Rapid / Expedited Systems Engineering

Presented To:

3rd Annual SERC Research Review

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The views expressed herein are those of the author and do not reflect the official policy or position of the United States Air Force, Department of Defense or the U.S. Government
Successful SE
Layered Integrated Framework

Oversight & Control Activities
(Governance: Policy, Councils, Oversight Boards, etc)

Collaborative Environments & Hierarchical Organizations
(Where SE’s Work)

Standard Systems Engineering Processes
(Tailored to Meet Organizational Needs)

Common Methods, Models & Tools
(Future Will Demand Greater Interoperability)

Common Language
(Obtained Through: Education, Training & Experience)
Overarching Conceptual Construct

The AFIT of Today is the Air Force of Tomorrow.

- Systems
- Design Environments
- Capabilities
- Effects

Developed w/ in Environments
Enabling Capabilities
Deliver an Effect
Overarching Conceptual Construct
Where SE’s Primarily Reside

The AFIT of Today is the Air Force of Tomorrow.

1. Systems
2. Design Environments
3. Capabilities
4. Effects

- Developed w/ in Environments
- Enabling Capabilities
- Deliver an Effect

Air University: The Intellectual and Leadership Center of the Air Force
Aim High…Fly - Fight - Win
Systems Engineering Processes In Context

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- Planning, Programming & Budgeting
  - JCIDS
- Technology Development & Insertion
- Life Cycle Program Management
- Configuration Management
- Decision Analysis
- Design
- Manufacturing
- Project Planning
- Requirements
- Risk Management
- Transition, Fielding & Sustainment
- Technical Management & Control
- Verification & Validation
**Earned Value Management**

**'Gold Card'**

- **VARIANCES**
  - Favorable is Positive, Unfavorable is Negative
  - Cost Variance: \( CV = BCWP - ACWP \) \( CV\% = \left( \frac{CV}{BCWP} \right) \times 100 \)
  - Schedule Variance: \( SV = BCWP - BAC \) \( SV\% = \left( \frac{SV}{BCWS} \right) \times 100 \)
  - Variance at Completion: \( VAC = BAC - EAC \)

- **OVERALL STATUS**
  - % Schedule: \( \left( \frac{BCWS_{actual}}{BAC} \right) \) \times 100
  - % Complete: \( \left( \frac{BCWP_{actual}}{BAC} \right) \) \times 100
  - % Spent: \( \left( \frac{ACWP_{actual}}{BAC} \right) \) \times 100

- **DoD TRIPWIRE METRICS**
  - Cost Efficiency: \( CPI = \frac{BCWP}{ACWP} \) Favorable is > 1.0, Unfavorable is < 1.0
  - Schedule Efficiency: \( SPI = \frac{BCWP}{BCWS} \) Favorable is > 1.0, Unfavorable is < 1.0

- **BASELINE EXECUTION INDEX (BEI)**
  - \( BEI = \frac{Tasks\ with\ Actual\ Finish\ Date}{(\#\ of\ Baseline\ Tasks\ Scheduled\ to\ Finish\ Prior\ to\ Status\ Date + Tasks\ Missing\ Baseline\ Start\ or\ Finish\ Date)} \)

- **CRITICAL PATH LENGTH INDEX (CPLI)**
  - \( CPLI = \frac{(CP\ Length\ (Time\ To\ Contract\ End) + Total\ Float\ (To\ Contract\ End\ Baseline\ Finish))}{CP\ Length} \)
  - Hit / Miss: Month's Tasks Completed On or AHEAD / Month's Tasks Scheduled to Complete

- **# ESTIMATE @ COMPLETION (EAC)**
  - \( EAC_{actual} = ACWP_{cumulative} + \left( \frac{BAC - BCWP_{cumulative}}{CPI_{cumulative}} \right) \)
  - \( EAC_{composite} = ACWP_{cumulative} + \left( \frac{BAC - BCWP_{cumulative}}{CPI_{cumulative} \times SPI_{cumulative}} \right) \)

- **# TO COMPLETE PERFORMANCE INDEX (TCPi)**
  - \( TCPi_{EAC} = \frac{Work\ Remaining}{Cost\ Remaining} = \frac{(BAC - BCWP_{cumulative})}{EAC - ACWP_{cumulative}} \)

- **Additional Definitions**
  - NCC: Latest Revised Estimate
  - PMB: Performance Measurement Baseline
  - PP: Planning Package
  - SLPP: Summary Level Planning Package
  - TPi: To Complete Performance Index

**EV misconceptions:**

- ACWP: Actual Cost of Work Performed
- AWW: Authorized Unpriced Work
- BAC: Budget At Completion
- BCWP: Budgeted Cost for Work Performed
- EAC: Estimated at Completion
- NCC: Latest Revised Estimate
- PMB: Performance Measurement Baseline
- SLPP: Summary Level Planning Package
- TPi: To Complete Performance Index

**Acronyms**

- **ACWP** Actual Cost of Work Performed
- **AWW** Authorized Unpriced Work
- **BAC** Budget At Completion
- **BCWP** Budgeted Cost for Work Performed
- **EAC** Estimated at Completion
- **NCC** Latest Revised Estimate
- **PMB** Performance Measurement Baseline
- **SLPP** Summary Level Planning Package

**Specialized Terms**

- **DoD TRIPWIRE METRICS**
- **BASELINE EXECUTION INDEX (BEI)**
- **CRITICAL PATH LENGTH INDEX (CPLI)**

**EV POLICY:**

- DoD 5000.82, Enc 4, Table 5. EVMS in accordance with ANSI/EIA-748 is required for cost or incentive contracts, subcontracts, intra-government work agreements, and other agreements valued $20M (then $30M).

