693 | 92.4% | 7.6% |
| PM | 12,781 | 10.2% | 8,070 | 4,711 | 63.1% | 36.9% |
| Purchasing | 1,196 | 1.0% | 1,184 | 12 | 99.0% | 1.0% |
| SPRDE (ST) | 480 | 0.4% | 416 | 64 | 86.7% | 13.3% |
| SPRDE (SE) | 34,501 | 27.4% | 32,385 | 2,116 | 93.9% | 6.1% |
| SPRDE (PSE) | 36 | 0.0% | 36 | 0 | 100.0% | 0.0% |
| T&E | 7,420 | 5.9% | 5,608 | 1,812 | 75.6% | 24.4% |
| Other | 129 | 0.1% | 129 | 0 | 100.0% | 0.0% |
| Not Listed | 897 | 0.7% | 817 | 80 | 91.1% | 8.9% |
| Unknown | 232 | 0.2% | 229 | 3 | 98.7% | 1.3% |
| Total | 125,879 | 100.0% | 110,934 | 14,945 | 88.1% | 11.9% |



AT&L Acquisition Workforce Career Fields

DEVELOPMENTAL TEST & EVALUATION

| Count and Composition Acquisition, Technology, and Logistics | | | | | |
|---|----------------|----------------|----------------|----------------|---------------|
| Service/Agency | 2005 | 2006 | 2007 | 2008 | 2008 (%) |
| Auditing | 3,536 | 3,486 | 2,852 | 3,638 | 2.9% |
| BCEFM | 8,119 | 7,747 | 7,387 | 7,085 | 5.6% |
| CON | 26,025 | 27,748 | 26,038 | 25,680 | 20.4% |
| FE | 8,356 | 3,927 | 4,394 | 4,920 | 3.9% |
| Property | 571 | 530 | 481 | 451 | 0.4% |
| IT | 5,472 | 4,843 | 4,423 | 3,934 | 3.1% |
| LCL | 12,493 | 12,332 | 12,604 | 13,361 | 10.6% |
| PQM | 9,397 | 8,966 | 8,364 | 9,138 | 7.3% |
| PM | 12,284 | 12,775 | 12,427 | 12,781 | 10.2% |
| Purchasing | 2,438 | 1,680 | 1,170 | 1,196 | 1.0% |
| SPRDE (ST) | 314 | 291 | 483 | 480 | 0.4% |
| SPRDE (SE) | 34,752 | 35,142 | 34,710 | 34,501 | 27.4% |
| SPRDE (PSE) | 0 | 0 | 0 | 36 | 0.0% |
| T&E | 7,384 | 7,280 | 7,419 | 7,420 | 5.9% |
| Other | 237 | 465 | 98 | 129 | 0.1% |
| Not Listed | 320 | 811 | 3,070 | 897 | 0.7% |
| Unknown | 2,672 | 219 | 112 | 232 | 0.2% |
| Total | 134,370 | 128,242 | 126,032 | 125,879 | 100.0% |



T&E Occupational Codes

DEVELOPMENTAL TEST & EVALUATION

| Top 5 OCC Series Test and Evaluation (Civilian) | | | |
|--|-------|-----------|----------------|
| OCC Series - Description | Total | Total (%) | Cumulative (%) |
| 0855 - Engineer, Electronics | 1,644 | 22.2% | 22.2% |
| 0801 - Engineer, General | 1,110 | 15.0% | 37.1% |
| 0830 - Engineer, Mechanical | 662 | 8.9% | 46.0% |
| 0861 - Engineer, Aerospace | 394 | 5.3% | 51.3% |
| 1515 - Operations Research Analyst | 389 | 5.2% | 56.6% |

#Occ Series in Career Field = 55



AT&L T&E Headcount by Component

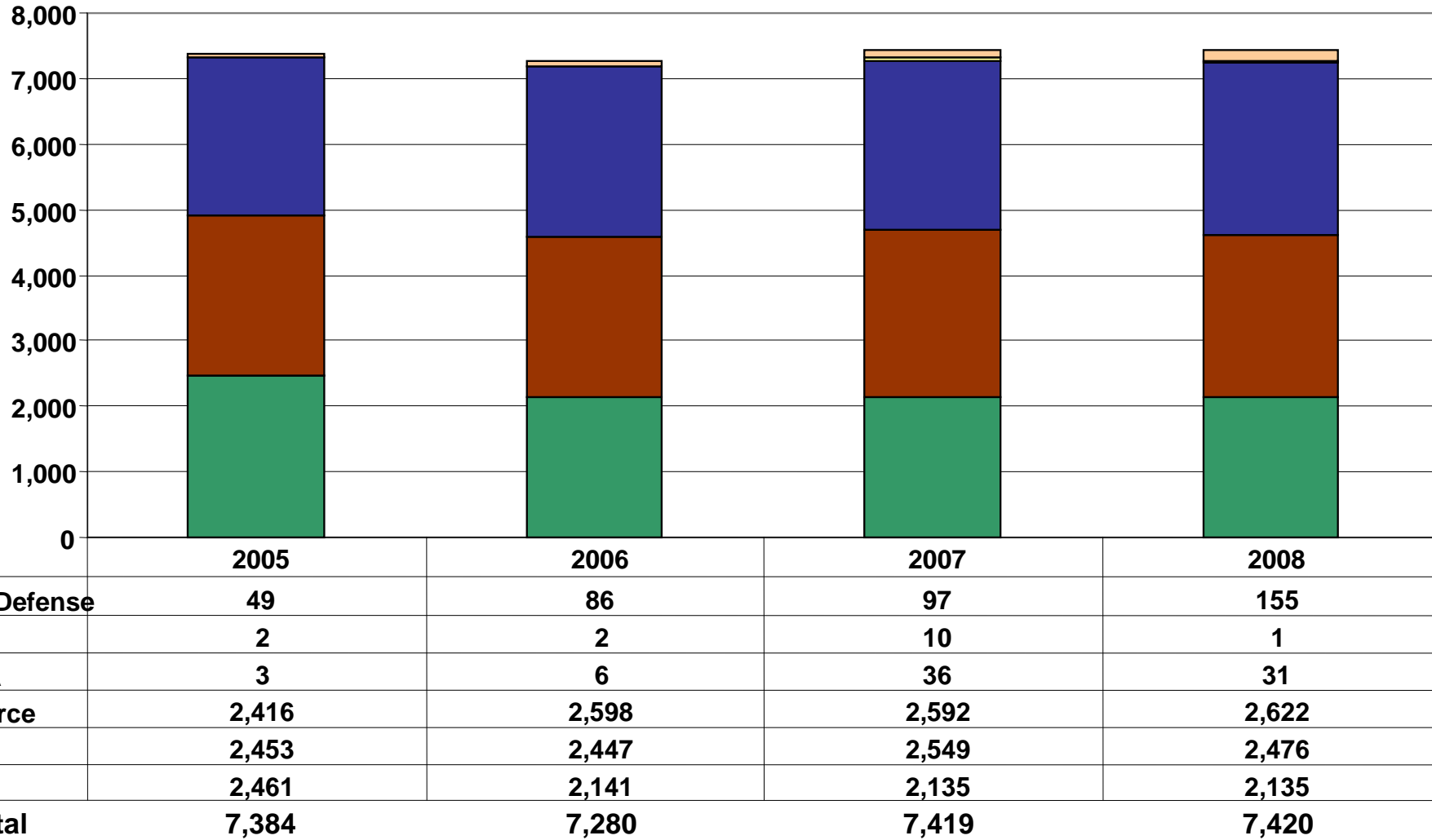
(As of End of FY2008)

DEVELOPMENTAL TEST & EVALUATION

| Count and Composition (FY08) Test and Evaluation | |
|--|-------------|
| Service/Agency | Count |
| Army | 2135 |
| Navy | 2360 |
| Marine Corps | 116 |
| Air Force | 2622 |
| Defense Contract Management Agency (DD63) | 31 |
| Defense Information Systems Agency (DD04) | 37 |
| Defense Logistics Agency (DD07) | 1 |
| Defense Threat Reduction Agency (DD61) | 11 |
| Dept of Defense Test Resource Mgmt Center (DD68) | 6 |
| Missile Defense Agency (DD27) | 86 |
| National Defense University (DD69) | 1 |
| Office of Inspector General (DD26) | 1 |
| Organization of the Joint Chiefs of Staff (DD02)/Defense System Management College | 6 |
| Under-Secretary of Defense/AT&L (OUSD/AT&L) | 7 |
| Total | 7420 |



Count and Composition Test and Evaluation





T&E acquisition work force composition by generations

DEVELOPMENTAL TEST & EVALUATION

| Generation | National Workforce* | | DoD Workforce (Civilian)** | | Defense Acquisition Workforce (Civilian)*** | | Defense Acquisition T&E Workforce (Civilian)**** | |
|--------------------------------|----------------------|-------------|----------------------------|-------------|---|-------------|--|-------------|
| | Workforce (millions) | % Workforce | Workforce | % Workforce | Workforce | % Workforce | Workforce | % Workforce |
| Traditional (born before 1946) | 7.4 | 4.8% | 45,625 | 6.7% | 6,624 | 5.9% | 237 | 4.2% |
| Baby Boomers (1946-64) | 56.7 | 36.5% | 438,971 | 64.5% | 74,887 | 67.3% | 3,327 | 59.3% |
| Generation X (1965-76) | 41.8 | 26.9% | 132,948 | 19.5% | 18,544 | 16.7% | 1,127 | 20.1% |
| Generation Y (1977-1989) | 42.8 | 27.5% | 62,676 | 9.2% | 11,286 | 10.1% | 921 | 16.4% |
| Millenium (1990-present) | 6.6 | 4.3% | 153 | 0.0% | 0 | 0.0% | 0 | 0% |

Notes:

*Source: Projected 2010 workforce size - DAU analysis using Bureau of Labor Statistics workforce participation data (Dec 2007) & US Census Bureau population data (2004) (best available data from agency web sites as of July 2008)

**Source: OSD P&R Report: DoD Civilian Workforce Statistics/DoD Demographics/May2006 Edition

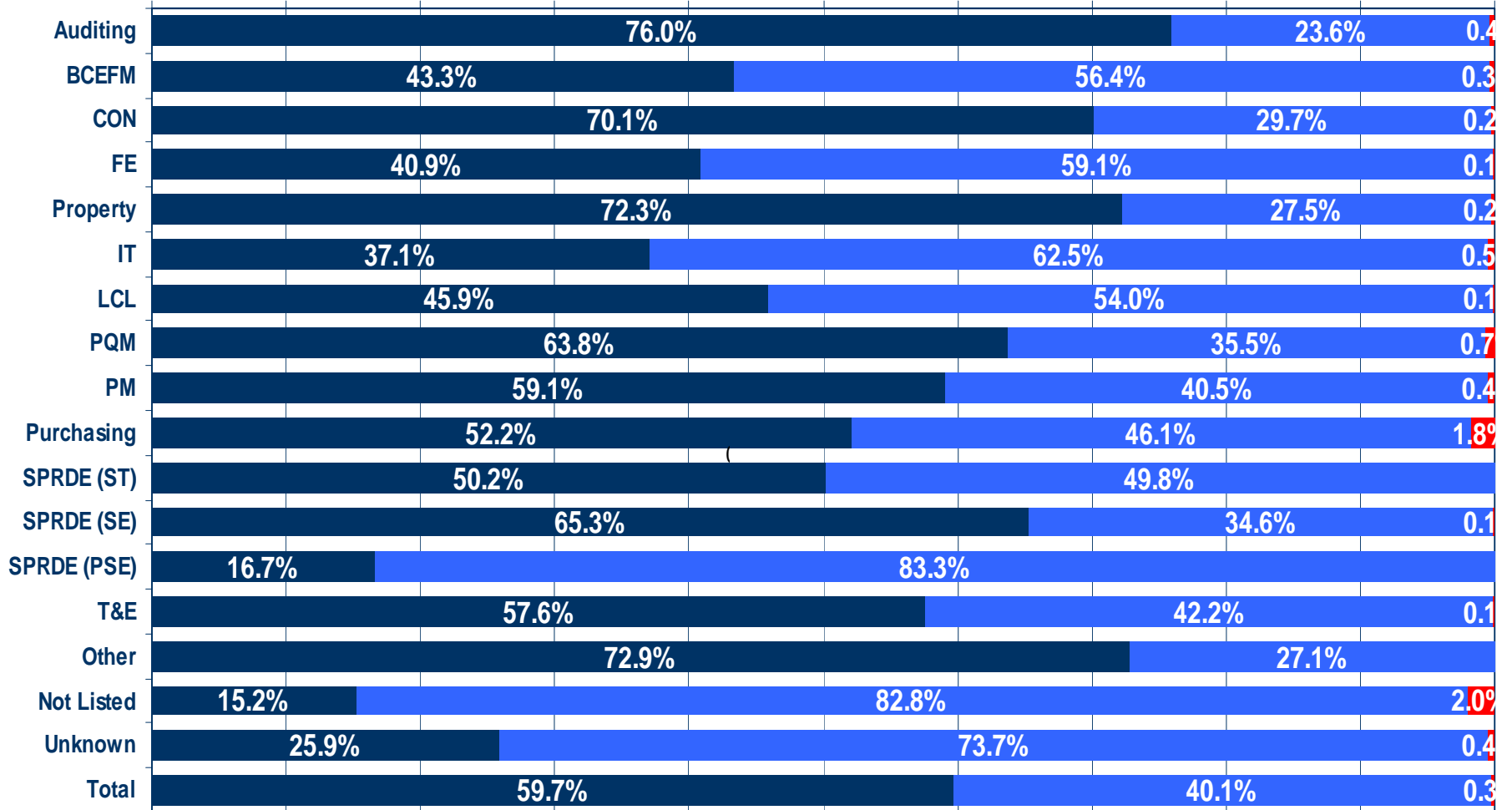
***Source: AT&L Datamart FY07 AT&L Workforce Count/AT&L workforce data; does not contain 456 files with null for age

****Source: AT&L Datamart FY07 AT&L Workforce Count/BCEFM workforce data; does not contain 12 files with null for age

Certification Rates by Career Field

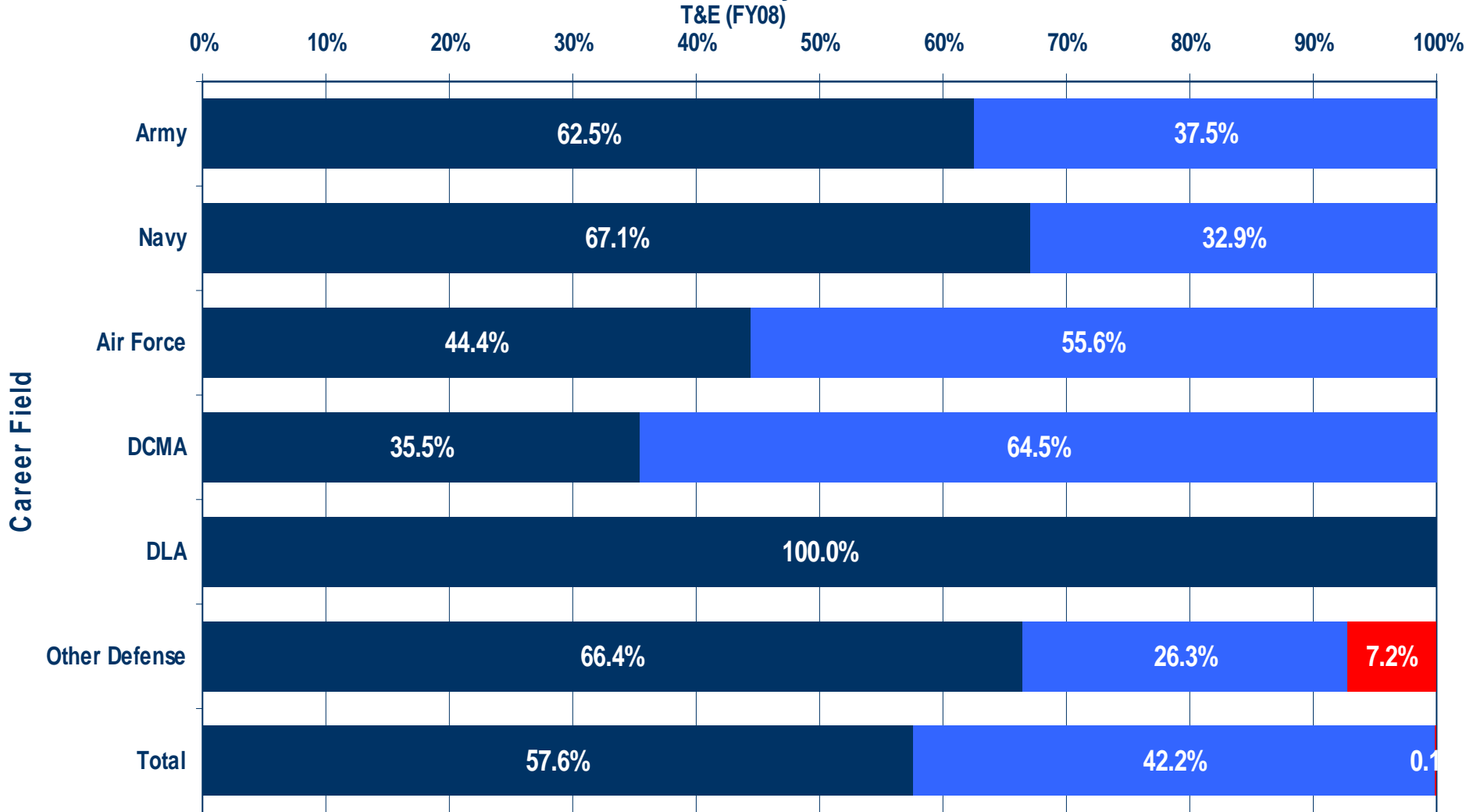
AT&L (FY08)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%



- Meets or exceeds position certification requirements
- Position certification requirements Not Met*
- Unknown

Certification Rates by Career Field



- Meets or exceeds position certification requirements
- Position certification requirements Not Met*
- Unknown

*The "Not Met" category includes workforce members who have been in their positions for less than 24 months.

These workforce members are in a "Grace Period" and in compliance with DAWIA policy

Source: AT&L Workforce Datamart



DEVELOPMENTAL TEST & EVALUATION

NUMBERS

COMPOSITION

AGE

WHAT WILL TOMORROW'S T&E ACQUISITION WORKFORCE LOOK LIKE

RETENTION

CERTIFICATION



Tomorrow's T&E Challenges

DEVELOPMENTAL TEST & EVALUATION

- DoDI 5000.02 Changes affecting T&E mission:
 - Materiel Development Decision Review
 - Competitive Prototyping
 - More Frequent Program Reviews
 - Configuration Steering Boards
 - Integrated DT and OT



SEC. 852. DoD ACQUISITION WORK FORCE DEVELOPMENT FUND NDAA FY 2008

DEVELOPMENTAL TEST & EVALUATION

”...(a) Establishment- The Secretary of Defense shall establish a fund to be known as the `Department of Defense Acquisition Workforce Fund' (in this section referred to as the `Fund') to provide funds, in addition to other funds that may be available, **for the recruitment, training, and retention of acquisition personnel of the Department of Defense.**”



SEC. 852. DoD ACQUISITION WORK FORCE DEVELOPMENT FUND NDAA FY 2008

DEVELOPMENTAL TEST & EVALUATION

- **Eleven Initiative areas to focus fund allocation for training, retention, and recruitment**
- **Components and Agencies to identify specific items for each Initiative for its acquisition career fields**

| | |
|----|--|
| 1 | Training Enhancement & Capacity Expansion |
| 2 | Comprehensive Acquisition Workforce and Student Information System |
| 3 | Competency Management & Assessments |
| 4 | Workforce Planning - Pilot Program |
| 5 | Retention and Recognition Incentives |
| 6 | Career Broadening and Academic Programs |
| 7 | Intern Programs |
| 8 | Recruiting Incentives |
| 9 | Outreach Programs |
| 10 | Journeyman Hiring |
| 11 | Highly Qualified Experts (HQE's) |



Tomorrow's T&E Workforce

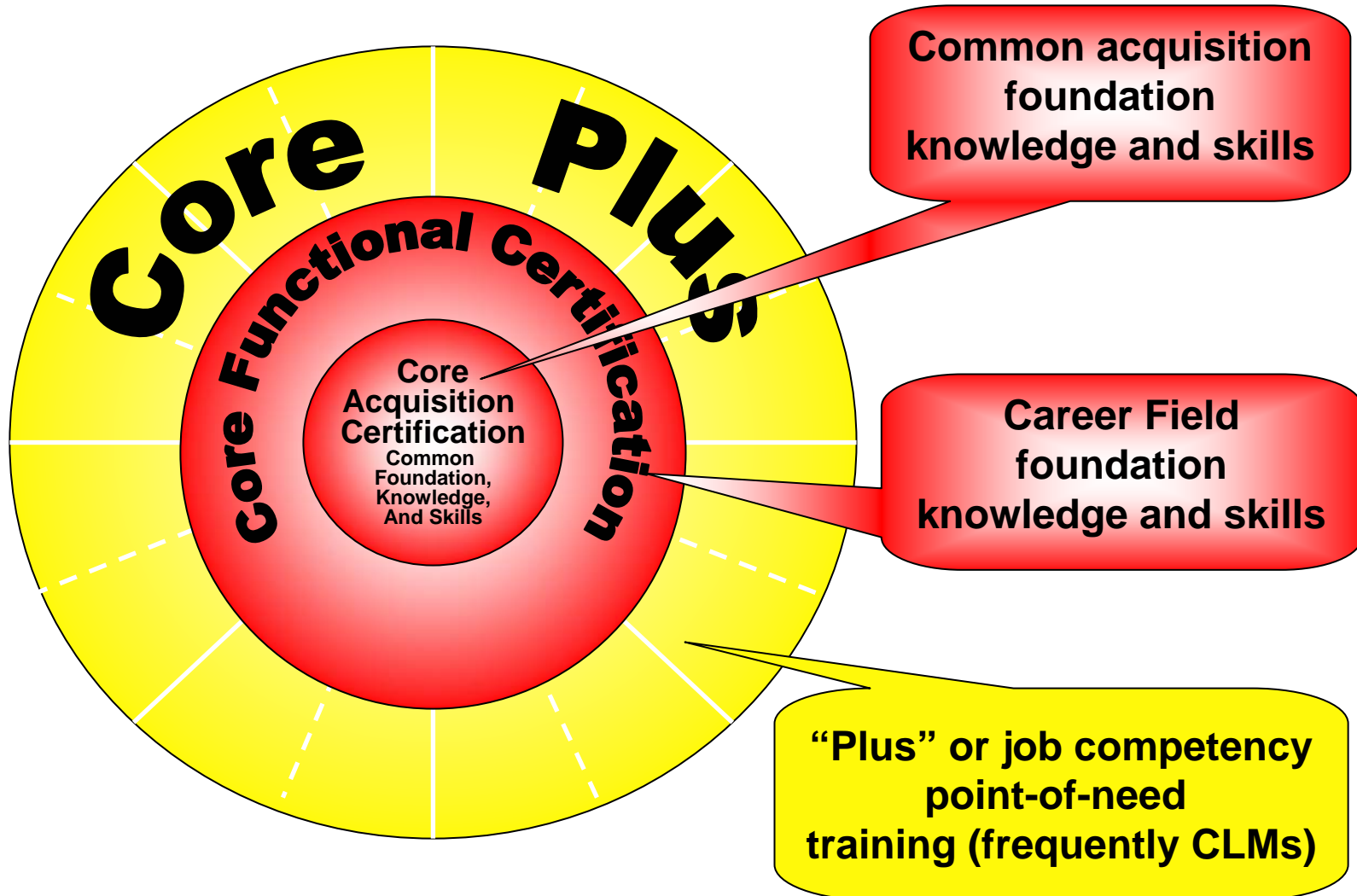
DEVELOPMENTAL TEST & EVALUATION

- Size – About the same total number
- Composition - Divided along the same Component/Agency Lines
- Age – Younger
- Retention - Current economy will slowdown retirements
- Competency – More Focused



Education & Training

DEVELOPMENTAL TEST & EVALUATION





Core Plus Guide

DEVELOPMENTAL TEST & EVALUATION

Program Management (Advanced) Level III

Type of Assignment

| Type of Assignment | Representative Activities |
|---------------------------|---|
| Weapon Systems | IPT lead & oversight, pre-award contract matters, financial management, risk management, systems engineering, total ownership cost, contract coordination, & communications. As appropriate, coordination on net-centric technology as a key enabler that allows a C2 capability to operate in the joint operational environment and force protection with a minimally sized forward footprint; or oversight and/or management of significant segments of a DoD Space MDAP. |
| Services | DoD professional, admin & mgmt support service contracting as relates to developing clearly stated & actionable requirements packages, coordination with local Procurement Contracting Officers and ensuring opportunities for socio-economic business concerns. Performs all Acquisition Strategy Requirements actions noted in Attachment 1 to AT&L Services Memo of 10/2/06. |
| Business Mgt Systems/IT | Transformation integration, planning and performance, and investment management as applies to the acquisition community, program office(s) & system(s) under development. |
| International Acquisition | Groundwork for future cooperation during pre-system acquisition or participated in successful cooperative development or production partnerships during system acquisition with allied & friendly foreign nation. Participation in successful cooperative development or production partnership during pre-system acquisition or system acquisition with allied & friendly foreign nations. Other type of assignment also applies. |

Core Certification Standards

| Core Certification Standards ¹ | |
|---|---|
| Acquisition Training ² | None Required |
| Functional Training ² | <ul style="list-style-type: none"> PMT 352A: Program Management Office Course PMT 352B: Program Management Office Course CR SYS 202: Intermediate System Planning, Research, Development, & Engineering (Required for certification on 4/1/08) |
| Education | Formal education not required for certification. |
| Experience | <ul style="list-style-type: none"> 4 years acquisition experience with at least: <ul style="list-style-type: none"> 2 years in a program office/similar organization (dedicated matrix support to a PM, PEO, DCMA Program Integrator, or Supervisors of Shipbuilding) 1 year in a program management position with cost, schedule, and performance responsibilities |

Unique Position Training Standards

| Unique Position Training Standards ³ | |
|---|--|
| PEOs; PM/DPM of MDAP/MAIS; PM/DPM of Significant Non Major Programs | PMT 401: Program Mgr's Course CR and PMT 402: Executive Program Mgr's Course CR; OR PMT 302: Advanced PM Course and PMT 402: Executive Program Mgr's Course CR |

Core Plus Development Guide

| Core Plus Development Guide ⁴ | Type Assignment | | | | |
|--|-----------------------|----------------|----------|-------------------|---------------|
| | Training ² | Weapon Systems | Services | Business Mgmt, IT | International |
| ACQ 452: Forging Stakeholder Relationships CR | X | | X | X | |
| BCF 206: Cost Risk Analysis CR | X | | X | X | |
| BCF 207: Economic Analysis CR | X | | X | X | |
| BCF 209: Acquisition Reporting for Major Defense Acquisition Programs CR | X | | | X | |
| IRM 201: Intermediate Information Systems Acquisition CR | X | | X | X | |
| LOG 200: Intermediate Acquisition Logistics, Part A | X | | X | | |
| LOG 204: Configuration Management | X | | | X | |
| LOG 235: Performance Based Logistics, Part A | X | | X | | |
| LOG 236: Performance Based Logistics, Part B CR | X | | X | | |
| PMT 304: Advanced International Management Workshop CR | | | | | X |
| PMT 403: Program Manager's Skills (ACAT III only) CR | X | | X | X | |
| PQM 201A: Intermediate Production, Quality & Manufacturing, Part A | X | | | | |
| SAM 301: Advanced Software Management CR | X | | X | X | |
| SYS 203: Intermediate SPRDE Part B CR | X | | | | |
| TST 202: Intermediate Test & Evaluation CR | X | | | | |
| CLC 032: Understanding & Utilizing Performance Based Payments | X | | X | | |
| CLE 008: Six Sigma: Concepts and Processes | X | | X | X | |
| CLL 201: Diminishing Mfg Sources & Materials Shortages Fundamentals | X | | X | X | |

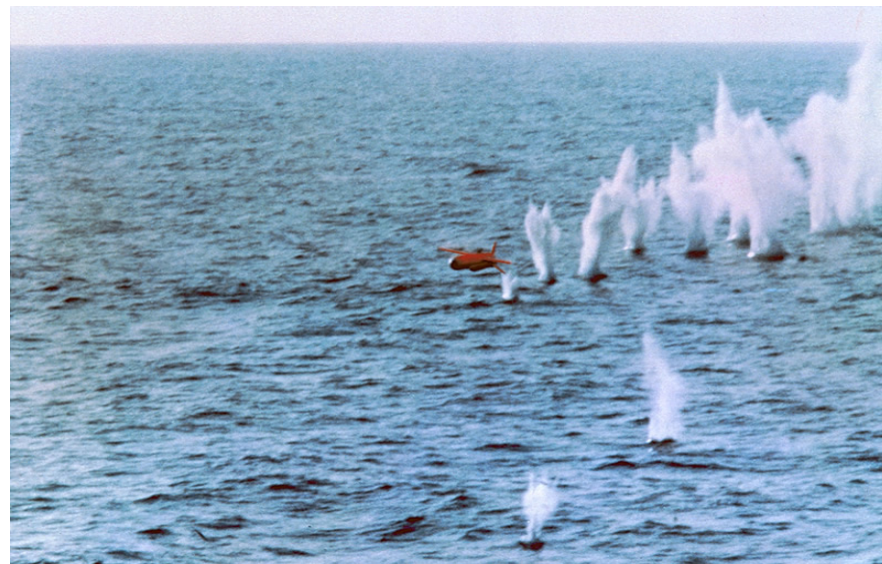
Footnotes

| Education |
|---|
| At least 24 semester hours from among accounting, business finance, law, contracts, purchasing, economics, industrial management, marketing, quantitative methods, and organization and management (DANTES equivalency may be substituted). |
| Experience |
| 2 additional years of acquisition experience |
| ¹ These Standards list the training, education and experience required for certification at this level. |
| ² A "CR" following a course title indicates the course is delivered as resident based instruction. |
| ³ Workforce members assigned to the position(s) identified must meet the training standard(s) identified within six (6) months of assignment. |
| ⁴ When preparing your IDP, you and your supervisor should consider the training, education and experience listed in this and the lower level Core Plus Developmental Guides if not already completed. |



Summary

DEVELOPMENTAL TEST & EVALUATION



In Summary

The T&E Acquisition Work Force has and will continue to adjust and learn new skills, as necessary, to meet the product and system acquisition challenges, and provide accurate and complete performance and risk assessments decision-makers require



DEVELOPMENTAL TEST & EVALUATION

Ms. Darlene Mosser-Kerner

703-697-3406

DSN: 227

Darlene.mosser-kerner@osd.mil

Visit Our Website

<http://www.acq.osd.mil/sse/dte/>



BACK-UP CHARTS



SEC 852 Initiative Focus Areas

DEVELOPMENTAL TEST & EVALUATION

- **Line Item 1: Training Enhancement and Capacity Expansion.**
- Initiatives in this line item will provide additional throughput, curriculum development and other learning support to meet previously unmet demand. There is a gap between the Components' demand for certification and assignment-specific training and the capacity of the Defense Acquisition University to provide training. In addition, the Components have identified unique Component requirements that will be funded.
- **Line Item 2: Comprehensive Acquisition Workforce and Student Information System.**
- Initiatives in this line item will provide a single clearinghouse for workforce data, the statutorily mandated workforce management information system, and a commercial best-in-class student information system. The objective is to drive standardization, integrate systems, build transparency, and improve data quality, and ensure a comprehensive workforce analysis capability. This will enable strategic workforce planning and decision making capability. This line item will ensure current, accurate and transparent information is available on the Defense acquisition workforce for acquisition leaders.



SEC 852 Initiative Focus Areas

DEVELOPMENTAL TEST & EVALUATION

- **Line Item 3: Competency Management and Assessments.**
- Initiatives in this line item will provide a standardized competency management program, validated competency models for all career fields, tools to produce individual development plans, the ability to determine training needs, and support for human capital planning. The Department is committed to an enterprise competency management and workforce assessment capability. This will improve the Department's ability to appropriately identify workforce skill gaps, requirements, and needed learning assets.
- **Line Item 4: Workforce Planning Pilot Program.**
- This Air Force pilot initiative is being worked with OPM to develop a human capital architecture that includes interview tools, occupational questionnaires, and job previews. If successful, it has the potential to enable acquisition centers to deploy competency-based tools and create organization specific recruitment and retention strategies. A key outcome will be tailored succession plans that will help acquisition organizations transition from their current state to their forecasted "to be" mission.



SEC 852 Initiative Focus Areas

DEVELOPMENTAL TEST & EVALUATION

- **Line Item 5: Retention and Recognition Incentives.**
- Initiatives in this line item will retain high performers with critical skills and in key leadership positions and improve retention in positions that are in short supply through incentives and programs designed to make a career in DoD acquisition more attractive. The forecasted loss of corporate knowledge and expertise has the potential to significantly impact the ability of the acquisition workforce to carry out its mission of achieving successful acquisition outcomes.
- **Line Item 6: Career Broadening and Academic Programs.**
- Initiatives in this line item will provide developmental assignments, rotations, programs at academic institutions, training outside one's current specialization, and opportunities to acquire joint and interagency experience. The legacy career structure for civilian employees has emphasized depth over breadth, which results in a "silo" framework that inhibits the broader perspective needed to manage complex acquisition programs. A more attractive career structure, which will improve retention in the acquisition workforce, is one that provides breadth of experience, training and education.



SEC 852 Initiative Focus Areas

DEVELOPMENTAL TEST & EVALUATION

- **Line Item 7: Intern Programs.**
- Initiatives in this line item will: 1) recruit, hire and develop interns to be better qualified at the point of migration into the acquisition workforce; and 2) augment the current workforce in numbers above the currently programmed levels. Seventy-three percent of the current Defense acquisition workforce are in the Baby Boomer and Traditional generations and 19 percent (20,000 civilians) are eligible for full retirement. At the same time, there are skill and competency areas within the current workforce that have too few people and need to be built up.
- **Line Item 8: Recruiting Incentives.**
- Initiatives in this line item seek to attract qualified applicants in such critically needed areas as Science, Technology, Engineering, and Mathematics (STEM), minority applicants, and recent college graduates. This complements other hiring initiatives by enabling DoD to more effectively hire high demand talent in an increasingly competitive labor market. Hiring incentives include first-duty-station PCS moves, hiring bonuses, student-loan reimbursement, tuition assistance, scholarships, and SCEP (formerly Co-op) programs.



SEC 852 Initiative Focus Areas

DEVELOPMENTAL TEST & EVALUATION

- **Line Item 9: Outreach Programs.**
- Initiatives in this line item will deliberately market the DoD acquisition community as an employer of choice. It is a DoD goal to maintain a diverse, capable, and ready civilian and military workforce, which this line item will support. According to the Gallup poll conducted for the Council for Excellence in Government, DoD is one of the most attractive brand names in the federal government. However, the acquisition community needs to be more active in reaching out to prospective employees. A preferred approach is to leverage federal, DoD P&R, and Component programs to improve the supply of quality candidates.
- **Line Item 10: Journeyman Hiring Programs.**
- Initiatives in this line item will target experienced employees, such as retiring military and seasoned industry candidates. Workforce analysis indicates a need for mid-career hires to complement our intern initiatives and to ensure strong bench strength to fill senior and executive positions as the Baby Boomer and Traditional generations depart the workplace.
- **Line Item 11: Hiring Expert Knowledge – Highly Qualified Experts (HQE).**
- Initiatives in this line item are to hire temporary employees for up to five years. In many cases, there is a need for people with special expertise who are already at a senior level and are recognized experts in an acquisition field or related discipline. HQEs are hired under a special hiring authority granted by Congress. This line item complements other hiring initiatives.



Extending Test and Evaluation Modeling and Simulation Capabilities with Gaming Technology

**NDIA National Test & Evaluation
Conference
2-5 March 2009**



Agenda



- Purpose
- Current Efforts
- TTEC Integration Facility
- Gaming Technology
- Simulation and Gaming
- Cost Benefit
- Future Work
- Summary



Purpose

To provide information on the collaborative efforts between OTC and TRADOC to integrate gaming technology into OTC's test technology enterprise to provide more capable simulation and visualization tools for use by the Testing and Evaluation community.



Current Efforts

- Technology Transformation Division (TTD) of the US Army Operational Test Command (USAOTC).
 - Federates models and simulations to form a tool kit of Enterprise Members (OASIS) for use by Test Officers and Operational Research/System Analysts
 - Integrates tools from various battlefield areas to provided an adjustable set that maximizes the strengths of each while minimizing any shortcomings of the individual simulations.
- TRADOC Capabilities Manager (TCM) Gaming.
 - Manages gaming technology fielded to units for use in training.
 - Provides terrain and entity data.



History

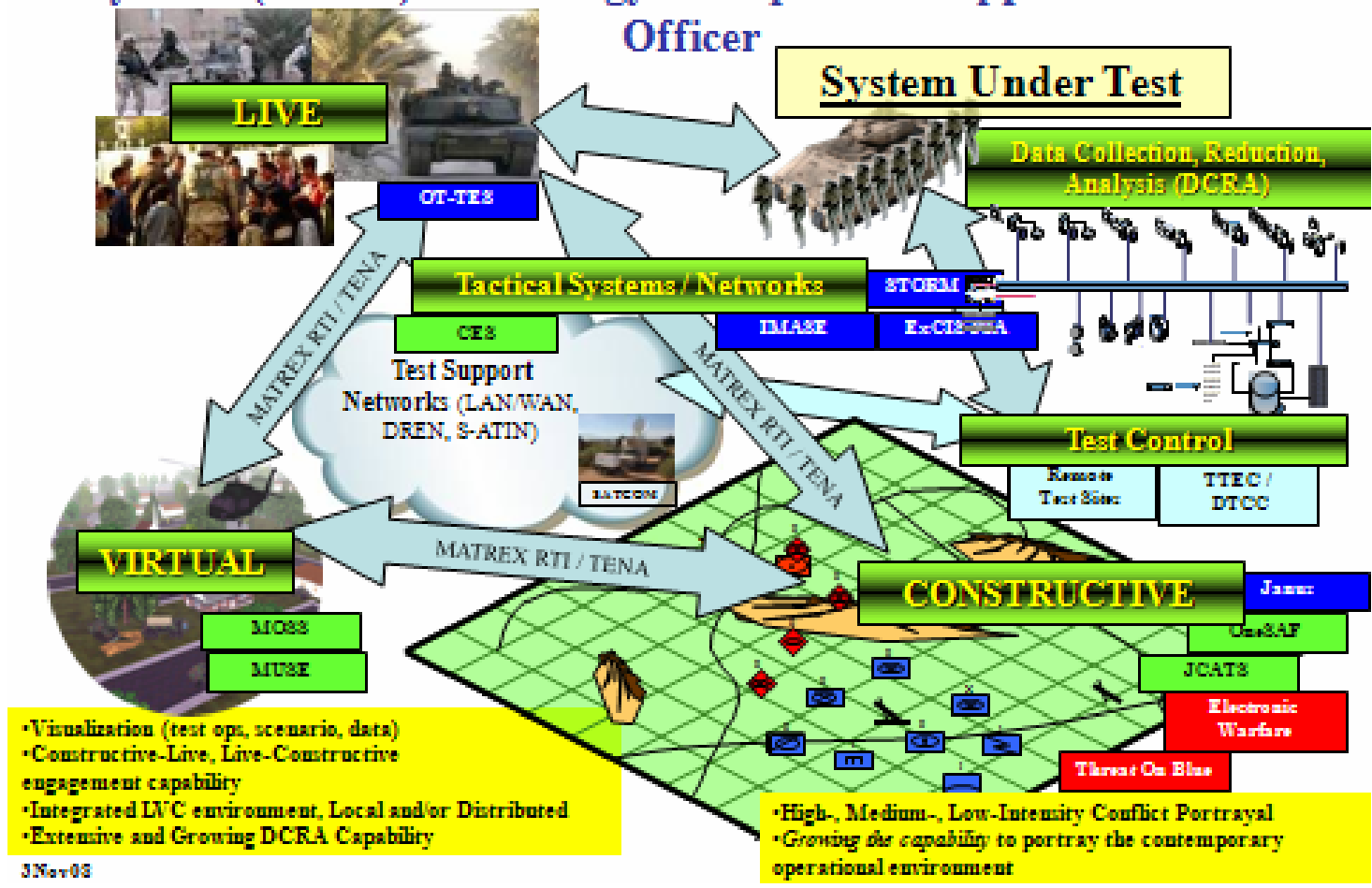


- OTC has over 20 years of experience collaborating with the training domain to share knowledge and costs to economically federate simulations



OASIS

OV-1: OTC's Advanced Simulation and Instrumentation Systems (OASIS) Technology Enterprise in Support of the Test Officer



33Nov03



Gaming Technology



- Off the shelf simulation developed by industry .
- Ability for individual and small unit leaders to act in a first person fashion under battlefield conditions and refine their Tactics, Techniques and Procedures (TTP).
- Training tool with Test and Evaluation applications.
- Visualization tool for the unit under test and for the test officer.



Test Technology Execution Center Integration Facility

- Works to keep simulations updated and exchanging data.
- Brings simulations into common language; i.e. Distributed Interactive Simulation (DIS), High Level Architecture (HLA), MATREX.
- Links technology provided by TRADOC TCM Gaming to OTC tools.



Constructive View



JANUS
CONTROLLER WS

CURRENT FORCE

SIDES: 1 2 3 4 5 6
FLOOR: 01

Clouds Obstacles

Display Janus
Select Force
Routes
Draw Plots
Draw CAC
View
Deagg
MAGIC
Re-Org
PLOTS Options

Counted Losses

| | DF | IF | RF | CH | TOTAL |
|---|----|----|----|----|-------|
| 1 | | | | | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |
| 6 | | | | | |

Zoom 1000 PREV NEXT M

CLEAR GRID HELP [D] [M] [Z]

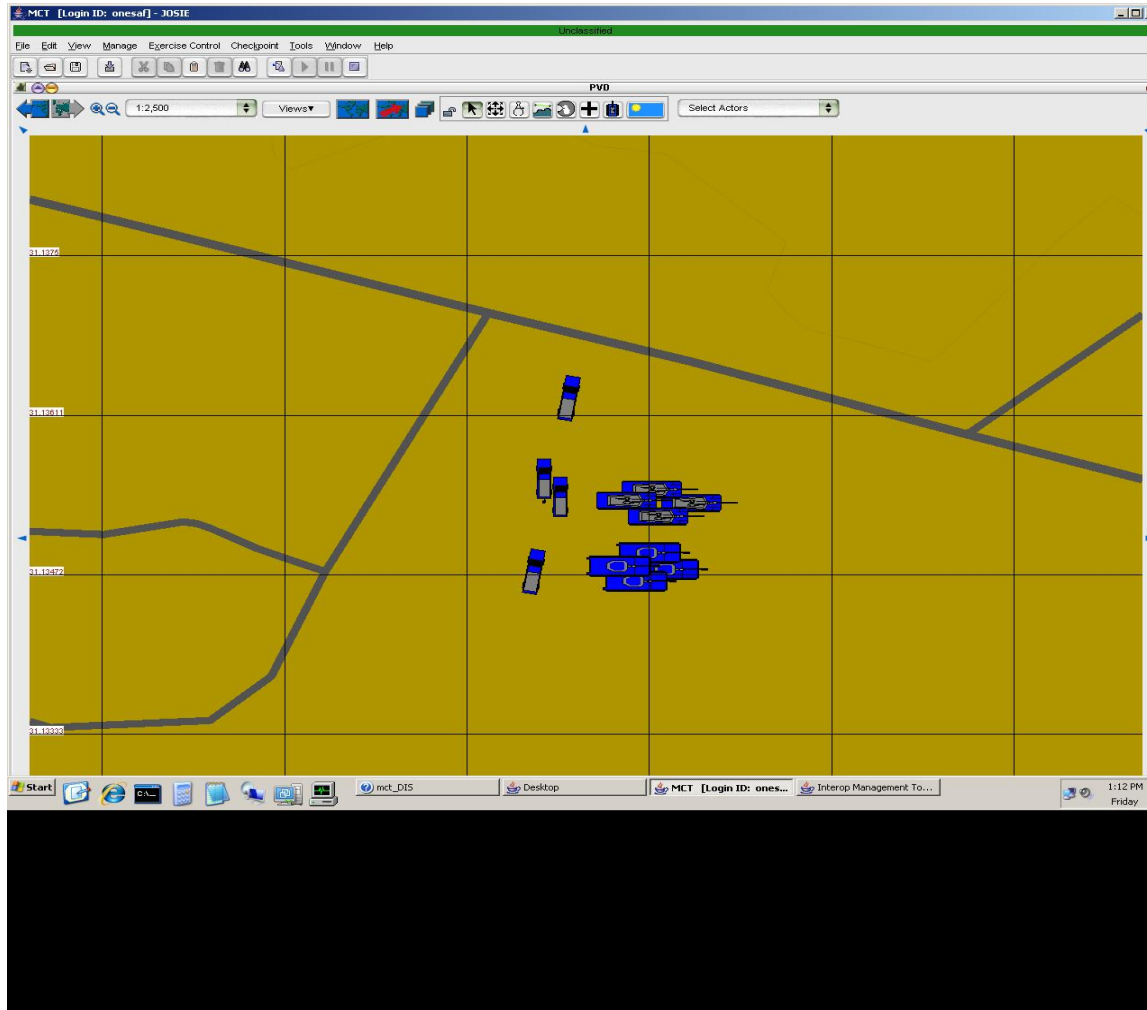
ADORN CAC HULKS

Time of Day Day Hrs Min Sec
0903 03:56





Updated Constructive View





Gamer's View



Fuel
Health

1

Alt. 4145ft
Set 9843

Speed 50kts
Set 153

Position
13684383

7.9x

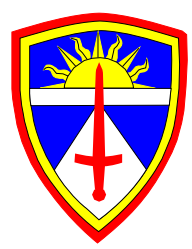
12:28:49
Sun, Mar 1

Exit remote control



Cost Benefit

- No development costs.
- Minimal integration cost.
- Test units already know the gaming simulation
- Much more credible set of observations than previously available to those watching the simulation.
- Augment simulation quantitative data with more valuable qualitative data for eventual use by the evaluation team.



Future Work

- Utilize latest gaming from TRADOC TCM after next selection decision.
- Adapt to latest US Army simulations when fielded.
- Continue use of latest integration language.



Summary



Gaming technology can provide a powerful solution to some gaps when federated with existing simulations and data collection systems used within the Test and Evaluation Community.



An Enhanced Analysis of Alternatives (AoA)

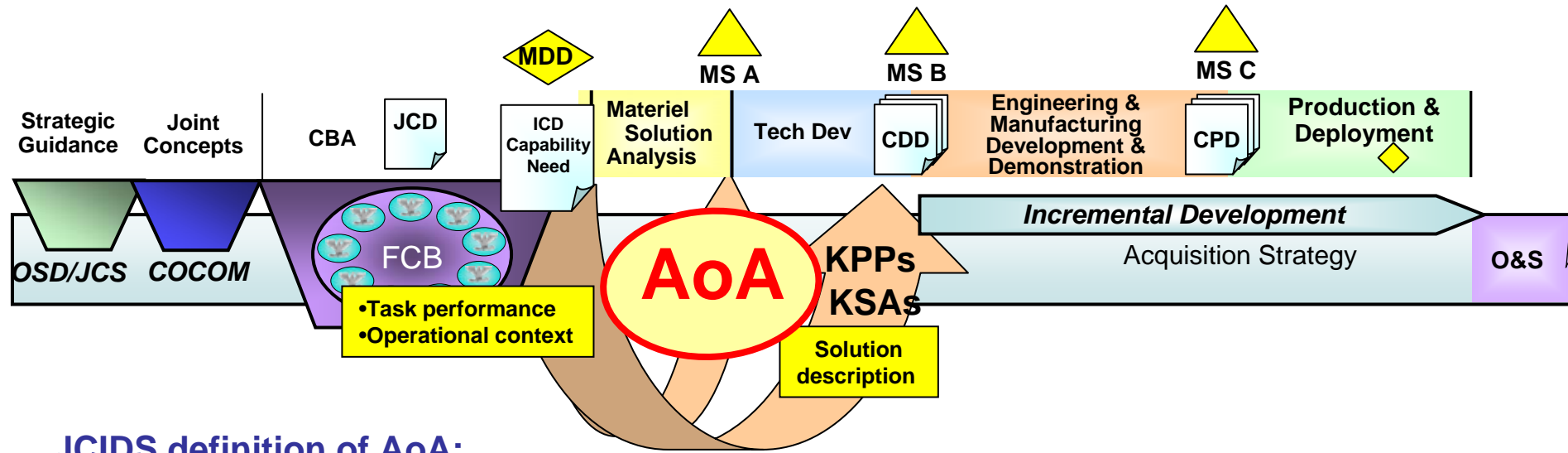
A Mission-Oriented, Evaluation-Based Framework for Defense Test & Evaluation

NDIA

March 2-5, 2009

Role of the Analysis of Alternatives (AoA)

Analysis of Alternatives (AoA)
 Translates tasks to be performed in an operational context into a system “solution” for acquisition

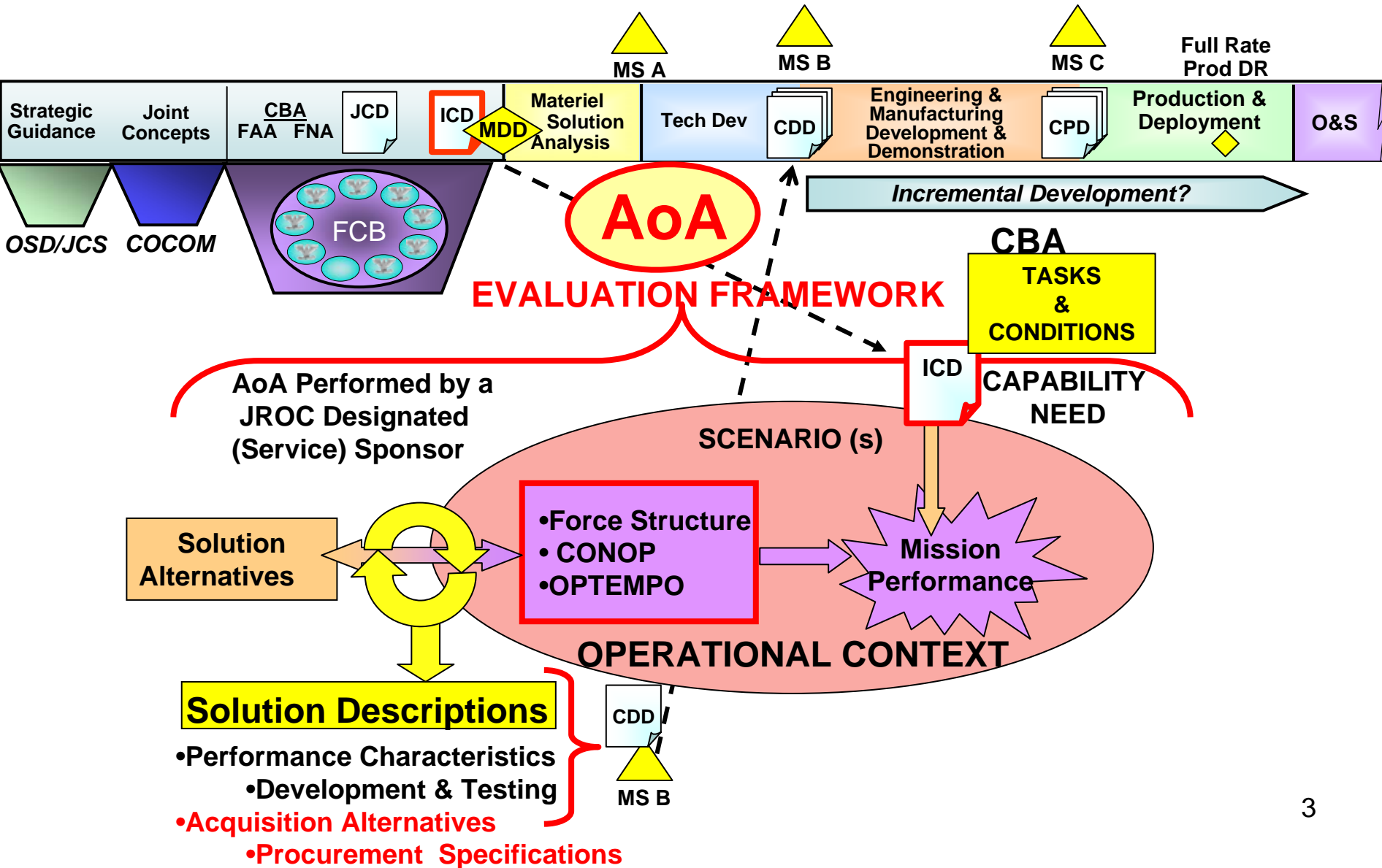


JCIDS definition of AoA:

*“The **evaluation** of the performance, operational effectiveness, operational suitability, and estimated costs of alternative systems to meet a mission capability.**The AoA is one of the key inputs to defining the system capabilities in the Capability Development Document (CDD)**”*

Insights Needed to Build a TEMP

AoA Methodology



A Review of AoAs

- **Reviewed AoAs**
 - AoAs Done Between 2003 and 2008 AND Done for DOT&E Oversight List Programs
- **Implications for T&E:**
 - Each Contains a Description of an **Operational Context** Potentially Useful to T&E Planning
 - Scenario, Forces, Objectives CONOPS, Climate, OPTEMPO, etc
 - Each includes a **“Sensitivity Analysis”** (SA) Relating System Performance to Mission Accomplishment

HOWEVER: SAs do NOT Relate Variations in System Characteristics Performance to Mission Effectiveness

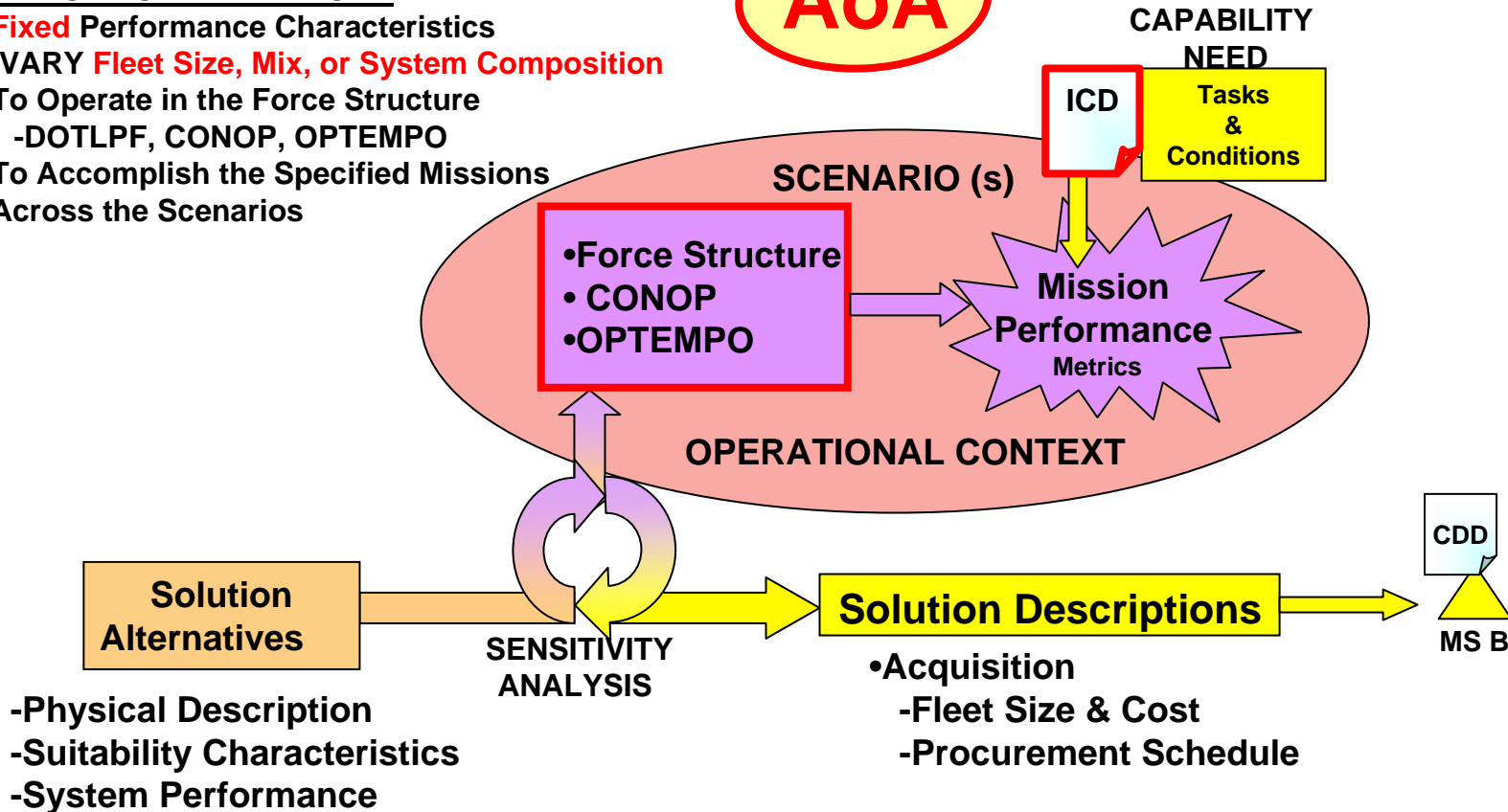
 - SAs Treat Performance Characteristics as “Fixed”;
 - Used to Derive System Fleet Size or System Configurations of Fixed Components for “Mission Accomplishment” Across Varied Scenarios
 - **AoA Informs a System Acquisition Strategy**
 - » A “Packing Algorithm” Paradigm: “How Many “Systems as Defined” are Needed, When, for Mission Success and at What Cost
 - **AoA Does NOT Recognize T&E as a Customer**
 - » T&E Examines System and Component Characteristics Performance relative to Mission Effectiveness measures

Analysis of Alternatives (AoA) Requirements-Based

EVALUATION FRAMEWORK

- **Fixed** Performance Characteristics
- VARY **Fleet Size, Mix, or System Composition**
- To Operate in the Force Structure
 - DOTLPF, CONOP, OPTEMPO
- To Accomplish the Specified Missions
- Across the Scenarios

AoA

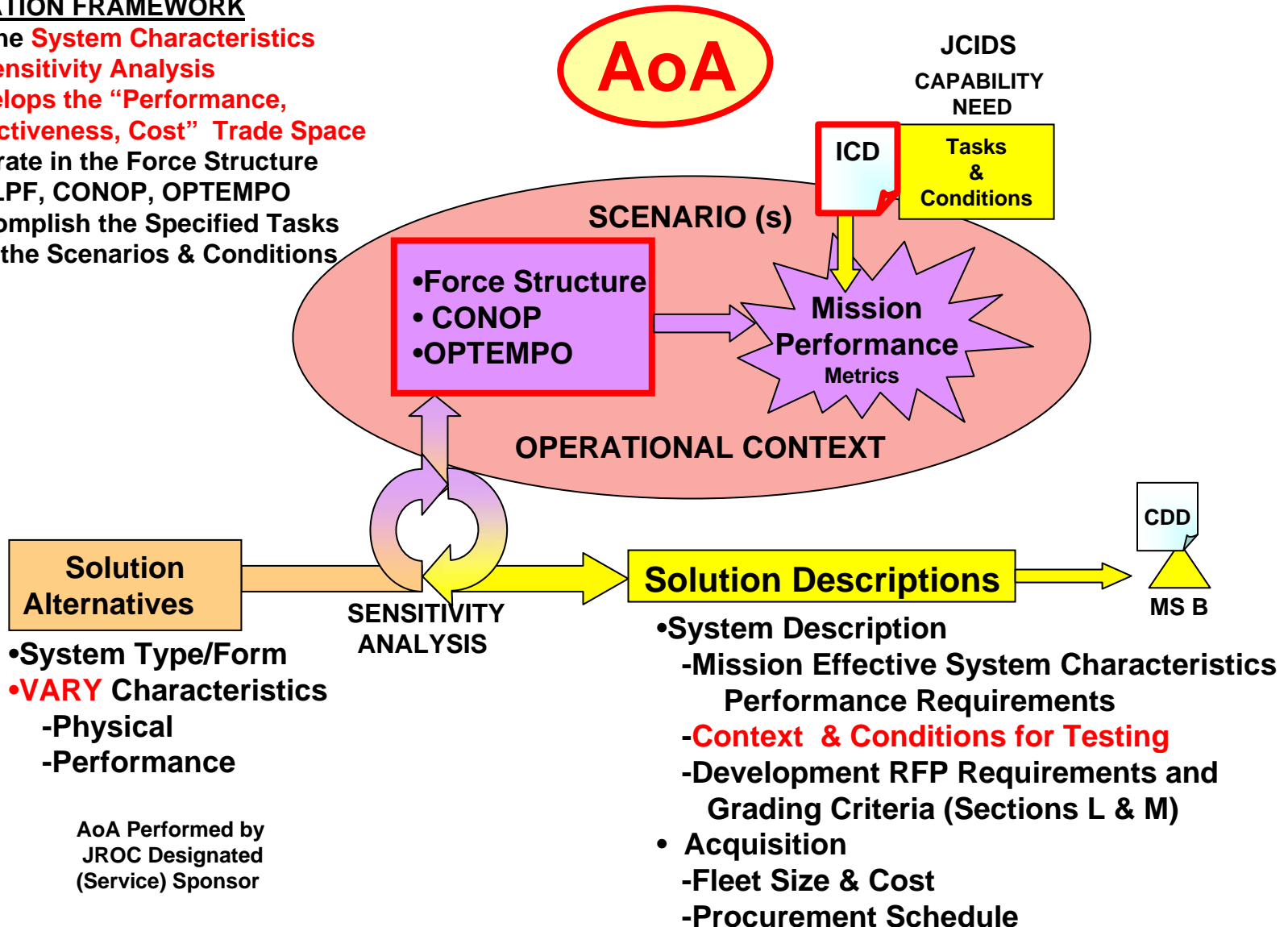


AoA Performed by
JROC Designated
(Service) Sponsor

An **Enhanced** Analysis of Alternatives (AoA) Capability-Based Sensitivity Analysis

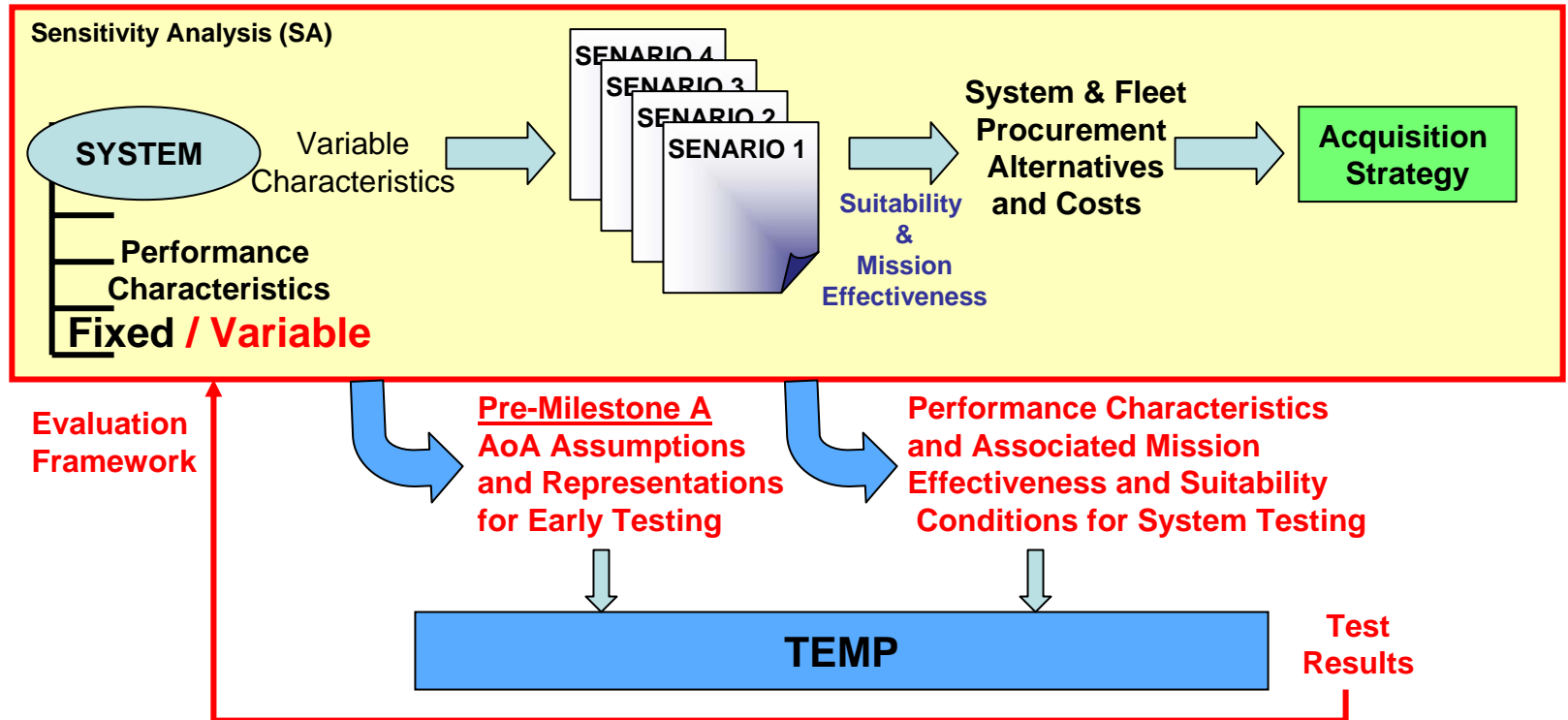
EVALUATION FRAMEWORK

- **VARY** the **System Characteristics**
In the Sensitivity Analysis
 - Develops the “Performance, Effectiveness, Cost” Trade Space
- To Operate in the Force Structure
 - DOTLPF, CONOP, OPTEMPO
- To Accomplish the Specified Tasks
- Across the Scenarios & Conditions



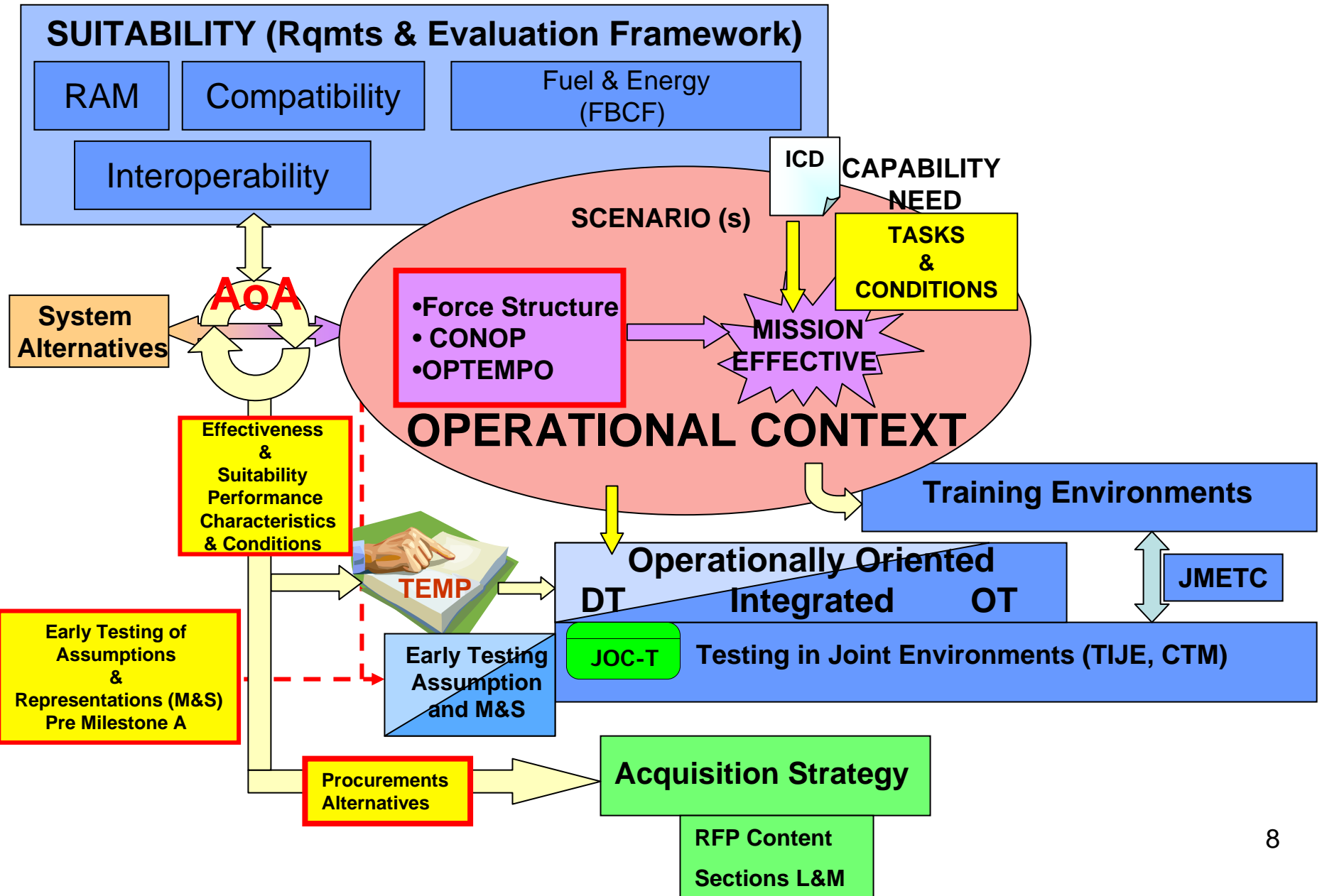
Treats System Performance Characteristics as Variables in the AoA / SA

Enhanced AoA





An Enhanced AoA an Integrating Process





T&E Benefits from an Enhanced AoA

- Enhanced Description of the Operational Context
 - For use in the AoA
 - For deriving operational environments for testing
 - For integrating development and operational test planning
- Consistent Validated Evaluation Framework
 - For systems design, testing, and assessment of system and mission cost / effectiveness
 - MDA better informed for Confidence in the System and for mitigating any performance deficiencies
- More Comprehensive and Effective Test Planning
 - Enhancing Confidence in the AoA
 - Early testing of key AoA assumptions and representations
 - Responsive to pre-Milestone A program reviews
 - Tasking and Resource Planning in the TEMP
 - » For M&S in the AoA
 - » For M&S supporting DT and OT events
 - Mission Oriented, Evaluation Based Test Planning
 - Testing integrated with the AoA
 - Testing focused on most important performance characteristics and conditions
 - Test results evaluated for mission effectiveness in the AoA analysis framework

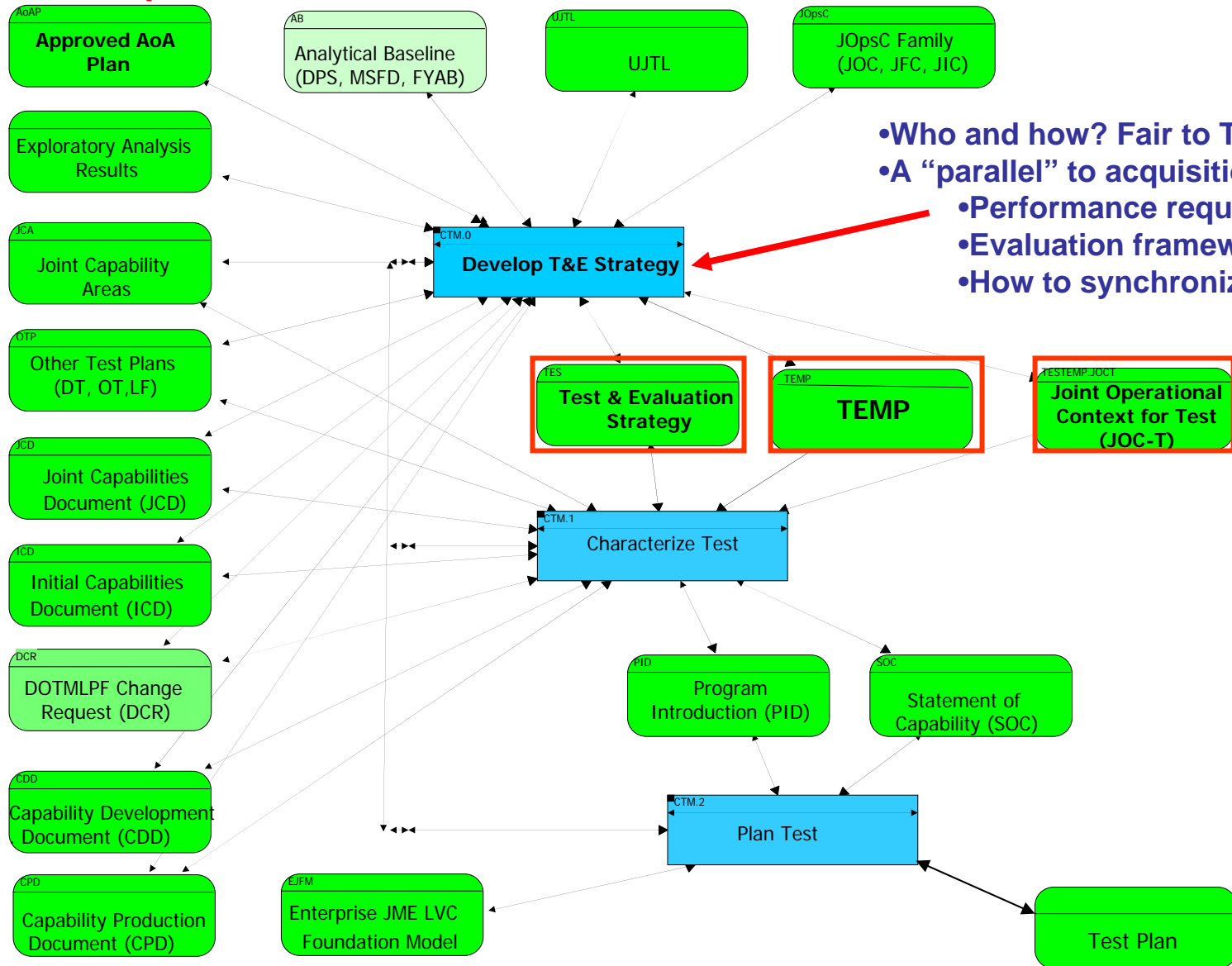
Harmonized Acquisition Milestone Decision Support

System Design, Cost / Effectiveness Evaluation, Acquisition Strategy, and Test Program



Benefits to T&E: Capability Test Method (CTM)

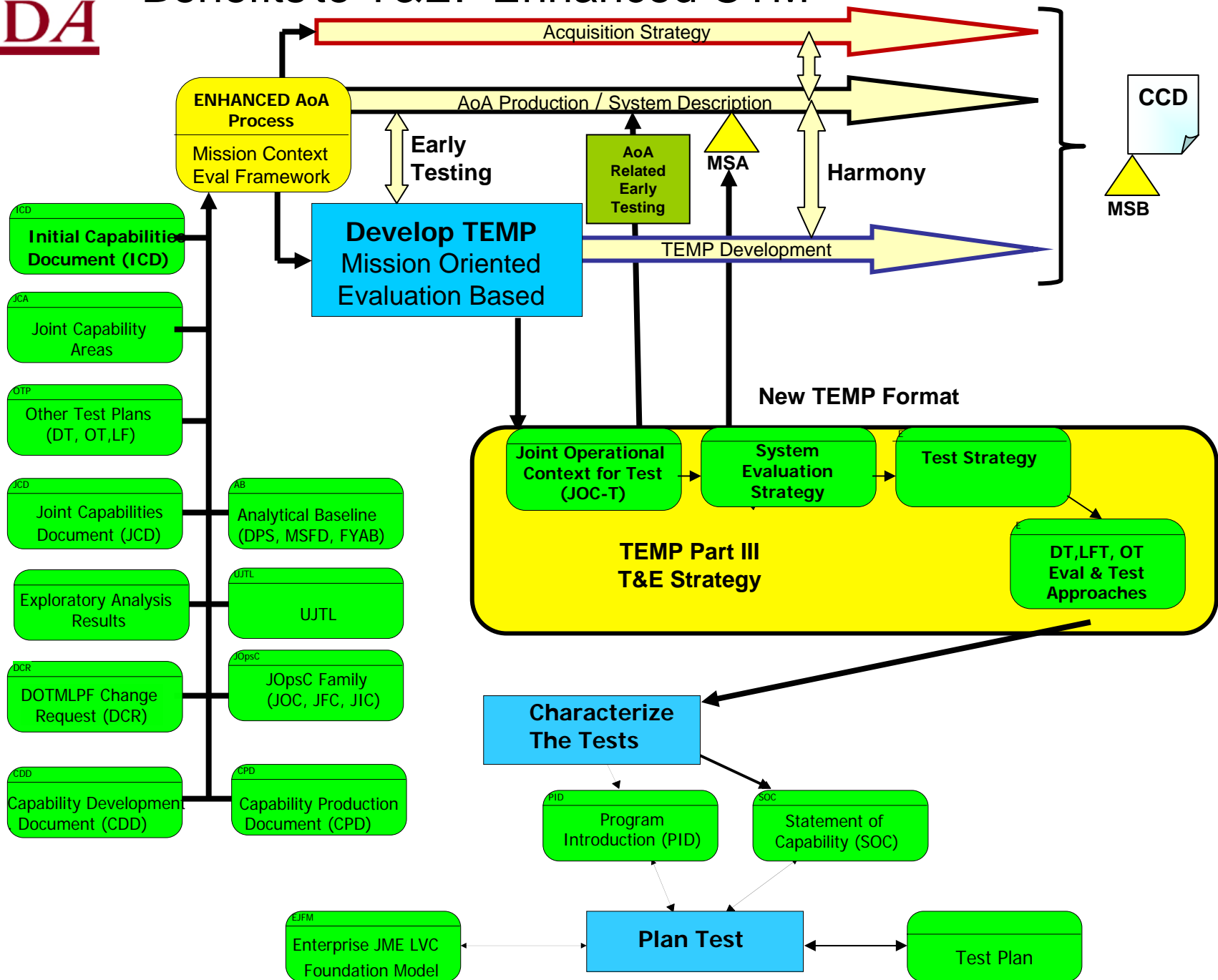
System Design → ACQ



- Who and how? Fair to T&E or others?
- A “parallel” to acquisition process?
- Performance requirements?
- Evaluation framework?
- How to synchronize?



Benefits to T&E: Enhanced CTM





Benefits to T&E: An Emerging TEMP Format

| Part I Introduction | Part II Test Program Management & Schedule | Part III Test & Evaluation Strategy | Part IV Resource Summary |
|--|--|--|--|
| <p>Brief Purpose of TEMP</p> <p>Brief Mission Description</p> <p>Brief System Description</p> <ul style="list-style-type: none"> -System Threat Assessment -Program Background -Key capabilities -Key Interfaces -Cert Rqmts -Sys Engr Rqmts | <p>T&E Management</p> <p>Comment T&E Data Base Rqmts</p> <p>Deficiency Reporting</p> <p>TEMP Updates</p> <p>Integrated Test Program Schedule</p> | <ul style="list-style-type: none"> •System Evaluation Strategy (T&E Perspective, Relates to AoA, Explains Testing's Role in System/Mission Effectiveness Evaluation) <ul style="list-style-type: none"> - Joint Operational Context for Evaluations - Evaluation Approach <ul style="list-style-type: none"> -Mission Effectiveness Evaluations -Comparison to Current Capability -Test Support to Evaluations •Test Strategy (Testing's Approach to Supporting the Evaluation Strategy) <ul style="list-style-type: none"> -Joint Operational Context for Test (JOC-T) -DT & OT Objectives from Evaluation Strategy -Assumptions and M&S Validation Tests -Integrated DT & OT Planning Objectives | <p>Introduction</p> <ul style="list-style-type: none"> -Test Articles -Test Sites & Instrumentation -Test Support Equipment -Threat Representations -Test Targets & Expendables -OPFOR Test Support -M&S and Test-beds -Joint Operational Test Environment -Special Requirements <p>Federal, state, Local Rqmts</p> <p>Manpower/ Personnel Training</p> <p>Test Funding Summary</p> |
| <div style="border: 1px solid black; background-color: #ffff00; padding: 5px; display: inline-block;"> <ul style="list-style-type: none"> •AoA Overview (T&E Perspective) <ul style="list-style-type: none"> -Operational Context of Evaluations -AoA System/Mission Evaluation Approach •Acquisition Strategy Overview <ul style="list-style-type: none"> -Milestone Information Needs -System Maturity Schedule </div> | | <div style="border: 1px solid black; background-color: #e0f0f0; padding: 5px; display: inline-block;"> <ul style="list-style-type: none"> •Developmental Evaluation Approach <ul style="list-style-type: none"> -Developmental Test Approach -M&S, Test Limitations •Live Fire Evaluation Approach <ul style="list-style-type: none"> -Test Objectives, M&S, Test Limitations •Certification for IOT&E •Operational Evaluation Approach <ul style="list-style-type: none"> -Operational Test Approach -M&S, Test Limitations •Other Certifications •Reliability Growth •Future T&E </div> | |
| <p style="color: red; font-weight: bold; font-size: 1.2em;">Describing a Mission-Oriented, Evaluation-Based Test Program</p> | | | |



Realities Facing the World of Defense and Homeland Security Test & Evaluation

**Maj Gen Steve Sargeant
Commander, AFOTEC**

**3 March 2009
NDIA Test & Evaluation National Conference
Atlantic City, NJ**

"This information is approved for public release; distribution is unlimited."



