System Model Concept

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DASD, Systems Engineering

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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

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

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
System Model Supports All Dimensions of System Acquisition
(from Dr. P. Montgomery, NPS)

Stakeholders, Program Resources, TOC Control, P3I

AN EXAMPLE......
Purpose: One page that conveys a high-level, concise, and comprehensive set of truths for Mod/Sim usage in Systems Engineering support to acquisition

Key Areas Emphasized:
- Program Systems Engineer is responsible for Mod/Sim planning and coordination
- Mod/Sim is included in key schedule and programmatic plans
- SE uses models to define, understand, and communicate technical artifacts
- Models are continually updated throughout program life-cycle
- Project success is dependent on appropriate Mod/Sim training of team

• **Section 4.1 Introduction**

• **Section 4.2 Systems Engineering Activities in the Life Cycle**

• **Section 4.3 Systems Engineering Processes** provides a description of each process and contains the design considerations including specialty engineering.
  
  − 4.3.19 Tools, Techniques, and Lessons Learned - SE tools and techniques support the Program Manager and Systems Engineer in performing and managing the SE activities and processes to improve productivity and system cost, schedule, capabilities, and adaptability. The program should begin applying SE tools and techniques during the early stages of program definition to improve efficiency and traceability and to provide a technical framework for managing the weapon system development.

  − 4.3.19.1 Modeling and Simulation - Models and simulations are SE tools used by multiple functional area disciplines during all life-cycle phases. Modeling is essential to aid in understanding complex systems and system interdependencies, and to communicate among team members and stakeholders. Simulation provides a means to explore concepts, system characteristics, and alternatives; open up the trade space; facilitate informed decisions and assess overall system performance.
DAG Ch 4: Weapon System Development Life Cycle

Weapon System Development Life Cycle

Enabling S&T
Pre-Acquisition Concepts, Experimentation and Prototyping

MDD
Material Solution Analysis

A
Technology Development

B
Engineering and Manufacturing Development

C Production and Deployment

FRP/FD
IOC
FOC

Disposal

Mandatory technical reviews

Best practice technical reviews and audits

Test reviews (see DAG Chapter 9)

- AOTR - Assessment of Operational Test Readiness
- ASR - Alternative Systems Review
- CDR - Critical Design Review
- EMD - Engineering and Manufacturing Development
- FCA - Functional Configuration Audit
- FD - Full Deployment
- FOC - Full Operational Capability
- FRP - Full Rate Production
- IOC - Initial Operational Capability
- ISR - In-Service Review
- MDD - Material Development Decision
- OTRR - Operational Test Readiness Review
- PCA - Physical Configuration Audit
- PDR - Preliminary Design Review
- PRR - Production Readiness Review
- S&T - Science and Technology
- SRR - System Requirements Review
- SFR - System Functional Review
- SVR - System Verification Review
- TRR - Test Readiness Review
DAG Ch 4: Various Applications of Modeling and Simulation

Modeling and Simulation in the DoD Acquisition Life Cycle
“Weapon System Development”

Analysis of Alternatives
- Concept of Operations (CONOPS) modeling
- Cost / schedule / performance trades
- System interoperability discoveries
- Portfolio coverage analysis

Analysis of Alternatives
- Assess materiel solutions
- Estimate life cycle costs
- Model CONOPS and mission context
- Interoperability and warfighter integration analysis
- Industrial / manufacturing capability analysis
- Supportability and sustainment modeling

Technology Maturation and Risk Reduction
- Trade studies
- System threat integration
- Model environment and demonstrate technology
- Interoperability and supportability analysis
- Operational suitability and affordability
- Industrial / manufacturing capability and readiness assessment
- Estimate manpower / cost
- Model system to performance specifications
- T&E planning
- Human interface prototyping

Develop Affordable and Executable Manufacturing Process
- Ensure operational supportability
- Reduce logistics footprint
- Survivability analysis
- Human Systems Integration (HSI)
- Design for producibility
- Demonstrate system safety
- Verify functionality and performance to specifications / needs
- Manpower estimates

Manufacturing Development
- Industrial / manufacturing readiness assessment
- Environment, Safety, and Occupational Health (ESOH) models
- Military equipment valuation
- Corrosion prevention and control
- Refine LCSP
- Production qualification testing
- Verify and validate production configuration
- Economic analysis

Post-Production Support
- Supply chain management
- Monitor performance and adjust product support
- Training
- Supportability assessments
- Disposal planning
- Validate failures and determine root causes
- Determine system risk / hazard severity
- ECP impact analysis
Problem Statement

**ISSUE:** Current DoD acquisition activities do not develop, or maintain a single, integrated authority/artifact (aka system model) for a TBD subset of program data. Further, relevant data between acquisition activities is not adequately shared.

