

Results of a Study on the Management of Broadly-Needed Modeling and Simulation Tools

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Presentation Outline

- **Study Background**
- **Study Objectives and Approach**
- **Information Gathering on M&S Tools and Management Approaches**
- **Categories of Tool Management Approaches**
- **Taxonomy for Assessing Success of Management Approaches**
- **Best Management Practices**
- **Recommended Action Items**

Study Background

- Many government-managed models and simulations are already used broadly, but typically suffer from several problems (e.g., lack of funding, lack of a stakeholder requirements management council, etc.)
- Study was initiated in October 2008 by the Director, Office of the Director of Systems and Software Engineering (D, SSE) in the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics (OUSD(AT&L))
 - On behalf of the Acquisition M&S Working Group (AMSWG)
- Study is an initial step in addressing Acquisition M&S Master Plan (AMSMP) Action 3-4 (“Centrally fund and manage the development of high-priority, broadly-needed M&S tools”)
 - Before embarking on such an initiative, it is prudent to objectively study DoD’s current experience in the management of broadly-needed tools
 - Attempt to identify innovative approaches that could be leveraged to improve the cost-effectiveness of DoD M&S tools more broadly

Study Objectives

- **Identify best practices for managing broadly-needed M&S tools**
- **Based on these findings, recommend actions the U.S. DoD should take to improve its management of such M&S tools**

Study Approach

- **Develop list of M&S tools used by multiple organizations not under the same chain of command or contract**
- **Survey M&S tool managers and users on management approaches**
- **Document and categorize management approaches for the tools identified**
- **Assess degree of success each tool management approach has had in avoiding certain problems**
- **Develop a taxonomy for assessing success of M&S tool management approaches**
- **Identify/develop best practices for managing broadly needed M&S tools**
- **Recommend actions DoD should take to improve its management of broadly-needed M&S tools**
- **Develop list of desirable characteristics of candidate tools to be used in pilot applications**

List of M&S Tools with Responses to Tool Manager Survey (32 responses on 28 tools)

- Advanced Joint Effectiveness Model (AJEM)
- Advanced Testing Capability (ATC)
- Battle Command Management Service (BCMS)
- BRL-CAD
- Comprehensive Mine and Sensor Simulator
- Extended Air Defense Simulation (EADSIM)
- Hazard Prediction and Assessment Capability (HPAC)
- Intelligence Modeling and Simulation for Evaluation
- Joint Analysis System (JAS)
- Joint Conflict and Tactical Simulation (JCATS)
- Joint Communication Simulation System (JCSS)
- Joint Integrated Mission Model (JIMM)
- Joint Semi-Automated Forces (JSAF) (JFCOM version)
- Joint Theater Level Simulation (JTLS)
- Langley Standard Real-Time Simulation in C++ (LaSRS++)
- Model for Intratheater Deployment by Air/Sea (MIDAS)
- Naval Simulation System (NSS)
- One Semi-Automated Forces (OneSAF)
- OpenEagles Simulation Framework
- ProtoCore
- Role Player Workstation
- RunTime Infrastructure (RTI) - MATREX
- RTI NG Pro
- Simulation Display (SIMDIS)
- SPIRITS
- Suppressor
- Synthetic Theater Operations Research Model (STORM)
- Threat Modeling and Analysis Program (TMAP)

Questions on the M&S Tool User Survey

Responder Information

- 1) Name
- 2) Rank/Title
- 3) Organization
- 4) Email Address
- 5) Phone Number

Requirements Management

- 6) How should user requirements be prioritized when funding and/or schedule are insufficient to meet all requirements?

Configuration Management

- 7) Is it critical to maintain a single source baseline, or are there circumstances under which multiple forks should be permissible? What criteria should be used to make this decision?
- 8) Identify good tool distribution mechanisms/methods (for source, executable, or both).
- 9) How frequent should releases be? Please describe the criteria upon which the frequency may depend, e.g. tool maturity, criticality of bug fixes.

Code Development

- 10) Should externally developed code (by users or others) be integrated into the code baseline?
- 11) How should conflicts between modifications submitted by different users/co-developers be mediated?

Test Management

- 12) Should V&V be a formal part of the integration process?
- 13) What processes/products are critical prior to product release, e.g., regression testing, reference data?

