Modeling & Simulation in the Test & Evaluation Master Plan

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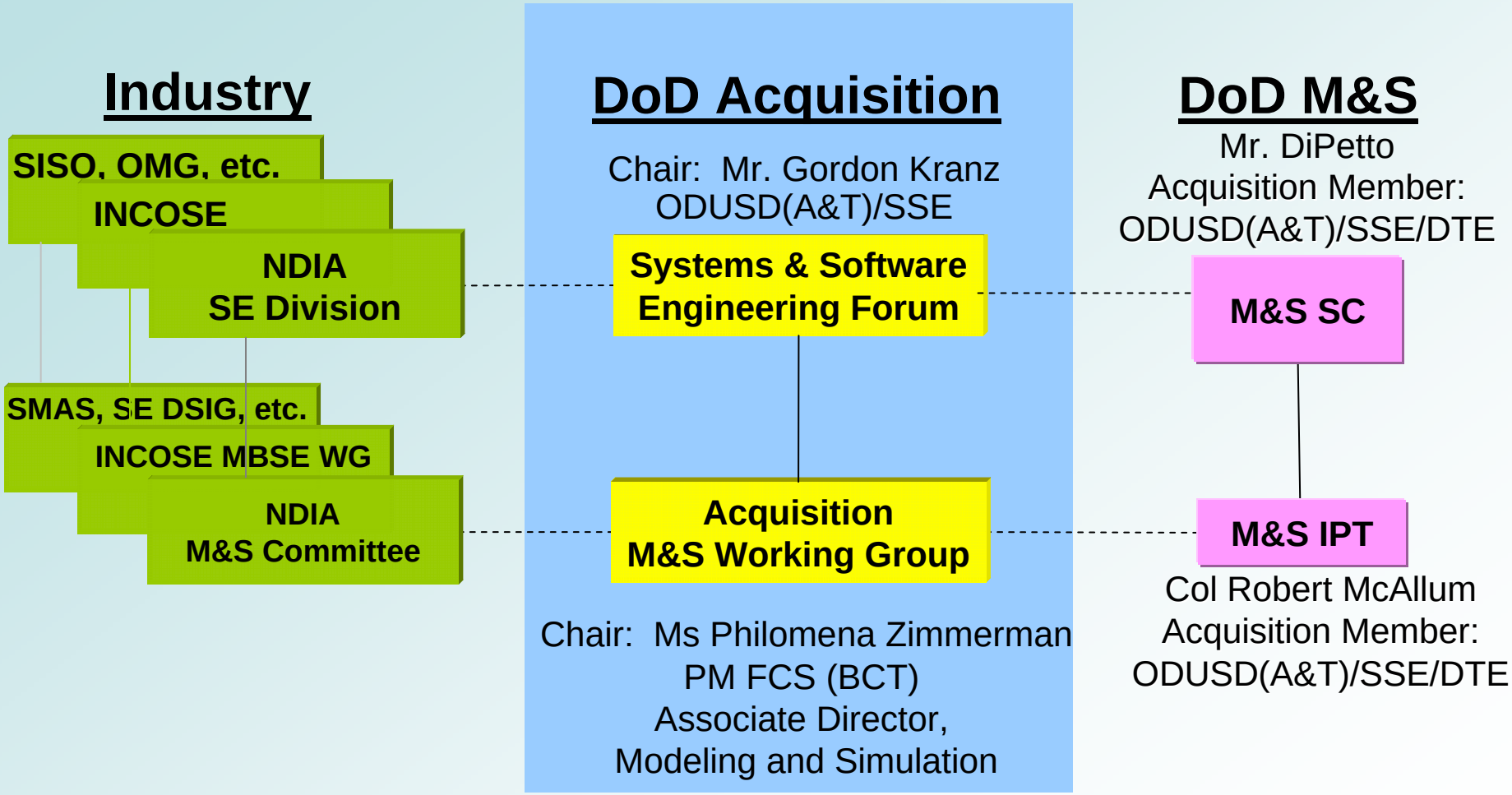
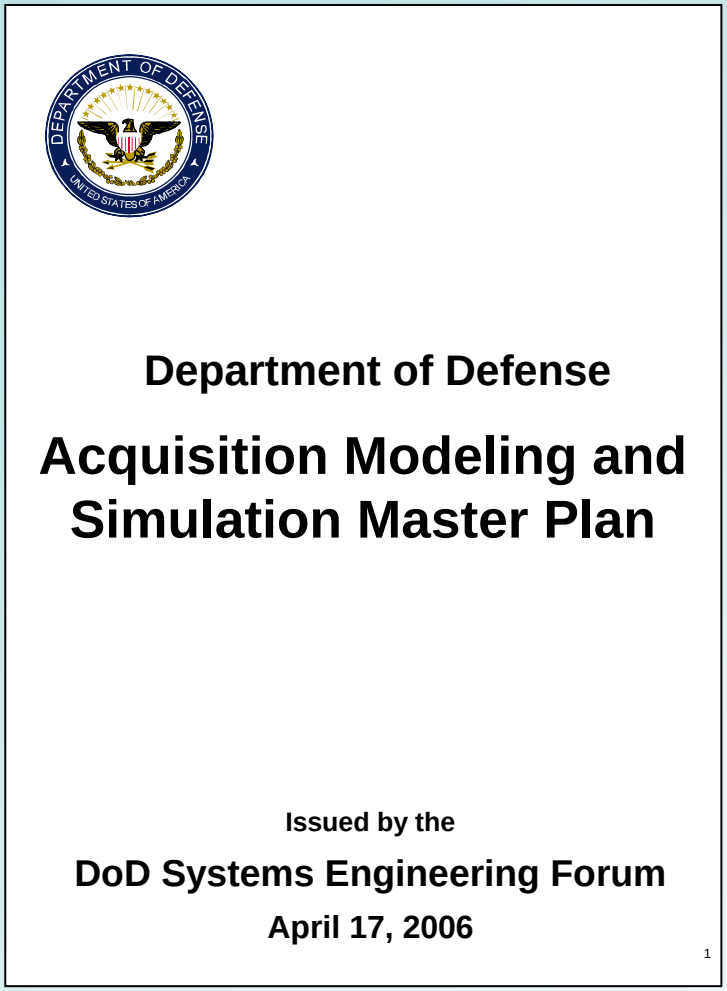
Acquisition M&S Governance Structure



