



# **DoD Modeling and Simulation Support to Acquisition**

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**National Institute of Standards and Technology (NIST)  
Model-Based Enterprise Summit  
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# 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



*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**

**We apply best engineering practices to:**

- Support and advocate for DoD Component initiatives
- Help program managers identify and mitigate risks
- Shape technical planning and management
- Provide technical insight to OSD stakeholders
- Identify systemic issues for resolution above the program level





# 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

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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 will identify and maintain an authoritative system design model (ASDM), representing all necessary viewpoints on the design, and capturing all relevant system interactions.
  - a. Unless impractical, the ASDM will be developed using standard model representations, methods, and underlying data structures
  - b. The ASDM is a product of both system and design engineering efforts, and is constructed by integrating the various data consumed by, and produced by the modeling and simulation activities across, and related to, the program. It is base-lined at appropriate technical milestones
  - c. Depictions of system concepts developed in support of technical reviews are constructed using the ASDM as source data
  - d. The ASDM includes, 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 ASDM is a part of, and evolves with, the program development baseline. The authoritative system design model must be integrated throughout the program life cycle, and across domains within a program's various phases
  - f. The ASDM provides 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 ASDM is continually updated throughout the program lifecycle. Capturing these updates in the ASDM 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. Program success is partially dependent on proper use of models and simulations. This is dependent on adequate training of the project team regarding models and simulations. Sufficient training will be provided to identify metrics associated with assessing value added by the appropriate use of modeling and simulation
7. Modeling and simulation provide critical capabilities to efficiently and effectively address interoperability, joint and SoS requirements in system design.

Version 1.5, July 2012.

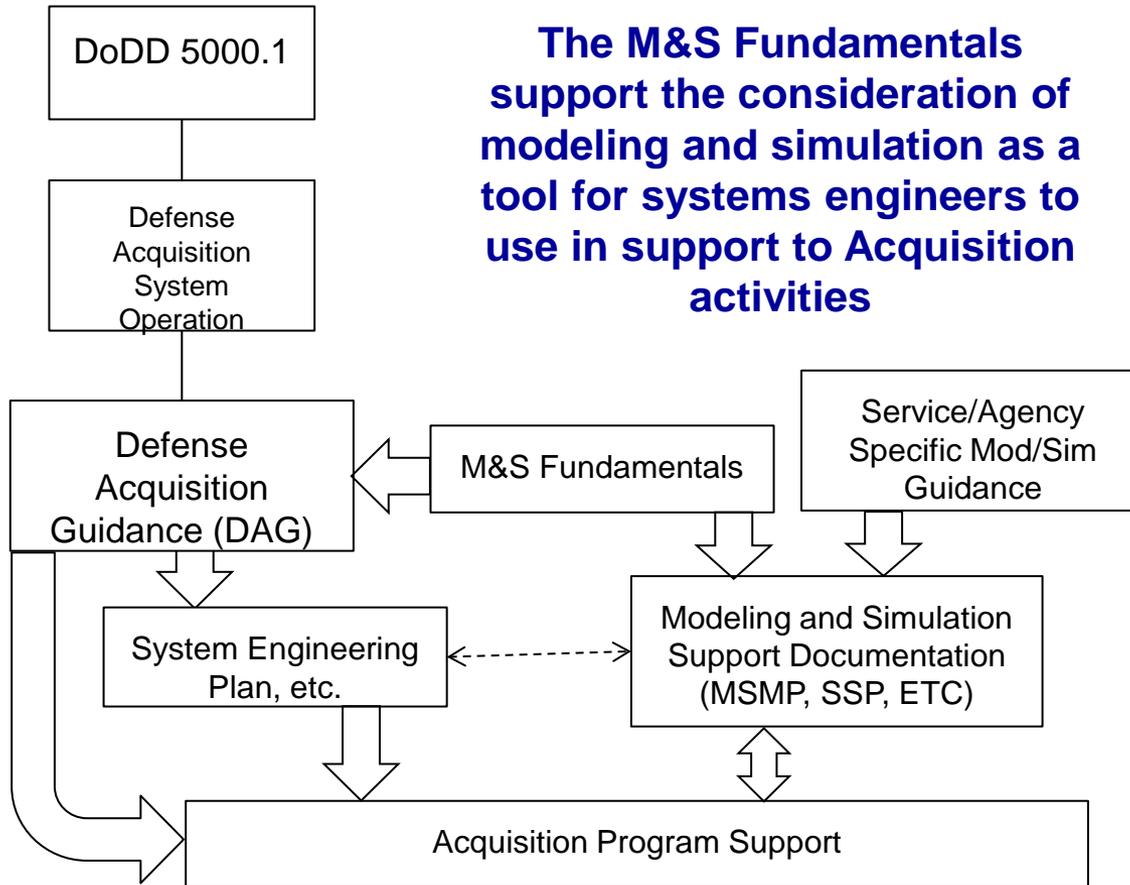
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- **Purpose:** One page that conveys a high-level, concise, and comprehensive set of truths for Mod/Sim usage in Systems Engineering support to programs
- **Key Areas Emphasized:**
  - Program Systems Engineer is responsible for Mod/Sim planning and 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

