Modeling, Simulation, and Analysis (MS&A) Fundamentals for Acquisition

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Office of the Deputy Assistant Secretary of Defense for Systems Engineering

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Agenda

- **Repeating: Acquisition Modeling & Simulation – the Call for Action**
- **The Fundamentals**
- **Details within the Fundamentals**
- **Fundamentals and Program Support**
- **Summary**

MS&A Fundamentals

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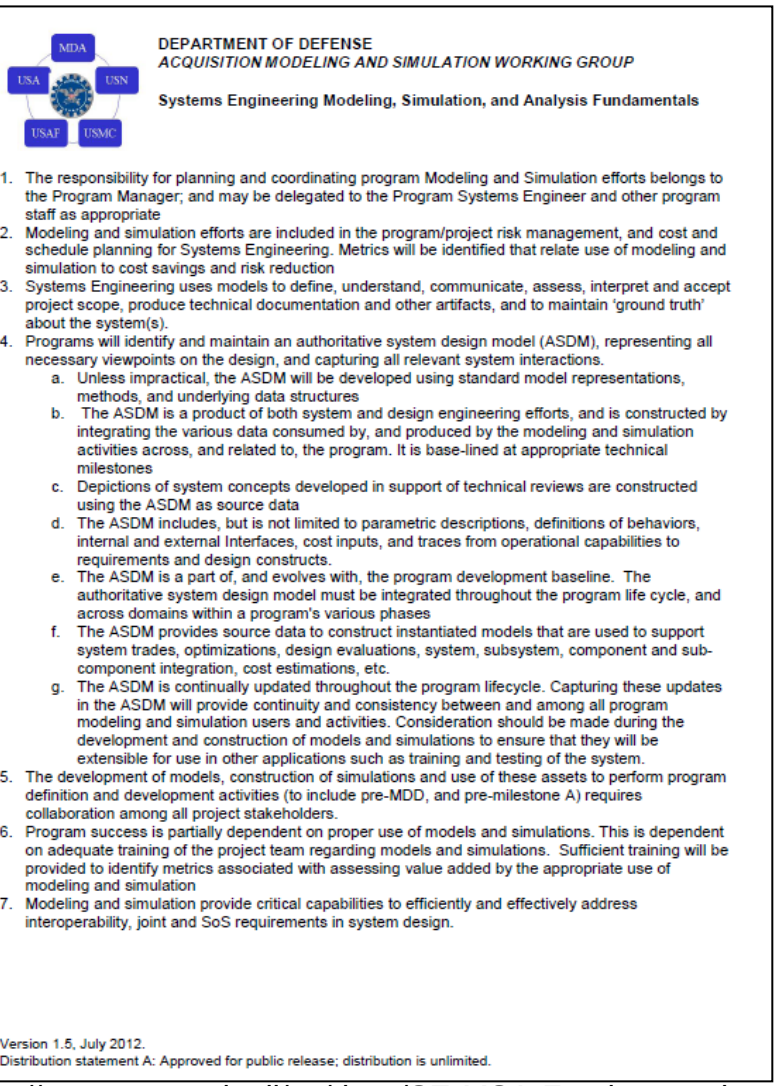

DEPARTMENT OF DEFENSE
ACQUISITION MODELING AND SIMULATION WORKING GROUP

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.

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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

Why Fundamentals?

- The purpose of the MS&A Fundamentals for the acquisition community within the Department of Defense is to convey a high-level, concise, and comprehensive set of MS&A characteristics for the systems engineer to support the program development.
- They are intended to assist the SE staff (and PM staff) in assessing the balance, coherence, and completeness of the stewardship and credibility of the modeling and simulation area of technical activity within a given program.
- At the Department level, the ultimate objective of such a set of fundamental concepts is to anchor all the modeling and simulation activities (guidance, policy, process, tool development, program support, etc.) in a consistent manner, to ensure that the modeling and simulation capabilities needed are both available and sufficient to support all system acquisition activities.

