



DoD Modeling and Simulation Support to Acquisition

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**NDIA Modeling & Simulation Committee
February 21, 2013**



Agenda



- **Modeling and Simulation within ODASD(SE)**
- **Modeling and Simulation Observations**
- **Modeling and Simulation Fundamentals**
- **System Modeling and DoD Acquisition**
- **Engineered Resilient Systems**



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 Acquisition Corps Certified Systems Engineers (SPRDE)***



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 and Industry Engineering Research

Modeling and Simulation

Systems Engineering FFRDC Oversight



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
Nicholas Torelli

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 (HSI))

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



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
- **They 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, but it does not have a current roadmap for improvement in application**
 - Acquisition modeling and simulation needs, capabilities, messages from PEO, PM not reaching OSD; and vice versa
- **Contemporary challenge: Mr. Kendall's remarks at CSIS, 6 Feb 2012**



MS&A Fundamentals



DEPARTMENT OF DEFENSE
ACQUISITION MODELING AND SIMULATION WORKING GROUP
Systems Engineering Modeling, Simulation, and Analysis Fundamentals

1. The responsibility for planning and coordinating program Modeling and Simulation efforts belongs to the Program Manager; and may be delegated to the Program Systems Engineer and other program staff as appropriate
2. Modeling and simulation efforts are included in the program/project risk management, and cost and schedule planning for Systems Engineering. Metrics will be identified that relate use of modeling and simulation to cost savings and risk reduction
3. Systems Engineering uses models to define, understand, communicate, assess, interpret and accept project scope, produce technical documentation and other artifacts, and to maintain 'ground truth' about the system(s).
4. Programs should identify and maintain a system model, representing all necessary viewpoints on the design, and capturing all relevant system interactions.
 - a. Unless impractical, the system model should be developed using standard model representations, methods, and underlying data structures
 - b. The system model is a product of both system and design engineering efforts, and should be constructed by integrating the various data consumed by, and produced by the modeling and simulation activities across, and related to, the program. It should be base-lined at appropriate technical milestones
 - c. Depictions of system concepts developed in support of technical reviews will be constructed using the system model as source data
 - d. The system model should include, but is not limited to parametric descriptions, definitions of behaviors, internal and external Interfaces, cost inputs, and traces from operational capabilities to requirements and design constructs.
 - e. The system model should be a part of, and should evolve with, the program development baseline. The system model should be integrated throughout the program life cycle, and across domains within a program's various phases
 - f. The system model can provide source data to construct instantiated models that are used to support system trades, optimizations, design evaluations, system, subsystem, component and sub-component integration, cost estimations, etc.
 - g. The system model is continually updated throughout the program lifecycle. Capturing these updates in the system model will provide continuity and consistency between and among all program modeling and simulation users and activities. Consideration should be made during the development and construction of models and simulations to ensure that they will be extensible for use in other applications such as training and testing of the system.
5. The development of models, construction of simulations and use of these assets to perform program definition and development activities (to include pre-MDD, and pre-milestone A) requires collaboration among all project stakeholders.
6. Proper use of modeling and simulation throughout the acquisition lifecycle is critical for program success. Sufficient training should be provided to support the appropriate use of modeling and simulation. Metrics should be identified and tracked to support the linkage between the training and increased support to the program Modeling and simulation provide critical capabilities to efficiently and effectively deal with issues of, but not limited to interoperability, joint operations and system of systems across the entire acquisition lifecycle

