The Acquisition Community Modeling & Simulation Strategy (AMSS)

Philomena Zimmerman
Office of the Deputy Assistant Secretary of Defense for Systems Engineering

15th Annual NDIA Systems Engineering Conference
San Diego, CA | October 24, 2012
Agenda

• Acquisition Modeling & Simulation – the Call for Action
• AMSS – Why was it conceived and How was it created
• Systems Modeling Use in Acquisition - Vision and Possibilities
• Systems Modeling Use in Acquisition – Supporting the Future

AMSS – Acquisition Modeling & Simulation Strategy
Observations: Call for Action

• **Modeling and Simulation is not consistently applied in the acquisition lifecycle**
  – It is not consistently recognized as a component or enabler of Systems Engineering
  – It is not consistently productive for the program management team
  – It is inconsistently applied in phases of the acquisition lifecycle

• **Models and simulations are never used as a continuum of tools, or as a supplier of rationale and justification for analysis, evaluations, and assessments across the acquisition lifecycle**
  – It is not consistently represented in Service and component organizations
  – It is not, as a community, organized to answer questions, fill SE gaps, or share best practices

• **Modeling and simulation has a long-standing strategy for the general use, but it does not have a current roadmap for improvement in application (especially for acquisition)**
  – Acquisition modeling and simulation needs, capabilities, messages from PEO, PM not reaching OSD; and vice versa

• **“What do you need to model? How much fidelity do you need in that modeling? Is the modeling credible for use?”**
Purpose of the AMSS

The purpose of the Acquisition Community Modeling & Simulation Strategy is to synthesize the findings of recent research into the application of modeling & simulation in support of the acquisition system life cycle technical activities and recommend a near-term set of activities or investments that will move the Department of Defense forward towards improved use of systems modeling in acquisition.
Development Guidance for the AMSS

• Identify high-priority opportunities focused on improving modeling & simulation’s usefulness to program managers
• Concentrate on improving the confidence and usefulness of modeling and simulation In programs
• Focus on opportunities that can be executed within the next 2 to 4 years
• Ensure that projects have “leave-behind capability” or identify potential areas for further inquiry
• Support the Modeling and Simulation Coordination (M&SCO) office in developing modeling and simulation enterprise needs and capabilities
How AMSS Was Conceived & Created
From Strategy to Execution

A number of other independent efforts also influenced the overall Systems Modeling strategy:

- National Defense Industry Association (NDIA) study on Model Based Engineering (MBE)
- Rapid Capability Fielding “Toolbox” Study (Study sponsor: DDR&E)
- Various SBA studies from the late 1990s

Acquisition Modeling and Simulation Master Plan (April 2006)

Ubiquitous Modeling and Simulation Report (Jan 2011)

Systems Engineering Modeling, Simulation, & Analysis Fundamentals (July 2012)

Acquisition Modeling and Simulation Working Group

Acquisition Modeling and Simulation Strategy (Sept 2012)

Acquisition Modeling and Simulation Implementation Plan (Under Development)

Provides a broadly focused mod/sim technology gap analysis

Identifies near term acquisition related mod/sim shortfalls

Captures essentials of mod/sim use in acquisition programs

Establishes recommendations for strengthening mod/sim usage in acquisition

Translates AMSS recommendations into a series of project ideas
The AMSS is NOT a grand vision document, it is focused on critical ‘next step’ enablers to improve mod/sim effectiveness for acquisition functions & phases

- Identifies key near-term recommendations for research & innovation with primary focus on support to PM & Chief Engineers
- Heavy focus on viability vice policy
- Derived from recent sponsored research/studies on existing capabilities and needs
- Shaped with AMSWG and community collaboration
- Advocates increased emphasis on concurrent and integrated modeling between requirements, cost, schedule, performance, risk

Next Steps:
- convert appropriate AMSS recommendations into a set of (proposed) project definitions
- a 10 Page (or less) companion: AMSS Executive Overview
AMSS
Recommendations in 7 Topic Areas

1. **Leadership**
   1. Establish proponency for systems modeling use across the acquisition lifecycle
   2. Expand view of systems modeling to include physical modeling techniques

2. **Reference Models**
   1. Develop current and future state reference models
   2. Manage appropriate changes to policy and guidance related to systems modeling use in acquisition
   3. Gather evidence and build guidance for incorporation of modeling use early in the program lifecycle

3. **Data Management**
   1. Assess current standards in metadata capture, and develop standards where gaps exist
   2. Assess data warehousing approaches and develop appropriate implementation requirements and plans
   3. Improve access to BLUFOR data
   4. Collect and use environmental data
AMSS
Recommendations in 7 Topic Areas

4. Making Model Based Systems Viable and Affordable
   1. Assess current costs (resources and schedule) associated with use of modeling; identify reduction activities
   2. Establish priorities for improving quality and effectiveness of systems modeling use in acquisition

