Identification of Modeling and Simulation Capabilities by Acquisition Life Cycle Phase

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Jim Coolahan

Johns Hopkins University

Applied Physics Laboratory

Jeff Bergenthal

Lockheed Martin

Global Training & Logistics

Presentation Outline

- **Genesis of the Topic**
- **NDIA Systems Engineering Modeling and Simulation Committee – Subcommittee on the Topic**
  - **Charter**
  - **Meeting Participants**
  - **Process to Date**
- **Some Sources of Information**
- **Issues Encountered**
- **Some Interim Results**
- **The Way Forward**

Genesis of the Topic

- **Discussions between NDIA SE M&S Committee leadership and ODASD(SE/SA) representatives, November 2011**
  - Interest in M&S Capabilities by Acquisition Life Cycle Phase
- **Discussions with NDIA SE Division leadership, November 2011**
  - Interest in identifying M&S tools prevalent in systems engineering
- **Proposed 2012 task included in NDIA SE M&S Committee report at December NDIA SE Division Planning Meeting:**
  - "Assessment of M&S capabilities, and prevalence of specific M&S tools, used in each phase of the Systems Acquisition process"
- **U.S. Air Force (Col Ogawa) presentation at December NDIA SE Division Planning Meeting:**
  - Citation of Objective 2.2 in U.S. Air Force SE Strategic Plan on "Standard practices, tools, metrics … Focus on modeling & simulation across life cycle"
- **Resulting action item from SE Division planning meeting:**
  - "(NDIA SED) Consider: state of the art in M&S, M&S across the life cycle. Reusable architectures. Physics-based modeling, support architectures w/ M&S."

Subcommittee Charter

- **Consider the state of the art and practice of modeling and simulation (M&S) across the Defense Systems Acquisition Life Cycle**

- **For each phase of the life cycle, identify systems engineering and acquisition functions that need to be performed that can be enabled by the use of M&S**

- **For each engineering/acquisition function, identify specific existing M&S capabilities that can contribute to the performance of that function**

- **For each M&S capability, identify government and industry M&S tools that are prevalent in helping to provide that capability**

- **In performing the above activities, keep in mind such things as reusable architectures, support of architectures using M&S, physics-based modeling, and similar activities that are enabled by the use of M&S**

Subcommittee Meeting Participants

- **Jim Coolahan (JHU/APL)**
- **Jeff Bergenthal (Lockheed Martin)**
- **Tim Ewart (US Air Force)**
- **Michael Heaphy (Booz Allen Hamilton)**
- **Ken ("Crash") Konwin (Booz Allen Hamilton)**
- **Robert Leach (Dynamic Animation Systems)**
- **Margaret Loper (GTRI)**
- **Joe McDonnell (Dynamic Animation Systems)**
- **Kirk Michealson (Lockheed Martin)**
- **Katherine L. Morse (JHU/APL)**
- **Hans Polzer**
- **John Lohse (Raytheon)**

- **Tammy McNeley (Lockheed Martin)**
- **Frank Salvatore (DRC)**
- **Greg Pollari (Rockwell Collins)**
- **Jeff Wallace (Intelligent Integration)**
- **David Broyles (US Navy)**
- **David Allsop (Boeing)**
- **Kevin Flood (AGI)**
- **George Harris (US Army)**
- **George Hazelrigg (NSF)**
- **Favio Lopez (Trideum)**
- **Dennis Pippy (SAF/AQ Ctr)**
- **Steve Reading (Cutlass Systems Engineering)**
- **Anne Ricks (Cutlass Systems Engineering)**

Subcommittee Process to Date

- **Initial subcommittee formation at 21 February 2012 NDIA SE M&S Committee meeting**

- **Bi-weekly teleconferences scheduled**

- **Data collection spreadsheet designed and distributed**

- **Sources of information identified**

- **Individual subcommittee members did research on different sources and parts of the problem**

- **Face-to-face meetings at 19 June and 21 August NDIA SE M&S Committee meetings**

- **Presentations by industry team members in bi-weekly teleconferences, August - October**

Some Sources of Information

- **Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System (the Defense Acquisition University "wallchart"), Jun 2010**

- **A Roadmap for Simulation Based Acquisition (Appendix C), Dec 1998**

- **NDIA SE M&S Committee report, "M&S Support to the New DoD Acquisition Process," Feb 2004**

- **Final Report, Study on Management Concepts for Broadly-Needed Modeling and Simulation Tools, Jun 2010**