SE Modeling & Simulation Fundamentals

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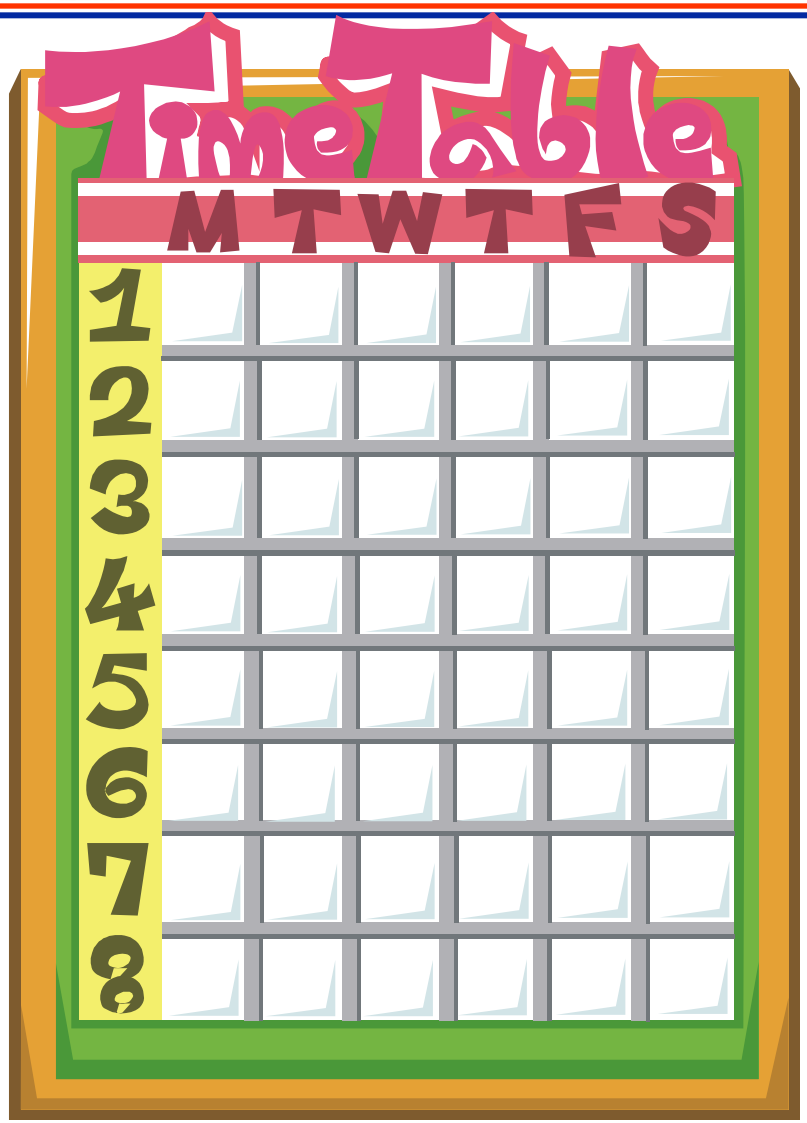
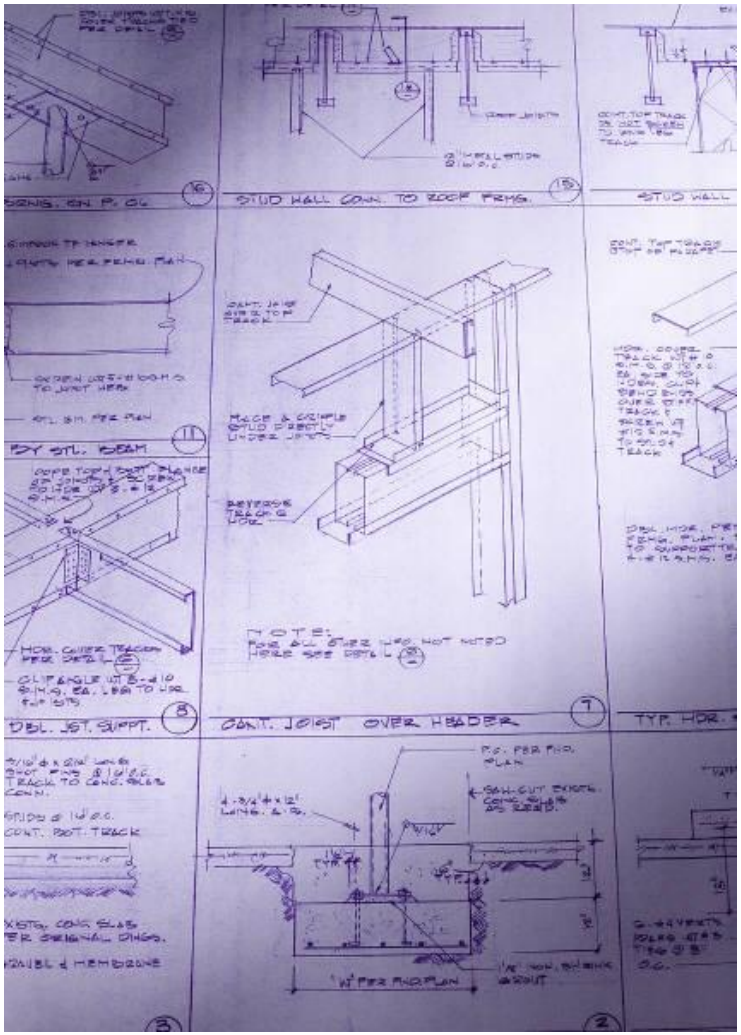
SE Modeling & Simulation Fundamentals