Purpose



- Describe AFOTEC's efforts to enhance acquisition excellence



Overview



- **Education and Training**
- **Common Lexicon**
- **Institutionalized Early Influence and Integrated DT/OT**
- **Way Ahead**



Education and Training



- **Partnerships with:**
 - **Defense Acquisition University**
 - AFOTEC guest lecturers integrated into select courses
 - Provided case studies for T&E courseware based on Section 231 initiatives
 - **Air Force Institute of Technology**
 - Instruction at AFOTEC T&E University Reliability Courses
 - AFIT T&E Certificate in work
- **AFMC Wing and Group Commander's Courses**
- **Identifying and tracking T&E experience**



Common Lexicon



- **Commonly understood**
 - Early Influence
 - Integrated DT/OT
- **Definitions still in refinement**
 - Test plans
 - Operationally relevant data
 - Production representative
 - Operationally realistic scenarios



Institutionalizing EI and IDT/OT



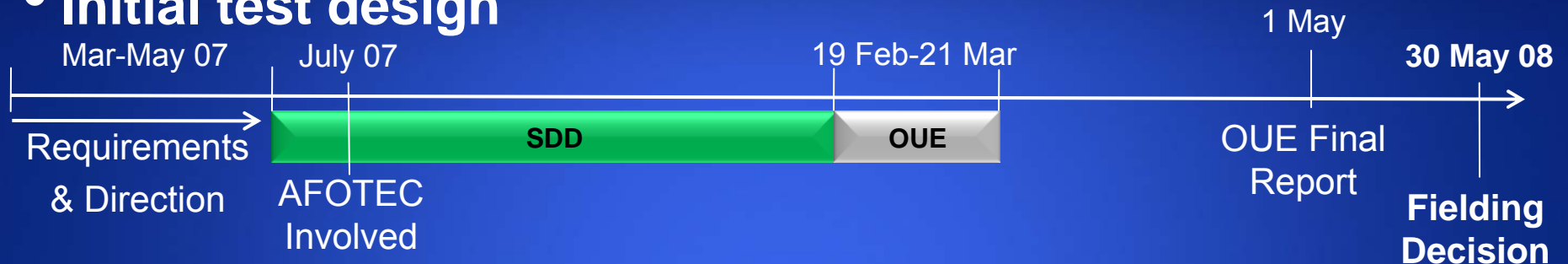
- **Early Influence**
 - Refining test requirements (M&S) early, enabling correction of shortfalls when costs are lower
- **Integrated DT/OT**
 - Contracts with access to DT data
 - Mold DT scenarios to gather operationally relevant data
 - Communication and coordination required to manage risk
- **Reducing the cost & time of the T&E enterprise**
 - Maintain the level of confidence
 - Get capabilities to the warfighter on time and at cost



LJDAM OUE IDT/OT

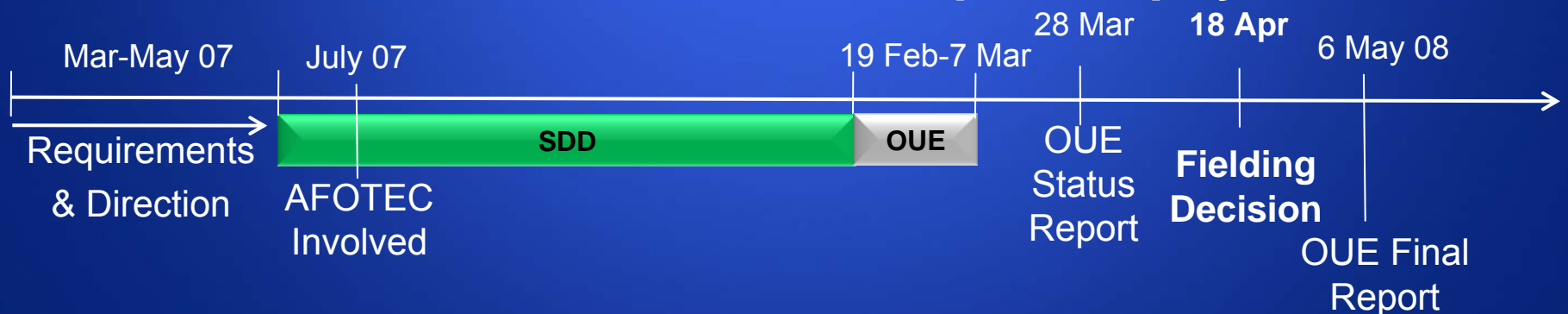


• Initial test design



- Initial OT requirement was 10 weapon drops
- Initial OUE cost and schedule estimate was \$2.58M / 31 Days

• Actual test execution with IDT/OT philosophy



- Leveraged 12 DT weapon drops, reduced OT reqt to 5
- Final OUE saved \$1.43M and accelerated fielding 6 weeks



Way Ahead



- Refine and codify IDT/OT
- Continue to develop a common understanding of IDT/OT process
- Focus on Cyberspace Testing



Summary



- We must manage of T&E experience
- Integrated DT/OT is the way ahead and will require breaking paradigms and engender greater communication and coordination between DT and OT

AFOTEC's objective: deliver warfighting capabilities faster and with more confidence, enabling Airmen, and often our Joint and Coalition partners, to accomplish their mission more effectively and with less risk



Panel Questions



- **Army Test & Evaluation Command**
 - As the largest test agency in the DoD, how will you recruit and develop your workforce?
- **Commander, Operational Test & Evaluation Force**
 - What is the effect of DoDI 5000.02 on test & evaluation of ship building?
- **Marine Corps Operational Test & Evaluation Agency**
 - Describe your ability to execute OT&E in a reduced resource environment.
- **Department of Homeland Security**
 - With the 22 agencies consolidated under the DHS umbrella and reduced budgets, do you see an opportunity for an operational test agency across all DHS agencies and an integrated approach for OT&E?

What Will It Take to Get Better Program Outcomes?

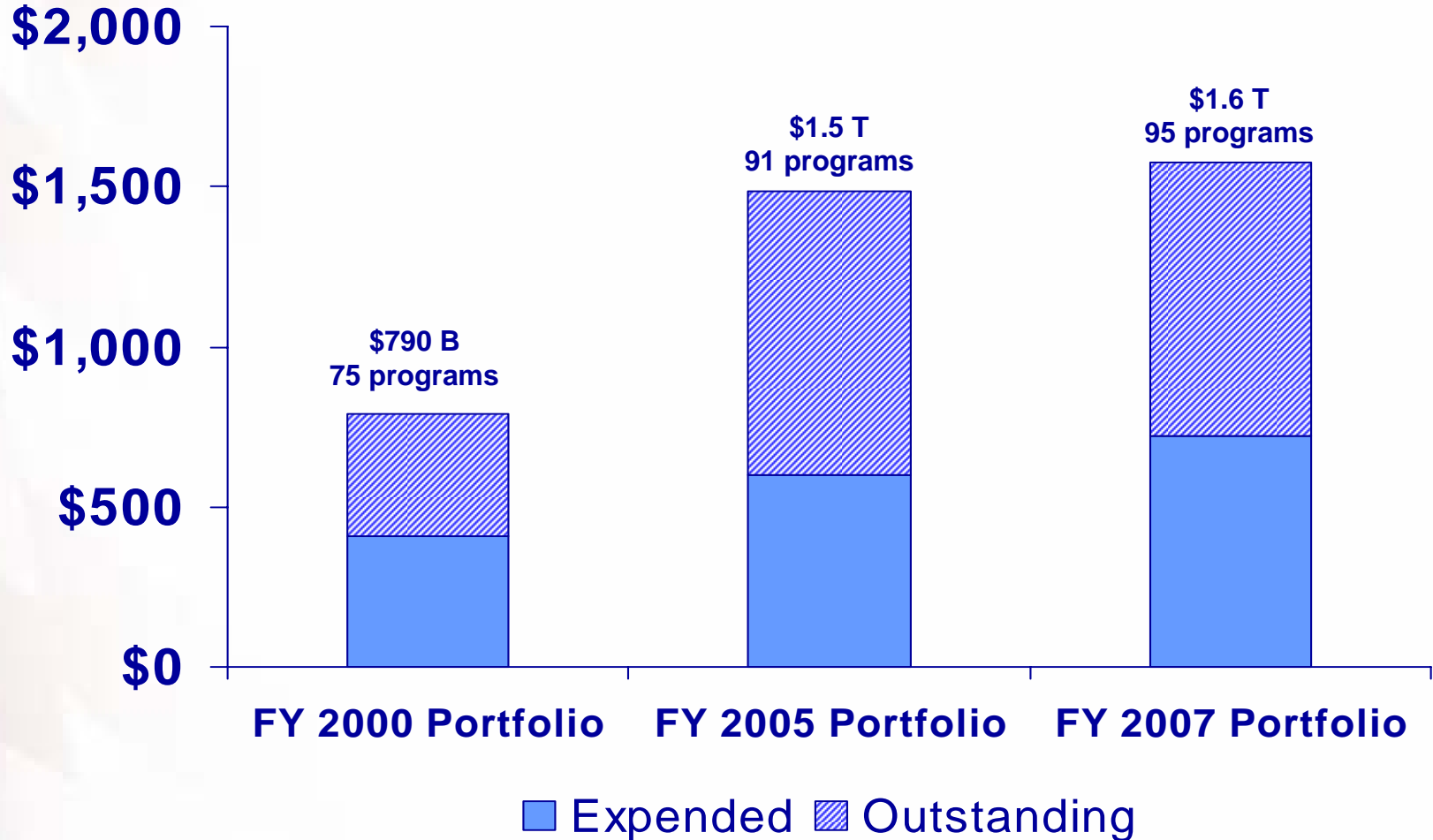
**25th Annual Test & Evaluation National Conference:
“New Administration, New Opportunities”
March 2-5, 2009**

**Paul Francis, Director
Acquisition and Sourcing Management
U.S. Government Accountability Office**

francis@gao.gov

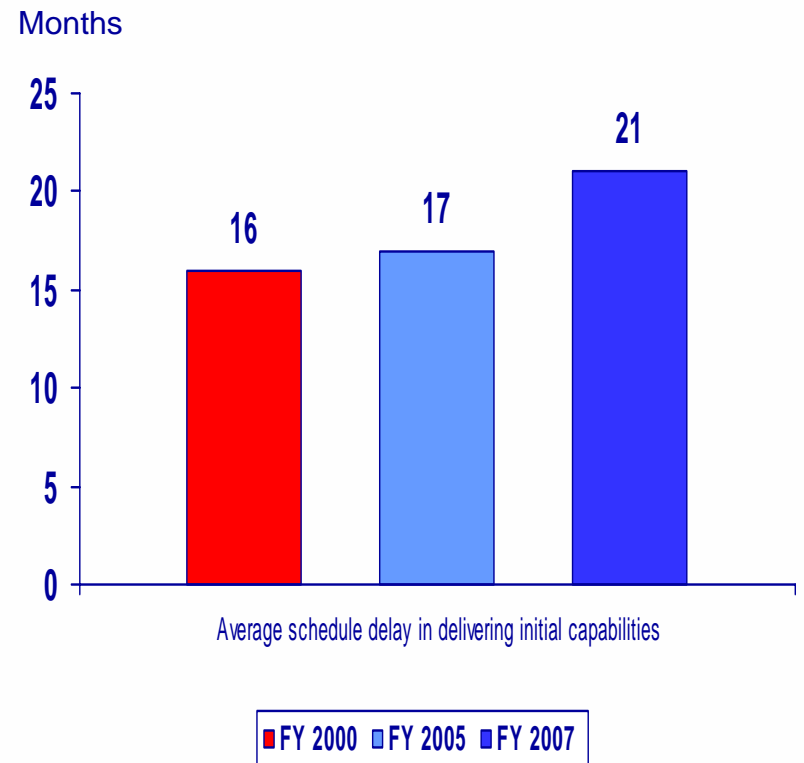
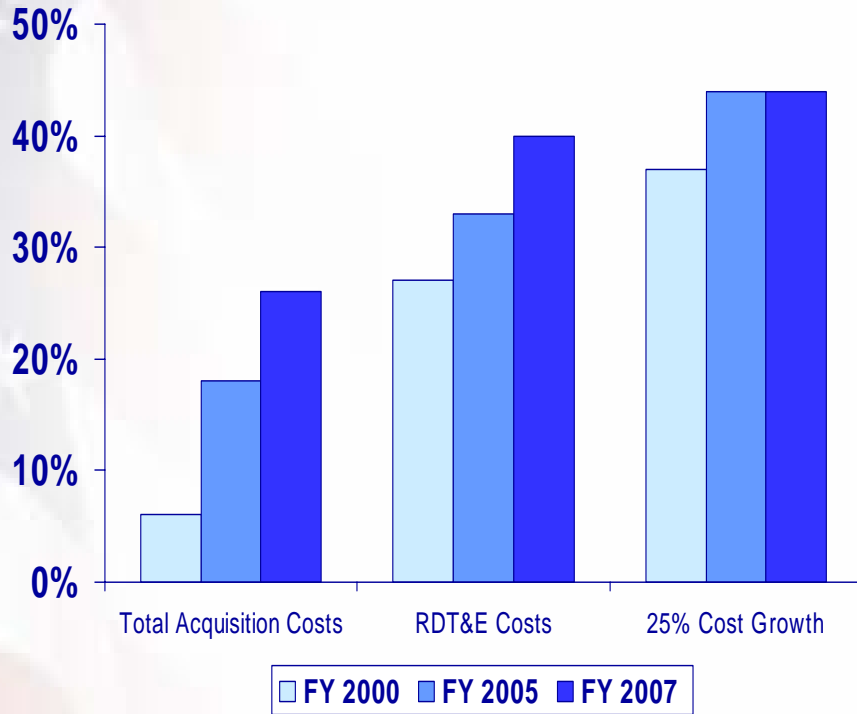
Weapon System Investment Levels

FY 2008 Dollars in Billions



Source: GAO analysis of DOD data.

Decline in Cost and Schedule Outcomes



Source: GAO analysis of DOD data.

Cost and Schedule Overruns in Five Programs

| | Total Cost (billions of \$) | | Total Quantities | | Increase in Unit Cost | Initial Delivery of Capability | |
|-------------------------|--------------------------------|--------|------------------|--------|--------------------------|-----------------------------------|--------|
| | Planned | Latest | Planned | Latest | | Planned | Latest |
| JSF | 203.0 | 240.0 | 2,866 | 2,458 | 38% | 2010 | 2012 |
| FCS | 88.3 | 128.5 | 15 | 15 | 46% | 2010 | 2015 |
| SBIRS High | 4.4 | 10.5 | 5 | 3 | 300% | 2003 | 2009 |
| EFV | 8.7 | 13.5 | 1,025 | 593 | 168% | 2006 | 2015 |
| H-1 Upgrades | 3.4 | 8.3 | 284 | 284 | 140% | 2005 | 2008 |

Source: GAO analysis of DOD data

Consequences of Poor Outcomes

Cost Growth

Reduces DOD's buying power

Means less funding for other priorities

DOD must request more funding to cover cost overruns, make trade-offs with existing programs, delay the start of new programs, or take funds from other accounts

Schedule Delays

Critical capabilities not provided to warfighter when needed

DOD must operate costly legacy systems longer than expected, find alternatives to fill capability gaps, or go without a capability

A Knowledge-Based Approach Is Key to Good Outcomes

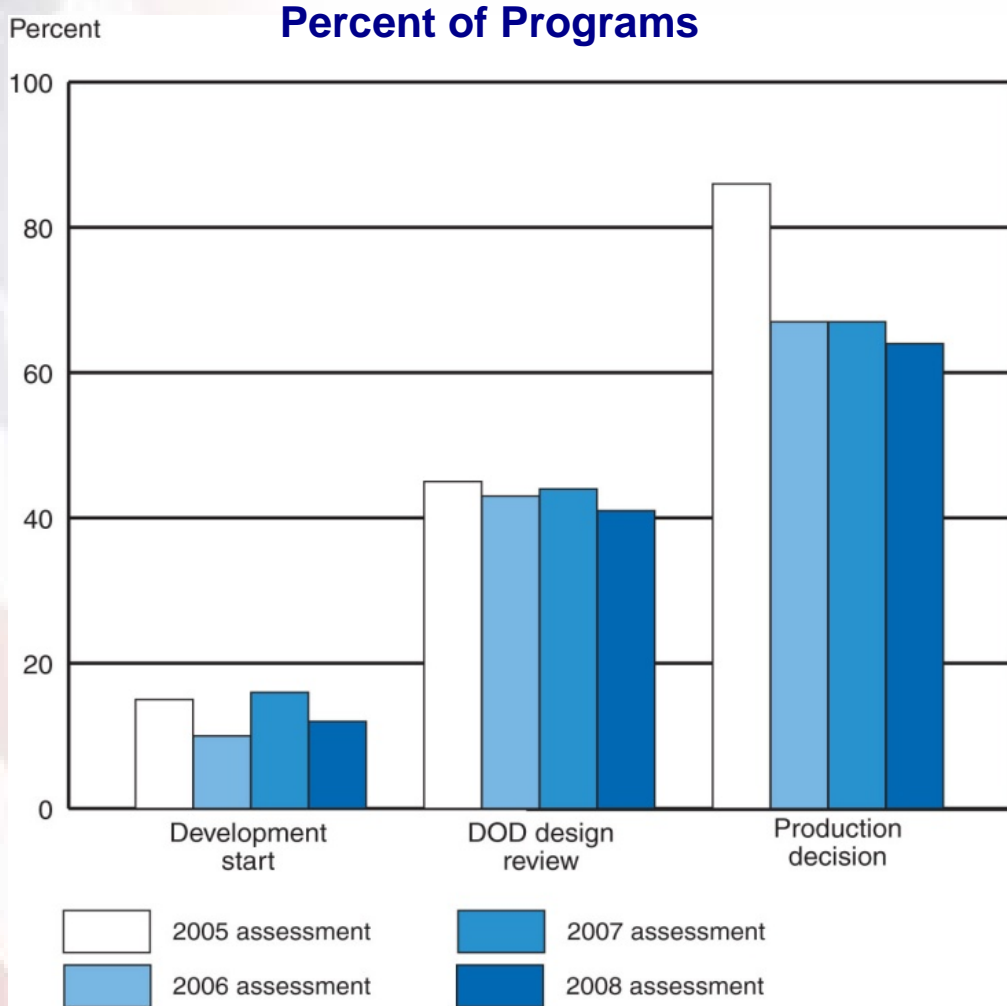


Knowledge Point 1: At milestone B, a match is achieved between the user's needs and the developer's resources. Technology maturity is demonstrated and preliminary design is achieved.

Knowledge Point 2: At critical design review, the product design demonstrates its ability to meet user needs and is stable. Prototype demonstration that design will meet requirements.

Knowledge Point 3: At milestone C, it is demonstrated that the product can be produced within cost, schedule, and quality targets. Full-up, integrated product tested in relevant environment.

Immature Technologies Ripple Through the Development Cycle

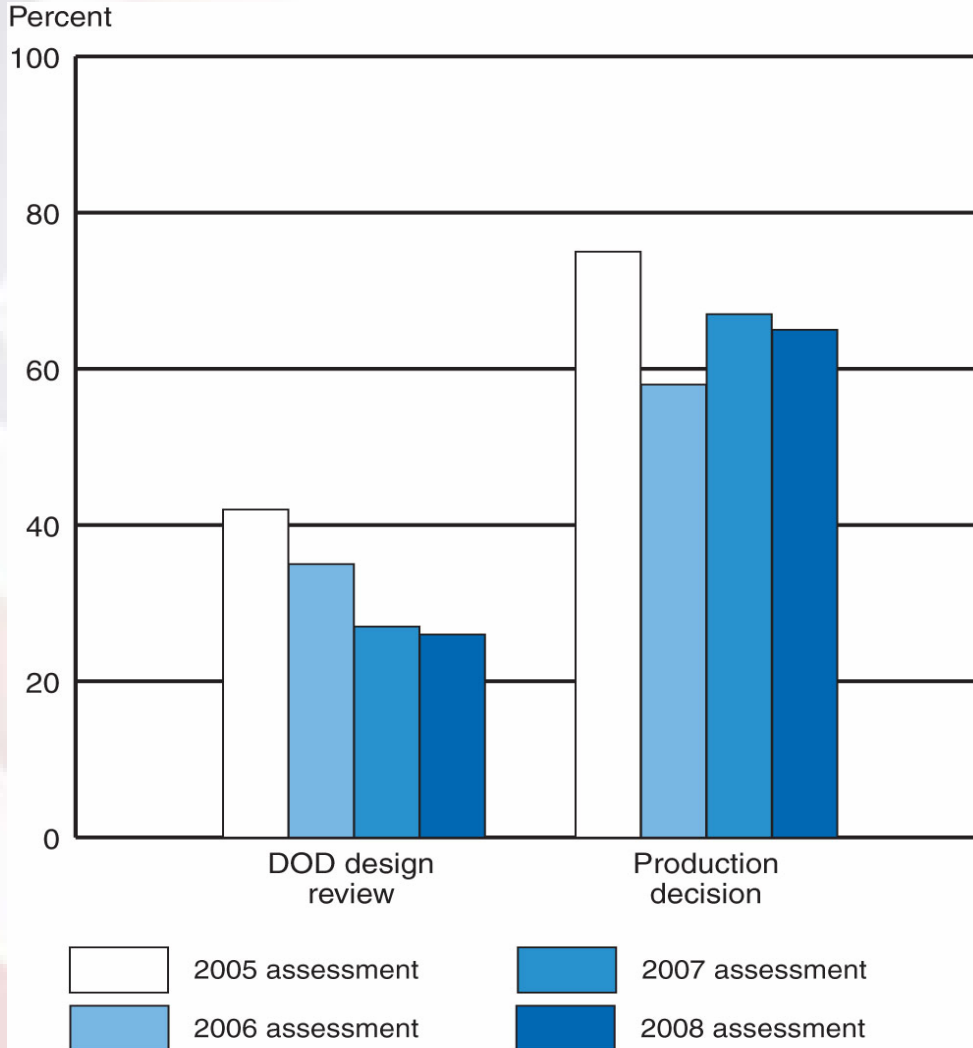


- Less than 20% of programs have mature technologies at start
- Most programs do not have mature technologies at CDR
- Many programs still maturing technologies into production
- Cost growth for programs with immature technologies was 44% higher
- Only 10 percent of programs had completed PDR at start

Source: GAO analysis of DOD data.

Programs Proceed Through CDR without Design Stability

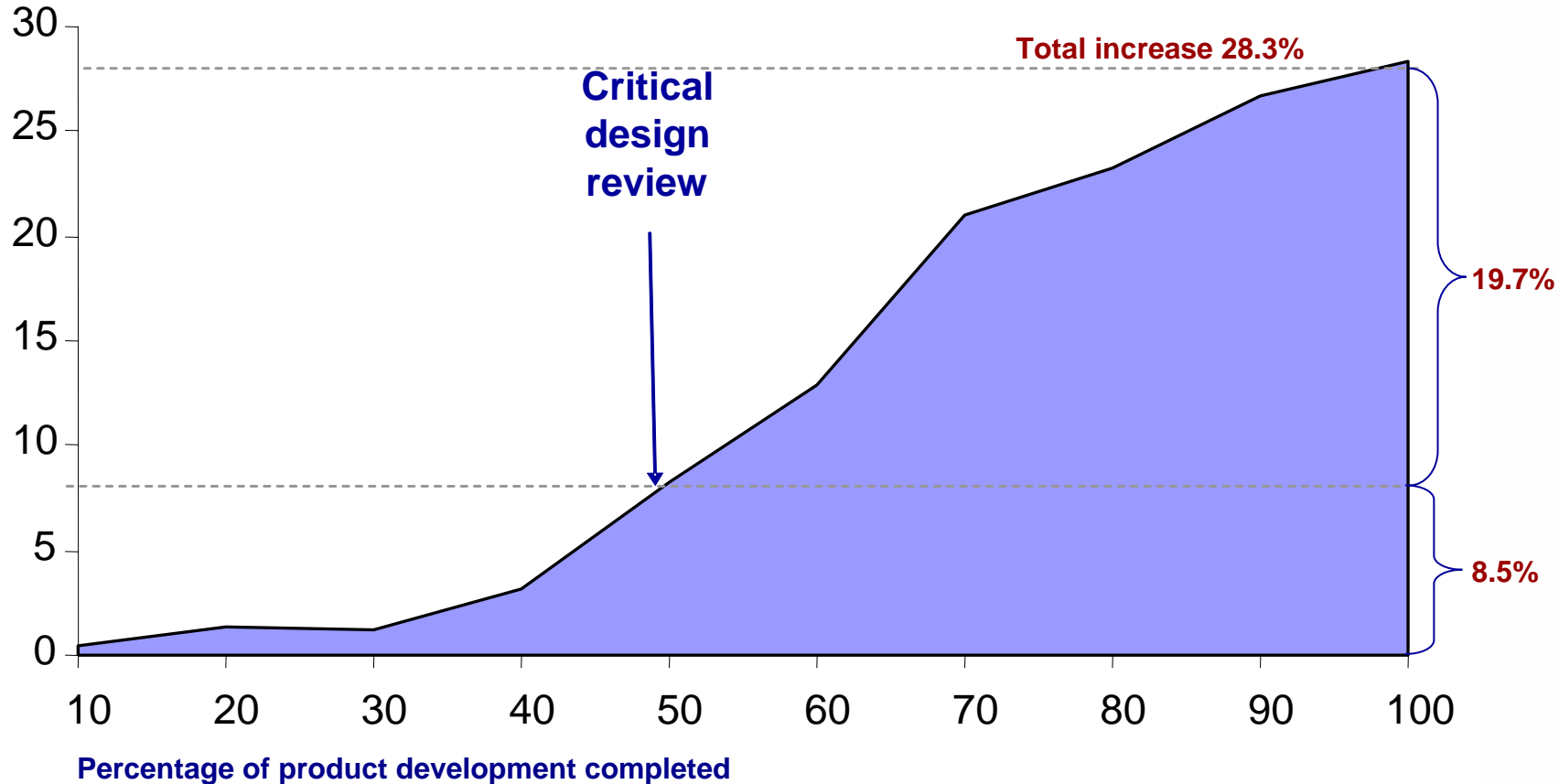
Drawing Releases



- Goal is 90% drawings releasable at CDR
- 3/4 of programs do not meet this standard at CDR
- At milestone C, over 1/3 of programs still did not meet this standard

R&D Cost Growth Experience

Percentage of RDT&E cost increase over development estimate



Other Observations on Current Practices

- Fewer than half of programs plan to test fully-integrated, production-representative prototypes before Milestone C (including JSF and FCS)
- During FY 2007, DOT&E reports that 50% of programs failed operational suitability; reliability is on a downward trend
- GAO has recently reported that during FY 2008, missile defense assets were produced and fielded before being flight tested
- Programs, like JSF, are using cost-reimbursable contracts in production.

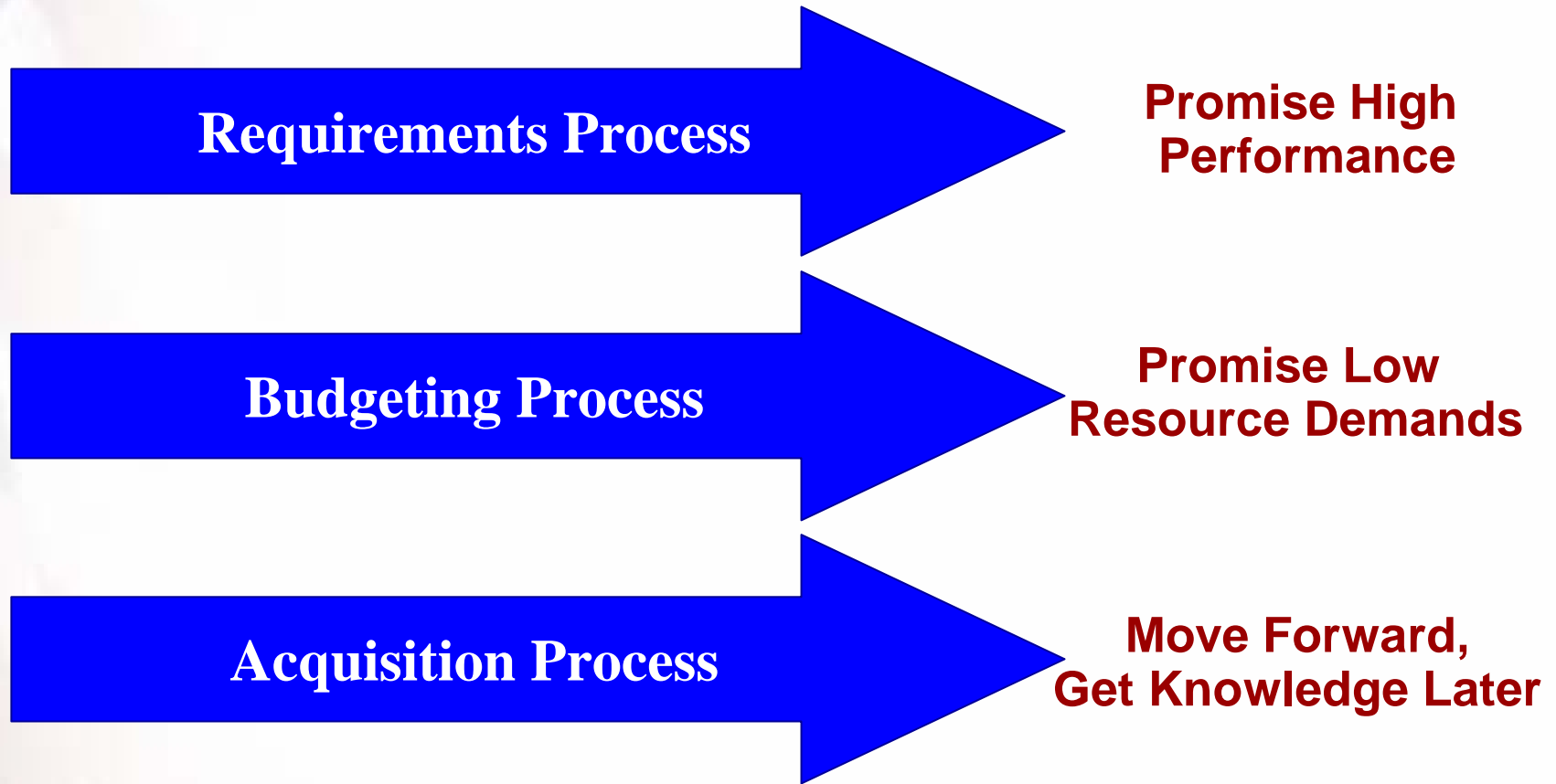
2008 DOD 5000 Policy

- Reinvigorated Milestone A and technology development phase
- Configuration Steering Boards established to control requirements creep
- Stronger emphasis on systems engineering
- Preliminary Design Review before Milestone B
- Formal post-CDR assessment
- Stronger pre-milestone C requirements (DT&E, M&S, production-representative prototypes, pilot line production)

2009 Weapon System Acquisition Reform Act (proposed)

- Identify and fill gaps in systems engineering capabilities
- Create Director of Developmental Test and Evaluation
- DDR&E review and assessment of critical technology maturities
- Create Director of Independent Cost Assessment
- Cut across requirements, budgeting, and acquisition stovepipes to make needed tradeoffs.
- PDR before Milestone B

Cause: Process Pressures



The process is not broken: it's in equilibrium
Good people are not put in a position to succeed

Prognosis for Change

- Weapon system issues have been consistent for 30 years
- They are primarily **not** due to mistakes, lack of expertise, or unforeseeable events
- Consider the process as being in equilibrium versus broken:
 - The acquisition process may be producing what the participants collectively want or are willing to settle for.
 - It is a rational process that involves good people. It works—this is how programs get money and survive.
- Our principles are revealed by what we do and what we do with money; if unexecutable programs continue to win funds, then our principles remain something other than what is stated in policy.
- Process reforms, funding cuts, and cancellations aren't enough to change the culture or equilibrium: programs with executable strategies (technology, design, test, & cost) must win the budget battles.
- For this to happen, we need a significant emotional event; I hope that a new administration and new opportunities may constitute that event.



RDECOM

Integrating the Systems Engineering "V" in a Systems of Systems

3 March 2009



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Mr. Jack Sheehan (jhs@orsacorp.com)

Dr. Paul H. Deitz (Paul.H.Deitz@us.army.mil)

Dr. David M. Bassan

- Employ a Mission-based SE in an SoS environment approach to **complete** the (traditional) Materiel-based SE “V” (SE-V) in the development of DOTMLPF Capabilities for the warfighter.
- Retaining Mission, Task, **and** Human Dimension context throughout the Capability lifecycle provides assessment results
 - in traditional Materiel-base terms **and**
 - their relationships and contributions both direct and indirect to warfighting operational performance and mission effectiveness.
- Mission-based SE in SoS is an **extension** of MBT&E compatible with the
 - OSD/P&R directives for reporting METL-based Readiness
 - Joint GEL directive for certifying deploying units,
 - JCIDS Capability-based Acquisition
 - DoD SE Guide for SoS, and
 - DOT&E JTEM framework and procedures.

METL: Mission-Essential-Task-List with measures, conditions and standards to accomplished a desired end result

SoS: Systems of Systems

SE “V”: Top-Down definition and design then Build followed by Bottom-Up integration, and verification

DOTMLPF: Doctrine, Organization, Materiel, Leadership, Personnel, and Facilities

HD: Army Human Dimension initiative in three behavior domains -- Social, Cognitive, and Physical

MBT&E: ATEC Mission-based Test & Evaluation framework, procedure, and complexity constraint strategies

GEL: Joint Guidance for Employment of Forces for unit certification prior to deployment

P&R: OSD Personnel & Readiness

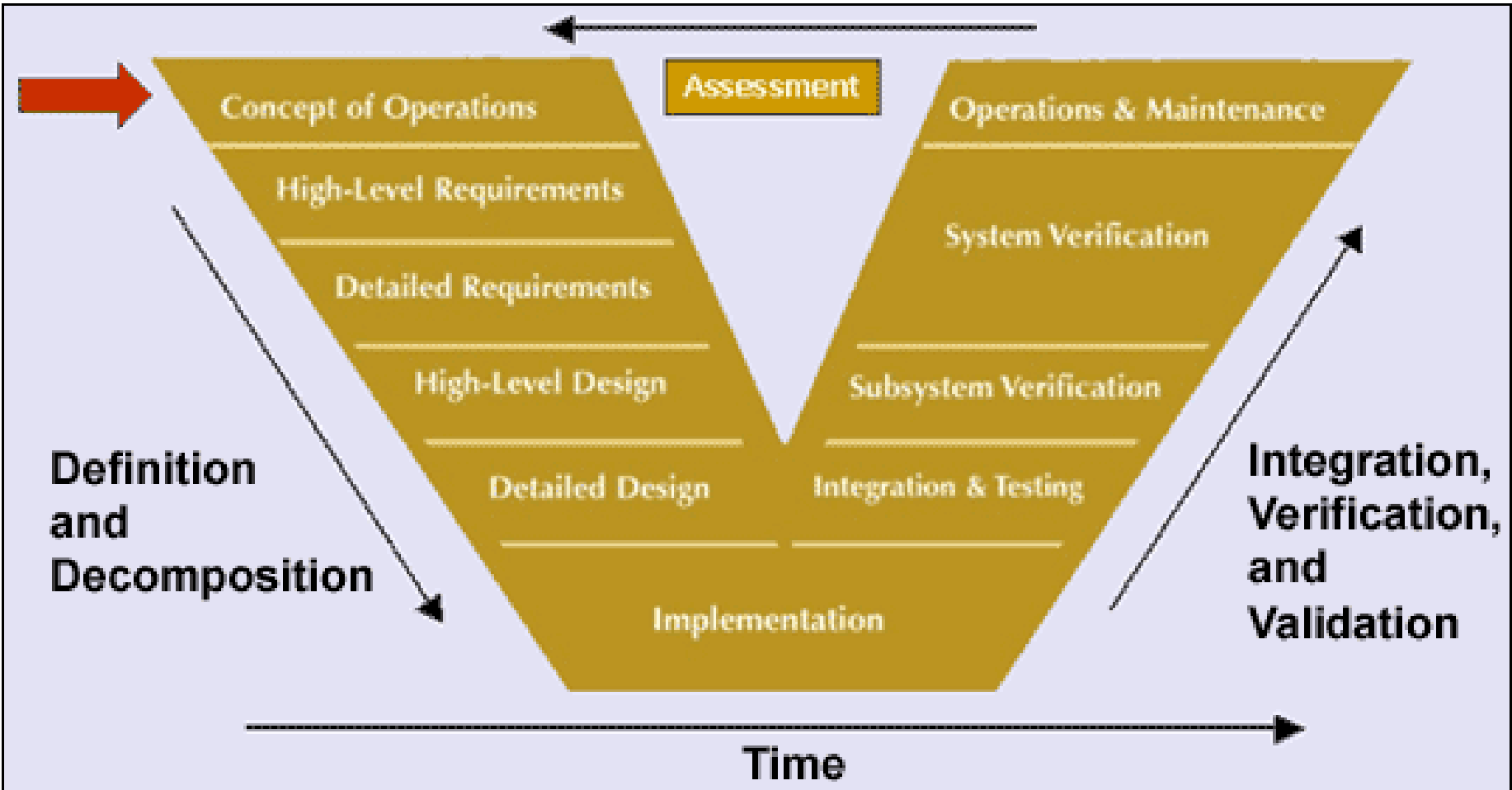
JTEM: Joint Test & Evaluation Methodology

- **System (S)*** - A functionally, physically, and/or behaviorally related group of regularly interacting or interdependent elements; that group of elements forming a unified whole [JP 1-02 & JP 3-0].
- **Capability*** - is the ability to achieve a desired effect under specified standards and conditions through combinations of ways and means to perform a set of tasks [CJCS, 2007(2)].
- **Family of Systems (FoS)*** - a set of systems that provide similar capabilities through different approaches to achieve similar or complementary effects [CJCS, 2007(1)].
- **System of Systems (SoS)*** - is defined as a set or arrangement of systems that results when independent and useful systems are integrated into a larger system that delivers unique capabilities [DoD, 2004(1)].

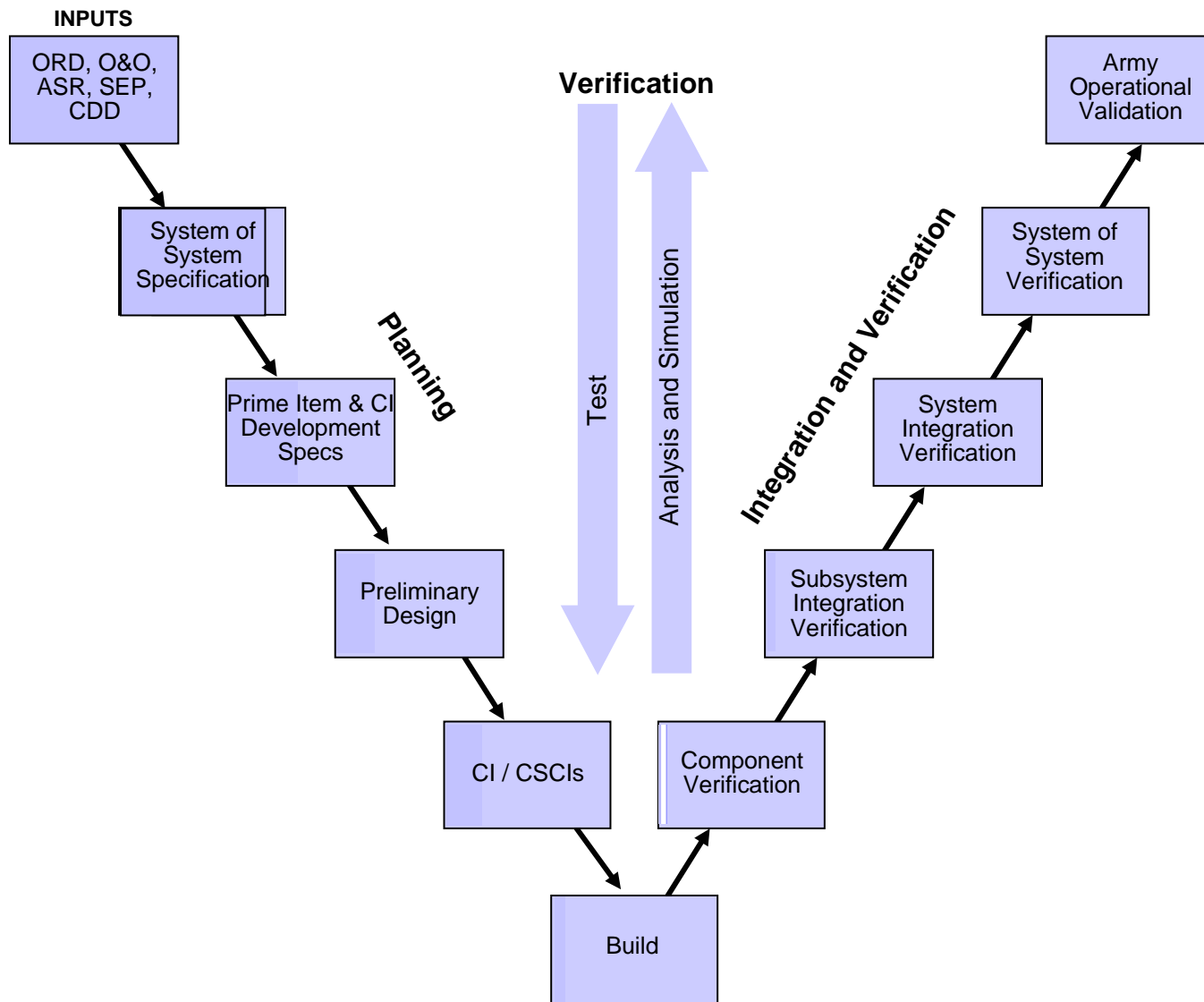
* Taken from the DoD SE Guide for SoS

- **Virtual SoS*** – Group lacks a central management authority and a centrally agreed upon purpose for the system-of-systems.
- **Collaborative SoS*** – Group component systems interact more or less voluntarily to fulfill agreed upon central purposes.
- **Acknowledged SoS*** – Group has recognized objectives, a designated manager, and resources for the SoS; however, the constituent systems retain their independent ownership, objectives, funding, and development and sustainment approaches. Changes in the systems are based on collaboration between the SoS and the systems.
- **Directed SoS*** - The group, an integrated system-of-systems, is built and managed to fulfill specific purposes. It is centrally managed during long-term operation to continue to fulfill those purposes as well as any new ones the system owners might wish to address. The component systems maintain an ability to operate independently, but their normal operational mode is subordinated to the central managed purpose.

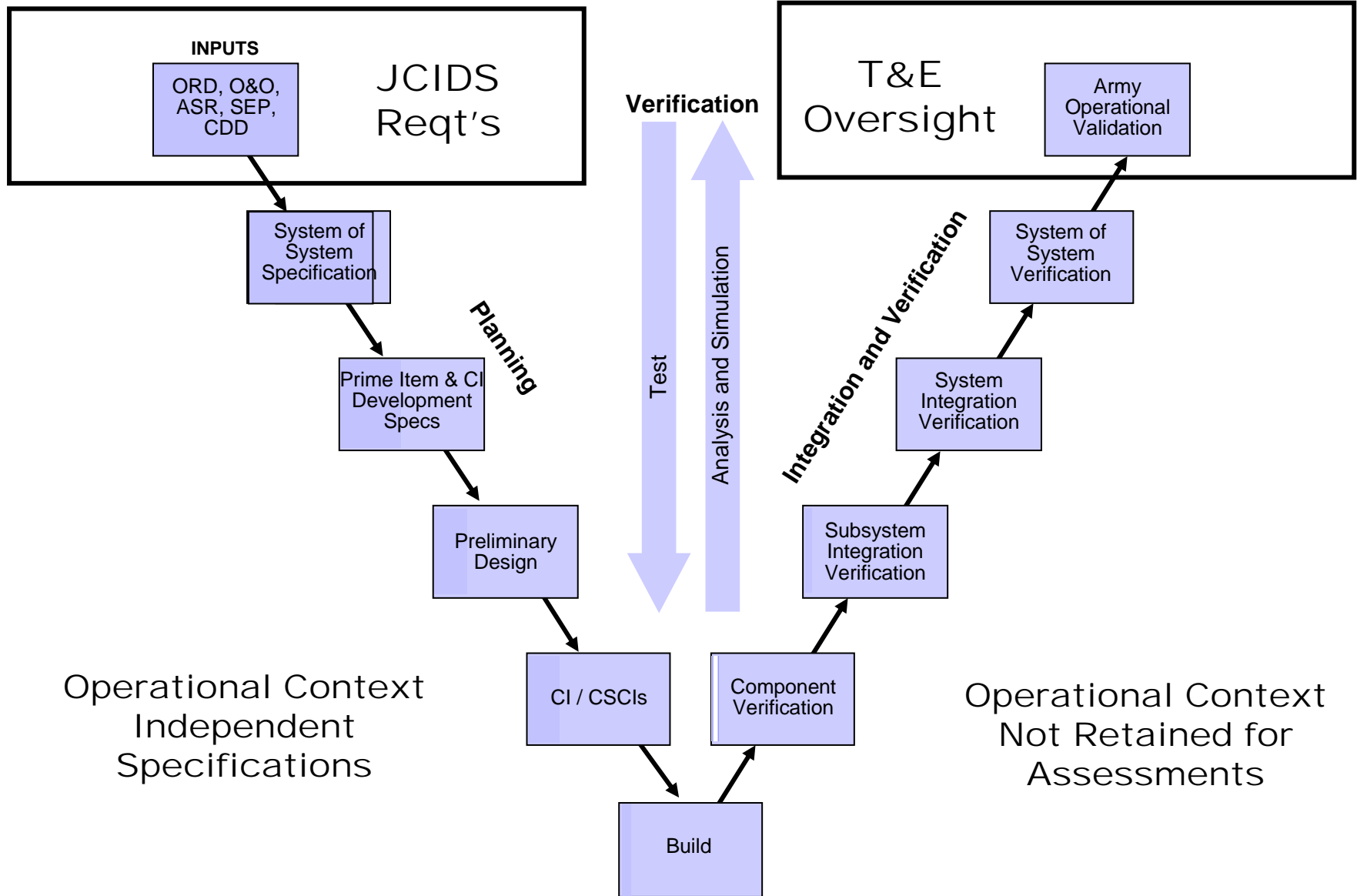
* Taken from the DoD SE Guide for SoS



Systems of System Engineering (2 of 3)



SE in SoS Environment Issues (3 of 3)

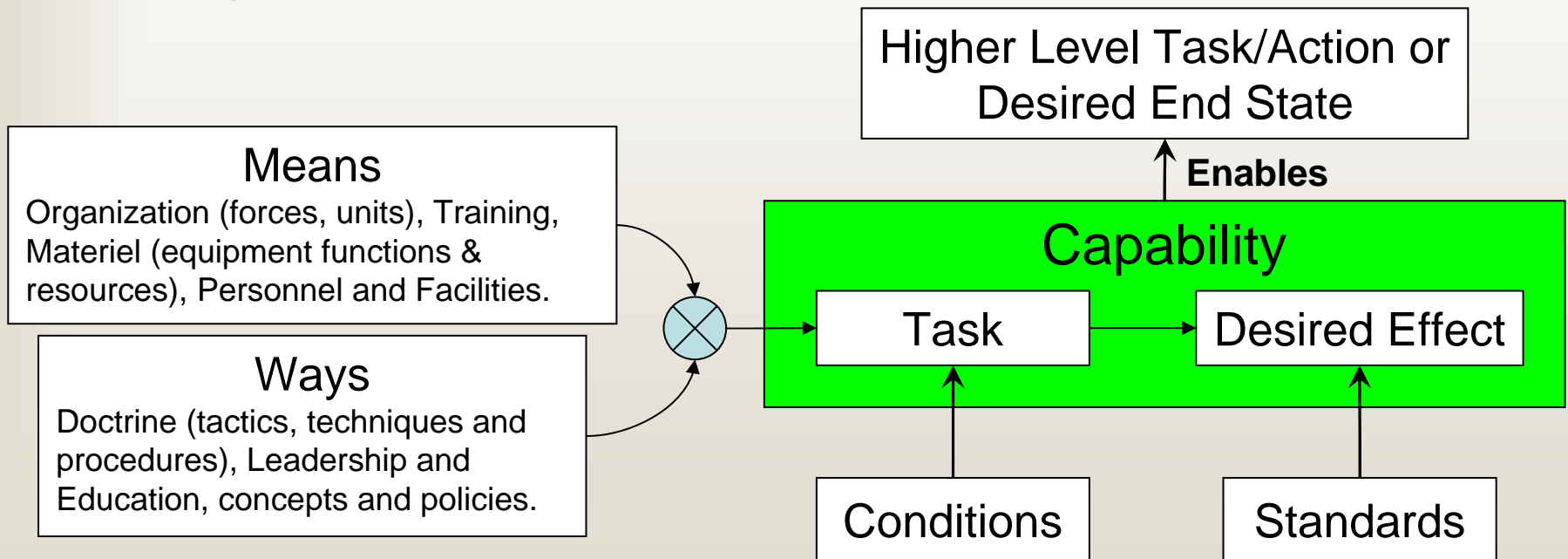




MBT&E Building Block

Capability¹ – The ability to achieve a **desired effect** [or result, outcome, or consequence of a task²] ...

- under specified **standards and conditions**
- through a combination of **means and ways**
- to perform a set of tasks.



1. CJCSI 3170.01F, May 2007

2. Taken from JP1-02, Mar 2007, definition of effect.



MBT&E - Task Hierarchy



MBT&E Framework – v2

Process/Products

$$\text{Capability} = \text{Set of Tasks} + \text{Desired Result}$$

Commander's Task to Subordinates

Desired End State

Transition to Allocating Mission Means

Mission Analysis
 • Higher Commander's Intent
 • Restated Mission
 • Task to Subordinates

Operations (Mission Tasks)
 • UJTLs
 • Service TLs
 • Implied Tasks

Desired Mission Task Results

Enables

Commander's Task to Subordinates

Mission Task Capability

Mission Analysis
 • Higher Commander's Intent
 • Restated Mission
 • Task to Subordinates

System-of-Systems Tasks
 • Service TLs
 • Implied Tasks
 • Collective/Individual Tasks

Desired SoS Task Results

Enables

System Attributes

SoS Task Capability

Transition to Allocating Materiel Means

Systems Engineering
 • Functional Baseline
 • Allocated Baseline
 • Product Baseline

System Performance
 • Functions (shall do)
 • "shall be's"

Desired System Performance Results

Enables

System Performance

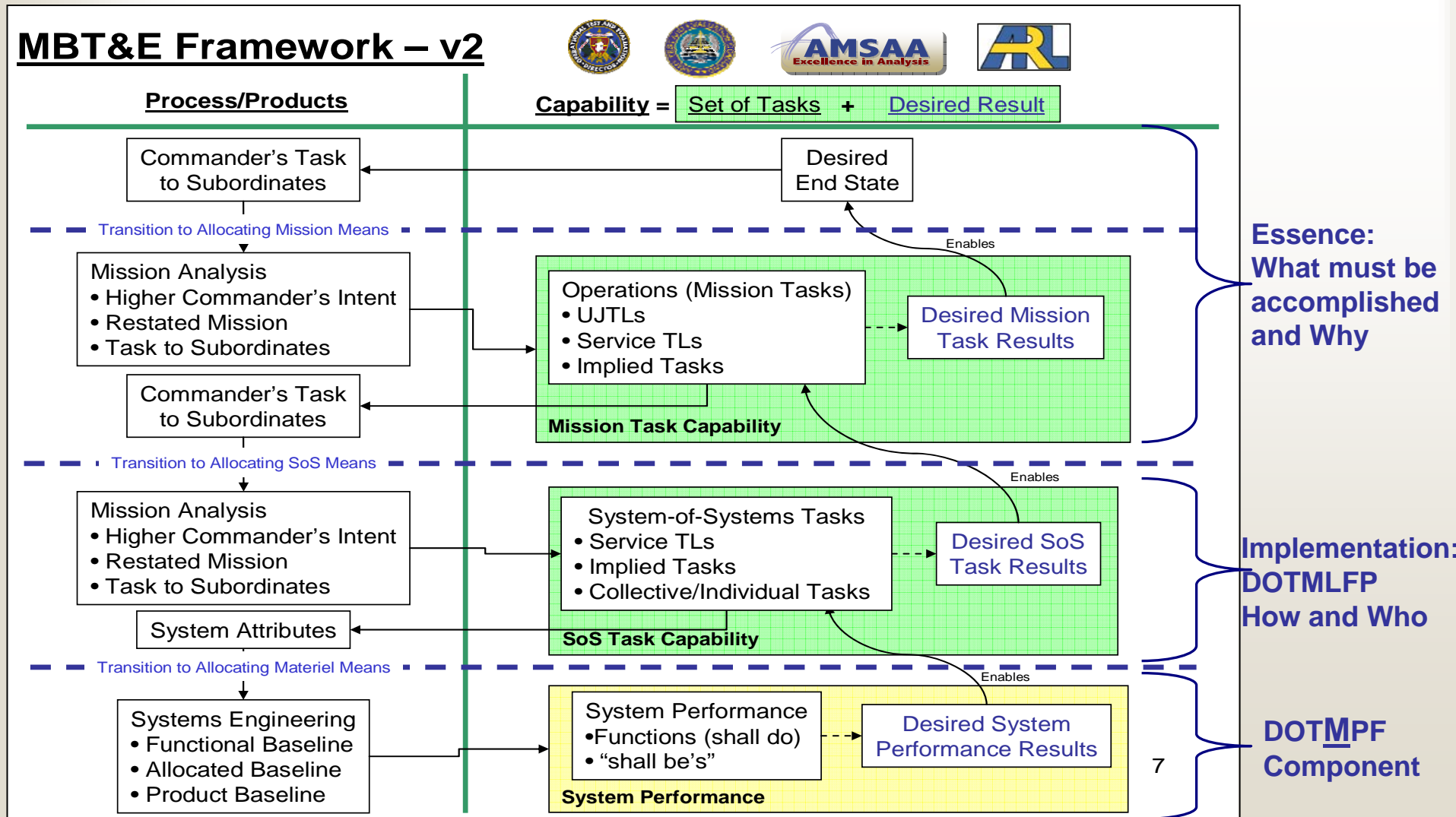
High Level Tasks/Results

Tasks/Results Specific to System



System Functions



MBT&E - Task Hierarchy



- **ATEC Mission Based Test & Evaluation is consistent with**
 - OSD P&R directives for reporting METL-based Readiness
 - Joint GEF certification for Deployment of Operational Forces
 - JCIDS Capability based Acquisition
 - DoD Systems Engineering guide for Systems of Systems (SE for SoS)
 - DOT&E Joint Test & Evaluation Methodology (JTEM)

- 
Based on Generic, General Purpose Measures/Conditions/Standards
 - TPFData List TO&E (standing) C-METL OSD P&R Readiness
 - TPFDeployment Data MTOF (transient) D-METL Joint GEF Certification
- 
Based on Mission, Situation Specific Measures/Conditions/Standards

TPFDL: Time Phased Force Data List for deployment planning
 TPFDD: Time Phased Force Deployment Data for deployment execution
 TO&E: Table of Organization and Equipment for a standing unit
 MTOF: Mission Task Organized Force (modeling & simulation term)
 C-METL: Core METL defined by Army Force Generation (ARFORGEN) for commonality between units of the same type
 D-METL: Directed METL defined by Army Force Generation (ARFORGEN) for a unit with specific deployment orders
 GEL: Joint Guidance for Employment of Forces for unit certification prior to deployment
 P&R: OSD Personnel & Readiness directives for METL-based readiness reporting
 JCIDS: Joint Capability Integrated Development System



MBT&E Procedure

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to collect information.

PLANNING

UNDERSTAND THE MISSION • 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SYSTEM • 2 steps to understand the components and attributes of the materiel system-of-systems.

- 1 additional step to understand the mission and system linkages.

DESIGN THE T&E • 7 steps to design the T&E given the mission and system understanding.

EXECUTING & REPORTING

DETERMINE THE RESULTS • 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS • 1 step to format and report the results.



Adaptation to Complete SE-V

- N steps divided into 5 major purpose areas.
 - 1 Pre-step to collect information.

PLANNING

UNDERSTAND THE MISSION • 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SPEC'S • 2 steps to understand the Context-Independent specifications of the of the materiel system-of-systems.

- 1 additional step to understand the mission and system specifications linkage (retain Context-Dependence link).

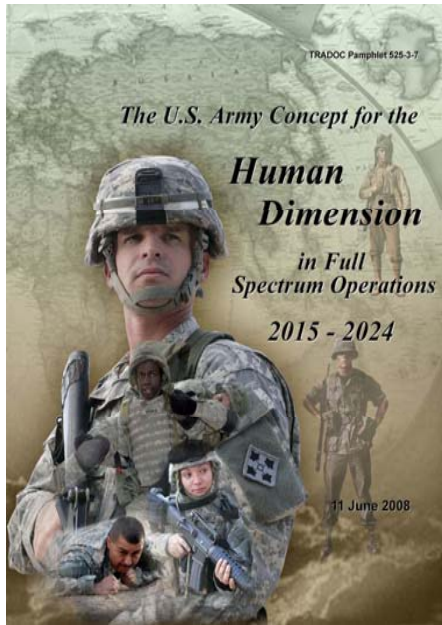
SE

DESIGN THE System • SE steps to design the system to the specifications given the Mission, Task, HD context understanding.

EXECUTING & REPORTING

DETERMINE THE RESULTS • 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS • 1 step to format and report the results.



Human Dimension is parsed by three behavioral domains: Social, Cognitive, and Physical



Social Behavior (9)

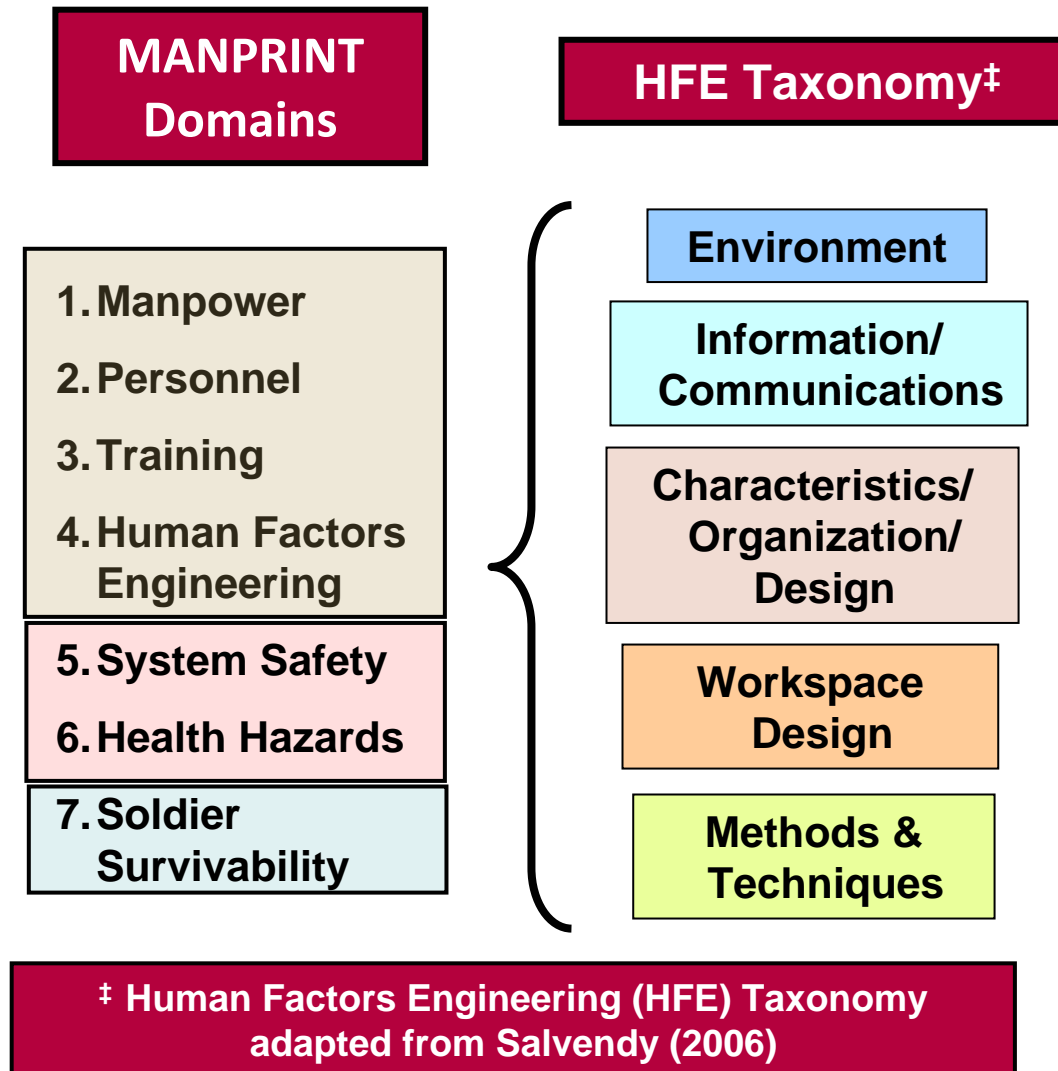
- Affects, Emotions, and Moods
- Cultural Awareness (CA) & CA Training
- Ethics & Values / Morals & Beliefs
- Group Dynamics / Group Interactions
- Interpersonal Relations
- Leadership & Leadership Training
- Networking
- Personnel Issues / Recruitment & Retention
- Quality of Life

Cognitive Behavior (12)

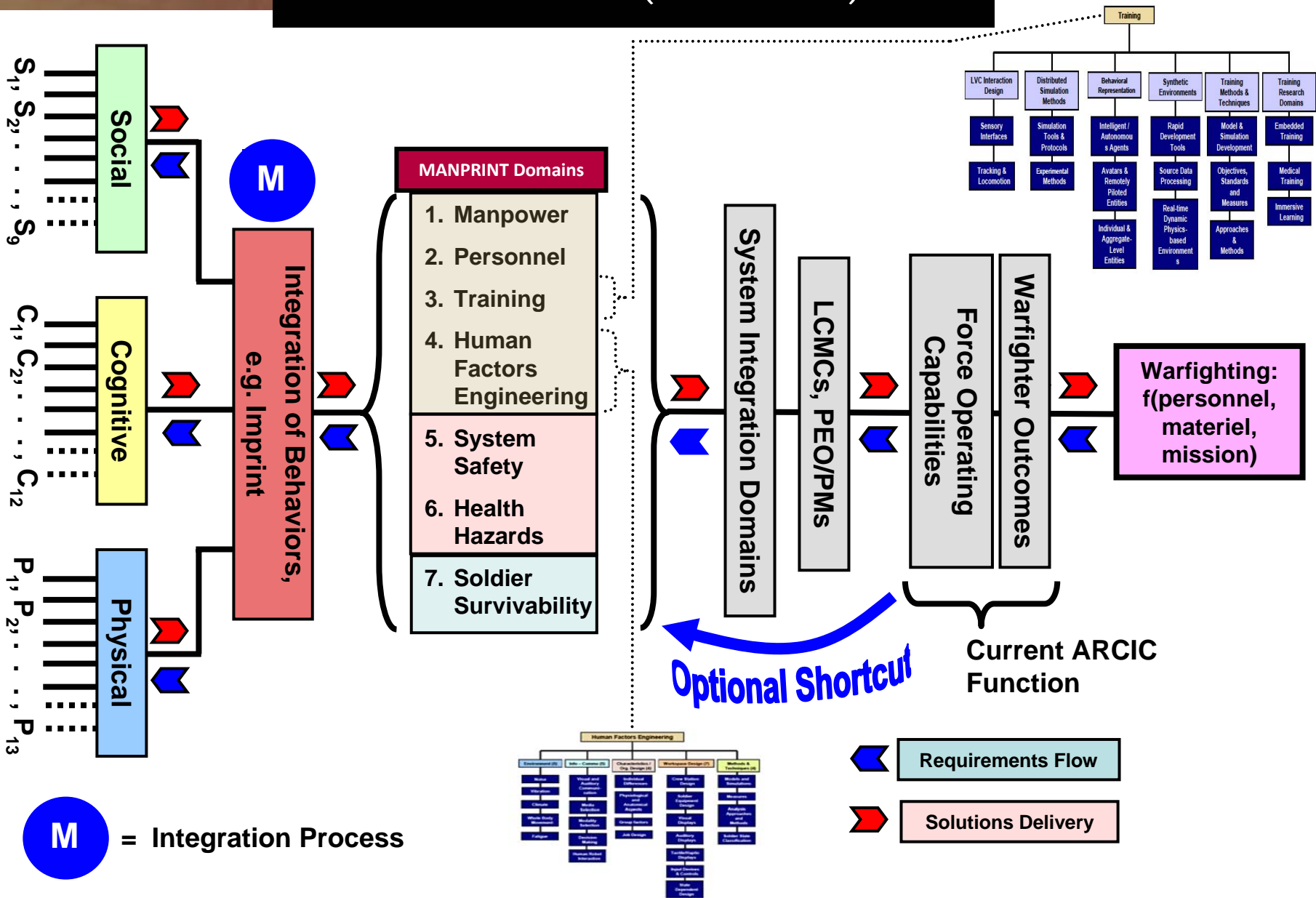
- Attention & Memory
- Cognitive Workload
- Comprehension / Understanding
- Creativity & Imagination
- Decision Making
- Learning
- Motivation
- Pattern Recognition
- Perception
- Problem Solving
- Projection & Planning
- Situation Awareness

Physical Behavior (13)

- Anthropometry
- Biological/Physiological Mechanisms
- Biomechanics
- Endurance & Tolerance
- Fitness & Strength
- Health Protection / Preventive Medicine
- Medical Intervention
- Mobility & Dexterity / Movement
- Nutrition
- Physical Adaptability / Survivability
- Physical Comfort
- Sensing
- Task Execution /Action & Reaction

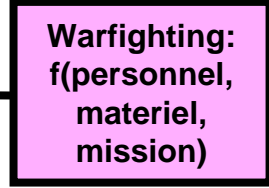
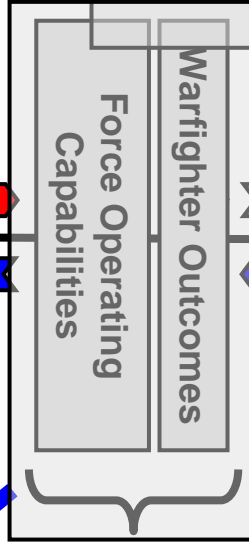
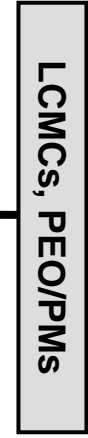
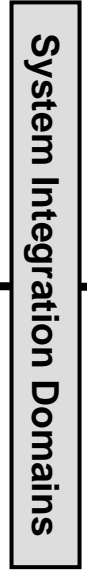
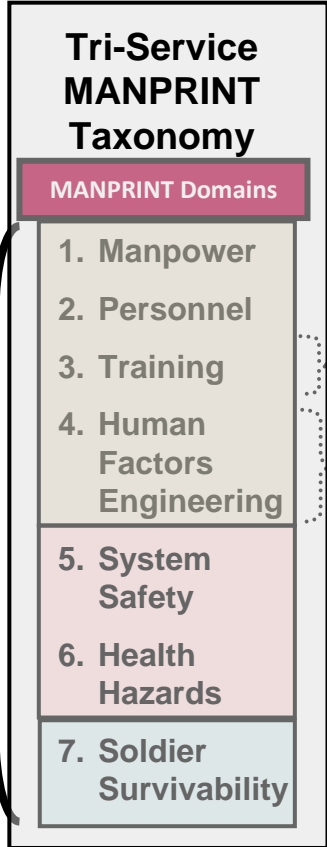
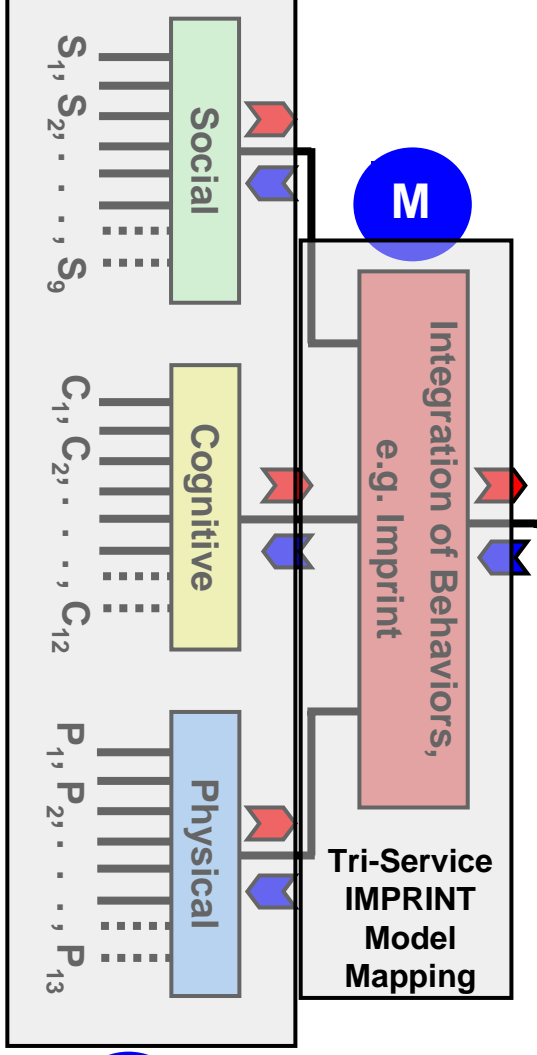
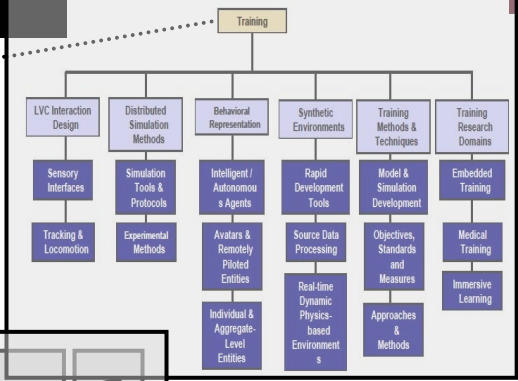


Current: Warfighter to Human Dimension (and back)

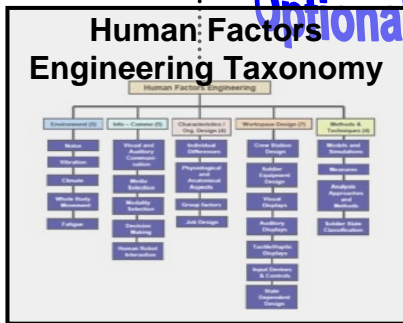


Current: Warfighter to Human Dimension (and back)

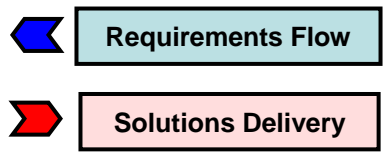
Training Taxonomy



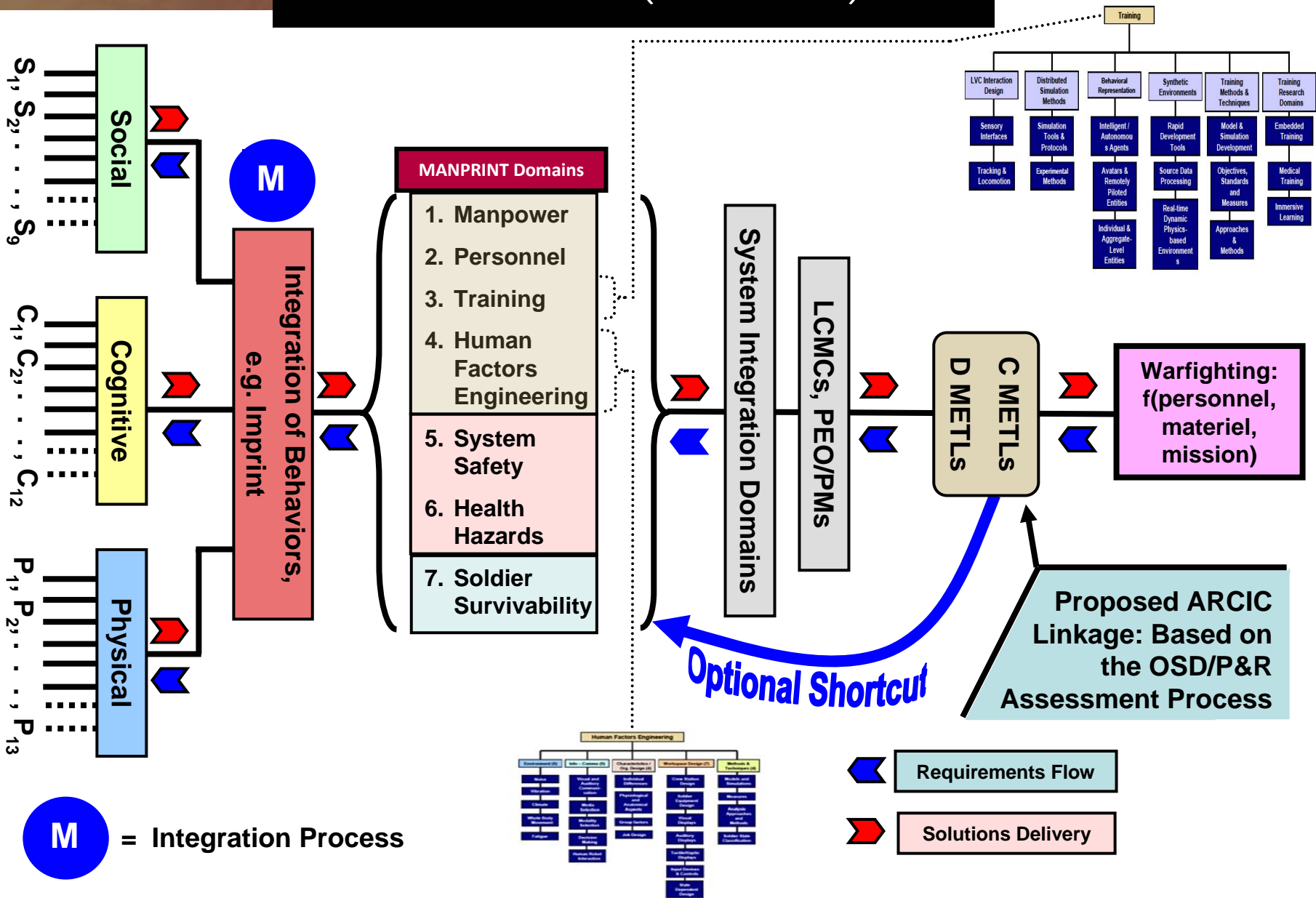
Current ARCIC Function



M = Integration Process



Alternate: Warfighter to Human Dimension (and back)

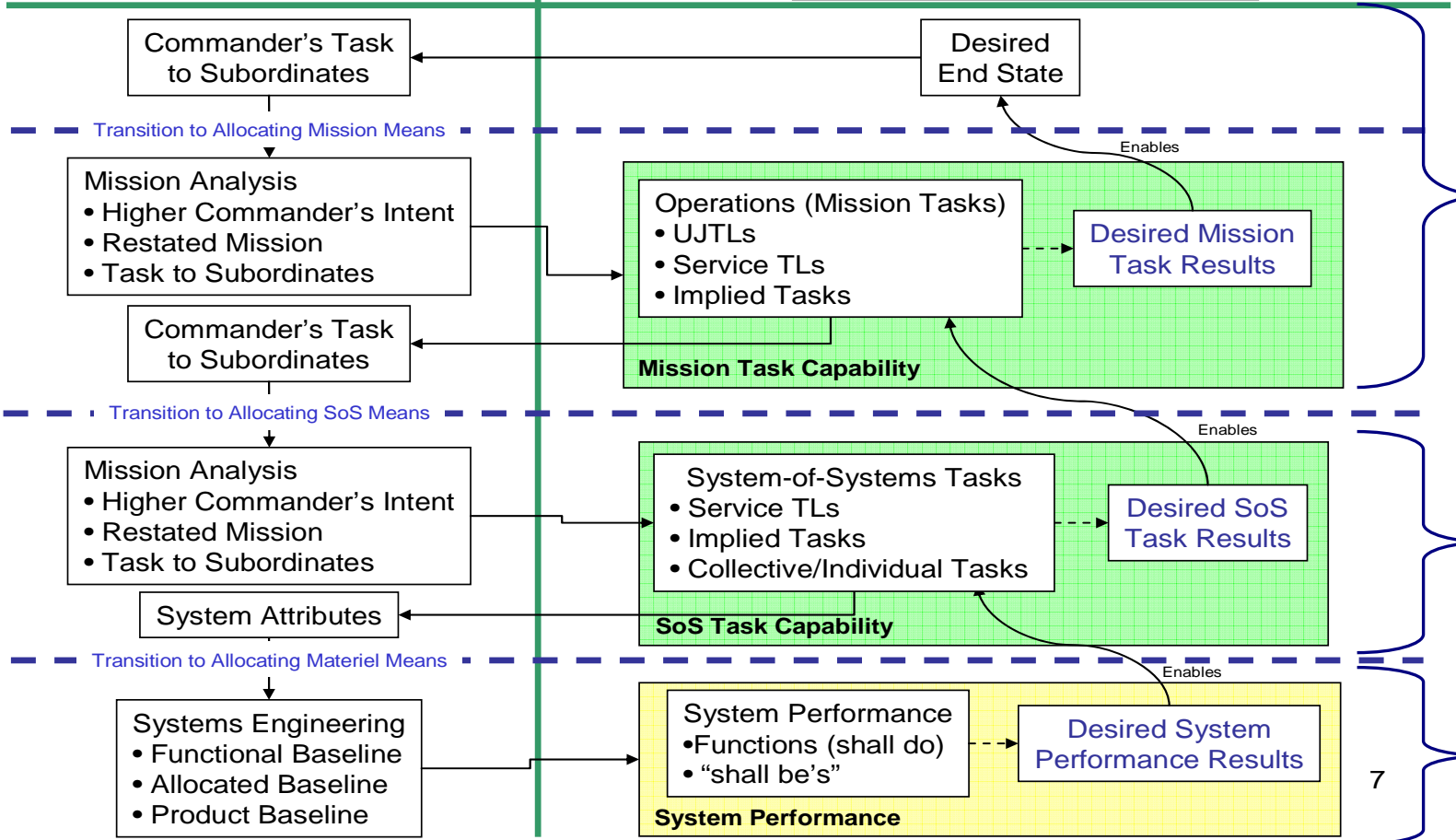




MBT&E Framework – v2

Capability = Set of Tasks + Desired Result

Process/Products



Essence:
What must be accomplished and Why

Implementation:
DOTMLFP
How and Who

DOTMPF
Component

Mission-base SE in an SoS Environment enables identification, trade-off, and design of System structure and allocation, characteristics and performance to:

- Prioritize by stressor relevance to End-Results, Mission-Task effectiveness, SoS-Task performance, Human Dimension, and Operational Variables **as well as** stressor relevance to traditional Materiel and Technology considerations.
- Articulate the impact of System capabilities in **the language of** the warfighter as expressed in the originating JCIDS FAA, FNA, and FSA

FAA: Functional Area Analysis

FNA: Functional Needs Analysis

FSA: Functional Solution Analysis

- For identified gaps in required Capability, employ a Mission-Essential-Task-List (METL, with measure, conditions and standards) centric Systems-of-Systems (SoS) approach to complete the (traditional) materiel centric Systems Engineering “V” (SE-V) in the conception, development, evaluation, and fielding of DOTMLPF (Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities) solutions for the warfighter
- The key is systematically deriving, retaining, and employing Mission, Task, and Human Dimension context throughout the extended SE-V in the SoS environment to need analysis, trade study, design allocation, and capability assessment results in traditional materiel centric terms and their relationships and contributions both direct and indirectly to the impact on warfighting operational performance and mission effectiveness.
- This approach is an application of the Missions and Means Framework (MMF) that is tailored to be compatible with the existing Army Guidance for Employment of Forces (GEF) directive for certifying operational forces prior to deployment, the recently released USD/AT&L Systems Engineering Guide for a SoS Environment, and the emerging ATEC Mission-Base Test & Evaluation (MBT&E) and DOT&E Joint Test & Evaluation Methodology (JTEM) a frameworks and procedures. .