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



# 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

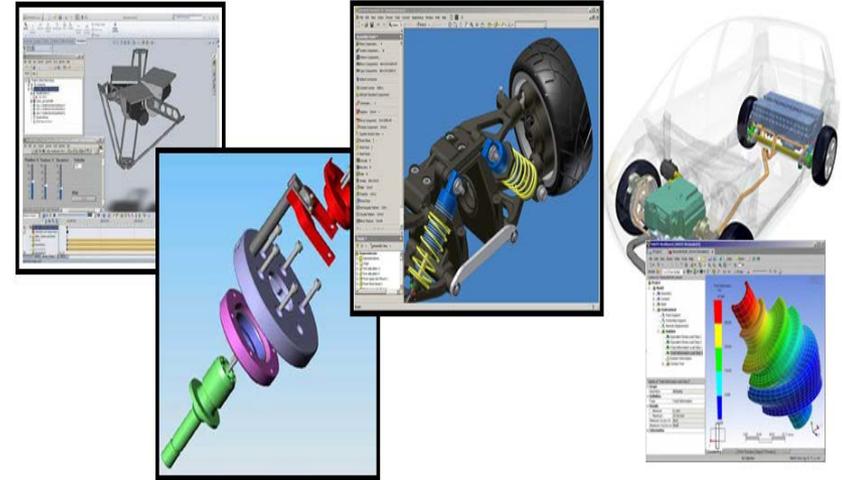
**The M&S Fundamentals provide the modeling and simulation basis of support for programs, posturing modeling and simulation as a part of systems engineering, not separate from it.**