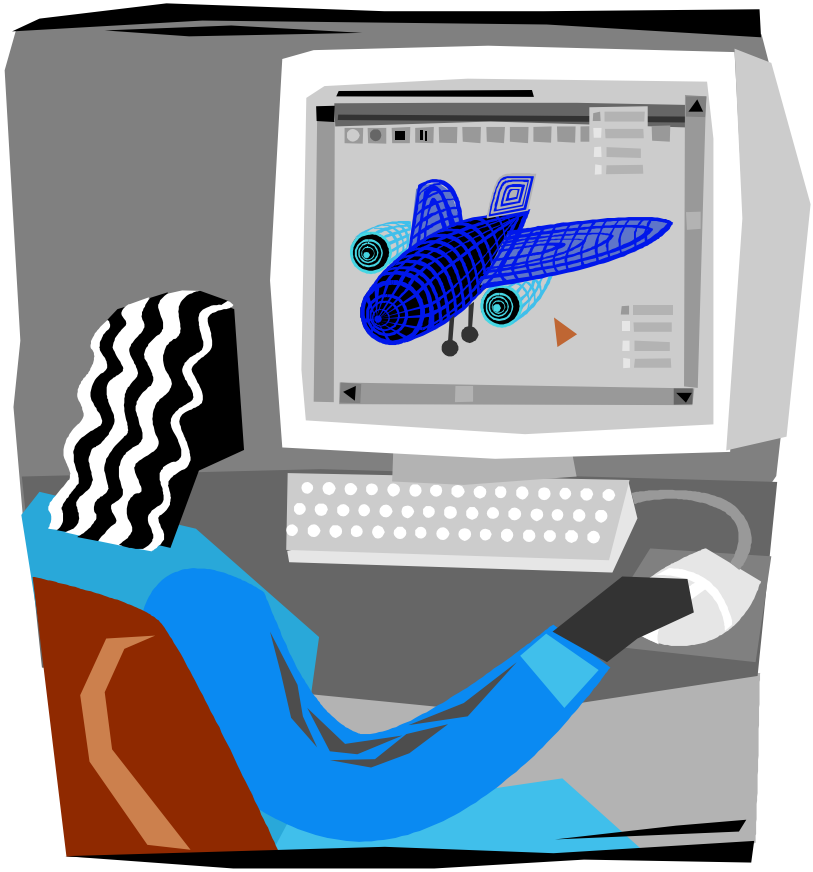
2. **Modeling and simulation efforts are included in the program/project risk management, and cost and schedule planning for Systems Engineering. Metrics will be identified that relate use of modeling and simulation to cost savings and risk reduction**

SE Modeling & Simulation Fundamentals



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).**

SE Modeling & Simulation Fundamentals



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.**

Authoritative System Design Model (ASDM)

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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.

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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.

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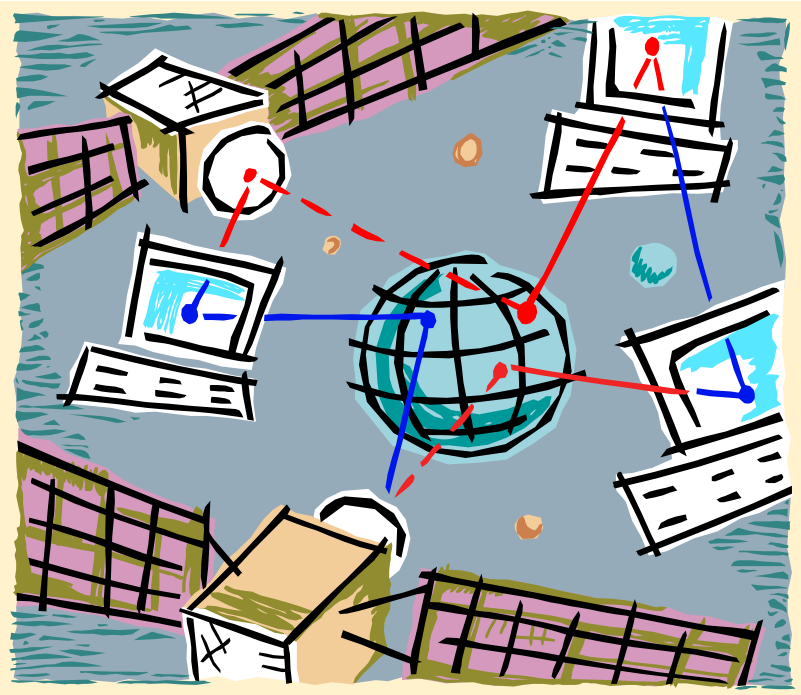
SE Modeling & Simulation Fundamentals