5. Improving Human Behavior Representation and Other Orphaned Technologies
   1. Improve Human-Interpretable Modeling
   2. Identify next-generation simulation design, and design techniques
   3. Assess and improve federation construction tools
   4. Improve understanding of results from model-based analysis
   5. Explore alternate modeling techniques, and support to conceptual modeling
   6. Improve integration with physics-based models
   7. Provide enhanced support to test
   8. Provide enhance HBR, and interoperation with HBR models
   9. Explore ensemble modeling to assist with uncertainty exploration
AMSS
Recommendations in 7 Topic Areas

6. Business Processes
   1. Provide method to analyze POM and program planning to anticipate gaps in system modeling use in acquisition
   2. Identify rationale to support investment in system modeling use in acquisition
   3. Establish a technology working group focused on system modeling use in acquisition
   4. Establish best practices and guidance, and revise as system modeling use in acquisition advances
   5. Develop boilerplate (RFP, CDRL, SOW….) language for ensuring adequate systems modeling across the acquisition program lifecycle
   6. Use system modeling results in the RFP and RFP response process
   7. Develop practitioners skilled in system modeling use in acquisition.

7. Measuring Progress
   1. Identify metrics and methods for measuring progress of adoption and use of system modeling in acquisition activities
   2. Accurately identify model capabilities used in system modeling use in acquisition, and measure progress.
Systems Modeling Use in Acquisition
A 10,000 Ft View of the Practice

• The use of models and the insights gained from their use, aid in the conceptualization, resource estimation, design, deployment and sustainment of systems

• It is not limited to engineering; it enables engineering rigor across all acquisition functions

• The tools and processes for systems modeling and use are not separate functions; they enable acquisition functions to be more efficient

• “Modeling” refers to a wide range of artifacts, to include physical and computer based

• Application of models supports reduction of program uncertainties, at any point in time, in cost, schedule, and performance

The concept is still maturing
• In far more use that often recognized
• Has proven to be powerful when used
• Is not perfected, and requires intelligent use
• Adoption has been uneven across DoD to date

Model based acquisition does not diminish the importance of simulations; it increases the relevance of simulation output through consistent use of complete models
Desired Systems Modeling Use in Acquisition

**Capabilities Based Assessment**
- Digital ICD format and content, including the associated models, simulations and data
- Similar data for the doctrine/tactics/training community

**Materiel Solution Analysis**
- Contracting language
- Intellectual property (IP) management
- Model validation adequate to manage contract
- PM guidelines for standing up a model based program

**Tech Development/EDM**
- Authoritative system design model definition, including manufacturing data
- Integrated processes across program elements
- Adequate engineering quality models and processes

**Production**
- Full linkage from ASDM to logistics support docs
- Linkage from TD/EDM modeling to training systems

**Deployment**
- Ability to field support documentation simultaneous with end product

**Testing**
- Automated test planning linked to system evolution

**Across the Board**
- Singular ASDM, current with design, usable in all acquisition lifecycle activities.
- Provides ability to keep the End User engaged and providing valuable input across the development life cycle
- Provides ability to manage data across the life cycle, with current SE practices
- Provides for integrated cost and scheduling activities and analysis
- Full application of MBSE/MBE practices

... and necessary to support Engineered Resilient Systems
As a Basis for the Future – Engineered Resilient Systems

**Systems Representation and Modeling**
- Physical, logical structure, behavior, interactions, interoperability…

**Characterizing Changing Operational Contexts**
- Deep understanding of warfighter needs, impacts of alternative designs

**Cross-Domain Coupling**
- Model interchange & composition across scales, disciplines

**Data-driven Tradespace Exploration and Analysis**
- Multi-dimensional generation/evaluation of alternative designs

**Collaborative Design and Decision Support**
- Enabling well-informed, low-overhead discussion, analysis, and assessment among engineers and decision-makers
Summary

• The AMSS and AMSS Implementation Plan encourage common solutions, through implementation experiences
  – converge towards improved use of systems modeling use across all acquisition activities

• Systems modeling use in acquisition is a practice for changing, identifying and delivering key enablers that will support the Services’ and Agencies’ development of capabilities
  – Evidence based guidance and support to programs of record
  – Identify and incorporate best practices in application of mod/sim
  – Implementation challenges are not limited to the tools

• Service and agency participation in support body (AMSWG) will enable consistent understanding and execution of systems modeling use in acquisition.
  – HOWEVER, it’s up to the Services and Agencies in support of their program managers to determine the best implementation for their acquisition programs
Questions?