Backup

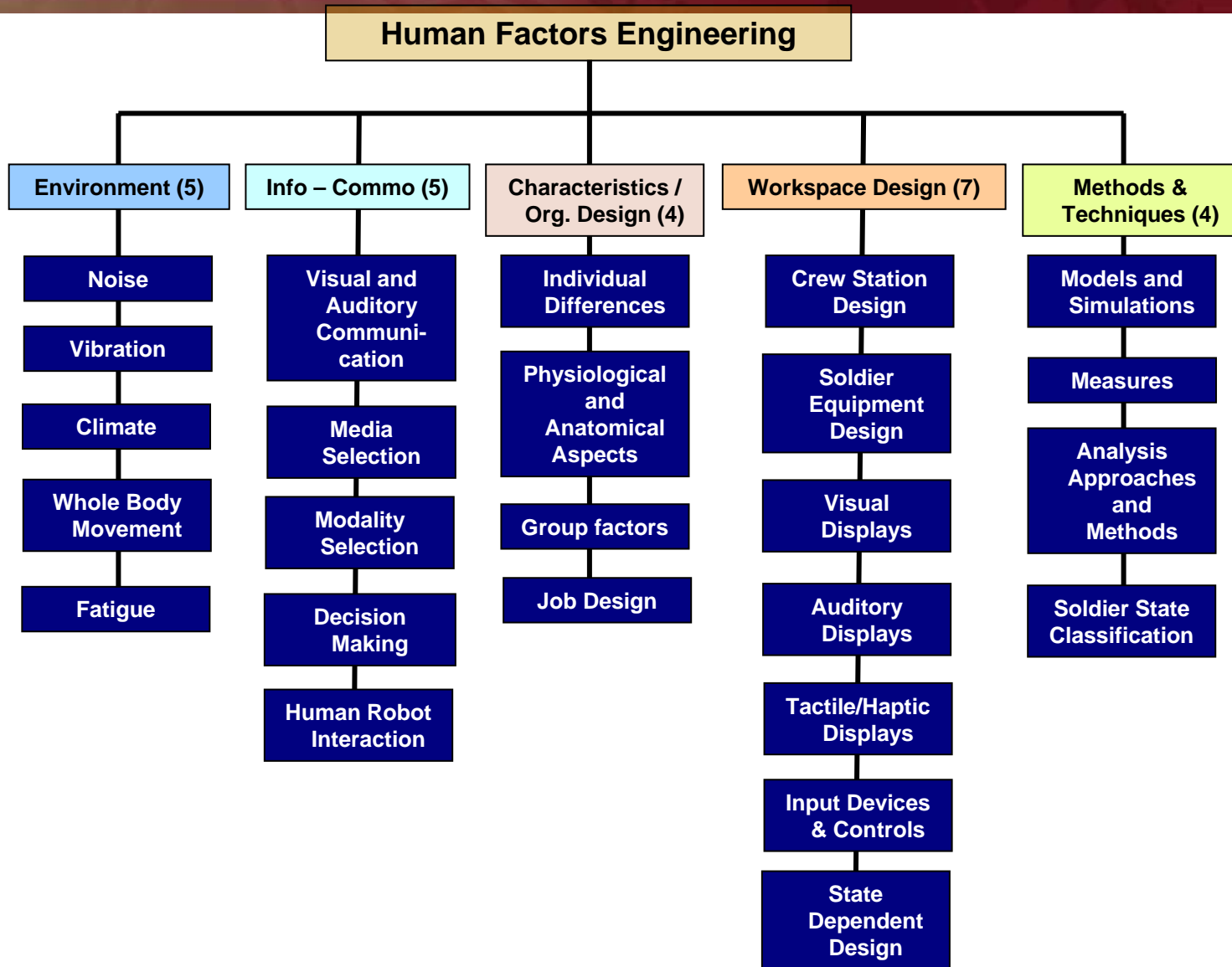


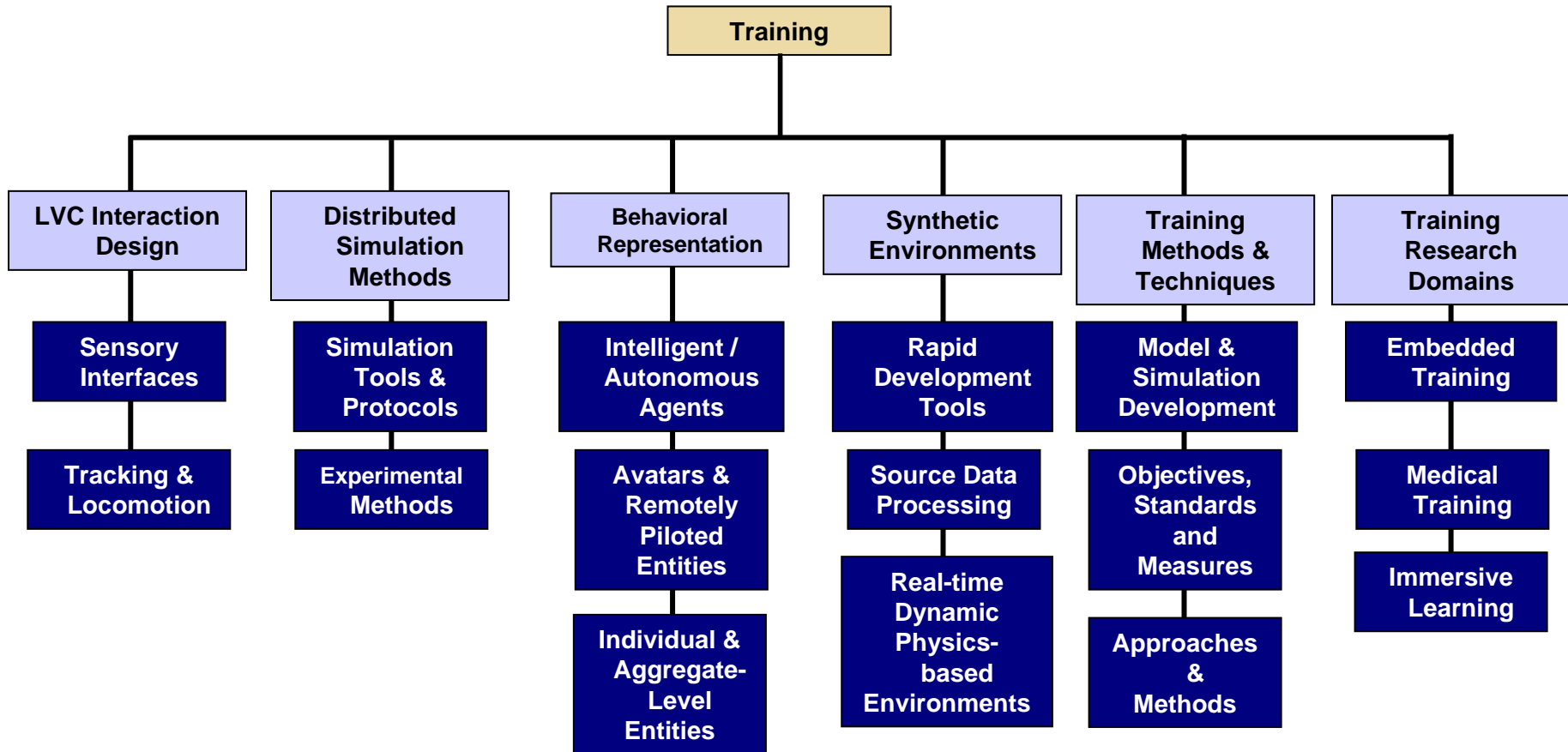
- **System (S)*** - A functionally, physically, and/or behaviorally related group of regularly interacting or interdependent elements; that group of elements forming a unified whole [JP 1-02 & JP 3-0]
- **Capability*** - is the ability to achieve a desired effect under specified standards and conditions through combinations of ways and means to perform a set of tasks [CJCS, 2007(2)].
- **Family of Systems (FoS)*** - a set of systems that provide similar capabilities through different approaches to achieve similar or complementary effects [CJCS, 2007(1)].
- **System of Systems (SoS)*** - is defined as a set or arrangement of systems that results when independent and useful systems are integrated into a larger system that delivers unique capabilities [DoD, 2004(1)].
- Both individual systems and SoS conform to the accepted definition of a system in that each consists of parts, relationships, and a whole that is greater than the sum of the parts; however, although an SoS is a system, not all systems are SoS. *

* Taken from the DoD SE Guide for SoS

- **Virtual SoS*** – Group lacks a central management authority and a centrally agreed upon purpose for the system-of-systems.
- **Collaborative SoS*** – Group component systems interact more or less voluntarily to fulfill agreed upon central purposes.
- **Acknowledged SoS*** – Group has recognized objectives, a designated manager, and resources for the SoS; however, the constituent systems retain their independent ownership, objectives, funding, and development and sustainment approaches. Changes in the systems are based on collaboration between the SoS and the systems.
- **Directed SoS*** - The group, an integrated system-of-systems, is built and managed to fulfill specific purposes. It is centrally managed during long-term operation to continue to fulfill those purposes as well as any new ones the system owners might wish to address. The component systems maintain an ability to operate independently, but their normal operational mode is subordinated to the central managed purpose.
- When a group of systems morphs into an SoS – synergy occurs between the various systems
- When a group of systems is not an SoS – synergy between the various elements does not occur

* Taken from the DoD SE Guide for SoS





| | Mission | Doctrine | Organization | Organization Success Measures |
|----------------------------|-------------------------|-----------------|---------------------|--------------------------------------|
| Context Dependent | Major Combat Ops | Match | Match | Exist |
| Context Dependent | Stability & Support Ops | Mismatch | Mismatch | Not well developed |
| Context Independent | Maintain Force | Match | Match | Exist |
| Context Independent | Establish Cordon | Match | Match | Exist |

| | System | Directed SoS | Acknowledged SoS | Collaborative SoS | Virtual SoS |
|----------------------------|---------------|--|--|--------------------------|---------------------|
| Governance | Feudal | Central with limited local autonomy (France, Russia) | Federation with states rights freedom of action (US, Canada) | Tribal | Fair market economy |
| Conflict Resolution | Adjudicated | Adjudicated | Negotiated | Competed | Pair-wise consent |
| Schedule | Synchronized | Synchronized | Emergent | Synchronized | Asynchronous |

| | System | Directed SoS | Acknowledged SoS | Collaborative SoS | Virtual SoS |
|--------------------------------|---|---|--|--|---------------------------------------|
| Enterprise | No | Yes | Yes | No | No |
| Communities of interest | Yes, A Priori by design, Stable over whole period | Yes, A Priori by design, evolving, stable when eventually complete | Yes, Evolving during development, then stable when complete | Yes, Evolving during development, then stable when complete | Yes, Morphs as the partners change |
| local | Yes Abrams | Yes SoSCOE | Yes USMTF/VMF | Yes AKO | Yes Proprietary Protocols |



SoS Forms Crossed with Acquisition Life Cycle Management



| | System | Directed SoS | Acknowledged SoS | Collaborative SoS | Virtual SoS |
|--------------------------------|-----------------------------|----------------------------|----------------------------|---|-------------------------------------|
| Program Risk | Internal | Internal & external | Internal & external | Internal & external | internal |
| AoA – TRADOC | Early, simple, and complete | Extensive and on-going | Extensive and on-going | Extensive at S level but not at SoS level | Partner selection in business sense |
| Rqmts - PM | Directed | Directed | Directed | Negotiated | Pair-wise Consent |
| Trade Studies - PM | Early, simple, and complete | Extensive and on-going | Extensive and on-going | Extensive at S level but not at SoS level | Partner selection in business sense |
| Build - PM | Well defined prime | Multiple primes & PMs | Multiple primes & PMs | Competitive | By independent partners |
| Integrate, V&V - PM | Internal to defined prime | Over multiple primes & PMs | Over multiple primes & PMs | Over multiple primes & PMs | Internal to partnership |
| T&E - ATEC | Independent oversight | Independent oversight | Independent oversight | By developers | By customers |



Mission-Based T&E

Tutorial, 2 March 2009

**25th Annual NDIA
T&E Conference**

Chris Wilcox

US Army Evaluation Center

410-306-0475

chris.wilcox1@us.army.mil




MBT&E Background




MBT&E Framework

- **ATEC Mission Based Test & Evaluation is consistent with**
 - OSD P&R directives for reporting METL-based Readiness
 - Joint GEF certification for Deployment of Operational Forces
 - JCIDS Capability based Acquisition
 - DoD Systems Engineering guide for Systems of Systems (SE for SoS)
 - DOT&E Joint Test & Evaluation Methodology (JTEM)

 **Based on Generic, General Purpose Measures/Conditions/Standards**

- TPFData List TO&E (standing) C-METL OSD P&R Readiness
- TPFDeployment Data MTOF (transient) D-METL Joint GEF Certification

 **Based on Mission, Situation Specific Measures/Conditions/Standards**

TPFDL: Time Phased Force Data List for deployment planning
 TPFDL: Time Phased Force Deployment Data for deployment execution
 TO&E: Table of Organization and Equipment for a standing unit
 MTOF: Mission Task Organized Force (modeling & simulation term)
 C-METL: Core METL defined by Army Force Generation (ARFORGEN) for commonality between units of the same type
 D-METL: Directed METL defined by Army Force Generation (ARFORGEN) for a unit with specific deployment orders
 GEF: Joint Guidance for Employment of Forces for unit certification prior to deployment
 P&R: OSD Personnel & Readiness directives for METL-based readiness reporting
 JCIDS: Joint Capability Integrated Development System



MBT&E Framework



Case Study Introduction



Case Study

- The purpose of this case study is to to present the concepts and operation of the MBT&E methodology using a example.
- The intent is to involve the audience in the development of an MBT&E strategy and to focus discussions.
- The information presented in the case study is fictional.



Case Study

- Joint Capabilities Integration and Development System conducting a capabilities-based assessment of modular combat brigades.
- Brigade Combat Team supported by Reconnaissance Attack battalion from Combat Aviation Brigade.
- Functional Area Analysis
 - Combat brigades required to support noncontiguous operations.
 - Ground units conducting simultaneous full spectrum operations in separate locations.
 - Aviation units providing support to simultaneous operations (one aviation team supporting more than one ground unit operation).
 - Capability: Attack time-sensitive targets based on maneuver ground units call for fire (eyes-on) and limited intelligence (developing situation).



Case Study

- Function Need Analysis

- Gap 1: Time sensitive targets need to be engaged within 15 minutes.
 - High priority targets, once identified, need to be destroyed before they have a chance to escape or hide in dense urban terrain, approx 15-20 minutes.
 - Current aviation unit response time from call for fires to prosecuted target as much as 45 minutes, depending on current location and location of the support call (50 nm).
 - Current quick-response call for fires from other assets (artillery and current air-launched munition set) not reliably available or not desired due to need to minimize collateral damage in dense urban terrain.
- Gap 2: Immediate response (<15 minutes) and extended surveillance (>45 minutes) needed to develop situational intelligence.
 - Success seen in using pre-planned reconnaissance/surveillance assets (RSAs) to observe suspicious behavior of initial target leading to other, more valuable, targets.
 - Currently, initial targets are being lost due to response time from observation to re-tasking of RSAs and inability of ground units to continue to surveil initial targets in dense urban terrain unobserved. Most targets lost within 15 minutes.
 - Currently, targets taking as much as 45 minutes to move from initial observation area to centralized base. (Based on pre-planned RSA missions.)



Case Study

- Functional Solution Analysis
 - Reconnaissance/Attack System (RAS)
 - Air-launched loitering sensor/munition.
 - Man-in-the-loop control and targeting after launch.
 - IR and SAL seeker
- RAS ICD/Draft CDD
 - Air-launched (AH-64D, F/A-18E/F, and UAS based on aircraft supporting ground operations).
 - Loiter Capability (>45 minutes, based on time it takes aviation units to move from one location to another.)
 - Multi-purpose warhead (Structure, Vehicle, Personnel targets, based on expanded target set.)
 - Range (50nm, based on distributed operations.)
 - Time to Target (<15 minutes to 50 nm)
 - Probability of single-shot kill (Pssk) (>80%)



MBT&E Procedure



MBT&E Procedure

Step 1

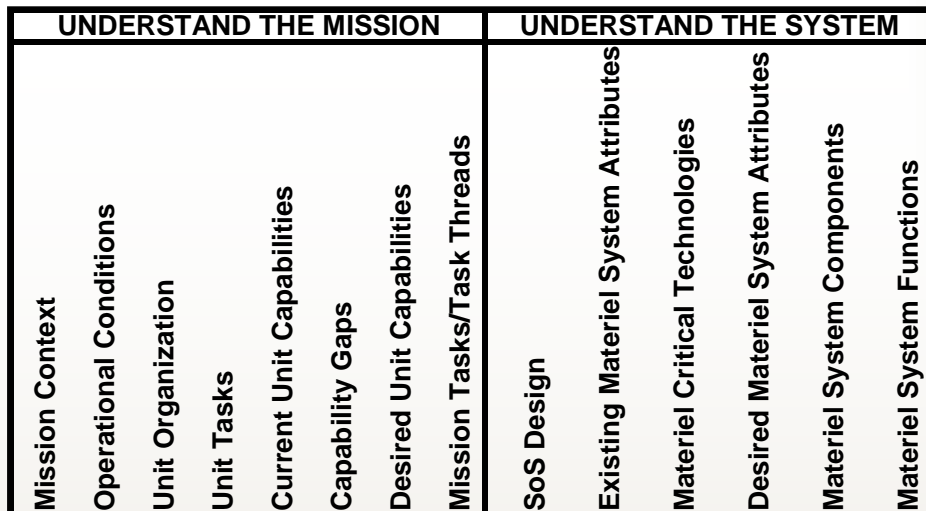
Collect Information



Collect Information (Step 1)

Currently building/maintaining document list.

| Document Title | Who to ask? |
|--|----------------------|
| Functional Area Analysis | TRADOC |
| Functional Need Analysis | TRADOC |
| Functional Solution Analysis | TRADOC |
| Analysis of Alternatives | TRADOC |
| Operational Mode Summary/Mission Profile | TRADOC |
| Initial Capabilities Document | TRADOC |
| DoDAF OV-1 (Appendix A) | TRADOC |
| Capabilities Documents (CDD, CPD) | TRADOC |
| DoDAF OV-1 (Appendix A) | |
| DoDAF OV-2 (Appendix A) | |
| DoDAF OV-4 (Appendix A) | |
| DoDAF OV-5 (Appendix A) | |
| DoDAF OV-6C (Appendix A) | |
| DoDAF SV-2 (Appendix A) | |
| DoDAF SV-4 (Appendix A) | |
| DoDAF SV-5 (Appendix A) | |
| DoDAF SV-6 (Appendix A) | |
| COI/Cs | TRADOC |
| Army Universal Task List, FM 7-15 | HQDA |
| Unit Mission Training Plan | TRADOC/School House |
| Support Unit Mission Training Plans | TRADOC/School House |
| Universal Joint Task List, CJCSM 3500 | Joint Staff (online) |
| System Threat Assessment Report | PM |
| Technology Development Strategy | PM |
| Acquisition Strategy | PM |
| Work Breakdown Structure | |
| Material Fielding Plan | PM |
| System Performance Specification | PM |



| Document Title | Who to ask? | Mission Context | Operational Conditions | Unit Organization | Unit Tasks | Current Unit Capabilities | Capability Gaps | Desired Unit Capabilities | Mission Tasks/Task Threads | SoS Design | Existing Materiel System Attributes | Materiel Critical Technologies | Desired Materiel System Attributes | Materiel System Components | Materiel System Functions |
|--|----------------------|-----------------|------------------------|-------------------|------------|---------------------------|-----------------|---------------------------|----------------------------|------------|-------------------------------------|--------------------------------|------------------------------------|----------------------------|---------------------------|
| Functional Area Analysis | TRADOC | X | m | m | m | m | X | X | m | | | | | | |
| Functional Need Analysis | TRADOC | m | m | m | m | X | X | X | m | | | | | | |
| Functional Solution Analysis | TRADOC | | | | | | | | | | | | | | |
| Analysis of Alternatives | TRADOC | X | X | X | X | | | | | | X | m | X | | |
| Operational Mode Summary/Mission Profile | TRADOC | X | m | X | | | | X | X | | | | | | |
| Initial Capabilities Document | TRADOC | X | X | X | X | | | X | X | X | | | X | | |
| DoDAF OV-1 (Appendix A) | TRADOC | X | X | X | X | | | X | X | X | | | X | | |
| DoDAF OV-2 (Appendix A) | TRADOC | X | X | X | X | | | X | X | X | | | X | | |
| DoDAF OV-4 (Appendix A) | TRADOC | | | X | | | | X | | | | | | | |
| DoDAF OV-5 (Appendix A) | TRADOC | | | X | | | | X | | | | | | | |
| DoDAF OV-6C (Appendix A) | TRADOC | | | X | | | | X | | | | | | | |
| DoDAF SV-2 (Appendix A) | TRADOC | | | X | | | | X | | | | | | | X |
| DoDAF SV-4 (Appendix A) | TRADOC | | | X | | | | X | | | | | | | X |
| DoDAF SV-5 (Appendix A) | TRADOC | | | X | | | | X | | | | | | | X |
| DoDAF SV-6 (Appendix A) | TRADOC | | | X | | | | X | | | | | | | X |
| COI/Cs | TRADOC | | | X | | | | X | | | | | X | | |
| Army Universal Task List, FM 7-15 | HQDA | | | X | | | | X | | | | | X | | |
| Unit Mission Training Plan | TRADOC/School House | | | X | | | | X | | | | | X | | |
| Support Unit Mission Training Plans | TRADOC/School House | | | X | | | | X | | | | | X | | |
| Universal Joint Task List, CJCSM 3500 | Joint Staff (online) | | | X | | | | X | | | | | X | | |
| System Threat Assessment Report | PM | | X | | | | | | | | | | | | |
| Technology Development Strategy | PM | | | | | | | m | | | | | X | | X |
| Acquisition Strategy | PM | | | | | | | m | | | | | X | | X |
| Work Breakdown Structure | PM | | | | | | | | | | | | X | | X |
| Material Fielding Plan | PM | | | | | | | | | | | | | | X |
| System Performance Specification | PM | | | | | | | | | | | | | | X |

X = provides
m = may provide



MBT&E Procedure

Steps 2-5

Understand the Mission



MBT&E Procedure

Step 2

Define the Mission Context



Focused Mission Case

- Strategic End State: Restore secure stable environment
 - Mission 1: Restore basic services
 - [Basic services restored to 80% of the population.]
 - Mission 2: Create a professional security forces
 - [Security forces able to maintain order.]
 - Mission 3: Provide area security.
 - [Create conditions for government to function and citizens to live, work and play.]
- Scenario for Mission 3: BCT establishes platoon sized Combat Outposts in cleared areas to prevent local insurgent forces/foreign fighter cells from operating. Units conduct patrolling and presence operations to reassure civilian population and disrupt insurgent operations in the area of operations. Attack Recon Company (AH 64) supports ground units with aerial recon, cooperative engagement of High Payoff Targets and attack of time sensitive targets.



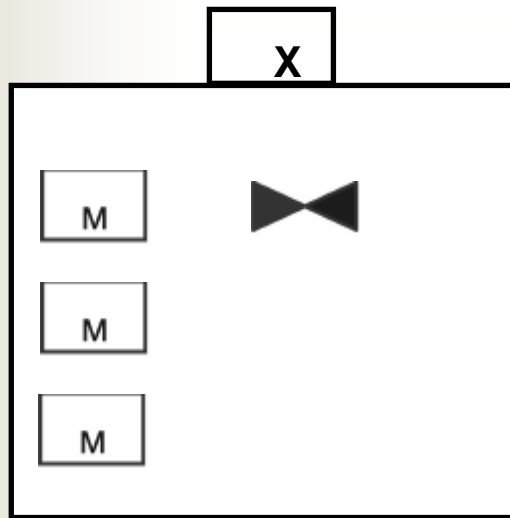
Case Study (Fictional)

Scenario Operational Setting

- Situation
 - Brigade Combat Team conducting full spectrum operations within an assigned Area of Operations.
 - Active insurgency with mix of discontented local tribes and foreign extremist fighters equipped with modern communications and MANPADS.
 - Subordinate Combined Arms Battalions operating platoon sized Combat Outposts throughout the AO
 - Insurgent leadership conducts planning and coordination meetings at varying times and locations to reduce vulnerability to attack with meeting times normally limited to less than 1 hour.
 - Insurgent gatherings are CCIR for BCT Cdr and insurgent leaders are High Payoff Tgts
- BCT Mission: Secure the BCT AO in order to set conditions for local civilians to carry on normal activities and handover responsibility to HN Forces
- Execution
 - Commander's Intent
 - Locating and eliminating insurgent leadership is critical to our ability to establish a secure environment for the civilian population.
 - Equally important is the need to ensure positive identification and avoid collateral damage. Unintentional civilian casualties will severely undermine the mission by throwing support to the insurgents.



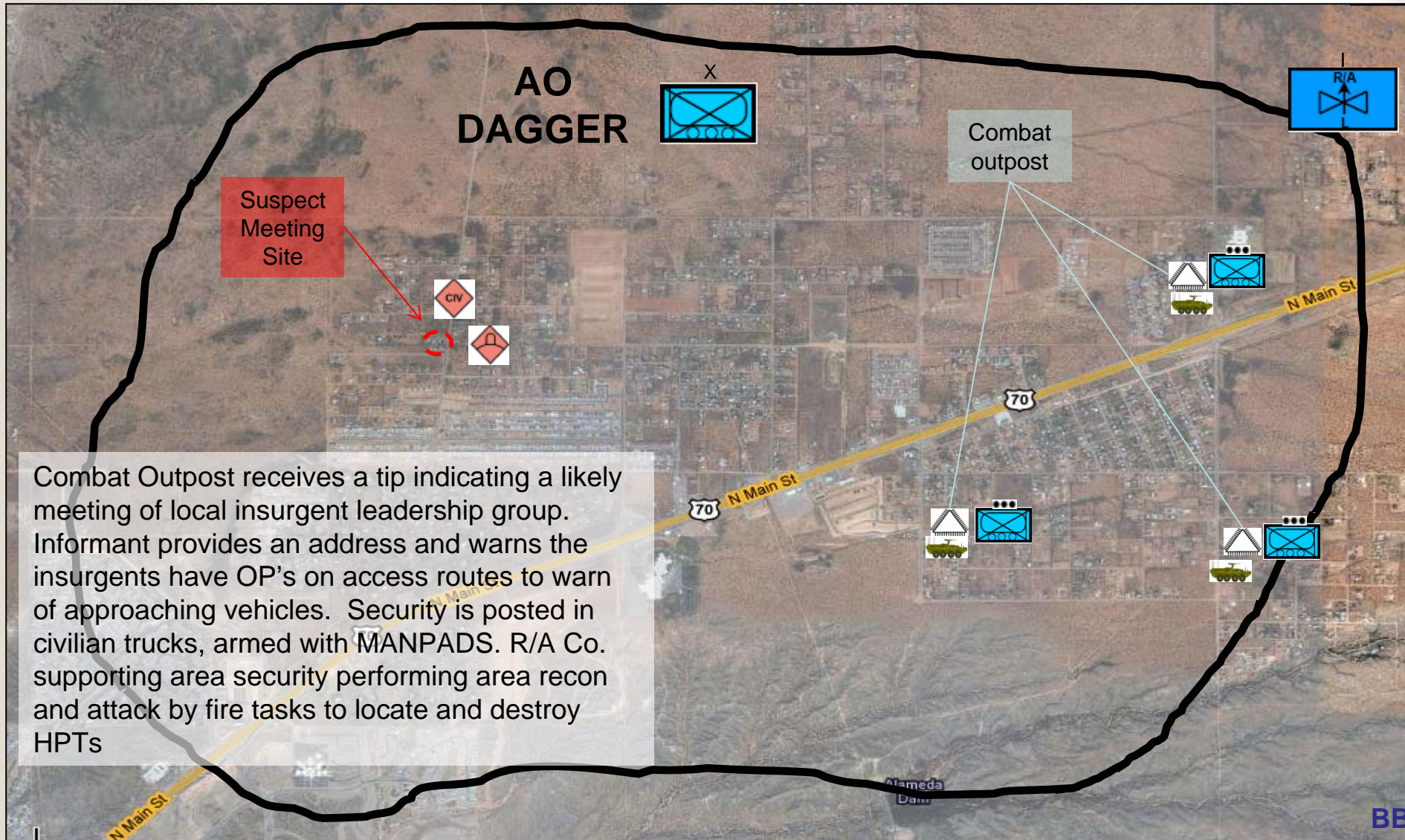
Task Organization



Brigade Combat Team (BCT) task organized with 3 Stryker battalions and 1 Attack Helicopter battalion from the Corps Aviation Brigade



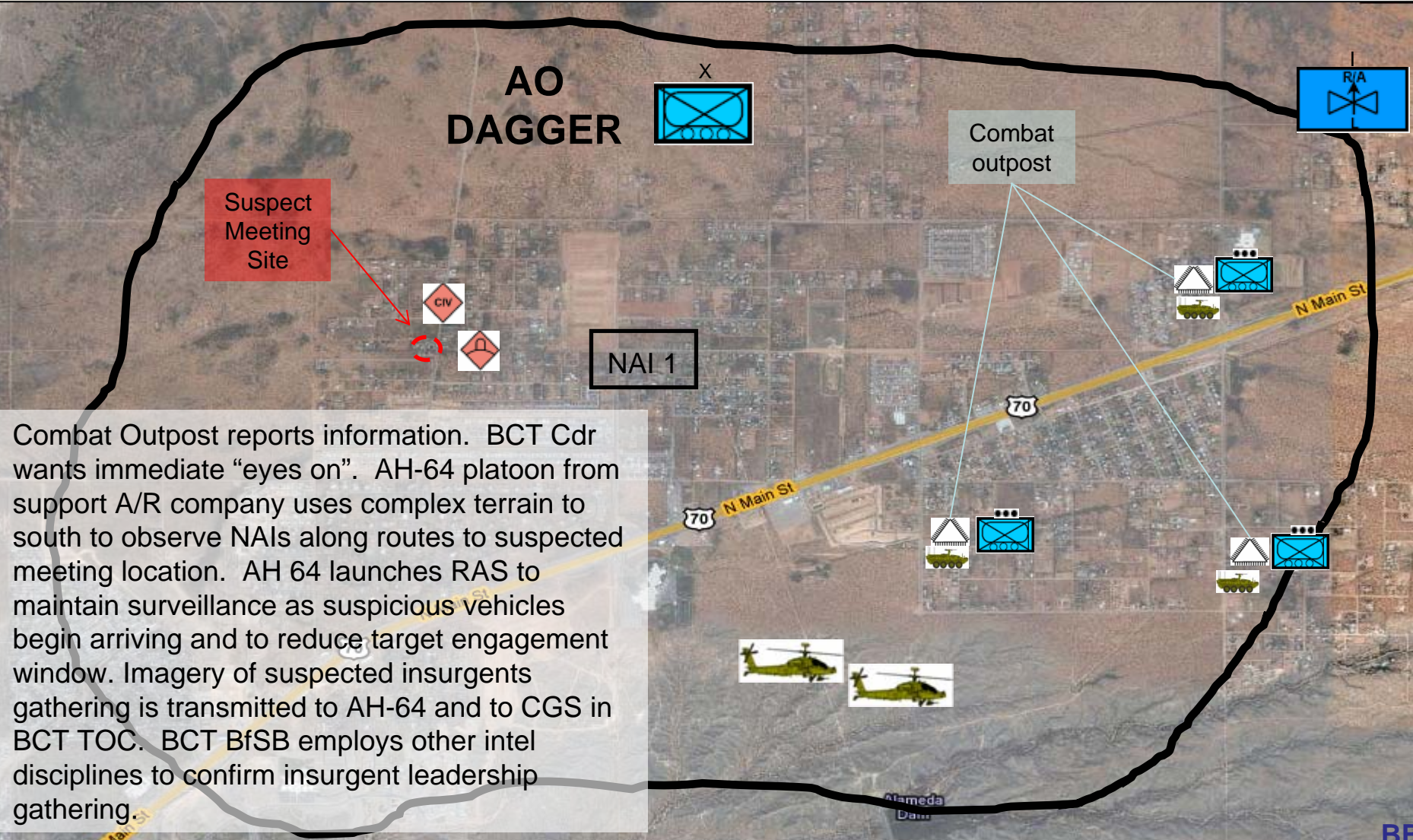
Current Situation



Combat Outpost receives a tip indicating a likely meeting of local insurgent leadership group. Informant provides an address and warns the insurgents have OP's on access routes to warn of approaching vehicles. Security is posted in civilian trucks, armed with MANPADS. R/A Co. supporting area security performing area recon and attack by fire tasks to locate and destroy HPTs



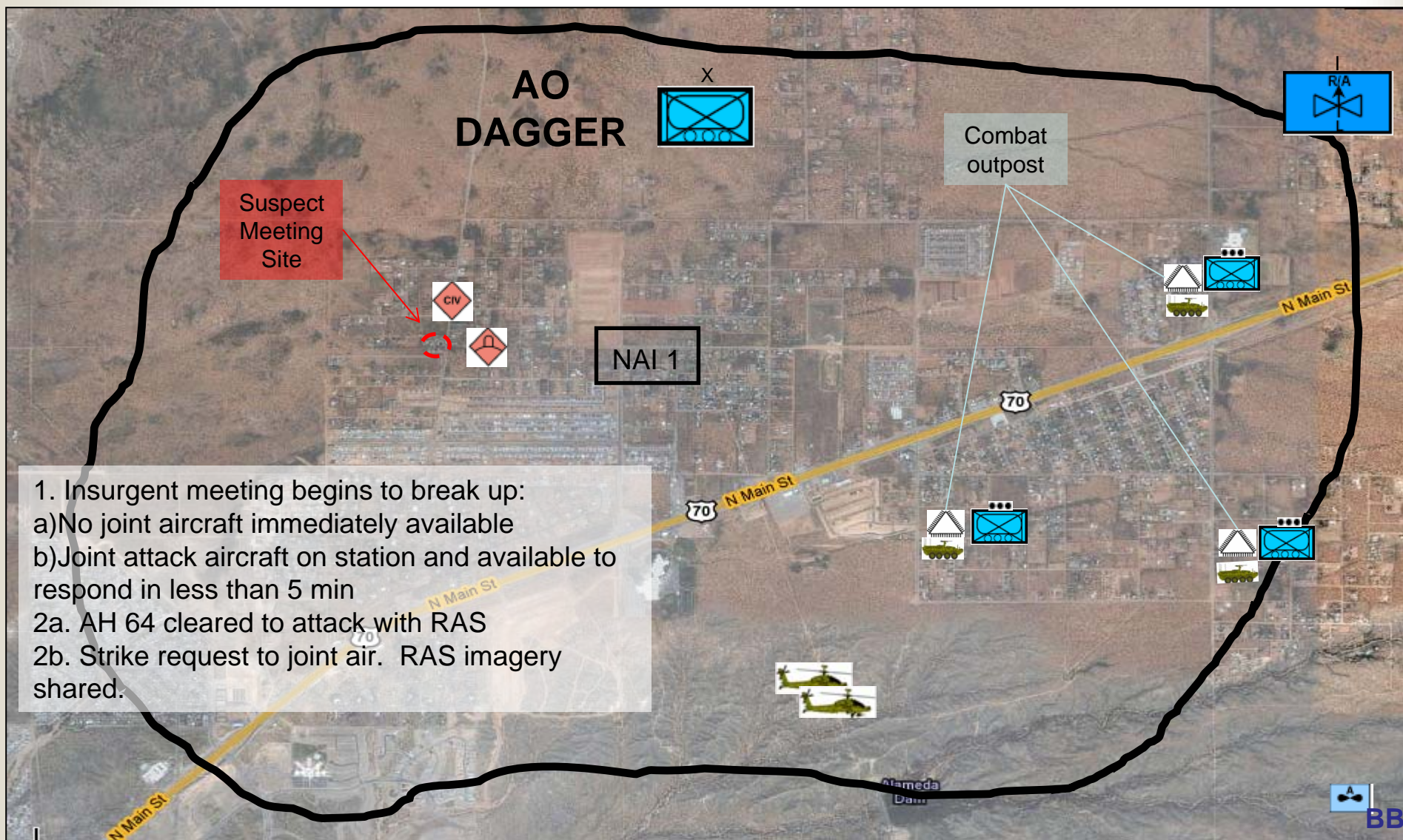
Current Situation



Combat Outpost reports information. BCT Cdr wants immediate "eyes on". AH-64 platoon from support A/R company uses complex terrain to south to observe NAIs along routes to suspected meeting location. AH 64 launches RAS to maintain surveillance as suspicious vehicles begin arriving and to reduce target engagement window. Imagery of suspected insurgents gathering is transmitted to AH-64 and to CGS in BCT TOC. BCT BfSB employs other intel disciplines to confirm insurgent leadership gathering.



Current Situation



1. Insurgent meeting begins to break up:
a) No joint aircraft immediately available
b) Joint attack aircraft on station and available to respond in less than 5 min
2a. AH 64 cleared to attack with RAS
2b. Strike request to joint air. RAS imagery shared.



Operational Conditions

- **Mission 3: In RAS context.**
 - **Conduct Dynamic Targeting (OP 3.1.9):** To achieve timely and accurate detection and prosecution of time-sensitive targets through integration of dynamic ISR support and operations in support of the operational level JFC's intent.¹
 - **Conduct Air to Surface Attack (ART 3.3.1.2):** Use fixed- and rotary-wing aircraft-mounted weapon systems to destroy, suppress, or neutralize equipment (including aircraft on the ground), materiel, personnel, fortifications, and facilities.²
- **Summary of operational conditions (METT-TC)**
 - **Mission:** Employ Lethal Fire Support (ART 3.3.1)
 - Joint Task: TA 3.2.1 Conduct Fire Support
 - Army Task: ART 1.4.1 Conduct Lethal Direct Fire against a Surface Target
 - **Enemy:** Vehicles, and Personnel in open. Personnel in buildings.
 - **Troops:** SBCT; R/A Company (AH 64); joint air attack teams (USAF and USN).
 - **Terrain & Weather:** Urban, desert, mountain, all weather
 - **Time Available:**
 - Clock Hours: Daylight, Night and Crossover.
 - Planning Time: Extensive coordination planning. Engagement plan developed as situation unfolds.
 - **Civil Considerations:** Limited collateral damage. Positive ID of targets necessary (friendlies in the area).

1. CJCSM 3500.04C Universal Joint Task List

2. FM 7-15 The Army Universal Task List



MBT&E Procedure

Step 3

Develop the Mission Tasks



Mission Analysis

- Area Reconnaissance and Lethal Direct Fire against surface targets (As requested by supported BCT Cdr).
 - Plan Mission [Mission planned and mission data loaded on data cartridge.]
 - Weapon Load Planning.
 - Complete Performance Planning Calculations.
 - Prepare for Mission [Aircraft report 'go' status and lined up at tactical assembly area.]
 - Load Aircraft and Weapon Status Check.
 - Lineup for takeoff.
 - Execute Mission [R and A mission executed as requested by ground units.]
 - TAA to AO
 - **Support Ground Unit in AO**
 - AO to TAA



Mission Analysis

- Support Ground Units in AO
 - Check in with ground units [Contact with ground units is established]
 - Accept attack mission [Attack mission is accepted by aviation unit.]
 - Employ RAS [Aviation units arrive at engagement area (EA).]
 - Launch RAS Munition [RAS munition is launched and is flying normally.]
 - Guide RAS to EA [RAS munition arrives in target area.]
 - Gather situational information [SA is understood and target is identified.]
 - Decide on employment technique [Engagement technique is selected.]
 - Engage Target [Target is engaged and destroyed.]
 - 1. Engage with RAS [Target is destroyed by RAS.]
 - 2. Engage with onboard munitions [Target is destroyed by selected munition.]
 - 3. Call in Joint Air Attack Team [Target is destroyed by supporting aircraft.]
 - Battle Damage Assessment [Target state is determined.]
 - Decide on re-attack or return to supporting position [Followon action is identified.]



Mission Analysis

- Support in AO →
 - Check in with ground units →
 - Accept attack mission →
 - Employ RAS →
 - Launch RAS Munition →
 - Guide RAS to AO →
 - Gather situational information →
 - Decide on employment technique →
 - Engage Target →
 - 1. Engage with RAS →
 - 2. Engage with onboard munitions →
 - 3. Call in JAAT →
 - Battle Damage Assessment →
 - Decide on re-attack or return to supporting position →
- ART 3.3.1.2 Conduct Air to Surface Attack
- ART 5.1.2.1 Est. Coordination & Liaison
- ART 5.1.1.1 Receive the Mission
- ARTEP 01-2-5183 Tactical Air Movement
- **RAS 7 Launch RAS**
- **RAS 15 Control RAS**
- ART 2.3.4 Conduct Surveillance; ART5.1.4.1 Monitor Situation
- TC 251-1422 Perform Firing Techniques
 - same as above
 - **RAS 10 Modify RAS Warhead Setting; RAS 9 Modify RAS Employment Setting**
- TC 251-1458 Engage with Point Target Weapon System
- ARTEP 01-2-0106.01 Conduct JAAT Operations
- ART 5.1.4.3.1 Conduct BDA
- ART 5.1.4.3.3 Provide re-attack recommendation
- TC 251-1405 Transmit Tactical Report



MBT&E Procedure

Step 4

Develop the Supporting Tasks



Supporting Tasks

- Conditional Tasks

- Deny Enemy Engagement [Enemy can not engage aircraft.]
 - ART 5.7.1 Protect against Enemy Hazards in the A.O.
- Jettison Launcher [Launcher with munitions is jettisoned.]
 - TC 251-1070 Respond to Emergencies

- Enabling Tasks

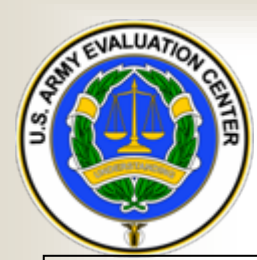
- Replace IR Coolant Bottle [Spent coolant bottle is removed, replacement bottle is installed, and missile provides a “go” status.]
 - ARTEP 01-2-5212 Perform helicopter repairs and required inspections of aircraft subsystems
- Training [Aircrew is trained and certified in RAS control tasks.]
 - ART 5.1.2.5 Conduct Pre Operations Checks and Inspections



MBT&E Procedure

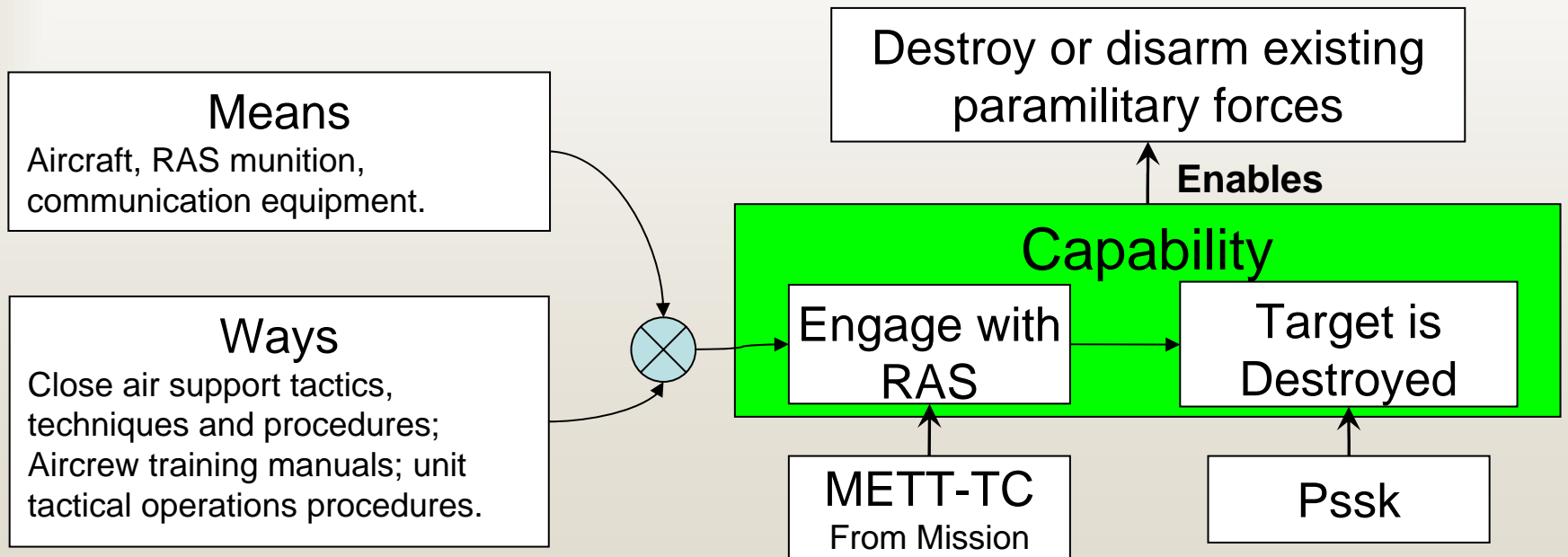
Step 5

Identify Task Capabilities



Associate Tasks with Requirements

- Air to Surface Attack (ART 3.3.1 Employ Lethal Fire Support) {Time to target observation < 15 minutes.}
- Support SBCT in AO (ART 1.4.1 Conduct Lethal Direct Fire)
- Employ RAS (RAS 7) {Positive control range > 50 nm.}
- **Engage with RAS (TC 251-1522 Perform Firing Techniques) {Probability of Single-Shot Kill (Pssk) > 80%.}**





Afternoon Break

1500-1515



MBT&E Procedure

Steps 6-8

Understand the System &
Associate Capabilities with Attributes



MBT&E Procedure

Step 6

Determine the SoS Components



SoS Description

- AH-64D [Transport / deliver missile.]
 - Launcher [Control, communicate, launch missile.]
 - Tactical Data Link [Control RAS during flight.]
 - Avionics [Communicate with ground forces.]
- RAS Munition [1. Provide situational information, 2. Destroy target.]
- Simulator [Exercise aircrews in RAS TTPs.]
- Remote Designator [Designate Target]
- Mission Planning System [Load and performance planning downloaded on cartridge.]



SoS Description

- Aligned with PM's Work Breakdown Structure
- RAS Munition [1. Provide situational information, 2. Destroy target.]
 - Seeker [Provide situational images, acquire and track target.]
 - Motor [Provide Thrust.]
 - Warhead [Provide lethal effects.]
 - Guidance and Control System [Guide munition.]
 - Wings [Provide lift.]
 - Tactical Data Link (TDL) [Communicate with controlling asset.]



SoS Description

- Aligned with Critical Technologies List
- Motor identified as a critical technology
 - Proposed miniature air-breathing engine not previously demonstrated.
 - Planned wind tunnel test prior to MS B.
- Miniature control data link.
 - Capability to provide positive/fail-safe control of a miniature munition not previously demonstrated.
 - Planned captive flight testing prior to MS B.



MBT&E Procedure

Step 7

Develop System Attributes



Associate Materiel with Requirements

- RAS Munition [1. Provide situational information, 2. Destroy target.] **{In-flight Reliability; % non-essential function failure > 93%.}** **{Loiter time > 45 minutes.}**
 - Seeker [Provide situational images, acquire and track target.] **{Minimum Delta-Temperature.}** **{Operate with all semi-active laser code frequencies.}**
 - Motor [Provide Thrust.] **{Low observable smoke.}**
 - Warhead [Provide lethal effects.] **{Probability of a kill given a hit; Pk/h, >95%.}**
 - C&G [Guide munition.] **{Probability of a hit given a shot; Ph/s, >90%.}**
 - Tactical Data Link [Receive control signals. Transmit target information.] **{Positive communication link range >60 nm.}**



MBT&E Procedure

Step 8

Associate Capabilities with Attributes



Linking task to materiel

- Air to Surface Attack (ART 3.3.1 Employ Lethal Fire Support) {Time to target observation <15 minutes.}
- Support Ground Unit in AOS (ART 1.4.1 Conduct Lethal Direct Fires)
- Employ RAS (RAS 7) {Positive control range >50 nm.}
- Engage with RAS (TC 251-1522 Perform Firing Techniques)
{Pssk >80%.}

- Aircraft TDL [Control RAS during flight.] {Positive communication link range > 60nm}

- RAS Munition [1. Provide situational information, 2. Destroy target.] {Prel; % non-essential function failure > 93%.} {Loiter time > 45 minutes.}
 - Seeker [Provide situational images, acquire and track target.] {Minimum Delta-Temperature.} {Operate with all semi-active laser code frequencies.}
 - Warhead [Provide lethal effects.] {Pk/h, >95%.}
 - C&G [Guide munition.] {Ph/s, >90%.}



Enabling Attributes

- Materiel system attributes that apply to all tasks.
 - Electromagnetic Survivability [Materiel system is protected from electromagnetic interference.]
 - Information Assurance [Materiel system is protected from IO attack and critical information is not compromised.]
 - Reliability [Materiel system has sufficient time between failures to enable execution of soldier tasks.]
 - Maintainability [Materiel system is maintainable by field/fleet maintainers and operators.]



MBT&E Procedure

Steps 9-15

Design the T&E



MBT&E Procedure

Step 9

Unconstrained Operational Conditions



Operational Conditions

- Engage with RAS

- Mission: Close Air Support, Interdiction Attack, Suppression of Enemy Air Defenses
- Enemy: Vehicles, Personnel, Vehicles with Countermeasures
- Troops: rotary wing, fixed wing, unmanned aerial systems
- Terrain and Weather: Terrain: Urban, Mountain, Desert, Jungle. Weather: Clear, Dust, Fog, Rain, Snow.
- Time: Clock Hours: Day, Night, Crossover. Time Available: Deliberate, Hasty Planning
- Civil Considerations: Positive ID, Weapons Free, Collateral Damage Considerations.



• RAS Munition - Seeker

- Mission: All
- Enemy: **Vehicles, Personnel, Vehicles with Countermeasures**
- Troops: All
- Terrain and Weather: Terrain: All. Weather: **Clear, Dust, Fog, Rain, Snow.**
- Time: Clock Hours: **Day, Night, Crossover.** Time Available: Deliberate, Hasty Planning
- Civil Considerations: **Positive ID, Weapons Free,** Collateral Damage Considerations.



Strategy Benefits

MBT&E enables Strategy Development to

- Prioritize by End-Results, Mission-Task effectiveness, SoS-Task performance, and Operational Variables that are **most stressing** to System characteristics and performance
- Employ these **most stressing** circumstances to integrate technical, Developmental, Force Development, and Operational testing.
- Articulate results in **the language** of the Warfighter.



MBT&E Procedure

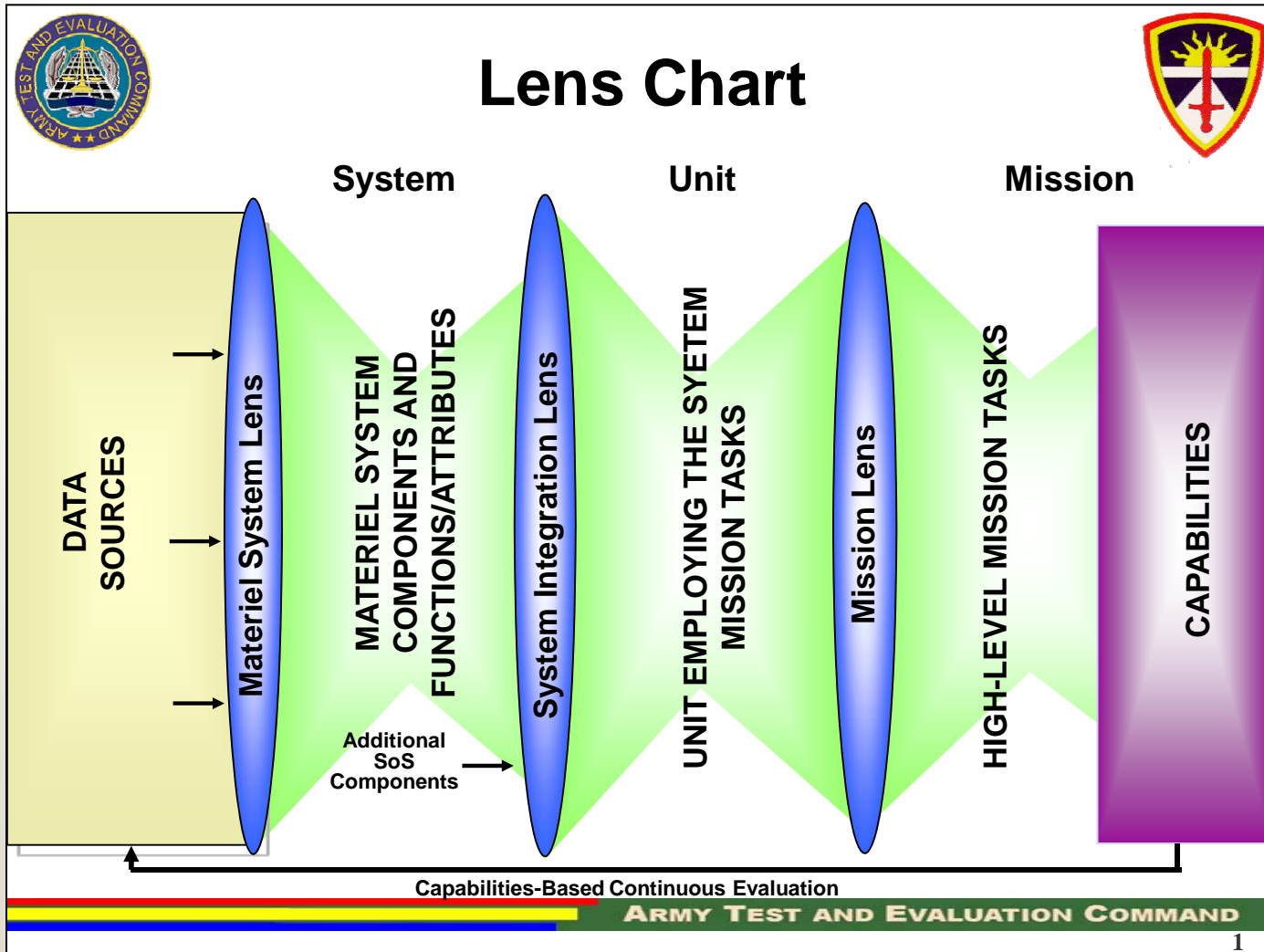
Step 10

Develop the Evaluation Strategy



Evaluation Strategy Summary

- Outline Summary or Lens Chart.





MBT&E Procedure

Step 11

Develop the Evaluation Measures



Operational Measures

- Air to Surface Attack (ART 3.3.1 Employ Lethal Fire Support) {Time to target observation <15 minutes.}
 - Operational Measure: % missions enemy is observed.
 - OM: % missions course of action is completed (Engage RAS or JAAT).*
 - OM: Time to first target observation.*
 - OM: Stowed kills.

- Support SBCT in AO (ART 1.4.1 Conduct Lethal Direct Fire)
 - Employ RAS (RAS 7) {Positive control range >50 nm.}
 - Engage with RAS (TC 251-1522 Perform Firing Techniques) {Pssk >80%.}

- OM: % missions target is destroyed.*
- OM: Time of engagement (attack order to target hit).*
- OM: Operator rating of engagement procedures.
- OM: Pssk (demonstrated and predicted).

* Measure referenced in FM 7-15, *The Army Universal Task List*.



Technical Measures

- Aircraft TDL [Control RAS during flight.] {Positive communication link range > 60nm}
 - Technical Measure: Average maximum positive control range.
 - TM: RAS position, speed and attitude information accuracy.
- RAS Munition [1. Provide situational information, 2. Destroy target.] {Prel; % non-essential function failure > 93%.} {Loiter time > 45 minutes.}
 - TM: In-flight reliability (% non essential function failures)*
 - TM: Maximum loiter time (predicted and demonstrated)*
- Seeker [Provide situational images, acquire and track target.] {Minimum Delta-Temperature.} {Operate with all semi-active laser code frequencies.}
 - TM: Minimum delta-temperature.*
 - TM: Verification of SAL code performance.*
 - TM: SAL acquisition range.*



MBT&E Procedure

Step 12

Assign Measures to Data Sources



Link to Data Sources

- Chronologically linked to data source

| Task | Operational Measure | Materiel System | Technical Measure |
|--------------------------|----------------------------------|-----------------|--|
| Close Air Support | | | |
| | % missions enemy is observed | | |
| | % missions COA is completed | | |
| | Time to first target observation | | |
| | Stowed Kills | | |
| Support in AO | | | |
| | Employ RAS | | |
| | Engage with RAS | | |
| | A/C TDL* | | Average maximum positive control range |
| | | | RAS position, speed and attitude info accuracy |
| | RAS Munition | | In-flight Reliability |
| | | | Maximum loiter time |
| | Seeker | | |
| | Guidance and Control | | |
| | G&C S/W | | |
| | Warhead | | |
| | Motor* | | |
| | | | Thrust vs. Time |

| Task | Operational Measure | Materiel System | Technical Measure |
|--------------------------------------|------------------------|-----------------|-------------------|
| Tower Tests | | | |
| | Captive Flight P1 | | |
| | Motor Static Runs | | |
| | Motor Wind Tunnel Runs | | |
| | MS B | | |
| Arena Tests | | | |
| | HWIL (seeker) | | |
| Armor Penetration P2 (seeker) | | | |
| | DT Flight Tests | | |
| | M&S (Lethality) | | |
| | IFS | | |
| | LUT/OT-B | | |
| Certifications | | | |
| | MS C | | |
| Logistics Demonstration | | | |
| | IFS | | |
| Full-up System Live Fire | | | |
| | Analysis | | |
| | IOT | | |
| Full-rate Production decision | | | |

| Task | Operational Measure | Materiel System | Technical Measure | Tower Tests | Armor Penetration P1 (seeker sim) | Captive Flight P1 | Motor Static Runs | Motor Wind Tunnel Runs | Integrated Flight Simulation | MS B | Arena Tests | Fue Tests | HWIL (seeker) | Armor Penetration P2 (seeker) | Captive Flight P2 | DT Ground Firings | DT Flight Tests | M&S (Lethality) | IFS | LUT/OT-B | Analysis | Certifications | MS C | Logistics Demonstration | M&S (Lethality) | IFS | Full-up System Live Fire | Analysis | IOT | Full-rate Production decision |
|-------------------|----------------------------------|-----------------|-------------------|-------------|-----------------------------------|-------------------|-------------------|------------------------|------------------------------|------|-------------|-----------|---------------|-------------------------------|-------------------|-------------------|-----------------|-----------------|-----|----------|----------|----------------|------|-------------------------|-----------------|-----|--------------------------|----------|-----|-------------------------------|
| Close Air Support | % missions enemy is observed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Close Air Support | % missions COA is completed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Close Air Support | Time to first target observation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Close Air Support | Stowed Kills | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Support in AO | Employ RAS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Support in AO | Engage with RAS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Support in AO | A/C TDL* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Support in AO | RAS Munition | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Support in AO | In-flight Reliability | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Support in AO | Maximum loiter time | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Seeker | Guidance and Control | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Seeker | G&C S/W | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Seeker | Warhead | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Seeker | Motor* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Seeker | Thrust vs. Time | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



Link to Data Sources

- Critical technologies linked to capabilities.

| Task | Operational Measure | Material System | Technical Measure | Captive Flight P1 | Motor Static Runs | Motor Wind Tunnel Runs | Integrated Flight Simulations |
|--|---------------------|-----------------|-------------------|-------------------|-------------------|------------------------|-------------------------------|
| Engage with RAS | | | | | | | |
| A/C TDL* | X | | | | | | |
| Average maximum positive control range | X | | | | | | |
| RAS position, speed and attitude info accuracy | X | | | | | | |
| RAS Munition | | | | | X | | |
| Motor* | | X | X | | | | |
| Thrust vs. Time | | X | X | | | | |

- Capabilities assessed through continuum of T&E

| Task | Operational Measure | Material System | System | Technical Measure | DT Flight Tests | LUT/OT-B | Analysis | MS C | Analysis | IOT |
|----------------------------------|---------------------|-----------------|--------|-------------------|-----------------|----------|----------|------|----------|-----|
| Close Air Support | | | | | X | X | X | | X | X |
| % missions enemy is observed | X | X | | | | | | | X | |
| % missions COA is completed | | X | | | | | | | X | |
| Time to first target observation | X | X | | | | | | | X | |
| Stowed Kills | | | X | | | | X | | | |



MBT&E Procedure

Step 13

Constrained Operational Conditions



Constrained Op Conditions

- RAS Munition – Seeker, Minimum delta-T
 - Terrain and Weather: Terrain: All. Weather: **Clear, Dust, Fog, Rain, Snow.**
 - Identified Data Sources: Tower Tests, Captive Flight, DT Flight Tests, HWIL.
 - Fog, rain and snow not available to be controlled during any of these tests.
- T&E Limitation
 - Limitation: Not able to test the performance of the seeker under fog, rain and snow.
 - Impact: Not able to evaluate seeker performance under these conditions.
 - Current Mitigation: Integrated flight simulation (IFS) may be used to analyze seeker performance under these conditions.



T&E Alternate COA

- T&E Limitation: Not able to test the performance of the seeker under fog, rain and snow.
- Recommended COA
 - Use IFS to characterize predicted seeker performance under fog, rain and snow conditions.
 - Conduct chamber “tower” test to confirm degraded performance in worst condition.



MBT&E Procedure

Step 14

Develop Data Source Requirements



Data Source Requirements

- Use design of experiments given constrained operational conditions.
- Engage with RAS
 - OM: % missions target is destroyed
 - OM: Time of engagement (attack order to target hit).
- Engage with RAS Operational Conditions
 - Mission: **Close Air Support, Interdiction Attack, SEAD**
 - Enemy: Vehicles, Personnel, Vehicles with Countermeasures
 - Troops: **Rotary wing, fixed wing, unmanned aerial systems**
 - Terrain and Weather: Terrain: **Urban**, Mountain, **Desert**, Jungle.
Weather: Clear, Dust, Fog, Rain, Snow.
 - Time: Clock Hours: Day, Night, Crossover. **Time Available:**
Deliberate, Hasty Planning
 - Civil Considerations: Positive ID, Weapons Free, Collateral Damage Considerations.



DOE Recommendation

- Desire to test with 3 crews

Option 1: random draw of 3 crews.

- Pro: Smallest number of runs (24).
- Con: Can not separate crew performance

Option 2: Test each run once for each crew.

- Pro: Can separate crew performance
- Con: Maximum number of runs (72).

| Mission | Troops | Terrain | Time Available |
|---------|--------|---------|----------------|
| SEAD | UAS | Desert | Planned |
| CAS | F/W | Urban | Planned |
| SEAD | UAS | Urban | Planned |
| CAS | F/W | Desert | Hasty |
| IA | R/W | Urban | Planned |
| IA | F/W | Urban | Planned |
| IA | F/W | Desert | Hasty |
| SEAD | R/W | Desert | Hasty |
| IA | R/W | Urban | Hasty |
| SEAD | F/W | Desert | Planned |
| CAS | UAS | Desert | Hasty |
| CAS | F/W | Desert | Planned |
| SEAD | F/W | Urban | Hasty |
| IA | UAS | Desert | Planned |
| IA | UAS | Urban | Hasty |
| CAS | R/W | Desert | Planned |
| SEAD | R/W | Urban | Planned |
| IA | R/W | Desert | Hasty |
| SEAD | UAS | Desert | Hasty |
| SEAD | UAS | Urban | Hasty |
| CAS | F/W | Urban | Hasty |
| CAS | R/W | Urban | Hasty |
| IA | R/W | Desert | Planned |
| CAS | UAS | Urban | Planned |



DOE Recommendation

Option 3 (recommended): Partial factorial using crews.

- Pro: Medium set of runs (48).
- Pro: Can separate crew performance to acceptable level.
- Con: More than minimum set of runs.

| | Mission | Troops | Terrain | Time Available | Crew | | Mission | Troops | Terrain | Time Available | Crew |
|----|---------|--------|---------|----------------|------|----|---------|--------|---------|----------------|------|
| 1 | SEAD | F/W | Desert | Planned | C | 25 | CAS | F/W | Desert | Planned | A |
| 2 | CAS | R/W | Desert | Hasty | B | 26 | IA | R/W | Desert | Hasty | B |
| 3 | SEAD | R/W | Desert | Planned | B | 27 | CAS | R/W | Urban | Planned | A |
| 4 | IA | F/W | Desert | Hasty | C | 28 | IA | UAS | Desert | Planned | C |
| 5 | SEAD | UAS | Urban | Hasty | A | 29 | SEAD | F/W | Urban | Hasty | C |
| 6 | IA | F/W | Desert | Planned | A | 30 | CAS | UAS | Desert | Planned | B |
| 7 | SEAD | UAS | Desert | Hasty | B | 31 | IA | UAS | Urban | Hasty | C |
| 8 | CAS | F/W | Desert | Hasty | C | 32 | SEAD | F/W | Desert | Hasty | B |
| 9 | IA | R/W | Urban | Planned | B | 33 | CAS | UAS | Urban | Planned | C |
| 10 | CAS | R/W | Urban | Planned | B | 34 | CAS | R/W | Desert | Hasty | A |
| 11 | SEAD | R/W | Urban | Planned | C | 35 | CAS | R/W | Desert | Planned | C |
| 12 | IA | UAS | Desert | Hasty | A | 36 | IA | R/W | Urban | Planned | C |
| 13 | IA | UAS | Urban | Hasty | B | 37 | SEAD | F/W | Urban | Planned | A |
| 14 | CAS | F/W | Urban | Planned | C | 38 | CAS | UAS | Desert | Hasty | C |
| 15 | SEAD | UAS | Urban | Planned | B | 39 | SEAD | UAS | Desert | Planned | A |
| 16 | SEAD | F/W | Desert | Hasty | A | 40 | IA | UAS | Urban | Planned | A |
| 17 | CAS | F/W | Urban | Hasty | A | 41 | IA | F/W | Urban | Planned | C |
| 18 | SEAD | R/W | Urban | Hasty | B | 42 | CAS | UAS | Desert | Planned | A |
| 19 | SEAD | UAS | Urban | Planned | C | 43 | SEAD | R/W | Desert | Hasty | C |
| 20 | IA | UAS | Desert | Planned | B | 44 | CAS | F/W | Desert | Planned | B |
| 21 | IA | R/W | Desert | Planned | A | 45 | CAS | UAS | Urban | Hasty | B |
| 22 | CAS | R/W | Urban | Hasty | C | 46 | IA | F/W | Urban | Hasty | B |
| 23 | SEAD | F/W | Urban | Planned | B | 47 | IA | R/W | Urban | Hasty | A |
| 24 | CAS | UAS | Urban | Hasty | A | 48 | SEAD | R/W | Urban | Planned | A |



MBT&E Procedure

Step 15

Develop T&E Databases



MBT&E Toolbox



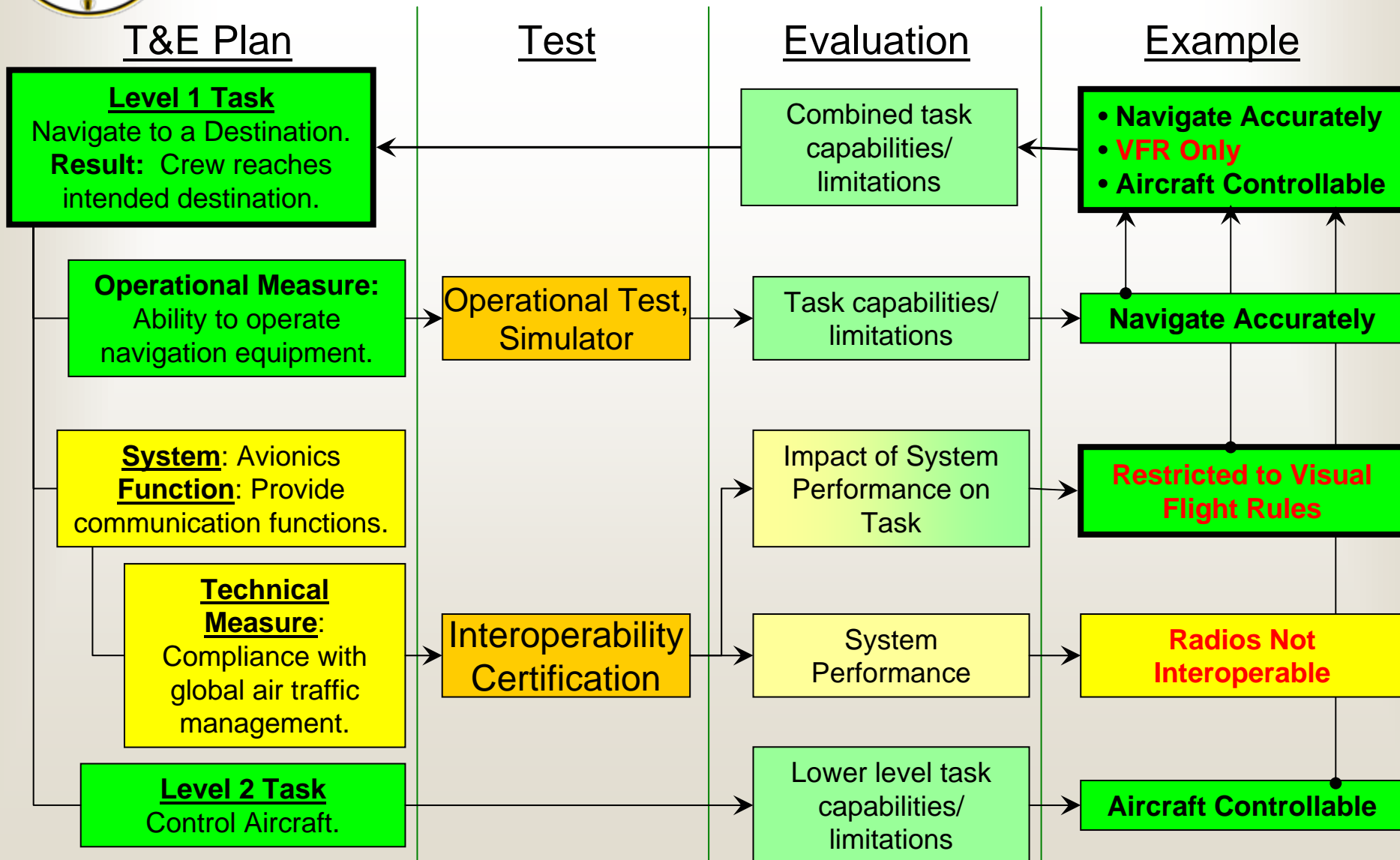
MBT&E Procedure

Steps 16-19

Determine the Results &
Report the Results



Report Example





Case Study Results (Fictional)

• Summary Results

| Task | Operational Measure | Material System | Technical Measure | Requirement | Result |
|--------------------------|----------------------------------|-----------------|-------------------|----------------------|---|
| Close Air Support | | | | | |
| | Time to first target observation | | | < 15 min (13 min) | 14.6 min |
| | Stowed Kills | | | NC | Predicted: 3, 6, 12 Demonstrated: 2, 5, 11 |
| Employ RAS | | | | | |
| | Rating of control | | | NC | 4.7/5 Excellent |
| | A/C TDL | | | | |
| | Positive Control Range | | | 50 km | 62 km |
| | RAS Munition | | | | |
| | Avg Max Loiter Time | | | 45 min | 52 min |
| Engage with RAS | | | | | |
| | % missions target is destroyed | | | NC | 84% |
| | Time of Engagement | | | < 15 min (2 min) | 1.6 min |
| | Pssk | | | 80% | P: 76%, D: 69% |
| | RAS Munition | | | | |
| | In-flight Reliability | | | 93% | 82% |
| | Guidance and Control | | | | |
| | Ph/s Predicted | | | 90% | 95% |
| | Ph/s Observed | | | NC | 84% |
| | Warhead | | | | |
| | Pk/h Predicted | | | 95% | 97% |
| | Pk/h Observed | | | NC | 100% |

Employ Lethal Fire Support

- Able to arrive in the engagement area within 15 minutes.
- Able to arrive in the engagement area and destroy the target within 16.2 minutes.
- Able to destroy from 3 to 12 targets per sortie (2 aircraft) based on load out.

Employ RAS

- Able to employ the RAS up to a range of 62 km with a loiter time of 52 minutes.

Engage with RAS

- Able to engage the target within 2 minutes.
- Able to engage and destroy targets with a probability of single shot kill of 76%, +/- 4%.



MBT&E Procedure

Steps 19

Report the Results



Evaluation Report

• Effectiveness

Employ Lethal Fire Support

- Able to arrive in the engagement area within 15 minutes.
- Able to arrive and destroy the target within 16.2 minutes.
- Able to destroy from 3 to 12 targets per sortie (2 aircraft) based on load out.
- Able to employ the RAS up to a range of 62 km with a loiter time of 52 minutes.
- Able to engage and destroy targets with a probability of single shot kill of 76%, +/- 4%.

• Suitability

Replace IR Coolant Bottle (enabling task)

- Able to replace a spent IR coolant bottle within 15 minutes on the flight line.

Training (enabling task)

- Able to task qualify and conduct RAS missions.

Reliability (enabling attribute)

- The RAS demonstrated a reliability of 82% (time to essential function failure). This supported a stowed kill rate of 3 to 12 targets per sortie (2 aircraft) based on load out.

Maintainability (enabling tasks)

- OPTEMPO was supported with a mean time to repair of 1.2 hours and anticipated stockpiles at the ammunition supply point.



Evaluation Report

- **Survivability**

Electromagnetic Survivability (enabling attribute)

- The RAS was compatible with existing and induced electromagnetic environments.

Information Assurance (enabling attribute)

- The RAS was able to deny all information operations attacks.

Jettison Launcher (conditional task)

- Jettison of the launcher was demonstrated for each load configuration.



Case Study

- **Function Need Analysis**

- Gap 1: Time sensitive targets need to be engaged within 15 minutes.
 - High priority targets, once identified, need to be destroyed before they have a chance to escape or hide in dense urban terrain, approx 15-20 minutes.
 - Current aviation unit response time from call for fires to prosecuted target as much as 45 minutes, depending on current location and location of the support call (50 nm).
 - Current quick-response call for fires from other assets (artillery and current air-launched munition set) not reliably available or not desired due to need to minimize collateral damage in dense urban terrain.

Employ Lethal Fire Support

- **Able to arrive in the engagement area within 15 minutes.**
- **Able to arrive and destroy the target within 16.2 minutes.**
- Able to destroy from 3 to 12 targets per sortie (2 aircraft) based on load out.
- Able to employ the RAS up to a range of 62 km with a loiter time of 52 minutes.
- Able to engage and destroy targets with a probability of single shot kill of 76%, +/- 4%.



Case Study

- **Function Need Analysis**

- Gap 2: Immediate response (<15 minutes) and extended surveillance (>45 minutes) needed to develop situational intelligence.
 - Success seen in using pre-planned reconnaissance/surveillance assets (RSAs) to observe suspicious behavior of initial target leading to other, more valuable, targets.
 - Currently, initial targets are being lost due to response time from observation to re-tasking of RSAs and inability of ground units to continue to surveil initial targets in dense urban terrain unobserved. Most targets lost within 15 minutes.
 - Currently, targets taking as much as 45 minutes to move from initial observation area to centralized base. (Based on pre-planned RSA missions.)

Employ Lethal Fire Support

- **Able to arrive in the engagement area within 15 minutes.**
- Able to arrive and destroy the target within 16.2 minutes.
- Able to destroy from 3 to 12 targets per sortie (2 aircraft) based on load out.
- **Able to employ the RAS up to a range of 62 km with a loiter time of 52 minutes.**
- Able to engage and destroy targets with a probability of single shot kill of 76%, +/- 4%.



MBT&E Tutorial

Discussions

-

Questions

-

Answers



MBT&E Point of Contact

Christopher Wilcox

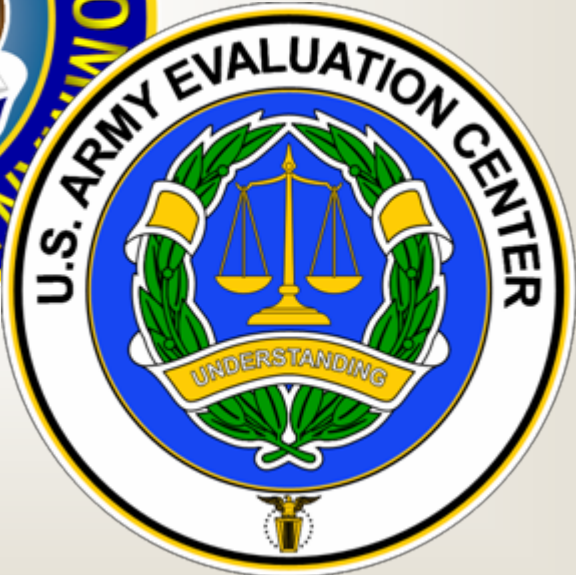
US Army Evaluation Center
ATTN: TEAE-AVA (Mr. Chris Wilcox)
4120 Susquehanna Ave.
Aberdeen Proving Ground, MD 21005

Office: (410) 306-0475

Mobile: (410) 652-0168

Fax: (410) 306-0398

chris.wilcox1@us.army.mil





Backup slides



Mission-Based T&E

Tutorial, 2 March 2009

**25th Annual NDIA
T&E Conference**

Chris Wilcox

US Army Evaluation Center

410-306-0475

chris.wilcox1@us.army.mil



Purpose

- To present and overview the MBT&E methodology (framework and process).
- To engage in question/answer discussions on the MBT&E methodology.
- To obtain audience feedback on the MBT&E methodology.



Agenda

1330: Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study Introduction

1415: Steps 1-5: Understand the Mission

1500-1515: Afternoon Break

1515: Steps 6-8: Understand the System

1545: Steps 9-15: Design the T&E

1615: Steps 16-19: Determine & Report the Results

1630: Discussions/Questions/Answers



Background - Why MBT&E?

- Because we were asked to...
 - DA/OSD-level guidance:
 - Address recent policy initiatives, such as: Section 231 Report; DOT&E/OUUSD(AT&L) *T&E Policy Revisions* memo; etc.
 - “Show impact of materiel system strengths/weaknesses on the operational capabilities.”
 - “Integrate DT and OT and make use of all available data.”
 - Address goals, strategies and initiatives in DUSA-TEO Strategic Plan, 2007.
 - “Continuously improve T&E policy and procedures.”
 - “Increase operational realism in developmental tests to improve the likelihood of successful operational tests.”
 - New TEMP format and DoD 5000 changes.
 - “Integrated T&E” chapter vs. DT and OT chapters.