# 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



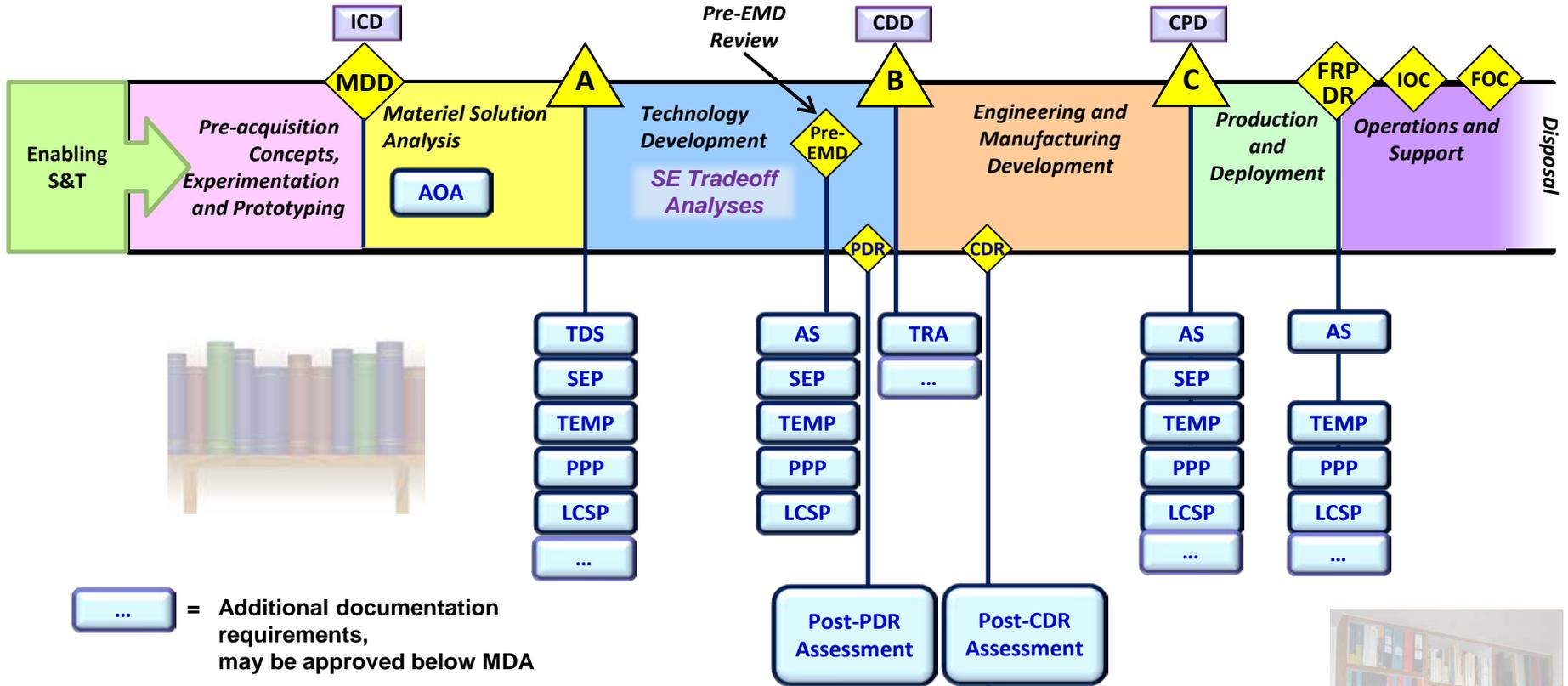
## The concept is still maturing

- 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

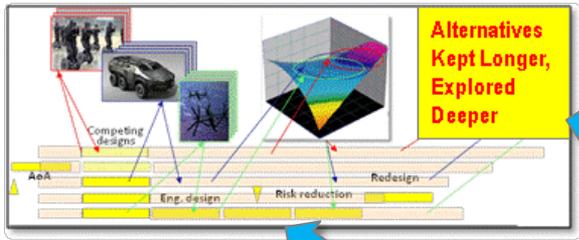


## Systems Representation and Modeling

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

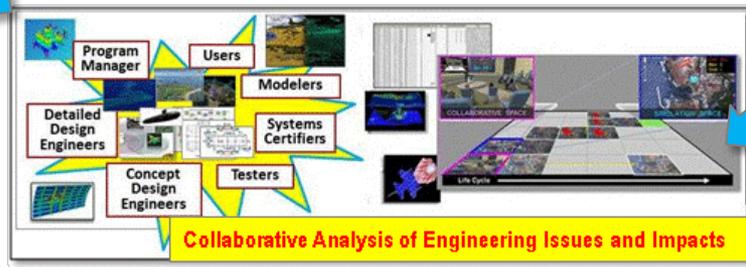
## Characterizing Changing Operational Contexts

- 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



# MS&A Presentations



**Richard Neal - The Integrated Manufacturing Technology Initiative**

***“Imperatives for Achieving Model-Based Product Realization”***

**Charlie Stirk - CostVision Inc**

***“Model standards interoperability across domains, the life cycle, and the supply chain”***

**Tom Hannon - Lockheed Martin Corporation**

***“The Lockheed Martin Model-Centric Digital Tapestry”***