- EVMS is discouraged on fixed price / time / material contracts, and LOE activities regardless of cost.

**EV Contracting Requirements:**

- FAR EVMS Clauses: Not for DoD
  - 52.223-4 for Solicitation
  - 52.223-3 for Price Award
  - 52.223-4 for Solicitation & Contract

- DoD Use of DFAR Clauses: 52.223-8

- Contract Performance Report
- Integrated Master Schedule
- Integrated Baseline Review

**EVM Home Page:**

- EVM Evans AFI
- EVM DODAF

**Revised November 2019**
## Doing The Same - Differently

### Sample Reporting Format

<table>
<thead>
<tr>
<th>PERIOD ENDING (DATE)</th>
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<tr>
<th>TASK DESCRIPTION</th>
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<th>ACTUAL START DATE</th>
<th>SCHEDULED COMPLETE DATE</th>
<th>ACTUAL COMPLETE DATE</th>
<th>BUDGETED AMOUNT ($)</th>
<th>ACTUAL AMOUNT EXPENDED TO DATE ($)</th>
<th>ESTIMATED PERCENT COMPLETE</th>
<th>PERCENT EXPENDED TO DATE (BUDGET/ACTUAL) ($)</th>
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### Shifting The Curve
What’s Needed

Collaborative Design and Decision Support:

Tools, methods, processes and environments that allow engineers, warfighters, and other stakeholders to share and discuss choices. This spans human-system interaction, collaboration technology, visualization, virtual environments, and decision support.
Breaking It Down

The AFIT of Today is the Air Force of Tomorrow.

• The capability when employed—will serve as the critical integrating component in attainment of systems by bringing together all of the stakeholders (engineers, warfighters, logisticians, etc.) across all of the processes (conception, design, engineering, prototyping, production and field use and adaption).

• At a minimum the environment will link:
  • Engineering models/tools
  • Virtual demonstration space (e.g. war gaming, synthetic environments, virtual environments)
  • Deployed systems (live and physical test environments)
  • Situational factors (e.g. funding constraints, presently available resources, physical environment, threats, political situation, adversarial military and technological capabilities, etc)
Breaking It Down (con’t)

The AFIT of Today is the Air Force of Tomorrow.

• The purpose of the environment is to:
  • Support a closer to "real-time" Executive Information System (EIS)
  • Enabled by Analysis of Alternatives (AoA) models which together;
  • Drive a Decision Support Systems (DSS)

• The environment must support both development of new systems and stimulate adaption of existing systems

• The goal will be to assist decision makers in decisions regarding:
  • How to best achieve established requirements
  • Examination and setting of requirements based on combined "knee of the curve" determinations
  • “Mission utility breadth assessments”
  • Alternative product and system of systems configurations
  • Divisions of solution between system solution and ConOps
Potential Virtual Collaborative Environment (VCE) OV-1

Systems with Resilient Qualities
Derived as a result of improved decision processes, understanding and sharing of critical engineering and acquisition information

Managed Information Sharing Environment:
Collaborative Capabilities:
Tools, Services, Social & Virtual Spaces

Analysis & SE Processes
Acquisition Processes

RDT&E Feedback
Warfighter Feedback

Transfer
Transfer
Transfer

Decision Makers
Program Managers
Engineers
Analysts
Users

Program Information
Authoritative Standardized Data Sources

Locally managed, accessible, standards compliant information regarding: Requirements, Plans, Architecture, System Engineering, Cost, Performance, Analysis, Logistics

Derived during Jul 2011 Joint Service CONOPS workshop hosted by the AF CSE
Potential Research Needs

1. **Dissemination:**
   • Robust, trusted, standardized information exchange policy enforcement services

2. **Process - Business:**
   • Definition of business intelligence services that address enterprise scale large data analytics and visualization of system engineering data

3. **Infrastructure - Synthetic Environments for Professional and Social Interactions:**
   • Social services that inform and integrate the acquisition community
4. **People:**
   - Training & retraining techniques and curriculum to accelerate workforce MBSE skills acquisition and maintenance

5. **Security & Information Assurance:**
   - Policies and supporting tools and methods to ensure cyber security in a relaxed RDT&E CVE IA environment
6. **MBSE:**

- Automated techniques that can assess modeling patterns and products
- Tools and techniques to reverse engineer and assess legacy systems software to generate modernized less vulnerable code.
- Tools and techniques to simplify and accelerate the transformation of system engineering models into simulated virtual entities for analysis and training.
The Challenge

Create the nations technical workplace of tomorrow by shifting the curve