Lessons Learned

- 14) Please describe any other management best practices that are critical to successful model management.

Categories of Tool Management Approaches

(1 of 2)

- **Government Coordinated (GC)**

- A single government office coordinates development of one version of the tool for all users. Government mechanisms, like MIPRs, are used to contribute funds. Developers (contractors or DoD employees) are paid and/or directed through a single coordinator.

- **Developer Coordinated (DC)**

- A single development contractor coordinates one version of the tool for all users. Commercial mechanisms, like license fees or development contracts, are used to contribute funds from users.

- **Independent Development (ID)**

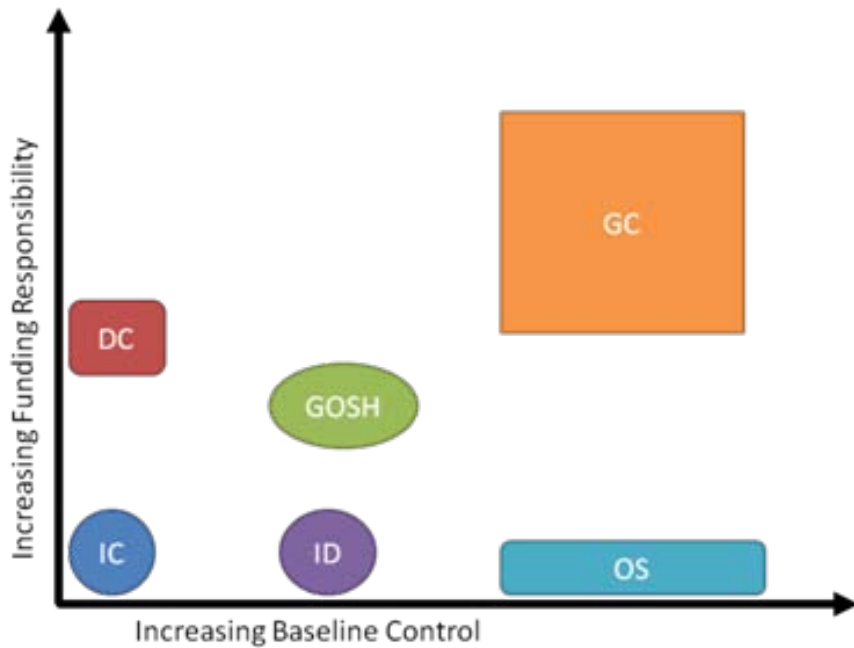
- One or more developers (contractors or DoD employees) produce their own versions from a common tool baseline. Each user is free to select a version and/or developer.

Categories of Tool Management Approaches

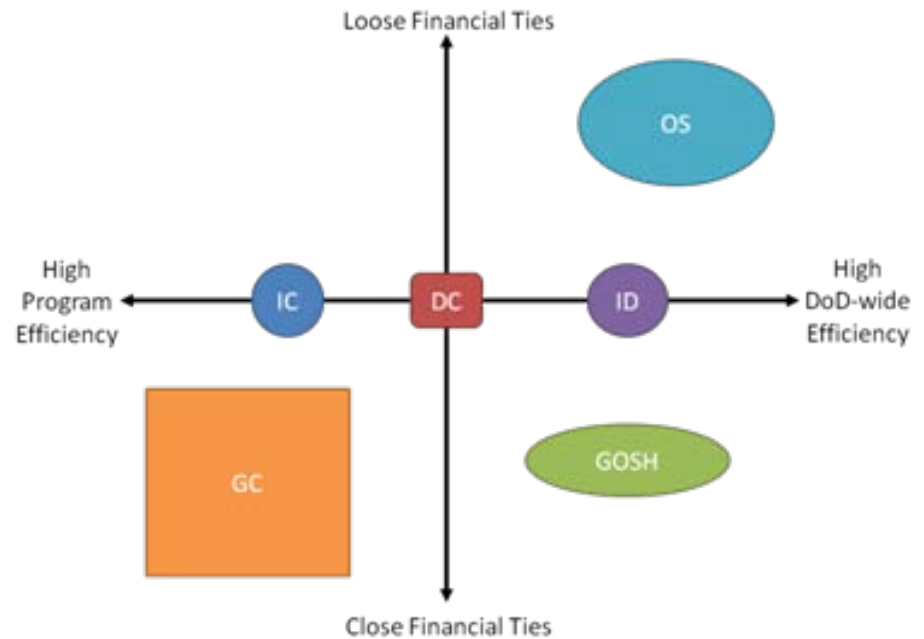
(2 of 2)

