Model-Based Systems Acquisition in the Department of Defense

Frontiers 2007
Georgia Tech Research Institute
Atlanta, GA
May 16, 2007

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Agenda

- DoD's Acquisition Challenges
- Acquisition M&S Master Plan
  - Objectives & Actions
  - Progress
- Some thoughts on information sharing

A Radical Shift in DoD Acquisition

- Top-down, "joint concepts-centric," integrated process for identifying military needs (CJCSI 31070.01)
  - As opposed to requirements flowing up from individual military communities
- Acquisition process to refocus on delivering the required functional capabilities (DoDD 5000.1, DODI 5000.2)
  - Versus traditional orientation toward individual weapon systems (*e.g.*, tanks, aircraft, ships)
- Policy set in 2003 but has only begun to be implemented

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Components of Functional Capability "DOTMLPF"

- **Doctrine**
- **Organization**
- **Training**
- **Materiel (usually systems of systems)**
- **Leadership and education**
- **Personnel**
- **Facilities**

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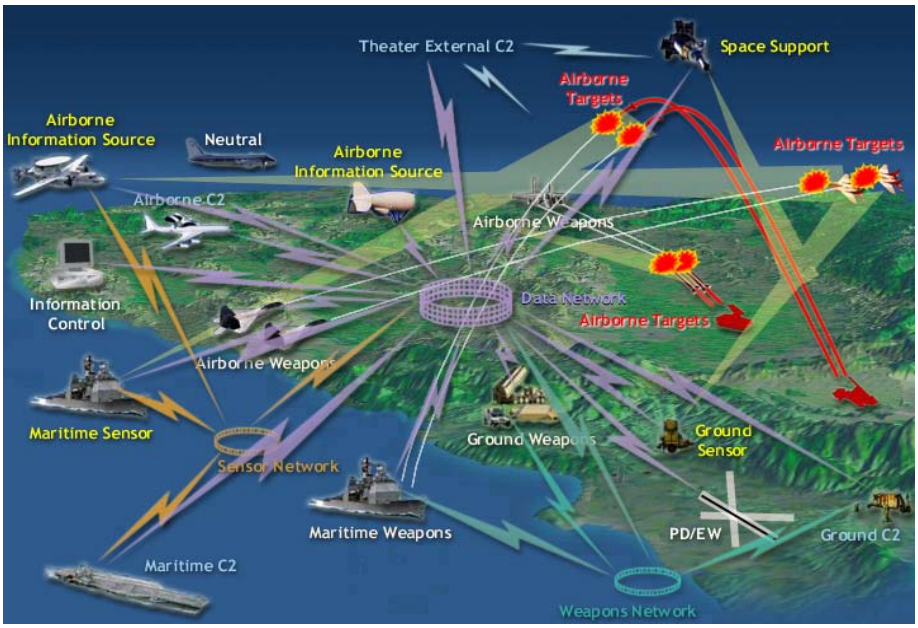
DoD "System of Systems" Example



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First Order Impacts

- Expanded trade space = dramatic increase in complexity
  - Many more entities, variables, interactions, etc.
  - Development enterprises become vast
  - Many more stakeholders, with much at stake
- Need systems engineering above the individual system level
  - Complexity precludes intuitive design/analysis or program to program negotiations
- Traditional T&E methods won't suffice
  - Capability/SoS testing requires >> forces, systems, volumes, events
  - Scarcity of real equipment constrains lab integration and live testing
  - Range size, security needs, and safety concerns limit live testing

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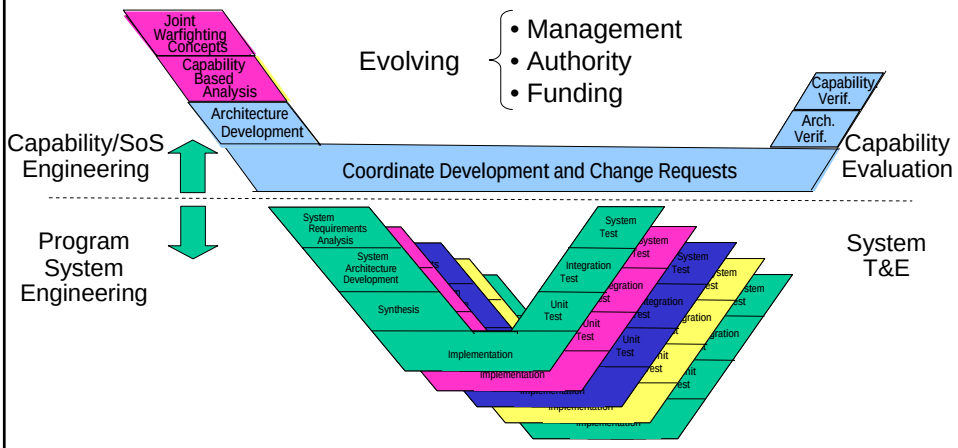
Systems Engineering Implications



