

# 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

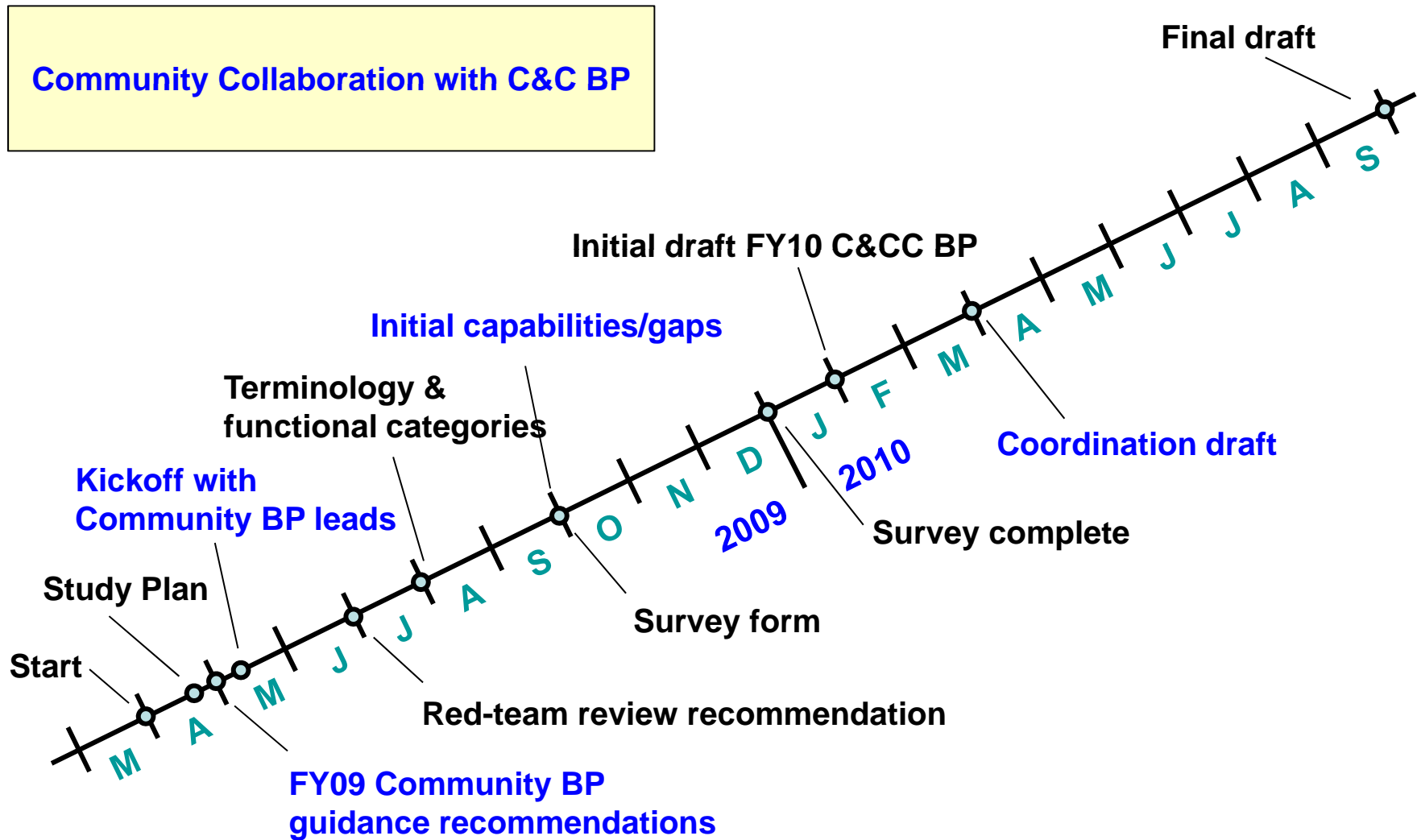
# Update AMSMP

- 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

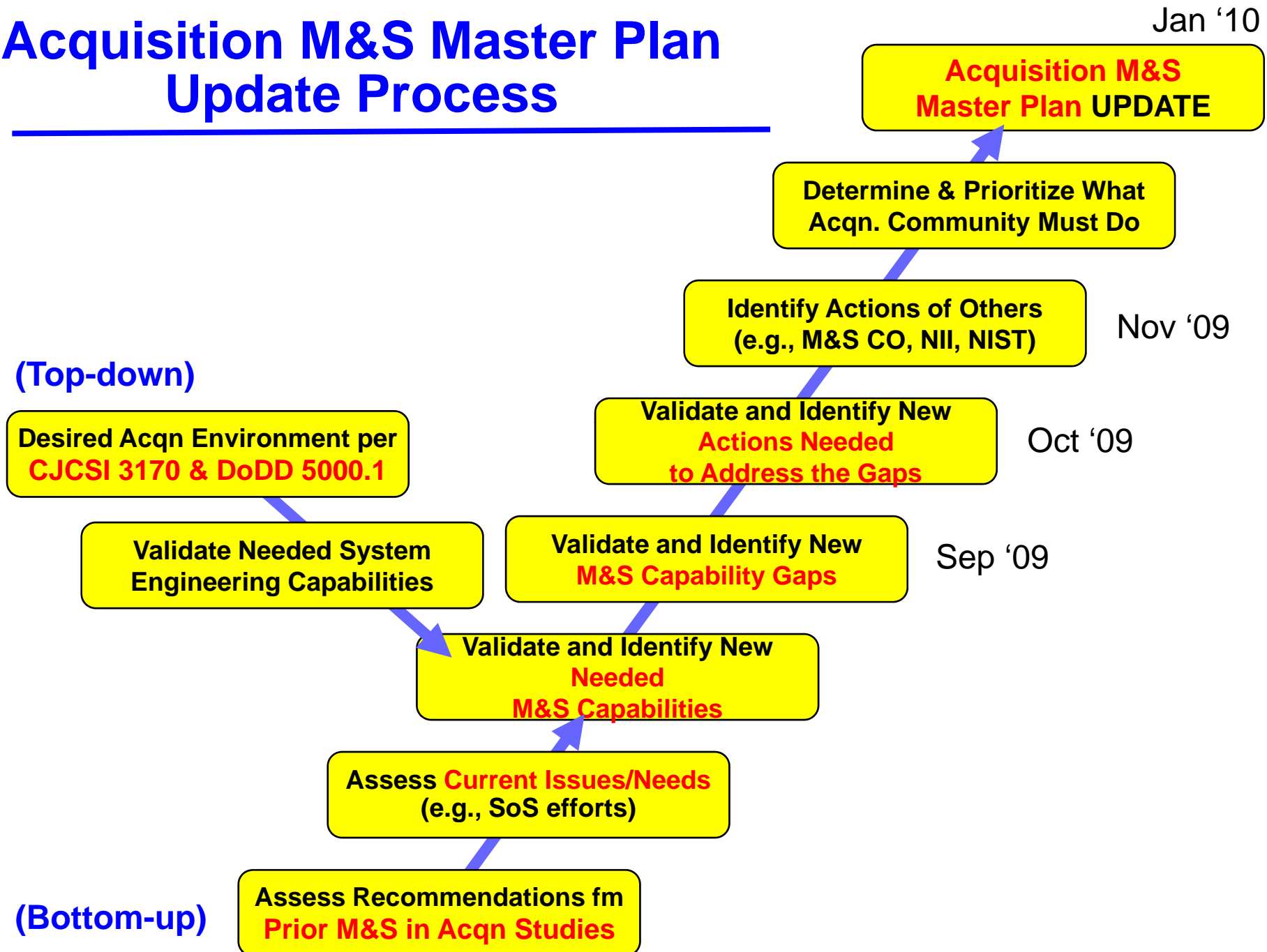
# C&C BP Target Timeline



# 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

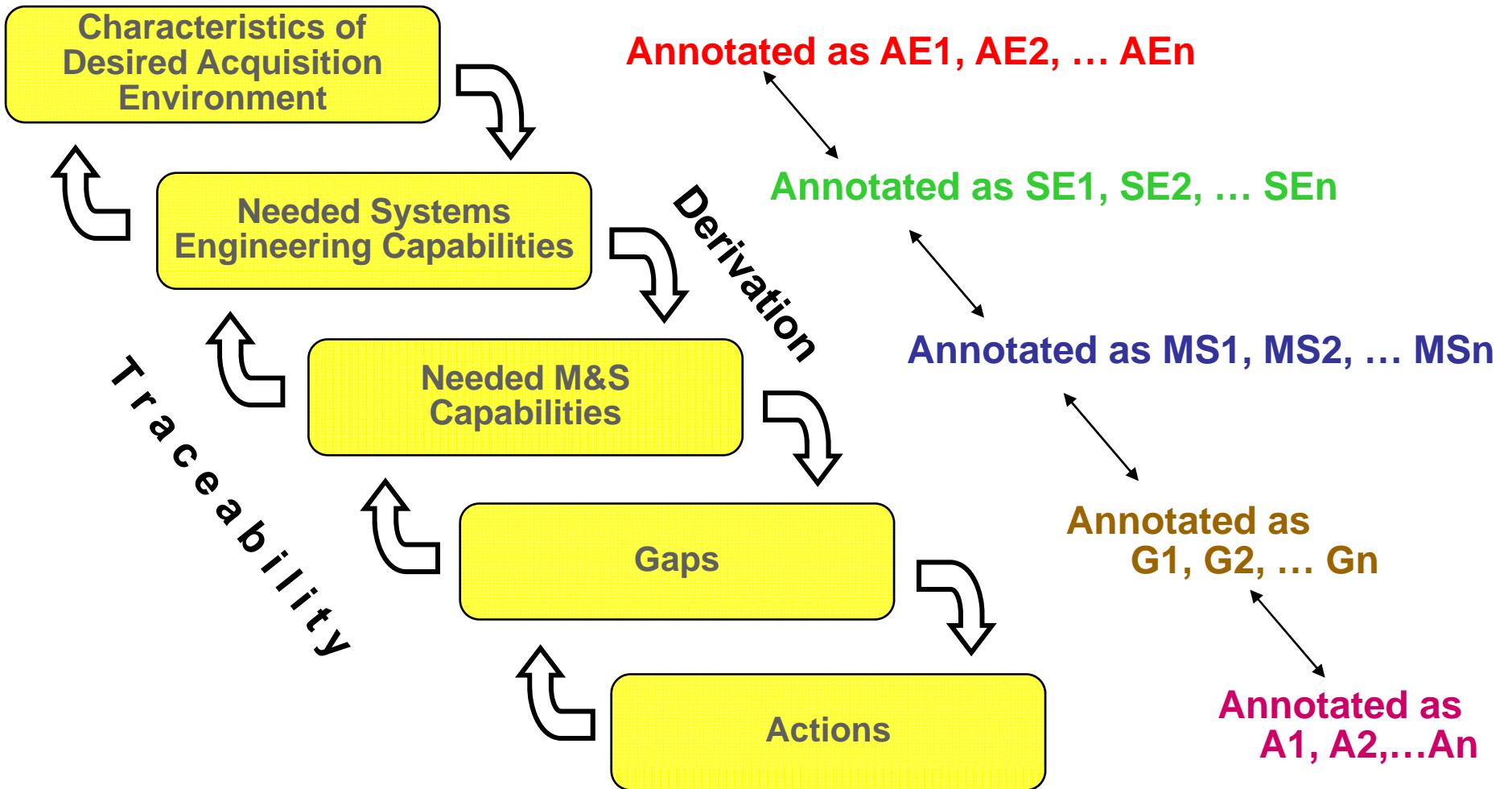


# Policy/Guidance Reference Documents

1. DoD Directive 5000.1, "The Defense Acquisition System," May 12, 2003
2. DoD Directive 5000.59, "DoD Modeling and Simulation (M&S) Management," August 8, 2007
3. Chairman of the Joint Chiefs of Staff Instruction 3170.01G, "Joint Capabilities Integration and Development System," March 1, 2009
4. DoD 5025.1-M, "DoD Directives Systems Procedures," October 28, 2007
5. DoDD 8320.2, "Data Sharing in a Net-Centric Department of Defense," December 3, 2004
6. DoD 5000.59-M, "Glossary of Modeling and Simulation Terms," January 15, 1998
7. Defense Acquisition University, "Glossary of Acquisition Acronyms and Terms," July 2005
8. "Defense Acquisition Guidebook, Version X.Y," November 1, 2006
9. DoD Instruction 5000.2, "Operation of the Defense Acquisition System," Dec 8, 2008
10. "Federal Acquisition Regulation," March 31, 2008
11. DoD Instruction 8500.2, "Information Assurance (IA) Implementation," February 6, 2003
12. "DoD Architecture Framework," April 23, 2007
13. DoDI 5000.61, "DoD Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A)," May 13, 2003
14. Revision to T&E Policy; Memorandum; December 22, 2007
15. DoD M&S Human Capital Strategy (DRAFT)
16. Implementing a Life Cycle Management Framework; DTM; July 31, 2008
17. Weapons Systems Acquisition Reform Act; May 22, 2009