AMSWG is anchored in acquisition community and linked to industry and the DoD M&S community

Content of Acquisition M&S Master Plan



- **Foreword**
- **Introduction**
  - **Purpose**
  - **Vision**
  - **Scope**
- **Objectives (5)**
- **Actions (40)**
  - **Action**
  - **Rationale** (why it's needed)
  - **Discussion** (implementation guidance)
  - **Lead & supporting organizations**
  - **Products** (what is expected)
  - **Completion goal (year)**
- **Execution Management**

http://www.acq.osd.mil/sse/as/guidance.html

A Decade of Studies on M&S Support to Acquisition

1. *Final Report of the Acquisition Task Force on M&S*, 1994
   Sponsor: DDR&E (Dr. Anita Jones); Chair: VADM T. Parker, USN (Ret.)
2. *Naval Research Advisory Committee Report on M&S*, 1994
   Sponsor: ASN(RDA); Chair: Dr. Delores Etter
3. *Collaborative Virtual Prototyping Assessment for Common Support Aircraft*, 1995
   Sponsor: Naval Air Systems Command; conducted by JHU APL and NSMC
4. *Collaborative Virtual Prototyping Sector Study*, 1996
   North American Technology & Industrial Base Organization; sponsor: NAVAIR
5. *Application of M&S to Acquisition of Major Weapon Systems*, 1996
   American Defense Preparedness Association; sponsor: Navy Acqn. Reform Exec.
6. *Effectiveness of M&S in Weapon System Acquisition*, 1996
   Sponsor: DTSE&E (Dr. Pat Sanders); conducted by SAIC (A. Patenaude)
7. *Technology for USN and USMC, Vol. 9: M&S*, 1997
   Naval Studies Board, National Research Council; sponsor: CNO
8. *A Road Map for Simulation Based Acquisition*, 1998
   Joint SBA Task Force (JHU APL lead); sponsor: Acquisition Council of EXCIMS