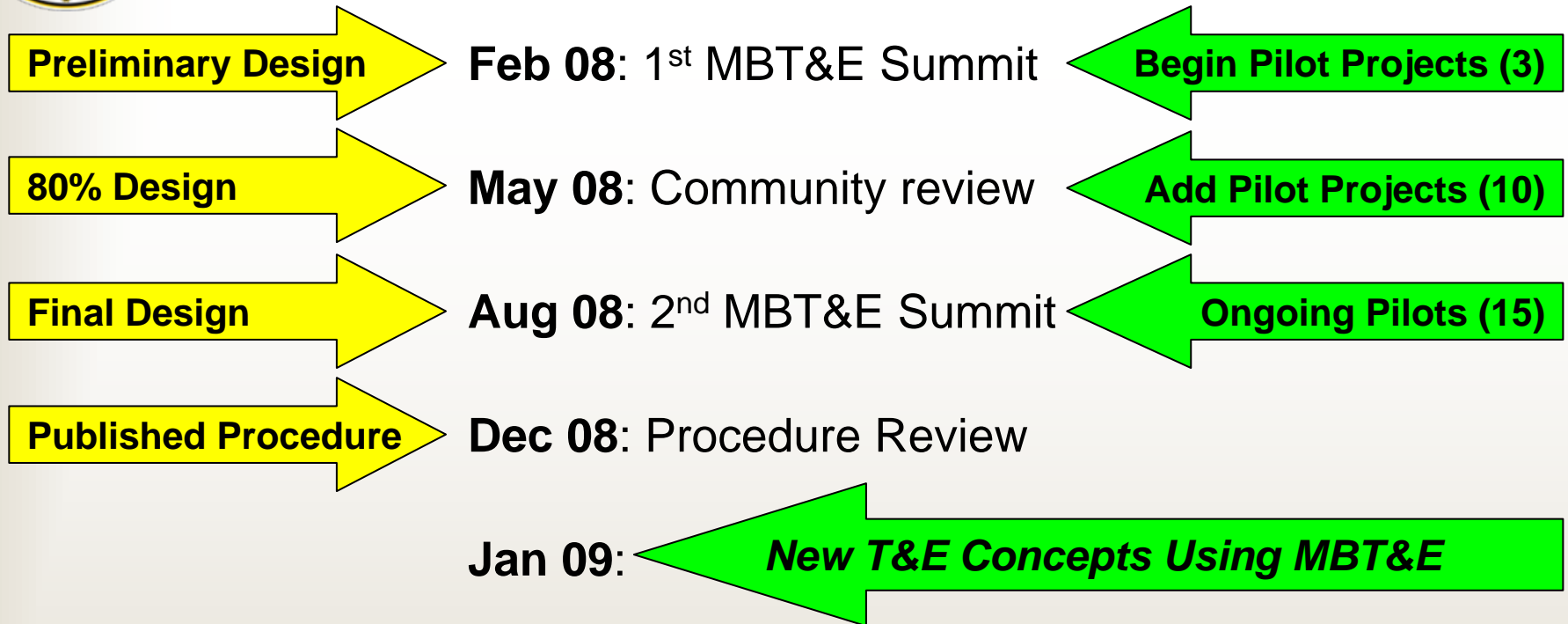


Background - Why MBT&E?

- Because we want to improve:
 - The way we do our job...
 - Enable robust T&E strategy development for Joint networked system-of-systems.
 - The way we support the warfighter...
 - Answer the “so what” question. (Complete feedback loop to Capability-Based Analysis.)
 - Develop way to link system performance to unit and higher unit task capabilities.
 - The way we support the materiel developer...
 - Scope T&E effort earlier in the acquisition cycle.



MBT&E Implementation



Lessons Learned:

- MBT&E framework providing context of operational capability.
- MBT&E process is executable with current personnel skill set.
- Efficiencies can be increased through:
 - Improved tools (templates, IT, training, etc.); and
 - Combat and materiel developer participation.



Background – MBT&E Overview

Mission-Based Test and Evaluation

is a methodology that focuses T&E on the **capabilities** provided to the warfighter. It provides a framework, procedure and complexity constraint strategies to:

- **link capabilities to the attributes** of the materiel system-of-systems;
- develop evaluation measures that **assess capabilities and attributes**;
- and link the evaluation measures to all **available data sources**.



Agenda

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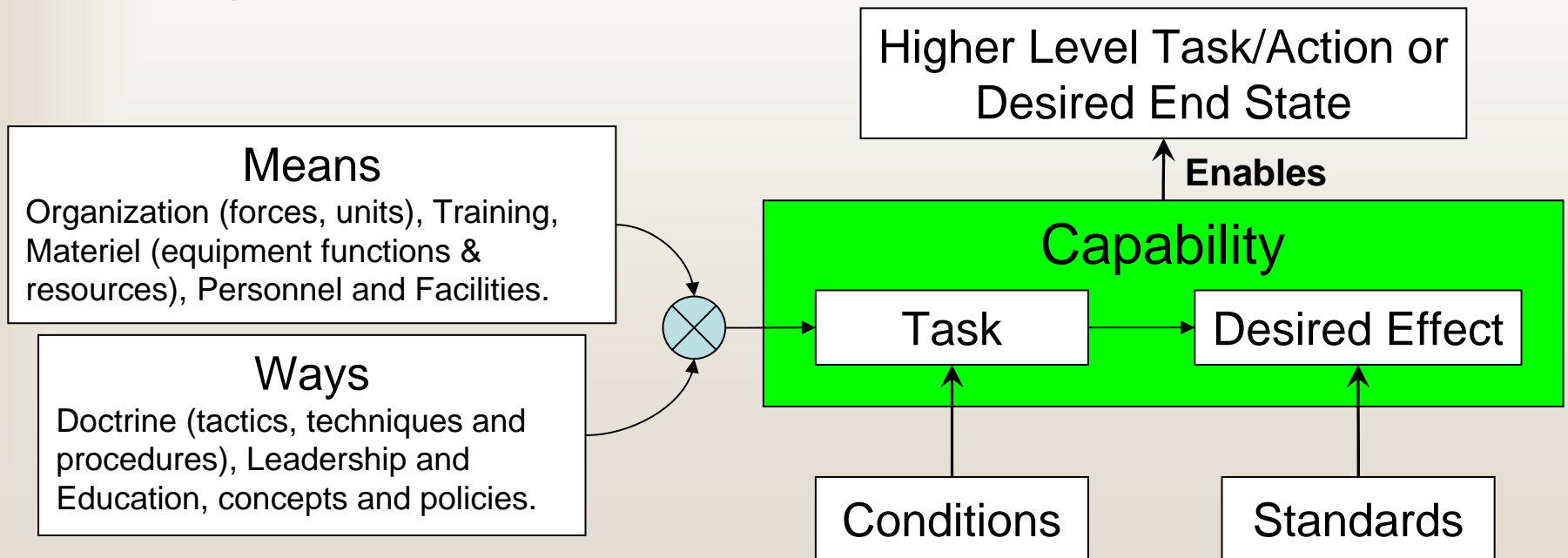
1630: Discussions/Questions/Answers



Framework Building Block

Capability¹ – The ability to achieve a **desired effect** [or result, outcome, or consequence of a task²] ...

- under specified **standards and conditions**
- through a combination of **means and ways**
- to perform a set of tasks.



1. CJCSI 3170.01F, May 2007

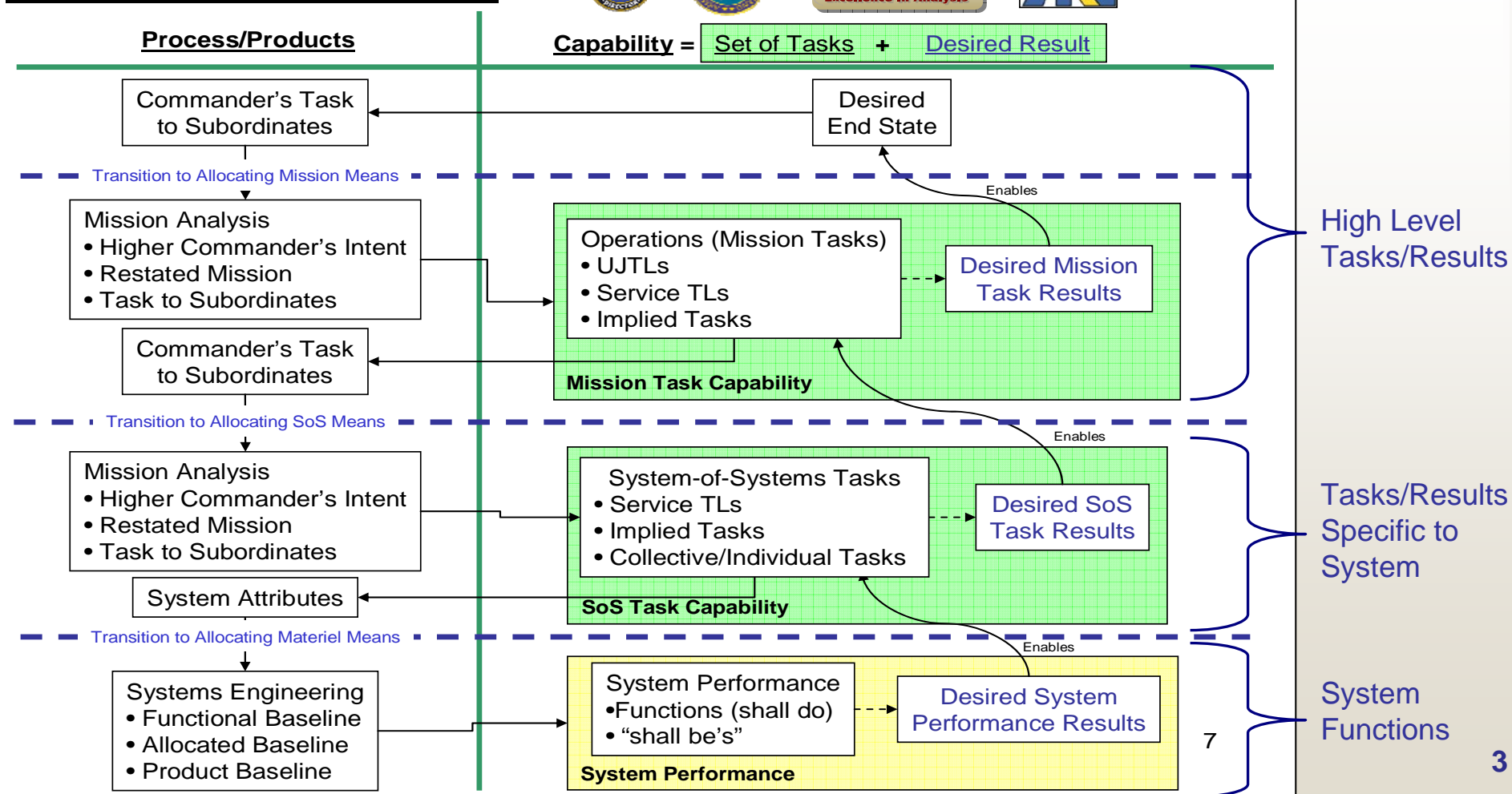
2. Taken from JP1-02, Mar 2007, definition of effect.

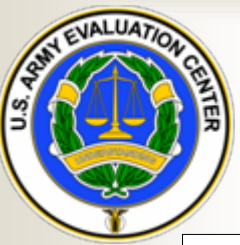


Framework - Task Hierarchy



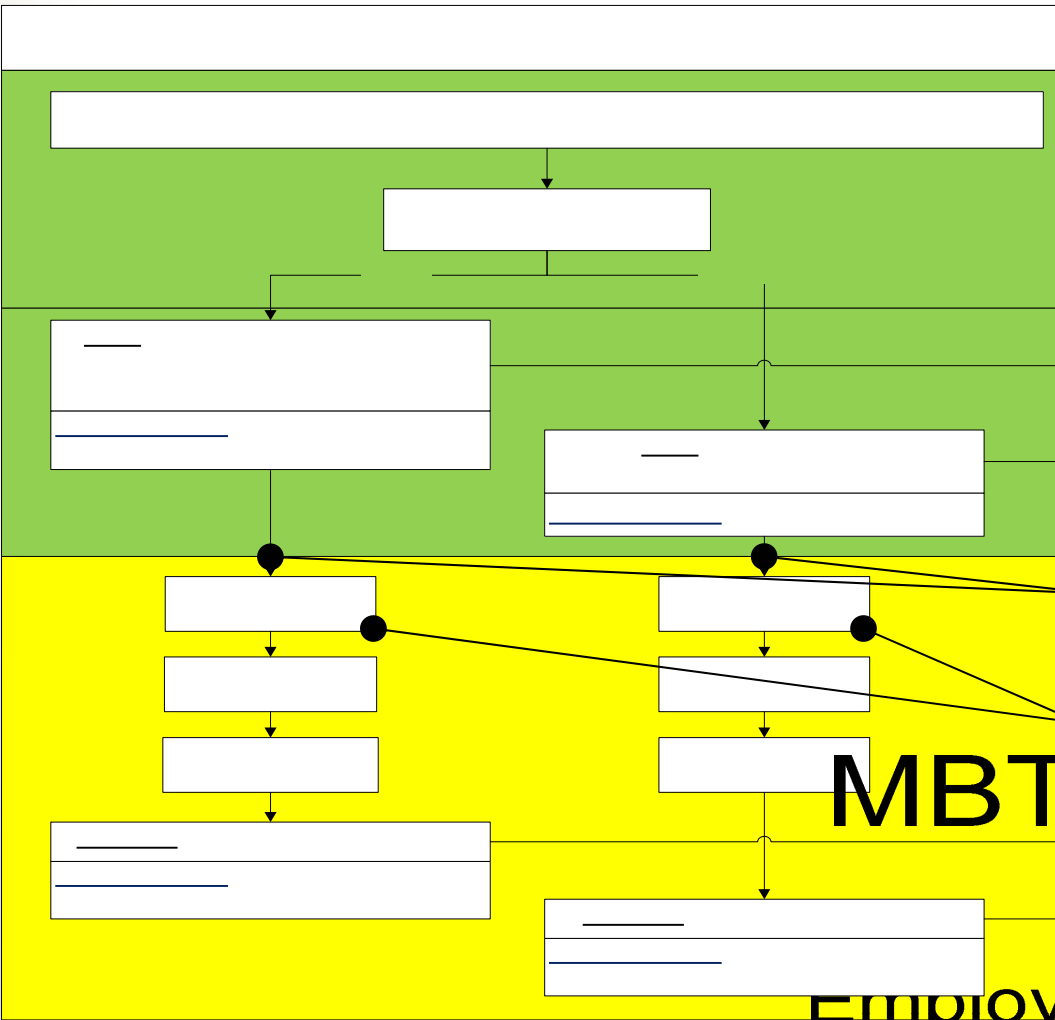
MBT&E Framework – v2





MBT&E Framework Example

Task Capability Linked to System Performance
 T&E Planning
 T&E Execution



All Available Data Used

| | | | |
|---|---|--|---|
| | | | |
| | | | |
| | | | X |
| X | X | | X |

Attributes Linked to Capabilities

SoS Identified

| | | | |
|---|---|--|---|
| | | | |
| | | | |
| X | | | X |
| X | X | | |

MBT&E Inthread

Employ Fires to Influence

T&E Planning T&E Execution

Capability and Performance Linked to Integrated T&E



Agenda

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Case Study Introduction



Agenda

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Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to collect information.

PLANNING

UNDERSTAND THE MISSION • 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SYSTEM • 2 steps to understand the components and attributes of the materiel system-of-systems.

- 1 additional step to understand the mission and system linkages.

DESIGN THE T&E • 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS • 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS • 1 step to format and report the results.

EXECUTING & REPORTING

11-12



Procedure - Collect Information (Step 1)

Purpose: Collect available information to gain understanding of:

- initiating capability gaps,
- mission context and operational conditions,
- mission tasks and capabilities,
- system-of-systems design and materiel system required attributes.

What do I do?

- Work through capabilities developer and materiel developer to obtain the available information.
 - Functional Area, Needs & Solution Analyses, Analysis of Alternatives, Requirements Documents (DoDAF Views), Threat Assessments, Acquisition Strategies, Performance Specifications, etc.

When am I done?

- Checklist of documents available/not available is completed.
- Available documents Archived.
- Actions to obtain copies of documents available, but not archived, are presented to appropriate IPTs.

12-13



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to understand the program context.

UNDERSTAND THE MISSION

- 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SYSTEM

- 2 steps to understand the components and attributes of the materiel system-of-systems.
- 1 additional step to understand the mission and system linkages.

DESIGN THE TEST AND EVALUATION

- 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS

- 3 steps to generate, collect, analyze, and evaluate the data.

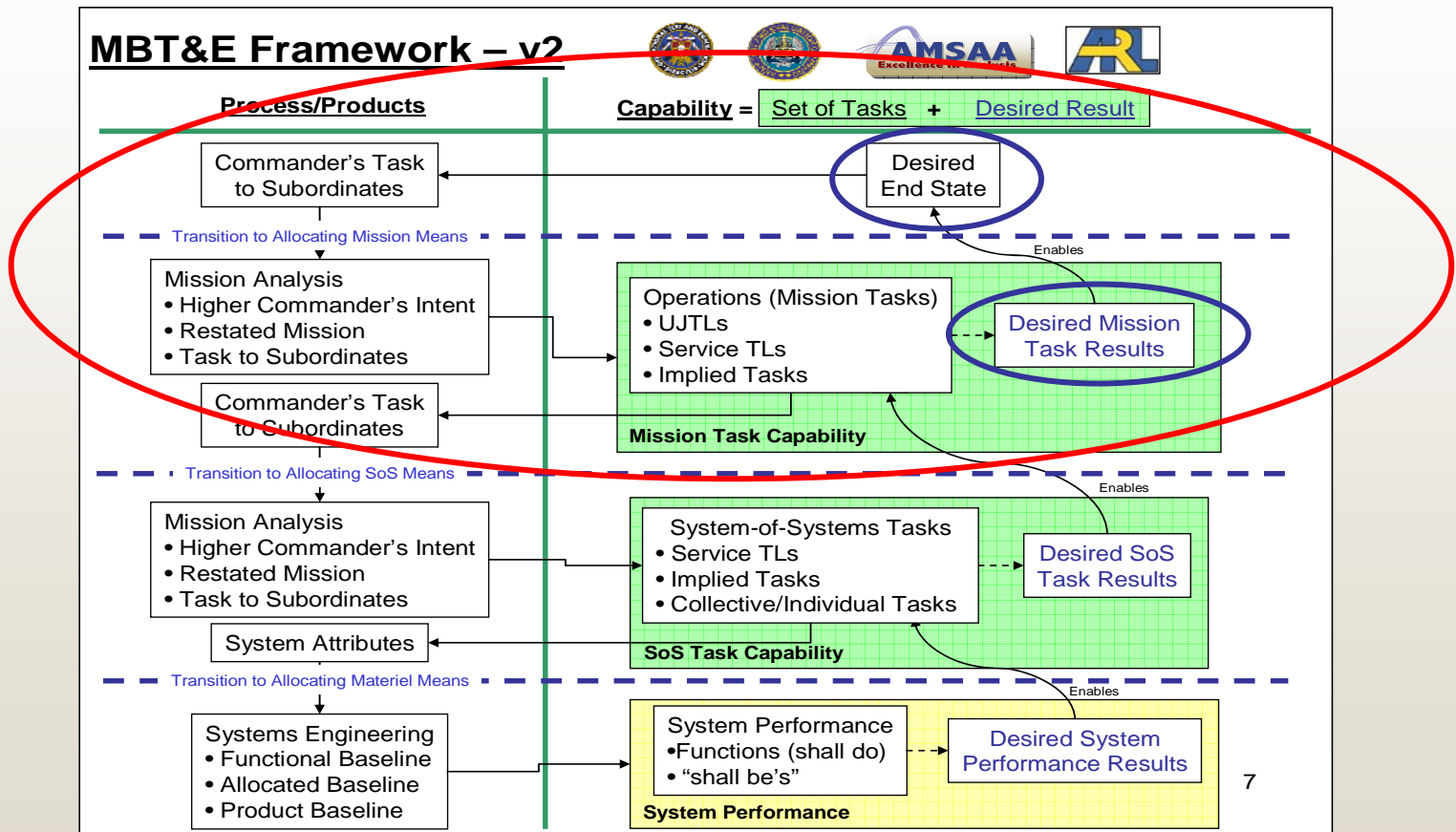
REPORT THE RESULTS

- 1 step to format and report the results.



Define the Mission Context (Step 2) Relation to Framework

- **High-level operations/mission/tasks.**
- **Task desired end states/results.**





Define the Mission Context (Step 2)

Purpose: Define the overall mission area context that the proposed materiel solution is being developed to support.

What do I do?

- Determine Operations/Mission/Tasks
 - Develop a description of high-level operations/mission/tasks and their desired end states/results,
 - Determine Joint, network and SoS construct, and
 - Determine organizational and support unit construct.
- Determine Operational Conditions
 - Determine the essential elements of mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC).

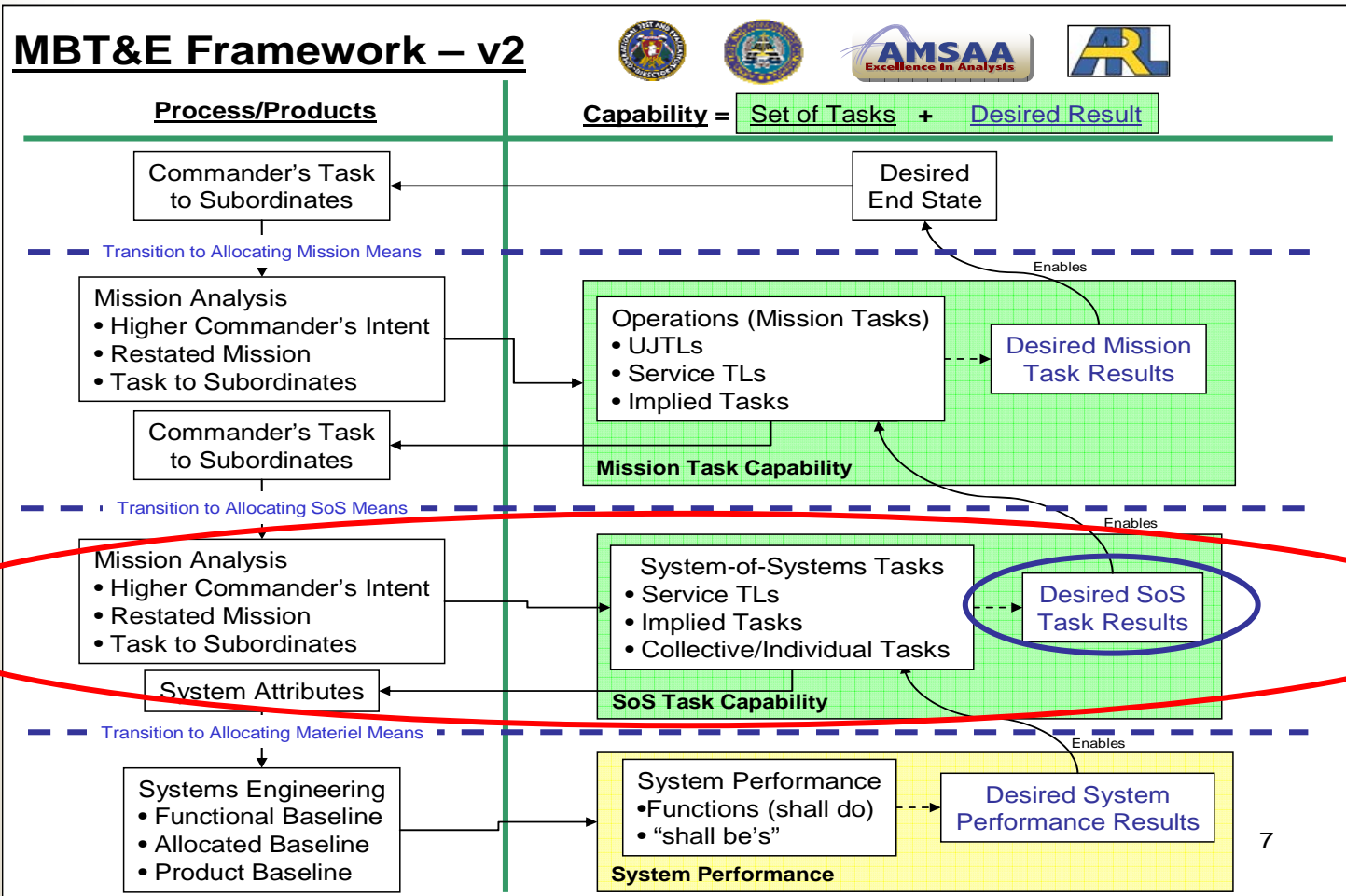
When am I done?

- High-level operations/missions/tasks with their desired end states/results are documented.
- Operational conditions (METT-TC factors) are documented.



Develop the Mission Tasks (Step 3) Relation to Framework

- SoS tasks and task threads.
- SoS Task desired end states/results.





Develop the Mission Tasks (Step 3) Mission Analysis References

- Reference authoritative task lists
 - Looking for most applicable task reference
 - Task Description
 - Conditions
 - Standards
- References used in case study
 - Universal Joint Task List (UJTL), CJCSM 3500.
 - Army Universal Task List (AUTL), FM 7-15.
 - Attack Helicopter Battalion Mission Training Plan, ARTEP 1-112-MTP.
 - Aircrew Training Manual, TC 1-251.



Develop the Mission Tasks (Step 3)

Purpose: Develop the required SoS mission tasks and link these tasks to authoritative tasks lists.

What do I do?

- Document/Conduct Mission Analysis
 - Develop SoS mission task threads and alternate task threads where applicable. (MS project or similar tool can be used.)
 - Determine task desired end states/results
- Link to Authoritative Task Lists
 - Develop linkages between the tasks identified above and the appropriate authoritative task lists. (UJTL, AUTL, unit Mission Training Plans, etc.)

When am I done?

- SoS mission tasks with their desired end states/results are documented.
- Links to associated authoritative tasks are documented.



Procedure

Develop Supporting Tasks (Step 4)

Purpose: Develop the required supporting tasks that enable the execution of the SoS mission tasks.

What do I do?

- Determine Conditional Tasks and their desired effects/results.
 - Conditional tasks are performed during a normal mission but are only **required due to some influencing condition**.
 - Examples: *avoid threat missile, extinguish engine fire, reset network node, etc.*
- Determine Enabling Tasks and their desired effects/results.
 - Mission enabling tasks are conducted in order to **enable the SoS mission tasks** (task developed in step (3)) **to be performed**.
 - Examples: *train, deploy, maintain, etc.*

When am I done?

- Conditional tasks, enabling tasks and their desired end states/results are documented.
- Links to associated authoritative tasks are documented.



Procedure

Identify Task Capabilities (Step 5)

Purpose: Identify and associate the capabilities required to execute the SoS, conditional and enabling tasks.

What do I do?

- Identify Required Capabilities
 - Identify the capabilities required to support each task with a reference to applicable requirements documents. (CDD, CPD, etc.)
- Associate Tasks with Capabilities
 - Link the capabilities determined above with the mission, conditional and enabling tasks determined in steps (3) and (4)

When am I done?

- Links between the (SoS, conditional and enabling tasks) and the requirements are documented.



Agenda

1330: Introduction and Mission-Based T&E Background

1340: Framework MBT&E Framework

1400: Case Study Introduction

1415: Steps 1-5: Understand the Mission

1500-1515: Afternoon Break

1515: Steps 6-8: Understand the System

1545: Steps 9-15: Design the T&E

1615: Steps 16-19: Determine and Report the Results

1630: Discussions/Questions/Answers



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to understand the program context.

UNDERSTAND THE MISSION

- 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SYSTEM

- 2 steps to understand the components and attributes of the materiel system-of-systems.
- 1 additional step to understand the mission and system linkages.

DESIGN THE TEST AND EVALUATION

- 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS

- 3 steps to generate, collect, analyze, and evaluate the data.

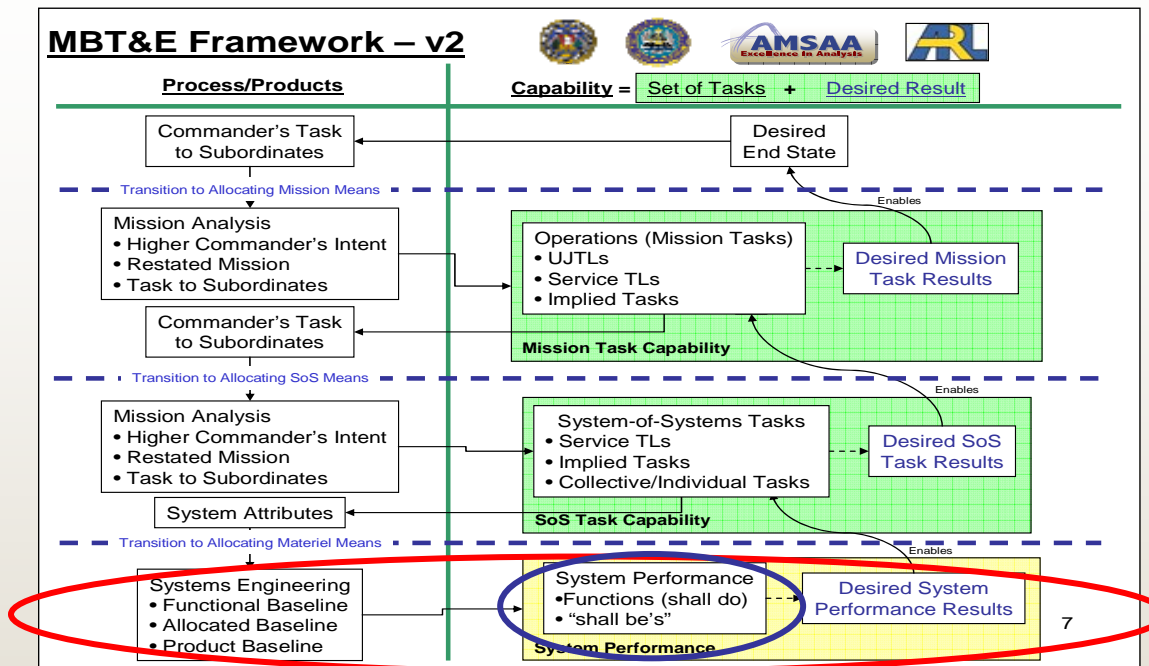
REPORT THE RESULTS

- 1 step to format and report the results.



Determine SoS Components (Step 6) Relation to Framework

- SoS Components
- SoS Component Functions & “Shall be’s”



Materiel System Functions: An activity or action the materiel system performs in support of a capability or part of a capability.

Materiel System “shall be”: An attribute the materiel system possesses that enables it to perform a function, for example, *reliability*.



Determine SoS Components (Step 6)

Purpose: Identify the physical components of the materiel system that support the mission tasks.

What do I do?

- Develop a materiel system description starting from the SoS level and breaking down into components.
 - Components at the lowest level should be able to be linked to identifiable functions (shall do's) and enabling attributes (shall be's).
- Identify the functions and “shall be's” of the materiel components.
- Option: Develop technology risk areas for pre-MS B systems.

When am I done?

– SoS components with their functions/shall be's are documented.



Procedure

Develop System Attributes (Step 7)

Purpose: Identify the materiel system attributes and associate them with the system components.

What do I do?

- Identify Attributes Required
 - Identify the materiel system's attributes required to support the component functions/shall be's with reference to applicable requirements documents. (CDD, CPD, Performance Specification, etc.)
- Associate Components with Attributes
 - Link the attributes determined above with the system components developed in step 6.

When am I done?

- Links between the SoS components and their required attributes are documented.



Procedure - Overview

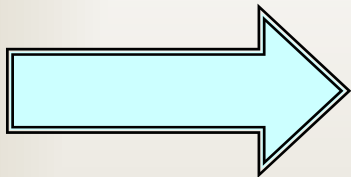
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UNDERSTAND THE SYSTEM

- 2 steps to understand the components and attributes of the materiel system-of-systems.



- 1 additional step to understand the mission and system linkages.

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DETERMINE THE RESULTS

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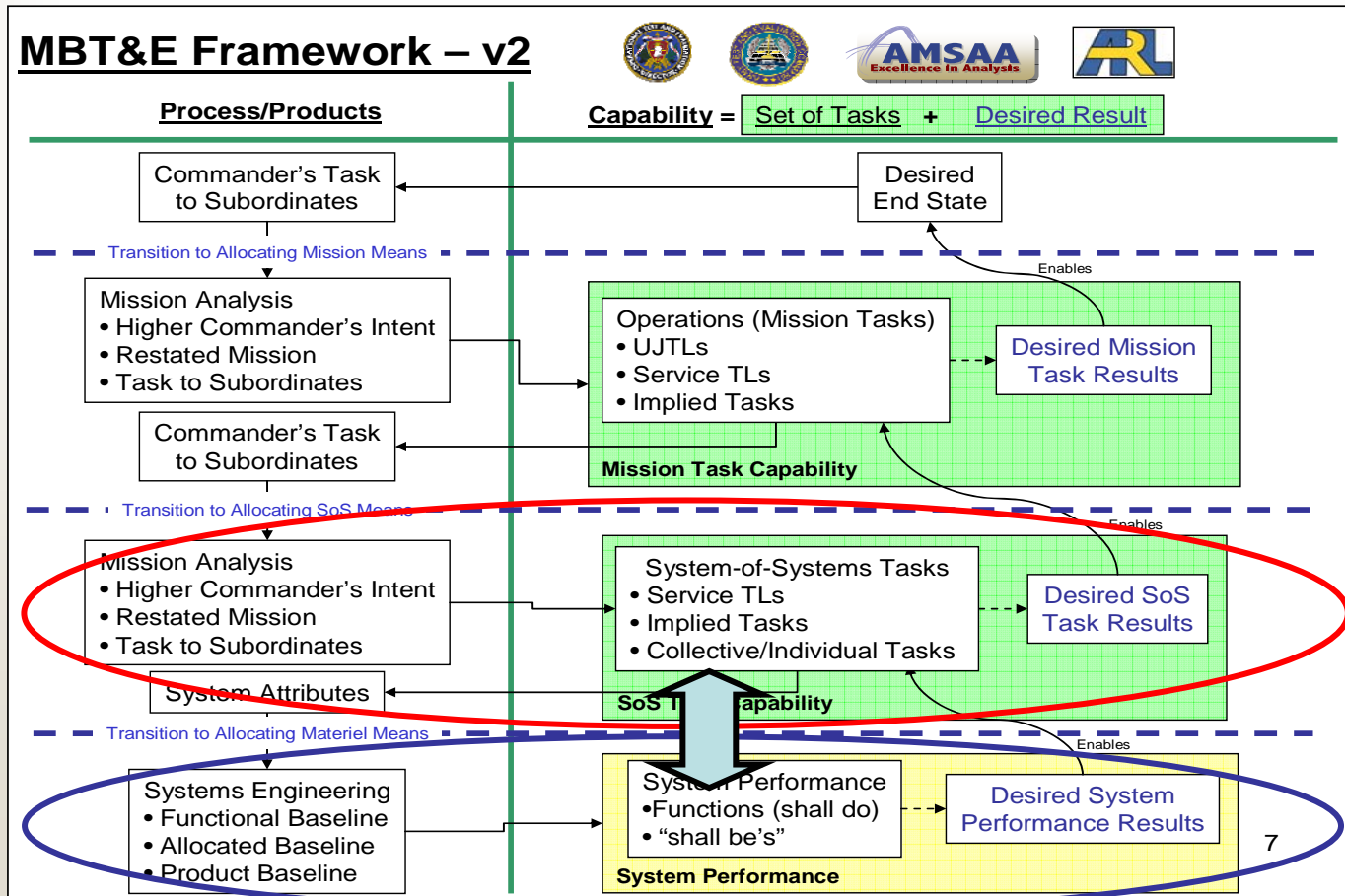
REPORT THE RESULTS

- 1 step to format and report the results.



Capabilities to Attributes – Relation to Framework

- Link **SoS mission task capabilities** to **SoS component attributes**.





Procedure

Associate Capabilities with Attributes (Step 8)

Purpose: Develop the linkages between the task capabilities identified in step (5) and the materiel system component attributes identified in step (7).

What do I do?

- Link the system attributes (functions/shall be's) to the task capabilities.
 - Determine how the system components support the task capability.
 - Determine redundant system support capability.
- Determine Mission Enabling Attributes
 - Mission Enabling Attributes are system enabling attributes that are not specific to a particular task capability – they address all tasks.

When am I done?

- Links between the system components and their supported tasks are documented.
- Enabling attributes of the SoS materiel components are documented.

40-41



Agenda

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1400: Case Study

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1500-1515: Afternoon Break

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- 1 step to format and report the results.



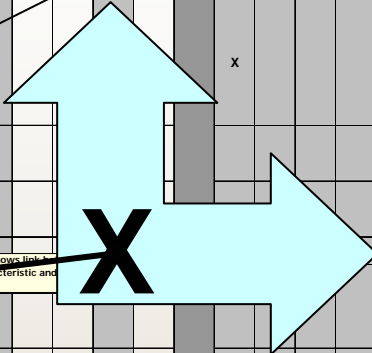
Operational Conditions - Linking with the Matrix

| MISSION | | | | | | | | | | | | | | | SYSTEM | | | | | |
|--|--|--|--|--|--|--|--|--|--|---|--|--|--|--|--|--|---|---|--|--|
| [Overall mission(s), ex. "ART 3.3 Employ Fires to Influence the Will, Destroy, Neutralize, or Suppress Enemy Forces."] | | | | | | | | | | | | | | | SYSTEM | FUNCTION or CHARACTERIS | CPD SYSTEM TECHNICAL PERFORMANCE REQUIREMENTS | | | |
| MISSION EXECUTION TASKS (Effectiveness) | | | | | ENABLING TASKS (Suitability) | | | | | CONDITIONAL TASKS (Survivability) | | | | | | | | | | |
| [Effectiveness mission task(s), ex. "ART 3.3.1 Conduct Lethal Fire Support"] | | | | | [Support Mission task(s), ex. "ART 6.0 Combat Service Support"] | | | | | [Survivability mission task(s), ex. ART 5.3 Conduct Survivability Operations] | | | | | ENABLING | | [First end-item, ex. "Self Propelled Howitzer"] | [First end-item integrated function or characteristic, ex. "Reliability"] | [System end-item technical requirement, ex. "KPP7, Howitzer Reliability"] | |
| [First effectiveness sub-task, ex. "ART 3.3.1.1 Conduct Lethal Fire Support to Support Mission"] | | | | | [First enabling sub-task, ex. "ART 6.0.1 Provide Ammunition Class Support"] | | | | | [First survivability sub-task, ex. "ART 5.3.1 Provide Class Reliability in an AO"] | | | | | [First enabling characteristic, ex. "Reliability"] | [Second enabling characteristic, ex. "Availability"] | | | | [Additional enabling characteristics, examples: Logistics, etc.] |
| [Second effectiveness sub-task, ex. "ART 3.3.1.2 Conduct Lethal Fire Support to Support Mission"] | | | | | [Second enabling sub-task, ex. "ART 6.0.2 Provide Ammunition Class Support"] | | | | | [Second survivability sub-task, ex. "ART 5.3.2 Provide Class Reliability in an AO"] | | | | | [Second enabling characteristic, ex. "Availability"] | [Additional enabling characteristics, examples: Logistics, etc.] | [First end-item sub-system function #2, ex. "Protect Crew and Systems"] | [Additional technical requirements] | | |
| [Third effectiveness sub-task, ex. "ART 3.3.1.3 Conduct Lethal Fire Support to Support Mission"] | | | | | [Third enabling sub-task, ex. "ART 6.0.3 Provide Ammunition Class Support"] | | | | | [Third survivability sub-task, ex. "ART 5.3.3 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | | | [Second end-item sub-system function, ex. "Cannon"] | [Second end-item sub-system technical requirement, ex. "KPP2, Force Protection"] |
| [Fourth effectiveness sub-task, ex. "ART 3.3.1.4 Conduct Lethal Fire Support to Support Mission"] | | | | | [Fourth enabling sub-task, ex. "ART 6.0.4 Provide Ammunition Class Support"] | | | | | [Fourth survivability sub-task, ex. "ART 5.3.4 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | [First sub-system of second end-item sub-system, ex. "Gun Drives"] | [First sub-system of second end-item sub-system technical requirement, ex. "Control Tube Traverse/Turret movement"] | | |
| [Fifth effectiveness sub-task, ex. "ART 3.3.1.5 Conduct Lethal Fire Support to Support Mission"] | | | | | [Fifth enabling sub-task, ex. "ART 6.0.5 Provide Ammunition Class Support"] | | | | | [Fifth survivability sub-task, ex. "ART 5.3.5 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | | | [Second sub-system of second end-item sub-system, ex. "Tube Temperature Sensor"] | [Additional technical requirements] |
| [Sixth effectiveness sub-task, ex. "ART 3.3.1.6 Conduct Lethal Fire Support to Support Mission"] | | | | | [Sixth enabling sub-task, ex. "ART 6.0.6 Provide Ammunition Class Support"] | | | | | [Sixth survivability sub-task, ex. "ART 5.3.6 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional technical requirements] | [Additional technical requirements] | | |
| [Seventh effectiveness sub-task, ex. "ART 3.3.1.7 Conduct Lethal Fire Support to Support Mission"] | | | | | [Seventh enabling sub-task, ex. "ART 6.0.7 Provide Ammunition Class Support"] | | | | | [Seventh survivability sub-task, ex. "ART 5.3.7 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | | | [Additional technical requirements] | [Additional technical requirements] |
| [Eighth effectiveness sub-task, ex. "ART 3.3.1.8 Conduct Lethal Fire Support to Support Mission"] | | | | | [Eighth enabling sub-task, ex. "ART 6.0.8 Provide Ammunition Class Support"] | | | | | [Eighth survivability sub-task, ex. "ART 5.3.8 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional technical requirements] | [Additional technical requirements] | | |
| [Ninth effectiveness sub-task, ex. "ART 3.3.1.9 Conduct Lethal Fire Support to Support Mission"] | | | | | [Ninth enabling sub-task, ex. "ART 6.0.9 Provide Ammunition Class Support"] | | | | | [Ninth survivability sub-task, ex. "ART 5.3.9 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | | | [Additional technical requirements] | [Additional technical requirements] |
| [Tenth effectiveness sub-task, ex. "ART 3.3.1.10 Conduct Lethal Fire Support to Support Mission"] | | | | | [Tenth enabling sub-task, ex. "ART 6.0.10 Provide Ammunition Class Support"] | | | | | [Tenth survivability sub-task, ex. "ART 5.3.10 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional technical requirements] | [Additional technical requirements] | | |
| [Eleventh effectiveness sub-task, ex. "ART 3.3.1.11 Conduct Lethal Fire Support to Support Mission"] | | | | | [Eleventh enabling sub-task, ex. "ART 6.0.11 Provide Ammunition Class Support"] | | | | | [Eleventh survivability sub-task, ex. "ART 5.3.11 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | | | [Additional technical requirements] | [Additional technical requirements] |
| [Twelfth effectiveness sub-task, ex. "ART 3.3.1.12 Conduct Lethal Fire Support to Support Mission"] | | | | | [Twelfth enabling sub-task, ex. "ART 6.0.12 Provide Ammunition Class Support"] | | | | | [Twelfth survivability sub-task, ex. "ART 5.3.12 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional technical requirements] | [Additional technical requirements] | | |
| [Thirteenth effectiveness sub-task, ex. "ART 3.3.1.13 Conduct Lethal Fire Support to Support Mission"] | | | | | [Thirteenth enabling sub-task, ex. "ART 6.0.13 Provide Ammunition Class Support"] | | | | | [Thirteenth survivability sub-task, ex. "ART 5.3.13 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | | | [Additional technical requirements] | [Additional technical requirements] |
| [Fourteenth effectiveness sub-task, ex. "ART 3.3.1.14 Conduct Lethal Fire Support to Support Mission"] | | | | | [Fourteenth enabling sub-task, ex. "ART 6.0.14 Provide Ammunition Class Support"] | | | | | [Fourteenth survivability sub-task, ex. "ART 5.3.14 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional technical requirements] | [Additional technical requirements] | | |
| [Fifteenth effectiveness sub-task, ex. "ART 3.3.1.15 Conduct Lethal Fire Support to Support Mission"] | | | | | [Fifteenth enabling sub-task, ex. "ART 6.0.15 Provide Ammunition Class Support"] | | | | | [Fifteenth survivability sub-task, ex. "ART 5.3.15 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | | | [Additional technical requirements] | [Additional technical requirements] |
| [Sixteenth effectiveness sub-task, ex. "ART 3.3.1.16 Conduct Lethal Fire Support to Support Mission"] | | | | | [Sixteenth enabling sub-task, ex. "ART 6.0.16 Provide Ammunition Class Support"] | | | | | [Sixteenth survivability sub-task, ex. "ART 5.3.16 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional technical requirements] | [Additional technical requirements] | | |
| [Seventeenth effectiveness sub-task, ex. "ART 3.3.1.17 Conduct Lethal Fire Support to Support Mission"] | | | | | [Seventeenth enabling sub-task, ex. "ART 6.0.17 Provide Ammunition Class Support"] | | | | | [Seventeenth survivability sub-task, ex. "ART 5.3.17 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | | | [Additional technical requirements] | [Additional technical requirements] |
| [Eighteenth effectiveness sub-task, ex. "ART 3.3.1.18 Conduct Lethal Fire Support to Support Mission"] | | | | | [Eighteenth enabling sub-task, ex. "ART 6.0.18 Provide Ammunition Class Support"] | | | | | [Eighteenth survivability sub-task, ex. "ART 5.3.18 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional technical requirements] | [Additional technical requirements] | | |
| [Nineteenth effectiveness sub-task, ex. "ART 3.3.1.19 Conduct Lethal Fire Support to Support Mission"] | | | | | [Nineteenth enabling sub-task, ex. "ART 6.0.19 Provide Ammunition Class Support"] | | | | | [Nineteenth survivability sub-task, ex. "ART 5.3.19 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | | | [Additional technical requirements] | [Additional technical requirements] |
| [Twentieth effectiveness sub-task, ex. "ART 3.3.1.20 Conduct Lethal Fire Support to Support Mission"] | | | | | [Twentieth enabling sub-task, ex. "ART 6.0.20 Provide Ammunition Class Support"] | | | | | [Twentieth survivability sub-task, ex. "ART 5.3.20 Provide Class Reliability in an AO"] | | | | | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional enabling characteristics, examples: Logistics, etc.] | [Additional technical requirements] | [Additional technical requirements] | | |
| | | | | | | | | | | | | | | | X | | | | | [First system end-item, ex. "Self Propelled Howitzer"] |
| | | | | | | | | | | | | | | | | | | [First end-item sub-system, ex. "Armor"] | [First end-item sub-system function #1, ex. "Protect Crew and Systems"] | [First end-item sub-system technical requirement, ex. "KPP2, Force Protection"] |
| | | | | | | | | | | | | | | | | | | [First end-item sub-system function #2, ex. "Protect Crew and Systems"] | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | [Second end-item sub-system, ex. "Cannon"] | [Second end-item sub-system function] | [Additional technical requirements] |
| | | | | | | | | | | | | | | | | | | [First sub-system of second end-item sub-system, ex. "Gun Drives"] | [First sub-system of second end-item sub-system function, ex. "Control Tube Traverse/Turret movement"] | [Additional technical requirements] |
| | | | | | | | | | | | | | | | | | | [Second sub-system of second end-item sub-system, ex. "Tube Temperature Sensor"] | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | [Second end-item, ex. "Resupply Vehicle"] | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |
| | | | | | | | | | | | | | | | | | | etc. | [Additional technical requirements] | |

This task...

Under these conditions.

is supported by this component/function...





Procedure

Unconstrained Operational Conditions (Step 9)

Purpose: Develop the unconstrained operational conditions that must be addressed through test and evaluation.

What do I do?

- Determine the operational factors and conditions that T&E needs to address given:
 - the task capability required and
 - the system function/shall be.

When am I done?

- Operational conditions (for the intersection between mission task and system components are documented.

44-45



Process

Develop the Evaluation Strategy (Step 10)

Purpose: Develop a summary description of the evaluation to support an early strategy coordination and review.

What do I do?

- Develop the early strategy review brief from the mission, task, and system worksheets developed in steps (2) through (9).

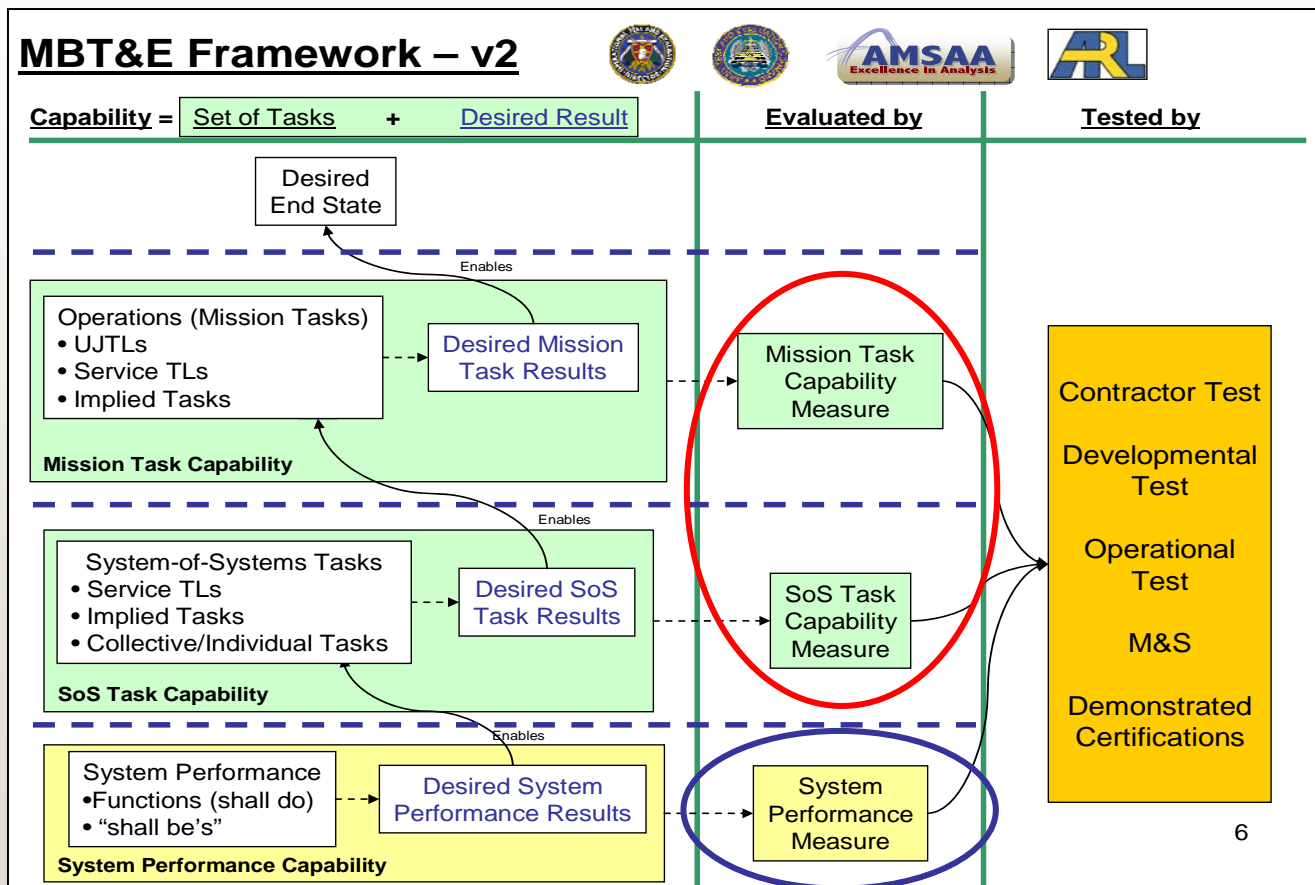
When am I done?

- Early strategy review brief is prepared.



Evaluation Measures – Relation to Framework

- **Task Capability Measures**
- **Materiel Performance Measures**





Process

Develop Evaluation Measures (Step 11)

Purpose: Develop the evaluation measures.

What do I do?

- Develop measures supporting the evaluation of:
 - task capabilities (task capability measures), and
 - system attributes (materiel performance measures).
- Complete linkages from measure -to- system -to- task.
- Develop linkages between measures and COIs/Criteria.

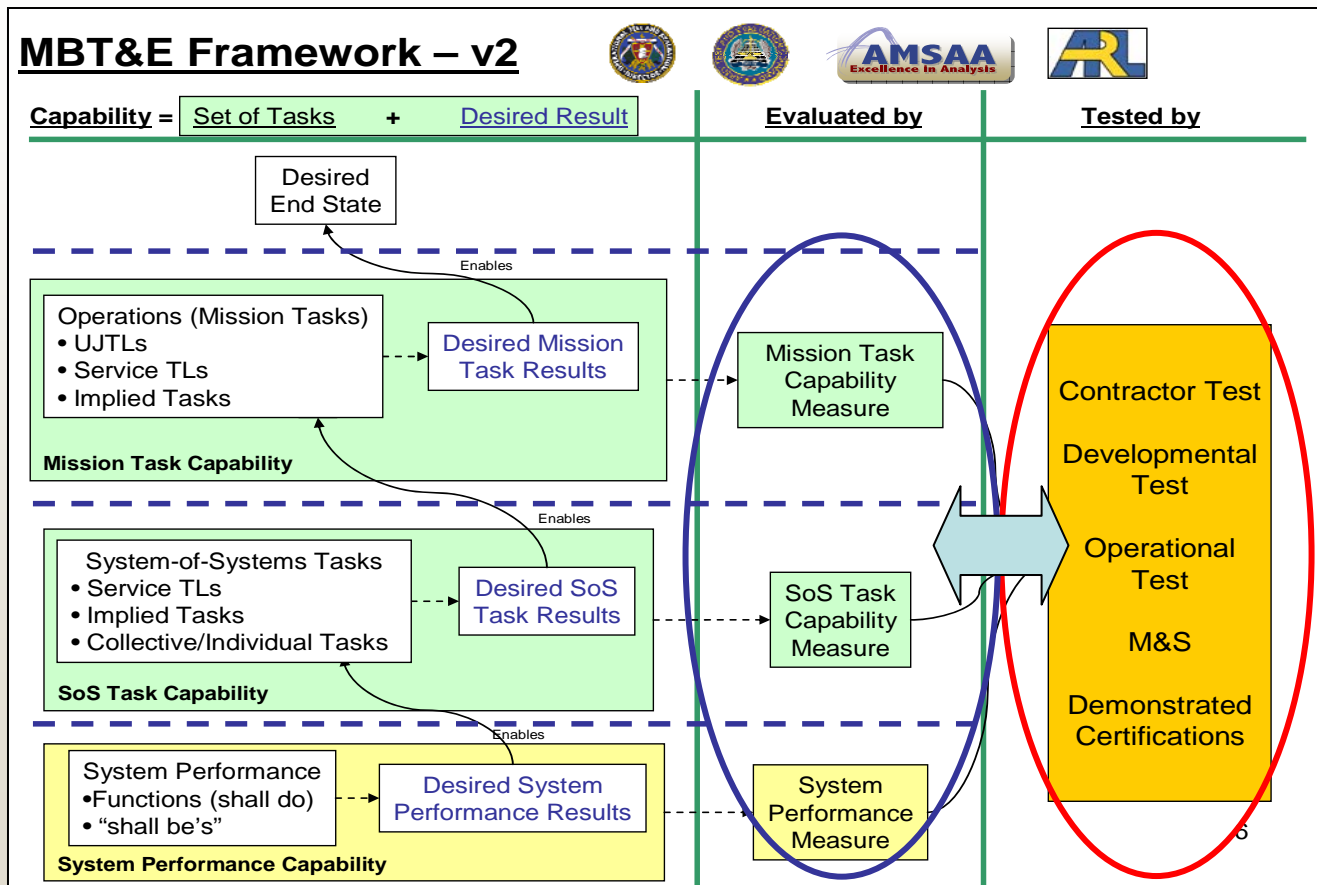
When am I done?

- Task capability and materiel performance measures are documented.
- Operational conditions pulled from task.



Data Sources - Relation to Framework

- **Data Sources**
- **Linked to Evaluation Measures**





Design the T&E Assign Measures to Data Sources (Step 12)

Purpose: Identify the sources of data to support the analysis of the evaluation measures.

What do I do?

- Assign one or more data sources to each evaluation measure.
- Review data source matrix to determine:
 - T&E execution risk by assessing critical data sources;
 - Developmental risk by assessing when critical technologies are demonstrated; and
 - Determine appropriate use of M&S.

When am I done?

- Data sources supporting each measure are documented.
- T&E effort and program execution risk issues are identified and coordinated with the appropriate IPTs.



Design the T&E

Constrained Operational Conditions (Step 13)

Purpose: Develop the constrained operational conditions by looking at the conditions that can be addressed by the identified data sources.

What do I do?

- Determine the operational conditions that can be addressed by the identified data sources. These are the “constrained” operational conditions.
- Determine the T&E limitations by comparing the constrained vs. unconstrained conditions (step 9).

When am I done?

- T&E limitations caused by the lack of ability to address all operational conditions documented.
- Mitigation effort(s) to lesson impact of T&E limitations are documented.



Design the T&E

Develop Data Source Requirements (Step 14)

Purpose: Develop data elements from each linked data source.

What do I do?

- Develop detailed measure design.
- Determine data elements required from the data source.
- Determine the operational conditions required for each run, sortie or sample.

When am I done?

- Data source requirements documented and coordinated with the appropriate executing test agent (contractor, government range, independent test facility, M&S, etc.)

57-60



Design the T&E

Develop T&E Databases (Step 15)

Purpose: Develop database architecture to enable efficient delivery, formatting and analysis of delivered data.

What do I do?

- Develop an evaluation data model from the task description, enabling attribute, measure description worksheets.
 - The evaluation data model is a representation of the information and data assets required to evaluate the system expressed in terms of entities and relationships between entities.
- Provide evaluation data model results to the tester.
 - The evaluation data model will ensure properly documented data for communication between the evaluator and the tester..

When am I done?

- T&E database design is documented.



MBT&E Current Toolbox

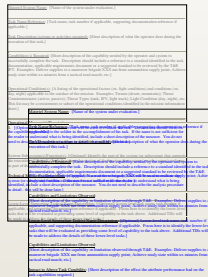
MBT&E Worksheets

- Used to build test and evaluation plan.

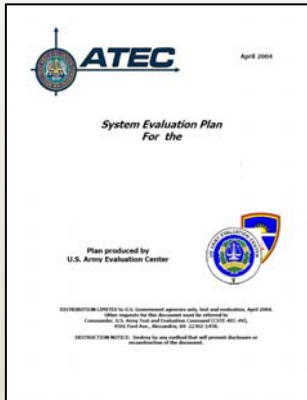
Mission Summary



Task and Enabling Attribute Descriptions



Evaluation Measure Description



MBT&E Matrix

- Maintains status and tracks changes during execution.

| MISSION | | | | | | | | | | SYSTEM | | | EVALUATION | |
|--|--|--|---|--|--|---|--|--|--|--|----------------------------|---|--|------------------------------|
| General Guidance: An ART 5.3 Enabling Plan to Influence the W&E, System, Subsystem, or Supporter Entry Priority | | | | | | | | | | SYSTEM | FUNCTION OF CHARACTERISTIC | CPO SYSTEM TECHNICAL PERFORMANCE REQUIREMENTS | EVALUATION | |
| Performance Mission (MIG), An ART 5.3 Condition Level (Pre-Supporter) | | | Support Mission (MIG), An ART 5.0 Condition (Service Supporter) | | | Performance Mission (MIG), An ART 5.3 Condition (Pre-Supporter) | | | | | | | OPERATIONAL MEASURES (OM/NOEs) | TECHNICAL MEASURES (TM/NOEs) |
| <p>1. The purpose of this plan is to define the mission, task, and enabling attributes for the system, subsystem, or supporter. This plan is used to build the test and evaluation plan (TEP) and to track the status of the system, subsystem, or supporter during execution.</p> <p>2. This plan is used to build the test and evaluation plan (TEP) and to track the status of the system, subsystem, or supporter during execution.</p> <p>3. This plan is used to build the test and evaluation plan (TEP) and to track the status of the system, subsystem, or supporter during execution.</p> | | | | | | | | | | <p>1. The purpose of this plan is to define the mission, task, and enabling attributes for the system, subsystem, or supporter. This plan is used to build the test and evaluation plan (TEP) and to track the status of the system, subsystem, or supporter during execution.</p> <p>2. This plan is used to build the test and evaluation plan (TEP) and to track the status of the system, subsystem, or supporter during execution.</p> <p>3. This plan is used to build the test and evaluation plan (TEP) and to track the status of the system, subsystem, or supporter during execution.</p> | | | <p>1. The purpose of this plan is to define the mission, task, and enabling attributes for the system, subsystem, or supporter. This plan is used to build the test and evaluation plan (TEP) and to track the status of the system, subsystem, or supporter during execution.</p> <p>2. This plan is used to build the test and evaluation plan (TEP) and to track the status of the system, subsystem, or supporter during execution.</p> <p>3. This plan is used to build the test and evaluation plan (TEP) and to track the status of the system, subsystem, or supporter during execution.</p> | |
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Agenda

1330: Introduction and Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study

1415: Steps 1-5: Understand the Mission

1500-1515: Afternoon Break

1515: Steps 6-8: Understand the System

1545: Steps 9-15: Design the T&E

1615: Steps 16-19: Determine and Report the Results

1630: Discussions/Questions/Answers



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to understand the program context.

UNDERSTAND THE MISSION • 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SYSTEM • 2 steps to understand the components and attributes of the materiel system-of-systems.

- 1 additional step to understand the mission and system linkages.

DESIGN THE TEST AND EVALUATION • 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS • 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS • 1 step to format and report the results.



Execution

(Steps 16 through 18)

CONDUCT TEST AND GATHER DATA (Step 16)

Purpose: Execute the planned data source activities and gather the data for analysis.

What do I do?

- Execute test, run M&S, record data.
- Review data for integrity and authentication.
- Adjust T&E program based on impacts of changes in schedule and system design.

PERFORM DATA ANALYSIS (Step 17)

What do I do?

- Data is analyzed according to the procedures identified in step 11 and 14.
- Performance results are compared to standards identified in steps 5 (task capabilities) and 7 (system attributes).

GENERATE EVALUATION RESULTS (Step 18)

What do I do?

- Determine materiel system attribute performance.
- Determine SoS task capabilities and limitations.
 - Determine task capability C&L directly from task capability measure results.
 - Determine task capability C&L based on system attribute measure results.
- Determine task C&L impact on high-level mission task capabilities.
 - Determine ability to achieve desired end state directly from capability measures.
 - Determine ability to achieve desired end state from SoS task capability C&Ls.

63-65



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to understand the program context.

UNDERSTAND THE MISSION

- 4 steps to understand the military operations, tasks, task capabilities and mission context.

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DETERMINE THE RESULTS

- 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS

- 1 step to format and report the results.



Mission Element Task Type Definitions

Mission execution tasks.

- Tasks that describe a discrete action that the unit (system and its operators) must perform in order to accomplish its main mission.

Conditional mission tasks.

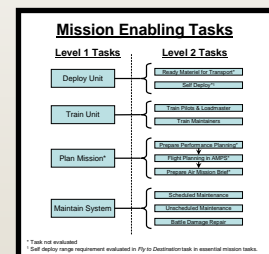
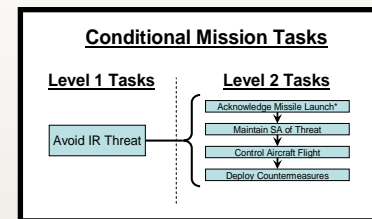
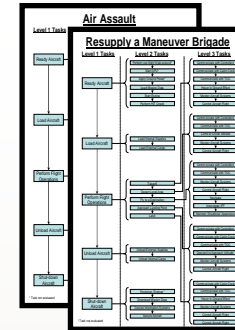
- Tasks that are performed during the mission that become required due to some influencing condition.

Mission enabling tasks.

- Tasks that enable the mission execution and conditional tasks to be performed. They usually occur before or after the mission.

Enabling Attributes

- System attributes that affect **all** tasks.



| ENABLING CHARACTERISTICS (Suitability) | |
|--|--|
| Accuracy | |
| Availability | |
| Cost/Supportability | |
| Support/Trainability | |
| Interoperability/Net Ready | |
| Basic Survivability | |
| Non- lethal Survivability | |
| Information Assurance | |
| Security | |

Normally aggregated into **Effectiveness** and **Survivability**

Normally aggregated into **Suitability**



Reporting

Generate Evaluation Report (Step 19)

Purpose: To generate the evaluation report which will document the evaluation conclusions.

What do I do?

- Generate system performance and SoS task C&L conclusions.
- Generate summary of key C&Ls.
- Generate effectiveness, suitability and survivability conclusions.

When am I done?

- System performance, (strengths and weaknesses), and the impact they had on the task capabilities are documented.
- SoS task C&Ls and high-level task C&Ls are documented.
- Overall summary of effectiveness, suitability and survivability is documented.



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MBT&E Tutorial

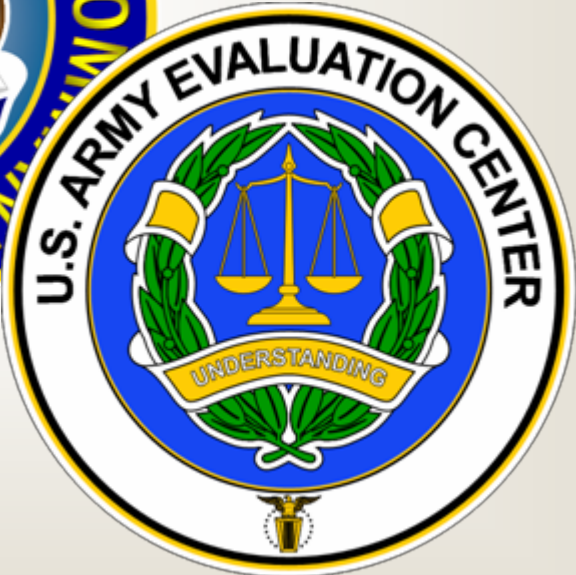
Discussions

-

Questions

-

Answers





RDECOM

System of Systems Survivability, Lethality, Vulnerability Assessment (SoS SLVA):

Ballistic Vulnerability Modeling Demonstration



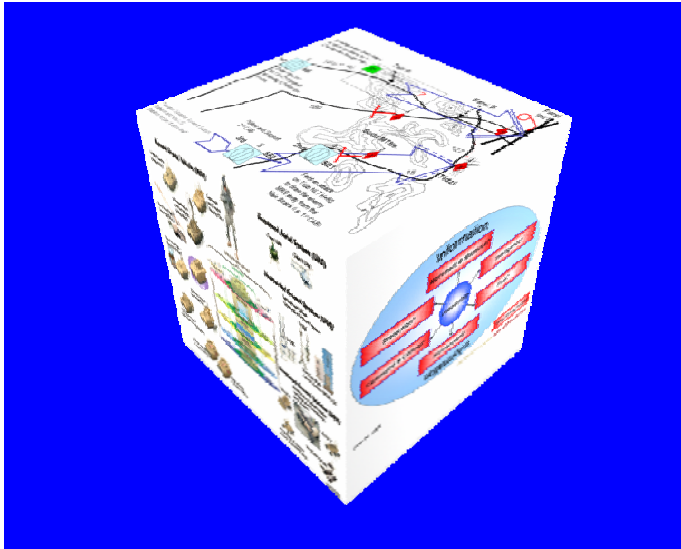
TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Jeffrey A. Smith, Ph.D.
US Army Research Laboratory
White Sands Missile Range, NM 88002-5513
jeffrey.a.smith1@us.army.mil (575) 678-1332

Beth S. Ward
US Army Research Laboratory
Aberdeen Proving Ground, MD 21005
beth.squier.ward@us.army.mil (410) 278-6315

To present a concept of a System of Systems SLVA and a demonstration to support methodology development.

- **Concept of System of Systems SLVA**
 - Our concept of a SoS
 - System-of-System Survivability Simulation (S4)
- Methodology
 - New metrics
 - Decision making process (DMP) in S4
- Demonstration overview
- Benefits to Test & Evaluation community
- Summary



A design connecting multiple levels of decision makers and assets through which decision makers at every level can adapt the application of their assets to achieve their purpose.

The Physical Systems:

e.g., Future Brigade Combat Team (14+1+1).

The Leaders

Capabilities conceptualized as combat power, a term that encompasses all means available to a given unit at a given time.

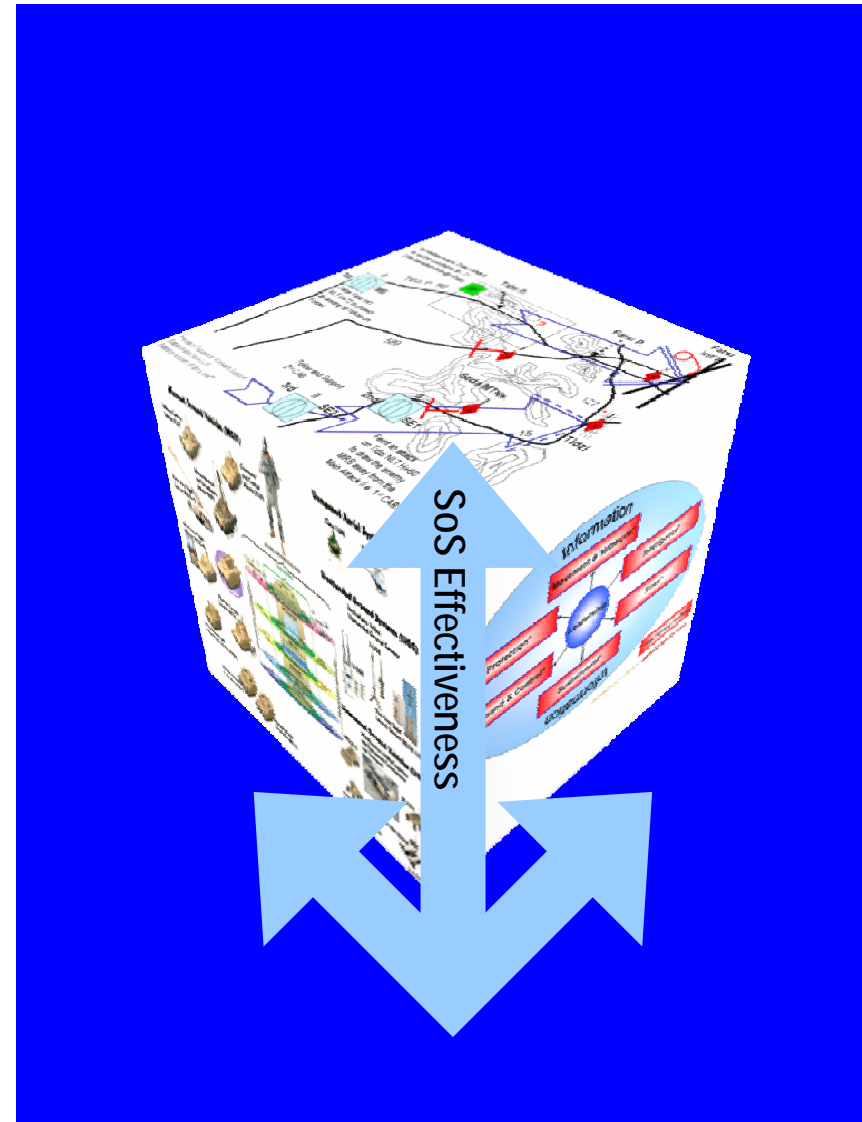
Leaders at the center, enabled by information, execute the six traditional warfighting functions.

The Context

While we can discuss each of the above abstractly, a domain context grounds the assessment.

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.
Within this context, assessment is a

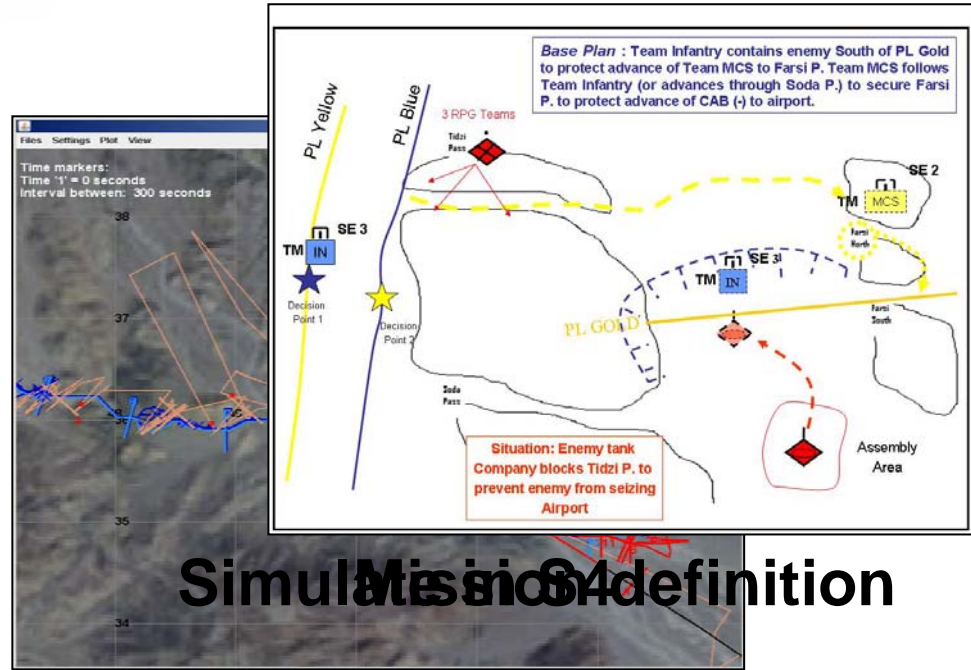
- “Doing the correct thing well”.
 - Assesses an ability to reach the chosen position of attack, or to maintain formation and arrangement of forces, etc.
 - Is more about the physical situation, and focuses more on the internals of a unit.
- “Doing the correct thing”
 - Traces the flow of information (e.g., an enemy spot report) through the network to its consumer (a leader); thence, to an observable domain impact upon a war fighting function.
 - Is more about the information system, and looking outward from a unit.
- SoS effectiveness is a joint result these measurements.



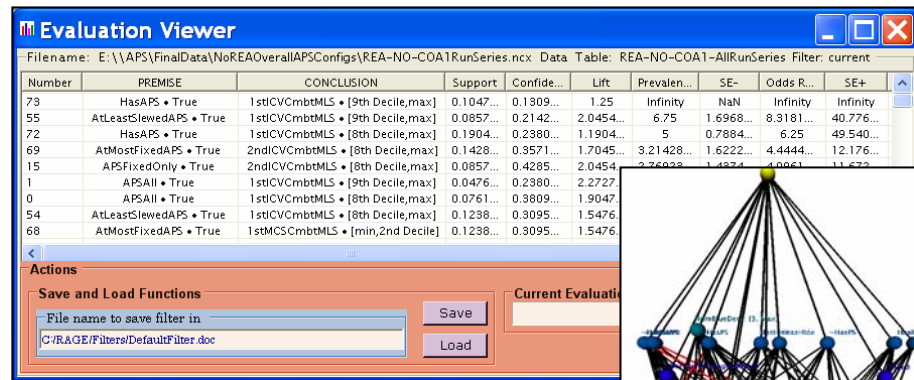


- I. Identify customer questions.
- II. Define the concept that addresses customer questions.
- III. Determine simulation requirements and develop model configuration.
- IV. Generate metrics from simulation results .
- V. Apply analysis methods to address customer question.