# Top-Down Derivation/Traceability

CJCSI 3170 & DoDD 5000.1



# 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
- G09** Managing distributed collaboration, needed for SoSE, is very hard
- G10** Public law precludes OT based solely on M&S, but no clear guidance on use for SoS/FoS T&E
- G11** 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)
- G12** No standard for interchanging systems engineering information (same examples as above)
- G13** No conceptual framework (like Open System Interconnect protocol stack) for data exchange
- G14** Lack of agreement on a common distributed simulation standard increases complexity
- G15** DoDAF v1.0 is difficult to use for architecting due to lack of data-centricity and executability; some products of marginal value
- G16** Use of DoD-unique standards limits their user base, quality, COTS tool support, and opportunities for reuse
- G17** 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 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

Key

Broader than Acqn

## 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

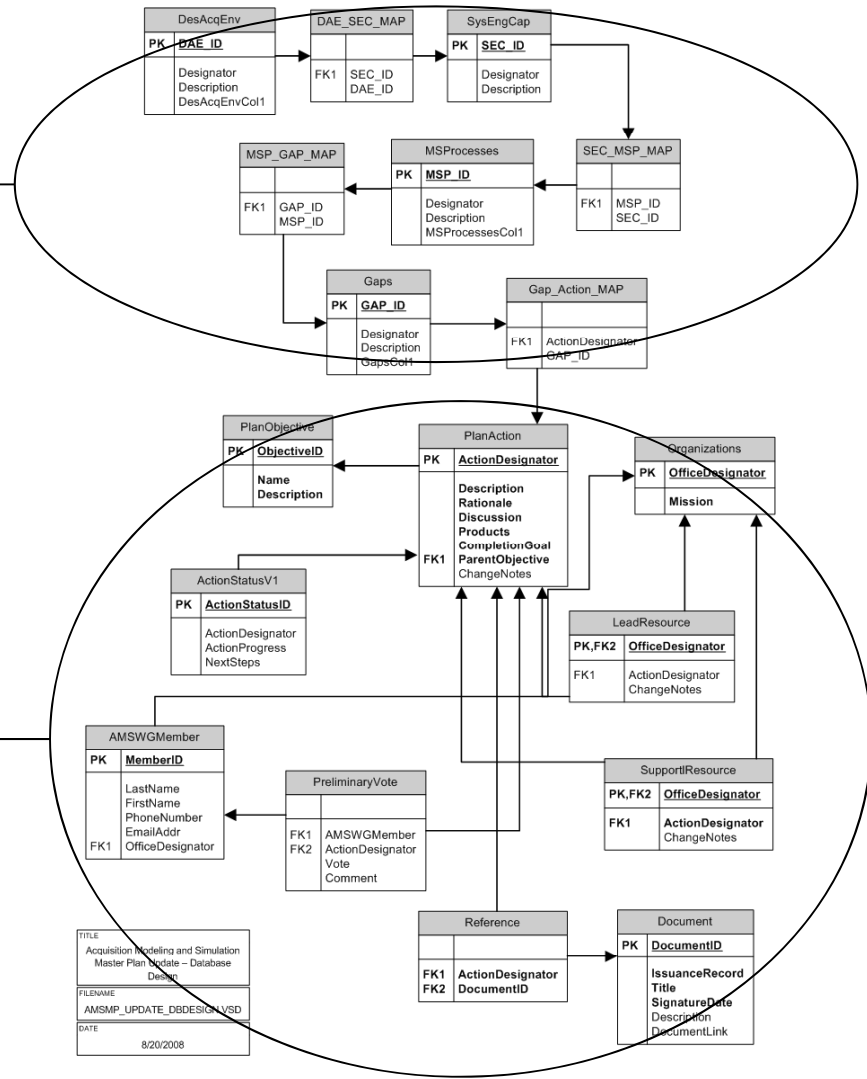
Shape the workforce

- 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

# AMSMP Update Database

Systems Engineering  
Artifacts; Fully  
Traceable.