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A Decade of Studies on M&S Support to Acquisition

9. *M&S for Analyzing Advanced Combat Concepts*, 1999
   Defense Science Board Task Force (Co-chairs: L. Welch, T. Gold)
10. *Advanced Engineering Environments*, 1999
    National Research Council; sponsor: NASA
11. *Survey of M&S in Acquisition*, 1999 and 2002
    Sponsor: DOT&E/LFT&E; conducted by Hicks & Associates (A. Hillegas)
12. *Test and Evaluation*, 1999
    Defense Science Board Task Force (Chair: C. Fields)
13. *"SIMTECH 2007" Workshop Report*, 2000
    Military Operations Research Society (Chair: S. Starr)
14. *M&S in Manufacturing and Defense Systems Acquisition*, 2002
    National Research Council; sponsor: DMSO
15. *M&S Support to the New DoD Acquisition Process*, 2004
    NDIA Systems Engineering Div. M&S Committee; sponsor: PD, USD(AT&L)DS
16. *Missile Defense Phase III M&S*, 2004
    Defense Science Board Task Force (Chair: W. Schneider)

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Five Objectives, 40 Actions

Objective 1	Objective 2	Objective 3	Objective 4	Objective 5
Provide necessary policy and guidance	Enhance the technical framework for M&S	Improve model and simulation capabilities	Improve model and simulation use	Shape the workforce
1-1 M&S management	2-1 Product development metamodel	3-1 Acquisition inputs to DoD M&S priorities	4-1 Help defining M&S strategy	5-1 Definition of required M&S competencies
1-2 Model-based systems engineering & collaborative environments	2-2 Commercial SE standards	3-2 Best practices for model/sim development	4-2 M&S planning & employment best practices	5-2 Harvesting of commercial M&S lessons
1-3 M&S in testing	2-3 Distributed simulation standards	3-3 Distributed LVC environments	4-3 Foster reuse	5-3 Assemble Body of Knowledge for Acqn M&S
1-4 M&S planning documentation	2-4 DoDAF utility	a) Standards	a) Business model	5-4 M&S education & training
1-5 RFP & contract language	a) DoDAF 2.0 Systems Engineering Overlay	b) Sim/lab/range compliance	b) Responsibilities	a) DAU, DAG & on-line CLMs
1-6 Security certification	b) Standards for depiction & interchange	c) Event services	c) Resource discovery	b) Conferences, workshops & assist visits
	2-5 Metadata template for reusable resources	3-4 Central funding of high-priority, broadly-needed models & sims	4-4 Info availability	5-5 MSIAC utility
		a) Prioritize needs	a) Scenarios	
		b) Pilot projects	b) Systems	
		c) Expansion as warranted	c) Threats	
			d) Environment	
			4-5 VV&A	
			a) Documentation	
			b) Risk-based	
			c) Examination	
			4-6 COTS SE tools	
			4-7 M&S in acqn metrics	

Key

Broader than Acquisition

Acquisition M&S Master Plan: Actions 1-3 & 1-4

ACTION 1-3. Establish policy and guidance on appropriate use of M&S to plan tests, complement system live tests, and assess joint capabilities.

ACTION 1-4. Establish policy to require documented M&S planning as part of the Systems Engineering Plan, T&E Strategy, and T&E Master Plan.