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USD(AT&L) Imperatives

Honorable Michael W. Wynne, May 2003:

- "Provide a context within which I can make decisions about individual programs."
- "Achieve credibility and effectiveness in the acquisition and logistics support processes."
- "Help drive good systems engineering practices back into the way we do business."

I should note … that we have taken important steps that will help us to produce improved capability on time and within budget by re-energizing our approach to systems engineering. This critical discipline has always contributed significantly to effective program management at every level and will receive sustained emphasis during my tenure.

Testimony of the Honorable Kenneth J. Krieg, USD(AT&L), before Senate Committee on Armed Services, September 27, 2005

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Architecting Needs

- More architecting up front to deal with greater project complexity
- Integrated, explicit depiction of behaviors and system design
  - Better, coherent understanding of needs, solutions, and relationships
  - Reduced risk of divergence between desired behavior and system design
- Standard means to communicate architecture information across disparate organizations involved in development of a SoS
  - In past, architecture syntax and semantics could be left to an individual program's discretion

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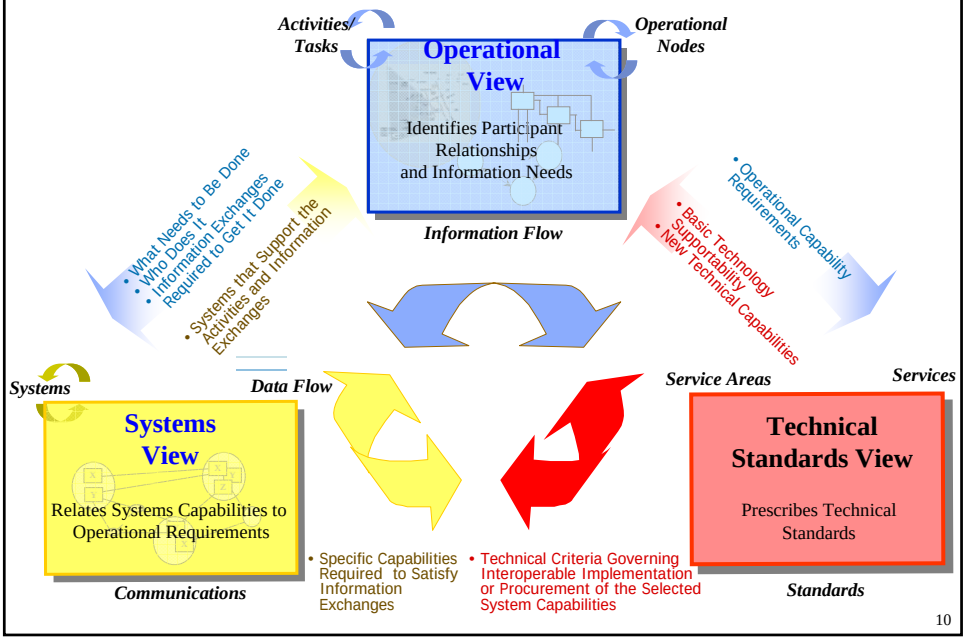
DoD Architecture Framework (DoDAF)

To Develop Integrated Architectures with Three Views



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Potential M&S Benefits Were Recognized
(at both the system and SoS level)

- Improved design and evaluation (both sides of SE "V"; all levels)
  - Accurately track complex relationships and interactions at the micro-level
  - Present macro-level measures of merit to decision makers
  - Earlier and more accurate understanding of design, less risk
- Faster design-evaluation cycle, saving time/$
- Defendable analytical underpinning for decisions
- Surrogates for other systems/effects to cost-effectively flesh-out the battlespace for live tests
  - Flexibly federate real systems (on ranges or elsewhere) with lab hardware/software, simulations and utilities
- Only practical way to do SoS/capability evaluation