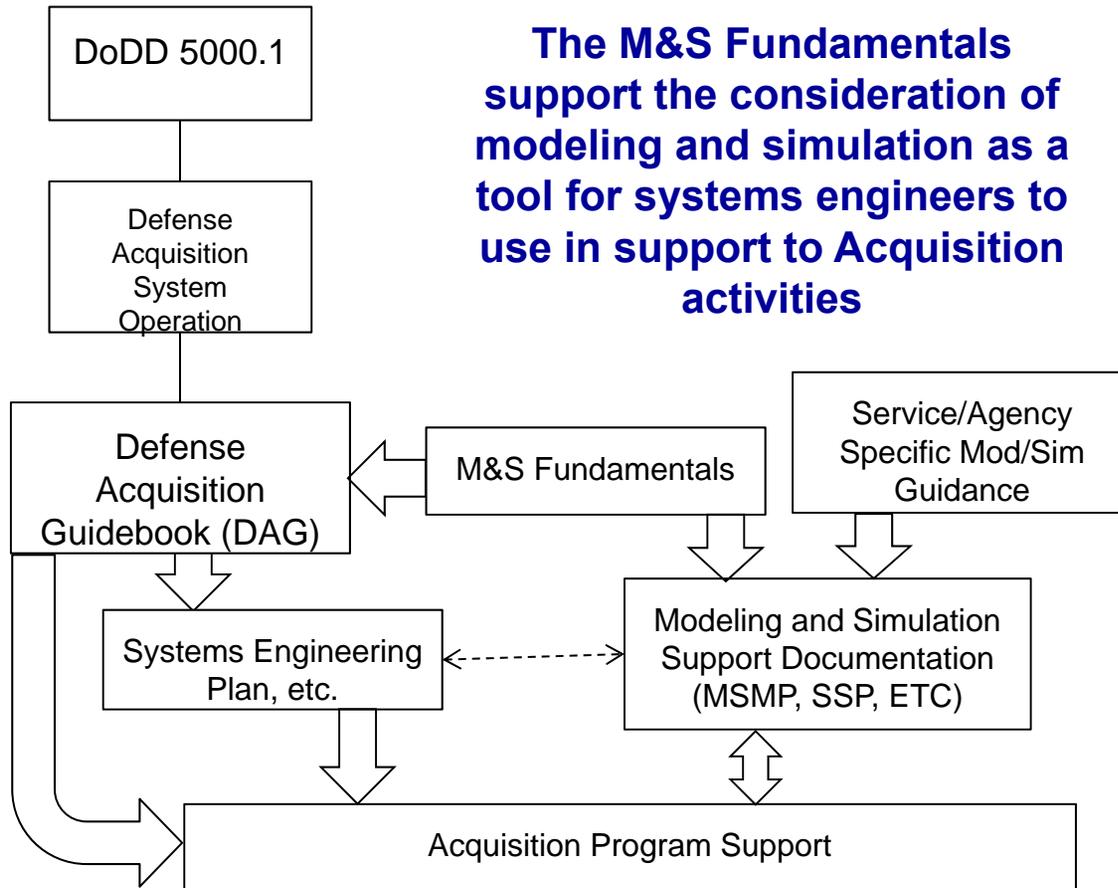
Version 2.0, January 2013
Distribution statement A: Approved for public release; distribution is unlimited.
For Additional Information: http://www.acq.osd.mil/se/initiatives/init_ms.html

<http://www.acq.osd.mil/se/docs/SE-MSA-Fundamentals.pdf>

- **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



Using the Modeling and Simulation Fundamentals



The M&S Fundamentals support the consideration of modeling and simulation as a tool for systems engineers to use in support to Acquisition activities

- The Fundamentals connect the M&S community to the acquisition use of M&S
- The Fundamentals suggest how M&S should be incorporated into the SE position on the program, but do not dictate how
- The Fundamentals assist both OSD and the programs maintain a common understanding of M&S use for acquisition program support

The M&S Fundamentals provide the modeling and simulation basis of support for programs, posturing modeling and simulation as a part of systems engineering, not separate from it.