Master Plan  
Contents

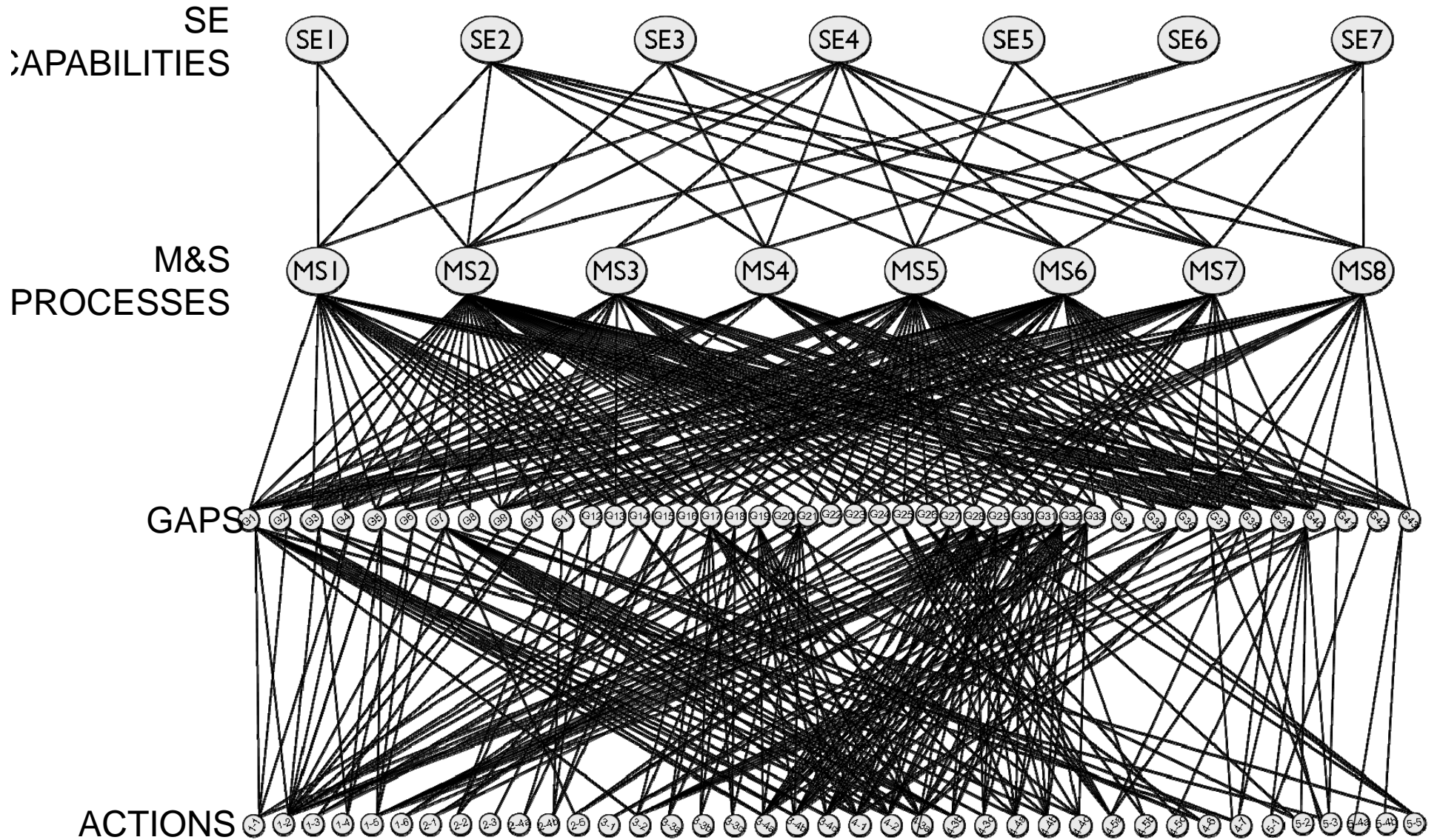


TITLE  
Acquisition Modeling and Simulation  
Master Plan Update - Database  
Design

FILENAME  
AMSMP\_UPDATE\_DBDESIGN.VSD

DATE  
8/20/2008

# AMSMP Traceability Map



# 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.”

James F. Moore, *The Death of Competition – Leadership and Strategy in the Age of Business Ecosystems*, Harper Business, New York, 1996.