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.**

SE Modeling & Simulation Fundamentals

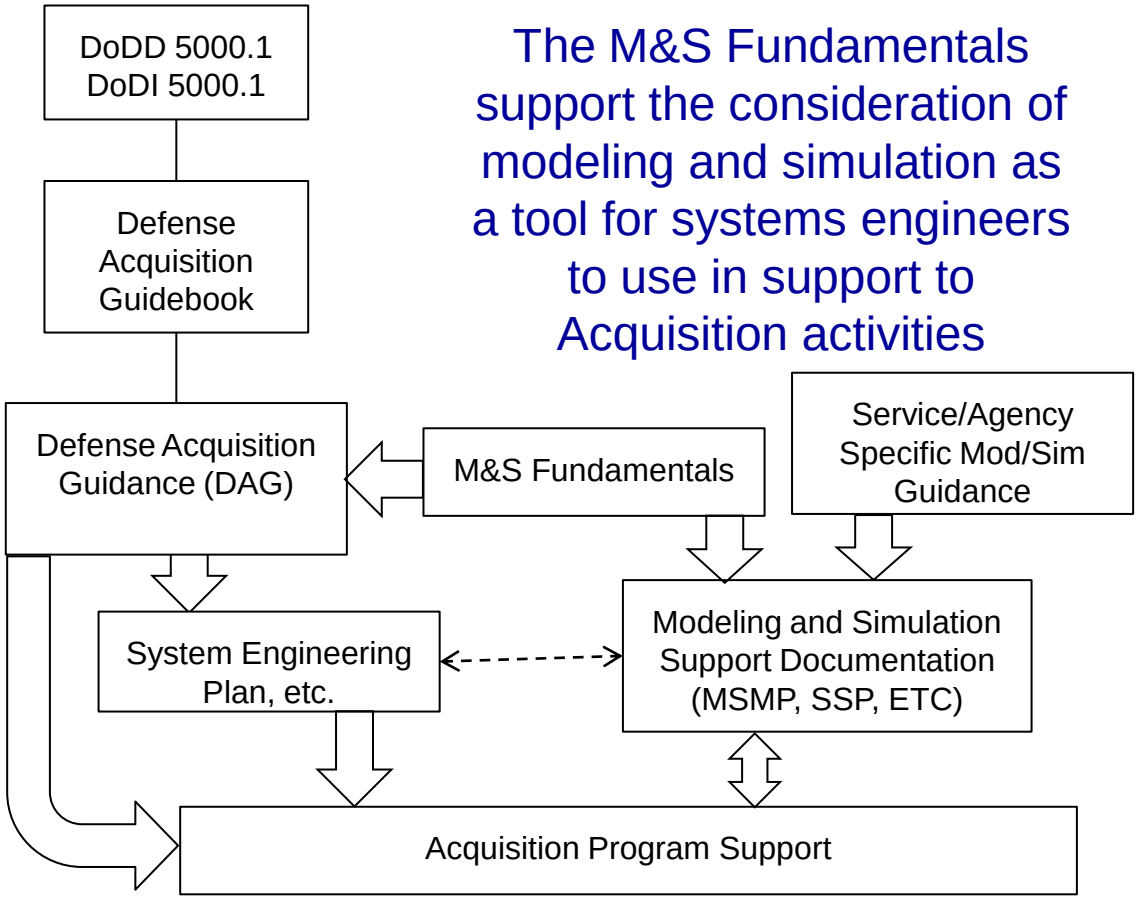
6. **Program success is partially dependent on proper use of models and simulations. This is dependent on adequate training of the project team regarding models and simulations. Sufficient training will be provided to identify metrics associated with assessing value added by the appropriate use of modeling and simulation.**

SE Modeling & Simulation Fundamentals



7. **Modeling and simulation provide critical capabilities to efficiently and effectively address interoperability, joint and SoS requirements in system design.**

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.