AMSWG in 2012



- **Cost Modeling**
 - MORS Affordability Workshop
 - Service Mod/Sim in Acquisition and SE
- **Services and System Engineering**
 - Defense Acquisition Guidebook (DAG) Chapter 4 (Systems Engineering)
 - Defense Acquisition University (DAU)
- **Activities within Lifecycle Supported by Mod/Sim**
 - Materiel Solutions Analysis
 - NDIA Interim Results
 - Manufacturing
- **The Case for Model-based “x”**
- **System Model Development**

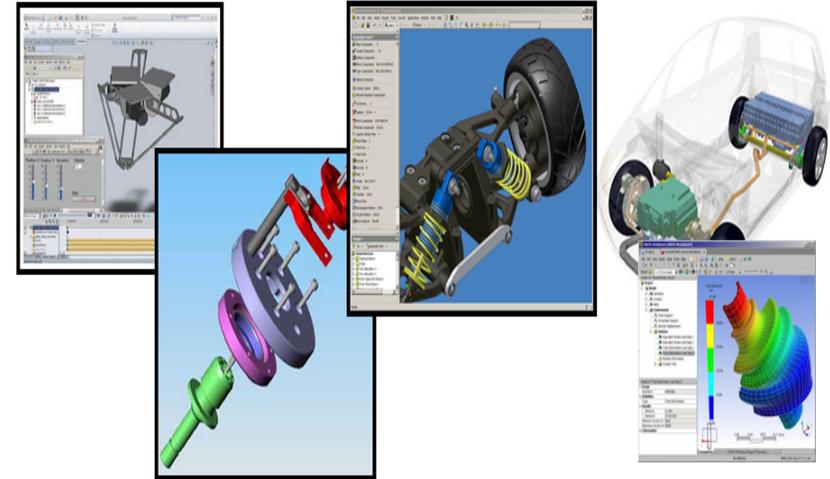


Systems Modeling Use in Acquisition

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 use 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