- **DoD M&S Catalog**

- **CBA Handbook – A Guide for Implementing Capabilities-Based Analysis (CBA), Jun 2010**

- **"M&S Across the System Acquisition Life Cycle" (Campbell and Lashlee), 2010**

- **Materiel Solution Analysis Activities and Descriptions (Riski), Jun 2012**

Data Collection Template

System Acquisition Activities		Supporting M&S Capabilities		Prevalent M&S Tools	
Activity	Source Document	Capability	Source Document	Acronym	Name

- **There is no accepted taxonomy for describing "M&S Capabilities"**
  - **Need to have a "level" set of descriptors**
    - Not too high-level (e.g., "Constructive simulations")
    - Not too low-level (e.g., "EADSIM simulation")
- **As an adjunct to this study, need to either develop a taxonomy, or advocate for its creation**

- **Mapping of "system acquisition activities in a phase" to "supporting M&S capabilities" to "prevalent M&S tools" is not a hierarchical tree structure**

  - **Some supporting M&S capabilities could be applicable in multiple system acquisition activities in multiple phases**

  - **Some prevalent M&S tools could be used in providing multiple M&S capabilities**

  - **A two-dimensional spreadsheet is not a good way of representing the structure, since there will be many replications**

    - Is a relational database a sufficient structure?

    - Do we have to go to an ontology?
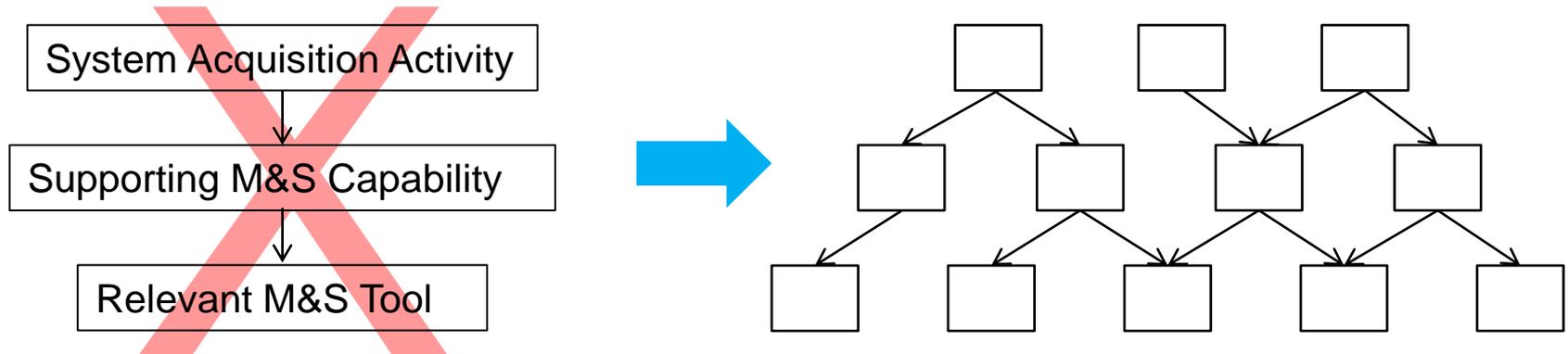
- **Selected EMD Phase M&S Capabilities and Prevalent M&S Tools (developed by Greg Pollari, Rockwell Collins)**

Supporting M&S Capabilities	Prevalent M&S Tools
Manufacturing Process Simulation	Discrete Event Simulator (ARENA)
Supply Chain Analysis & Simulation	Discrete Event Simulator (ARENA)
Design for Manufacturing/Assembly (DFM/A) Analysis	Virtual Prototype Model
Producibility Analysis (e.g., Design Rules Checking)	DFXpert
Operation & Support Analysis	Discrete Event Simulator (ARENA)
Mechanical & Electrical Design Models	NA, SolidWorks, AutoCAD, ProE, CATIA DxDesigner, Zuken CR-5000

# Some Interim Results – From Industry Briefings to the Subcommittee

- **Two distinct Industry groups:**
  - Providers of Commercial-Off-The-Shelf models and simulations
  - System developers who use M&S
- **M&S capabilities are broadly used across all phases of the acquisition life cycle**
  - Use of an M&S capability is generally not limited to a single phase
  - Models and simulations are often linked together to achieve the desired capability
- **Challenges remain to more fully exploiting the value of M&S across the acquisition life cycle**
  - Data availability and interchange
  - Confidence, trust, relevancy, ROI
  - Etc.