Philomena Zimmerman
OASD(SE)/SA
philomena.zimmerman@osd.mil
(571) 372-6695

Kenneth “Crash” Konwin
Mission Support
Kenneth.konwin.ctr@osd.mil
(571) 372-6690
Systems Engineering: Critical to Program Success

Innovation, Speed, and Agility

http://www.acq.osd.mil/se
Key Activity: MS&A Fundamentals
AMSS Builds upon the Basics

• **Purpose:** One page that conveys a high-level, concise, and comprehensive set of truths for Mod/Sim usage in Systems Engineering support to programs

• **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

Model Based System Acquisition
High Level View

Capabilities Based Assessment
• Digital ICD format and content, including the associated models, simulations and data
• Similar data for the doctrine/tactics/training community

Material Solution Analysis
• Contracting language
• IP management
• Model validation adequate to manage contract
• PM guidelines for standing up a MBSA based program

Testing
• Life cycle V&V for testing support

 Across the Board
• Effective methods to keep the End User engaged and providing valuable input across the development life cycle
• Methods to manage data across the life cycle
• Efficient (cost/schedule) methods to develop necessary models & simulations
• New and better model based engineering practices

Production
• Full linkage from ASDM to logistics support docs
• Linkage from TD/EDM modeling to training systems

Deployment
• Ability to field support documentation simultaneous with end product

Tech Development/EDM
• Authoritative System Design Model (ASDM) definition, including manufacturing data
• Integrated processes across program elements
• Adequate engineering quality models & processes

Missing Today: Identified Leadership to Set A Common Vision and Direction
MBSE, MBE, … and MBSA

- **MBSE (INCOSE):** Model-based systems engineering (MBSE) is the formalized application of modeling to support system requirements, design, analysis, verification and validation, beginning in the conceptual design phase and continuing throughout development and later life cycle phases.

- **MBE (NDIA):** MBE, … is an approach to engineering in which models: are an integral part of the technical baseline; evolve throughout the acquisition life cycle; are integrated across all program disciplines (e.g., systems engineering, operations analysis, software engineering, hardware engineering, manufacturing, logistics, etc.); and can be shared and/or reused across acquisition programs, including between Government and Industry stakeholders.

**MBSA:** a way to infuse the MBSE/MBE approach across all phases and activities of the defense acquisition life cycle. ODASD(SE) is approaching this through use of an Authoritative System Design Model (ASDM).

This perspective represents a major shift from the current practice, which tends to result in multiple instantiations of the system concept created and maintained by different functional disciplines involved in the program.
MBSA: Haven’t I Heard this Before?

• DoD M&S Master Plan (1995) – Objective 3: Provide authoritative representations of systems. Systems include US, Allied, coalition and threat major platforms, weapons, sensors, units, life-support systems, C4I systems, and logistics support systems. Authoritative representations of systems require models of the systems and their associated parameters.....

• SBA TF (1998) – SBA: an acquisition process in which DOD and industry are enabled by robust, collaborative use of simulation technology that it integrated across acquisition phases and programs

• SBA, from DSMC (1998) – the goals of SBA are to: Substantially reduce the time, resources, and risk associated with the enterprise acquisition process; Increase the quality, military worth, an supportability of fielded systems, while reducing total ownership costs throughout the total lifecycle; and to enable Integrated Product and Process Development across the entire acquisition lifecycle

• Digital Product Description (DPD – 2011) from Wikipedia - is the practice of using 3D digital data (such as solid models and associated metadata) within 3D CAD software to provide specifications for individual components and product assemblies. The types of information included are geometric dimensioning and tolerancing (GD&T), component level materials, assembly level bills of materials, engineering configurations, design intent, etc. By contrast, other methodologies have historically required accompanying use of 2D drawings to provide such details.

MBSA represents a subtle shift away from simulation by emphasizing the importance of a central model, without diminishing the importance of simulation
How Do We Make It Real?

- **Guide:** Build experience-based guidance and take advantage of OSD(AT&L) activities (e.g. DAG update)
- **Build:** Reuse definitional work that has already been done for other purposes, both within DoD and elsewhere. We need to **discover**, identify, and most of all, not disturb the ongoing efforts; rather take advantage of their results…
- **Apply:** Prototype the system content, and system viewpoints, and the relationships between the elements of the viewpoints, and encapsulate them in the Authoritative System Design Model.
- **Cost:** Do not burden the Programs of Record with development of the concept; rather use their needs to drive the direction; provide “Starter Kit” capabilities and training
Acquisition Modeling & Simulation
Document Relationships

Acquisition Modeling & Simulation Master Plan
(April 2006)

Provides a broadly focused mod/sim technology gap analysis

Ubiquitous Modeling & Simulation Report
(Jan 2011)

Identifies near term acquisition related mod/sim shortfalls
Provides specific project recommendations in selected high priority areas

Systems Engineering Modeling, Simulation & Analysis Fundamentals
(July 2012)

Captures the Essentials of Acquisition Modeling & Simulation in 1 page

Acquisition Modeling & Simulation Strategy (AMSS)
(September 2012)

Based upon the synthesis of the Ubiquitous Modeling & Simulation Report and other recent professional community studies

Acquisition Modeling & Simulation Implementation Plan
(Under Development)

Translates AMSS recommendations into a series of (potential) projects