Revision of the Acquisition Modeling and Simulation Master Plan

August 13, 2009
Circumstance

• Acquisition Modeling and Simulation Master Plan (AMSMP)
  – Signed out April 17, 2006
  – Forty actions designed to:
    • Foster widely-needed M&S capabilities beyond the reach of individual programs
    • Better enable acquisition of effective joint capabilities and systems-of-systems
    • Empower program and capability managers by removing systemic M&S obstacles, identifying new options for approaching tasks, and helping support widely-shared needs.
    • Promote coordination and interface with M&S activities of the DoD Components.

• M&S Steering Committee requires that each community develop and maintain a business plan
• Update required for 2010 to feed development of DoD’s Common and Cross-Cutting Business Plan
Update AMSMP

• Completed by end of CY2009
• Current AMSMP is our departure point
  – Maintain objectives
  – Most actions will carry-over, update as required to reflect progress, policy change, results of studies, etc
  – Completed actions will be replaced by their follow-on actions
  – New actions will be added to reflect change in business, policy and technology
• Structure will change
• Heavy reliance on the Acquisition Modeling and Simulation Working Group (AMSWG)
End Result

• Cogent guidance for choosing projects and influencing other acquisition community M&S
  – Metrics for selecting appropriate, cost-effective projects traceable to requirements
  – Defined interfaces to other projects and activities
  – Aligning influence on other acquisition M&S
• Provides for systematic integration and evaluation of components as they are produced & assembled
• Allows for visible progress assessment against the vision, holding ourselves accountable
• Provides mechanism for iterating requirements, needed actions, and the plan accordingly
• Provides guidance for influencing policies and other’s activities
C&C BP Target Timeline

Community Collaboration with C&C BP

- Initial draft FY10 C&CC BP
- Terminology & functional categories
- Initial capabilities/gaps
- Kickoff with Community BP leads
- Study Plan
- Start
- FY09 Community BP guidance recommendations
- Survey complete
- Survey form
- Red-team review recommendation
- Coordination draft
- 2009
- 2010
- Final draft
Our Contribution

• Description of the “To-Be” State – Vision
• Description of the “As-Is” State -- Capabilities
  – Tools
  – Data
  – Services
• Capability Gaps
• Initiatives / Actions

• Acquisition Community M&S Business Plan
Acquisition M&S Master Plan Update Process

Jan ‘10
Acquisition M&S Master Plan UPDATE

Determine & Prioritize What Acqn. Community Must Do

Identify Actions of Others (e.g., M&S CO, NII, NIST)

Nov ‘09

Validate and Identify New M&S Capability Gaps

Oct ‘09

Validate Needed System Engineering Capabilities

Sep ‘09

Validate and Identify New Needed M&S Capabilities

(Top-down)

Desired Acqn Environment per CJCSI 3170 & DoDD 5000.1

Assess Current Issues/Needs (e.g., SoS efforts)

Sep ‘09

Validate and Identify New Actions Needed to Address the Gaps

Assess Recommendations fm Prior M&S in Acqn Studies

(Bottom-up)
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<thead>
<tr>
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<th>Policy/Guidance Reference Documents</th>
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<tr>
<td>3.</td>
<td>Chairman of the Joint Chiefs of Staff Instruction 3170.01G, &quot;Joint Capabilities Integration and Development System,&quot; March 1, 2009</td>
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<td>7.</td>
<td>Defense Acquisition University, &quot;Glossary of Acquisition Acronyms and Terms,&quot; July 2005</td>
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<td>14.</td>
<td>Revision to T&amp;E Policy; Memorandum; December 22, 2007</td>
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<td>15.</td>
<td>DoD M&amp;S Human Capital Strategy (DRAFT)</td>
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<td>17.</td>
<td>Weapons Systems Acquisition Reform Act; May 22, 2009</td>
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Top-Down Derivation/Traceability