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 it of Authoritative System Design Model**
  - Discover/Identify best practices based on examples from the Services/Agencies
  - Develop definition, build business case by studying elements in existence today
- **Provide your recommendations with supporting rationale for consideration in future revisions**
  - The AMSWG reviews the fundamentals and their applicability on a quarterly basis
    - MDA – Sandy Veautour, Doug Parsons
    - USA – Nancy Bucher, Jerry Kniphfer
    - USAF – Col John Simeoni, Ernie Gonzalez
    - USMC – Mike Oneal, LTC Walt Yates
    - USN – Dennis Reed, Mike Lamarche, John McMaster
    - Industry: NDIA – Jim Coolahan, Jeff Bergenthal
    - : INCOSE – Sandy Friedenthal, Kevin Weinstein
    - : SISO – John Daly

Questions?

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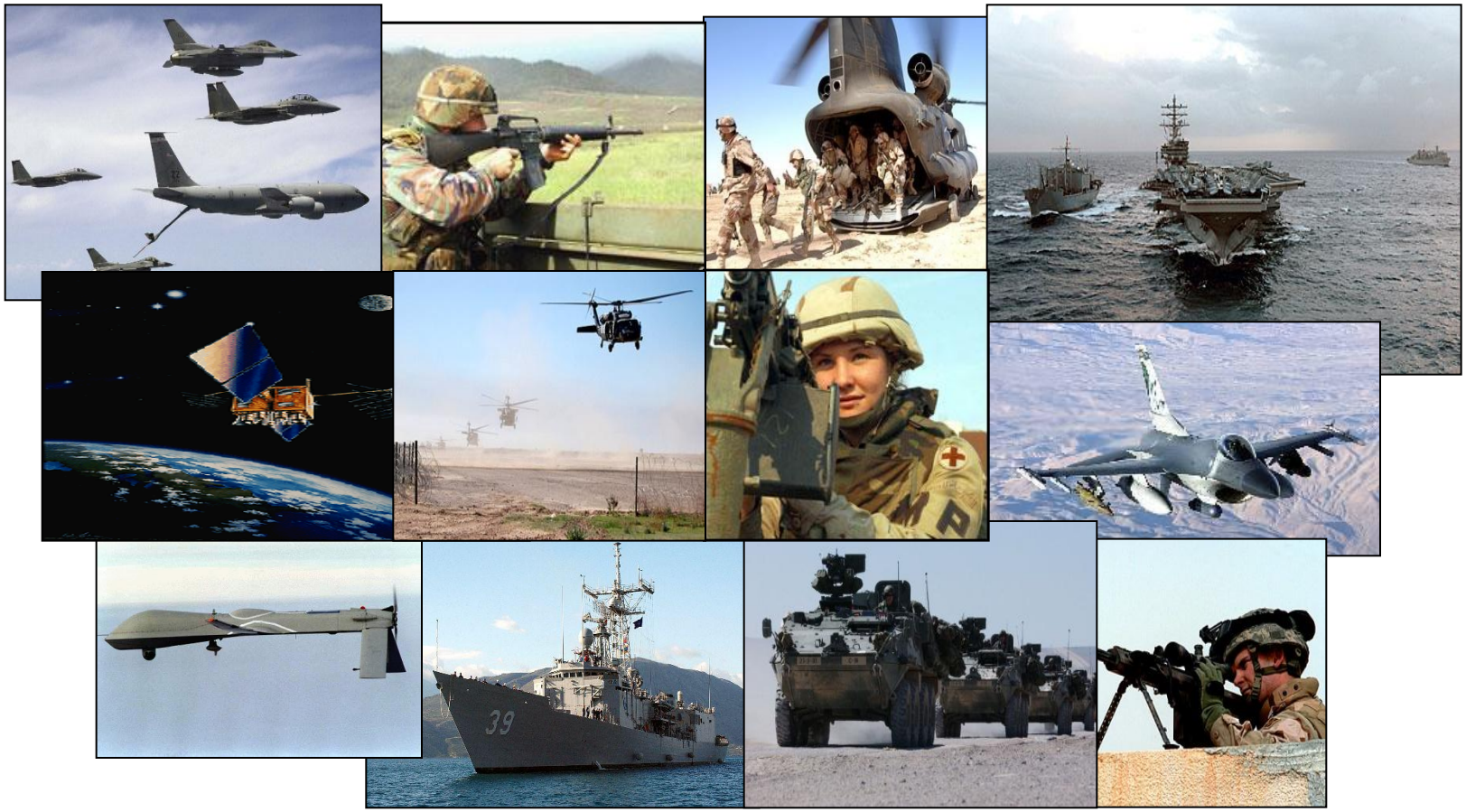
Systems Engineering: Critical to Program Success



