Writing a Systems Engineering Plan, or a Systems Engineering Management Plan? Think About Models and Simulations

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Office of the Deputy Assistant Secretary of Defense for Systems Engineering

16th Annual NDIA Systems Engineering Conference

Arlington, VA | October 30, 2013

DASD, Systems Engineering Mission

Systems Engineering focuses on engineering excellence − the creative application of scientific principles:

- To design, develop, construct and operate complex systems
- To forecast their behavior under specific operating conditions
- To deliver their intended function while addressing economic efficiency, environmental stewardship and safety of life and property

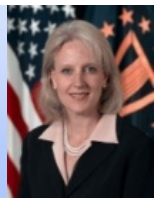
DASD(SE) Mission: Develop and grow the Systems Engineering capability of the Department of Defense – through engineering policy, continuous engagement with component Systems Engineering organizations and through substantive technical engagement throughout the acquisition life cycle with major and selected acquisition programs.

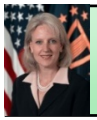
A Robust Systems Engineering Capability Across the Department Requires Attention to Policy, People and Practice

- ***US Department of Defense is the World's Largest Engineering Organization***
- ***Over 99,000 Uniformed and Civilian Engineers***
- ***Over 39,000 in the Engineering (ENG) Acquisition Workforce***

DASD, Systems Engineering

DASD, Systems Engineering
Stephen Welby
Principal Deputy Kristen Baldwin





Systems Analysis
Kristen Baldwin (Acting)

Addressing Emerging Challenges on the Frontiers of Systems Engineering

- Analysis of Complex Systems/Systems of Systems
- Program Protection/Acquisition Cyber Security
- University, FFRDC and Industry Engineering and Research
- Modeling and Simulation

Major Program Support
James Thompson

Supporting USD(AT&L) Decisions with Independent Engineering Expertise

- Engineering Assessment / Mentoring of Major Defense Programs
- Program Support Reviews
- OIPT / DAB / ITAB Support
- Systems Engineering Plans
- Systemic Root Cause Analysis

Mission Assurance
Vacant

Leading Systems Engineering Practice in DoD and Industry

- Systems Engineering Policy & Guidance
- Development Planning/Early SE
- Specialty Engineering (System Safety, Reliability and Maintainability Engineering, Quality, Manufacturing, Producibility, Human Systems Integration)
- Counterfeit Prevention
- Technical Workforce Development
- Standardization

Providing technical support and systems engineering leadership and oversight to USD(AT&L) in support of planned and ongoing acquisition programs

SEP Outline

- **1.0 Introduction**
- **2.0 Program Technical Requirements**
  - **2.1 Architectures and Interface Control**
  - 2.2 Technical Certifications
- **3.0 Engineering Resources and Management**
  - 3.1 Technical Schedule and Schedule Risk Assessment
  - **3.2 Engineering Resources and Cost/Schedule Reporting**
  - 3.3 Engineering and Integration Risk Management
  - 3.4. Technical Organization
    - **3.4.1 Government Program Office Organization**
    - 3.4.2 Technical Staffing Levels
    - 3.4.3 Contractor(s) Program Office Organization
    - 3.4.4 Engineering Team Organization and Staffing
  - 3.5 Relationships with External Technical Organizations
  - 3.6 Technical Performance Measures and Metrics
- **4. Technical Activities and Products**
  - **4.1 Results of Previous Phase SE Activities**
  - **4.2 Planned SE Activities for the Next Phase**
  - 4.3 Requirements Development and Change Process
    - **4.3.1 Analysis and Decomposition**
    - **4.3.2 Requirements Management and Change Process**
  - **4.4 Technical Reviews**
  - **4.5. Configuration and Change Management Process**
  - 4.6 Design Considerations
  - 4.7 Engineering Tools

Red indicates areas where SEP Outline changes are suggested.

The SEP Outline doesn't sufficiently cover planning for Modeling and Simulation

2.1 Architectures and Interface Control

- **2.1. Architectures and Interface Control –** List the architecture products that will be developed, to include system level physical and software architectures and DODAF architectures. Summarize the approach for architecture development to include:
  - Program's DODAF architecture development efforts.
  - A system physical architecture diagram (delineating physical interfaces)**, if available.**
  - A system functional architecture diagram (delineating functional interfaces)**, if available.**
  - How software architecture priorities will be developed and documented.
  - How architecture products are related to requirements definition.
  - How engineering and architecture activities are linked.
- **Expectations:** Programs whose system has external interfaces need to have dependencies (i.e., hierarchy) clearly defined. This should include interface control specifications, which should be confirmed early on and placed under strict configuration control. Compatibility with other interfacing systems and common architectures should be maintained throughout the development/design process. **Architectures should be developed in an integrated manner with appropriate relationships established between architecture artifacts and objects, and their uses.**

Programs need to develop architectures to fully describe their design and mission context. These artifacts should be an output of the Systems Engineering Process.

3.2 Engineering Resources and Cost/Schedule Reporting

- **3.2. Engineering Resources and Cost/Schedule Reporting** – List and summarize the program oversight and management systems **including modeling and simulation tools** that will integrate cost, schedule, and technical performance goals, metrics, and resources.

- **Expectations:** Program should have an adequate IMP and IMS **which address all the planning, to include tools planning and usage of models (and simulations),** and requires the same from its contractor(s).

Models and simulations are tools that should be planned for if they are to be used effectively. Developer and government efforts need to be complementary.