CJCSI 3170 & DoDD 5000.1

Characteristics of Desired Acquisition Environment

Annotated as AE1, AE2, … AEn

Needed Systems Engineering Capabilities

Annotated as SE1, SE2, … SEn

Needed M&S Capabilities

Annotated as MS1, MS2, … MSn

Gaps

Annotated as G1, G2, … Gn

Actions

Annotated as A1, A2, … An
Needed Systems Engineering Capabilities

| SE1 | Early, continuing systems engineering from an SoS/FoS capabilities perspective; seamless transition from JCIDS to acquisition |
| SE2 | Lifecycle-wide exploration of the maximum available trade space, including time-phased requirements and technology insertion |
| SE3 | Collaboration among multiple organizations, Service & contractors for all key enterprise-level SE decisions |
| SE4 | Comprehensive, accurate, early assessment of designs; avoidance of costly fixes for problems discovered late in the acquisition process |
| SE5 | Tighter decision cycles (faster design-assessment process) |
| SE6 | More effective & efficient testing, including in a SoS/FoS environment |
| SE7 | Appropriate reuse of all resources -- information, software tools, expertise, facilities, ranges, etc -- across programs & organizations |
M&S Processes for Better Systems Engineering

MS1 Use of a model-based systems engineering approach
MS2 Establishing M&S-enabled collaborative engineering environments
MS3 Model-Test-Model process to improve both M&S tools and testing
MS4 Harnessing M&S knowledge to formulate an effective M&S strategy
MS5 Disciplined M&S planning and employment
MS6 Efficient development/maintenance of credible M&S tools
MS7 Access/sharing of authoritative data needed for M&S representations
MS8 Inspection of M&S used and cost burden that inhibits M&S use
Gaps (1 of 3)

G01 Robust but confused landscape of M&S activities; no clearly designated leadership or effective coordinating mechanism.

G02 Inadequate constancy of purpose because time to fix problems >> tour length; "DoD has an attention deficit disorder."

G03 Gov't acquisition guidelines don't promote M&S use or reuse.

G04 No DoD requirement for formal M&S planning to support acquisition (other than T&E).

G05 No contractual guidelines regarding M&S and the data it needs.

G06 Gov't typically doesn't give contractors meaningful M&S guidance.

G07 Most DoD M&S takes a project, vice an enterprise approach.

G08 No consensus on value of integrated architectures, nor responsibility for managing distributed collaboration, needed for SoSE, is very hard

G09 Public law precludes OT based solely on M&S, but no clear guidance on use for SoS/FoS T&E

G10 No standard modeling notation (like UML v2.0) for capturing full range of information critical to system engineering (e.g., structure, behavior, requirements hierarchy/traceability, test cases, verification results)

G11 No standard for interchanging systems engineering information (same examples as above)

G12 No conceptual framework (like Open System Interconnect protocol stack) for data exchange

G13 Lack of agreement on a common distributed simulation standard increases complexity

G14 DoDAF v1.0 is difficult to use for architecting due to lack of data-centricity and executability; some products of marginal value

G15 Use of DoD-unique standards limits their user base, quality, COTS tool support, and opportunities for reuse

G16 Many M&S tool gaps and deficiencies
Gaps (2 of 3)

G18 No good way to develop and maintain widely-needed M&S tools that cut across programs
G19 M&S developers, not M&S users, tend to drive M&S development
G20 In general, architecture development (modeling) is lagging, not collaborative, and not exploiting COTS SE tools
G21 No readily-available distributed M&S infrastructure (e.g. JDEP)
G22 Hard to get security certification for multi-organization distributed simulation
G23 Hard to get approval and security certification for M&S involving multiple compartmented programs
G24 Post-development model validation expensive and slow
G25 VV&A often weak or non-existent; documentation inconsistent
G26 VV&A usually not enforced and also not examined during program reviews
G27 Models and sims often not updated to reflect empirical evidence (e.g. test results)
G28 Little reuse; only 7% of models & sims used on > 1 program
G29 Concurrent engineering requires integrated culture, data & tool set, but <20% of programs have such a collaborative environment
G30 Hard to discover reusable resources (software, info, services)
G31 Insufficient info (metadata) to evaluate data/reuse candidates
G32 Hard to obtain reusable resources
G33 No incentives to encourage reuse
G34 Conceptual foundation of M&S weak
G35 Little acquisition community input to DoD S&T management
G36 No business model for how to M&S capabilities should be developed, used and maintained
G37 Metrics are critical to keep interest and funding up, but metrics regarding M&S use and cost-effective are inadequate
Gaps (3 of 3)