# 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.[\[1\]](#)

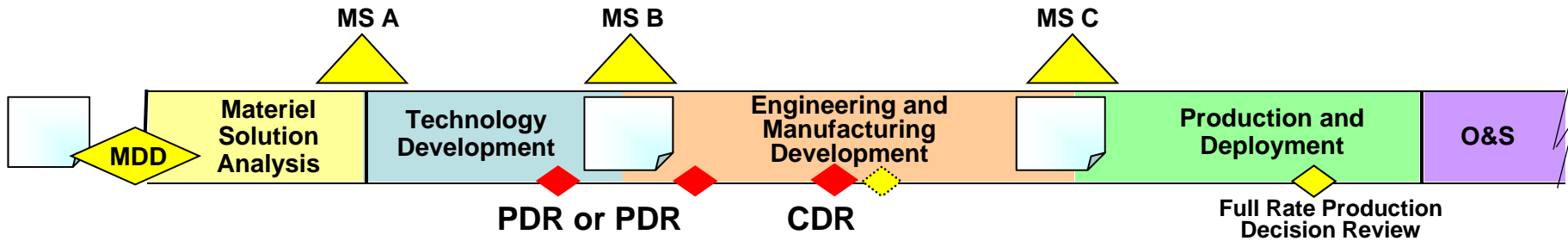
[\[1\]](#) Gareth Morgan, *Images of Organization*.

**Questions?**

# Technical Reference Documents

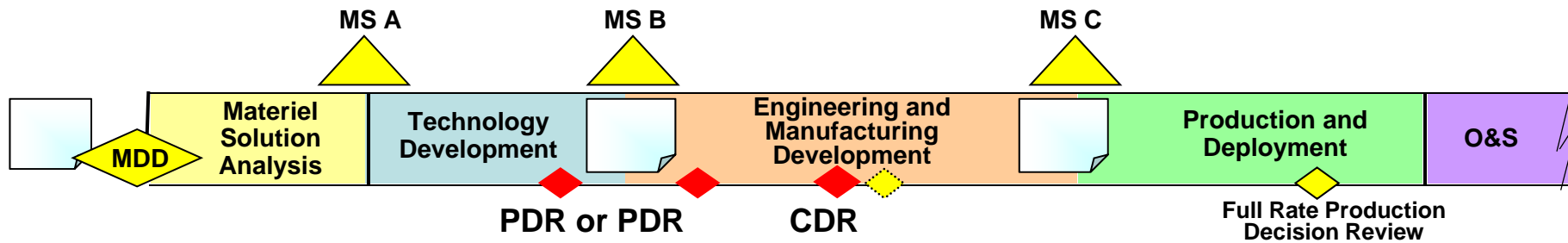
1. *Final Report of the Acquisition Task Force on M&S*, 1994; Sponsor: DDR&E (Dr. Anita Jones); Chair: VADM T. Parker, USN (Ret.)
2. *Naval Research Advisory Committee Report on M&S*, 1994; Sponsor: ASN(RDA); Chair: Dr. Delores Etter
3. *Collaborative Virtual Prototyping Assessment for Common Support Aircraft*, 1995; Sponsor: Naval Air Systems Command; conducted by JHU/APL and NSMC
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
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, OUSD(AT&L)DS
16. *Missile Defense Phase III M&S*, 2004 Defense Science Board Task Force (Chair: W. Schneider)
17. *Live, Virtual, Constructive Architecture Roadmap*, 2008, JFCOM (Lead: K Goad)
18. *Modeling and Simulation Resource Reuse Business Model*, 2008, Center for Naval Analyses (Lead: D. Shea)