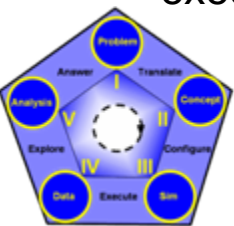
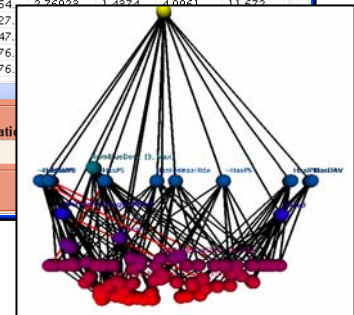
- S4 is a small-unit force-on-force Agent based simulation designed to assess SoS effectiveness.
- As an Agent based model, the approach to decision making is very different than current Army force-on-force models.
 - Emphasis is placed upon the military decision making processes (DMPs) and the communications network that link these DMPs within a SoS.
 - Each DMP represents human decision makers on the battlefield that is dynamically driven by the information available during simulation execution



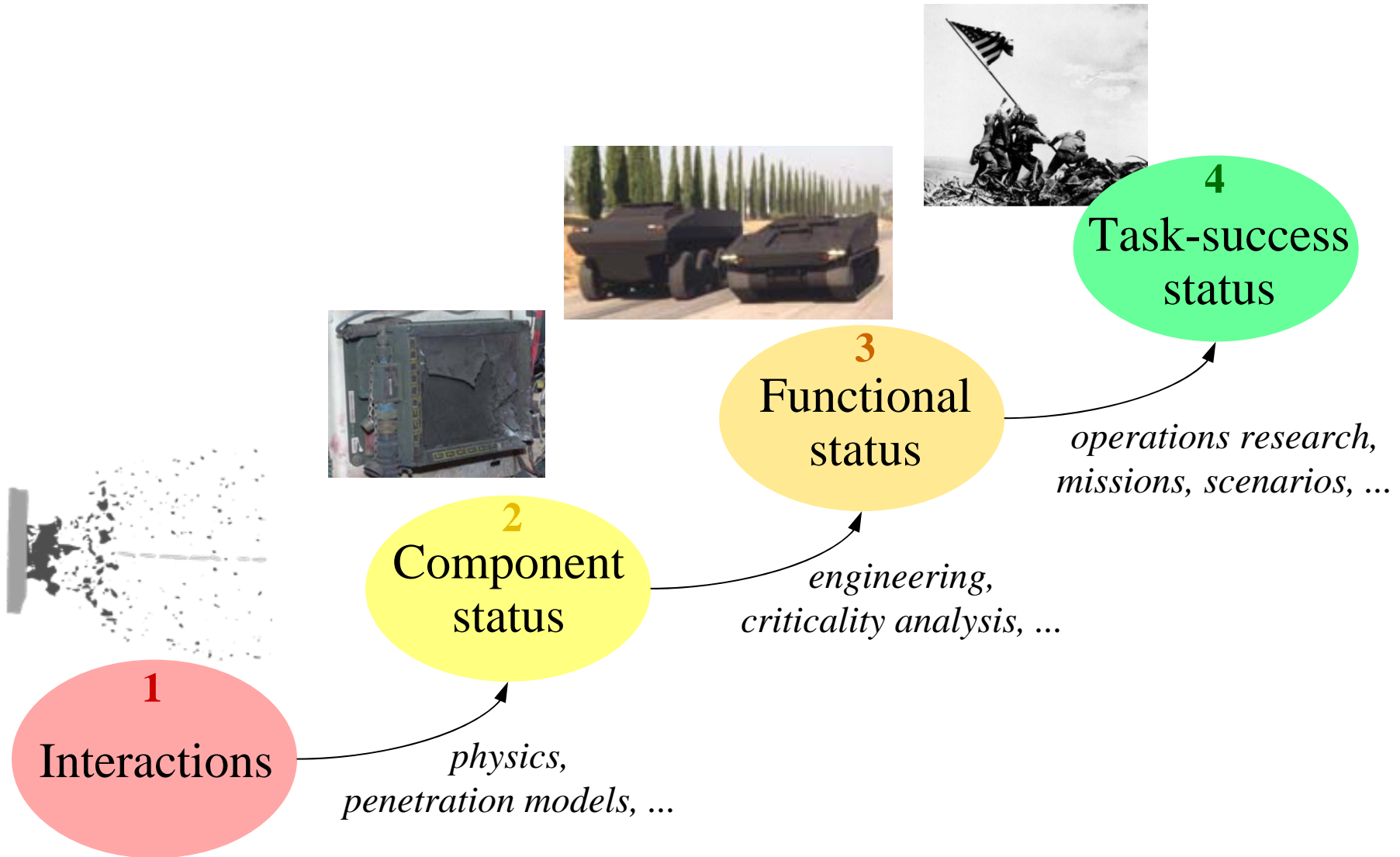
Simulation definition



Analyze results



- Concept of System of Systems SLVA
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(12) Level 2, (40) Level 3 Elements of Functional Degradation (EFD), and (2) Level 4 Loss-of-Functional (LoF) Utility

Level 2

Crew

- c_1 Commander Incapacitated
- c_2 Squad Leader Incapacitated
- c_3 Driver Incapacitated

Passengers

- p_1 Passenger 1 Incapacitated
- p_2 Passenger 2 Incapacitated
- p_3 Passenger 3 Incapacitated
- p_4 Passenger 4 Incapacitated
- p_5 Passenger 5 Incapacitated
- p_6 Passenger 6 Incapacitated
- p_7 Passenger 7 Incapacitated
- p_8 Passenger 8 Incapacitated

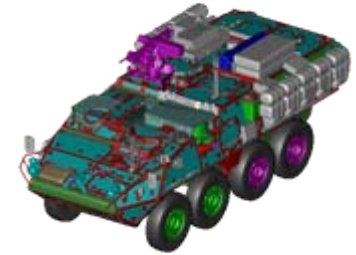
Catastrophic Loss

- k_1 Fuel/Ammo

Level 3

Mobility

- $m_{1,1}$ Reduced Maximum Speed 20%
- $m_{1,2}$ Reduced Maximum Speed 40%
- $m_{1,3}$ Reduced Maximum Speed 60%
- $m_{1,4}$ Reduced Maximum Speed 80%
- $m_{1,5}$ Reduced Maximum Speed 100%
- $m_{2,1.1}$ Reduced Acceleration 20%
- $m_{2,1.2}$ Reduced Acceleration 40%
- $m_{2,1.3}$ Reduced Acceleration 60%
- $m_{2,1.4}$ Reduced Acceleration 80%
- $m_{2,1.5}$ Reduced Acceleration 100%
- $m_{2,2.1}$ Reduced Steering 20%
- $m_{2,2.2}$ Reduced Steering 40%
- $m_{2,2.3}$ Reduced Steering 60%
- $m_{2,2.4}$ Reduced Steering 80%
- $m_{2,2.5}$ Reduced Steering 100%
- $m_{2,3.1}$ Reduced Braking 20%
- $m_{2,3.2}$ Reduced Braking 40%
- $m_{2,3.3}$ Reduced Braking 60%
- $m_{2,3.4}$ Reduced Braking 80%
- $m_{2,3.5}$ Reduced Braking 100%
- $m_{2,4}$ Reduced Visibility (driver's sensor)
- $m_{3,1}$ Stop After 60 Minutes
- $m_{3,2}$ Stop After 30 Minutes
- $m_{3,3}$ Stop After 10 Minutes
- $m_{3,4}$ Stop After 1 Minute



Firepower

- f_1 Lost Ability To Fire Buttoned Up Main (RWS)
- f_3 Degraded Initial Rate of Fire of Main (RWS)
- f_4 Degraded Subsequent Rate of Fire of Main (RWS)
- f_7 Total Loss of Firepower Main
- f_{12} Total Loss of Firepower Secondary

Communication

- $x_{1,1}$ Reduced Range (antenna loss)
- $x_{1,2}$ Reduced Range (power amp loss)
- x_2 Lost Line-of-Sight (LOS) Data
- x_3 Lost LOS Voice
- x_4 Lost Non-LOS Data
- x_7 Lost External Communications
 - $x_{7,1}$ Lost Encryption Capability
 - $x_{7,2}$ Lost Channel/Frequency Selection Capability

Target Acquisition ('sensing')

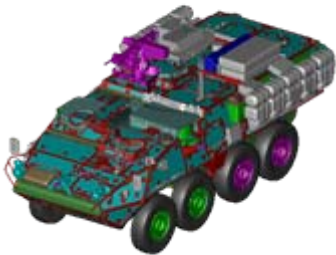
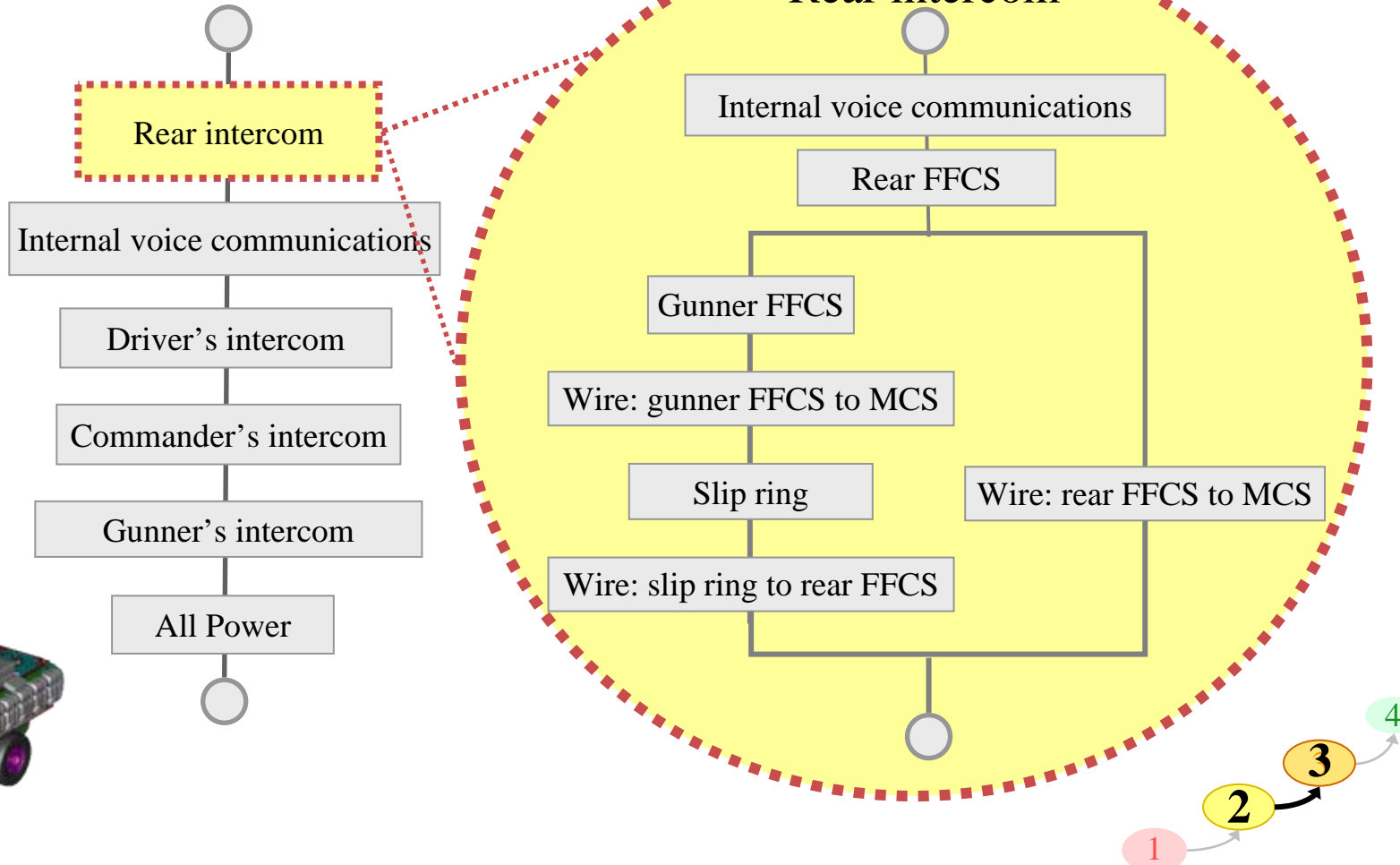
- a_1 Lost Daylight Acquisition
- a_2 Lost Night Acquisition
- a_3 Lost Range Finder Capability

Level 4

Loss of Function

- MLOF Mobility Loss of Function
- FLOF Firepower Loss of Function

The **x₆** fault tree... cutting it degrades the system with **lost internal communications**

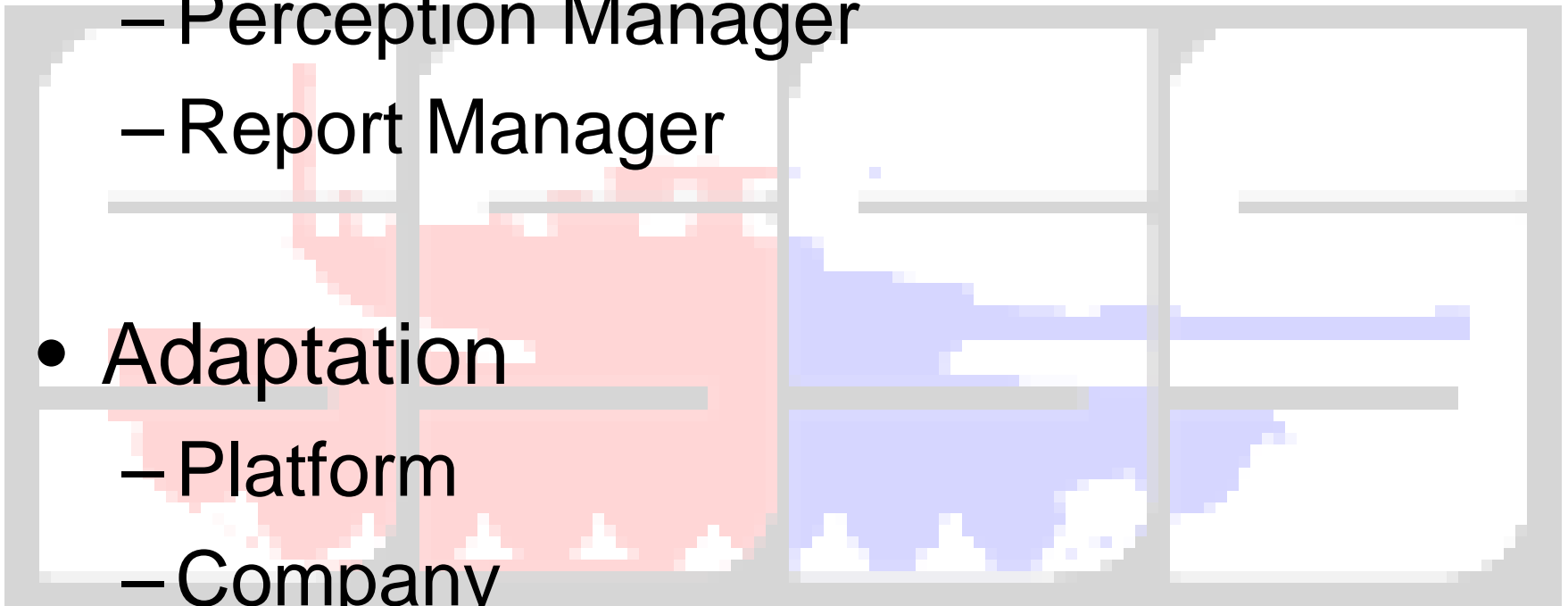


- Awareness of EFDs

- Perception Manager
- Report Manager

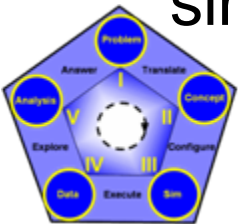
- Adaptation

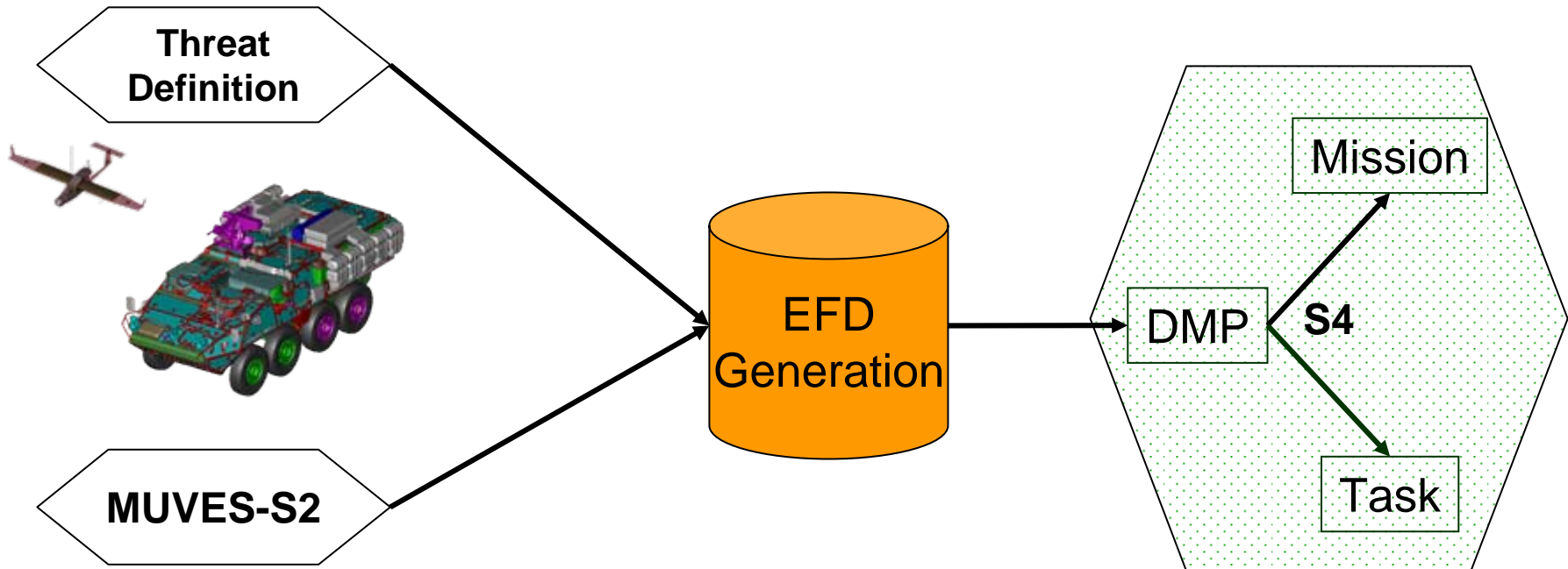
- Platform
- Company
- Platoon



- Concept of System of Systems SLVA
 - Our concept of a SoS
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- Methodology
 - New metrics
 - Decision making process (DMP) in S4
- **Demonstration overview**
- Benefits to Test & Evaluation community
- Summary

- How can Mission-based analysis support cost effective test planning, i.e., Live-Fire shot selection and Developmental/Operational Testing?
 - What EFD are critical to operational testing ($O_{3,4}$)?
 - What performance parameters are important to capture in developmental testing?
 - What are the platform vulnerability issues to assess with MUVES-S2?
- How can the impact of a test event be shown in a mission context?
 - What EFDs impact mission success?
 - By contrast, for which EFDs can the unit compensate?
- Can unknown SLV issues be revealed (discovered) via simulation involving adaptive agents?



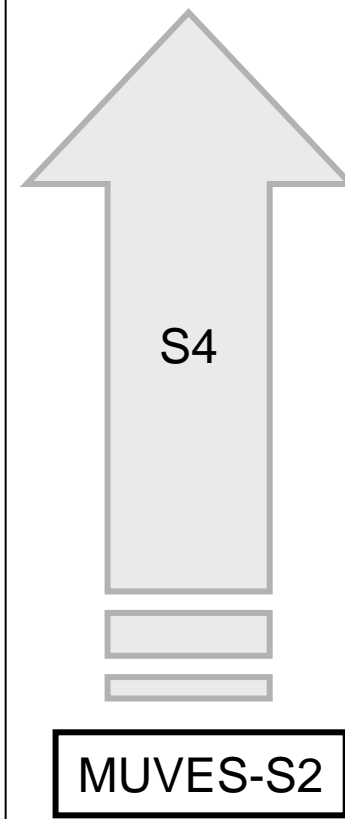
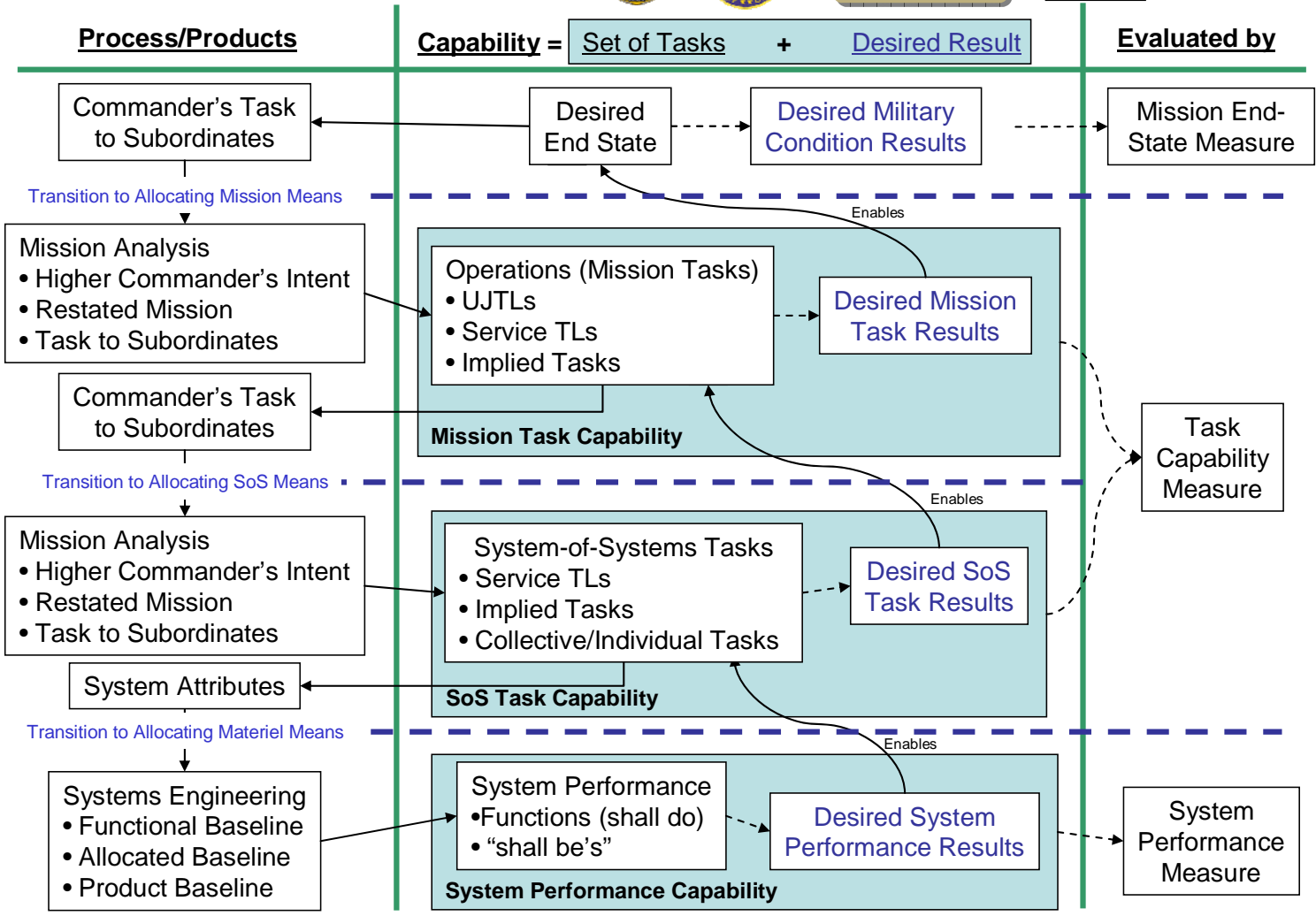


- $O_{3,4}$ in a controlled environment:
 - Assess task execution to “attack by fire”
- $O_{3,7}$
 - Assess EFD impact on mission

Demonstration objective was to put ballistic damage into mission context.

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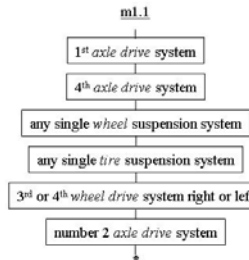
MBT&E Framework – v2





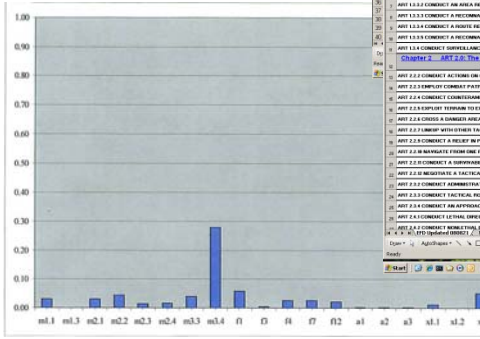
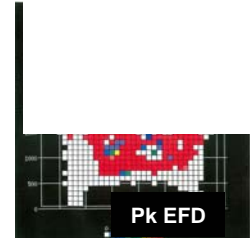
System representation (for each variant)

- Criticality analysis:
 - List of elements of functional degradation (EF)
 - System (critical categories and EFD) representation
- Identified tasks.
- Task to requirement capability mapping.



Model results analysis

- Cell-by-cell
 - Probability of each EFD per threat.
 - Probability of task failure.
- Bar charts
 - Probability of each EFD per threat.
 - Probability of task failure.
- View average tables
 - Probability of each EFD per threat.
 - Probability of task failure.
- Identified critical categories/components and EFD driving vulnerability.



Damage assessment and post-shot analysis report

- Identified critical categories/components and EFD driving vulnerability.
- Correlate ballistic damage to mission essential task failure.

For each platform

- Cumulative time that the platform spent with each EFD.

For each platform type

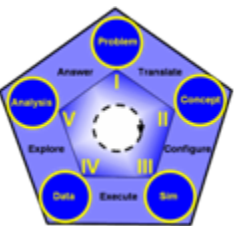
- A count of the total number of hits on platforms of each type by all munition types.
- Correlation of critical category to EFD.
- The absolute mean time a platform of a given type spends in each EFD.

Mean cumulative time in each ECD for instance: ICV-A15
 Cumulative time spent in ECD 0 (m1.1) = 0.0 or 0.0 %
 Cumulative time spent in ECD 1 (m1.2) = 0.0 or 0.0 %
 Cumulative time spent in ECD 2 (m1.3) = 0.0 or 0.0 %
 Cumulative time spent in ECD 3 (m1.4) = 364.75 or 29.53 %
 Cumulative time spent in ECD 4 (m1.5) = 0.0 or 0.0 %
 Cumulative time spent in ECD 5 (m2.1.1) = 0.0 or 0.0 %
 Cumulative time spent in
 Cumulative time spent in
 Cumulative time spent in

Results for cc antenna (1) vs EFD m1.2 (1):
 Sample size = 5
 Prob (Y | X) = 0.75
 Raw data
 1 0
 1 3
 mean and std dev for X = 0.8 0.39999999999999997
 mean and std dev for Y = 0.6 0.4898979485566356
 Covariance of X and Y = 0.12
 Correlation of X and Y = 0.6123724356957946

hits on platform type ICV by munition type ExampleLargeKE is 3
 P(m3.3 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m3.2 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m1.1 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m3.1 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m3.4 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m2.1.2 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m2.1.3 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m2.1.4 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m2.1.5 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m2.2.2 | hit by threat ExampleLargeKE) = 0.6666666666666666
 P(m1.3 | hit by threat ExampleLargeKE) = 0.6666666666666666

Mean cumulative time in each EFD for all targets of type: ICV
 Cumulative time spent in EFD 0 (m1.1) = 388.0 or 38.8 %
 Cumulative time spent in EFD 1 (m1.2) = 388.0 or 38.8 %
 Cumulative time spent in EFD 2 (m1.3) = 388.0 or 38.8 %
 Cumulative time spent in EFD 3 (m1.4) = 388.0 or 38.8 %
 Cumulative time spent in EFD 4 (m1.5) = 388.0 or 38.8 %



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- Integration of higher fidelity V/L data within the SoSA process has been demonstrated.
- DMPs have been enhanced to utilize additional information provided by higher fidelity V/L data.
- In light of the Mission-based T&E strategy, the community can benefit from higher fidelity V/L data and SoSA capability development in SLAD.



746th Test Squadron



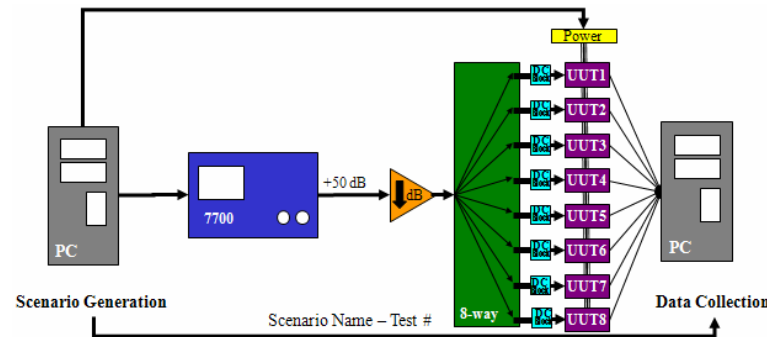
AFMCG

Central Inertial & GPS Test Facility (CIGTF)

Distribution Statement A: Approved for public release: distribution is unlimited. 96ABW-2009-0038

Automated GPS Simulation

Improving the Test Process



Lt. Matthew Steele – 746 TS
 James Javurek-Humig – 746 TS
 Eddie Thompson – 746 TS

Greg Gerten – PreTalen
 Kirk Meyer – PreTalen
 Ben Gerten - PreTalen



Jan 15, 2009

Innovate - Execute - Excel

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Introduction



- 746th Test Squadron Capabilities
- Navigation Test and Evaluation Laboratory (NavTEL) Capabilities
- Conventional Test Process
- Automated Test Process
 - Components
 - Flow & Layout
 - Receiver Support
- Automated Test Process Example
- Future Applications

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746th Test Squadron



AFMCG

Central Inertial & GPS Test Facility (CIGTF)

- **Premier Facility for System and Component Level Testing**
 - Missile Guidance and Control Systems
 - Inertial Navigation Systems (INS)
 - Global Positioning System (GPS) Receivers
 - Embedded GPS/INS (EGI) Navigation Systems
 - Systems Integration
 - Pointing and Tracking Systems
 - Joint UAV Testing
- **Laboratory Tests Target Variables Prior to Field Testing**
- **Reference and Field Tests Verify Lab Results**



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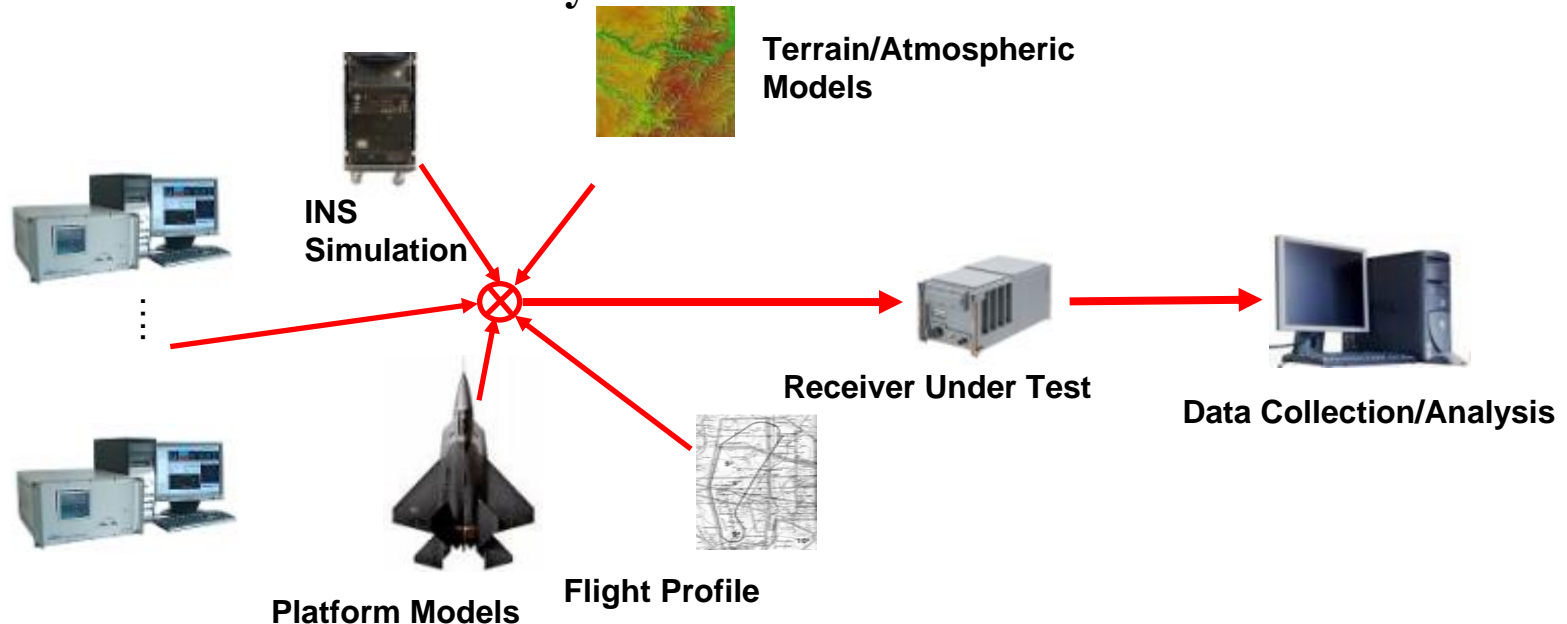


NavTEL



AFMC

GPS Receiver & EGI System Simulation Test



Navigation Test & Evaluation Laboratory (NavTEL)

- Hardware-in-the-Loop Design
- Trajectories (Real & Simulated Using AGI's STK)
- Models: Scenario Dependent (Sensors & Control)
- GPS Simulators (Spirent GSS 7700) *Modern Signals*
- EGI Simulator (Spirent SimInertial)
- Interference Signal Generators (Jammers)
- Wave Front Simulators (Multi-Element Antenna Test)

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Conventional Methodology



- Spirent GSS7700 Simulator
 - Setup individual scenarios
 - User needs to be present to start new scenarios
- DOS based PC/104 Data Acquisition System (DAS)
 - Limited number of receivers
 - Use of removable media for data and Operating System
 - Must be off to access data
 - Must be reloaded whenever media is cleared
 - Must be reconfigured every time a hardware change is made
 - User needs to be present to record new data set

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Conventional Process



AFMC

Spirent GSS7700 GPS Simulator



GPS
RF Signal

**PC/104 Data Acquisition System
(DAS) for Receiver Collection
and Control**

```
DOS>  
DOS> cd Navix  
DOS> dir  
DOS> dfkjdfkksfk,  
ksfkjd, lfksdfkd  
DOS>
```

DOS Prompt



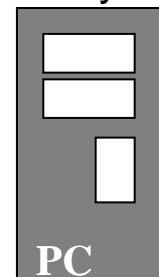
Disk



**Unit Under Test (UUT):
GPS/INS Receivers**



Analysis



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Motivation



- Control large numbers of receivers
- Data collection from large numbers of receivers
- Data transfer without affecting data collection
- Parametric Analysis – Characterize GPS Receivers
 - Perform Design of Experiments (DOE) on variables
 - Automated scenario loading
 - Automated data collection and analysis



Motivation Cont...



- Simulation Analysis – Recreate Field Test Events
 - Read in motion files and create MOD files to create the correct signal's characteristics
 - Create a software model that can be used to describe a receivers behavior
- **Solution: Remove the operator**
 - “Human-*on*-the-loop” –not in it



Automated Components



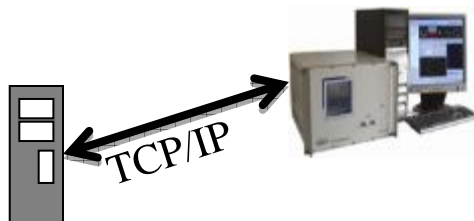
- MOCHA



- SPIDAR



- SimRemote



- EASI



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MOCHA

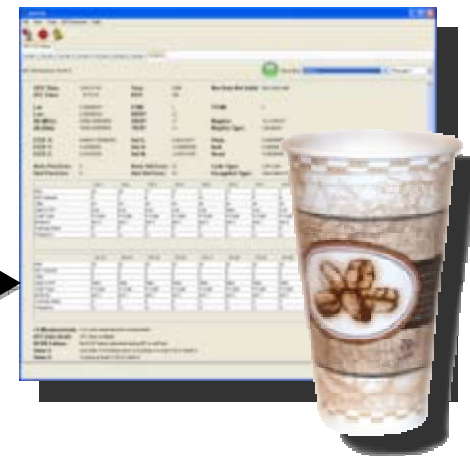


- Multiple Operation Central Host Application (MOCHA)
 - Utilizes multiple Quatech Serial Device Servers
 - Seamless Connectivity
 - Seamless Data Collection
 - Real-Time Monitoring
 - Quick Initialization
 - Remote Scripting

Serial Device Server



MOCHA



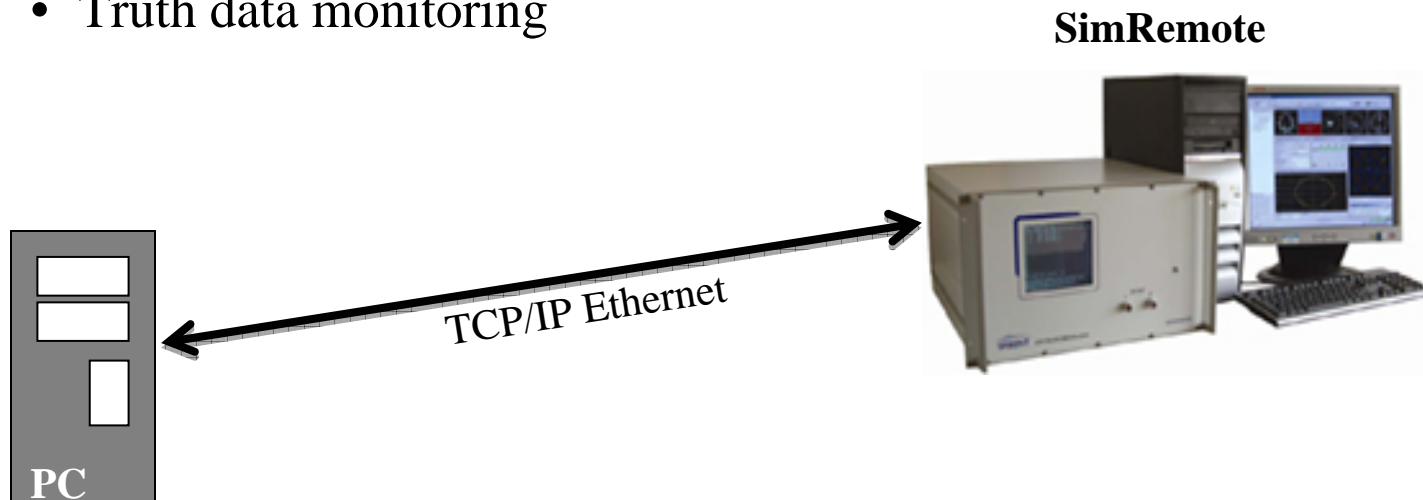
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SimRemote



- SimRemote
 - Extension of SimGEN software
 - Remote interface for Spirent Simulator control
 - Provides
 - Automated scenario loading
 - Truth data monitoring



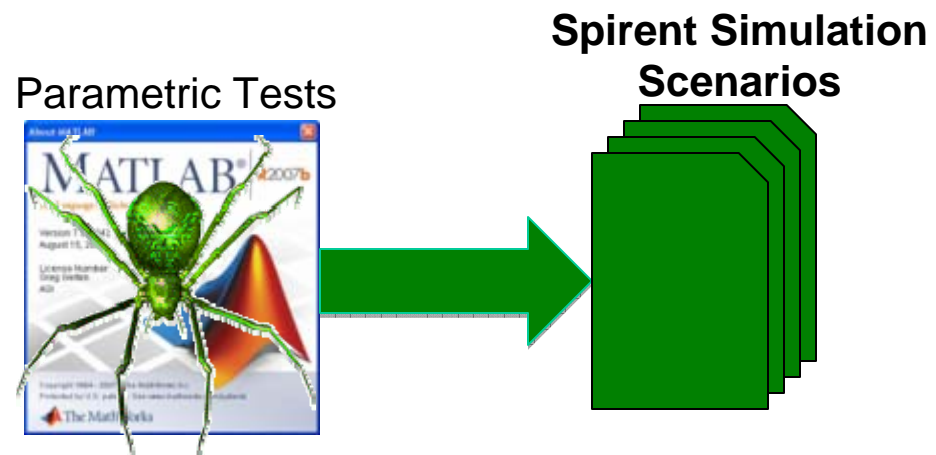
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SPIDAR



- SPIDAR
 - MATLAB based script
 - Easy to modify for new tests
 - Generates Spirent test scenarios
 - Allows parametric testing of multiple GPS variables



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EASI



- Easy Array Software Interface (EASI)
 - Glue Program for MOCHA and SimRemote
 - Digests Spirent scenarios
 - Records MOCHA summary data
 - Records simulator truth data

MOCHA



SimRemote



EASI



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Process Flow Chart



AFMG

Parametric Runs



Pretalen's Spirent Data Generator (SPIDAR)

Pretalen's easy array software interface (EASI)



Scenario data

SimRemote commands

Receiver Inputs

SimGEN / Simulator

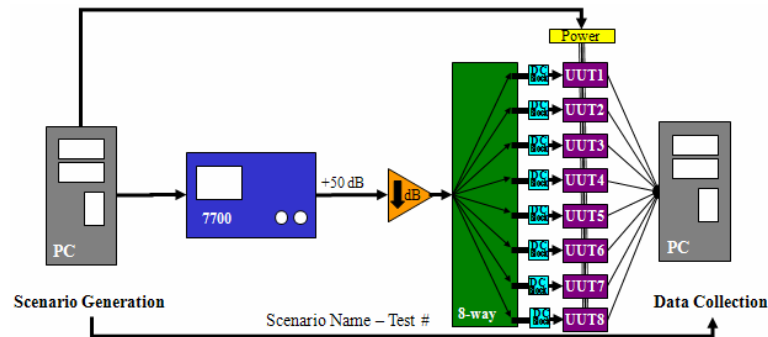
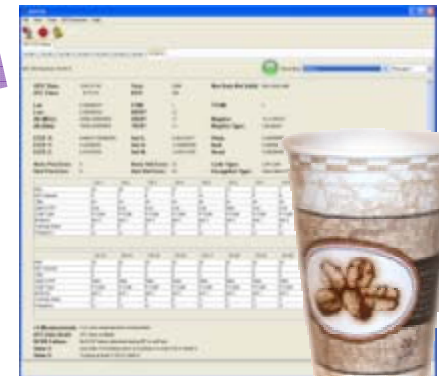
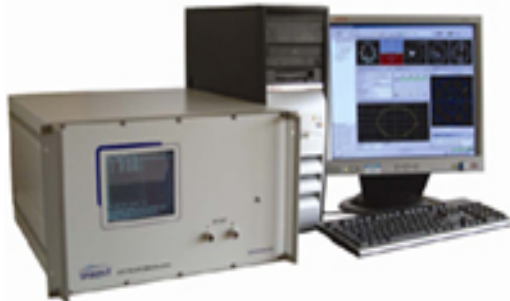
746 TS's receiver interface MOCHA

Initialization

RF

Receiver Test Array (1-8 receivers)

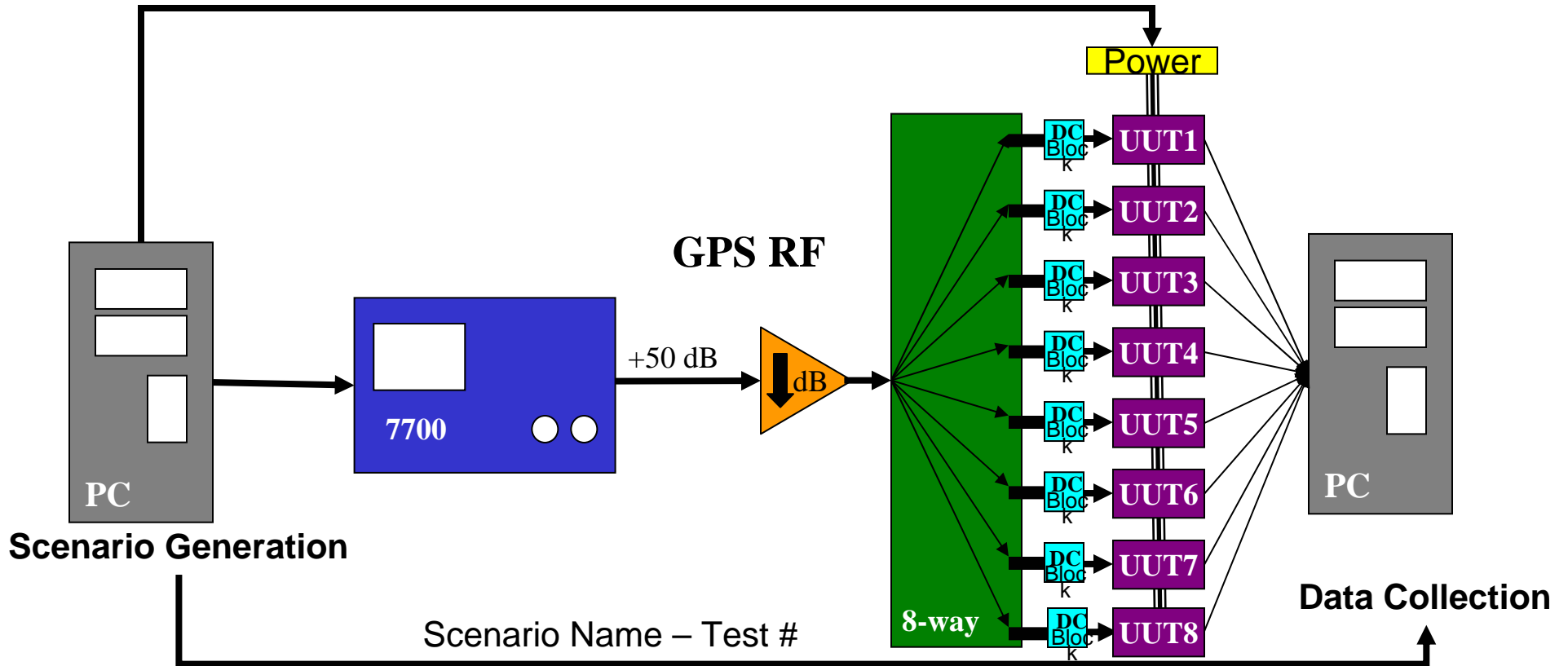
IS-GPS-153 data



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Process Layout



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Receiver Support



- Communication I/O Standards
- Output Data (from the receiver)
 - Used for real time display
 - Recorded for post-processing and analysis
- Input Data (sent to the receiver)
 - MOCHA sends commands to receivers with this data
 - Code type to track
 - Initialize position
 - etc...

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Supported Receivers



- MOCHA modules currently support:
 - Military (ICD-GPS-153 on RS-232 / RS-422)
 - PLGR, DAGR, GB-GRAM...
 - Civilian
 - Javad Receivers
 - NMEA data only



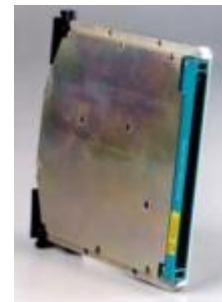
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Future Receiver Support



- MOCHA modules are being developed to support:
 - Military Receivers
 - MAGR, MAGRU, MAGR2K, R3A(046)
 - Force 5, GEM III, GEM IV ...
 - Civilian Receivers
 - Garmin V, üblox, Ashtech Z...



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Automated Test Process Example



AFMC

SPIDAR: generates 500 scenarios and a list of scenarios



EASI (Control)/SimRemote Software

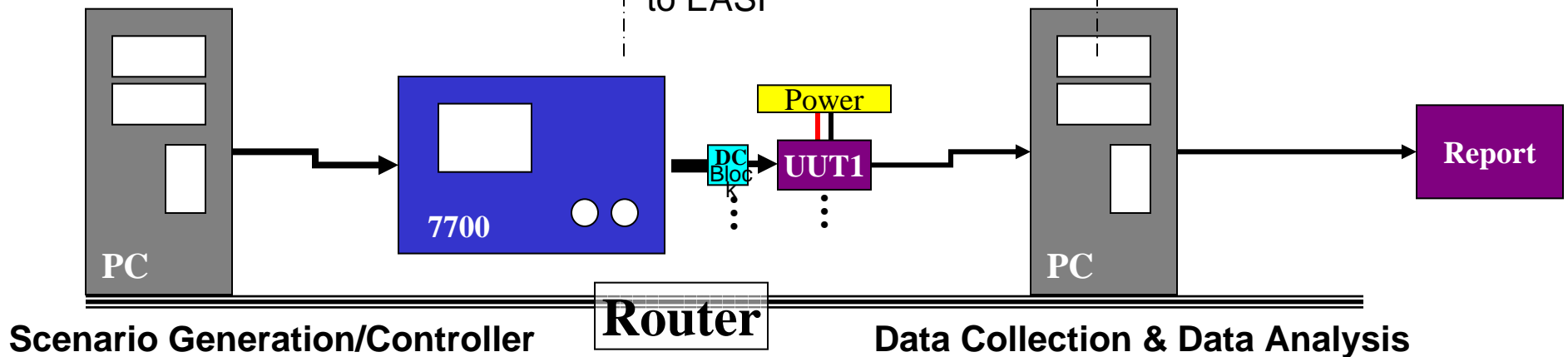
- Read File Listing Scenarios
- Initialize Rcvr / Send Run name & #
- Arm scenario / Command to Start
- Scenario ends - increment & repeat
- Set thresholds for events
- Compare data & write summary report

SimRemote: GPS Simulator

- Start Simulation
- Runs until running scenario is complete
- Wait for EASI to send next scenario
- Sends real-time truth data to EASI

MOCHA: Data Collection S/W

- Collects raw receiver data
- Read msgs 3,4,5040
- Sends real-time performance data to EASI



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Example Cont...



- Ran 500 scenarios each between 5-15 minutes long
- > 66 hours of GPS simulations
- Completed on 8 DAGRS in < 3 days



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Future Applications



- Advantages of Automated Test Process
 - Support multitude of receivers
 - Intuitive/Simple GUI monitoring & control
 - Quick access to multiple receiver functions
- Applications of Automated Test Process
 - GPS End-to-End Testing
 - Satellite Reference Station
 - Dynamic Flight/Van Testing



Summary



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- Navigation Test and Evaluation Laboratory (NavTEL) Capabilities
- Conventional Test Process
- Automated Test Process
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- Future Applications

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746th Test Squadron



Questions?

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Evaluating the Mission – Translating System Performance to Unit Capabilities

NDIA National Test & Evaluation Conference

Atlantic City, NJ



**ROUNDTABLE
DEFENSE, LLC**



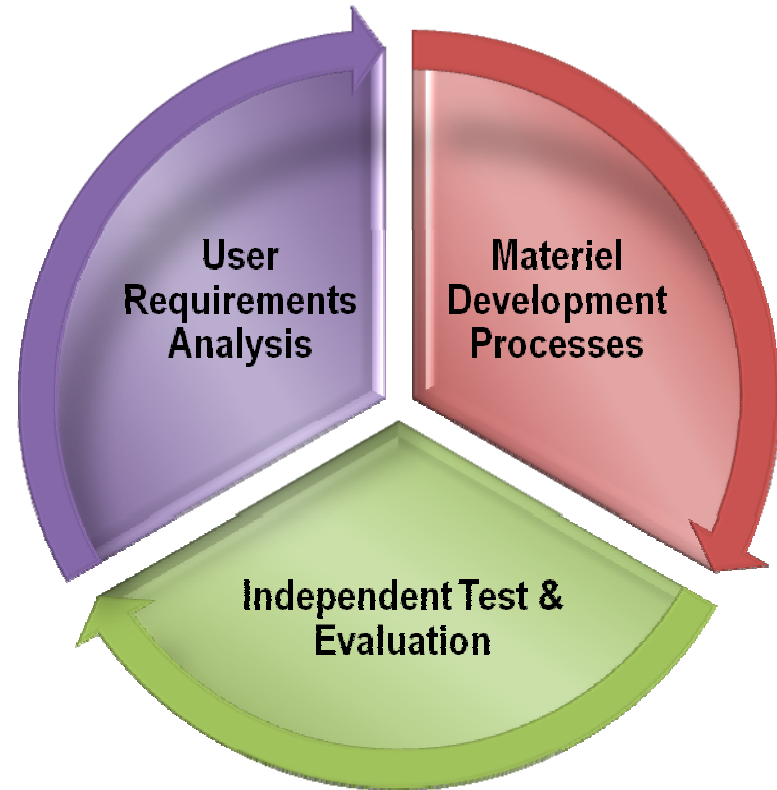
Agenda

- Purpose
- Background
- MBT&E Fundamentals
- SE Approach
- Example
- Summary



Purpose

- Identify a Systems Engineering Approach that may be useful in translating system performance to unit capabilities
- Present a methodology that integrates the test & evaluation function with requirements analysis and materiel development

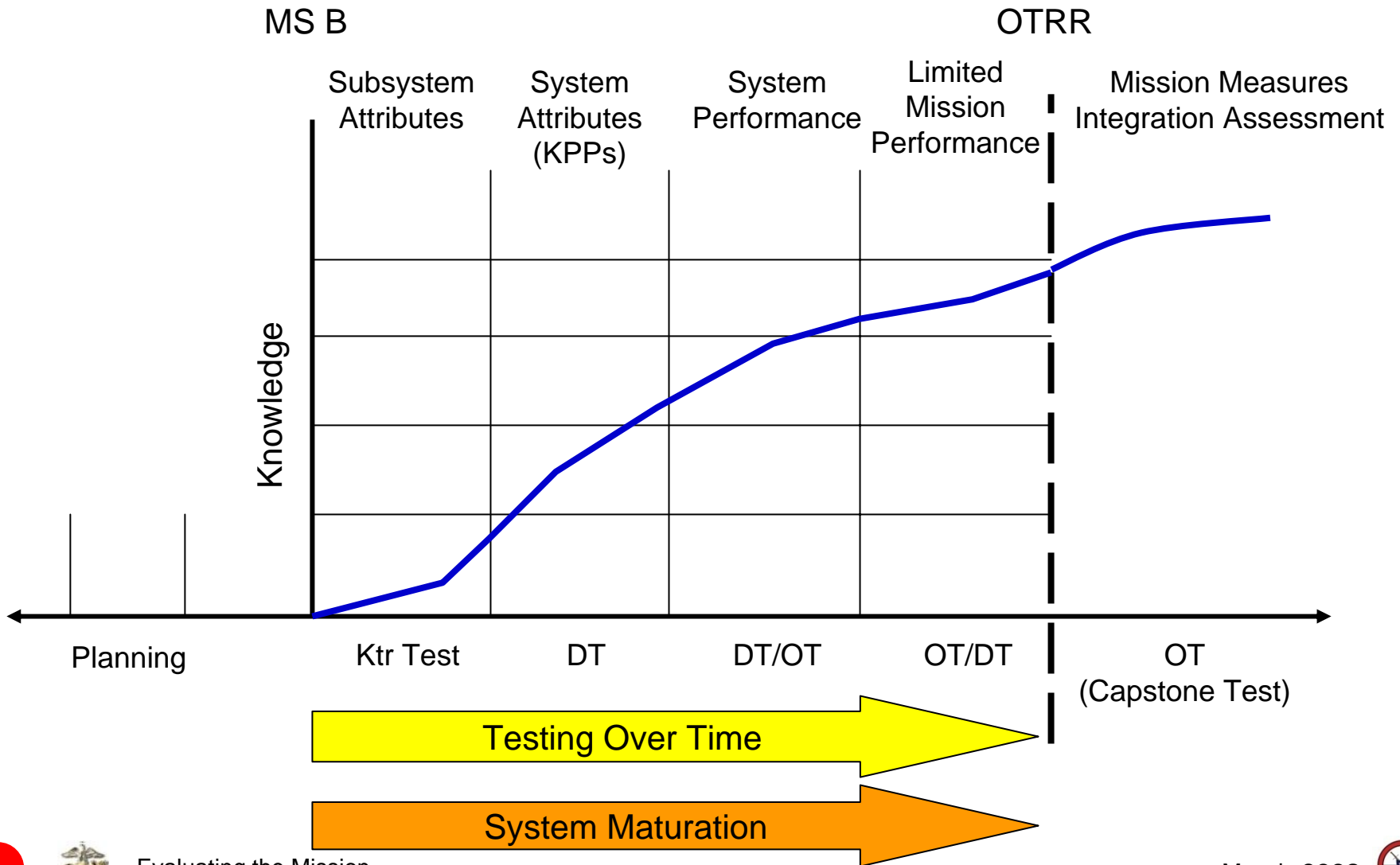


Background

- Some factors driving MBT&E:
 - McQueary-Young Memo (Dec 2007)
 - Section 231 Report (July 2007)
 - CJCSI 3170.01F JCIDS Process
- ATEC, MCOTEA, COMOPTEVFOR and AFOTEC developing approaches
 - Similarities in the Mission Task identification and decomposition process
 - Key differences are in the complexity of the evaluation methodology
- Integrated Testing (DT & OT) provides a continuum of knowledge throughout System development



Integrated Test Approach

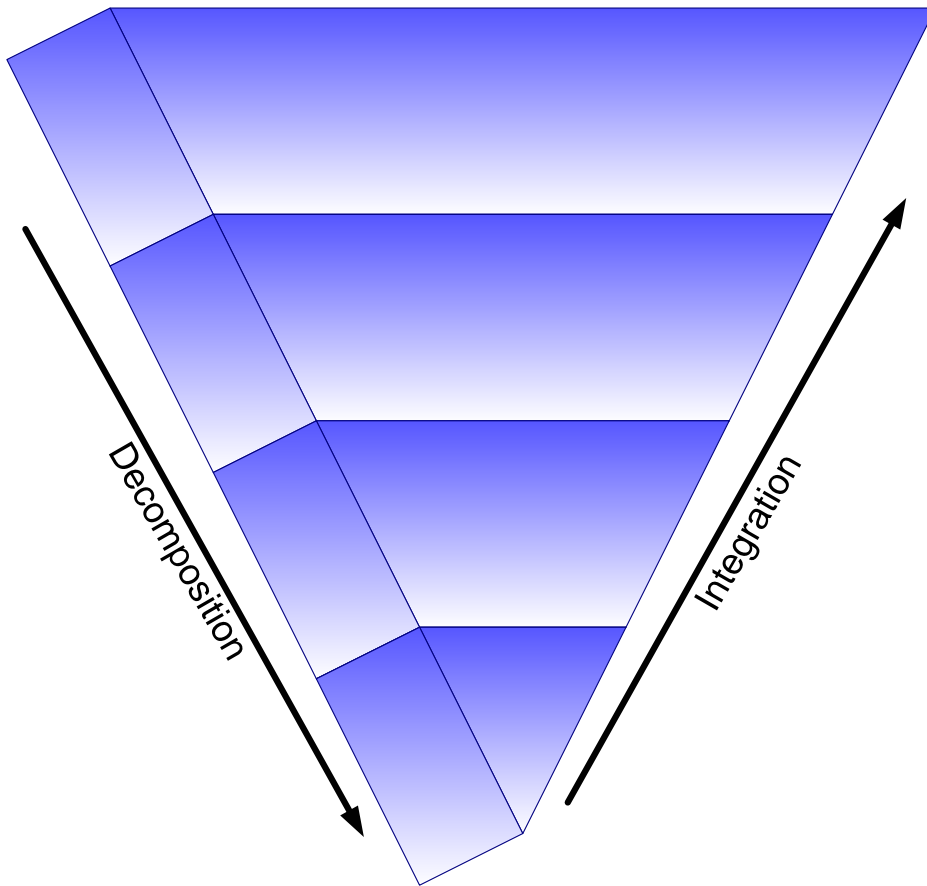


MBT&E Fundamentals

- In order to gather data that accurately answer the Critical Operational Issues (COI) and illustrate capabilities and limitations of the system, the test process must begin and end with a paradigm that ties system Attributes to operational tasks or missions at the unit level.
- Mission Based Test & Evaluation (MBT&E) represents a thought process to guide the evaluators in developing the T&E strategy
 - Must take advantage of work done before by other agents in the Acquisition process
 - Understanding the documented missions for the System vice recreating mission and task analysis
- Definitions (For the purpose of this brief)
 - **Effectiveness** – Capability of the Unit to accomplish the Mission
 - **Suitability** – Factors that Impact the Unit's Mission Capability



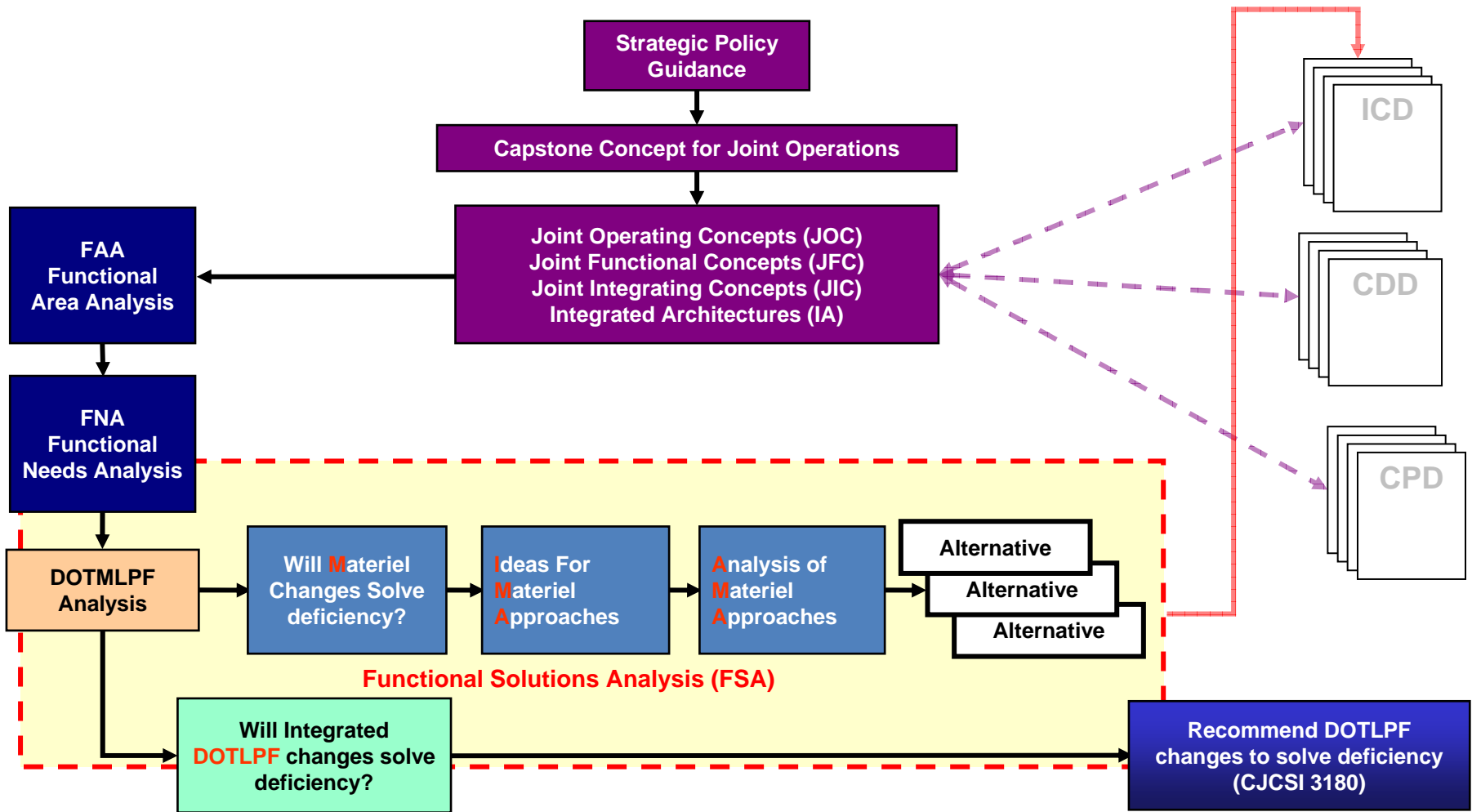
SE Approach



- What Mission Tasks was the System developed to perform?
- What System Functions are required to perform those Tasks?
- What Attributes, defined in the CDD and delivered in the System, enable the function?
- Which measures in the Evaluation Matrix were identified in the JCIDS process that convinced leadership to develop the System?



JCIDS Gap Analysis Process



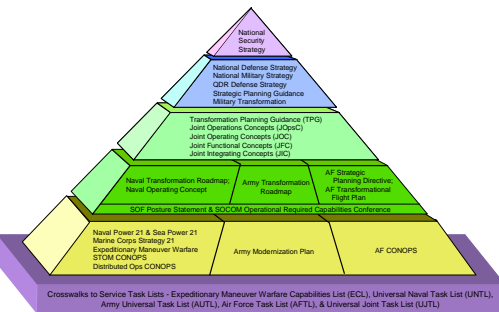
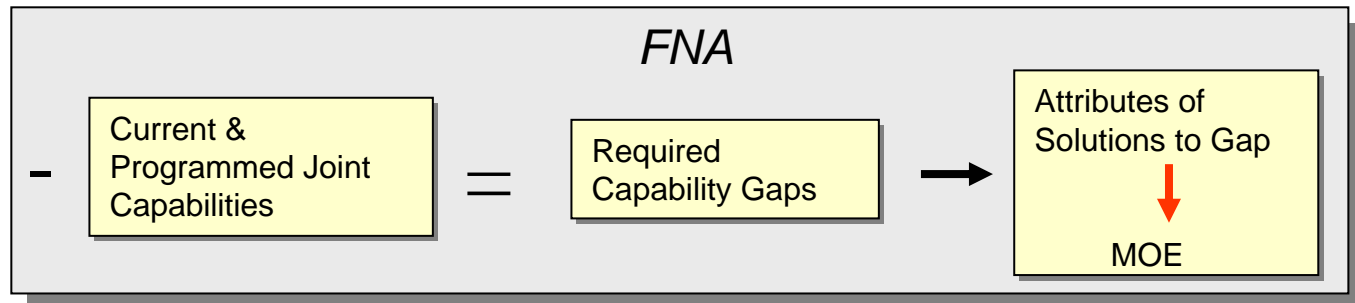
FAA & FNA JCIDS Analysis

FAA

- Joint Concepts
- Threat & Environment
- Military Objectives



Required Joint Capabilities



| Priority | Subtasks | Benefit Value | Legacy | Program 1 | Program 2 | Program 3 | Program 4 | |
|----------|----------------|---------------|-------------------|--|-----------|--------------|-----------|--|
| 1 | Subtasks 12 | 55 | 40% | 20% Solution | | 10% Solution | | |
| 2 | Subtasks 21 | 46.7 | 60% | | 35% | | | |
| 3 | Subtasks 13 | 29.4 | Gap – No solution | | | | | |
| 4 | Subtasks 9 | 14.4 | 30% | 15% | | | 43% | |
| 5 | Subtasks 1 | 10.3 | 90% | No Major Gap – Existing DOTMLPF meets need | | | | |
| 6 | Other Subtasks | ... | | ... | ... | ... | ... | |
| ... | Subtask x | 1.2 | 100% | No Gap – Existing DOTMLPF meets need | | | | |

Attributes & MOE

Defining the Solution Set

Gap Analysis

Provides the Foundation for the Functional Solutions Analysis (FSA) & Ultimately, the ICD



Mission Task Hierarchy

War (MCO)

MOOTW w/ Force

MOOTW w/o Force

Joint Operations



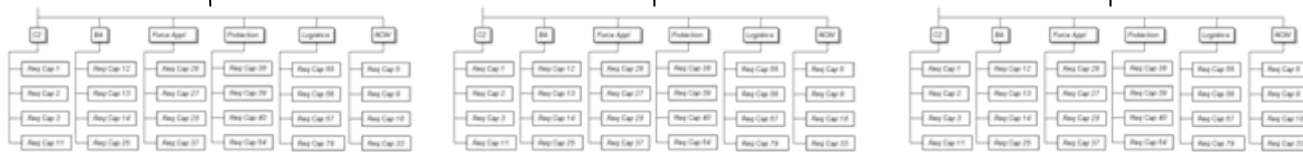
Deter/Engage

Seize Initiative

Decisive Operations

Transition

Activity Model



C2

BA

Force Appl

Protection

Logistics

NCW

Joint Functional Concepts

- Task 1
- Task 2
- Task 3

- Task 12
- Task 13
- Task 14
- Task 25

- Task 26
- Task 27
- Task 28
- Task 37

- Task 38
- Task 39
- Task 40
- Task 54

- Task 55
- Task 56
- Task 57
- Task 79

- Task 5
- Task 9
- Task 18
- Task 33

Joint Tasks

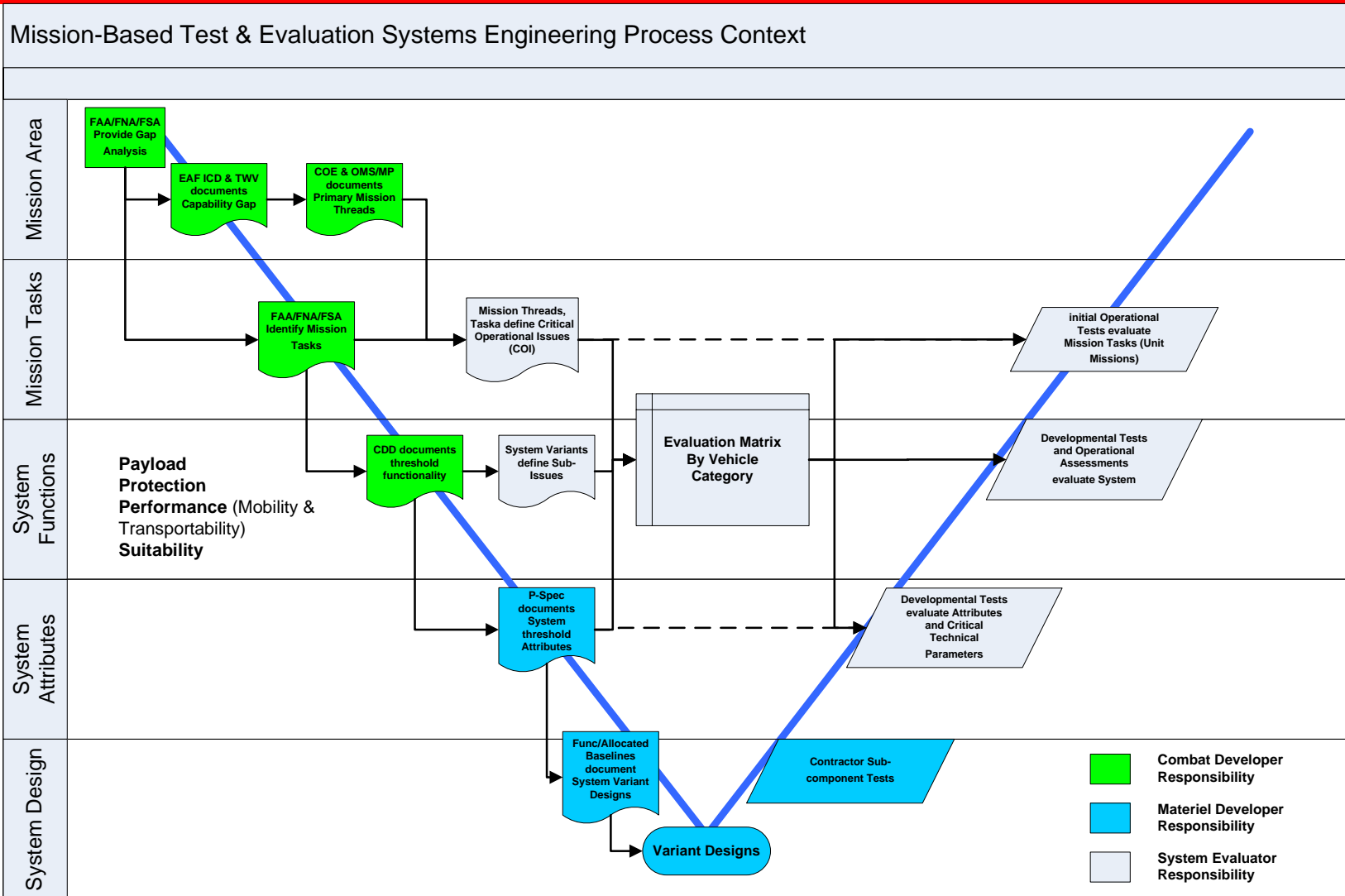


MBT&E Planning Process

- Four Basic Elements:
 - Mission analysis (Critical Operational Issue (COI) definition)
 - System performance measures (attribute traceability to functions)
 - Operating conditions (test scenario/environment description)
 - Test variables (controlled and uncontrolled)
- These items form the basis for the Scope of Test and resource requirement estimates that are included in the TEMP



MBT&E Process Responsibilities



Gap Assessment Process Flow

| Overall Assessment of Task by Capability | War | | MOOTW w/ High Probability of Threat | | MOOTW w/ Low Probability of Threat | |
|--|-----|------|-------------------------------------|------|------------------------------------|------|
| | Air | Grnd | Air | Grnd | Air | Grnd |
| B-166 | N/A | Y | N/A | Y | N/A | Y |
| B-167 | N/A | Y | N/A | Y | N/A | Y |
| B-168 | N/A | Y | N/A | Y | N/A | Y |
| B-169 | N/A | Y | N/A | Y | N/A | Y |
| B-170 | N/A | Y | N/A | Y | N/A | Y |
| B-171 | N/A | Y | N/A | Y | N/A | Y |
| B-172 | N/A | Y | N/A | Y | N/A | Y |
| B-173 | N/A | Y | N/A | Y | N/A | Y |

Comments by Capability (note on changes from basic rating above):
 B-166 (Collect combat intelligence): Though systems exist that nearly fulfil this need, there are critical gaps within the capability. (1) equipment - the inability to detect NBC threats at a distance, and (2) MOOTW which threat - inability to locate & identify threats through observation/walks. The capability is not met, due to the overall high level of accomplishment in other aspects of the capability.

1. Analysis Results

2. Subtask Gap Assessment

3. Gap Assessment Across Operational Scenarios

| Overall Assessment of Task: Ground Recon | War | MOOTW w/ High Probability of Threat | MOOTW w/ Low Probability of Threat |
|--|-----|-------------------------------------|------------------------------------|
| Air | N/A | N/A | N/A |
| Ground | Y | Y | Y |

Comment/Conclusion:
 36 Battlespace Awareness: Conduct Ground Reconnaissance

General Comments: Lessons learned in Iraq identify shortfalls in the insurgency environment. Items for consideration include:
 - The need to improve the ability to collect intelligence and employ enhanced human senses.
 - The need to improve robotics to conduct recon in high-risk situations.
 - The need to address sensor to shooter capability in net-centric warfare.
 - The effects of urban environment and insurgents on the force's ability to collect intel.
 Forces aboard all ground vehicles afford opportunity to conduct ground recon. Training is an essential element to ensure forces properly observe, record, and report.

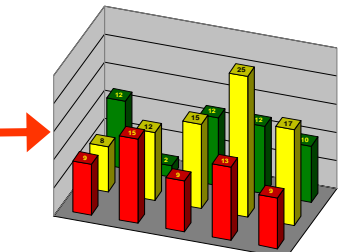
4. Gap Assessment at Task Level

| Capability | Gap | Describe solution to the gap in terms of attributes | Attributes | Joint Attribute |
|---|-----|--|---|---------------------------------------|
| B-166 - Collect combat/intelligence | Y | USMC collecting intel from recon units to fill all assigned CCDEs due to a lack of ML reach to achieve effects under all conditions and high software spectrum to provide systems to achieve those effects. Systems are needed to locate & identify threats through observation or walk, detect CCDE threats at a distance. | Spectrum: increased system capabilities Reach: application of effects under all conditions | Range & Reach |
| B-169 - Employ unattended human sensors to collect intelligence | Y | Systems to enhance human senses lack the spectrum and reach to collect all sensors. Though vision is enhanced through IR, there is a lack of ability to achieve effects in all conditions and a lack of variety of systems. This gap would be mitigated by adding systems to see through walls and obstructions. Other sensors are more severely lacking, but have less repeat as vision. Improving the accuracy and reliability of intelligence and sensor used enhance sensor needed for conducting ground recon. Tasks and test have been added to the gap. | Spectrum: increased system capabilities Reach: application of effects under all conditions | Spectrum & Reach |
| B-167 - Employ sensors to collect intelligence | Y | Existing sensors cover all spectra but lack range (distance) and precision. In some cases specifically on the distance from which the sensors are effective. Precision is required to make information more useful. This includes the ability to fill all CCDEs. | Spectrum: distance Precision: separate info on specific threats | Spectrum & Precision |
| B-170 - Conduct recon into being | Y | Ground recon elements need greater flexibility from their systems, this includes being "smarter" (vision, IR, RF, etc). Supporting systems such as micro-AUVs technology and intelligence gathering are being developed. This includes the ability to fill all CCDEs. | Response: maneuverability Spectrum: variety of systems Security: avoiding capture | Maneuverability, Spectrum, & Security |
| B-171 - Employ robotics in high-risk situations | Y | Robots in high-risk situations currently require manual human reach. Increasing mobility to handle all conditions (stairs, walls, and corridors), sensors, etc. would increase the situations where the robots could be employed and close this gap. | Reach: robot mobility | Reach |
| B-172 - Report collected intelligence/information | Y | Reporting of collected intelligence/information could be quicker. Reporting sensor-to-shooter capability would improve readiness and sharing of information flow to the decision-maker to improve percent of information available in a usable format. | Reporting: speed of sensor-to-shooter reporting Sharing: accessibility of info | Timeliness & Sharing |

5. Attributes for Gap Solutions

| Task | Wt | Pri | Subtask | Measure | Metric | Summary Op | WE | MEMERL | MEMERL | Rationale | Gap Solution | Attribute | Joint Attribute | ED | JOC | JFC |
|--|------|-----|---|---|---|------------|----|--------|--------|---|--|---|--|----|-----------------|-----------------|
| 13 Engagement: Deliver effective and sustained direct lethal, fires integrated with maneuver | 62.6 | 1 | E_054... Deliver autonomous or semi-autonomous direct fires | % of acquired targets, of certain target types, within a specified range, engaged with autonomous or semi-autonomous direct fire weapons systems, while achieving the commander's desired effects | Effects Achieved 90% (T) Range: 0-2 km (T) 0-5 km (O) | R | R | R | R | No existing system had this capability. Of future systems, only FCS, UAVs and TUGVs were deemed to provide any capability in this area but at a very low level. | Develop autonomous or semi-autonomous direct fire systems | Range, effects radius, probable error, precision, response time. | Discriminating Agile Persistent Survivable Effective | | Armed/Int/Comms | Armed/Int/Comms |
| 09 Man: Breach obstacles, both natural and man-made, as encountered | 55.8 | 2 | M_023... Breach buildings | Maximum time that obstacle delays movement of the force | Obj: 0.5 hr Th: 1 hr | R | R | R | O | Capability uniformly rated red across all rated systems. Only the MERS provide a marginal capability in this area. This is a gap to fill. | The USMC does not meet the threshold requirement to breach a building within the time required. This can be solved by providing equipment to aid in building breaching operation and in training Marines to improve methods to breach buildings. | Number and size of buildings cleared to facilitate unit maneuver Time to breach a building and allow forces to enter | Effective Agile | | Armed/Int/Comms | Armed/Int/Comms |

6. Compiled Gap Assessment



7. Prioritized & Grouped Results



Gap 1: Conduct Fire and Maneuver

- *EO Gap 1 Description: The EAF combat elements cannot move rapidly & safely as a cohesive force while executing deep operational maneuver*
- *EAF must be able to: Conduct/support extended ops w/ armor*
 - Move light armor by air: Employ, via air, the light armor elements of EAF to achieve positional advantage; 110nm in 8 hrs (TH), 6 hrs (Obj)
 - Breach obstacles, manmade and natural: Combat element must maneuver through or around any obstruction designed or employed to disrupt, fix, turn or block movement without delaying the force longer than 1 hr (TH), .5 hr (Obj).
 - Protect the force from the lethal effects of kinetic energy weapons systems: Detect & protect the force against blast, flame, thermal, fragmentation and ballistic effects by equipping 75% of the force (TH); equipping & training 100% of the force (Obj).
 - Provide Combat ID: Attain an accurate characterization of detected objects – friend, enemy, neutral - in the battlespace by employing Active Recognition and Tracking Systems and Passive Tracking Systems in 100% of the force (TH & Obj).
- *Characteristics of the Gap*
 - No capability to reposition light armor by air
 - Lack of mobility for vertical lift forces
 - Weight of inherent protection for combat systems adversely impacts EAF mobility
 - Unacceptable limitations in the EAF's combat forces' ability to detect/detonate explosive obstacles
 - Lack of active recognition and active tracking systems for employment with assault, CS or CSS elements of the EAF



Example Mission Task (COI)

Issue: Move Light Infantry (Airborne/Air assault) via ground.

- (Sub-Issue) The JLTV Payload Category B Vehicle will support...(based on unit T/E)
 - Payload Characteristics
 - Transport 9-man team
 - P-Spec Attributes
 - Performance Characteristics
 - Air Transport
 - P-Spec Attributes
 - Mobility
 - P-Spec Attributes
 - Protection Characteristics
 - Ballistic Survivability
 - P-Spec Attributes
 - IA
 - P-Spec Attributes
 - Suitability Characteristics
 - Availability
 - P-Spec Attributes
 - Safety
 - P-Spec Attributes
- (Sub-Issue) the JLTV Payload Category C Vehicle will support...(based on unit T/E)
 - Payload Characteristics
 - Transport Unit Shelters
 - P-Spec Attributes
 - Performance Characteristics
 - Air Transport
 - P-Spec Attributes
 - Mobility
 - P-Spec Attributes
 - Protection Characteristics
 - Ballistic Survivability
 - P-Spec Attributes
 - IA
 - P-Spec Attributes
 - Suitability Characteristics
 - Availability
 - P-Spec Attributes
 - Safety
 - P-Spec Attributes



Mission Evaluation

| System Functions | Vehicle Category | | |
|------------------|------------------|--------------|-------|
| | A | B | C |
| Payload | 3500 | 4000/4500 | 5100 |
| Performance | 4 man | 6 man | 2 man |
| | speed | 9 man | speed |
| | range | speed | range |
| | acceleration | range | |
| | braking | acceleration | |
| | etc | braking | etc |
| Protection | Ballistics | Ballistics | |
| | CBRNE | CBRNE | |
| | etc. | etc. | |
| Transportability | CH 47/53 | CH 47/53 | |
| | 2 x IAT C130 | 1 x IAT C130 | |
| Suitability | Availability | Availability | |
| | Safety | Safety | |
| | etc. | etc. | |

| System Functions | Sub-Configurations (Variant) Matrix | | | |
|------------------|---|--|---|------------------------|
| | C20TM | AMB | HVY Guns | Utility |
| Performance | 4 man C2 suite speed range acceleration braking etc | 3 man 2 x liter speed range acceleration braking etc | 4 plus Gunner speed range acceleration braking etc | 2 man cargo etc. |
| Protection | Ballistics CBRNE etc. | Ballistics CBRNE etc. | Ballistics CBRNE etc. | |
| Transportability | CH 47/53 2 x IAT C130 | CH 47/53 1 x IAT C130 | CH 47/53 1 x IAT C130 | CH 47/53 x IAT C130 |
| Suitability | Availability Safety etc. | Availability Safety etc. | Availability Safety etc. | |

Mission-Based COICs

- Move Light Infantry (Airborne/Air assault) via ground
 - Payload Category B Attributes
 - Payload Category A Attributes (Category mix based on Unit T/E)
- Move Combat Support forces via ground
- Etc.