PRODUCTS: Revised policy and guidance in DoDI 5000.2, DAG, and TEMP guidance

This is not a recommendation to replace testing with models and simulations

Current Policy Regarding the use of Models & Simulations

DoDI 5000.2; Enclosure 5

E5.1 The PM, in concert with the user and test and evaluation communities, shall coordinate developmental test and evaluation (DT&E), operational test and evaluation (OT&E), LFT&E, family-of-systems interoperability testing, information assurance testing, and modeling and simulation (M&S) activities, into an efficient continuum, closely integrated with requirements definition and systems design and development. The T&E strategy shall provide information about risk and risk mitigation, provide empirical data to validate models and simulations, evaluate technical performance and system maturity, and determine whether systems are operationally effective, suitable, and survivable against the threat detailed in the System Threat Assessment.

Adequate time and resources shall be planned to support pre-test predictions and post-test reconciliation of models and test results, for all major test events.

E5.3.1 Projects that undergo a Milestone A decision shall have a T&E strategy that shall primarily address M&S, including identifying and managing the associated risk, and that shall evaluate system concepts against mission requirements.

E5.4.7 Appropriate use of accredited models and simulation shall support DT&E, IOT&E, and LFT&E.

Recent Test & Evaluation Policy

Reference: December 22, 2007 Memorandum
Signed by:
Dr. Charles McQueary; Director, Operational Test & Evaluation
Mr. John Young, Jr.; Under Secretary of Defense for Acquisition, Technology & Logistics

T&E must be brought to bear at the beginning of the system life cycle.

Developmental and operational test activities shall be integrated and seamless throughout the systems life cycle.

Evaluations shall include a comparison with current mission capabilities using existing data, so that measurable improvements can be determined. If such evaluation is considered cost prohibitive the Service Component shall propose an alternative evaluation strategy.

To realize the benefits of modeling and simulation, T&E will be conducted in a continuum of live, virtual, and constructive system and operational environments.

Deputy, Director Developmental Test & Evaluation Initiative

Examine the formats for the Test and Evaluation Strategy (TES) and the Test & Evaluation Master Plan (TEMP)

Either establish a single format for both documents or make the transition from one to the other seamless with a direct correlation

Revise the format for the TES/TEMP

Provide a recommended TES/TEMP format to adequately consider M&S

Deputy, Director Developmental Test & Evaluation Initiative

A T&E Working Group worked the initiative:

Co-Leads: Darlene Mosser-Kerner, OUSD (AT&L)
Tom Carter, DOT&E

Participating Organizations:
OSD (AT&L) DT&E
OSD DOT&E
JFCOM
DISA
OPNAV 912
HQ Department of the Army (DUSA-TEO)
COMOPTEVFOR
HQ Air Force (AQXA)

How Documentation Can Help:

Help a program manager think about how to plan for and incorporate M&S into the T&E process by identifying:

- how M&S can contribute to the T&E process
- high payoff areas in which to invest testing resources
- the most cost effective way of conducting T&E
- when it is too impractical or too costly to incorporate real world assets into a test and M&S may provide insight
- opportunities for M&S to support the T&E of a system in a SoS environment

Original M&S Input to the TEMP Format Rejected

Submitted a full page for inclusion in the new TEMP format

Proposed new guidance for the Defense Acquisition Guidebook (DAG) Chapter 9

The full page submission was deemed too long and the input was rejected in total.

Convinced the T&E Working Group to include a short paragraph in the TEMP Format with a reference and link to new guidance in the DAG.

Current M&S Input for the New TEMP Format

2 .5 Modeling & Simulation (M&S) –

Describe the key models and simulations and their intended use.

Include the test objectives to be addressed using M&S to include operational test objectives.

Identify data needed and the planned accreditation effort.