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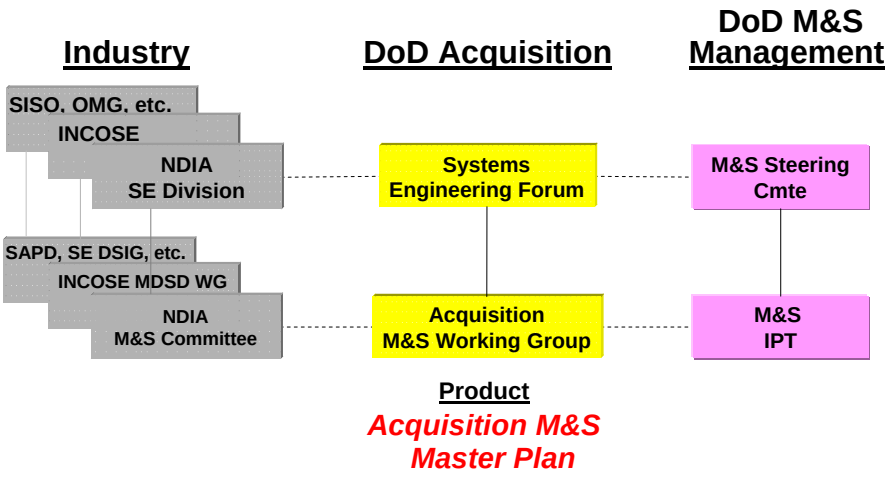
Acquisition M&S Working Group

Anchored in acquisition community, linked to industry and to corporate DoD M&S management



Product

Acquisition M&S Master Plan

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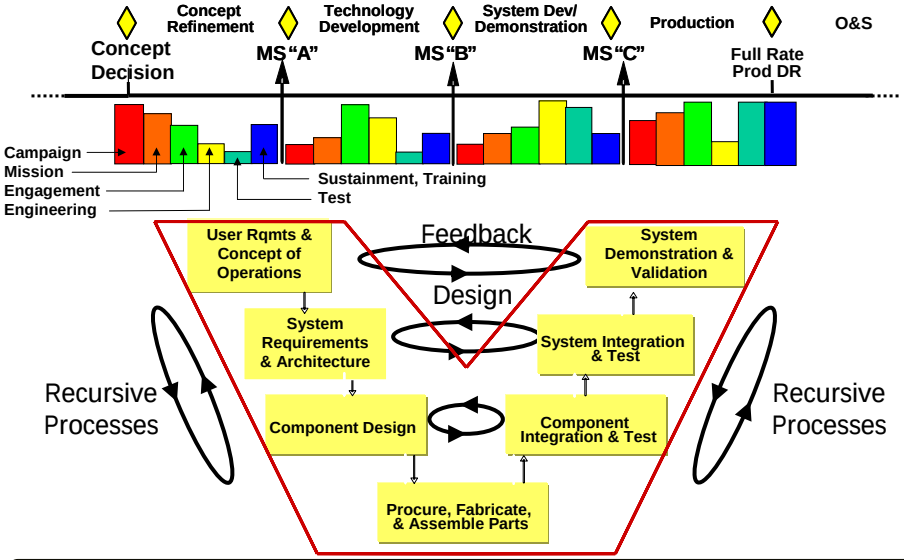
Scope of Acquisition M&S



M&S enables systems engineering across the acquisition life cycle...helps to define, develop, test, produce, operate, and sustain defense systems & systems-of-systems

Current Assessment Summary

- Widespread use of M&S in acquisition, albeit usually stove-piped
- Many gaps, obstacles, barriers to effective & efficient use
  - Body of knowledge (M&S support to acquisition): deficient, not managed
  - Acquisition community managers (and staffs) mostly uninformed about M&S capabilities and limitations
  - No business model for developing, using, maintaining M&S capabilities
  - Many M&S tool gaps and deficiencies
  - No DoD requirement for formal M&S planning to support acquisition
  - Lack of agreed standards for sharing info, interoperating M&S tools
  - Weak contractual guidelines for M&S and data needs
  - No readily-available L-V-C distributed environment
  - Minimal reuse of M&S tools & data; hard to discover reusable resources; insufficient info to evaluate reuse candidates; no reuse incentives
  - VV&A often weak or non-existent; documentation and examination inconsistent
  - Others