G38  Too little funding
G39  Body of knowledge for M&S support to acquisition is deficient, not managed
G40  Acqn community managers and staffs mostly uninformed about M&S capabilities and limitations
G41  M&S developers lack understanding of modeling best practices, abstraction techniques, context dependencies, etc.
G42  M&S users often not adequately options
G43  Insufficient M&S education options
AMSMP: Five Objectives, 40 Actions

**Objective 1**
Provide necessary policy and guidance

- 1-1 M&S management
- 1-2 Model-based systems engineering & collaborative environments
- 1-3 M&S in testing
- 1-4 M&S planning documentation
- 1-5 RFP & contract language
- 1-6 Security certification

**Objective 2**
Enhance the technical framework for M&S

- 2-1 Product development metamodel
- 2-2 Commercial SE standards
- 2-3 Distributed simulation standards
- 2-4 DoDAF utility
  - a) DoDAF 2.0 Systems Engineering Overlay
  - b) Standards for depiction & interchange
- 2-5 Metadata template for reusable resources

**Objective 3**
Improve model and simulation capabilities

- 3-1 Acquisition inputs to DoD M&S priorities
- 3-2 Best practices for model/sim development
- 3-3 Distributed LVC environments
  - a) Standards
  - b) Sim/lab/range compliance
  - c) Event services
- 3-4 Central funding of high-priority, broadly-needed models & sims
  - a) Prioritize needs
  - b) Pilot projects
  - c) Expansion as warranted

**Objective 4**
Improve model and simulation use

- 4-1 Help defining M&S strategy
- 4-2 M&S planning & employment best practices
- 4-3 Foster reuse
  - a) Business model
  - b) Responsibilities
  - c) Resource discovery
- 4-4 Info availability
  - a) Scenarios
  - b) Systems
  - 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

**Objective 5**
Shape the workforce

- 5-1 Definition of required M&S competencies
- 5-2 Harvesting of commercial M&S lessons
- 5-3 Assemble Body of Knowledge for Acqn M&S
- 5-4 M&S education & training
  - a) DAU, DAG & on-line CLMs
  - b) Conferences, workshops & assist visits
- 5-5 MSIAC utility

**Key**
Broader than Acqn
AMSMP Update Database

Systems Engineering Artifacts; Fully Traceable.

Master Plan Contents
Burning Questions

• How do we more effectively choose and defend projects?
• How do we provide appropriate guidance to project doers?
• How do we ensure that products fit together in the end?
• How do we assess progress at the action level, gap level, M&S process level?
• If we complete all of the actions, do we achieve the end state?
Current Activities

- Develop Detailed and Positive Expression of the End State
  - Based on Current Set of “M&S Processes for Better Systems Engineering”
  - In Consideration of Current Gap Set

- Liberally Identify and Assess Current Capabilities

- Attach Metrics to Gaps
Business Ecosystem

“An economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world. This economic community produces goods and services of value to customers, who themselves are members of the ecosystem. The member organizations also include suppliers, lead producers, competitors and other stakeholders. Over time, they coevolve their capabilities and roles, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward shared visions to align their investments and to find mutually supportive roles.”

Measures to Assess an Ecosystem’s Health

• Productivity
  – The ability of the ecosystem to continually transform technology and raw materials of innovation into lower costs and new products

• Robustness
  – An ecosystem’s ability to survive major disruptions, such as those caused by unpredictable technological innovation and change

• Niche Creation
  – Ability of an ecosystem to increase meaningful diversity through the creation of valuable new functions, or niches

Principles of the Ecosystem Model

• “Open system”: organic systems exist in a continuous exchange with their environment, characterized by a continuous cycle of input, internal transformation (throughput), output, and feedback.

• Homeostasis: self-regulation and the ability to maintain a steady state achieved through processes that regulate and control system operation on the basis of “negative feedback” whereby deviations from some standard norm initiate actions to correct the deviation.

• Entropy/negative entropy: closed systems are entropic in that they have a tendency to deteriorate and run down. Open systems seek to sustain themselves by importing energy – they are characterized by negative entropy.