3.4.1 Government Program Office Organization

- **3.4.1. Government Program Office Organization -** Provide planned program office organization structure (i.e., wiring diagram to illustrate hierarchy) with an as-of date and include the following elements:
  - Legend, as applicable (e.g., color-coding)
  - Organization to which the program office reports
  - Program Manager (PM)
  - Lead/Chief Systems Engineer (LSE/CSE)
  - Functional Leads (e.g., T&E, logistics, risk, reliability, software, **modeling and simulation)**
  - Core, matrix, and contractor support personnel
  - Field or additional Service representatives
- **Comment** to Figure 3.4.1-1 Insert "Modeling and Simulation Lead" as a Gov't Core Team member under the Gov't "SE Lead"
- **Expectations:** Programs should use a workload analysis tool to determine adequate level of staffing, appropriate skill mix, and required amount of experience to properly staff, manage, and execute successfully

Identify the appropriate responsible individual or team for use and execution of model and simulation resources

4.1 Results of Previous Phase SE Activities

- **4.1. Results of Previous Phase SE Activities -** Summarize (consider a tabular format) system-level technical reviews, trade studies, **system models created,** and independent reviews conducted to date; date(s) conducted; and key results or impact(s) to design and any related recommendations and status of actions taken. For MDAPs, these reviews shall include an assessment of manufacturing risk and r
- **Expectation:** Program should trace all requirements from JCIDS into a verification matrix

Models used in a previous phase of the life cycle should be identified and how and if it should be transitioned to the next phase in the life cycle needs to be considered as part of planning.

4.2 Planned SE Activities for the Next Phase

- **4.2. Planned SE Activities for the Next Phase –** Summarize key planned system engineering**, modeling**, integration, and verification processes and activities established or modified since the previous acquisition phase, including updated risk reduction and mitigation strategies and technical and manufacturing maturity.
- **Expectation:** Program should trace all requirements from JCIDS into a verification matrix

Modeling activities need to be included in the planning for each phase across the Acquisition Life Cycle.

4.3.1 Analysis and Decomposition

- **4.3.1. Analysis and Decomposition –** How will top-level requirements (i.e., from AoA, KPPs, KSAs, statutory, regulatory, certification, safety, software, hardware, etc.) be traced from the source JCIDS documents down to configuration item (CI) build-to specifications and Verification and Validation (V&V) plans?
  - Identify which program office position or team (e.g., IPT/WG) is responsible for continuously ensuring the accurate traceability of requirements.
  - Identify the **requirements management and system modeling/architecture** tool (s) the program plans to use (or continues to use) for requirements traceability in Tools Table 4.7-1.
  - If the program office and prime contractor(s) use different tools, how will information be transferred across them?
  - What approach will be used to ensure that there are no orphan or childless requirements?
  - Describe how the JCIDS sustainment characteristics were translated into R&M contract specifications **including models used for analysis.**
- **Expectation: Program should trace all requirements from JCIDS into a verification matrix**

Modeling tools used to support analysis and decomposition should be identified and how they will be used should be planned.

4.3.2 Requirements Management and Change Process

- **4.3.2. Requirements Management and Change Process –** How will requirements be managed and changes made and tracked?
  - If the program is a MDAP, and if it were to have a change in requirement which could result in a cost and/or schedule breech, summarize the mechanism by which the program will involve its Configuration Steering Board.
  - Identify which program office position or team (e.g., IPT/WG) will be responsible for continuously ensuring the accurate management of requirements and requirement changes.
  - **Describe how system requirements management/model/architecture tool(s) are used to assess the impact of the changes.**
- **Expectation:** Program should trace all requirements from JCIDS into a verification matrix

Models are often used to project and assess the impact of changes.

4.4 Technical Reviews

- **Planned System-Level Technical Reviews –** For each planned system-level technical review in the next acquisition phase, include a marker on the program schedule (Figure 4.1-1-n) and a technical review table. **Describe how system modeling/architecture artifacts are used to support these reviews.** This table, or something analogous, is mandatory.

- **Expectation**: Programs should use a standard process for conducting technical reviews

The actual source data (i.e. System Model) should be used to support technical reviews.

4.5. Configuration and Change Management Process

- **Configuration Management/Control (and Change) Process Description –** Provide a process diagram of how the program will maintain configuration control of its baselines. Identify when in the acquisition lifecycle the program will assume initial and full configuration control of its baselines. **Identify the system model as a means to manage and maintain a record of configuration changes, including to the above mentions artifacts. Identify additional models developed to support the acquisition.**

- **Expectation**: Programs should understand which artifacts make up each technical baseline and manage changes accordingly

Models should be controlled as part of the programs technical baseline and in a way that results in an authoritative set of integrated program data.

Summary

- **Modeling and Simulation is a tool used to support systems engineering.**
- **The SEP Outline doesn't sufficiently cover planning for Modeling and Simulation**
  - Need to plan across the Acquisition Life Cycle.
  - Need to identify responsibility and to ensure efforts government and industry efforts are necessary, sufficient and coordinated.
  - What is needed, why, when, how it is used…..
    - Analysis, System Definition, Design Decisions, Technical Reviews, Acquisition Decisions, Verification/Validation, Impact Assessment, etc…..
  - Models should be controlled as part of the programs technical baseline and in a way that results in an authoritative set of integrated program data.

For Additional Information

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Systems Engineering: Critical to Defense Acquisition










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