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Acquisition M&S Master Plan Goals

- Foster widely-needed M&S capabilities that are beyond the reach of individual programs
- Address M&S issues and actions necessary to enable acquisition of joint capabilities (systems of systems)
- Not try to do the job of program/capability managers; rather, seek to empower them
  - By removing systemic obstacles in their path
  - By identifying new options for approaching their tasks
  - By helping meet widely-shared needs
- Lay out tasks as a Work Breakdown Structure (WBS)
  - Discrete tasks with identified leads and explicit deliverables
  - Easier to resource, schedule and manage
  - Each contributes to better M&S support to acquisition

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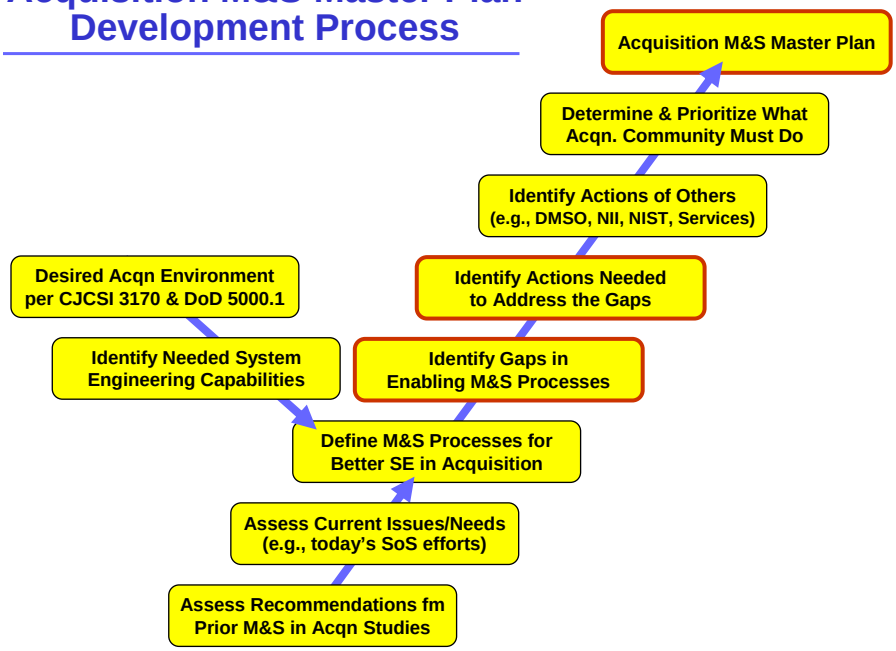
Acquisition M&S Master Plan Development Process



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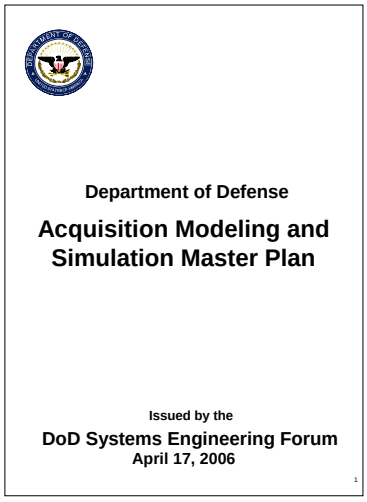
Content of Acquisition M&S Master Plan


Department of Defense

Acquisition Modeling and Simulation Master Plan

Issued by the

DoD Systems Engineering Forum

April 17, 2006

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- Foreword
- Introduction
  - Purpose
  - Vision
  - Scope
- Objectives (5)
- Actions (27)
  - Action
  - Rationale (why it's needed)
  - Discussion (implementation guidance)
  - Lead & supporting organizations
  - Products
  - Completion goal (year)
- Execution Management

http://www.acq.osd.mil/ds/se/publications/AMSMP_041706_%20FINAL2.pdf

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Five Objectives; 27 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 Acqn

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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

- New DoD M&S management structure is in place; time will tell if it is effective
- New DoD Directive still in "final" coordination
- No acquisition leadership role on M&S SC
- Key policies and processes await a DoDI

- Wide use of term "collaborative environment," including DAG (although implementations lag)
- INCOSE "SE Vision 2020" discusses MBSE: increasing industry use of MBSE concept & tools
- Need MBSE discussion in DAG