**VISION:** Use of a single model (aka system model) as an evolving, cohesive representation and unifying instantiation of the program under conceptualization, development, manufacture, and/or support:

- will increase efficiency of DoD system acquisition lifecycle activities, and
- increase confidence in decisions made regarding an acquisition program when the single (system) model (data) for that program is used.

**METHOD:** A system model will be instantiated by using artifacts and processes which already exist, or are already required by DoD acquisition policies, guidance, and best practices.

**OUTCOME:** The system model will be used by anyone performing activities related to the program as it evolves across the acquisition lifecycle, including but not limited to defining requirements, trading design aspects, designing, engineering, cost budgeting, staffing, manufacturing, fielding, training, sustaining, and disposing. The resultant system model will integrate program data into a complete description of the system.
DAG 4.3.19.1 Modeling and Simulation

• **Models and simulations should be:**
  - Developed and matured through the life of the program
  - Properly managed and controlled as part of the program’s technical baseline
  - Developed and documented, to include metadata (see Modeling and Simulation Community of Interest Discovery Metadata Specification (MSC-DMS)) and open systems standards, to maximize opportunity for reuse and repurposing (both within the program and in support of other acquisition efforts)
  - Included as part of the technical data package to be transitioned into the next phase of the life cycle or into other efforts
Some Uses of the System Model

- More complete evaluation of trade space
- Improved communications across stakeholders
- Earlier evaluation of manufacturing feasibility

- Rapidly evaluate changing threats and explore solution space
- Design reuse
- Lower costs with complex product families

- Reduced manufacturing related costs and schedule

DAG Ch 4: Benefits of Using Modeling and Simulation throughout the Acquisition Life Cycle
DAG Ch 4: Technical Data Management Process

**Technical Data** - Recorded information, regardless of the form or method of the recording, of a scientific or technical nature (including computer software documentation). The term does not include computer software or data incidental to contract administration, such as financial or management information. Source: DFARS 252.227.7013

**Product Data** - All data created as a consequence of defining (requirements), designing, testing, producing, packaging, storing, distributing, operating, maintaining, modifying and disposing of a product. Source: Army PEWG, based on ANSI/EIA-649-B-2011

**Technical Data Package**

- Includes:
  - Drawings / Models
  - Lists – Inspection / Test Equipment
  - Software Documentation
  - Interface Control Documents
  - Engineering Product Structure

**TDP** - A technical description of an item adequate for supporting an acquisition strategy, production, and engineering and logistics support. The description defines the required design configuration or performance requirements, and procedures required to ensure adequacy of item performance. It consists of applicable technical data such as models, drawings, associated lists, specifications, standards, performance requirements, quality assurance requirements, software documentation and packaging details. Source: MIL-STD-31000
Questions?

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# Core AMSWG Membership*

<table>
<thead>
<tr>
<th>Organization</th>
<th>Primary</th>
<th>Alternate</th>
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<tbody>
<tr>
<td>US Army</td>
<td>Dr. Nancy Bucher</td>
<td>Jerry Kniphfer</td>
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<tr>
<td>US Navy</td>
<td>Dennis Reed</td>
<td>Mike Lamarche</td>
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<td>John McMaster</td>
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<td>US Marine Corps</td>
<td>Mike O’Neal</td>
<td>LT COL Walt Yates</td>
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<td>US Air Force</td>
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<td>Dale Fogle</td>
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<td>Missile Defense Agency (MDA)</td>
<td>Sandra Veautour</td>
<td>Doug Parsons</td>
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<tr>
<th>Organization</th>
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<td>NDIA</td>
<td>Jim Coolahan, Jeff Bergenthal</td>
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<td>INCOSE</td>
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<td>MORS</td>
<td>Simon R. Goerger</td>
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* Additional Core members may be added at a later date.