(Additional guidance for planning for the use of M&S can be found at the DT&E web page which DAG Sections 4.5.7 and DAG Section 9.3.4 will link to.)
http://www.acq.osd.mil/sse/dte/docs/M-S-Guidance-Acquisition-Workforce.pdf

Proposal for DAG Section 9.3.4 of TEMP Recommended Format:

- Document the intended use of models & simulations
- Identify key models & simulations intended to support T&E
- Identify the modeling & simulation data needed to support T&E
- For each model & simulation and its data describe the planned accreditation effort based on the assessment of the risk of using the model & simulation results for decisions being made
- Describe the standards (both government and commercial) with which the models & simulations and associated data must comply

Proposal for DAG Section 9.3.4 T&E Documentation Planning

Document the intended use of models & simulations by documenting:

- Question(s) to be answered
- Decisions that will be made based on the results of the models & simulations
- The test objectives/critical operational issues the models & simulations will address
- The requirements for the use of the models & simulations
- Consequences resulting from erroneous outputs from the models & simulations
- Support resources required

Proposal for DAG Section 9.3.4 T&E Documentation Planning (cont.)

Identify all M&S intended to support T&E (1 of 2):

- Live, virtual, and constructive simulations; distributed simulations and associated architecture; federates and federations; emulators; prototypes; simulators; and stimulators
- Legacy systems, new developments, and modified or enhanced legacy models & simulations
- Models & simulations managed by Federally Funded Research and Development Centers, industry, academia, and other Federal or non-Federal government organizations
- Commercial-off-the-shelf and government-off-the-shelf models & simulations
- Model & simulation test resources including hardware-in-the loop, human-in-the-loop, and software-in-the-loop simulators; land-based, sea-based, air-and space-based test facilities

Proposal for DAG Section 9.3.4 T&E Documentation Planning (cont.)

Identify all M&S intended to support T&E (2 of 2):

- Threat models, simulations, simulators, stimulators, targets, threat systems, & surrogates
- Synthetic countermeasures, test beds, environments, and battlespaces
- Models & simulations whether embedded in weapon systems, implemented as stand-alone systems, or integrated with other distributed simulations
- Test assets, test planning aids, and post-test analysis tools that address other than real time characteristics
- Infrastructure needed to conduct a (the) test(s) to include networks, integration software, data collection tools, etc.
- Provide descriptive information for each model & simulation resource:
  - Title, acronym, version, date, proponent
  - Assumptions, capabilities, limitations, risks, and impacts of the M&S
  - Availability for use to support T&E
  - Schedule for obtaining

Proposal for DAG Section 9.3.4: T&E Documentation Planning (cont.)

Identify the modeling & simulation data needed to support T&E:

- Describe the input data the models & simulations need to accept
- Describe the output data the models & simulations should generate
- Describe the data needed to verify & validate the models & simulations
- Provide descriptive information for each data resource:
  - Data title, acronym, version, date
  - Data producer (organization responsible for establishing the authority of the data)
  - Identify when, where, and how data was or will be collected
  - Known assumptions, capabilities, limitations, risks, and impacts
  - Availability for use to support T&E
  - Schedule for obtaining

Proposal for DAG Section 9.3.4 T&E Documentation Planning (cont.)

For each model & simulation and its data describe the planned accreditation effort based on the assessment of the risk of using the model & simulation results for decisions being made

- Explain the methodology for establishing confidence in the results of models & simulations
- Document historical source(s) of verification, validation and accreditation (VV&A) in accordance with DoDI 5000.61
- Provide the schedule for accrediting prior to their use to support T&E

Proposal for DAG Section 9.3.4 T&E Documentation Planning (cont.)