- Concepts accepted, but little practical guidance
- JMETC launched, but many challenges ahead

- Revised DoD 5000.2 wording submitted
- Need language in DAG, SEP & TEMP guidance

- Soliciting inputs from AMSWG members
- Must synthesize best language & submit to DAG

- NII the lead for this action; adequacy of proposed solution questioned by AMSWG

Key
Broader than Acquisition

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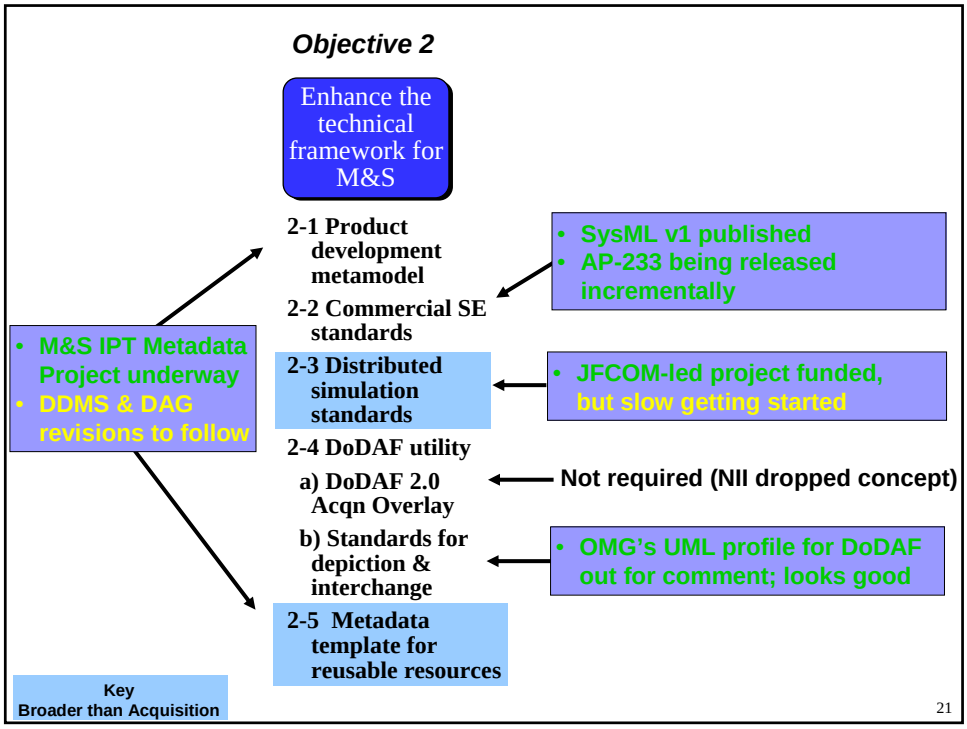
Objective 2
Enhance the technical framework for M&S
2-1 Product development metamodel
2-2 Commercial SE standards
2-3 Distributed simulation standards
2-4 DoDAF utility
a) DoDAF 2.0 Acqn Overlay
b) Standards for depiction & interchange
2-5 Metadata template for reusable resources
• SysML v1 published
• AP-233 being released incrementally
• JFCOM-led project funded, but slow getting started
Not required (NII dropped concept)
• OMG's UML profile for DoDAF out for comment; looks good
• M&S IPT Metadata Project underway
• DDMS & DAG revisions to follow