Objective: Reduce technical risks

- System integration
- ✓ Design
- ✓ Prototyping
- ✓ Military utility assessment
- ✓ Model environment and demonstrate technology
- ✓ Interoperability & supportability analysis
- ✓ Operational suitability
- Assess manufacturing risks
- Industrial/Manufacturing capability & readiness assessment
- Life-cycle sustainment planning

- ✓ Survivability analysis
- ✓ Update AoA
- ✓ Affordability assessment
- ✓ Estimate manpower/cost
- ✓ Model system to performance specifications
- ✓ Design/ Develop System Concepts
- ✓ System threat assessment
- Environment, Safety, and Occupational Health (ESOH) Models
- ✓ Human System Integration
- ✓ T&E Planning

Courtesy of Analytical Graphics, Inc.

Model & Simulation Usage Areas

- **Business Support & Operations Analysis**
- **Demo Centers**
- **Model-Based Systems Engineering (MBSE)**
- **Computer Aided Design (CAD)**
- **Product Data and Lifecycle Management**
- **Manufacturing M&S**
- **Training & Education**
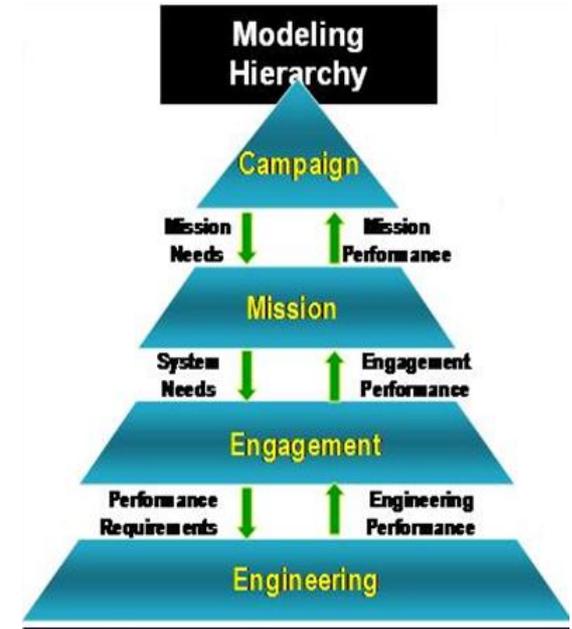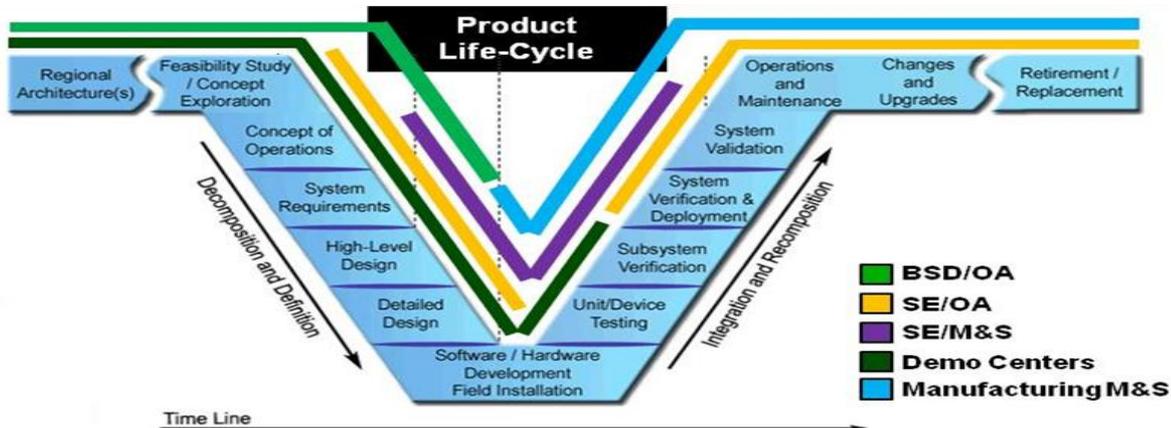
M&S Deeply Engrained w/in ALL Lines of Business and Throughout Life-Cycle

The Way Forward

- **Need to "complete" (as much as possible) threads in each acquisition phase**
  - Have some partial good examples, but not a consistent set
- **Short of developing a complete taxonomy of "M&S Capabilities," need to settle on an acceptable, fairly level, set of descriptors**
- **Need to pick a way to illustrate the flowdown from system acquisition activities to supporting M&S capabilities to prevalent M&S tools**
  - Separate mappings for activities to M&S capabilities, and from capabilities to specific tools?
- **Goal is to have a nearly final product by early 2013**