Describe the standards (both government and commercial) with which the models & simulations and associated data must comply

- Information technology standards identified in the DoD Information Technology Standards Registry (https://disronline.disa.mil/)
- Standards identified in the DoD Architecture Framework Technical Standards Profile (TV-1) and Technical Standards Forecast (TV-2)
- Modeling & Simulation Standards and Methodologies (http://assist.daps.dla.mil/)
- Data standards
- VV&A standards:
  - IEEE Std 1516.4TM -2007, IEEE Recommended Practice for VV&A of a Federation—An Overlay to the High Level Architecture Federation Development and Execution Process
  - IEEE Std 1278. 4TM -1997(R2002), IEEE Recommended Practice for Distributed Interactive Simulation - VV&A
  - **MIL-STD-3022 DoD Standard Practice for Model & Simulation VV&A Documentation Templates**

Summary

Incorporating the use of modeling & simulation planning into the TEMP:

- Responds to new T&E policy to plan for using models & simulations in support of the testing process.
- Supports the DT&E initiative to incorporate planning for modeling & simulation in the TEMP.
- Addresses recognized needs in the Acquisition M&S Master Plan
- Provides a thought process for a program manager to think about planning for the use of models and simulations to support the testing process

Currently this is still work in progress.

Back Ups

Current Recommended TEMP Format (DAG 9.10)

2. PART II-INTEGRATED TEST PROGRAM SUMMARY

b. Management

(2) Identify the T&E WIPT structure, to include the sub-T&E WIPTs, such as a M&S or Reliability, with their participating organizations.

3. PART III-DEVELOPMENTAL TEST AND EVALUATION OUTLINE

b. Future Developmental Test and Evaluation.

(3) …. List all M&S to be used to help evaluate the system's performance, explain the rationale for their credible use and provide their source of verification, validation and accreditation (VV&A).

4. PART IV-OPERATIONAL TEST AND EVALUATION OUTLINE

c. Future Operational Test and Evaluation

(3) …. Whenever M&S are to be used: identify the planned M&S; explain how they are proposed to be used; and provide the source and methodology of the VV&A underlying their credible application for the proposed use.

5. PART V-TEST AND EVALUATION RESOURCE SUMMARY

a. … Identify the following test resources:

(4) *Threat Representation:* Subject each representation of the threat (target, simulator, model, simulation or virtual simulation) to validation procedures to establish and document a baseline comparison with its associated threat and to determine the extent of the operational and technical performance differences between the two throughout the life cycle of the threat representation.

(7) Simulations, Models and Testbeds: … Identify the M&S to be used, including computer-driven simulation models and hardware/software-in-the-loop test beds. However, provide the discussion of how these M&S will be used in Parts III and IV. Identify the resources required to accredit their usage. Identify the M&S Proponent, the V&V Agent, and the Accreditation Agent for intended user.

Current Defense Acquisition Guidance Regarding the use of Models & Simulations

9.1 Introduction to Test and Evaluation (T&E): DT&E supports: the systems engineering process to include providing information about risk and risk mitigation; assessing the attainment of technical performance parameters; providing empirical data to validate models and simulations and information to support periodic technical performance and system maturity evaluations.

The program manager, in concert with the user and test communities, without compromising rigor, is required to integrate modeling and simulation (M&S) activities with government and contractor DT&E, OT&E, LFT&E, system-of-systems interoperability and performance testing into an efficient continuum.

9.1.5. Integrated T&E Philosophy: Live testing might be integrated with verified, validated, and accredited simulators or computer driven models and simulations, to optimize the amount of live testing required. Another aspect is integrating developmental test and evaluation with operational test and evaluation into a continuum that reduces testing resource requirements and time, or conducting concurrent DT and OT when objectives and realism are compatible.

9.3.2.T&E Working Integrated Product Team: Program managers should also consider forming lower level functional working groups, who report to the T&E WIPT, whose focus is on specific areas such as reliability scoring, M&S development and VV&A, threat support, etc.

9.3.4. Modeling and Simulation in DT&E

9.3.5. System Readiness for IOT&E

9.4.1. OT&E Guidelines

9.4.2. Validation of Threat Representations (targets, threat simulators, or M&S)

9.5.3. Early LFT&E

9.5.4. Full-Up, System-Level Testing (FUSL) and Waiver Process

9.6.1.1. TES Description

9.6.2.2. Test and Evaluation Master Plan (TEMP) Format