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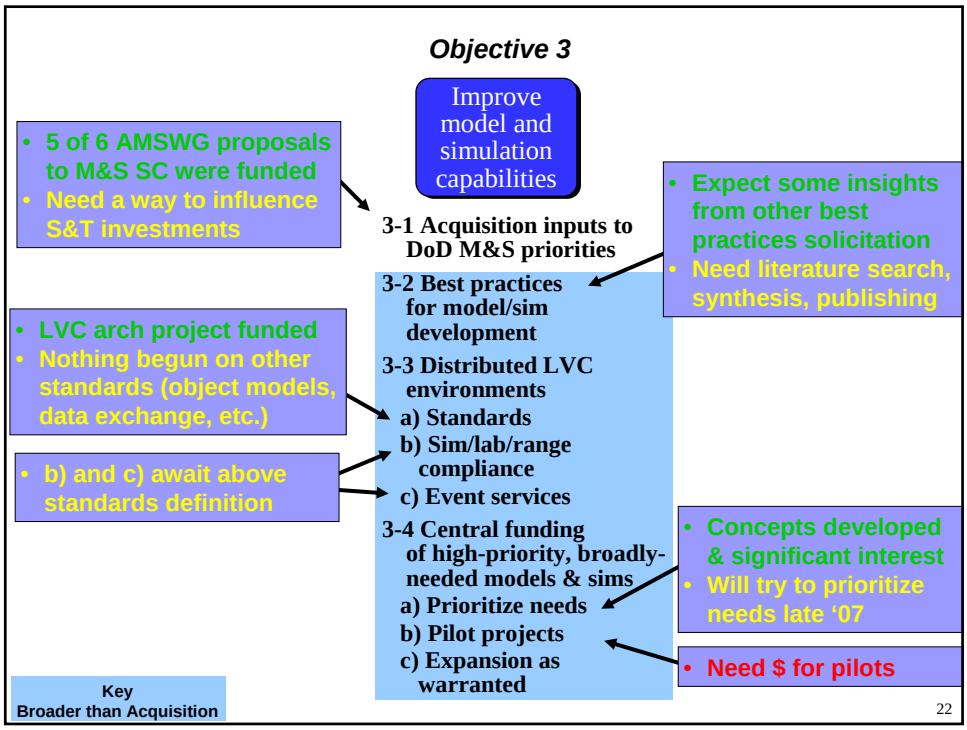
Objective 3
Improve model and simulation capabilities
• 5 of 6 AMSWG proposals to M&S SC were funded
• Need a way to influence S&T investments
3-1 Acquisition inputs to DoD M&S priorities
• Expect some insights from other best practices solicitation
• Need literature search, synthesis, publishing
3-2 Best practices for model/sim development
3-3 Distributed LVC environments
a) Standards
b) Sim/lab/range compliance
c) Event services
• LVC arch project funded
• Nothing begun on other standards (object models, data exchange, etc.)
• b) and c) await above standards definition
3-4 Central funding of high-priority, broadly-needed models & sims
a) Prioritize needs
b) Pilot projects
c) Expansion as warranted
• Concepts developed & significant interest
• Will try to prioritize needs late '07
• Need $ for pilots
Key
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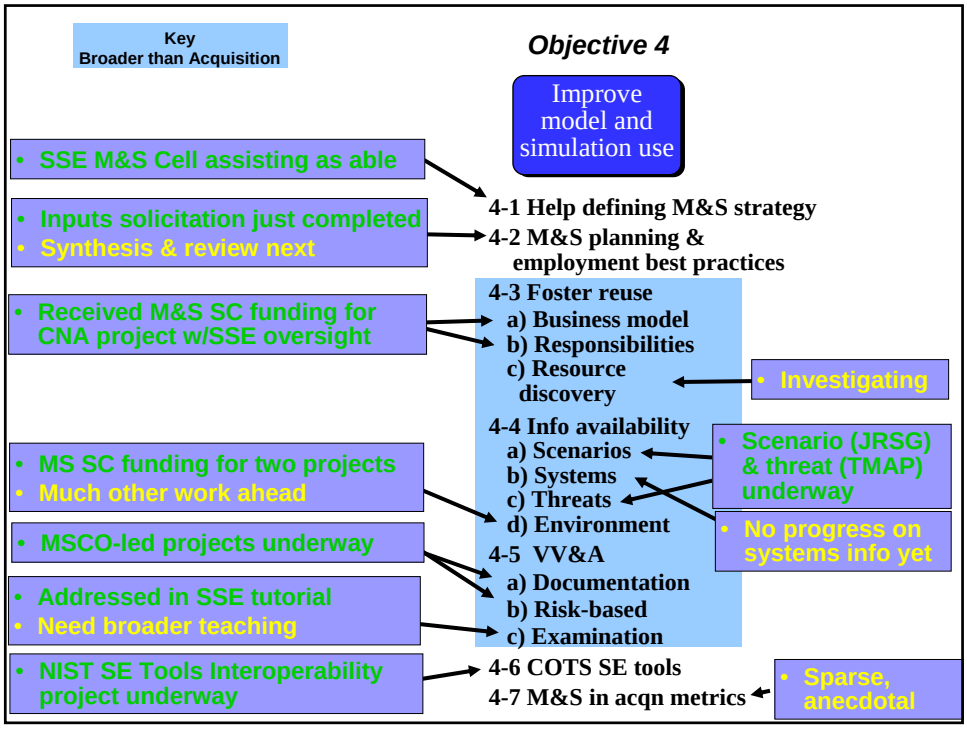
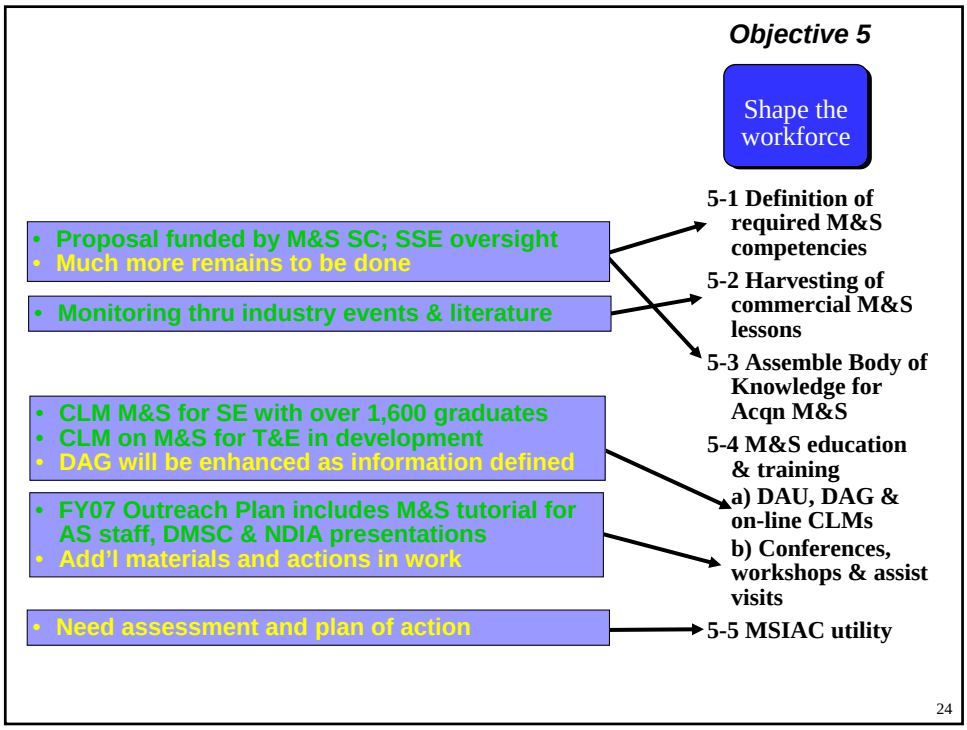