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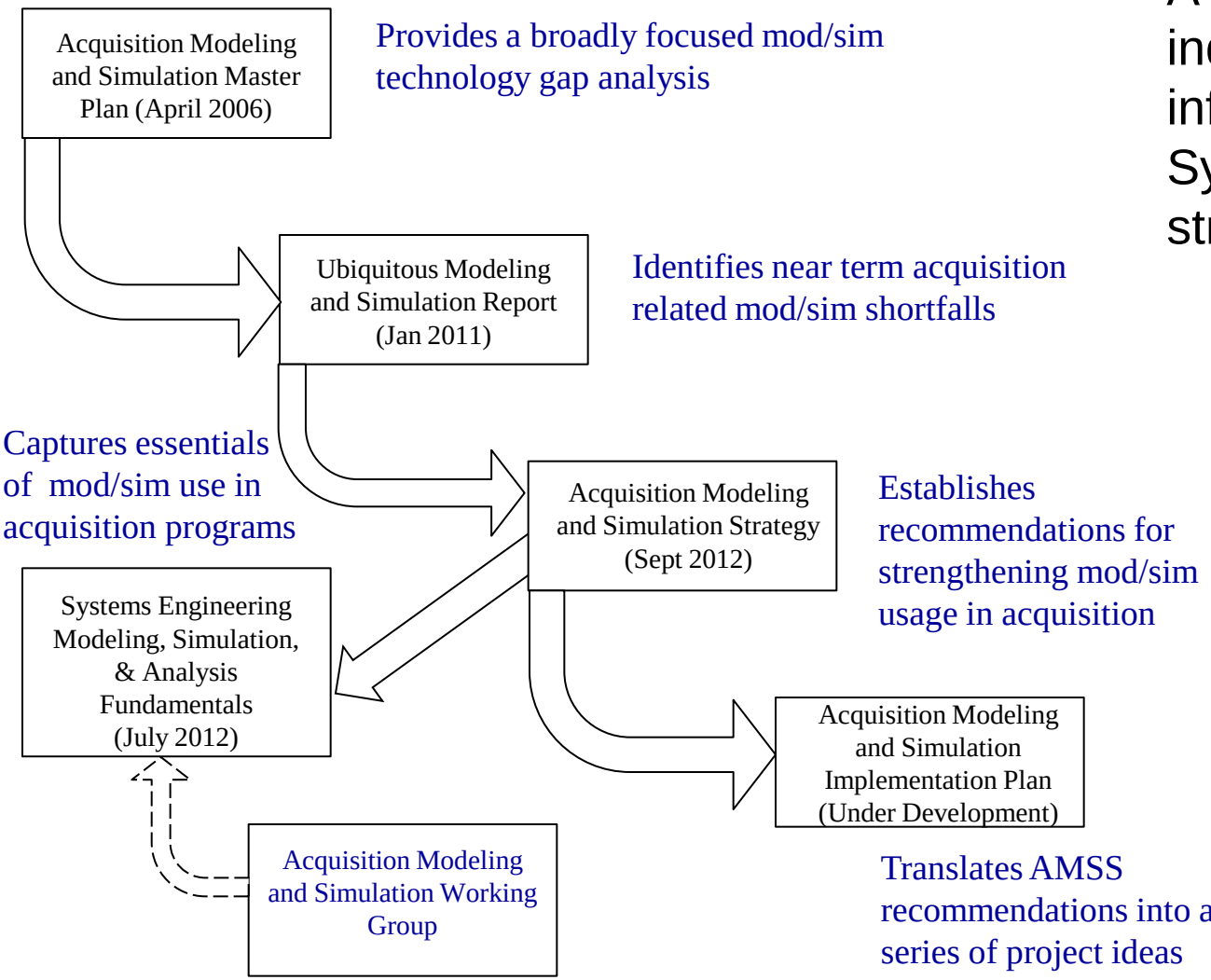
Observations: Call for Action

(Repeating from Last Year)

- **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?"**

How AMSS Was Conceived and 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