• Structure, function, differentiation, and integration: relationship between these concepts is crucial to understanding living systems as they are closely intertwined.

• Requisite variety: the internal regulatory mechanisms of a system must be as diverse as the environment with which it is trying to deal.

• Equifinality: in an open system, there may be many different ways of arriving at a given end state.

• System evolution: the capacity of a system to evolve depends on an ability to move to more complex forms of differentiation and integration.[1]

Questions?
Technical Reference Documents

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
6. Effectiveness of M&S in Weapon System Acquisition, 1996; Sponsor: DTSE&E (Dr. Pat Sanders); conducted by SAIC (A. Patenaude)
8. A Road Map for Simulation Based Acquisition, 1998; Joint SBA Task Force (JHU APL lead); sponsor: Acquisition Council of EXCIMS
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)
14. M&S in Manufacturing and Defense Systems Acquisition, 2002; National Research Council; sponsor: DMSO
17. Live, Virtual, Constructive Architecture Roadmap, 2008, JFCOM (Lead: K Goad)
M&S Activities During Acquisition

**Materiel Solution Analysis**
- Develop M&S requirements (SEP)
- Model and data discovery (SEP)
- Develop M&S Configuration Management Strategy (SEP)
- Assign Lifecycle Maintenance Responsibilities of Data and Models (SEP, RFP)
- Define role of M&S throughout the lifecycle
- Review and identify appropriate standards for M&S reuse and interoperability (SEP, RFP)
- Develop/Modify Required M&S
  - Accredit applicable M&S capabilities
  - Publish descriptions of M&S capability developed in this phase.
  - Assess required data ownership/use rights and accessibility (development RFP, materiel RFP)

**Technology Development**
- Develop M&S requirements (SEP)
- Influence Acquisition Strategy to address modeling and simulation requirements and use
- Document role of M&S in testing and initiate identification of required M&S assets
- Initiate discussion of requirements for use of M&S in operational test w/OT community (TEMP)
- Update SEP based on evolving M&S requirements
- Develop/modify required M&S including virtual prototype
  - Accredit applicable M&S capabilities
  - Publish descriptions of M&S capability developed in this phase.
  - Review data and ownership rights (LRIP RFP)

**Engineering and Manufacturing Development**
- Develop M&S requirements (SEP)
- Develop/modify required M&S
  - Accredit applicable M&S capabilities
  - Publish descriptions of M&S capability developed in this phase.
- Identify opportunities for M&S reuse for operations (e.g., training, decision support, etc)
- Develop/modify required M&S
  - Accredit applicable M&S capabilities
  - Publish descriptions of M&S capability developed in this phase.
  - Review data and ownership rights (Full Rate RFP)

**Production and Deployment**
- Capture data to strengthen M&S for operational use and feedback to other programs
  - Reuse/repurpose M&S for operational use (e.g., training, decision support, etc)

**O&S**
- Full Rate Production Decision Review
M&S Use During Acquisition

NOTE: THIS LIST IS NOT COMPLETE AND GROUPING BY PHASE IN THIS WAY DOES NOT ADEQUATELY COMMUNICATE BROAD-SPECTRUM USE M&S THROUGHOUT THE ACQUISITION PROCESS
Key CJCSI 3170.01E Policies

- Joint concepts-centric capabilities identification process to allow joint forces to meet the full range of military operations and challenges...
- Assess existing and proposed capabilities in light of their contribution to future joint allied and coalition operations. ... Produce capability proposals that consider the full range of DOTMLPF solutions in order to advance joint warfighting in a unilateral and multinational context. New solution sets...crafted to deliver technologically sound, testable, sustainable and affordable increments of militarily useful capability.
- The FoS and SoS solutions may also require systems delivered by multiple sponsors/materiel developers...
- The process to identify capability gaps and potential solutions must be supported by a robust analytical process...
- JCIDS implements a capabilities-based approach that...requires a collaborative process that utilizes joint concepts and integrated architectures to identify prioritized capability gaps and integrated DOTMLPF and policy approaches to resolve those gaps.

Mentioned/implied in the definition of the CDD (evolutionary acquisition)

Mentioned only in the definition of “Materiel Solution”

Implied throughout