Key
Broader than Acquisition
Objective 4
Improve model and simulation use
• SSE M&S Cell assisting as able
• Inputs solicitation just completed
• Synthesis & review next
• Received M&S SC funding for CNA project w/SSE oversight
• MS SC funding for two projects
• Much other work ahead
• MSCO-led projects underway
• Addressed in SSE tutorial
• Need broader teaching
• NIST SE Tools Interoperability project underway
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
• Investigating
4-4 Info availability
a) Scenarios
b) Systems
c) Threats
d) Environment
• Scenario (JRSG) & threat (TMAP) underway
• No progress on systems info yet
4-5 VV&A
a) Documentation
b) Risk-based
c) Examination
4-6 COTS SE tools
4-7 M&S in acqn metrics
• Sparse, anecdotal


Objective 5
Shape the workforce
• Proposal funded by M&S SC; SSE oversight
• Much more remains to be done
• Monitoring thru industry events & literature
• CLM M&S for SE with over 1,600 graduates
• CLM on M&S for T&E in development
• DAG will be enhanced as information defined
• FY07 Outreach Plan includes M&S tutorial for AS staff, DMSC & NDIA presentations
• Add'l materials and actions in work
• Need assessment and plan of action
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
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Way Ahead

- Coordinate & monitor implementation of plan
- Work cooperatively with other organizations
- Lead individual actions as resources permit
- Fight for more resources
- Annually assess progress and impact
- Revise and adjust plan as needed

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AMSMP Summary

- DoD Acquisition community cooperating to improve M&S use
- Acquisition M&S Master Plan provides a coherent, widely-appreciated approach
- Beginning to align the vectors of acquisition M&S
- Significant implementation progress, but much work remains