Mission-Based ROIs

- Add other Mission Tasks only as necessary based on planned tests (e.g., C2)

Risk Analysis for TD Phase

- Vehicle capabilities indicate potential to meet COI/ROI
- Vehicle limitations indicate risk area to meeting COI/ROI



Knowledge Management

Task: *What are the lethality capabilities and limitations of the EFSS when performing suppression missions?*

| Attributes | | | | Result | OTRR | Mission Measures | |
|-------------------|----|-------|-------|-------------|------|---|--|
| | DT | DT/OT | OT/DT | | | | |
| First Rd Response | | X | X | 28 sec | | | |
| Max ROF | | X | X | 5.1 rds/min | | | |
| Deflection CEP | X | | | 0.65 m | | <ul style="list-style-type: none"> •#Successes/#Total Missions •Operator Opinion •SME Evaluation | |
| Range CEP | X | | | 0.58 m | | | |
| Max Range | | X | | 6.5 km | | | |
| | | | | | | | |
| | | | | | | | |

OT (Capstone Test)



System Capability Evaluation Table (Each Category by Vendor)

- Use Measure results to evaluate Attributes and support COI Evaluation as Met, Partially Met, or Not Met
- Overall System Assessment based on weighted COI "performance"



| INTEGRATED SYSTEM EVALUATION - Category A by Vendor | | | | | | | | | | |
|---|-----------|--------------------|---------------------|---------------|--------------------|---------------------|----------|--------------------|------------|----------|
| | | Vendor 1 | | | Vendor 2 | | | Vendor 3 | | |
| | | Overall Assessment | | | Overall Assessment | | | Overall Assessment | | |
| | | COI Assessment | Attributes | Measures | COI Assessment | Attributes | Measures | COI Assessment | Attributes | Measures |
| COI | Move | Partially Met | A-1 (Partially Met) | M-1 (Met) | Met | A-1 (Partially Met) | M-1 | Met | A-1 | |
| | | | | M-2 (Not Met) | | | M-2 | | | |
| | | | | M-3 (Met) | | | M-3 | | | |
| | | | A-2 (Met) | M-7 | | A-2 (Met) | M-7 | | A-2 | |
| | | | | M-10 | | | M-10 | | | |
| | | | A-4 | M-5 | | A-4 | M-5 | | A-4 | |
| | | | | M-34 | | | M-34 | | | |
| | | | | M-36 | | | M-36 | | | |
| | | | | M-39 | | | M-39 | | | |
| | | | A-5 (Not Met) | M-40 | | A-5 | M-40 | | A-5 | |
| | A-8 (Met) | M-50 | A-8 | M-50 | A-8 | | | | | |
| | Transport | Met | A-9 | M-60 | Met | A-9 | M-60 | Not Met | A-9 | M-60 |
| | | | A-10 | M-61 | | A-10 | M-61 | | A-10 | M-61 |
| A-12 | | | M-62 | A-12 | | M-62 | A-12 | | M-62 | |
| A-13 | | | M-63 | A-13 | | M-63 | A-13 | | M-63 | |
| Carry | etc. | etc. | etc. | etc. | etc. | etc. | etc. | etc. | | |
| Payload | | | | | | | | | | |
| Sustain | | | | | | | | | | |
| Survive | | | | | | | | | | |
| Safety | | | | | | | | | | |
| Net Ready | | | | | | | | | | |



Mission Capability Evaluation Table

- COIs assessment (previous table) feeds Mission Capability Evaluation
- Evaluate COIs in the context of supporting individual Mission Capabilities (limit missions to most critical/probable?)
- Across all participating variants, evaluate impact on each Mission Capability as Met, Partially Met, or Not Met

| | | MISSIONS | | | | | | | | | |
|----------------------------|-----------------|---|-------------------------|--------------------------------|------------------|---------------------------|---------|-----------|-----------------|-----------|----|
| | | MSN 1 (Conduct Mounted Movement to Contact) (Met, Partially Met, Not Met) | | | | | | | | | |
| | | A ↑ | ↑ | ↑ | B ↑ | C | | | | | |
| Overall Variant Assessment | General Purpose | Inf Carrier (Army) | Infantry Carrier (USMC) | C2OTM | Hvy Guns Carrier | Close Combat Wpns Carrier | Utility | Ambulance | Shelter Carrier | Ambulance | |
| COI | Move | ↑ | ↑ | Not Required for this msn (NR) | ↑ | ↑ | NR | NR | NR | NR | NR |
| | Transport | | | | | | | | | | |
| | Carry | | | | | | | | | | |
| | Payload | | | | | | | | | | |
| | Sustain | | | | | | | | | | |
| | Survive | | | | | | | | | | |
| | Safety | | | | | | | | | | |
| | Net Ready | | | | | | | | | | |



Summary (1 of 2)

- Significant analysis is conducted in the requirements development process
 - Mission Tasks, Gaps and MOEs identified
 - Alternatives selected based on performance against thresholds
- Relationship between Mission Tasks and System Functions established in JCIDS analysis is maintained during the SE decomposition
 - Mission Profile analysis is key to evaluating Suitability characteristics
- Test develops system knowledge over time
 - All phases of test support evaluation of system “maturity”
 - Operational Test evaluates the effect of the System on the Unit Mission performance



Summary (2 of 2)

- Fiscal and schedule realities typically drive testing to focus on COIs and KPPs
 - System evaluation focuses on Gap Missions and System Functions/Attributes that support mission effectiveness
 - Evaluate Critical Tasks and Issues to identify risk and scope of unknown performance
- Potentially, test results would be used to validate early M&S assumptions and analysis
- Did the system deliver the expected capability?



QUESTIONS

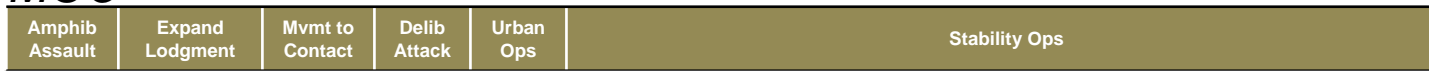


BACKUP



Mission Profile – Operational Context

MCO



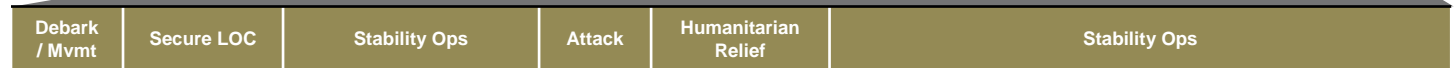
Composite Timeline



IrW – Humid/Jungle



IrW – Arid/Mountain



Operational Context

- MPCs arrive in theater aboard MPF shipping ; move ship to shore at SPOD or via connector (e.g. LCAC)
- Support infantry battalion with three variants:
- Support infantry battalion across ROMO
 - Offensive Ops: patrolling, movement in support of maneuver, urban ops
 - Defensive Ops: patrolling, support by fire positions
 - Stability: patrolling, security ops, QRF, checkpoints, convoy security

Summary

- MCO oriented on forces initially; then control of key areas (APODs / SPODs / Forward Bases / Key Cities) and routes between those areas
- Both IrW scenarios oriented on control of key areas / routes and restoring host nation capability
- Even during MCO, large % of operations = stability operations
- Stability operations drives larger % of on-road; wider variety of mission use



Roll Up Mission Risk Tables

- Assess the risk consequence and probability to effectively support the designated missions capabilities.

By Category

| | | CATEGORY "A" MISSION RISK | | | | Overall Assessment of Meeting All Missions | Overall Assessment of Meeting All Missions | Overall Assessment of Meeting All Missions |
|--------|---|---------------------------|-------|-------|----------|--|--|--|
| | | MSN 1 | MSN 2 | MSN 3 | MSN ETC. | Overall Assessment of Meeting All Missions | Overall Assessment of Meeting All Missions | Overall Assessment of Meeting All Missions |
| Vendor | 1 | High | High | Med | → | High Risk | High Risk | High Risk |
| | 2 | High | High | High | → | High Risk | High Risk | High Risk |
| | 3 | Med | Low | High | → | Med | Med | Med |

By Vendor

| | | VENDOR MISSION RISK | | | | Overall Assessment of Meeting All Missions | Overall Assessment of Meeting All Missions | Overall Assessment of Meeting All Missions |
|----------|---|---------------------|-------|-------|------|--|--|--|
| | | MSN 1 | MSN 2 | MSN 3 | ETC. | Overall Assessment of Meeting All Missions | Overall Assessment of Meeting All Missions | Overall Assessment of Meeting All Missions |
| Vendor 1 | A | High | High | Med | → | High Risk | High Risk | High Risk |
| | B | Low | Low | Low | → | Low | Low | Low |
| | C | Low | Low | Low | → | Med | Med | Med |



Structuring T&E for Validation of Complex Systems Capabilities and Exploration of Emergent Behaviors



Josh Tribble
MILITARY ANALYST
AVW TECHNOLOGIES

Phone: 757-348-4013 (Mobile)
E-mail: tribble@avwtech.com
860 Greenbrier Circle, Suite 305
Chesapeake, VA 23320
<http://www.avwtech.com>

25th Annual NDIA Test and Evaluation Conference
2-5 Mar 2009, Atlantic City, NJ

Agenda






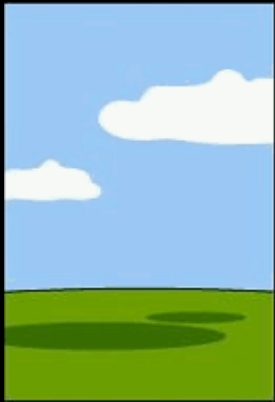


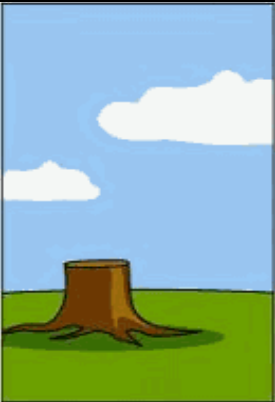

- SYSTEMS THEORY RELEVANT TO T&E
 - Complex Systems
 - Holism
 - Emergence

- STRUCTURING T&E FOR VALIDATION OF COMPLEX SYSTEMS
 - Complex System V&V
 - Complex System T&E
 - Considerations and Recommendations
 - Mission and Functional Analysis Based Test Planning
 - Risk Prioritized Integrated Testing across the Development Life-Cycle
 - Design of Experiments Based Test Planning and Analysis

- CONCLUSION

Systems Engineering

The way it really is?

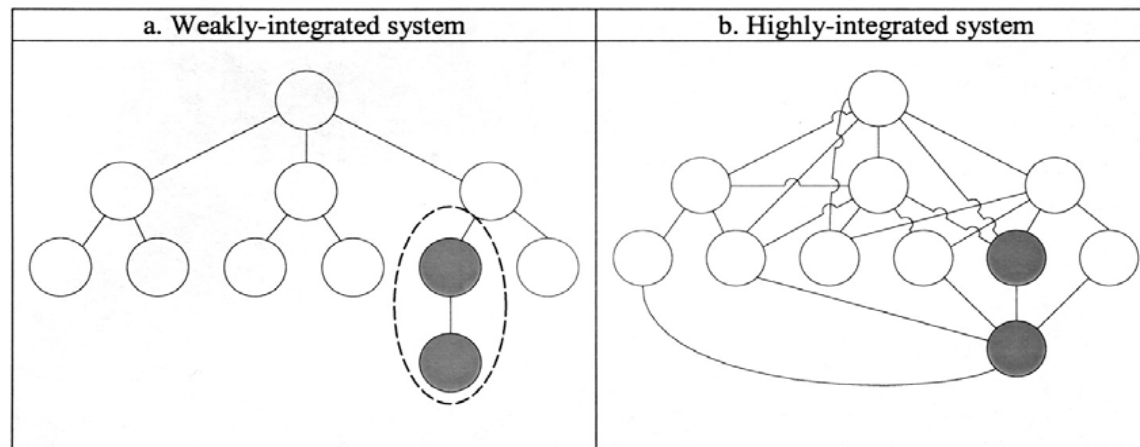
| | | | | |
|--|--|---|--|--|
|  |  |  |  |  |
| How the user described it | How the requirement was understood | How the contractor designed it | How the programmer wrote it | How the PM/sponsor described it |
|  |  |  |  |  |
| How the project was documented | What was actually installed | How the Government was billed | How the helpdesk supported it | What the user really needed |

SYSTEMS THEORY RELEVANT TO T&E

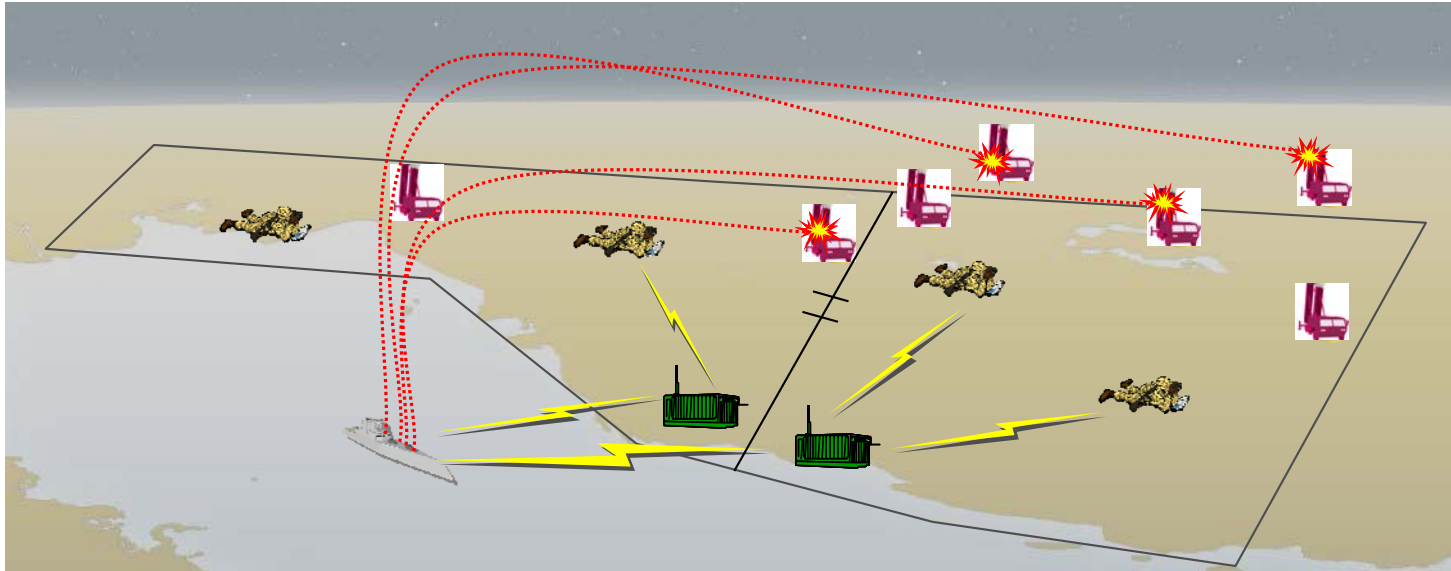
- Complex Systems
- Holism
- Emergence

Complex Systems

- **Holistic**, hierarchal, transient, **emergent**, non-deterministic, large number of elements and states, etc...
- **Detail complexity**—hierarchical relationships dominate; complex in size and scope but straight forward causal relationships; somewhat predictable; risks in contributing parts (Calvano & John, 2004)
- **Dynamic complexity**—lateral interfaces dominate; complex integration and behaviors; unpredictable; system risks dominate; causal relationships difficult if not impossible to determine (Calvano & John, 2004)



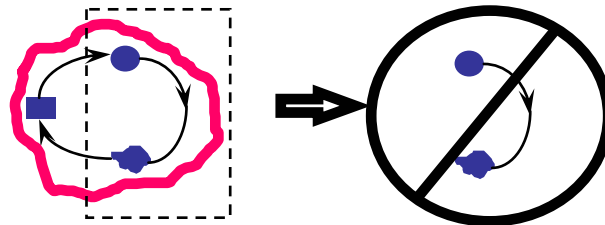
Complex Systems Example: Naval Surface Fire Support



- Very Complex System; also possibly a System of Systems
- Dynamic Complexity – many parts, high degree of coupling and interaction across a large number of complex interfaces; integration challenge!
- Diverse, separated, component systems; transient states & deterministic behavior
- Variability and unpredictability of human behaviors and interaction w/ system
- Emergent behaviors from coupling of sensors, weapons, & employment methods

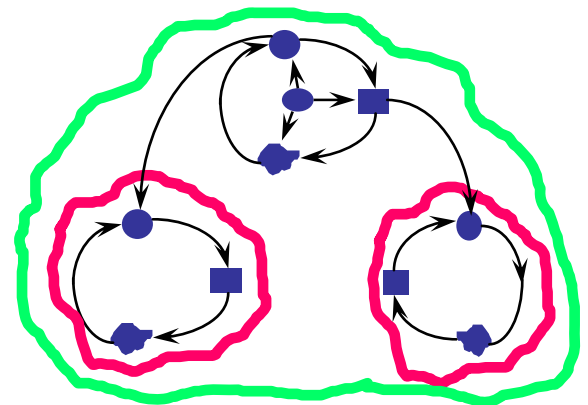
Holism

- “A system has holistic properties possessed by none of its parts. Each of the system parts has properties not possessed by the system as a whole.” Clemson (1984, p. 201)
- Holism emphasizes whole over parts; organizational level analysis ensuring elements function together to serve the purpose of the system. Jackson (2006, p. 650)
- Reductionism serves to help in building up a system design, but a holistic view is needed in order to evaluate complex systems.



Emergence

- A systems principle that whole entities exhibit properties that are meaningful only when attributed to the whole, not its parts – e.g. the pungent smell of ammonia, which comes from the properties of the molecule, not those of the constituent nitrogen and hydrogen atoms.
(Hitchens, 2003)
- Generally accepted aspects of emergence (see backup slides for references from literature):
 - Unpredictable / unexpected
 - Derives from integration, interfaces, and interaction of the systems' elements
 - Not present in the systems' elements nor can it be predicted by evaluating each of those – although can influence them



Emergence?



MISTAKES

IT COULD BE THAT THE PURPOSE OF YOUR LIFE IS
ONLY TO SERVE AS A WARNING TO OTHERS.

STRUCTURING T&E FOR VALIDATION OF COMPLEX SYSTEMS

- Complex System V&V
- Complex System T&E
- Considerations and Recommendations

Verification & Validation

- **Verification**: Confirmation by examination and provisions of objective evidence, that specified requirements have been fulfilled. (IEEE Std 1012, 1998, p.71)

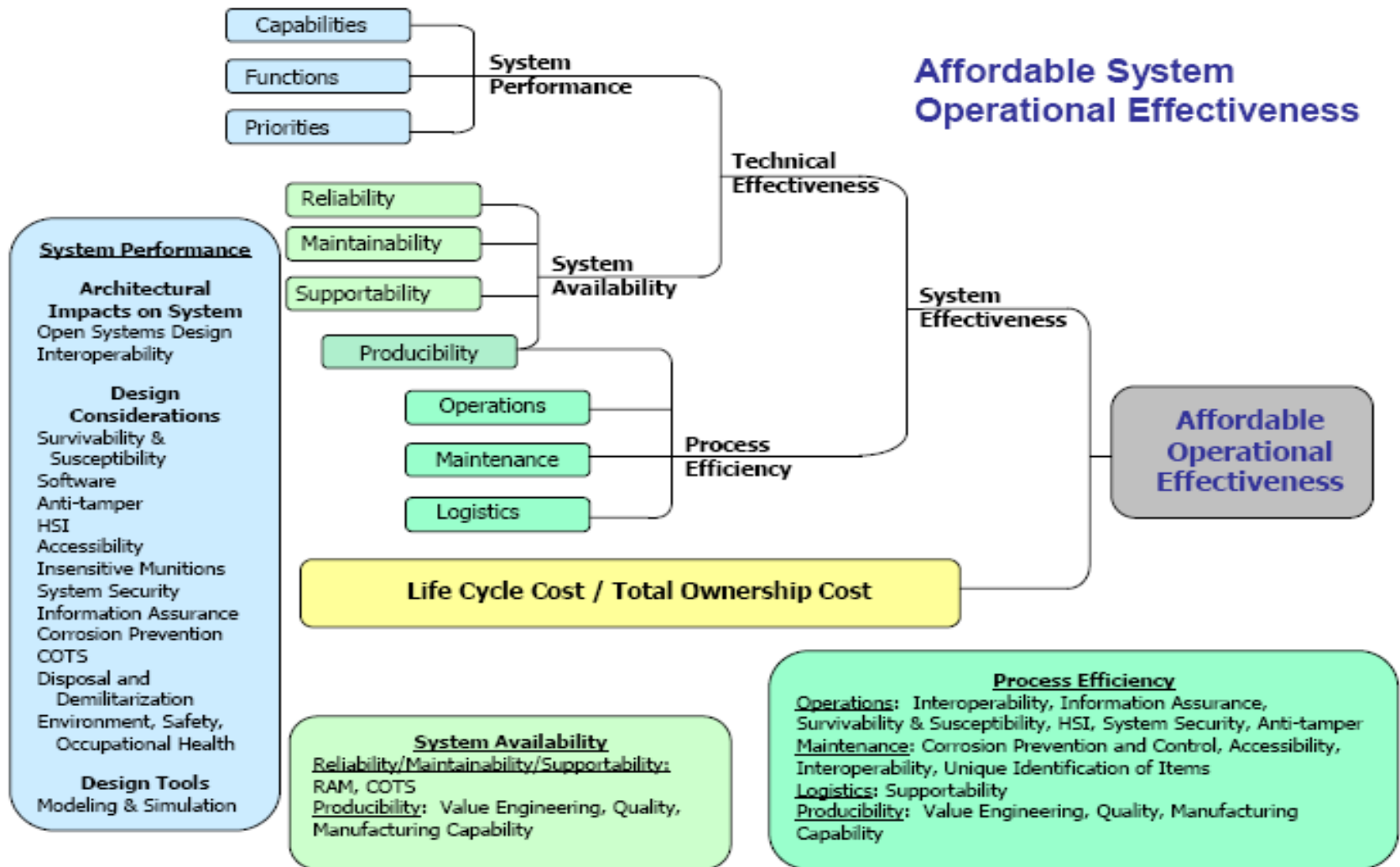
Did you build what you said you were going to build?

- **Validation**: Confirmation by examination and provisions of objective evidence that the particular requirements for a specific intended use are fulfilled. (IEEE Std 1012, 1998, p.71)

Did you build what the user needed?

- V&V is a broad set of activities for software or whole systems applied across the life-cycle, supporting a variety of activities from assessing technical alternatives in conceptual design to ensuring the as-built system meets its specifications and the user's need.

What encompasses a user's needs?



Test & Evaluation

- Test = procedure to measure performance under various conditions. (Parker, 1994)
- Testing = linchpin, intelligence/feedback loop for systems engineering. (Laskey, 1999, p. 6)
- T&E at its best = goal to provide necessary info to ensure quality.
At its worst = political game where programs fight for survival and money. (Laskey, 1999, p. 6)
- T&E ~ experiment & theory; predict outcome, validate points of doubt (Goode & Machol (1957, p. 509)
 - Unfortunately complex systems are often non-deterministic if not completely unpredictable

Focus of T&E

- “How well did the system actually perform, and did it accomplish its mission objective?” –
 - Mission accomplishment not just specs
 - System effectiveness + Support system capability (suitability)
- “Does the system meet all of the requirements as covered through the specified technical performance measures?”
 - Technical verification; developmental testing
- “Does the system meet all [user] requirements?”
 - Verification and validation?
 - Could a system meet the user’s requirements as stated and yet be not operationally effective/not suitable?



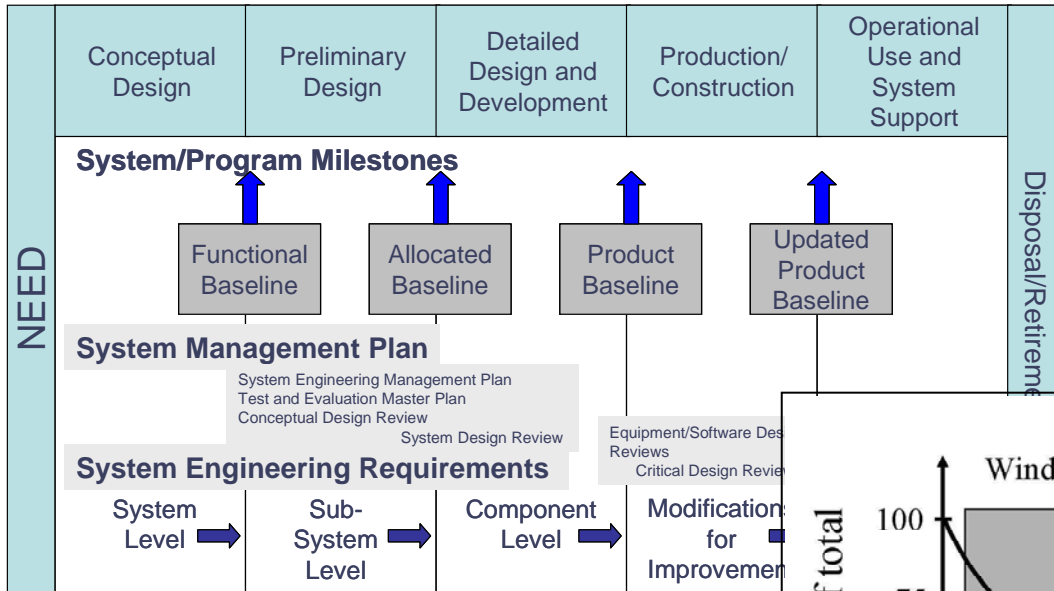
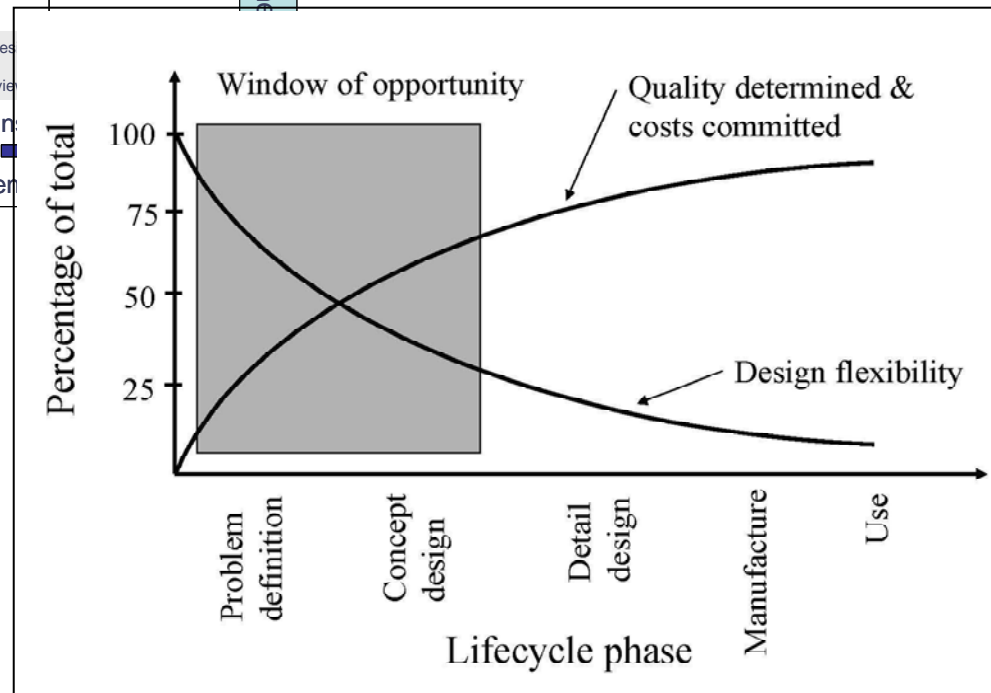


Figure adapted from Blanchard, S. & Fabrycky, W. J. (2006). *Systems Engineering and Analysis*. (4th ed.) Upper Saddle River, NJ: Prentice-Hall.

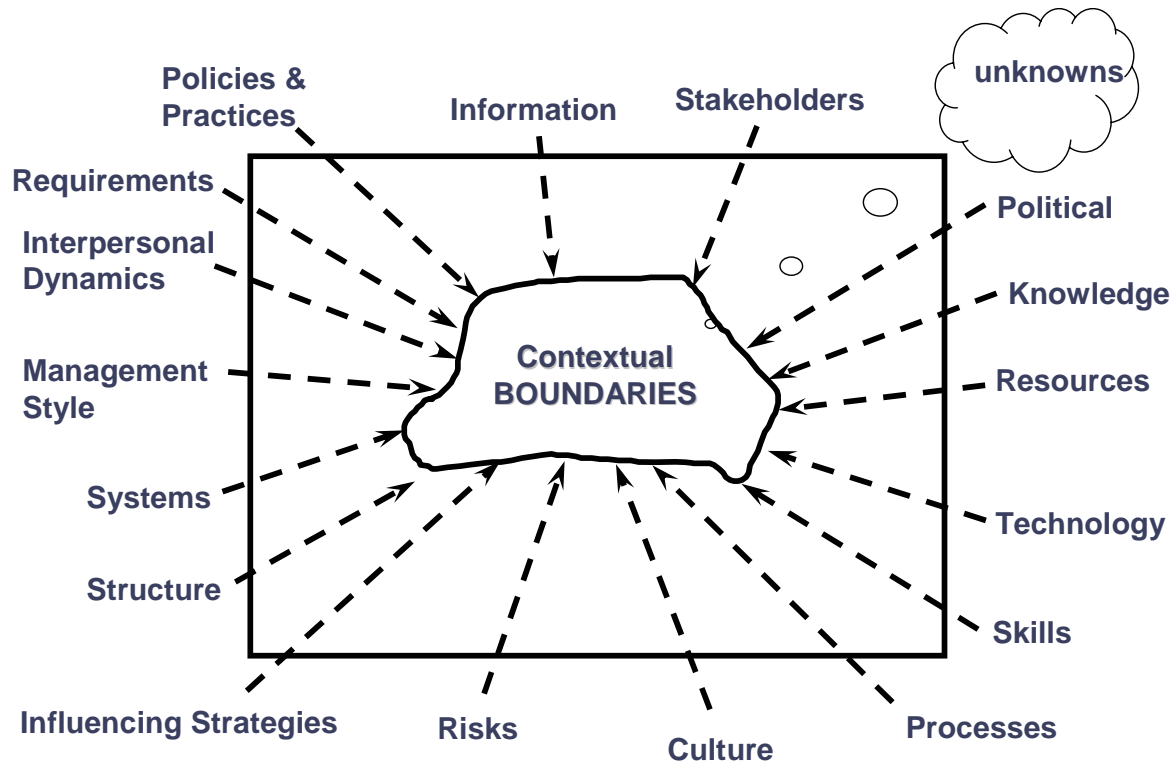
Get it right early!

- Importance of Conceptual Design
- Get testers involved (OT/DT/LFT)
- Understand mission environment
- Understand what constitutes operational effectiveness & suitability; what user really needs!
- Test early & often w/ honest assessment of risk to sustained mission capability



Source: Ford, R. B. & Barkan, P. (1995) "Beyond Parameter Design --A Methodology Addressing Product Robustness at the Concept Formation Stage", *Design for Manufacturability, 1995 Concurrent Engineering and Design Manufacturing Integration*, ASME DE-Vol. 81, J.R. Behun (Ed.), National Design Engineering Conference, Chicago, IL, March 13-16.

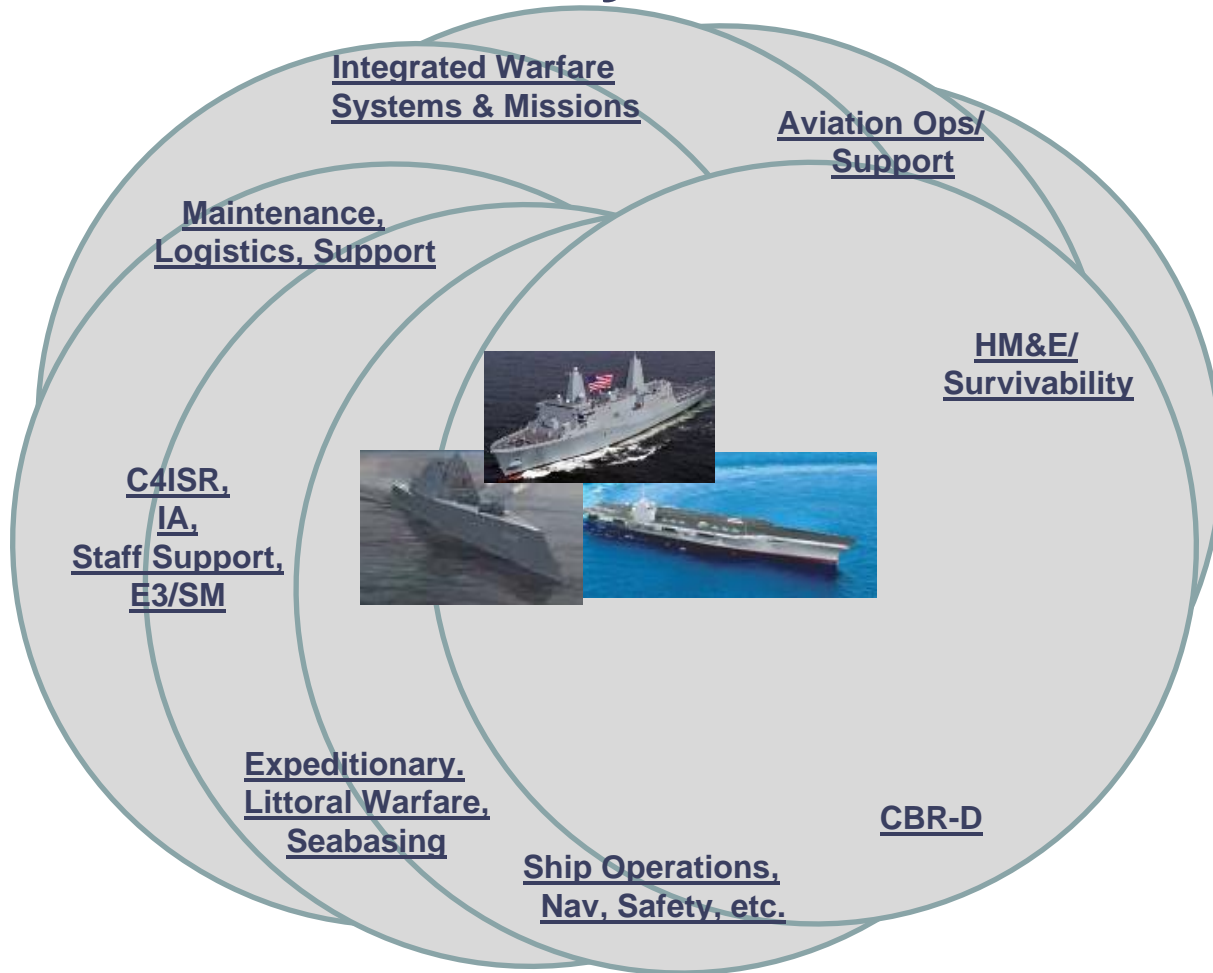
Program Context and Systems Evaluation



Implications for complex system T&E

- Understand mission environment and ensure testing explores those boundaries
- Evaluation of system/program performed in context of the program & many external and internal influences and drivers
- These also affect capabilities and limitations of T&E itself

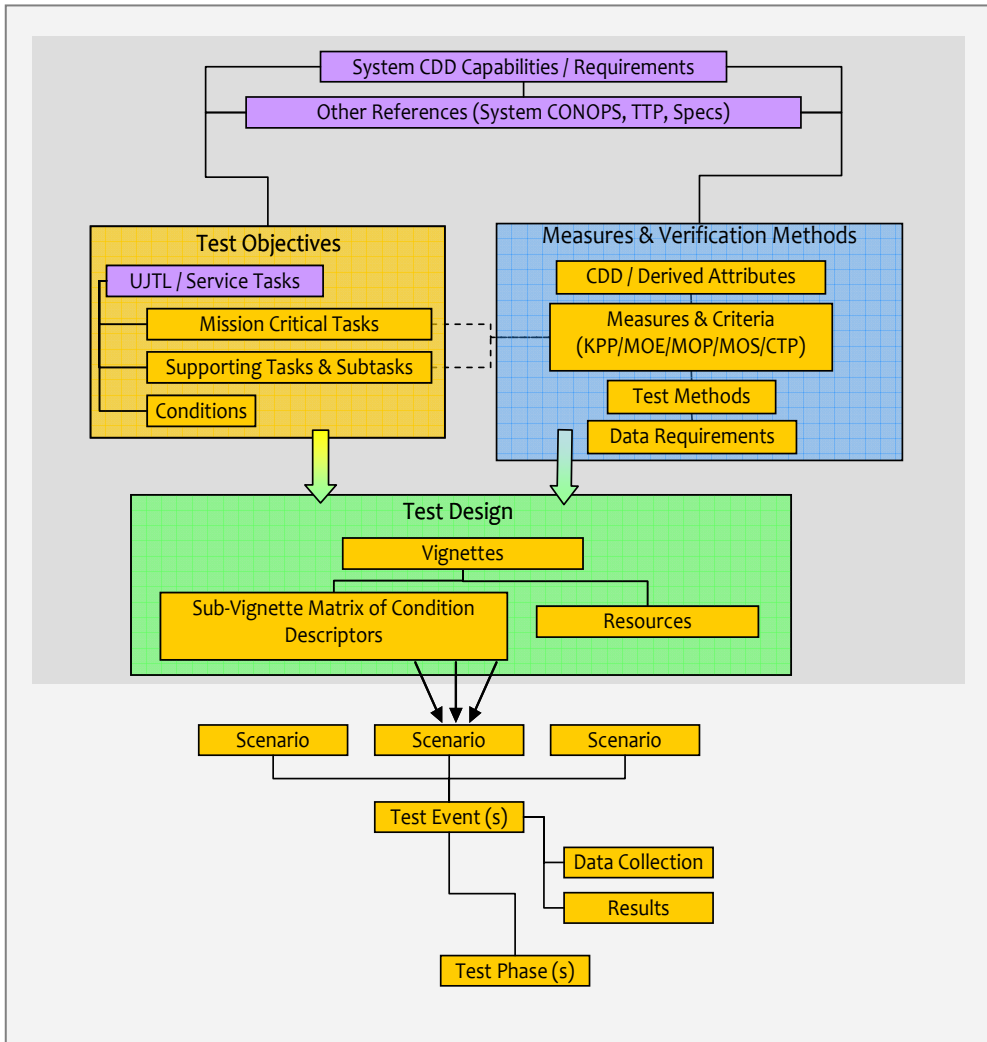
Total Platform/System Mission Context



Implications for complex system T&E

- Multiple, concurrent missions evaluated in complex scenarios

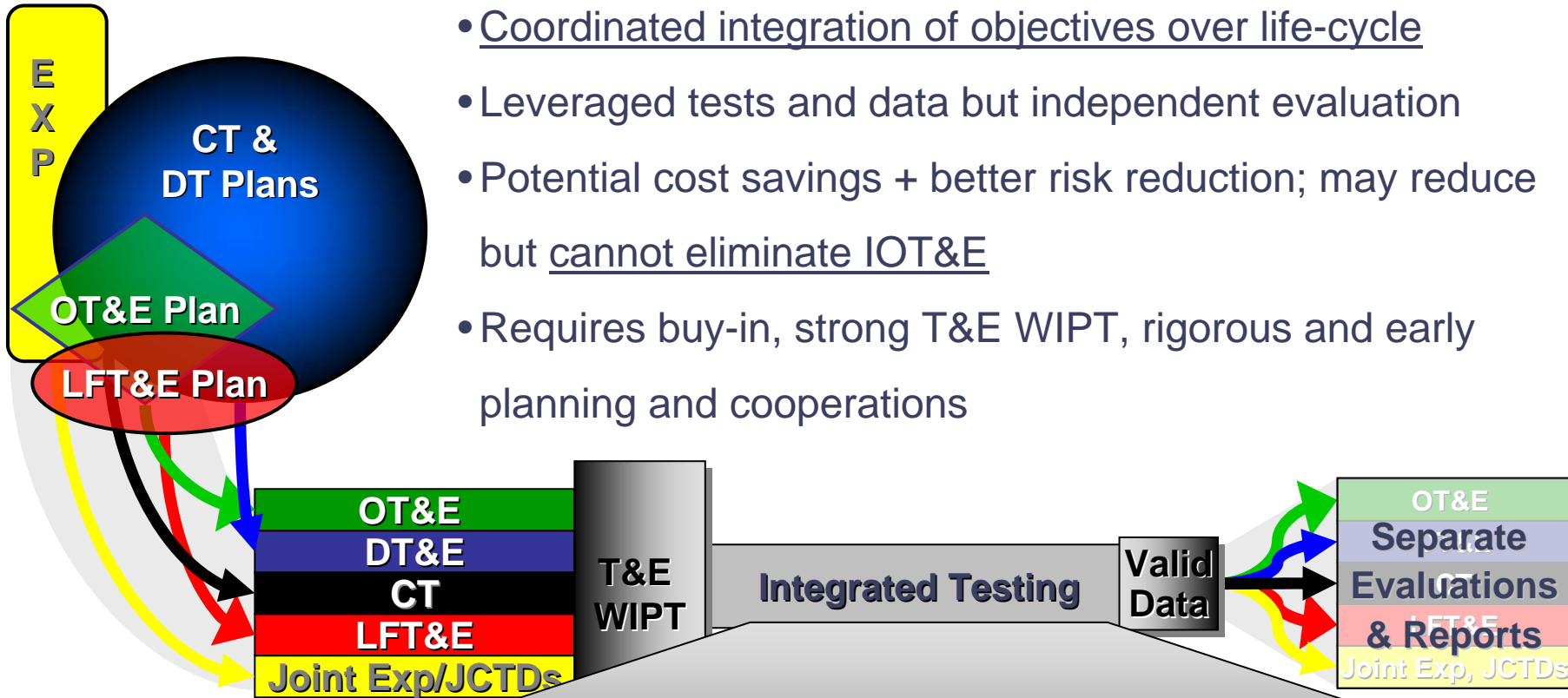
Mission Based Testing T&E Framework Toolset Architecture



- Describe discrete tasks to perform system missions in user's language
- Define conditions affecting task outcome
- Extract attributes & measures from requirements & other references; correlate to tasks
- Assign test methods & data requirements to measures
- Group tasks w/ conditions & measures into testable/meaningful vignettes
- Repeat vignettes to account for variability due to conditions and settings
- Test vignettes grouped into scenarios run during test events

Integrated Testing

- Planning and development of individual test objectives;
- Coordinated integration of objectives over life-cycle
- Leveraged tests and data but independent evaluation
- Potential cost savings + better risk reduction; may reduce but cannot eliminate IOT&E
- Requires buy-in, strong T&E WIPT, rigorous and early planning and cooperations



$$T\&E_{\text{integrated}} \int_{\text{Program Conception}}^{\text{System Disposal}} = f(\text{CT, DT, OT, LFT\&E, Joint Exp, M\&S, Analysis, etc.}) dt$$

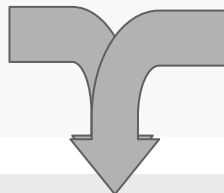
Integrated Testing

DT

- Test to specifications
- Limited test environment
- Focused on a specific set of criteria.
- Test threshold values not capability
- Critical technical parameters
- Integration testing designed around min performance criteria and interface specs.
- May not address all threats or missions.
- CT adds contractual issues

OT

- Operational environment & threat with end users & support
- End-to-end mission perf. & support
- Production representative; system/family of systems
- Test overall capability of an item to meet user's mission needs and value added for mission accomplishment.
- Test the limitations and capabilities of an item so that:
- Employ and assess doctrine/TTP
- Independent IOT&E & LFT&E mandates (Title X)

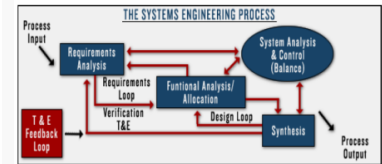
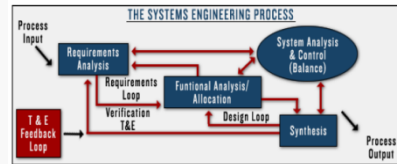
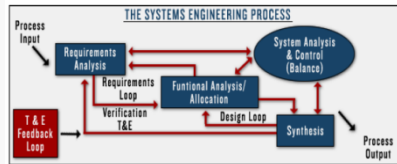
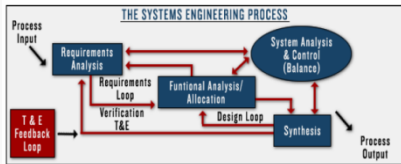


THIS MUST TRANSFORM INTO A CONTINUUM OF TESTING

- Increasing fidelity of technical and operational assessments
- Cooperating organizations
- Reduced budget and timeline ?
- Team/IPT structure not competitive



Systems Engineering + T&E within the Acquisition Cycle



Concept V&V
 Prototype Testing/Exp/Analysis

Component Testing
 Functional Arch V&V

Subsystem Testing
 Physical Arch V&V

System DT & OT
 Config Audits

Follow on OT
 Upgrade/Re-arch V&V

MORE THAN TESTING ... CONTINUOUS EVALUATION

RISK MANAGEMENT...

MISSION CAPABILITY DELIVERY...

INTEGRATED T&E & SYSTEMS ENGINEERING

Ability to influence system design

System maturity & design/ upgrade cost

Design of Experiments Process Overview

Project description and process decomposition

- Problem statement and objective of experiment (test)
- Response variables, and potential causal variables – Ishikawa fish bone.



Plan test matrix

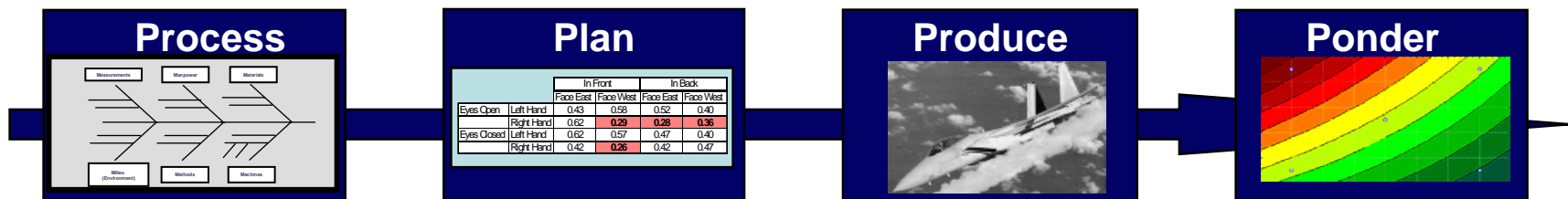
- Determine constraints, prioritize factors, and select statistical design (2^K vs. 3^K vs. mixed, Taguchi vs. classical arrays, full vs. fractional, non-linear effects?, replications?, blocking?)
- Write the test plan with sample matrices, profiles, and sample output; run sample analysis.

Produce observations

- Random run order & blocked against unknown effects
- Block runs to guard against uncontrollable unknown effects as needed.

Ponder the results

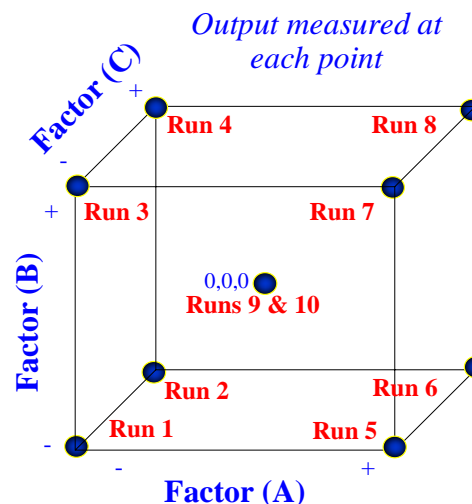
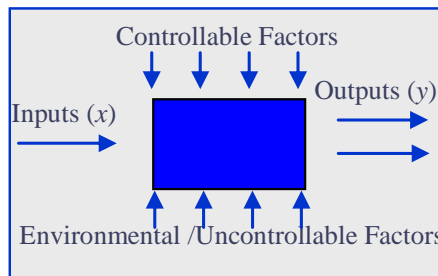
- Analyze and project data; draw conclusions, redesign test as necessary and assess results.
- Perform “salvo testing” (test-analyze-test); screen large # of factors then model



Design of Experiments Test Matrix Development

- Partial or full matrix of varying settings for the factors (usually 2 or sometimes 3 level)
- Perform larger matrices in increments, eliminating factors that are shown to be non-factors through analysis
- Goal is to determine cause of variability in output based on input factors

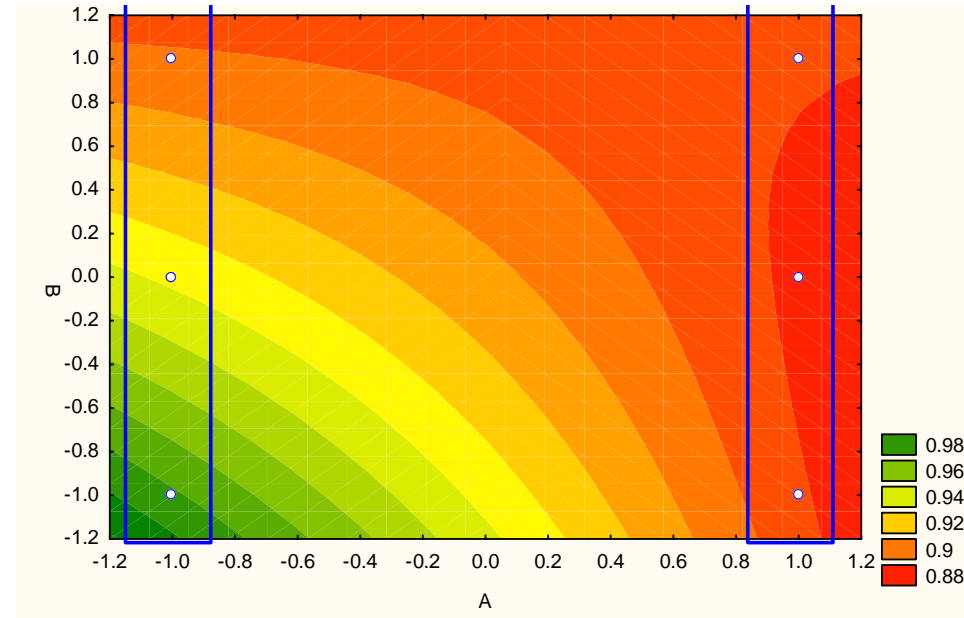
| Run | Setting | A | B | C |
|-----|-----------------|----|----|----|
| 1 | Factorial point | -1 | -1 | -1 |
| 2 | Factorial point | -1 | -1 | +1 |
| 3 | Factorial point | -1 | +1 | -1 |
| 4 | Factorial point | -1 | +1 | +1 |
| 5 | Factorial point | +1 | -1 | -1 |
| 6 | Factorial point | +1 | -1 | +1 |
| 7 | Factorial point | +1 | +1 | -1 |
| 8 | Factorial point | +1 | +1 | +1 |
| 9 | Center point 1 | 0 | 0 | 0 |
| 10 | Center point 2 | 0 | 0 | 0 |



Design of Experiments

Data Analysis

- Sample data analysis: produces regression model, predictions, response surface/curves as shown.
- Statistical analysis of the MOEs
- Exploration of mission performance variability across driving conditions



Design of Experiments Benefits

- Better way to design and test complex systems
- Systematically explores system performance, effectiveness, and suitability – breadth and depth of testing across the performance envelope
- Challenge assumptions and demonstrate real performance across the expected environment
- Better justification for sample sizes; potentially significant reduction from case or one factor at a time testing
- Better linkage between M&S and live test
- DOE works well in Mission Based Testing/Integrated Testing and relies on proper task derivation and attributes and conditions selection
- DOE can improve testing across all programs – it is simply smarter testing!



Conclusion

- Complex Systems
 - Complex Systems– detail vs. dynamic complexity
 - Holism
 - Emergence
- Structuring T&E to Validate Complex Systems
 - Understand program context and system mission context
 - Test early, test often...
 - Mission Based Test Design
 - Integrated Testing
 - CT + DT + OT + LFT + ...
 - Integrated testing and data collection
 - But...Independent evaluation
 - T&E as part of SE life-cycle
 - Design of Experiments
- Questions



NAV  AIR



AIR 5.3

THREAT/TARGET SYSTEMS

T&E

Gregg Van Splinter



DISTRIBUTION STATEMENT A. Approved for public release;
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Mission

OUR MISSION IS TO EMULATE THREATS FOR WEAPONS AND EW SYSTEMS, TEST AND EVALUATION AND TO SUPPORT EXPERIMENTATION AND FLEET TRAINING



UNDERSTANDING THE CRITICAL MASS
Generic/Surrogate/Validated/Replica/Actual
(Cost Effective Fidelity for T&E)

capabilities

Target Systems Engineering

Target systems technology development, acquisition support, systems integration, operations engineering, Els, LECs



Atlantic/Pacific Target & Marine Operations

World wide surface and airborne target and marine operational services including unique mods and augmentation



Threat/Target Systems Management

Provides entry point for Sponsors to form integrated project offices, and externally directed project offices



Airborne Threat Simulation

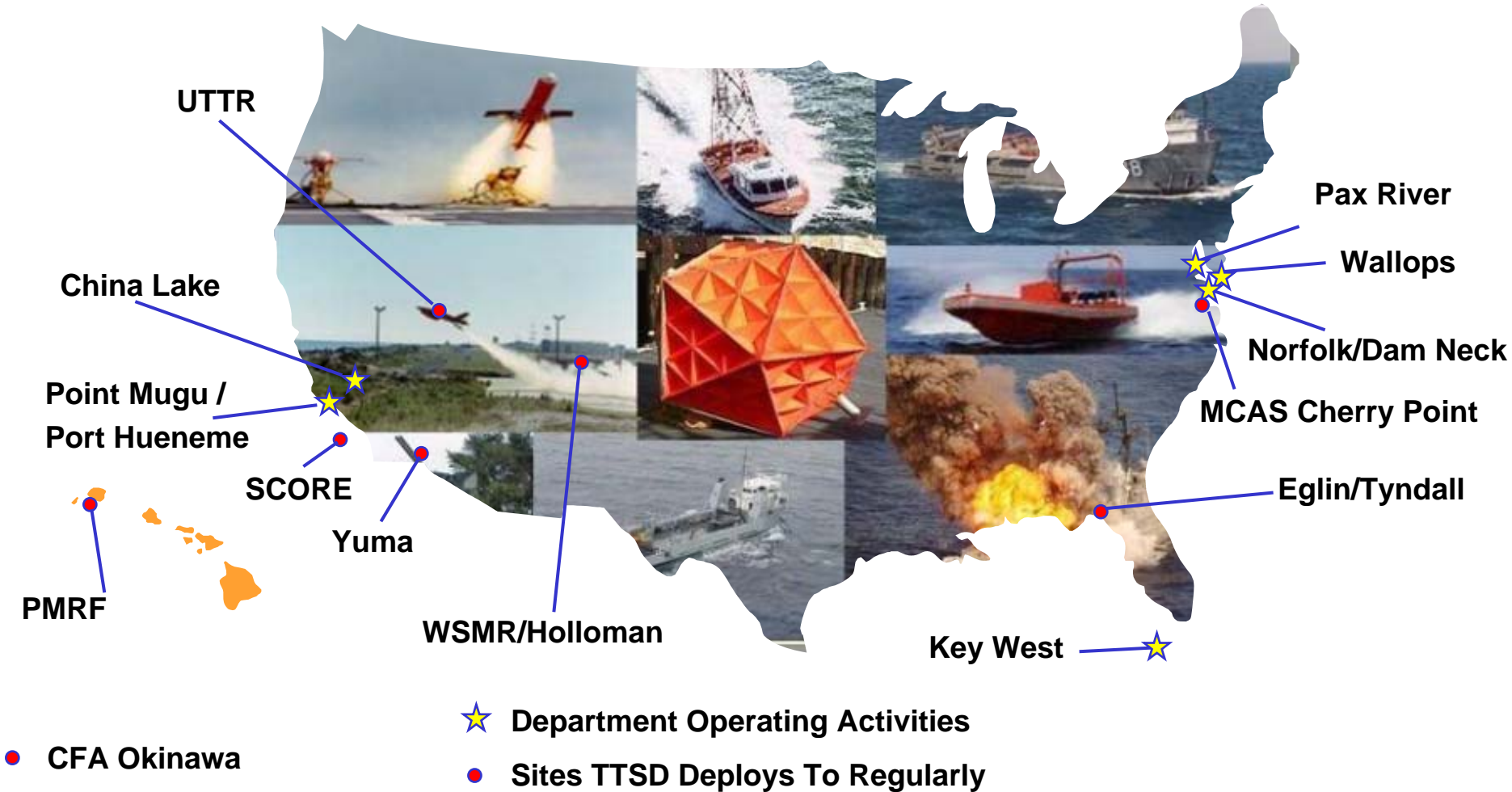
Design development and operational support of electronic attack and radar airborne threat emitter systems



Combat Environment Threat Simulation

Development and technical support of EO/IR/MW/UV/Laser/C4I threat simulator systems

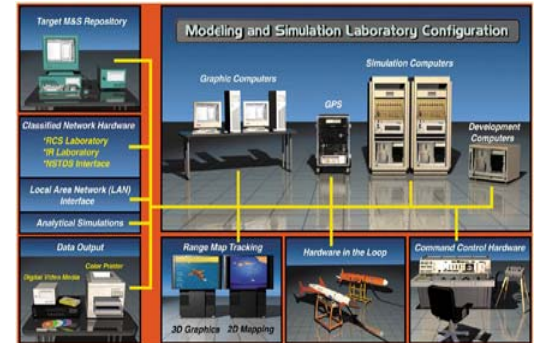
TTSD Operating Sites



Target Systems Division



- PROVIDES THE PEOPLE, PROCESSES, FACILITIES, AND EQUIPMENT NECESSARY TO:
 - EXECUTE TARGET SYSTEM TECHNOLOGY DEVELOPMENT
 - SYSTEMS ACQUISITION
 - SYSTEMS INTEGRATION
 - IN-SERVICE OPERATIONAL ENGINEERING
 - TARGET/DECOY SYSTEMS USE FOR TEST AND EVALUATION OF NAVY ACQUISITION PROGRAMS, FLEET OPERATIONS, AND TRAINING
 - TASKS ASSOCIATED WITH THE PREPARATION OF TEST INVENTORY TARGETS FOR SPECIFIC TEST PURPOSES



Target Systems Products

New Target System Acquisition Support



- Target Free Flight Clearance



- Modeling & Simulation Laboratory



- Scoring System Engineering



- Target Test Planning



- Target Engineering Investigation



Aerial Targets

Supersonic



AQM-37C



GQM-163A

Subsonic



BQM-34S



BQM-74E

Decoys



TALD

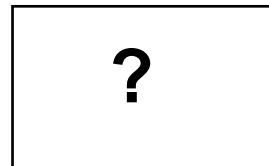


ITALD

Developmental



MSST
(IOC FY13)



SSAT (IOC FY12-13)



ATALD
(Currently unfunded)

Surface Targets Team



- Provide seaborne target services to the Fleet ,DoD, and Foreign Military Customers in support of weapon system T&E and Fleet Training
- US Navy Cognizant Field Activity for Seaborne Targets and augmentation systems
 - DEVELOPMENT
 - T&E
 - IN SERVICE ENGINEERING/DEPOT
 - INTEGRATED LOGISTICS SUPPORT
 - SUPPORT TO OTHER OPERATING ACTIVITIES
- Tri-Service Lead for development and operation of Seaborne Targets

Fast Attack Craft Target (FACT)

■ Requirement

- Threat-representative, open-ocean performance craft
 - 50+ feet
 - 50+ Knots - Sea State 2
- Capable of hi-speed towing



■ Development

- Two prototypes with different hull designs and propulsion systems were developed and evaluated under remote control
- One design was determined to be more threat-representative and to have superior handling qualities

Fast Attack Craft Target (FACT)

**FACT is now in production
and is operational
at NAWCWD**



Seaborne Powered Targets



Powered Surface Targets

QST-35



High Speed Maneuvering Surface Target (HSMST)



Ship Deployable Surface Target (SDST)



Aerial Target Launch Ship (ATLS)

- POWERED SURFACE TARGETS
- POWERED SURFACE TARGETS – UNIQUE HULLS
- UNMANNED SURFACE VESSELS



Coastal Patrol Interdiction Craft (CPIC)



Unmanned Surface Sea Vessel (USSV)



Mobile Ship Target (MST)

Non-Powered Surface Targets



Improved Surface Tow Target (ISTT)



High Speed Anti-Radiation Missile (HARM) Barge



Low Cost Tow Target (LCTT)



Low Cost Modular Target (LCMT)



Trimaran

Target Operations Division



- PROVIDES THE RESOURCES TO PROVIDE TARGET OPERATIONAL SERVICES FOR WEAPON SYSTEM AND TARGET DEVELOPMENT, TEST AND EVALUATION, FLEET OPERATIONS, AND FLEET TRAINING



Target Ops FY07/FY08



- EAST COAST:
 - 562 SURFACE EVENTS (2,700+ MISSION HOURS)(FY07)
 - 875 SURFACE EVENTS (FY08 NORFOLK)
 - 264 SURFACE EVENTS (FY08 PAX RIVER)
 - 46 AERIAL TARGET LAUNCHES (FEB 08)

- WEST COAST
 - 945 SURFACE EVENTS (FY07)
 - 151 AERIAL TARGET LAUNCHES (FY07)
 - ~892 SURFACE EVENTS TO DATE (FY08)
 - ~168 AERIAL TARGET LAUNCHES (FY08)



Atlantic Targets and Marine Operations Division

NAV  AIR



- ON-SCENE RANGE SAFETY SURVEILLANCE AND CLEARANCE OF THE CHESAPEAKE BAY TEST RANGE, THE ATLANTIC WARNING AREAS AND OTHER OPEN WATER AREAS
- SURFACE (STANDARD NAVY TARGETS AND FULL SCALE TARGET HULKS), LAND, AND AERIAL TARGETS FOR TEST AND TRAINING OPERATIONS
- DESIGNS AND FABRICATES PROTOTYPE TARGETS TO MEET UNIQUE CUSTOMER SPECIFICATIONS
- OPERATES AND MAINTAINS MARINE SURFACE VESSELS TO SUPPORT TESTING AND TRAINING
- PROVIDES UNDERWATER AND LAND TEST ARTICLE RECOVERY OPERATIONS



Support Vessels

NAV  AIR



- Navy MkIII 65ft Patrol Boat 777
- Navy Transporter and Retriever (100 ft)
- Hurricane 23ft Rib Boat
- Fountain
- Navy Prince
- NAVAIR-38 (Key West)



Support Vessels

Narragansett



Hugo



Hunter



Weapons Effect Testing

NAV  AIR



LPD-19 Shock Test

NAV  AIR



Ex-USS Oriskany Reefing

NAV  AIR

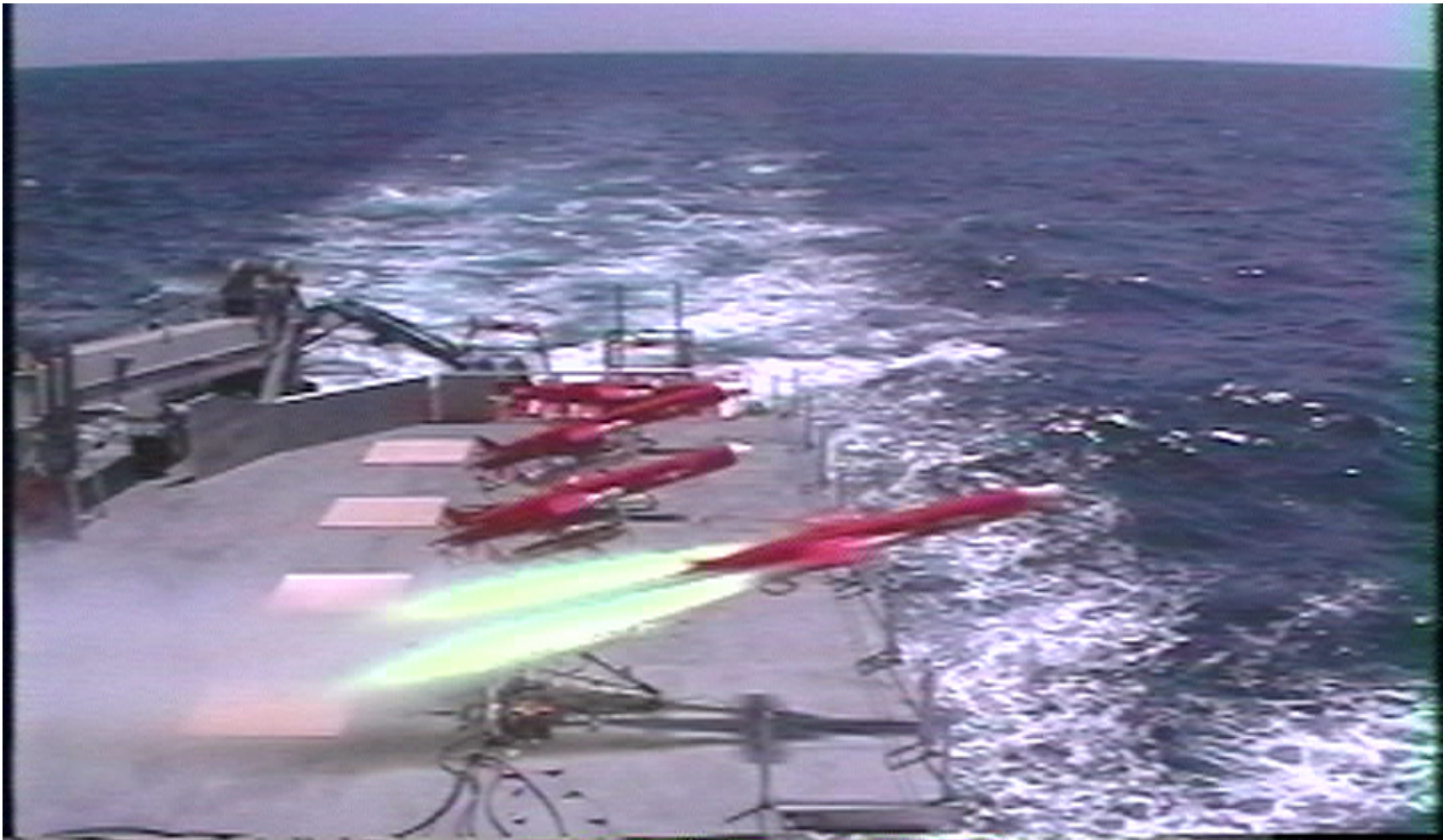


Mobile Launch Platform

NAV  AIR



BQM-74 Sea Launch Capability





Airborne Threat Simulation Division

NAV  AIR



NAV  AIR 

"ATSO: Providing the warfighter with highly representative, validated, timely, and affordable threat electronic-combat environments in which to test and train."





Electronic Attack and Active Emitter

NAV  AIR



- Electronic Attack (EA) Simulators
 - Simulation of jammer systems associated with both manned aircraft and cruise missiles
- Threat Radar Simulators
 - Transmitted Signal Simulators (Stimulators)
 - Manned Aircraft
 - Anti-Ship Cruise Missiles
 - Ground Based SAM, AAA
 - Full-up Seeker Simulators
 - Anti-Ship Cruise Missiles





ATSO Airborne Electronic Attack

NAV  AIR



- Weapons System Development
- DT&E
- OT&E





Airborne Electronic Attack AN/ALQ-167(V)

NAV  AIR



- AN/ALQ-167(V) is an advanced airborne electronic attack simulator pod developed for weapon system T&E and Fleet training
 - The “Have All” system can replicate several families of current and projected threat jammer systems
 - The system is based on the AN/ULQ-21(V) countermeasures set



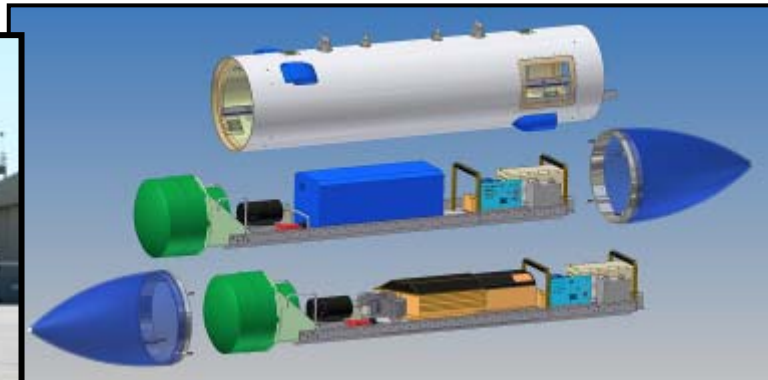
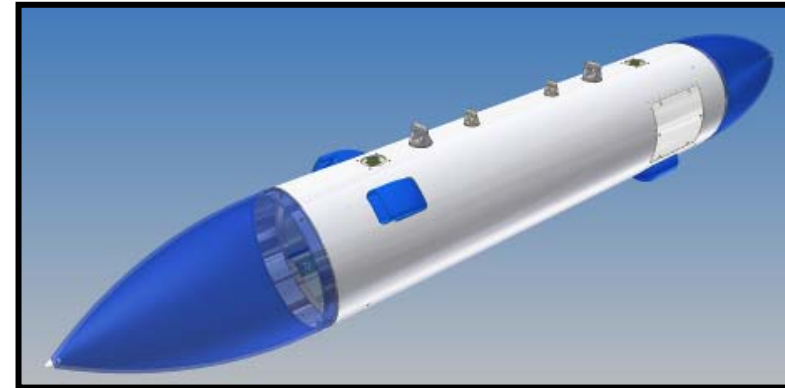


Airborne Radar Simulation AN/AST-9(V)

NAV  AIR



- AN/AST-9(V) is an advanced supersonic airborne radar simulator pod developed for weapon system T&E and Fleet training.
- The configurable AST-9 simulates airborne radar and anti-ship cruise missile systems using high power traveling wave tube and magnetron transmitters.

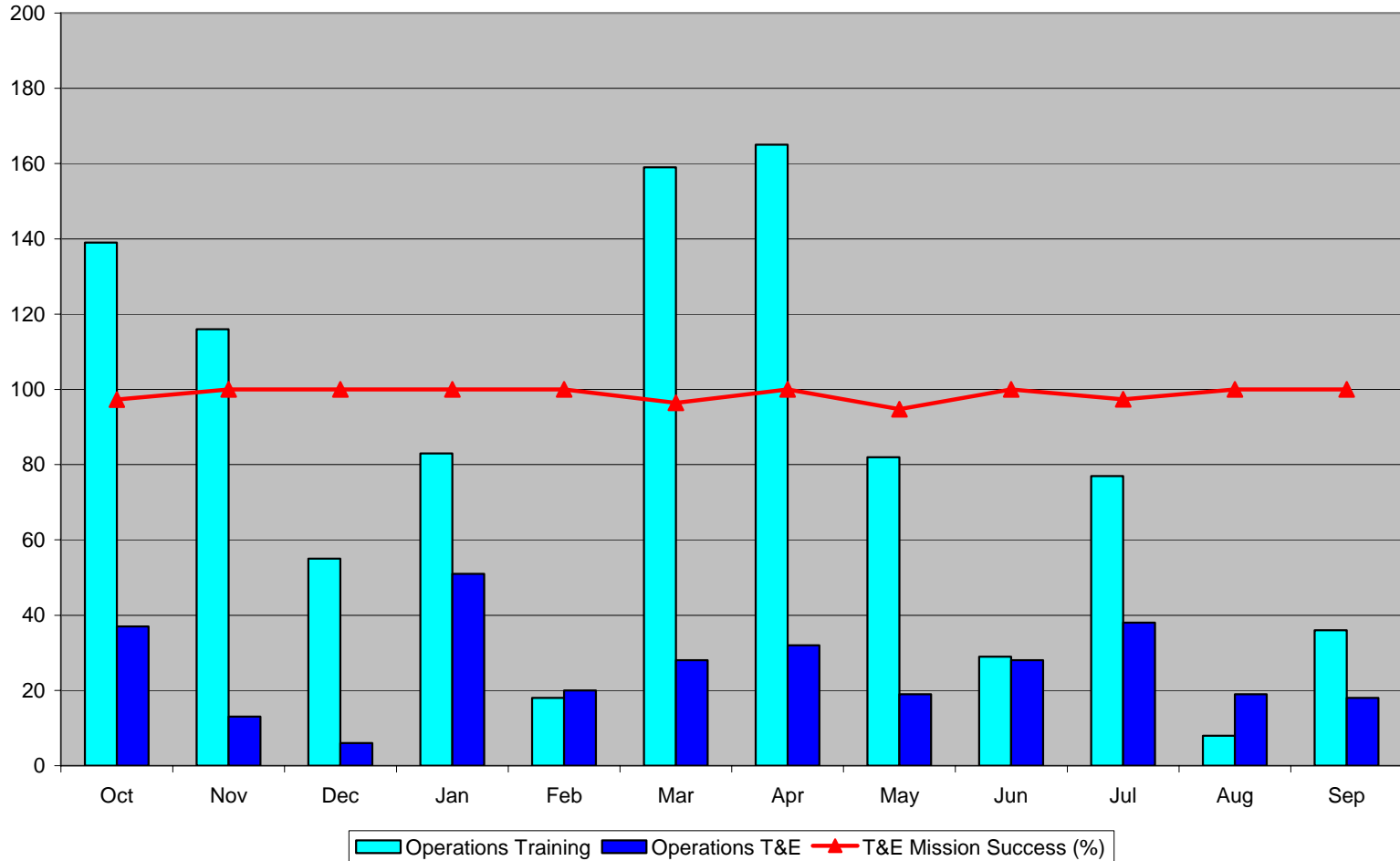




ATSO FY08 Operations Supported



ATSO FY-08 Monthly Operational Support Snapshot





Ground/Emitter Lite

NAV  AIR



- **Low/High Power Transmitter Options:**
 - Emitter Lite (DPT-2B)**
 - Emitter Lite (UPT-2A)**





Advanced Ground Target Threat Systems (AGTTS)



+

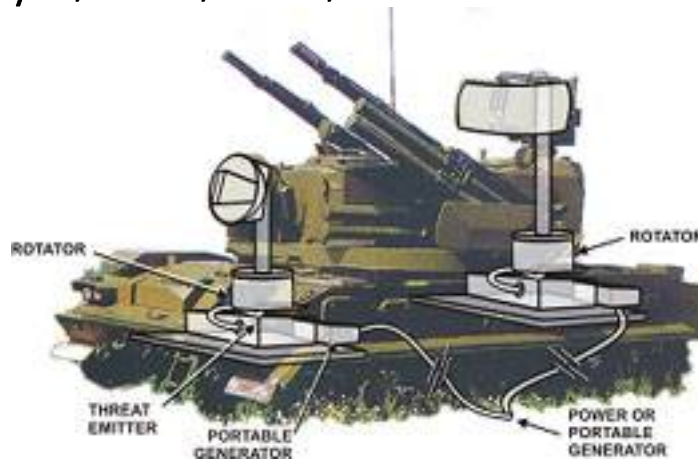


Plastic Target

- Realistic Shape, Size, RCS, Visual

Dual Emitters Track and Search Realistic Emitter Waveforms

=



Design Concept

- One Integrated Multi-Spectral System

Combat Environment Simulation Division



- THREAT SIMULATORS-RF, IR, UV FOR T&E RANGES SUCH AS ECR AT CHINA LAKE.
 - DEVELOPMENT
 - ACQUISITION
 - T&E
 - VALIDATION DOCUMENTATION
- ELECTRONIC WARFARE SYSTEMS FOR THE MAJOR DON AIRCREW TACTICAL TRAINING RANGES.
 - DEVELOPMENT
 - ACQUISITION
 - INTEGRATION
 - UPGRADES
- NAVY THREAT / SIMULATOR VALIDATION PROGRAM COORDINATION
 - INDEPENDENT OF DEVEL OFFICES/JOINT VAL MEMBER
 - DEVELOP AND MAINTAIN VALIDATION PROCEDURES
 - REVIEW VALIDATION REPORTS
 - MAINTAIN DATABASE AND SCHEDULES



CESD Test And Evaluation



- Open Air Range Threat Simulation
 - RF, MMW, IR, EO, UV
- Joint Asymmetric Warfare Systems (JAWS)
 - DT / OT / TAC D&E Testing, Training, and Tactics
- IR Simulator and Target Array (ISTAR)
- Advanced Threat Simulator System (ATSS)
- Sustainment Management Office for GPS

JAWS' Unique Support Cycle



Provides ASE and Training Requirements for...



• Warfighter Fleet Support

- ASE Readiness Flightline Checks
- MANPAD Tactics and Training
- Warfighter Response Center
- UUNS, JCAT, SAFIRE SMEs

Provides vetted Data, Tactics, SOPs, and Crisis Response for...



Develops Threats and Scientific Expertise for...

• DT / OT / TAC D&E Test & Evaluation

- DT / OT Testing at NAWC-WD (VX-9)
- TAC D&E at NSAWC and MAWTS-1
- OPFOR Training at MAWTS-1, NSAWC
- M & S for TSPIL and H-1 WSSA

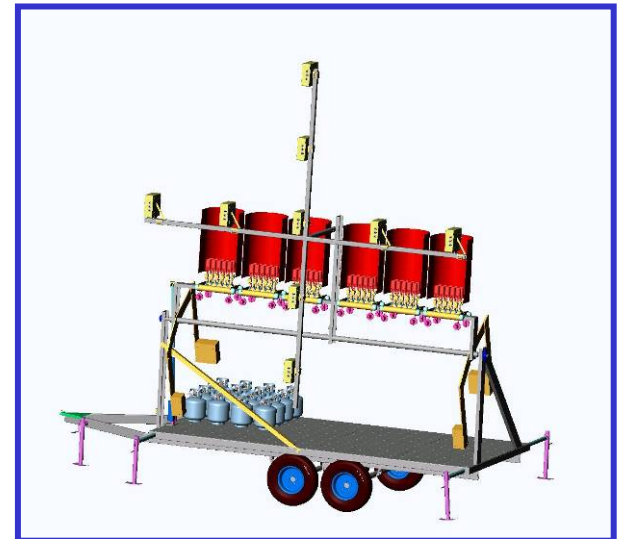
- Tactics Development & Training
 - Tactics Optimization & Training
 - Mission Planning and Analysis
 - NATOPS / NATEC Documentation
 - Support ADT&L at MAWTS-1



Provides IRCM & ASE Effectiveness Data for...

IR Stimulator and Target Array

- Tactical Aircraft Programs Are Developing Advanced Systems That Detect, Target, and/or Counter Threats in the Infrared and Electro-Optical Spectra
- Open-Air, End to End, Closed Loop Test Capabilities Required
- CES Developed End to End IRCM Test and Evaluation Capabilities
 - IR, UV, and Laser Simulation (MWS & DIRCM Tracker)
 - Jam-Beam Radiometry
 - Actual Passive Threat Missile Seekers (Guidance Electronics)
 - Missile Fly-out Models (Miss Distance)
 - Real-Time Atmospheric (Environmental Effects)
 - Real-Time IR Scenes (Target, CM, Environment)
 - Missile Closure / End-Game Evaluation
 - TSPI and Multi-Spectral Ground Truth



Open Air Range Threat Simulation

IR/UV Test Capability



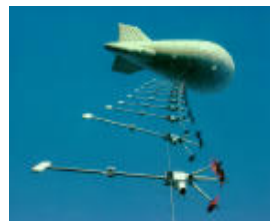
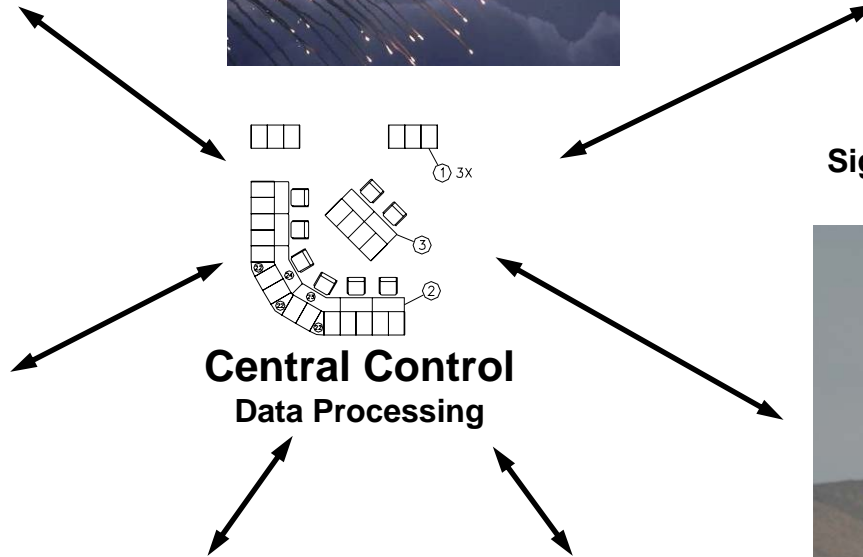
**Mallinas
(UV Plume
Simulator)**



**OAR SPIL
Open Air Range
Signal Processor in the Loop**



**ISTAR
(IR Plume Simulator)**



Atmospherics



Ground Truth



**FFM
(Seeker Test Van)**

EW Live Threat Training

- CESD is the major field activity for acquisition and development of the RED Force Surface to Air / IADS threats for DON major TTR's.



**AN/GPQ-11
Fallon, NV**



Land-Based Targets

- Target Mold Prototype & Manufacture
 - 3D, 2D, cold air inflatable
 - Copper cladded
 - Trailer mounted
 - Active Emitters Integrated



Examples of Current/Future Focus Areas

- Seaborne target swarm capability for Fleet training
- VBSS support to Navy, Coast Guard, Home Land Security
- Advanced Ground Target Threat System/Land Target Development
- Acquisition support and T&E of SSAT (BQM-74E replacement)
- Acquisition support and T&E of MSST
- Future testing of Hi Diver variant of SSST



Threat/Target Systems Department Summary



- T/TSD has tremendous operations and engineering capability
- We operate wherever the customer needs us
- We are committed to constant improvement
- The Military Value of our products and services is recognized by our Navy, DoD and FMS Customers
- We see many opportunities
 - Target Operations World Wide
 - New Target Developments
 - Homeland Security exercise scenario support

QUESTIONS?