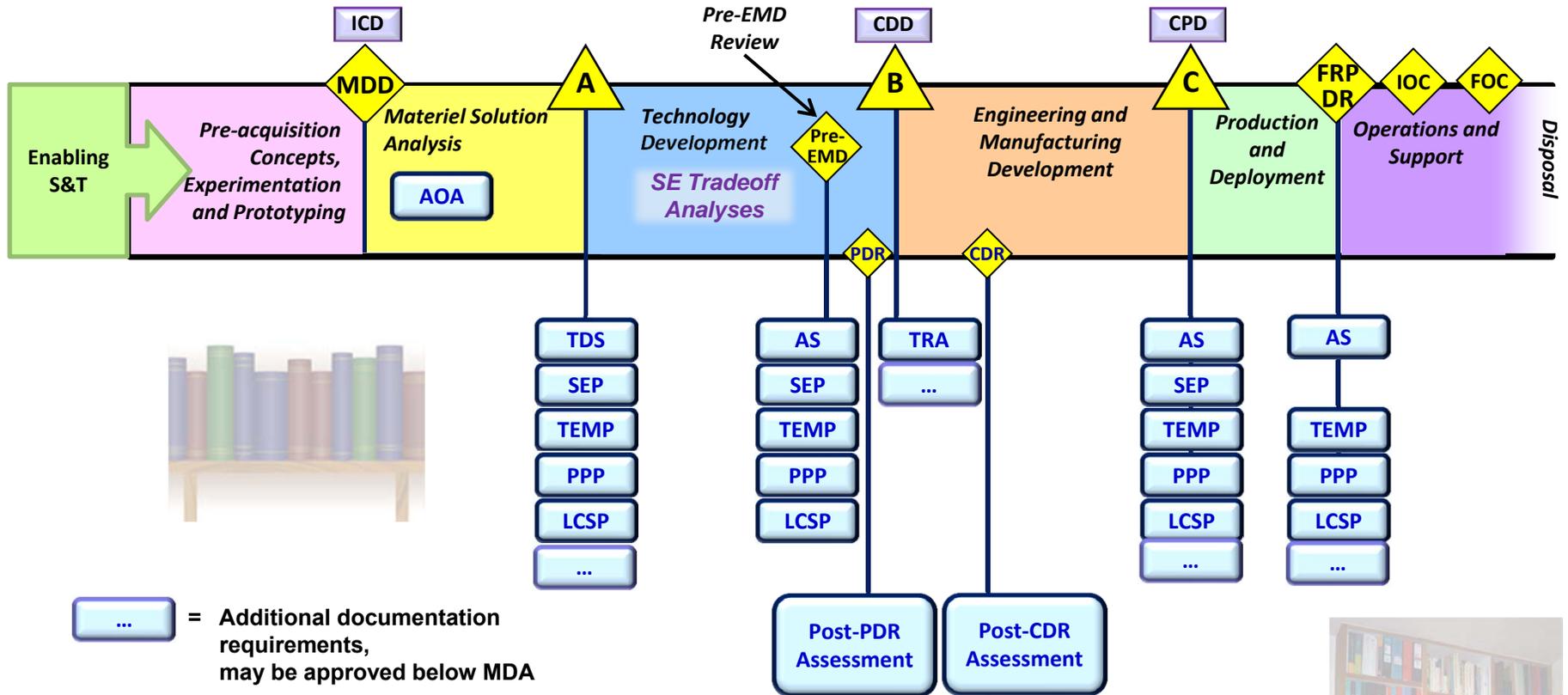
The concept is still maturing

- 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

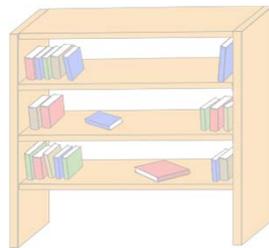
Model-based acquisition does not diminish the importance of simulations; it increases the relevance of simulation output through consistent use of complete models.



Acquisition Life Cycle Framework “Weapon System Development”



... = Additional documentation requirements, may be approved below MDA



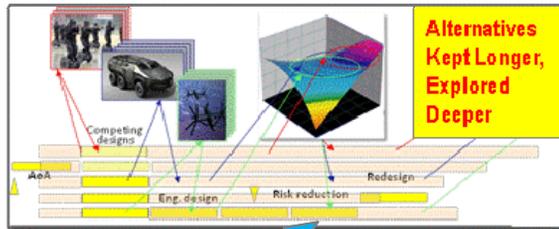


Why? Engineered Resilient Systems Key Technical Areas



Systems Representation and Modeling

- Physical, logical structure, behavior, interactions, interoperability...



Characterizing Changing Operational Contexts

- Deep understanding of warfighter needs, impacts of alternative designs

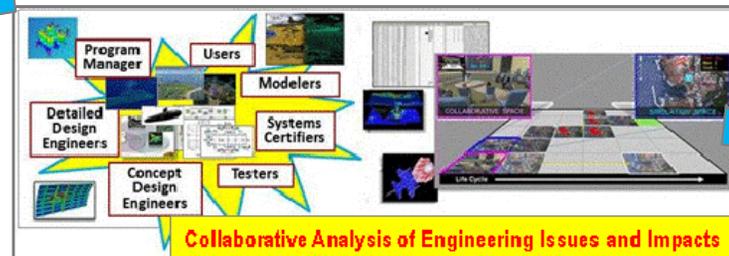


Cross-Domain Coupling

- 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 Modeling & Simulation Fundamentals are one of the keystones (NOT POLICY) of consistent modeling and simulation support to programs**
 - Established by the Acquisition Modeling and Simulation Working Group as a simple way to bridge the M&S community with the acquisition community.
- **Prove the best practices (real and expected) before applying the System Model**
 - Discover/Identify best practices based on examples from the Services/Agencies
 - Develop definition, build business case by studying elements in existence today
- **Develop the System Model from elements and artifacts of acquisition activities which already exist**
 - Do not invent anything new; instead, use 'aim points' from that which already exists
 - Population of the system model should not require separate contract clauses



Questions?



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