# M&S Activities During Acquisition



<p>Develop M&amp;S requirements (SEP)</p> <p>Model and data discovery (SEP)</p> <p>Develop M&amp;S Configuration Management Strategy (SEP)</p> <p>Assign Lifecycle Maintenance Responsibilities of Data and Models (SEP, RFP)</p> <p>Define role of M&amp;S throughout the lifecycle</p> <p>Review and identify appropriate standards for M&amp;S reuse and interoperability (SEP, RFP)</p> <p>Develop/Modify Required M&amp;S</p> <p>Accredit applicable M&amp;S capabilities</p> <p>Publish descriptions of M&amp;S capability developed in this phase.</p> <p>Asses required data ownership/use rights and accessibility (development RFP, materiel RFP)</p>	<p>Develop M&amp;S requirements (SEP)</p> <p>Influence Acquisition Strategy to address modeling and simulation requirements and use.</p> <p>Document role of M&amp;S in testing and initiate identification of required M&amp;S assets</p> <p>Initiate discussion of requirements for use of M&amp;S in operational test w/OT community (TEMP)</p> <p>Update SEP based on evolving M&amp;S requirements</p> <p>Develop/modify required M&amp;S including virtual prototype</p> <p>Accredit applicable M&amp;S capabilities</p> <p>Publish descriptions of M&amp;S capability developed in this phase.</p> <p>Review data and ownership rights (materiel RFP)</p>	<p>Develop M&amp;S requirements (SEP)</p> <p>Develop/modify required M&amp;S</p> <p>Accredit applicable M&amp;S capabilities</p> <p>Publish descriptions of M&amp;S capability developed in this phase.</p> <p>Review data and ownership rights (LRIP RFP)</p>	<p>Identify opportunities for M&amp;S reuse for operations (e.g. training, decision support, etc)</p> <p>Develop/modify required M&amp;S</p> <p>Accredit applicable M&amp;S capabilities</p> <p>Publish descriptions of M&amp;S capability developed in this phase.</p> <p>Review data and ownership rights (Full Rate RFP)</p>	<p>Capture data to strengthen M&amp;S for operational use and feedback to other programs.</p> <p>Reuse/repurpose M&amp;S for operational use (e.g., training, decision support, etc)</p>
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# M&S Use During Acquisition



<p>AoA</p> <ul style="list-style-type: none"> <li>Rapid virtual prototyping</li> <li>Exploration of alternatives and design variations</li> <li>CAD/CAM</li> <li>Promote stakeholder inspection of proposed solution, variations and alternatives</li> <li>Identify cost drivers and risk areas.</li> <li>Conduct initial manpower requirements studies.</li> </ul>	<ul style="list-style-type: none"> <li>System performance analyses (e.g., evaluate Pdet, Pcded, Pk, etc)</li> <li>CAD/CAM</li> <li>Human machine interface design</li> <li>Failure analyses (e.g., stress, fatigue, shock)</li> <li>Conduct manpower requirements studies.</li> <li>Evaluate cost implications</li> <li>Life cycle cost analyses</li> <li>Analyze and assess resource, readiness, and other key life cycle sustainment metrics</li> </ul>	<ul style="list-style-type: none"> <li>Evaluate performance of technology under development.</li> <li>Focus test and evaluation activities</li> <li>CAD/CAM</li> <li>Test and evaluation under conditions otherwise difficult/impossible to replicate (i.e., safety restrictions, environmental restrictions, cost restrictions)</li> <li>Predict human performance as a function of detailed design</li> <li>Anthropometry and biomechanics.</li> <li>Analyze and assess resource, readiness, and other key life cycle sustainment metrics</li> </ul>	<ul style="list-style-type: none"> <li>Design of manufacturing facilities</li> <li>Define production workflow</li> <li>Analyze and assess resource, readiness, and other key life cycle sustainment metrics</li> </ul>	<ul style="list-style-type: none"> <li>Support design and maintenance modifications</li> <li>Evaluate redesign efforts</li> <li>Analyze and assess resource, readiness, and other key life cycle sustainment metrics</li> </ul>
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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

# To CJCSI 3170.01G

dtd. 1 Mar 2009

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

## Key CJCSI 3170.01E Policies

- <sup>AE1</sup> 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 <sup>AE2</sup> 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 <sup>AE3</sup> technologically sound, testable, sustainable and affordable increments of militarily useful capability.
- The <sup>AE4</sup> FoS and SoS solutions may also require systems delivered by multiple sponsors/materiel developers. <sup>AE5</sup>
- The process to identify capability gaps and potential solutions must be supported by a robust analytical process. <sup>AE6</sup>
- JCIDS implements a capabilities-based approach that...requires a <sup>AE7</sup> collaborative process that utilizes joint concepts and integrated architectures to identify prioritized capability gaps and integrated DOTMLPF and policy approaches to resolve those gaps. <sup>AE8</sup>
- <sup>AE9</sup>

Mentioned only in the definition of "Materiel Solution"

Implied throughout