America's Incredible, Shrinking, Aging, Less Ready, More Expensive Armed Forces

Winslow T. Wheeler
Center for Defense Information
Wheeler@CDI.org

The talent, judgment, and insight collected in this book are phenomenal. Over the last generation, the authors have been more right, more often, about more issues of crucial importance to American security than any other group I can think of. It is a tremendous benefit to have their views collected in one place and concentrated on the next big choices facing a new administration. This really is a book that every serious-minded citizen should read.

James Fallows, National Correspondent, *The Atlantic Monthly*

Mr. President, you know the national economy is in a shambles. But you probably don't know the national defense is, too, according to a must read book, "America's Defense Meltdown."

George C. Wilson, former chief military correspondent, *The Washington Post*

The next big American implosion, comparable to the meltdown of our financial system, is likely to occur in the Pentagon and the military-industrial complex. For decades we have been going deeply into debt buying weapons that we don't need and don't work. Winslow Wheeler and his uniformed and civilian defense experts are the best informed analysts of military preparedness and procurement we have. They paint a picture of totally broken and dysfunctional military institutions that are simply waiting for the slightest push to send them over the edge. This book should be indispensable reading for the next president and his defense advisers.

Chalmers Johnson, author of *Blowback* (2000), *The Sorrows of Empire* (2004), and *Nemesis: The Last Days of the American Republic* (2006)

These authors have been forcing defense analysts to rethink their positions for years. While you may not agree with all they say, I can guarantee they will force you to reconsider how America will insure its future.

Col. Thomas X. Hammes (U.S. Marine Corps, ret.),
author of *The Sling and The Stone*

Winslow T. Wheeler is Director of the Straus Military Reform Project at the Center for Defense Information.

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Wheeler

AMERICA'S DEFENSE MELTDOWN



AMERICA'S DEFENSE MELTDOWN



Pentagon Reform for President Obama and the New Congress



Thirteen non-partisan Pentagon insiders, retired military officers
and defense specialists speak out

Edited by Winslow T. Wheeler

Mis-Measuring the “Defense” Budget

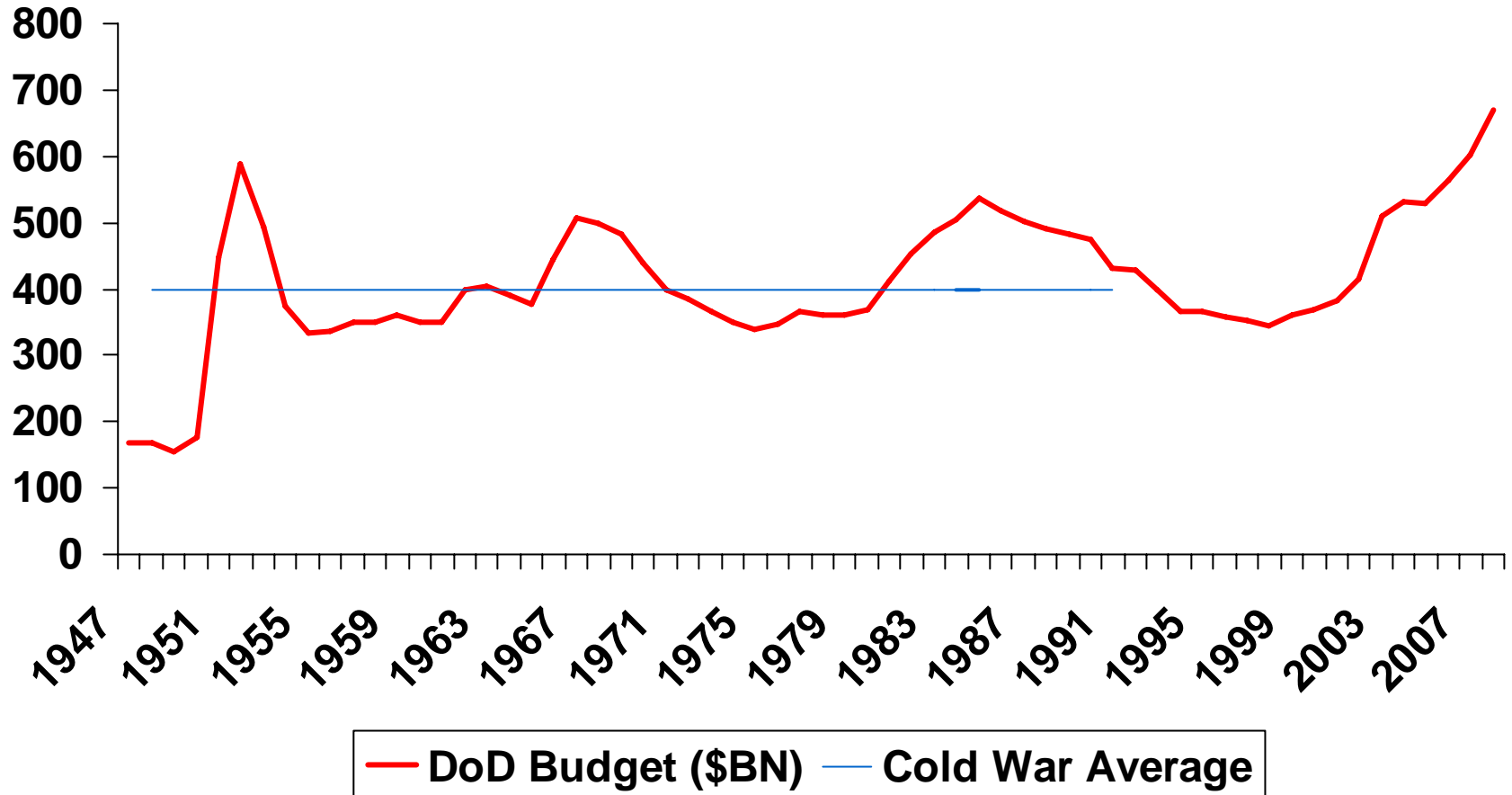
What Is the “Defense” Budget?

| Category | FY 2009 (Request) |
|--|----------------------|
| DOD (“Base”) | 518 |
| DOD War Funding | 70 + 87 |
| “Atomic Energy Defense Activities” (DOE) | 17 |
| “Defense Related Activities” (GSA, etc.) | 3 |
| Total “National Defense” | 698 |
| Homeland Security (DHS) | 40 |
| Veterans Affairs (DVA) | 91 |
| International Affairs | 38 |
| Non-DOD Military Retirement | 12 |
| 21% of Interest on the Debt | 54 |
| Grand Total | 934 |

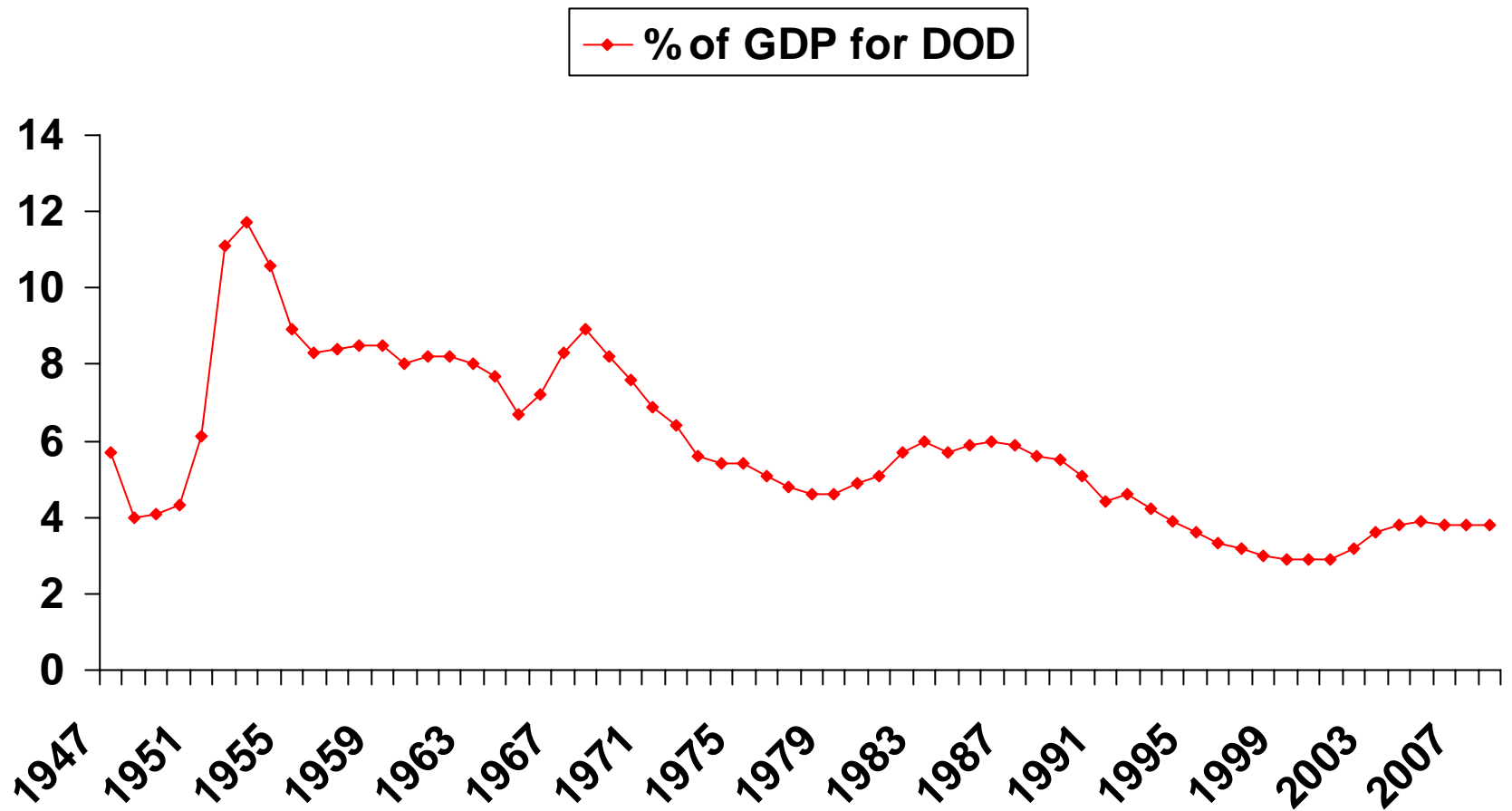
DOD Budget 1947-2008

(\$Billions, 2008\$)

Source: National Defense Budget Estimates for FY 2009, Office of the Under Secretary of Defense (Comptroller) March 2008

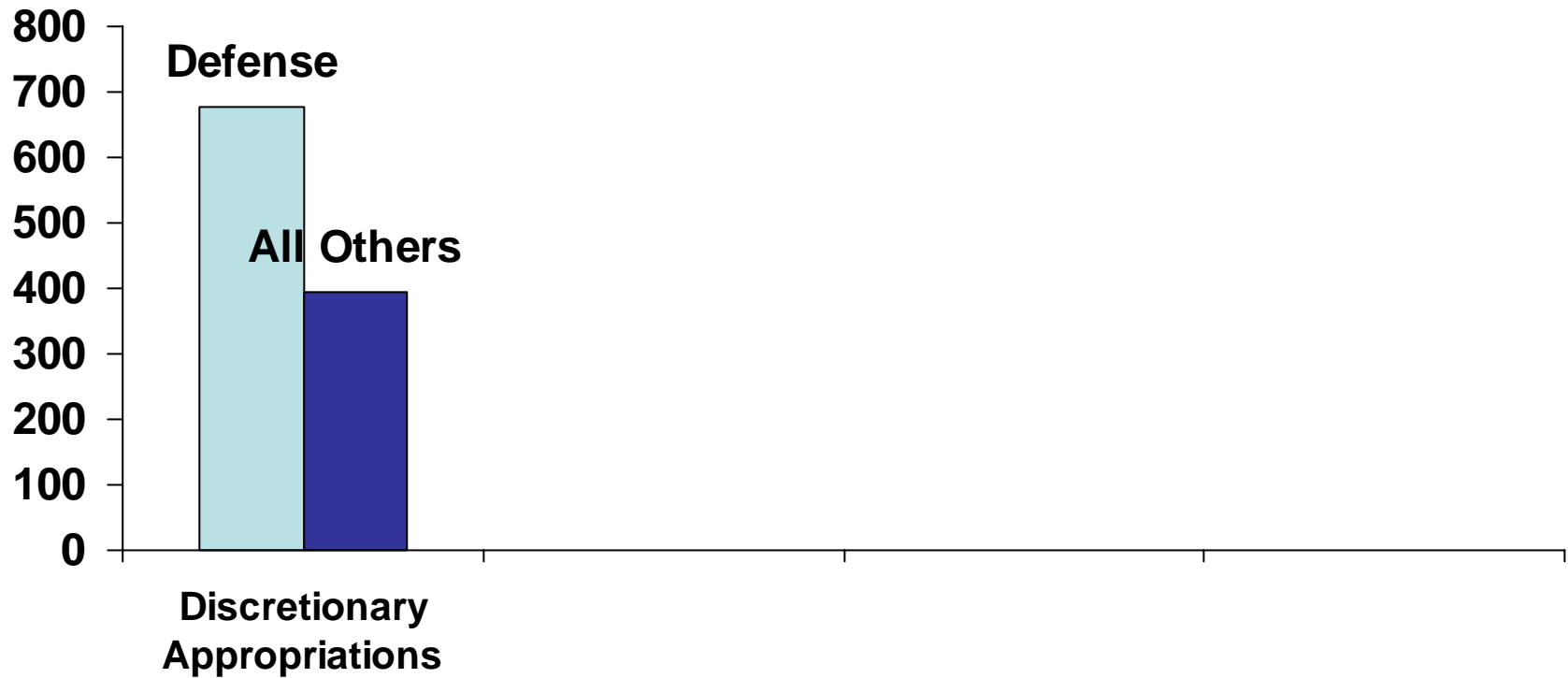


Mis-Measurement a la Conservatives



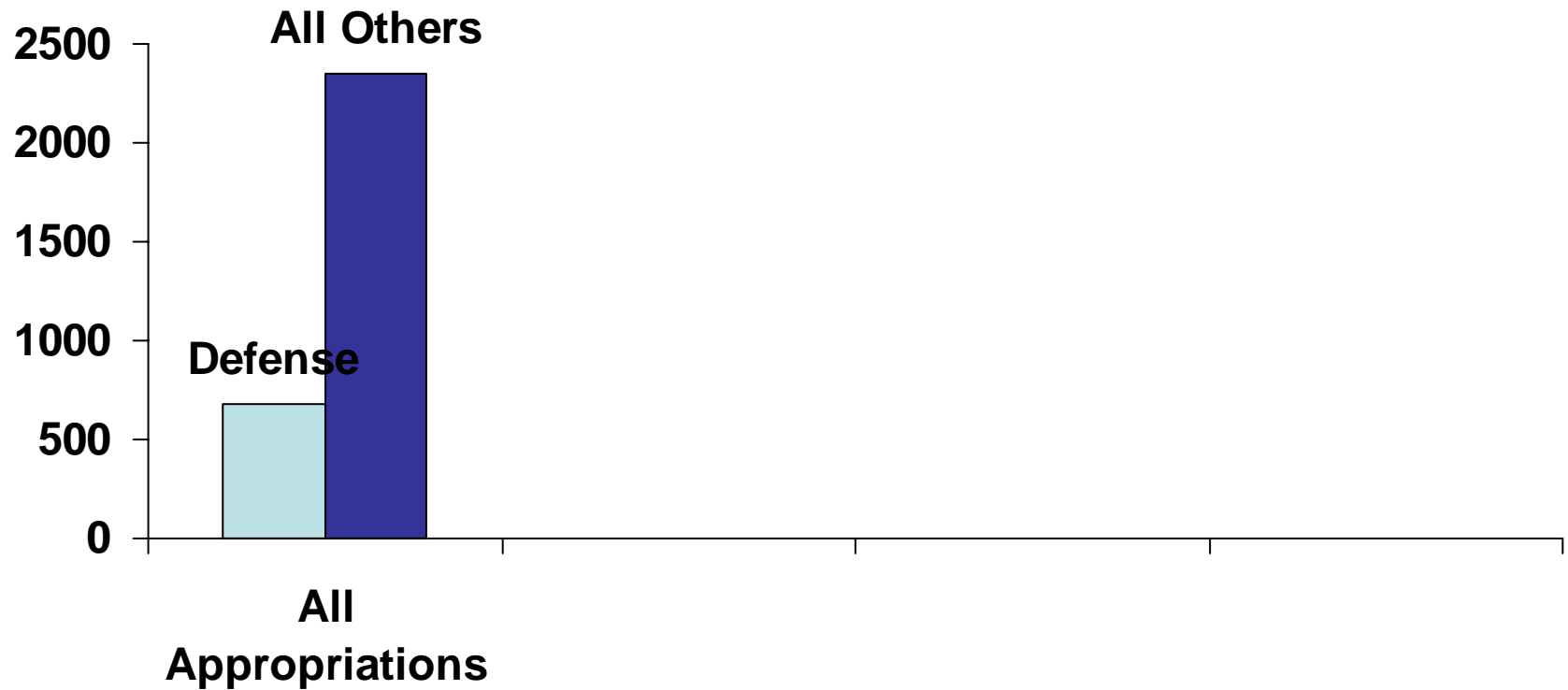
Mis-Measurement a la Liberals

Defense Spending v. Others



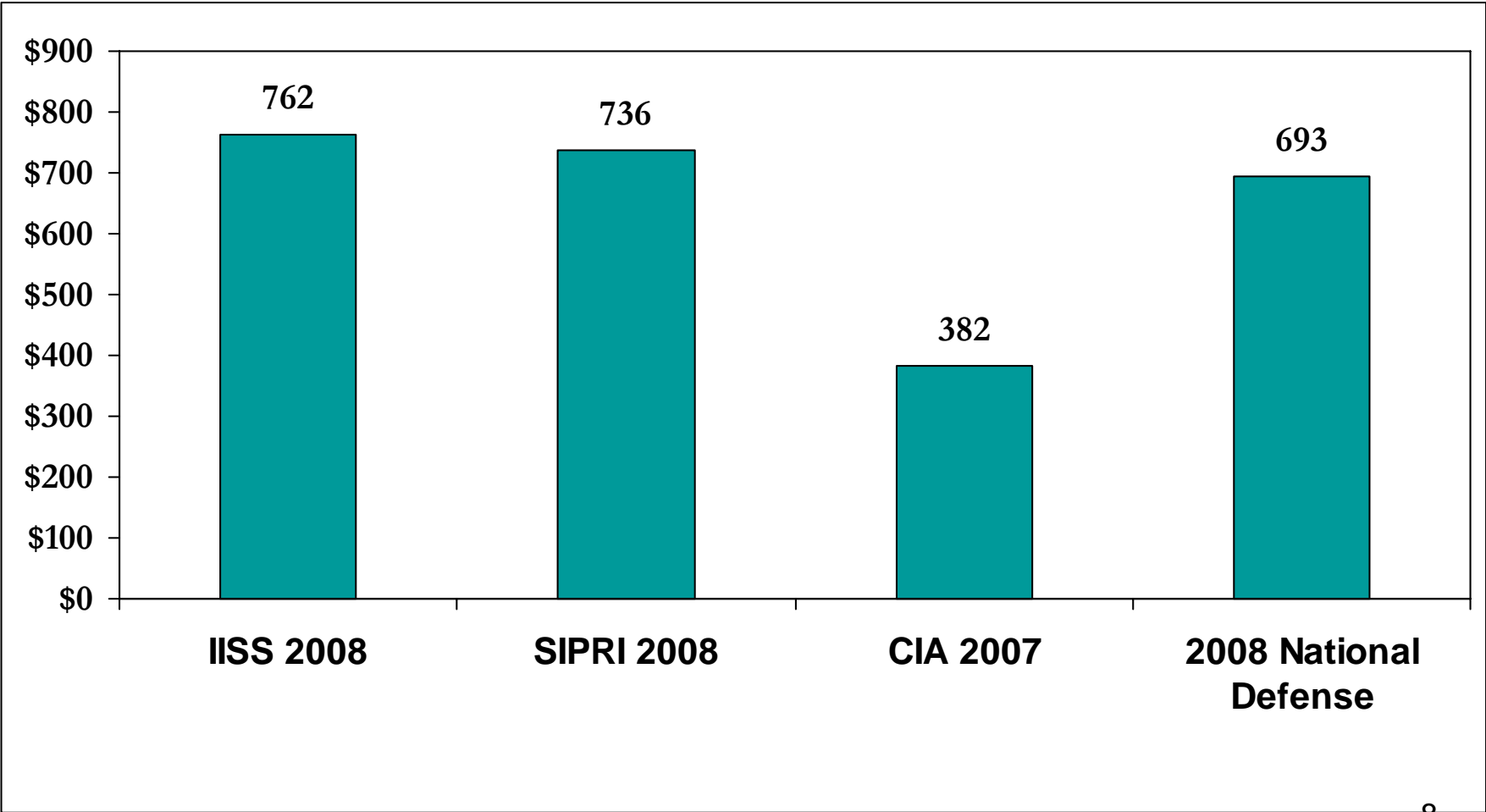
Mis-Measurement a la Liberals

Defense Spending v. Others



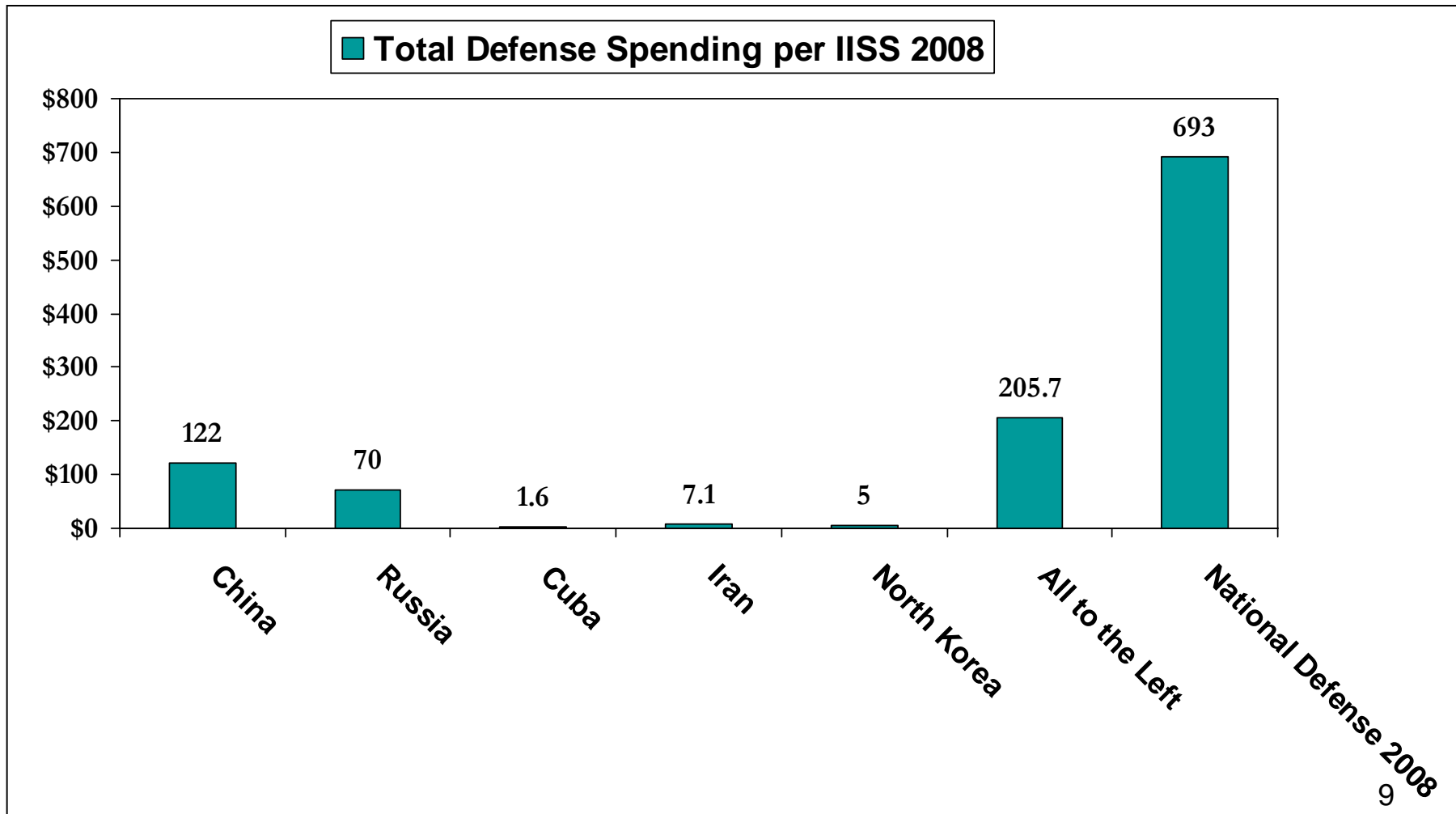
United States vs. the World

(\$ Billions)



US vs. China, Russia, Cuba, Iran, North Korea

(\$ Billions, 2009 Dollars)

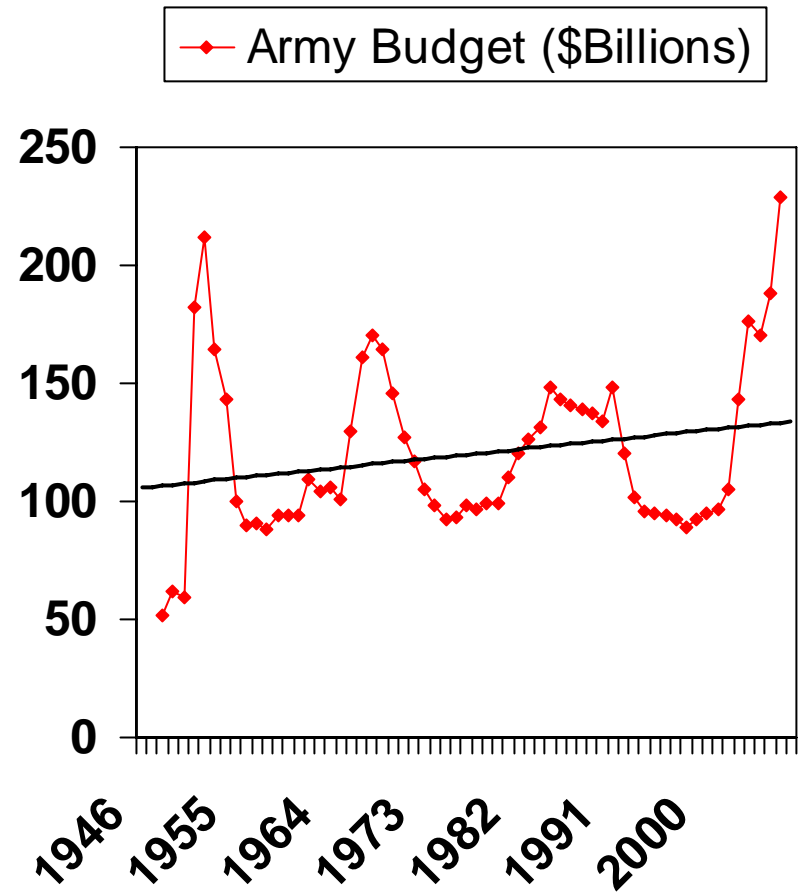
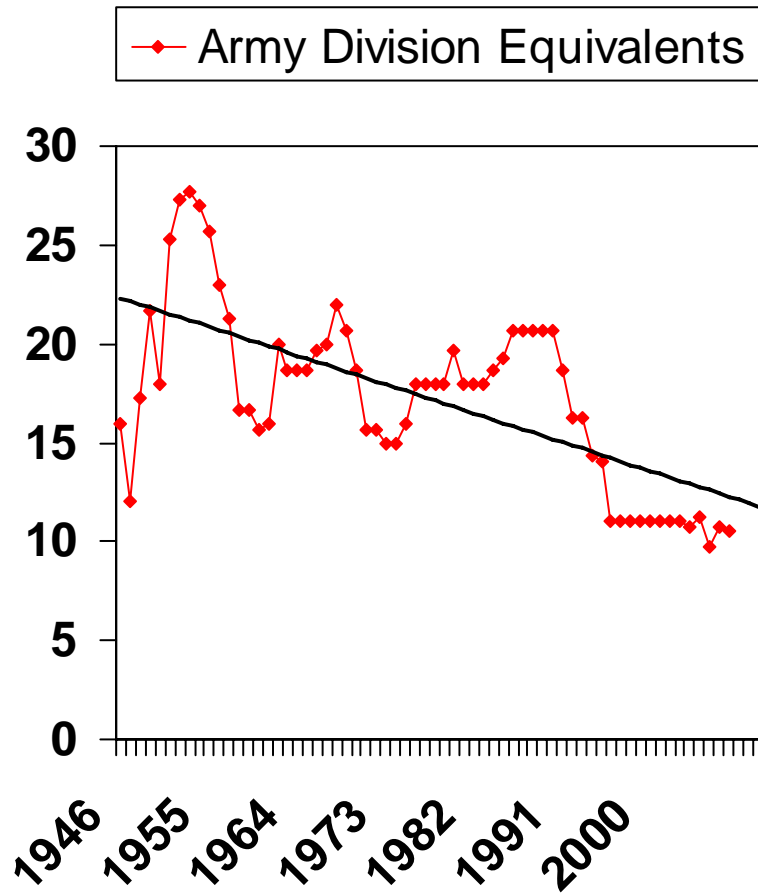


More Money Buys a Smaller Force

Army Division Equivalents and Budget

(\$Billions, FY 2009 Dollars)

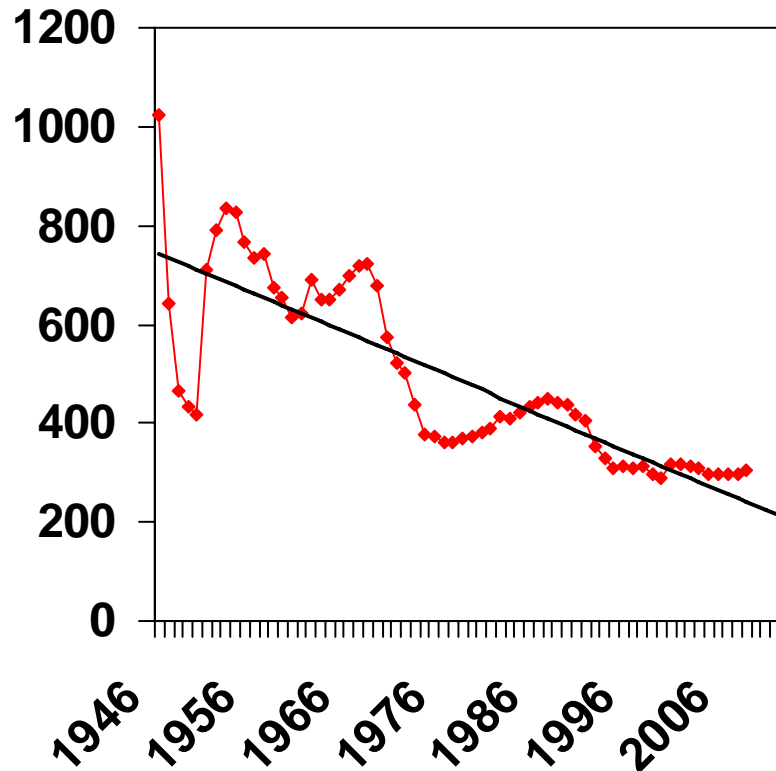
Sources: National Defense Budget Estimates for FY 2009, Office of the Under Secretary of Defense (Comptroller) March 2008, Center of Military History, Historical Perspective on Force Structure Reductions 1946-1988, Washington, D.C. 1989, Department of Defense Annual Reports, and Department of Defense Appropriations Bill Reports from the House Committee on Appropriations.



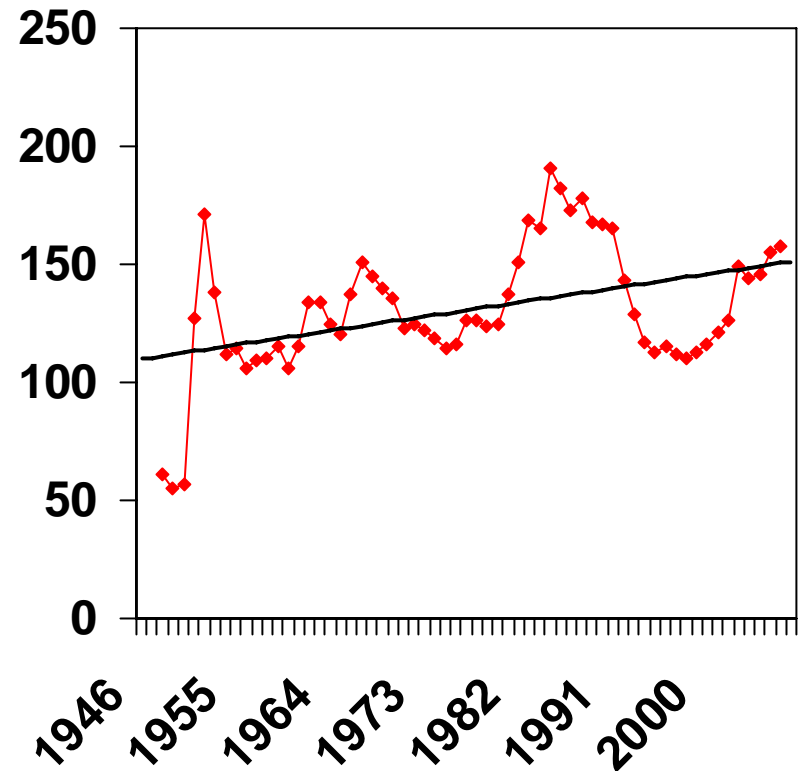
Navy Combat Ships and Budget

(\$Billions, FY 2009 Dollars)

Sources: National Defense Budget Estimates for FY 2009, Office of the Under Secretary of Defense (Comptroller) March 2008



Active Navy Combat Ships

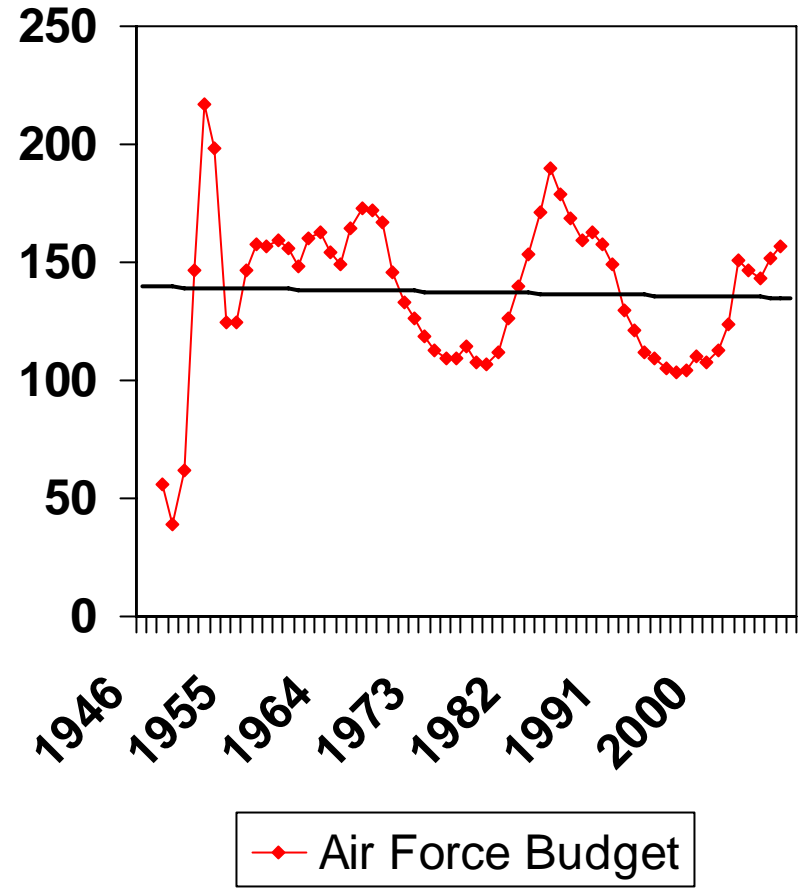
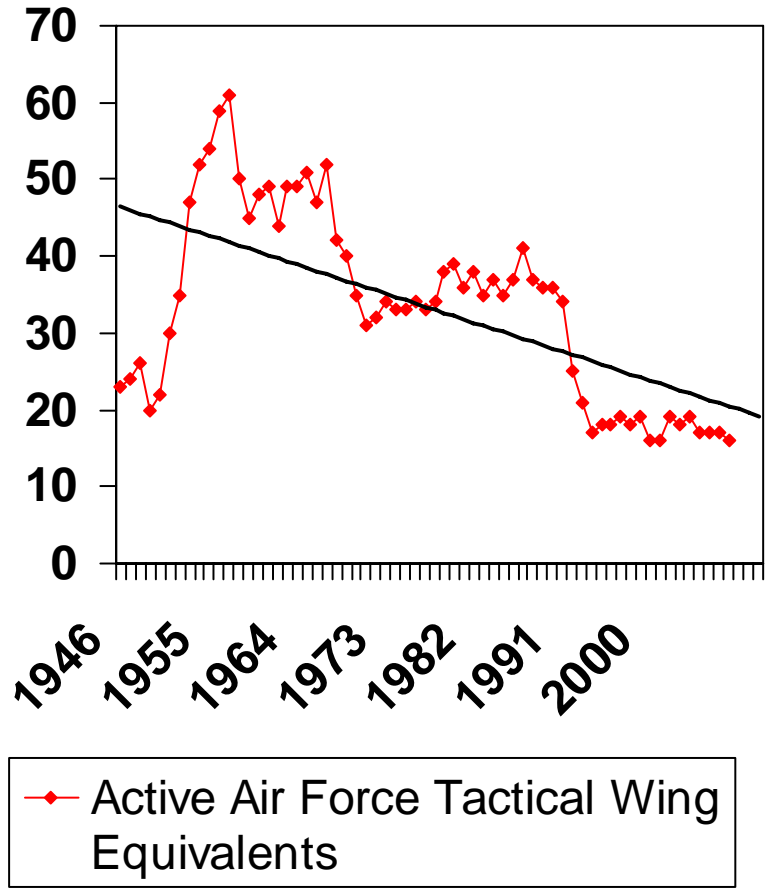


Navy Budget

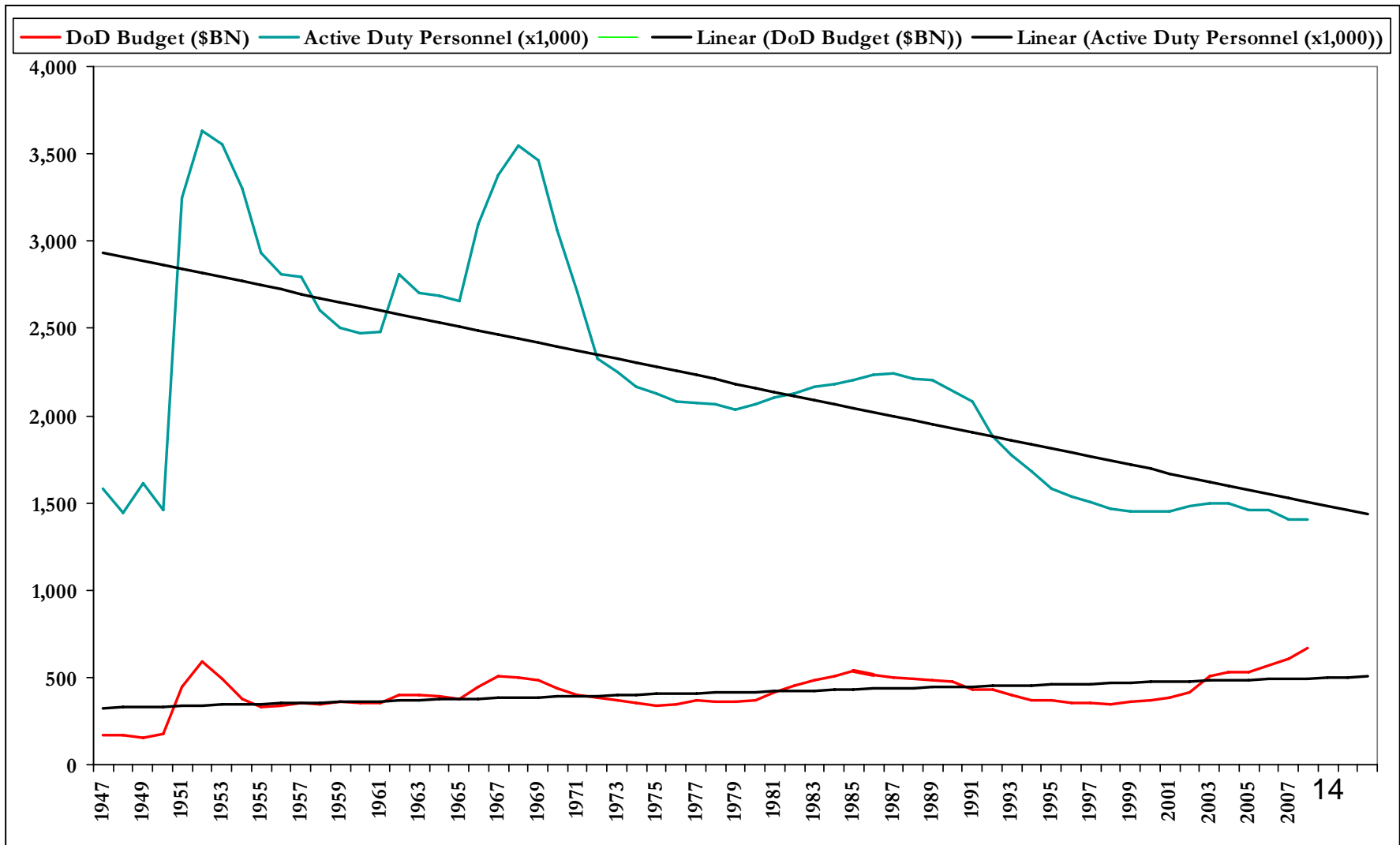
Air Force Tactical Wings and Budget

(Billions, FY 2009 Dollars)

Sources: National Defense Budget Estimates for FY 2009, Office of the Under Secretary of Defense (Comptroller) March 2008 and Air Force Historical Research Agency (Maxwell AFB) analysis, "Force Structure, United States Army Air Forces and United States Air Force."



DOD Budget & Active Duty Personnel (1947-2008) (\$Billions, 2008 Dollars)



More Money Buys an Older Force

Figure 3-5 Updated

Age and Inventory of Army Ground Combat Vehicles

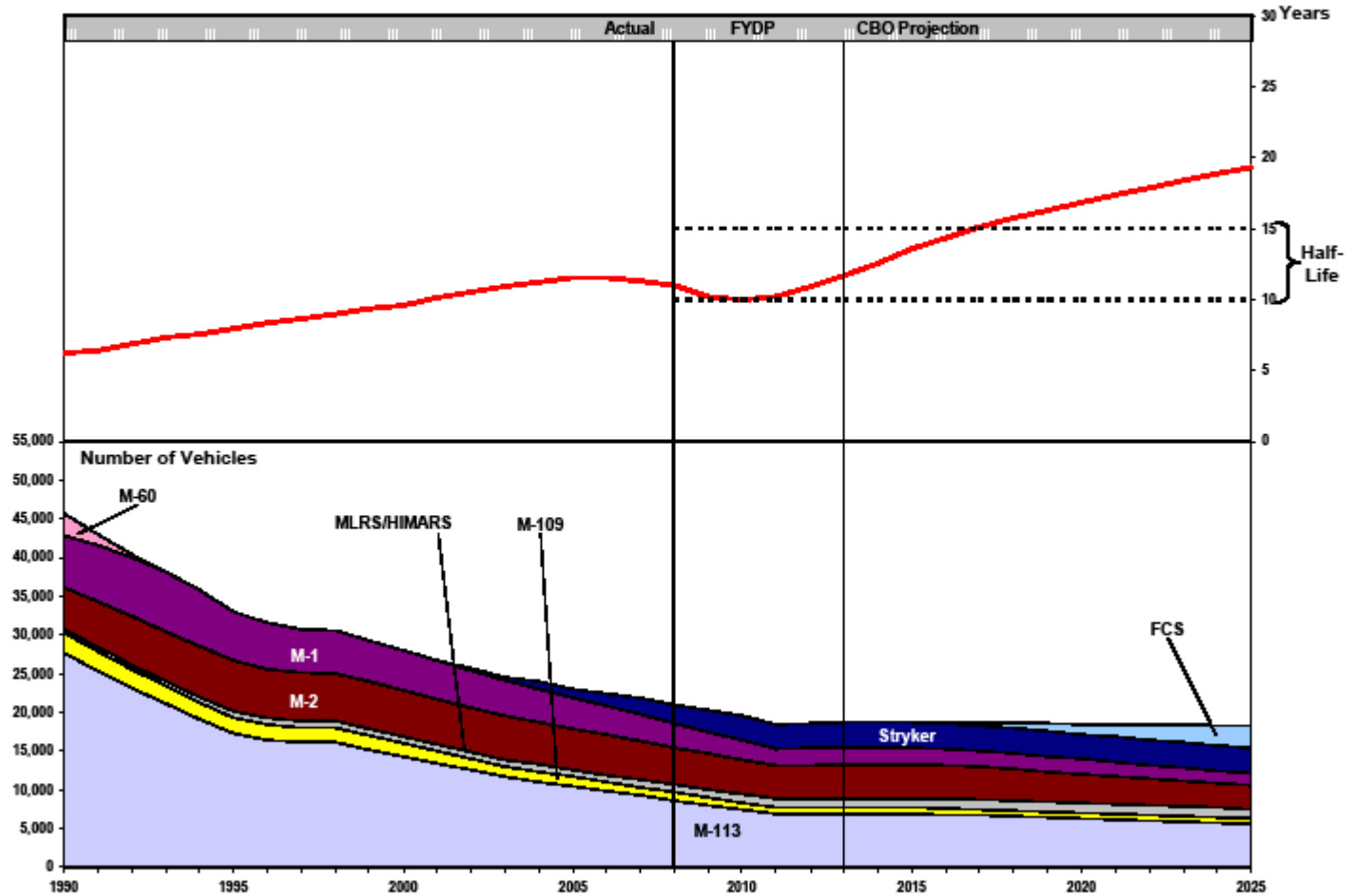


Figure 3-11 Updated

Age and Inventory of Battle Force Ships

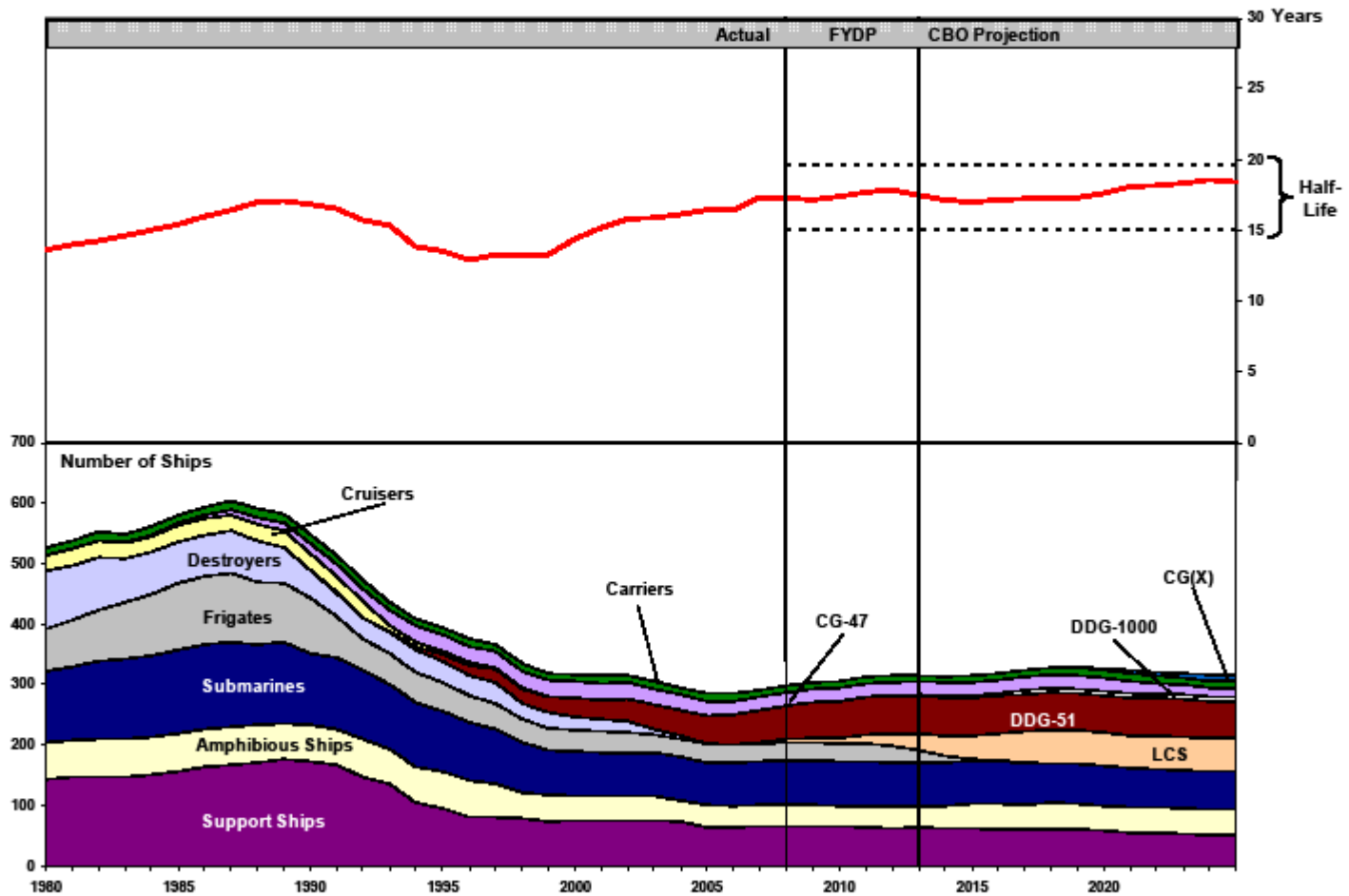
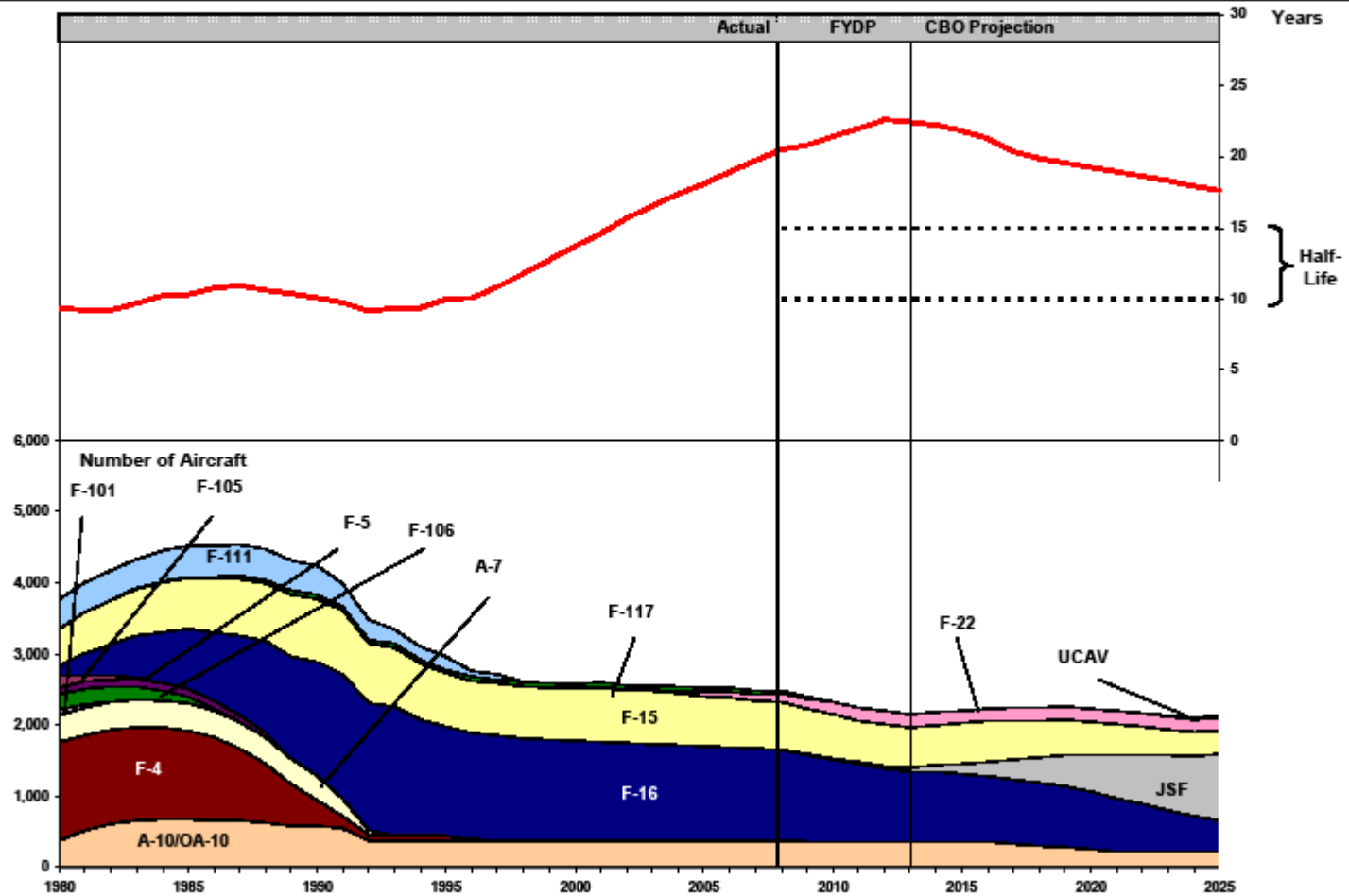


Figure 3-21 Updated

Age and Inventory of Air Force Fighter and Attack Aircraft



And, Less Ready

Readiness

- Army Tank Miles: Down from 1,000 to 459
- Are units going to Iraq “ready?”
- Naval aviators getting 17 hours/month.
- Air Force is worse.

More Capability?

- F-22 Example
 - Puny Force
 - Fewer Resources for Pilot Skill
 - Aerodynamic Disappointment
 - How much “Stealth” & “Supercruise”?
 - Unproven BVR Hypothesis
- Performance in Iraq & Afghanistan

Two Questions

Where Did the \$772 Billion Go?

- \$60+ billion for pork.
- \$295 billion for hardware overruns.
 - More for irrelevant systems.
- Now paying \$28 billion more for 4,000 fewer people.

More Money Won't Solve It; What Will?

- Non-phony reform of Pork rules.
- Budget Pause:
 - Independent assessment of all weapons & personnel programs.
 - Clean the financial management stables.
- Discriminate in favor of modern veterans.



Mission-Based T&E

Tutorial, 2 March 2009

**25th Annual NDIA
T&E Conference**

Chris Wilcox

US Army Evaluation Center

410-306-0475

chris.wilcox1@us.army.mil



Purpose

- To present and overview the MBT&E methodology (framework and process).
- To engage in question/answer discussions on the MBT&E methodology.
- To obtain audience feedback on the MBT&E methodology.



Agenda

1330: Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study

1415: Procedure – Steps 1-5

1500-1515: Afternoon Break

1515: Procedure – Steps 6-8

1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers



MBT&E Background



Background - Why MBT&E?

- Because we were asked to...
 - DA/OSD-level guidance:
 - Address recent policy initiatives, such as: Section 231 Report; DOT&E/OUUSD(AT&L) *T&E Policy Revisions* memo; etc.
 - “Show impact of materiel system strengths/weaknesses on the operational capabilities.”
 - “Integrate DT and OT and make use of all available data.”
 - Address goals, strategies and initiatives in DUSA-TEO Strategic Plan, 2007.
 - “Continuously improve T&E policy and procedures.”
 - “Increase operational realism in developmental tests to improve the likelihood of successful operational tests.”
 - New TEMP format and DoD 5000 changes.
 - “Integrated T&E” chapter vs. DT and OT chapters.

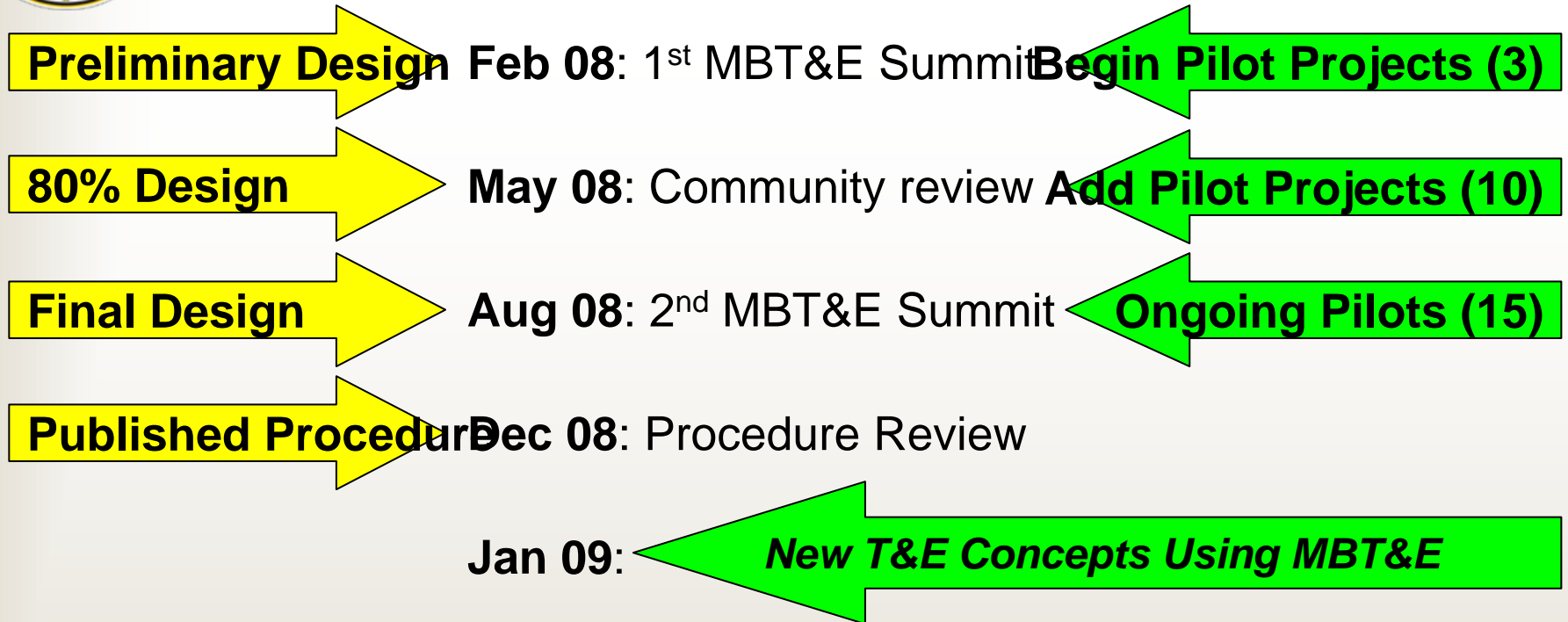


Background - Why MBT&E?

- Because we want to improve:
 - The way we do our job...
 - Enable robust T&E strategy development for Joint networked system-of-systems.
 - The way we support the warfighter...
 - Answer the “so what” question. (Complete feedback loop to Capability-Based Analysis.)
 - Develop way to link system performance to unit and higher unit task capabilities.
 - The way we support the materiel developer...
 - Scope T&E effort earlier in the acquisition cycle.



How is MBT&E Implemented?



Lessons Learned:

- MBT&E framework providing context of operational capability.
- MBT&E process is executable with current personnel skill set.
- Efficiencies can be increased through:
 - Improved tools (templates, IT, training, etc.); and
 - Combat and materiel developer participation.



Background – MBT&E Overview

Mission-Based Test and Evaluation

is a methodology that focuses T&E on the mission task **capabilities** provided to the warfighter. It provides a framework and procedure to:

- **link capabilities to the attributes** of the materiel system-of-systems;
- develop evaluation measures that **assess capabilities and attributes**;
- and link the evaluation measures to all **available data sources**.



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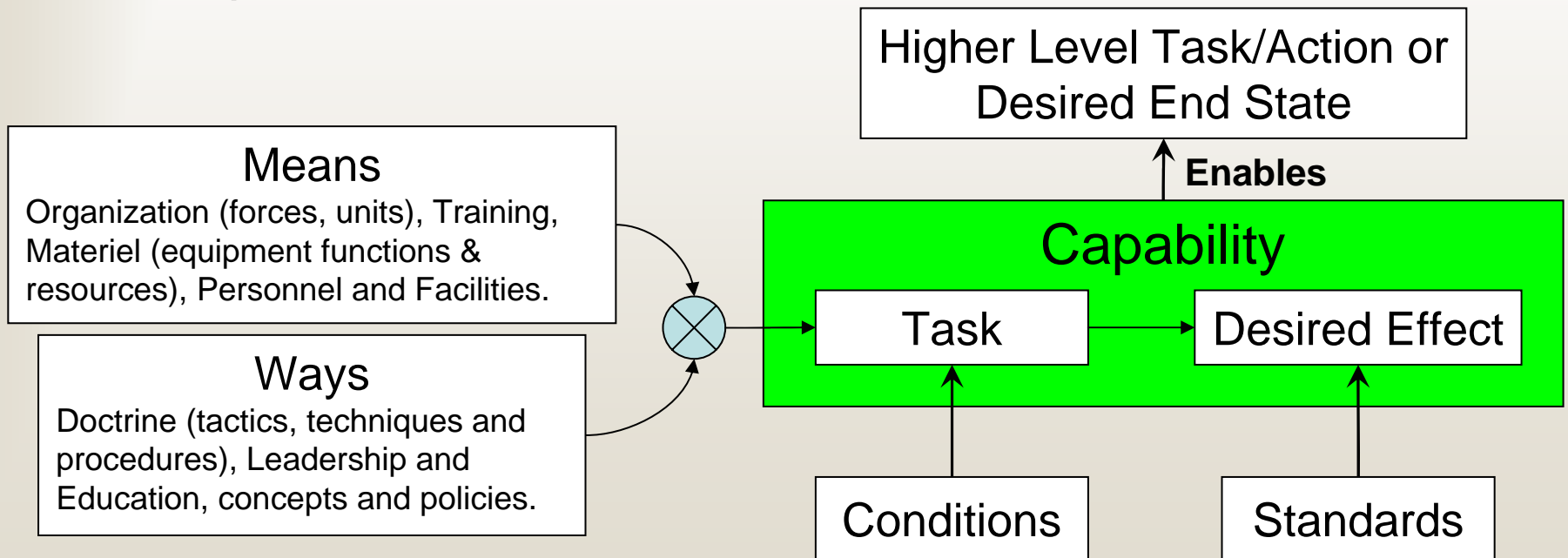
MBT&E Framework



Framework Building Block

Capability¹ – The ability to achieve a **desired effect** [or result, outcome, or consequence of a task²] ...

- under specified **standards and conditions**
- through a combination of **means and ways**
- to perform a set of tasks.



1. CJCSI 3170.01F, May 2007

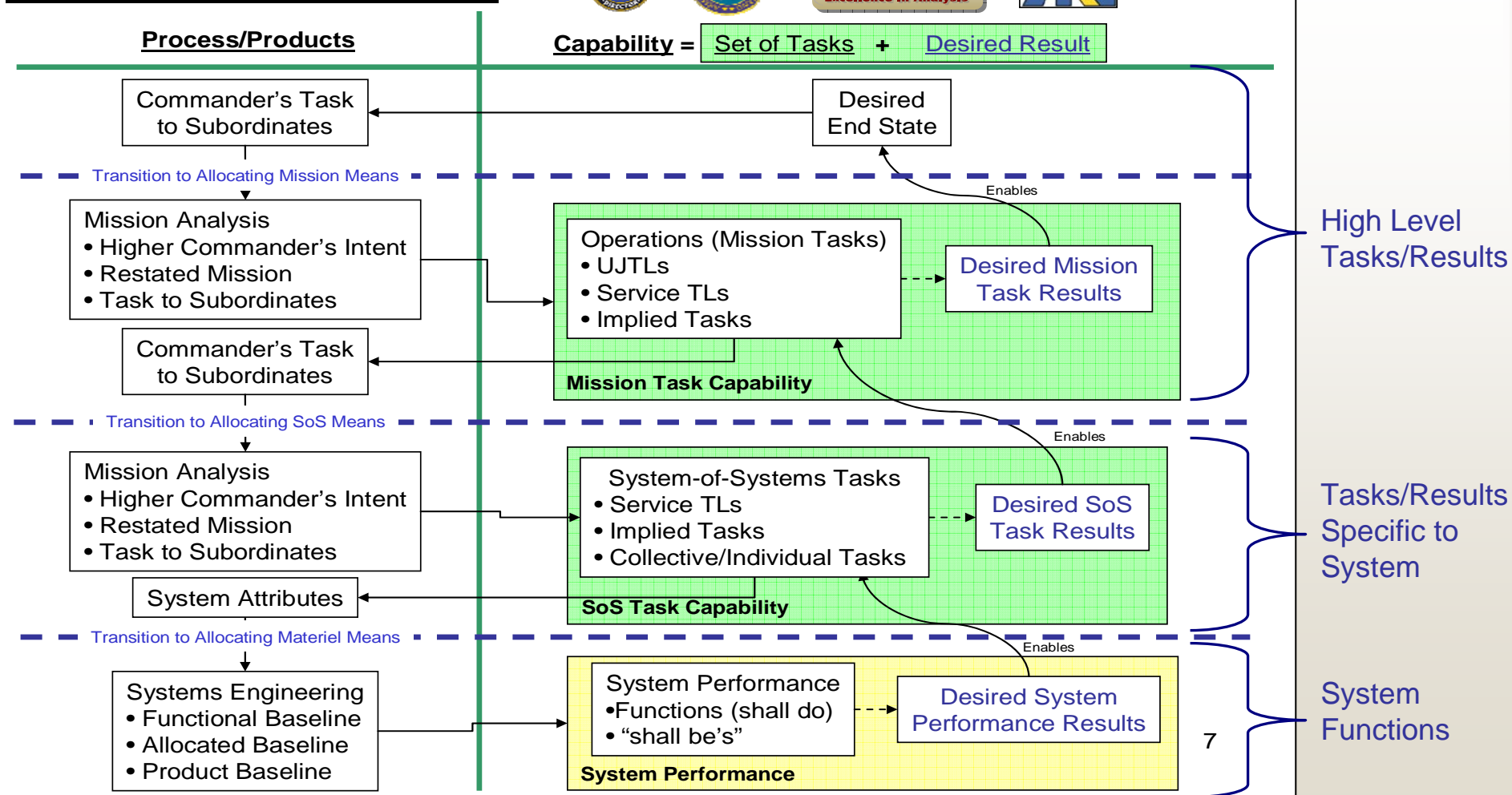
2. Taken from JP1-02, Mar 2007, definition of effect.

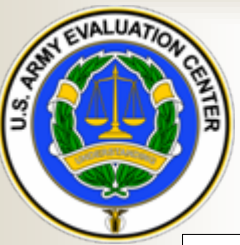


Framework - Task Hierarchy

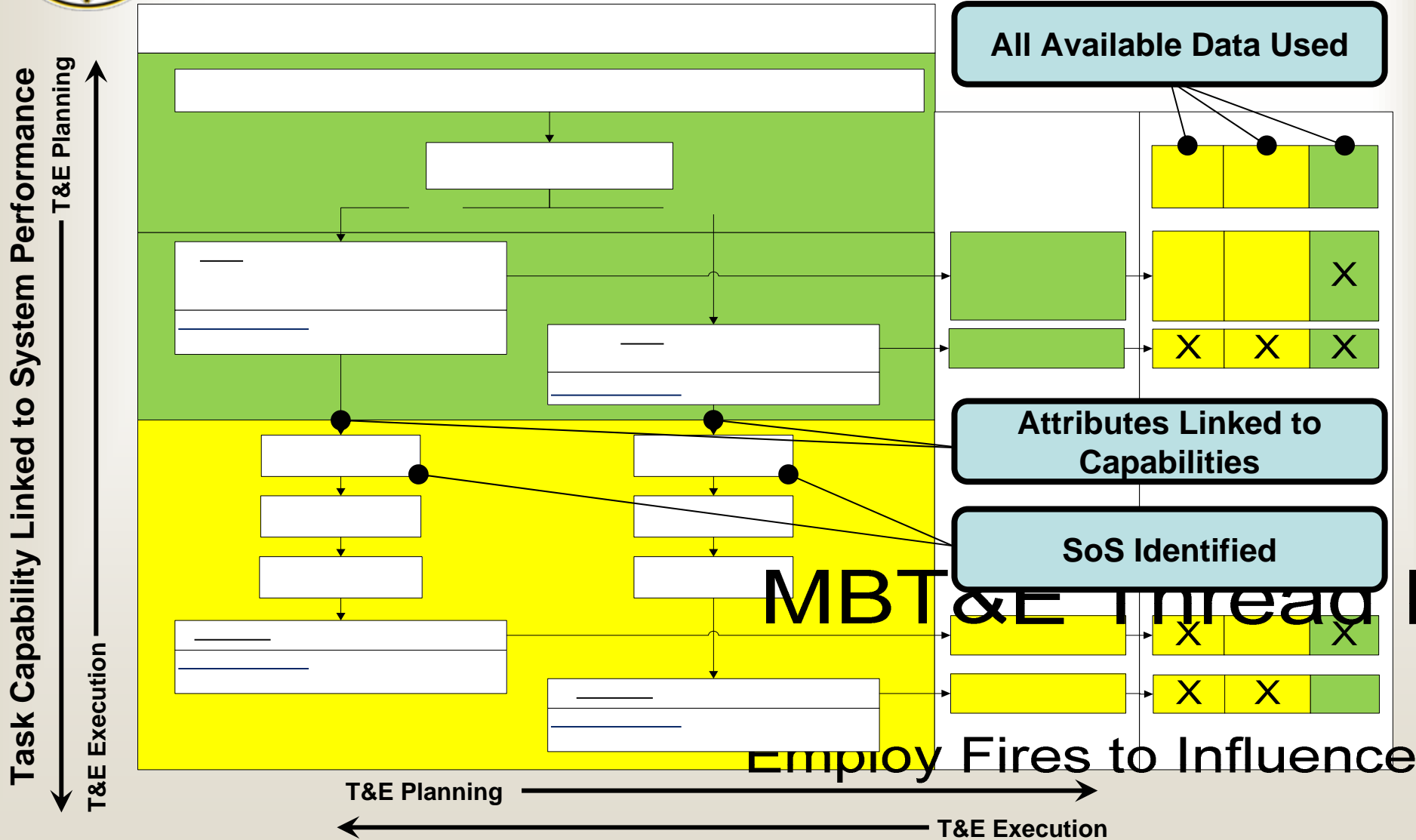


MBT&E Framework – v2





MBT&E Framework Example



Capability and Performance Linked to Integrated T&E

MBT&E Inthread
Employ Fires to Influence



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1630: Discussions/Questions/Answers



MBT&E Procedure

Steps 1-5

Understand the Mission



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to collect information.

PLANNING

UNDERSTAND THE MISSION • 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SYSTEM • 2 steps to understand the components and attributes of the materiel system-of-systems.

- 1 additional step to understand the mission and system linkages.

DESIGN THE T&E • 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS • 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS • 1 step to format and report the results.

EXECUTING & REPORTING



Procedure - Collect Information (Step 1)

Purpose: Collect available information to gain understanding of:

- initiating capability gaps,
- mission context and operational conditions,
- mission tasks and capabilities,
- system-of-systems design and materiel system required attributes.

What do I do?

- Work through capabilities developer and materiel developer to obtain the available information.
 - Functional Area, Needs & Solution Analyses, Analysis of Alternatives, Requirements Documents (DoDAF Views), Threat Assessments, Acquisition Strategies, Performance Specifications, etc.

When am I done?

- Checklist of documents available/not available is completed.
- Available documents Archived.
- Actions to obtain copies of documents available, but not archived, are presented to appropriate IPTs.



Procedure -

STEP 1

Collect Information (Step 1) **SIDE**

Currently building/maintaining document list.

Document Title

- Functional Area Analysis
- Functional Need Analysis
- Functional Solution Analysis
- Analysis of Alternatives
- Operational Mode Summary/Mission Profile
- Initial Capabilities Document
 - DoDAF OV-1 (Appendix A)
- Capabilities Documents
 - DoDAF OV-1 (Appendix A)
 - DoDAF OV-2 (Appendix A)
 - DoDAF OV-4 (Appendix A)
 - DoDAF OV-5 (Appendix A)
 - DoDAF OV-6C (Appendix A)
 - DoDAF SV-2 (Appendix A)
 - DoDAF SV-4 (Appendix A)
 - DoDAF SV-5 (Appendix A)
 - DoDAF SV-6 (Appendix A)
- COI/Cs
- Army Universal Task List, FM 7-15
- Unit Mission Training Plan
- Support Unit Mission Training Plans
- Universal Joint Task List, CJCSM 3500
- System Threat Assessment Report
- Technology Development Strategy
- Acquisition Strategy
 - Work Breakdown Structure
- Material Fielding Plan
- System Performance Specification

Who to ask?

| | Mission Context | Operational Conditions | Unit Organization | Unit Tasks | Current Unit Capabilities | Capability Gaps | Desired Unit Capabilities | Mission Tasks/Task Threads | SoS Design | Existing Materiel System Attributes | Materiel Critical Technologies | Desired Materiel System Attributes | Materiel System Components | Materiel System Functions |
|----------------------|-----------------|------------------------|-------------------|------------|---------------------------|-----------------|---------------------------|----------------------------|------------|-------------------------------------|--------------------------------|------------------------------------|----------------------------|---------------------------|
| TRADOC | X | m | | X | X | | | m | | | | | | |
| TRADOC | m | m | | m | m | X | | m | | | | | | |
| TRADOC | m | m | | m | m | X | X | m | | | | | | |
| TRADOC | | | | | | | X | m | | X | m | X | | |
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| HQDA | | | | X | | | | | | | | | | |
| TRADOC/School House | | | | X | | | | | | | | | | |
| TRADOC/School House | | | | X | | | | | | | | | | |
| Joint Staff (online) | | | | X | | | | | | | | | | |
| PM | | X | | | | | | | | | | | | |
| PM | | | | | | | m | | | | X | | X | |
| PM | | | | | | | m | | | | X | | X | |
| PM | | | | | | | | | | | | | X | |
| PM | | | | | | | | | | | | | X | X |

X = provides
m = may provide



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to understand the program context.

UNDERSTAND THE MISSION

- 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SYSTEM

- 2 steps to understand the components and attributes of the materiel system-of-systems.
- 1 additional step to understand the mission and system linkages.

DESIGN THE TEST AND EVALUATION

- 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS

- 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS

- 1 step to format and report the results.



Procedure - Define the Mission Context (Step 2)

Purpose: Define the overall mission area context that the proposed materiel solution is being developed to support.

What do I do?

- Determine Operations/Mission/Tasks
 - Develop a description of high-level operations/mission/tasks and their desired end states/results,
 - Determine Joint, network and SoS construct, and
 - Determine organizational and support unit construct.
- Determine Operational Conditions
 - Determine the essential elements of mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC).

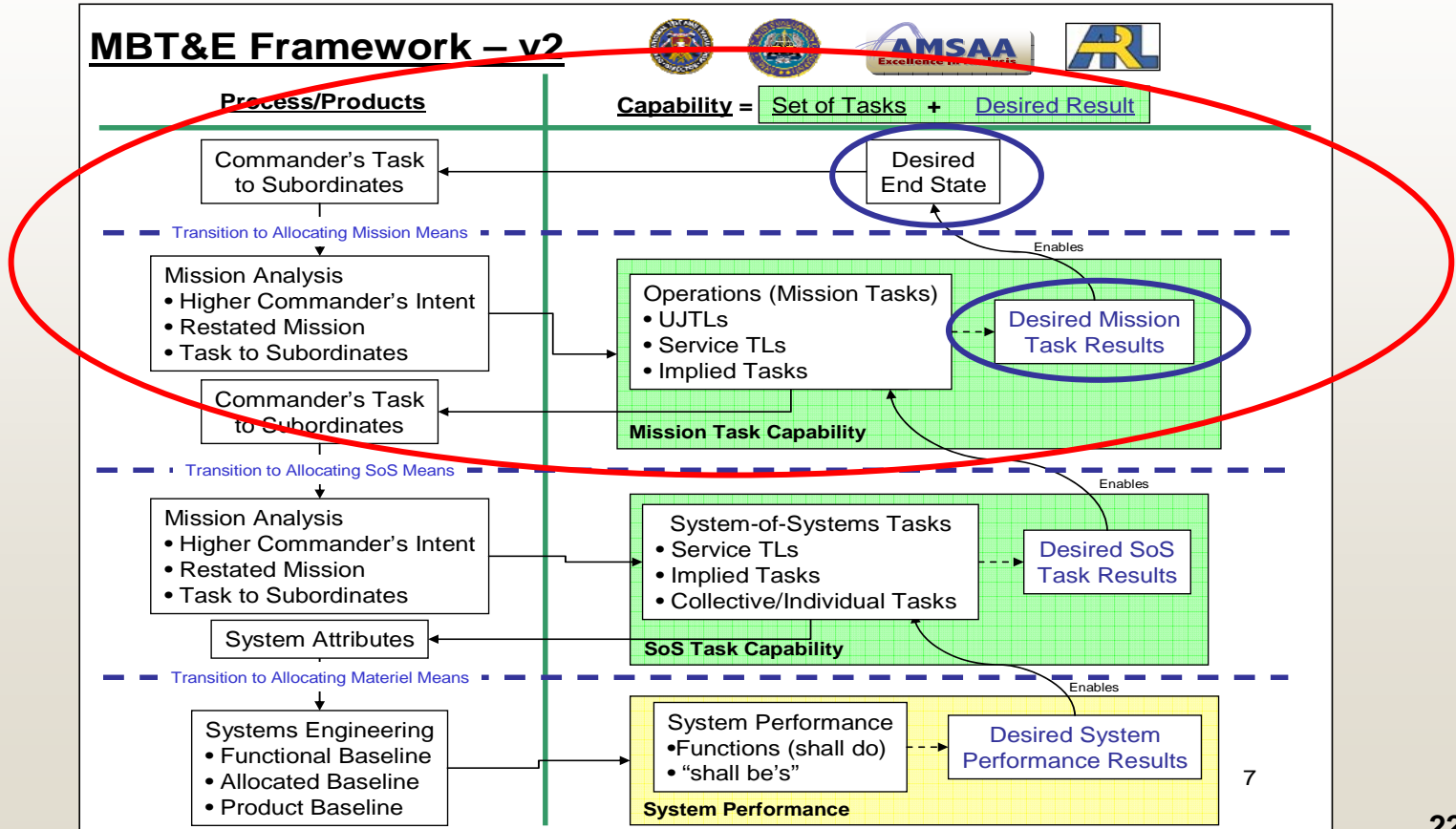
When am I done?

- High-level operations/missions/tasks with their desired end states/results are documented.
- Operational conditions (METT-TC factors) are documented.



Mission Context – Relation to Framework

- High-level operations/mission/tasks.
- Task desired end states/results.





Procedure

Develop the Mission Tasks (Step 3)

Purpose: Develop the required SoS mission tasks and link these tasks to authoritative tasks lists.

What do I do?

- Document/Conduct Mission Analysis
 - Develop SoS mission task threads and alternate task threads where applicable. (MS project or similar tool can be used.)
 - Determine task desired end states/results
- Link to Authoritative Task Lists
 - Develop linkages between the tasks identified above and the appropriate authoritative task lists. (UJTL, AUTL, unit Mission Training Plans, etc.)