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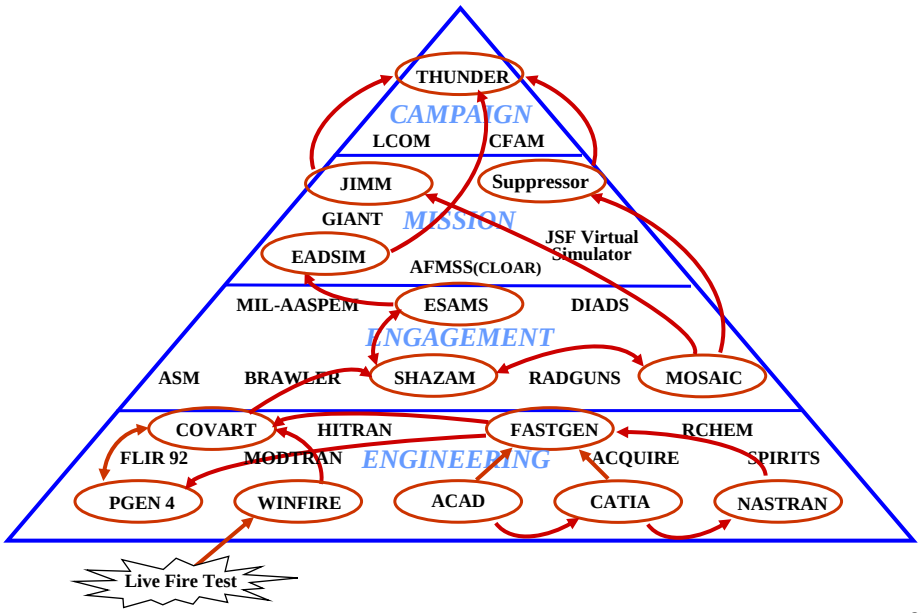
Data Lineage Example

(Surface-to Air Missile Vulnerability Analysis - simplified)



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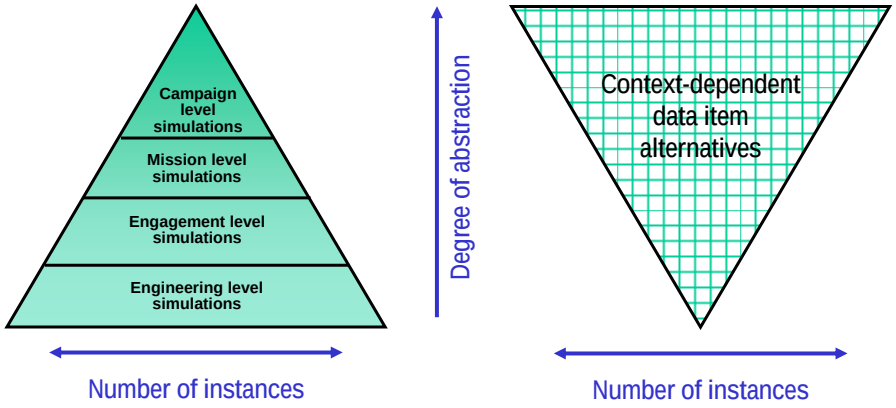
Inverse Abstraction Relationship



- Data applicability narrows as context dependencies increase
- Standard contexts reduce instances that must be managed
- Include context in metadata to guard against inappropriate use

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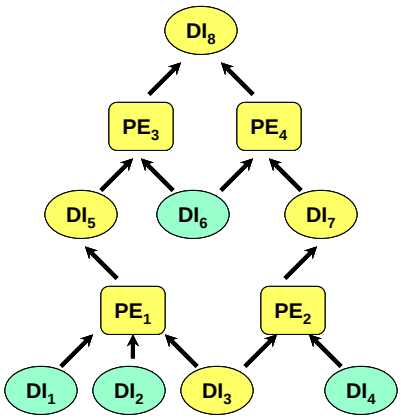
Impact Analysis and Consistency



DI – Data Item
PE – Process Execution

Impact Analysis: A change in DI_1 potentially necessitates the re-execution of PE1 and PE3 to produce DI_5 and DI_8.

Consistency: A consistent version of DI_3 must be used to eventually produce a coherent version of DI_8.

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Discussion

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