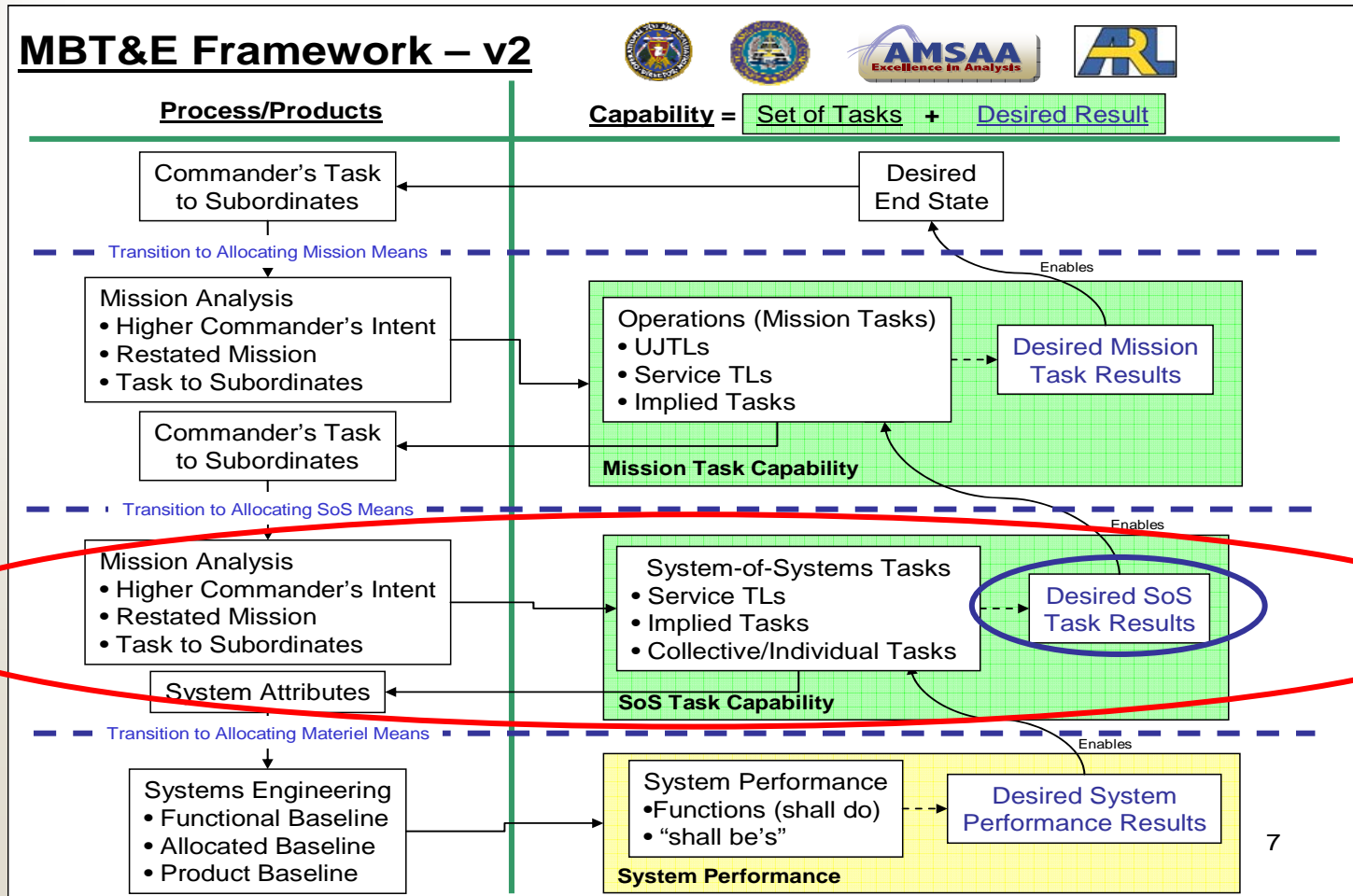
When am I done?

- SoS mission tasks with their desired end states/results are documented.
- Links to associated authoritative tasks are documented.



Mission Tasks - Relation to Framework

- SoS tasks and task threads.
- SoS Task desired end states/results.





Procedure

Develop Supporting Tasks (Step 4)

Purpose: Develop the required supporting tasks that enable the execution of the SoS mission tasks.

What do I do?

- Determine Conditional Tasks and their desired effects/results.
 - Conditional tasks are performed during a normal mission but are only **required due to some influencing condition**.
 - Examples: *avoid threat missile, extinguish engine fire, reset network node, etc.*
- Determine Enabling Tasks and their desired effects/results.
 - Mission enabling tasks are conducted in order to **enable the SoS mission tasks** (task developed in step (3)) **to be performed**.
 - Examples: *train, deploy, maintain, etc.*

When am I done?

- Conditional tasks, enabling tasks and their desired end states/results are documented.
- Links to associated authoritative tasks are documented.



Procedure

Identify Task Capabilities (Step 5)

Purpose: Identify and associate the capabilities required to execute the SoS, conditional and enabling tasks.

What do I do?

- Identify Required Capabilities
 - Identify the capabilities required to support each task with a reference to applicable requirements documents. (CDD, CPD, etc.)
- Associate Tasks with Capabilities
 - Link the capabilities determined above with the mission, conditional and enabling tasks determined in steps (3) and (4)

When am I done?

- Links between the (SoS, conditional and enabling tasks) and the requirements are documented.



MBT&E Procedure

Steps 6-8

Understand the System



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to understand the program context.

UNDERSTAND THE MISSION

- 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SYSTEM

- 2 steps to understand the components and attributes of the materiel system-of-systems.

- 1 additional step to understand the mission and system linkages.

DESIGN THE TEST AND EVALUATION

- 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS

- 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS

- 1 step to format and report the results.



Procedure

Determine SoS Components (Step 6)

Purpose: Identify the physical components of the materiel system that support the mission tasks.

What do I do?

- Develop a materiel system description starting from the SoS level and breaking down into components.
 - Components at the lowest level should be able to be linked to identifiable functions (shall do's) and enabling attributes (shall be's).
- Identify the functions and “shall be's” of the materiel components.
- Option: Develop technology risk areas for pre-MS B systems.

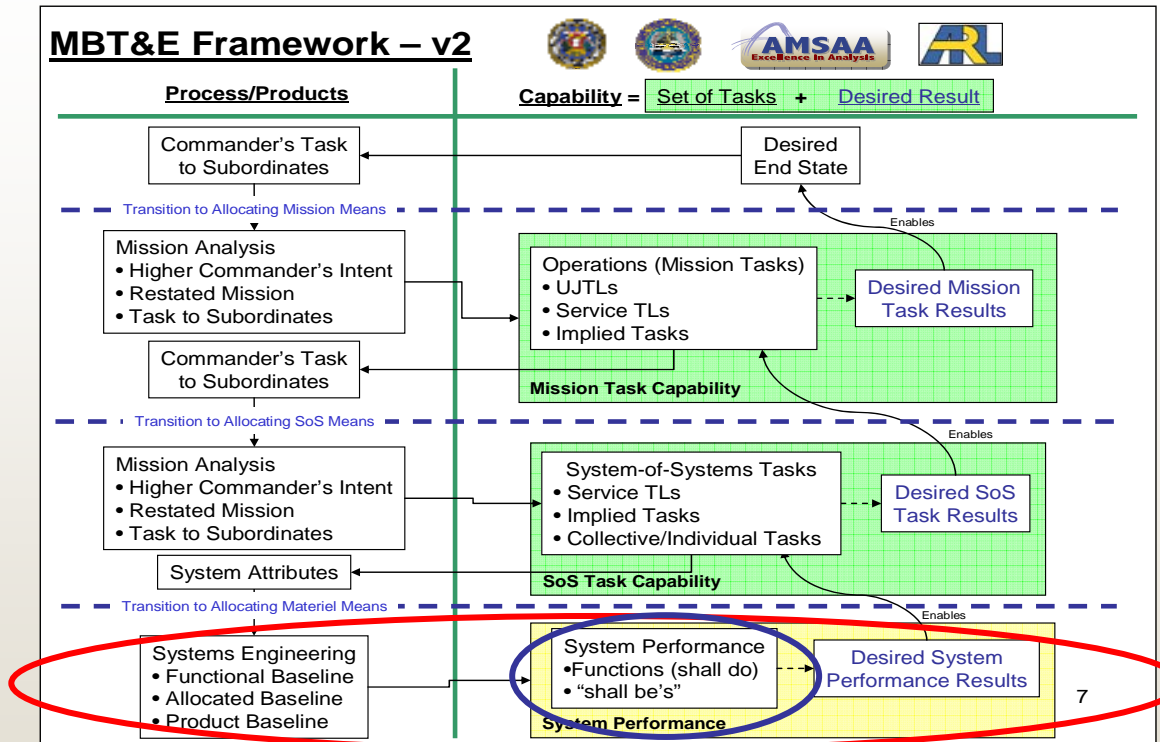
When am I done?

– SoS components with their functions/shall be's are documented.



SoS Components - Relation to Framework

- SoS Components
- SoS Component Functions & “Shall be’s”



Materiel System Functions: An activity or action the materiel system performs in support of a capability or part of a capability.

Materiel System “shall be”: An attribute the materiel system possesses that enables it to perform a function, for example, *reliability*.



Procedure

Develop System Attributes (Step 7)

Purpose: Identify the materiel system attributes and associate them with the system components.

What do I do?

- Identify Attributes Required
 - Identify the materiel system's attributes required to support the component functions/shall be's with reference to applicable requirements documents. (CDD, CPD, Performance Specification, etc.)
- Associate Components with Attributes
 - Link the attributes determined above with the system components developed in step 6.

When am I done?

- Links between the SoS components and their required attributes are documented.



Procedure - Overview

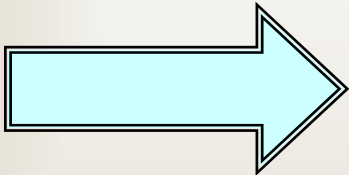
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- 1 additional step to understand the mission and system linkages.

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- 7 steps to design the T&E given the mission and system understanding.

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REPORT THE RESULTS

- 1 step to format and report the results.



Procedure

Associate Capabilities with Attributes (Step 8)

Purpose: Develop the linkages between the task capabilities identified in step (5) and the materiel system component attributes identified in step (7).

What do I do?

- Link the system attributes (functions/shall be's) to the task capabilities.
 - Determine how the system components support the task capability.
 - Determine redundant system support capability.
- Determine Mission Enabling Attributes
 - Mission Enabling Attributes are system enabling attributes that are not specific to a particular task capability – they address all tasks.

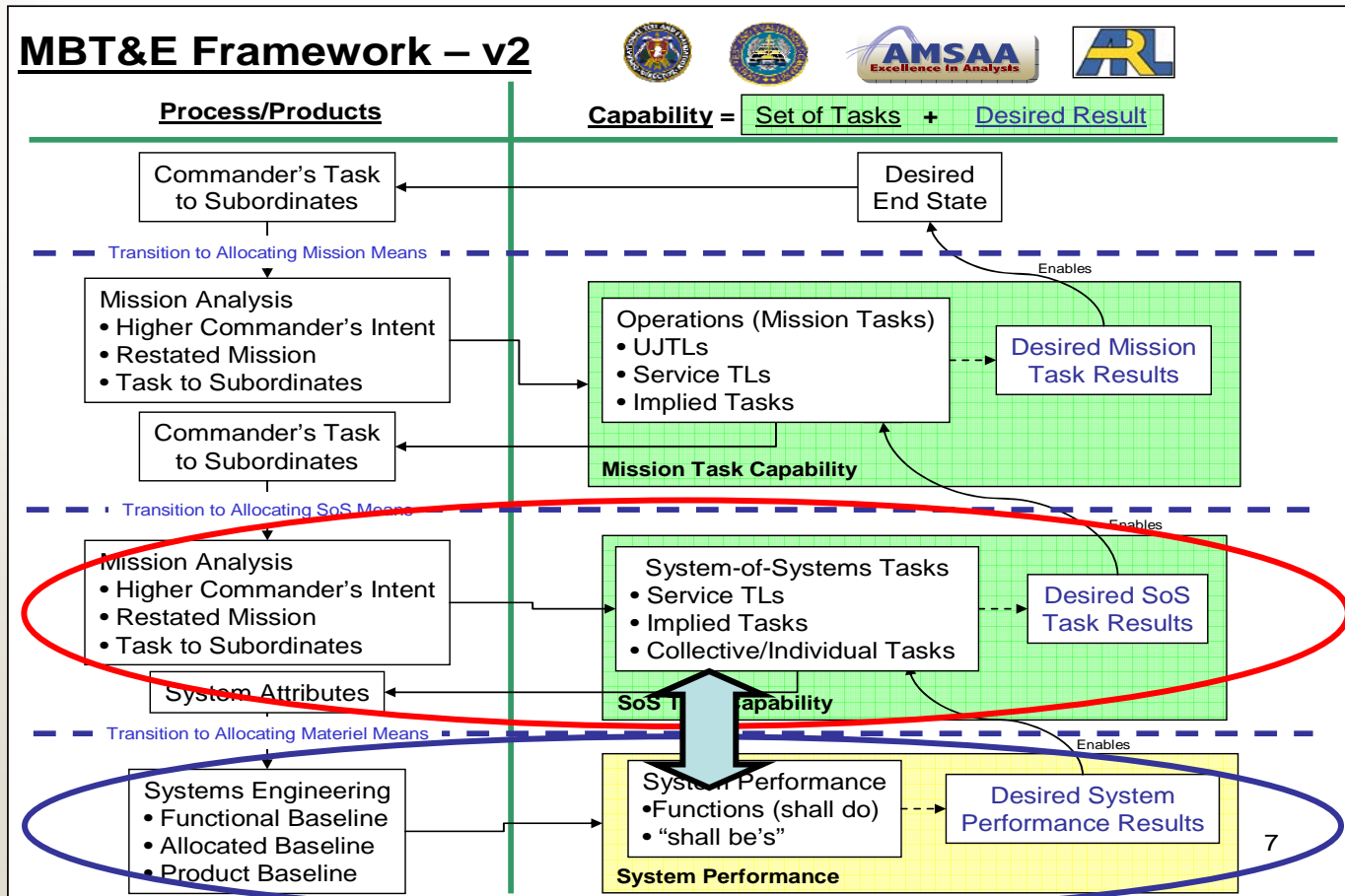
When am I done?

- Links between the system components and their supported tasks are documented.
- Enabling attributes of the SoS materiel components are documented.



Capabilities to Attributes – Relation to Framework

- Link **SoS mission task capabilities** to **SoS component attributes**.





Agenda

1330: Introduction and Mission-Based T&E Background

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1500-1515: Afternoon Break

1515: Procedure – Steps 6-8

1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers



MBT&E Procedure

Steps 9-15

Design the T&E



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
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Procedure

Unconstrained Operational Conditions (Step 9)

Purpose: Develop the unconstrained operational conditions that must be addressed through test and evaluation.

What do I do?

- Determine the operational factors and conditions that T&E needs to address given:
 - the task capability required and
 - the system function/shall be.

When am I done?

- Operational conditions (for the intersection between mission task and system components are documented.



Process

Develop the Evaluation Strategy (Step 10)

Purpose: Develop a summary description of the evaluation to support an early strategy coordination and review.

What do I do?

- Develop the early strategy review brief from the mission, task, and system worksheets developed in steps (2) through (9).

When am I done?

- Early strategy review brief is prepared.



Process

Develop Evaluation Measures (Step 11)

Purpose: Develop the evaluation measures.

What do I do?

- Develop measures supporting the evaluation of:
 - task capabilities (task capability measures), and
 - system attributes (materiel performance measures).
- Complete linkages from measure -to- system -to- task.
- Develop linkages between measures and COIs/Criteria.

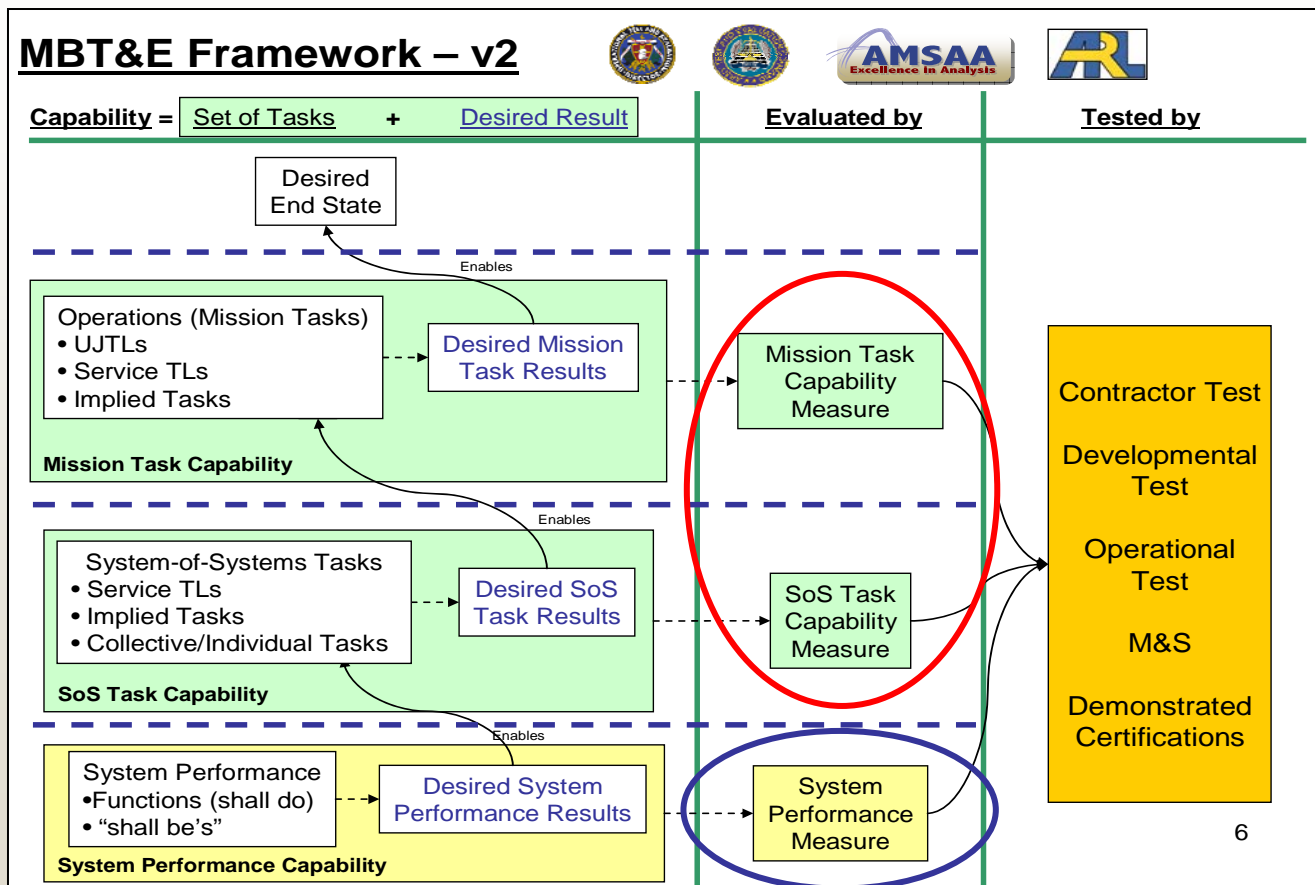
When am I done?

- Task capability and materiel performance measures are documented.



Evaluation Measures – Relation to Framework

- **Task Capability Measures**
- **Materiel Performance Measures**





Operational Measures **SIDE**

- Describe operational T&E measures linked to the tasks.
- Describe how operational conditions are used to define data requirements



Technical Measures

SIDE

- Describe technical T&E measures linked to the materiel system attributes (functions and characteristics).
- Describe how operational conditions are used to define data requirements



Design the T&E Assign Measures to Data Sources (Step 12)

Purpose: Identify the sources of data to support the analysis of the evaluation measures.

What do I do?

- Assign one or more data sources to each evaluation measure.
- Review data source matrix to determine:
 - T&E execution risk by assessing critical data sources;
 - Developmental risk by assessing when critical technologies are demonstrated; and
 - Determine appropriate use of M&S.

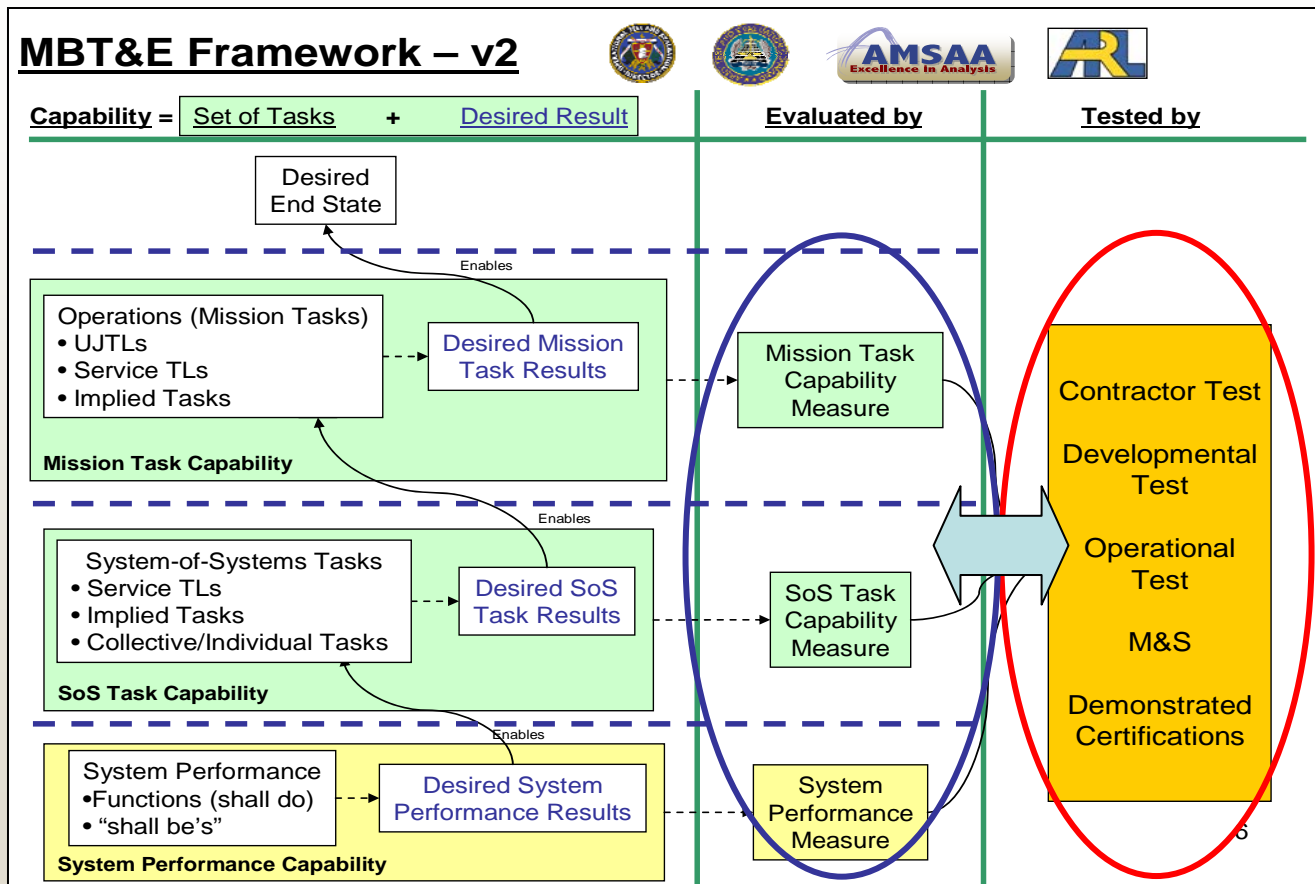
When am I done?

- Data sources supporting each measure are documented.
- T&E effort and program execution risk issues are identified and coordinated with the appropriate IPTs.



Data Sources - Relation to Framework

- **Data Sources**
- **Linked to Evaluation Measures**





Link to Data Sources

SIDE

- Describe the process used to link the evaluation measures to the appropriate data sources.
- Describe how to do first cut on what operational conditions are provided by the tests (data sources).



Design the T&E Constrained Operational Conditions (Step 13)

Purpose: Develop the constrained operational conditions by looking at the conditions that can be addressed by the identified data sources.

What do I do?

- Determine the operational conditions that can be addressed by the identified data sources. These are the “constrained” operational conditions.
- Determine the T&E limitations by comparing the constrained vs. unconstrained operational conditions (step 9).

When am I done?

- T&E limitations caused by the lack of ability to address all operational conditions documented.
- Mitigation effort(s) to lesson impact of T&E limitations are documented.



Design the T&E

Develop Data Source Requirements (Step 14)

Purpose: Develop data elements from each linked data source.

What do I do?

- Develop detailed measure design.
- Determine data elements required from the data source.
- Determine the operational conditions required for each run, sortie or sample.

When am I done?

- Data source requirements documented and coordinated with the appropriate executing test agent (contractor, government range, independent test facility, M&S, etc.)



Constrained Op Conditions

SIDE

- Describe DOE



Design the T&E

Develop T&E Databases (Step 15)

Purpose: Develop database architecture to enable efficient delivery, formatting and analysis of delivered data.

What do I do?

- Develop an evaluation data model from the task description, enabling attribute, measure description worksheets.
 - The evaluation data model is a representation of the information and data assets required to evaluate the system expressed in terms of entities and relationships between entities.
- Provide evaluation data model results to the tester.
 - The evaluation data model will ensure properly documented data for communication between the evaluator and the tester..

When am I done?

- T&E database design is documented.



Agenda

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1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers



MBT&E Procedure

Steps 16-19

Determine and Report the Results



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to understand the program context.

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- 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS

- 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS

- 1 step to format and report the results.



Execution

(Steps 16 through 18)

CONDUCT TEST AND GATHER DATA (Step 16)

Purpose: Execute the planned data source activities and gather the data for analysis.

What do I do?

- Execute test, run M&S, record data.
- Review data for integrity and authentication.
- Adjust T&E program based on impacts of changes in schedule and system design.

PERFORM DATA ANALYSIS (Step 17)

What do I do?

- Data is analyzed according to the procedures identified in step 11 and 14.
- Performance results are compared to standards identified in steps 5 (task capabilities) and 7 (system attributes).

GENERATE EVALUATION RESULTS (Step 18)

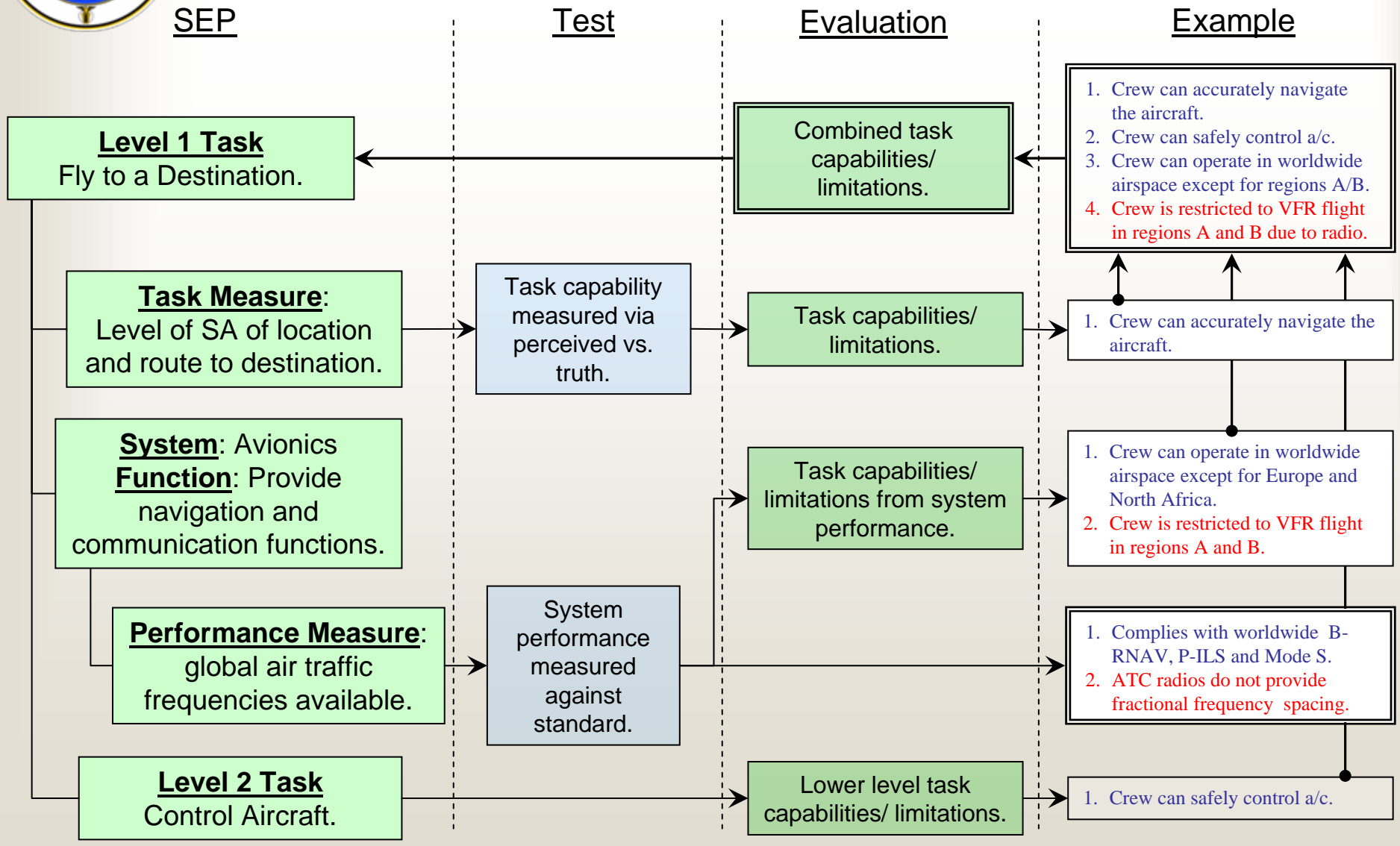
What do I do?

- Determine materiel system attribute performance.
- Determine SoS task capabilities and limitations.
 - Determine task capability C&L directly from task capability measure results.
 - Determine task capability C&L based on system attribute measure results.
- Determine task C&L impact on high-level mission task capabilities.
 - Determine ability to achieve desired end state directly from capability measures.
 - Determine ability to achieve desired end state from SoS task capability C&Ls.



Generate Evaluation Results

Validation Example





Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to understand the program context.

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DESIGN THE TEST AND EVALUATION • 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS • 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS • 1 step to format and report the results.



Reporting

Generate Evaluation Report (Step 19)

Purpose: To generate the evaluation report which will document the evaluation conclusions.

What do I do?

- Generate system performance and SoS task C&L conclusions.
- Generate summary of key C&Ls.
- Generate effectiveness, suitability and survivability conclusions.

When am I done?

- System performance, (strengths and weaknesses), and the impact they had on the task capabilities are documented.
- SoS task C&Ls and high-level task C&Ls are documented.
- Overall summary of effectiveness, suitability and survivability is documented.



Mission Element Task Type Definitions

Mission execution tasks.

- Tasks that describe a discrete action that the unit (system and its operators) must perform in order to accomplish its main mission.

Conditional mission tasks.

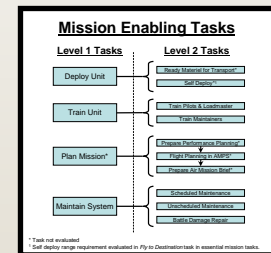
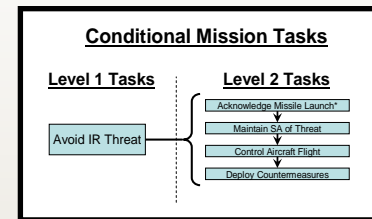
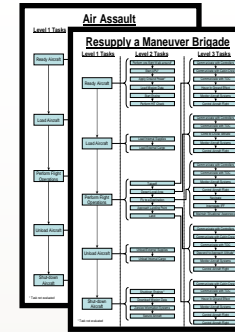
- Tasks that are performed during the mission that become required due to some influencing condition.

Mission enabling tasks.

- Tasks that enable the mission execution and conditional tasks to be performed. They usually occur before or after the mission.

Enabling Attributes

- System attributes that affect **all** tasks.



| ENABLING CHARACTERISTICS (Suitability) | |
|--|--|
| Availability | |
| Reliability | |
| Support/Supportability | |
| Support/Trainability | |
| Interoperability/Ready | |
| Basic Survivability | |
| Non-Illudic Survivability | |
| Information Assurance | |
| Security | |

Normally aggregated into **Effectiveness** and **Survivability**

Normally aggregated into **Suitability**



Evaluation Report

SIDE

- Describe reporting of overall capabilities and limitations
- Describe roll-up into effectiveness, suitability and survivability



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1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers



Discussions

-

Questions

-

Answers



MBT&E Point of Contact

Christopher Wilcox

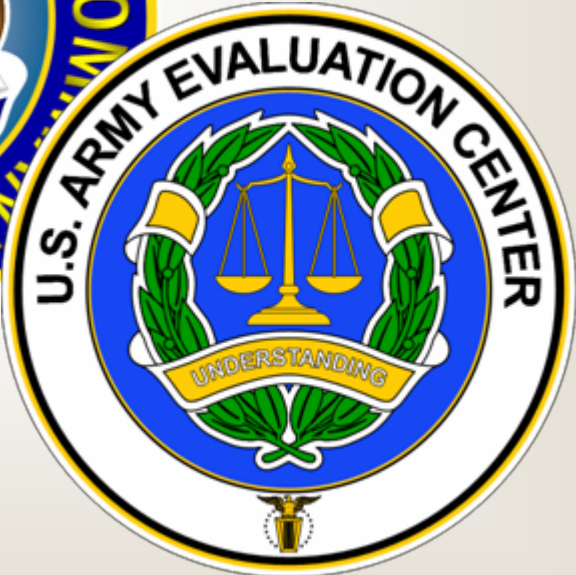
US Army Evaluation Center
ATTN: TEAE-AVA (Mr. Chris Wilcox)
4120 Susquehanna Ave.
Aberdeen Proving Ground, MD 21005

Office: (410) 306-0475

Mobile: (410) 652-0168

Fax: (410) 306-0398

chris.wilcox1@us.army.mil





Backup slides



UNITED STATES ARMY TEST AND EVALUATION COMMAND

Mission-Based Test & Evaluation

NDIA 25th Annual
T&E Conference

Mr. Christopher Wilcox
3 March 2009





Purpose

- **Inform T&E community peers** of the effort to design and implement a mission-based test and evaluation (MBT&E) methodology.
- **Solicit questions and comments** from peers to help improve the MBT&E methodology.



Agenda

- **Why** was MBT&E developed?
- **What** is MBT&E?
- **What** does MBT&E do?
- **How** is MBT&E implemented?
- **Where** is MBT&E headed?



Why was MBT&E developed?

- Networked system-of-systems
- Address Acquisition Initiatives
- Provide “feedback” to capabilities integration and development

“We will continue to examine and challenge our most basic institutional assumptions, organizational structure paradigms, policies, and procedures to better serve the Army.”

CG, ATEC Commander’s Priorities for FY 10-15



What is MBT&E?

Mission-Based Test and Evaluation

is a methodology that focuses T&E on the **capabilities** provided to the warfighter. It provides a **framework** and **procedure** to:

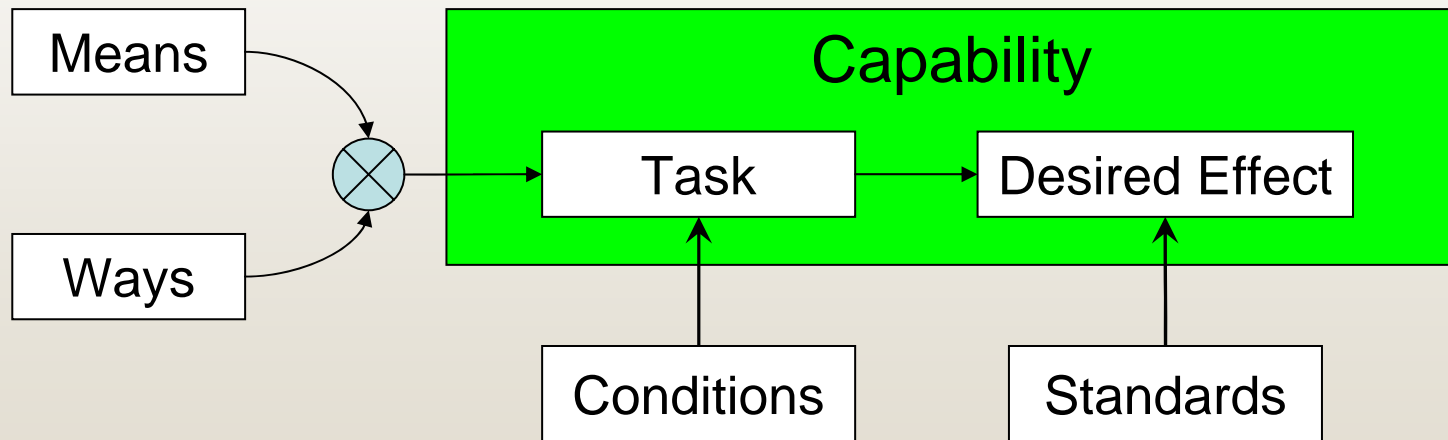
- link materiel system attributes to the operational capabilities;
- examine the SoS required to enable the operational capability; and
- enable synergistic use of all available data sources.



Framework Building Block

Capability¹ – The ability to achieve a **desired effect**
[or result, outcome, or consequence of a task²] ...

- under specified **standards and conditions**
- through a combination of **means and ways**
- to perform a set of tasks.



1. CJCSI 3170.01F, May 2007

2. Taken from JP1-02, Mar 2007, definition of effect.

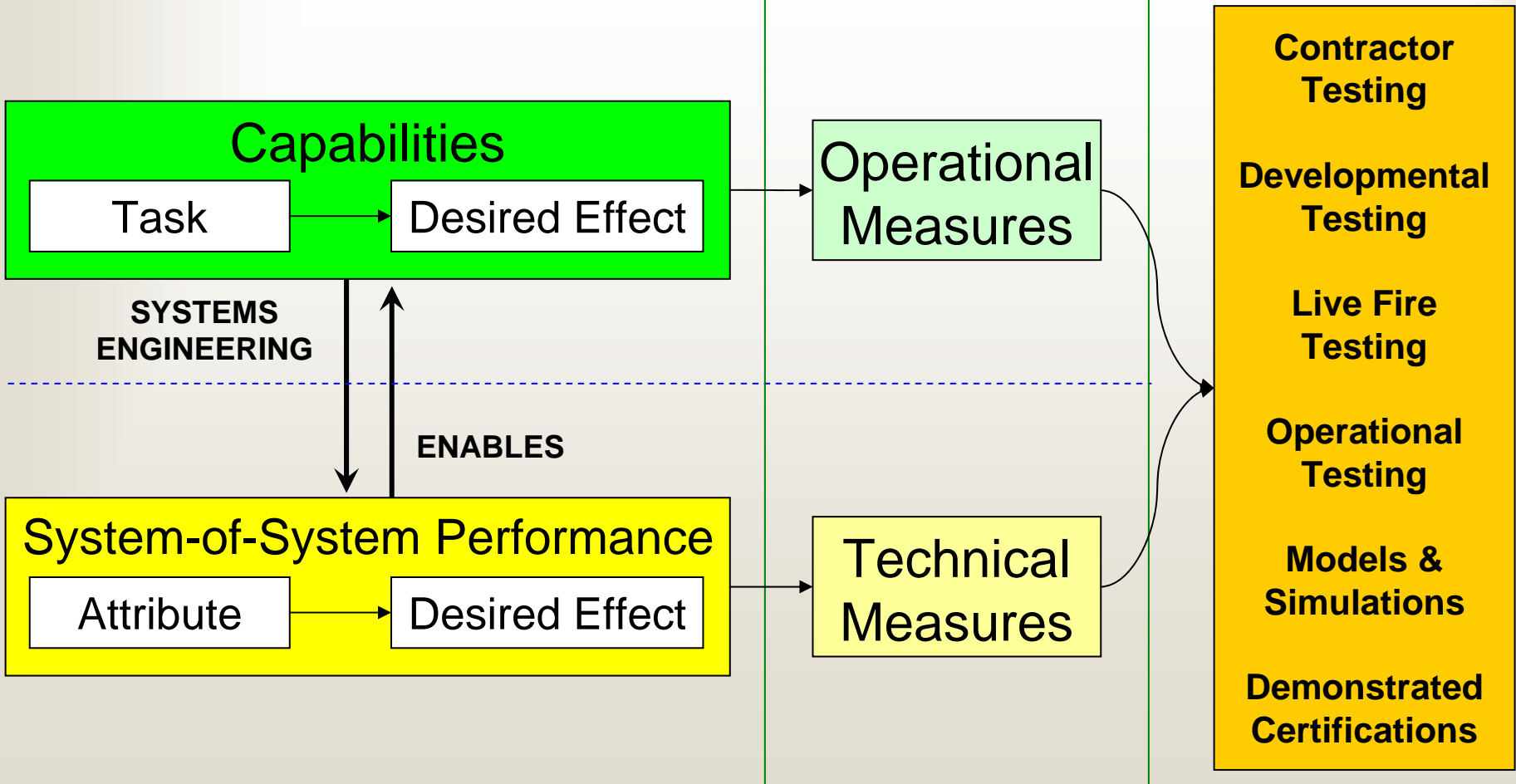


MBT&E Framework

MISSION AND SYSTEM

EVALUATED BY

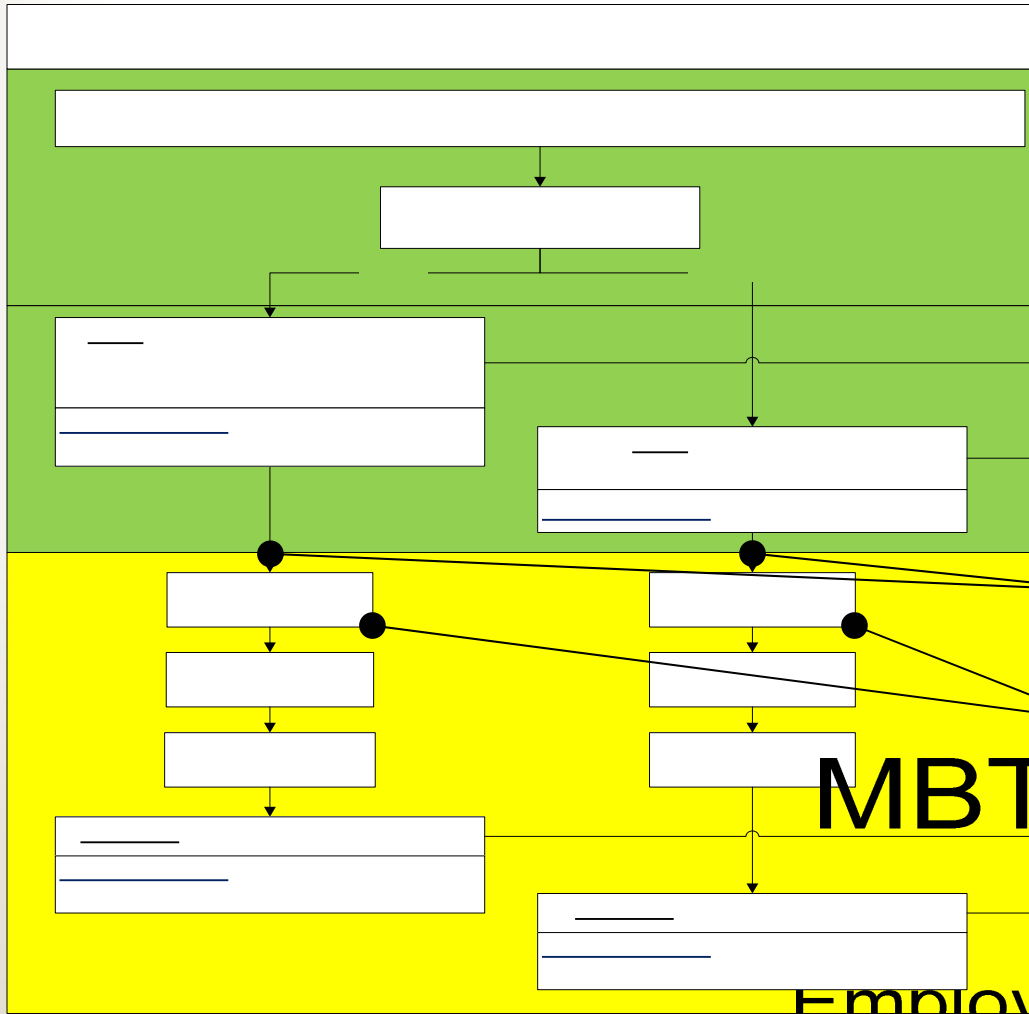
TESTED BY





MBT&E Framework Example

Task Capability Linked to System Performance
 T&E Planning
 T&E Execution



All Available Data Used

| | | | |
|---|---|---|---|
| ● | ● | ● | |
| | | | X |
| X | X | X | |

Attributes Linked to Capabilities

SoS Identified

MBT&E Thread Example

| | | |
|---|---|---|
| X | | X |
| X | X | |

Employ Fires to Influence the

T&E Planning ← T&E Execution

Capability and Performance Linked to Integrated T&E



MBT&E Process

- Process divided into steps.
- Steps divided into 5 major purpose areas.

UNDERSTAND THE MISSION

- Mission and task context.

UNDERSTAND THE SYSTEM

- Materiel components and attributes.
- **Linkages between** mission and materiel.

DESIGN THE TEST AND EVALUATION

- Test design and evaluation measures.

DETERMINE THE RESULTS

- Execute test and evaluation.

REPORT THE RESULTS

- Format and report the results.



What does MBT&E do?

- Operational capabilities and limitations.
- Materiel system performance and effect on operational capabilities.
- Effectiveness, suitability and survivability based on task.



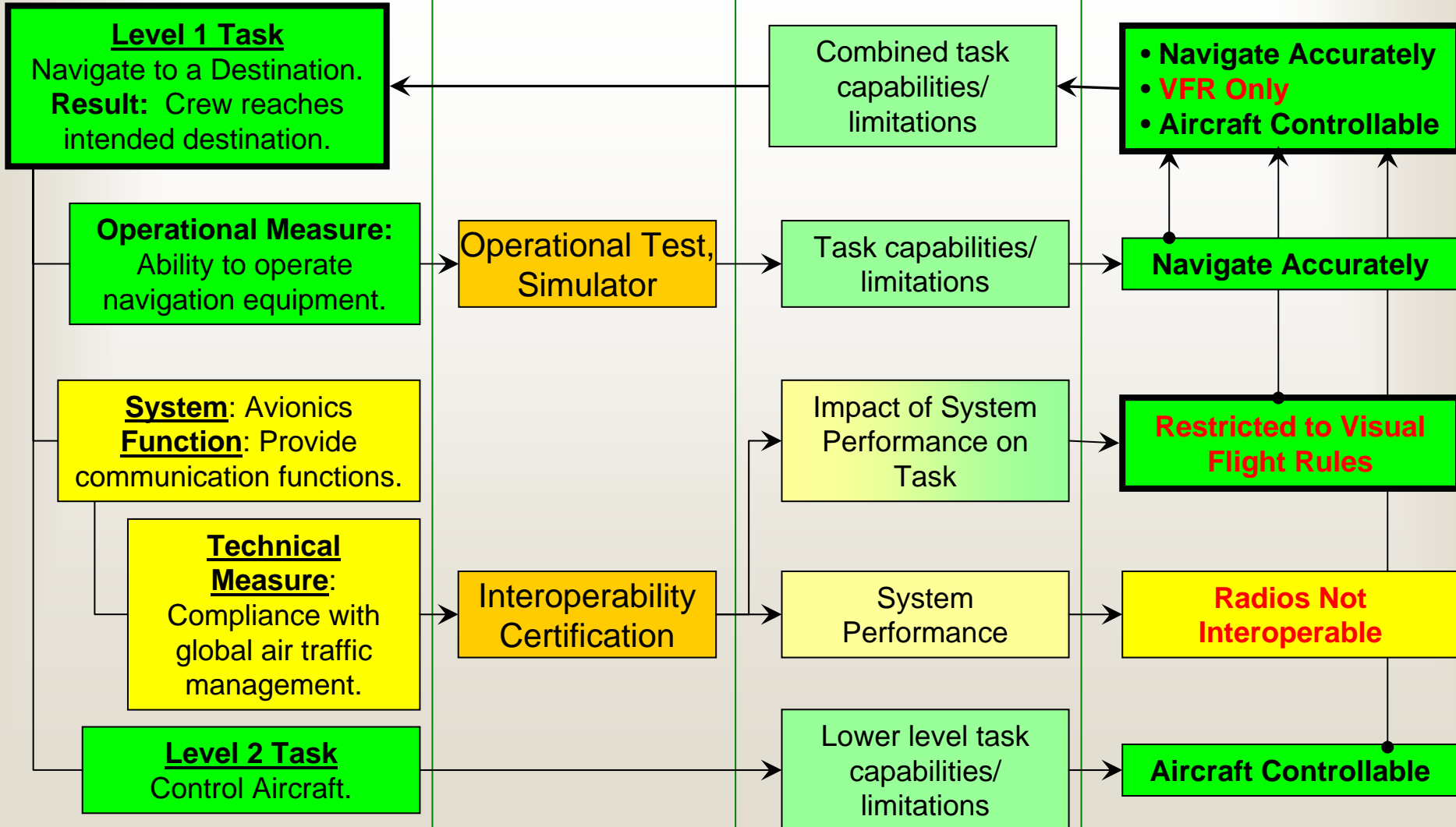
Report Example

T&E Plan

Test

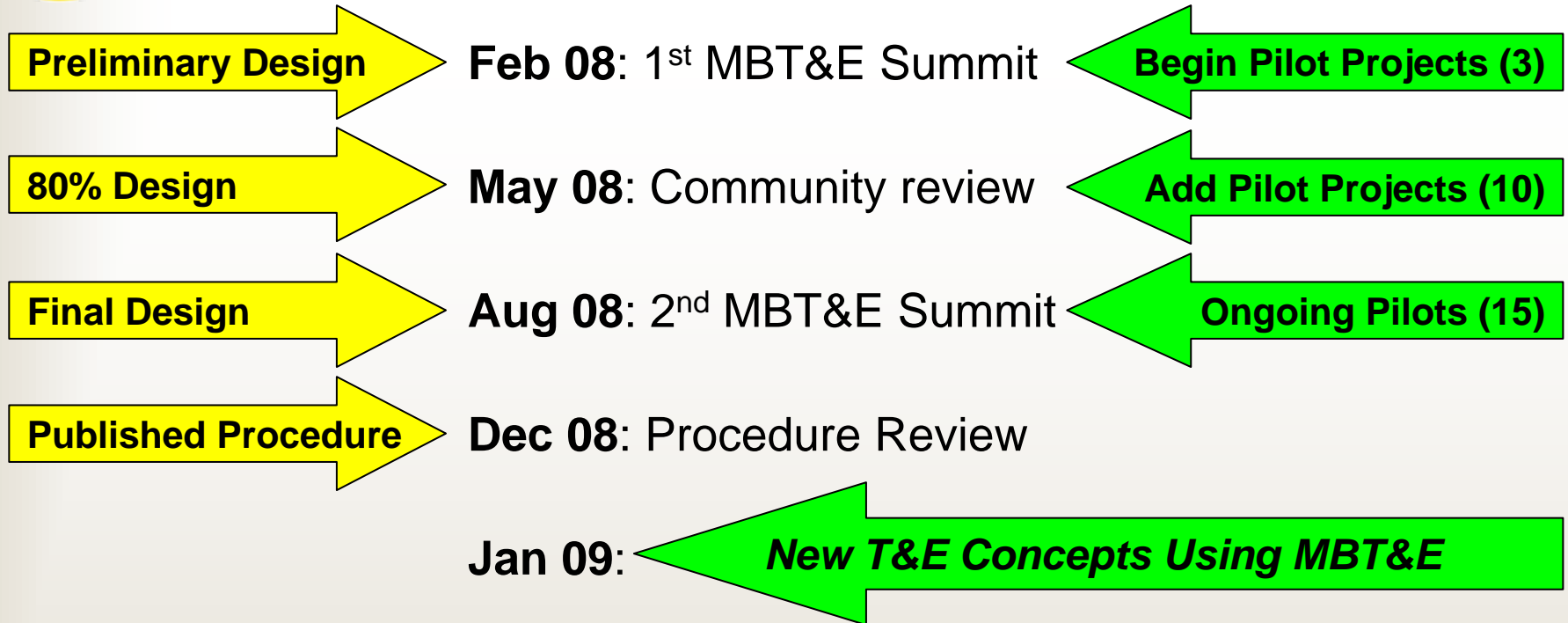
Evaluation

Example





How is MBT&E Implemented?



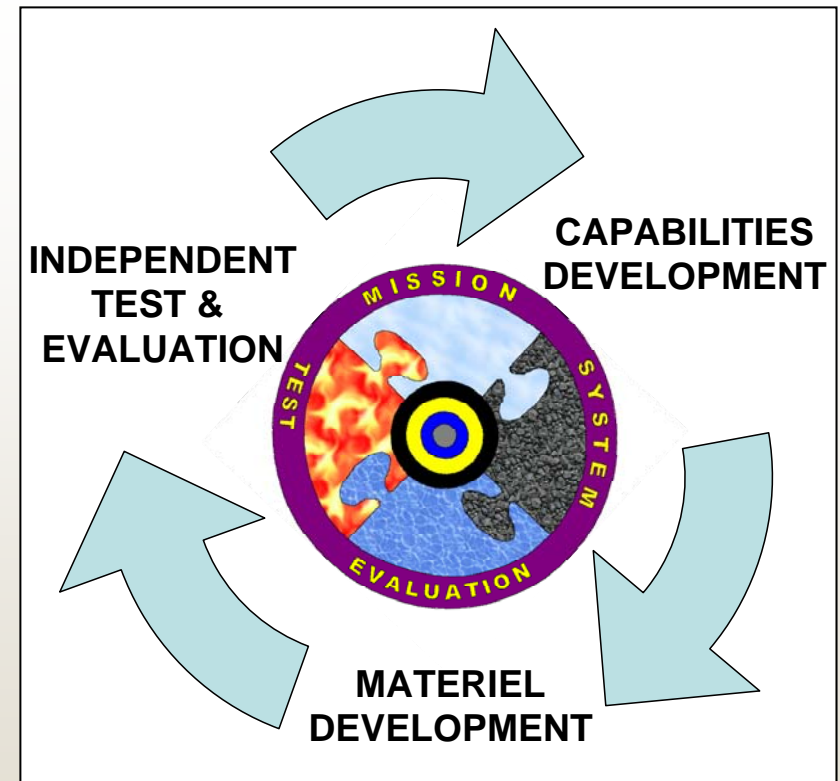
Lessons Learned:

- MBT&E framework providing context of operational capability.
- MBT&E process is executable with current personnel skill set.
- Efficiencies can be increased through:
 - Improved tools (templates, IT, training, etc.); and
 - Combat and materiel developer participation.



Where is MBT&E headed?

- Synchronize with capabilities-based analysis.
- Synchronize with systems engineering.
- Collaborative environment.





Summary

- MBT&E methodology developed.
- Positive results and path forward toward increased efficiencies.
- Aligning the efforts of the capabilities developer, materiel developer, and independent T&E.



MBT&E Point of Contact

Christopher Wilcox

US Army Test and Evaluation Command
US Army Evaluation Center
ATTN: TEAE-MAA (Mr. Chris Wilcox)
4120 Susquehanna Ave.
Aberdeen Proving Ground, MD 21005

Office: (410) 306-0475
Fax: (410) 306-0398
chris.wilcox1@us.army.mil

25th Annual National Test & Evaluation Conference

The Age of Alternative Energy

Keith Williams

President and CEO

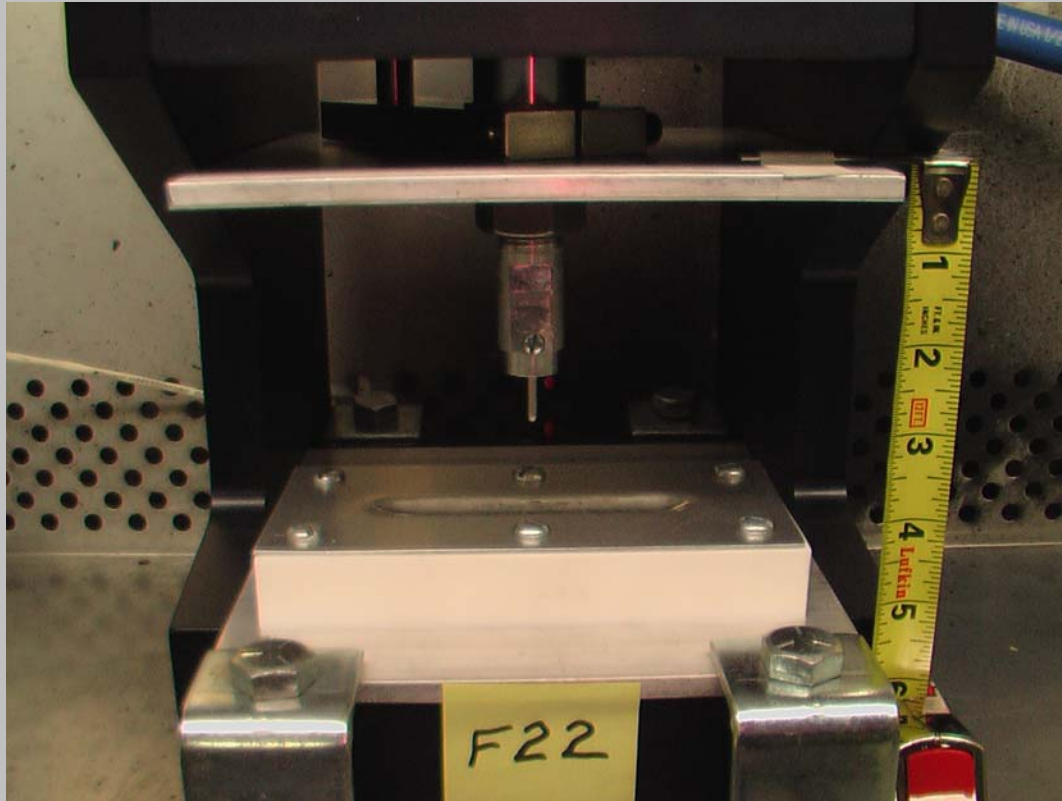
Underwriters Laboratories Inc.



March 3, 2009

Cell K66

0.125" Semi-Ball Crush



Cell K66

0.125" Semi-Ball Crush

QuickTime™ and a
DV/DVCPRO - NTSC decompressor
are needed to see this picture.



Cell K35

34° Carbide Nail - 6mm depth

QuickTime™ and a
DV/DVCPRO - NTSC decompressor
are needed to see this picture.



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March 3, 2009



the standard in safety

Walking the Line with Title 10: Implementation Strategies for Integrated Testing

Beth Wilson

Industry Co-Chair NDIA System Engineering Division, DT&E Committee
Test Architect, Raytheon Company

Darlene Mosser-Kerner

Government Chair NDIA System Engineering Division, DT&E Committee
Developmental Test & Evaluation
OUSD(AT&L)/Systems & Software Engineering

Why Integrated Testing?

5000.02

a. The fundamental purpose of T&E is to provide knowledge to assist in managing the risks involved in developing, producing, operating, and sustaining systems and capabilities. T&E measures progress in both system and capability development. T&E provides knowledge of system capabilities and limitations to the acquisition community for use in improving the system performance, and the user community for optimizing system use in operations. T&E expertise must be brought to bear at the beginning of the system life cycle to provide earlier learning about the strengths and weaknesses of the system under development. The goal is early identification of technical, operational, and system deficiencies, so that appropriate and timely corrective actions can be developed prior to fielding the system.

Dr. Charles E. McQueary
Director of Operational Test and Evaluation
Defense AT&L: January-February 2008

I strongly believe that OT&E should be a process of confirmation and not one of discovery. Unfortunately, OT&E is too often the place where performance shortcomings and new failure modes are discovered. When problems are discovered late in the acquisition process, the cost to fix these problems is much higher than if they were discovered earlier. In addition, the time lost when problems are found at this stage can be substantial—and when our forces need a new capability, the latter penalty may be even more substantial than increased cost.

Navy OT&E Framework Integrated Test Methodology

Robust testing minimizes “surprises” when the product is sent to the war fighter and ensures the specified capabilities are evaluated in the operational environment. Risk is reduced by bringing all testing agents together early in the process to ensure capabilities are tied to mission, mission oriented testing is conducted, system anomalies/deficiencies are identified early in the process, and

Need early identification of problems

Why Integrated Testing?

5000.02

a. The fundamental purpose of T&E is to provide knowledge to assist in managing the risks involved in the development of systems and capabilities. T&E involves the measurement of system performance and the identification of technical, operational, and system deficiencies, so that appropriate and timely corrective actions can be developed prior to fielding the system.

The goal is early identification of technical, operational, and system deficiencies

OT&E should be a process of confirmation and not one of discovery

Dr. Charles E. McQueary
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and new failure modes are discovered. When problems are discovered late in the acquisition process, the cost to fix these problems is much higher than if they were discovered earlier. In addition, the time lost when problems are found at this stage can be substantial—and when our forces need a new capability, the latter penalty may be even more substantial than increased cost.

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Robust testing minimizes “surprises” when the product is sent to the war fighter

Need early identification of problems

Why Integrated Testing?

DSB Task Force on DT&E May 2008 Report FINDINGS

The changes in the last 15 years, when aggregated, have had a significant negative impact on DoD's ability to successfully execute increasingly complex acquisition programs. Major contributors include massive workforce reductions in acquisition and test personnel, a lack of up-to-date process guidance in some acquisition organizations, acquisition process changes, as well as the high retirement rate of the most experienced technical and managerial personnel in government and industry without an adequate replacement pipeline.

- Major personnel reductions have strained the pool of experienced government test personnel

The attacks of September 11, 2001, ushered in a new era of warfighting with the Global War on Terrorism. Significant priority was given to finding more efficient ways to deliver new capabilities to the Combatant Commanders for use against quickly adapting threats. Rigorous T&E before deployment was sometimes sacrificed to meet schedule demands.

Navy OT&E Framework Integrated Test Methodology

all data are shared. Cost is reduced by the sharing of resources, elimination of duplicative testing, and the early identification and correction of deficiencies. Schedule compression is achieved by combined vs. sequential testing and the sharing of high-demand testing assets. None of these objectives can be achieved without the cooperation of all parties and commitment to a “team” approach between the program office, OT, DT, and contractor personnel involved.

Need integrated testing to meet cost/schedule demands

Why Integrated Testing?

DSB Task Force on DT&E May 2008 Report FINDINGS

The changes in the last 15 years, when aggregated, have significantly reduced DoD's ability to successfully execute increasing complex programs. Contributors include massive workforce reductions in acquisition and test organizations, out-of-date process guidance in some acquisition organizations, and the high retirement rate of the most experienced personnel in both government and industry without an adequate replacement pipeline.

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Negative impact on ability to successfully execute complex programs:
Massive workforce reductions in acquisition and test personnel

Rigorous T&E ... sacrificed to meet schedule demands

Cost is reduced by sharing of resources, elimination of duplicative testing

and the early identification and correction of deficiencies. Schedule compression is achieved by combined vs. sequential testing and the sharing of high-demand testing assets. Objectives can be achieved without the cost of a sequential approach between the program office, O&A, and test organizations.

Schedule compression is achieved by combined vs. sequential testing and the sharing of high-demand testing assets

Need integrated testing to meet cost/schedule demands

Integrated Test Definitions: DoD

DAG Chapter 9

9.3.3. Combined DT&E and OT&E

Whenever feasible, DT&E and OT&E events should be combined, if that supports technical and operational test objectives to gain the optimum amount of testing benefit for reasonable cost and time. The user community should be involved early in test planning to ensure the statement of desired capabilities is interpreted correctly and tested realistically. Certain events can be organized to provide information useful to developmental and operational evaluators and lend themselves to the combined DT and OT approach. The concept is to conduct a single, combined test program that produces credible qualitative and quantitative information that can be used to address developmental and operational issues. Examples of this approach include combined DT and OT events, or piggybacking an operational assessment onto a developmental test. Likewise, developmental testing data requirements can be accommodated by an operational test. This approach can reduce the time and expense of conducting dedicated OT events that replicate DT events, or vice versa, yet still provide adequate technical risk reduction. The developmental and operational testers can develop a test management structure to share control of the combined events. Combined DT and OT events and test data requirements must be identified early to prevent unnecessary duplication of effort and to control costs. It is important that neither the DT&E nor OT&E objectives are compromised in designing combined events. For further explanation of this combined strategy, refer to the [DAU Test and Evaluation Management Guide](#).

OSD McQueary/Young Memo 22 Dec 2007

- Developmental and operational test activities shall be integrated and seamless throughout the system life cycle. As technology, software, and threats change, follow-on T&E should be used to assess current mission performance and inform operational users' during the development of new capability requirements.

OSD McQueary/Finley Memo 25 Apr 2008

Integrated testing is the collaborative planning and collaborative execution of test phases and events to provide shared data in support of independent analysis, evaluation and reporting by all stakeholders particularly the developmental (both contractor and government) and operational test and evaluation communities.

Integrated Test Definitions: DoD

Developmental and operational test activities shall be integrated and seamless

DAG Chapter 9.3.3.

9.3.3. Combined DT&E and OT&E

Whenever feasible, DT&E and OT&E events should be combined, if that supports technical and operational test objectives to gain the optimum amount of testing benefit for reasonable cost and time. The user community should be involved early in test planning to ensure the statement of desired capabilities is interpreted correctly and organized to provide information useful to developers themselves to the combined DT and OT approach. A combined test program that produces credible qualitative information can be used to address developmental and operational test objectives. This approach can be used to address developmental and operational test objectives, or piggybacking an operational test. Likewise, developmental testing data requirements can be used to address operational test. This approach can reduce the time and cost of events that replicate DT events, or vice versa, yet still provide the necessary information.

The developmental and operational testers can develop a test management structure to share control of the combined events. Combined DT and OT events and test data requirements must be identified early to prevent unnecessary duplication of effort and to control costs. It is important that neither the DT&E nor OT&E objectives are compromised in designing combined events. For further explanation of this combined strategy, refer to the [DAU Test and Evaluation Management](#)

Dec 2007

activities shall be integrated and seamless technology, software, and threats change, assess current mission performance and inform development of new capability requirements.

Conduct a single combined test program that produces credible qualitative and quantitative information that can be used to address developmental and operational issues

Collaborative planning and collaborative execution

June 25 Apr 2008

collaborative planning and collaborative execution: to provide shared data in support of independent and reporting by all stakeholders particularly the developmental (both contractor and government) and operational test and evaluation communities.

Integrated Test Definitions: Services

Army DA PAM 73-1 • 30 May 2003

Integrated testing and evaluation

A T&E strategy that reduces the multiple and redundant products and processes, and encompasses the development of a single integrated system evaluation plan and a single integrated test/simulation strategy, leading to a single system evaluation report for the customer. The process also increases the use of contractor data for evaluation and expands the use of M&S with the goal of reducing T&E costs. Integrated T&E strategies may include combined DT/OT events where appropriate.

Integrated DT/OT

Integrated DT/OT, a special case of a Combined DT/OT, is a single phased event that generates data to address developmental and operational issues simultaneously under operational conditions. The execution strategy for this event is based on the requirements of the program.

Navy OT&E Framework Integrated Test Methodology

IT is a cooperative approach to T&E where CT, DT, and OT entities work to blend or integrate the T&E requirements throughout the defense acquisition process.

Integration of CT, DT, and OT does not involve the analysis and reporting aspects of T&E, which remain solely under the purview of the respective CT, DT, or OT organization.

Air Force AFI99-103 26 FEBRUARY 2008

Integrated Testing—The harmonization of all types of tests and evaluations that are planned and integrated as early as possible into an efficient continuum, efficiently phased and resourced over time, and reported collaboratively in order to achieve greater test efficiency, reduced cost, and schedule savings without compromising the objectives and needs of the participating test organizations.

Integrated Test Team (ITT)—A cross-functional team of empowered representatives from multiple disciplines and organizations and co-chaired by operational testers and the program manager. The ITT is responsible for developing the T&E strategy and TEMP, assisting the acquisition community with T&E matters, and guiding the development of test plans that are integrated. Note: The ITT is the Air Force equivalent to the T&E Working Integrated Product Team (T&E WIPT) described in the Defense Acquisition Guidebook.

Integrated Test Definitions: Services

Army DA PAM 73-1 • 30 May 2003

Integrated test

Single integrated test strategy

A T&E strategy, and encompasses the development of a single integrated system evaluation plan and a single integrated test/simulation strategy, leading to a single system evaluation report for the customer. The process also increases the use of contractor data for evaluation and expands the use of M&S with the goal of reducing T&E. Integrated T&E includes the use of DT/OT where appropriate.

Generates data to address developmental and operational issues simultaneously under operational conditions

Integrated DT/OT

Integrated DT/OT, a special case of a Combined Test Strategy, is based on the requirements of the program.

Navy OT&E Framework Integrated Test Methodology

IT is a cooperative approach to T&E where CT, DT, and OT entities or integrate the T&E requirements throughout the defense acquisition process. Integration of CT, DT, and OT does not involve the analysis and of T&E, which remain solely under the purview of the respective organization.

CT, DT, and OT entities work to blend or integrate the T&E requirements

Air Force AFI99-103 26 FEBRUARY 2008

Integrated Testing—The hardware and software are

Harmonization of all types of tests

integrated as early as possible in the development process. Test results are reported collaboratively in order to achieve greater test efficiency, reduced cost, and schedule savings without compromise.

Integrated as early as possible into an efficient continuum

Integrated Test Team (ITT) — A cross-functional team of empowered representatives from multiple disciplines and organizations and co-chaired by operational testers and the program manager. The ITT is responsible for developing the T&E test plan, conducting test planning, and guiding the development of test plans that are integrated

Development of test plans that are integrated

equivalent to the T&E Working Integrated Product Team (T&E WIPT) described in the Defense Acquisition Guidebook.

What Does Title 10 Say?

(d) Impartiality of Contractor Testing Personnel.— In the case of a major defense acquisition program (as defined in subsection (a)(2)), no person employed by the contractor for the system being tested may be involved in the conduct of the operational test and evaluation required under subsection (a). The limitation in the preceding sentence does not apply to the extent that the Secretary of Defense plans for persons employed by that contractor to be involved in the operation, maintenance, and support of the system being tested when the system is deployed in combat.

(e) Impartial Contracted Advisory and Assistance Services.—

(1) The Director may not contract with any person for advisory and assistance services with regard to the test and evaluation of a system if that person participated in (or is participating in) the development, production, or testing of such system for a military department or Defense Agency (or for another contractor of the Department of Defense).

(2) The Director may waive the limitation under paragraph (1) in any case if the Director determines in writing that sufficient steps have been taken to ensure the impartiality of the contractor in providing the services. The Inspector General of the Department of Defense shall review each such waiver and shall include in the Inspector General's semi-annual report an assessment of those waivers made since the last such report.

(3) (A) A contractor that has participated in (or is participating in) the development, production, or testing of a system for a military department or Defense Agency (or for another contractor of the Department of Defense) may not be involved (in any way) in the establishment of criteria for data collection, performance assessment, or evaluation activities for the operational test and evaluation.

(B) The limitation in subparagraph (A) does not apply to a contractor that is involved in such development, production, or testing solely in testing

10 USC 2332

NB: This unofficial compilation of the U.S. Code is current as of Jan. 3, 2009.

conduct of
OT&E

establishing
criteria for OT&E

OT&E
evaluation

Contractor cannot be involved in:

- OT&E conduct
- Establishing OT&E criteria
- OT&E evaluation

Title 10 Allows Support to OT&E

DAG Chapter 9

Integrating T&E consists of many aspects, all designed to optimize test scope and minimize cost. For example, separate contractor developmental testing might be combined with governmental developmental test and evaluation, with control being exercised by a combined test organization. Live testing might be integrated with verified, validated, and accredited

Army DA PAM 73-1 • 30 May 2003

c. Discussions with system contractor personnel may be necessary to ensure full technical understanding of test incidents observed during the IOT&E or related activities. All discussions will be held separately from any scoring or assessment activities. The MATDEV should maintain written record of the nature of these contractor and Government discussions.

Navy OT&E Framework Integrated Test Methodology

“Integrated testing” blends or combines contractor, developmental, and OT to form a cohesive testing continuum. This integration cannot occur unless the participants (CT, DT, and OT) have determined their entering requirements for adequate testing of the system under evaluation. IT does not remove or combine any of OPTEVFOR’s current or future requirements for reporting based on a separate (OPTEVFOR) analysis of the shared test information produced by the IT effort.

Air Force AFI99-103 26 FEBRUARY 2008

5.6.2. System Contractor Support to Operational Testing. System contractors may be beneficial in providing logistic support and training, test failure analyses, test data, and unique software and instrumentation support that could increase the value of operational test data. Explanations of how this con-

Title 10:

Contractor cannot be involved in:

- OT&E conduct
- Establishing OT&E criteria
- OT&E evaluation

Contractor **CAN** provide:

- **Technical understanding of test incidents**
- **Logistic support and training**
- **Support to test failure analysis**
- **Unique software and instrumentation support**

Title 10 Allows Sharing of Data

Army DA PAM 73-1 • 30 May 2003

- a. The T&E WIPT goals are to develop a mutually agreeable T&E program that will provide the necessary data for evaluations. T&E WIPTs provide support for the development, staffing, coordination, and approval of all required T&E
- (6) Support the CE process by accomplishing early, more detailed, and continuing T&E documentation, planning, integration, and promote the sharing of data.

T&E Management Guide

4.8 CONTRACTOR TESTING

The Deputy for T&E is responsible for ensuring that contractor-conducted tests are monitored by the government. The Deputy for T&E must also be given access to all contractor internal data, test results, and test reports related to the acquisition program. Usually, the contract requires that government representatives be informed ahead of time of any (significant or otherwise) testing the contractor conducts so the government can arrange to witness certain testing or receive results of the tests. Further, the contractor's internal data should be available as a contract provision. The Deputy for T&E must ensure that government test personnel (DT&E/OT&E) have access to contractor test results. It would be desirable to have all testers observe some contractor tests to help develop confidence in the results and identify areas of risk.

OSD McQueary/Young Memo 22 Dec 2007

- To maximize the efficiency of the T&E process and more effectively integrate developmental and operational T&E, evaluations shall take into account all available and relevant data and information from contractor and government sources.

Navy OT&E Framework Integrated Test Methodology

- Fourth, OT uses the shared data from the IT period to “answer” or achieve resolution on as many measures of effectiveness (MOE) and measures of suitability (MOS) as possible. The goal being to have sufficient data/test information at the end of the IT phase to resolve most COIs, pending successful completion of the final independent OT phase.

The product of the IT integration effort should be an IT database, similar in structure and content to the OT&E Framework database (step **nine**), but merged with DT and CT requirements.

Air Force AFI99-103 26 FEBRUARY 2008

Operational testers may use data from sources such as DT&E, integrated testing, and OAs to augment or reduce the scope of dedicated operational testing if the data can be verified as accurate and applicable.

5.5.2. Contractor T&E Data. Test teams and TIPTs should use as much contractor T&E data as possible if its accuracy can be verified. Contractor T&E data should be visible in the common T&E database.

AFMAN63-119 20 JUNE 2008

A12.1.2. DT&E and OT&E plans and concepts are structured so that OT&E can capture and use DT&E data to reduce OT&E requirements. (ITT) (See A14, A15, A23, A27)

T&E Strategies

5000.02

b. The PM, in concert with the user and the T&E community, shall coordinate DT&E, OT&E, LFT&E, family-of-systems interoperability testing, information assurance testing, and modeling and simulation (M&S) activities, into an efficient continuum, closely integrated with requirements definition and systems design and development. The T&E strategy shall provide information about risk and risk mitigation, provide empirical data to validate models and simulations, evaluate technical performance and system maturity, and determine whether systems are operationally effective, suitable, and survivable against the threat detailed in the STAR or STA. The T&E strategy shall also address development and assessment of the weapons support equipment during the EMD Phase, and into production, to ensure satisfactory test system measurement performance, calibration traceability and support, required diagnostics, and safety. Adequate time and resources shall be planned to support pre-test predictions and post-test reconciliation of models and test results, for all major test events. The PM, in concert with the user and the T&E community, shall provide safety releases (to include formal Environment, Safety, and Occupational Health (ESOH) risk acceptance in accordance with Section 6 of Enclosure 12) to the developmental and operational testers prior to any test using personnel.

Test and Evaluation Strategy:

- Knowledge to manage risks
- Empirical data to validate models and simulations
- Evaluate technical performance
- Evaluate system maturity
- Determine operational
 - Effectiveness
 - Suitability
 - Survivability

Implementation Framework

- **Integrate the People**
 - Integrated Test Teams
 - Coordination and cooperation for integrated strategy
 - Early OT&E influence on test design and scenarios
- **Integrate the Planning**
 - Early and collaborative planning for efficient use of test assets
 - Improve test efficiency and streamline test schedule
 - Reduce duplication and voids
- **Integrate the Data**
 - Maximize data available and usability for OT&E
 - Common data formats to facilitate sharing
 - Incorporate operational realism in DT&E

Path Forward

- **NDIA System Engineering Division**
 - Tasked DT&E Committee to focus on Integrated Testing
 - “Starting with the recommendation from the 2007-08 white paper, develop more detail on methods and practices for Integrated Test.”

- **Integrated CT/DT/OT Committee Approach**
 - Identify existing policies, methods, and practices
 - Determine barriers to Integrated CT/DT/OT
 - Data, resources, planning
 - Cultural constraints
 - Identify potential collaborative approaches within current policies
 - Roles and positions for the people involved
 - Interactions between stakeholders
 - When in lifecycle are these resources involved
 - What are the output products of each interaction

Attributes of Integrated Testing

- **If you find the contractor data augmenting the OT&E data,**
you might be doing integrated testing
- **If the DT&E and OT&E personnel recognize each other in the airport,**
you might be doing integrated testing
- **If the OT&E personnel influences DT&E scenarios,**
you might be doing integrated testing
- **If the DT&E system is operated by end users,**
you might be doing integrated testing
- **If the CT, DT, and OT teams are sharing data in a common format,**
you might be doing integrated testing
- **If the OT&E confirms DT&E results,**
you might be doing integrated testing

Summary

- **Integrated Testing is Needed**
 - Facilitate early identification and correction of system deficiencies
 - Make OT&E a process of confirmation instead of discovery
 - Minimize “surprises” when the product is sent to the war fighter
 - Reduce cost and schedule with shared resources and reduced duplication
- **Title 10**
 - Prohibits contractor involvement in OT&E conduct, criteria establishment, or evaluation
 - Allows contractor to provide technical understanding and support
 - Allows for collaborative planning and execution of an integrated test program to provide shared data to support independent analysis
- **Integrated Test Implementation Framework Involves Integrating**
 - **People:** Integrated test teams to introduce operational realism earlier
 - **Planning:** Early and collaborative efforts to streamline test program
 - **Data:** Sharing of data to address developmental and operational issues

Authors

- **Dr. Beth Wilson** is a Senior Engineering Fellow who earned her PhD in Electrical Engineering from the University of Rhode Island. Since joining Raytheon in 1983, she has worked as a design engineer, program manager, research scientist, functional manager, and test director on sonar, satellite, and radar programs. She is currently the Test Architect for the Dual Band Radar on the Zumwalt Destroyer program. Previous assignments have included deployments to Shemya, Alaska as the Test Director for the Cobra Dane Upgrade, and to Virginia to integrate the console upgrade for the Relocatable Over the Horizon Radar (ROTHR). She is the Industry Lead for the NDIA Systems Engineering Division Developmental Test and Evaluation Committee Integrated DT/OT focus area.
- **Ms. Mosser-Kerner** has over 20 years of test and evaluation experience at NASA and the Department of Defense. Ms. Mosser-Kerner currently works in the Developmental Test and Evaluation (DT&E) for the Department of Defense, focal point within the Office of the Secretary of Defense (OSD) for technical systems evaluation and DT&E matters. She served as the Chief Engineer on the NASA Systems Research Aircraft responsible for over 30 flight test projects involving advanced flight systems. She served as an Assistant Senior Technical Advisor at Edwards Air Force Base. She obtained program management experience with the Naval Air Systems Command. Ms. Mosser-Kerner began her career as an electrical engineer and flight test engineer qualifying as flight crew in high performance aircraft performing engineering duties for advanced systems research development and testing. She has received numerous awards including an Aviation Week & Technology Laurels Award and the DoD 2007 Civilian Tester of the Year. Ms. Mosser-Kerner has a Bachelors Degree in Electrical Engineering and a Masters Degree in Technology Management. She is a member of two academic engineering honor societies.