- **Government Open Source Hybrid (GOSH)**
 - A government office authorizes certain developers (contractors or DoD employees) to participate in a shared source effort. Each user chooses a developer and all changes are constantly available to all participants.
- **Open Source (OS)**
 - One or more developers (contractors or DoD employees) participate in a shared source baseline. Each user chooses a version to use. No contractual relationship necessarily exists between users and developers.
- **Independent “Co-opetition” (IC)**
 - One or more developers (contractors or DoD employees) produce independent changes to a shared baseline. Each user chooses a developer, and the user determines if and when their changes are made available for inclusion in future baselines.

Comparison of Tool Management Approaches



Funding responsibility vs. baseline control



Efficiency vs. financial ties

Management Approach Success Criteria

High – The M&S tool manager is highly experienced in M&S tool management and committed to maximizing user value and utility. The M&S tool manager has sufficient funds to implement effective mechanisms to achieve these goals.

Medium – The M&S tool manager is experienced in M&S tool management and committed to providing user value and utility. The M&S tool manager may not have sufficient funds to implement all the mechanisms necessary to achieve these goals and must make choices about which mechanisms to implement.

Low – Either the M&S tool manager is inexperienced or has insufficient funds to maintain the M&S tool management mechanisms necessary to provide user value and utility.

Taxonomy for Judging Success of Approaches (1 of 2)

Integrating User-Developed Enhancements

High – The M&S tool manager has a structured, documented process for evaluating user enhancements and integrating them into the standard version. The process includes regression testing and mediation of differences between submitted changes.

Medium – Enhancements from a recognized set of sources are accepted and/or the framework allows for users to individually integrate their own plug-ins or libraries.

Low – Integration of externally-developed enhancements is on an ad hoc basis or not at all.

Model Accuracy (Verification & Validation)

High – Validation or testing of the fully integrated tool is required as part of the structured management process.

Medium – The tool manager accepts validation data where available, but does not require it.

Low – The tool management process does not include V&V.

Taxonomy for Judging Success of Approaches (2 of 2)

Meeting Foreseeable Needs

High – The M&S tool manager solicits inputs to future needs; the manager prioritizes requirements and integration activities to meet projected user community needs.

Medium – Priorities are set by a configuration control board; users may provide additional funding to meet their specific requirements.

Low – Projected user community needs are not considered in the requirements and integration process.

Customer Support

High – The M&S tool manager provides broad and responsive customer support including live support (help desk) and extensive documentation that supports understanding and use of the tool; the tool manager actively communicates with the user community.

Medium – The manager provides documentation beyond just a technical/user's manual and live support.

Low – The manager provides a technical/user's manual; live support is on an ad hoc basis.

Best Management Practices – by M&S Tool Management Areas

Twelve task categories, corresponding to success attributes, were derived for best management practices for M&S tools, which align with the following five overarching M&S tool management areas:

1. Requirements Solicitation
2. Baseline Development
3. Testing, Quality Assurance, and Verification and Validation (V&V)
4. Baseline Maintenance
5. Customer Support

Best Management Practices – Requirements Solicitation

- **Canvas Users for Needed Changes**
 - Develop website to enable users and external developers to document needed capabilities
 - Send hard copy questionnaires periodically
- **CCB-Approved Recommendations Implemented**
 - Establish a Configuration Control Board (CCB) that meets periodically (quarterly to annually), to review requirements for new capabilities
 - M&S Tool Manager should chair and facilitate CCB
 - CCB should determine implementation timeline
- **Justification for Excluding User Requirements is Promulgated**
 - CCB should provide to all its justification for not satisfying certain requirements
- **M&S Tool Manager Engages Users and External Developers**
 - Establish an online User Forum
 - Host periodic (perhaps monthly) teleconference to augment online forum
 - Host periodic face-to-face User Group Conferences

Best Management Practices – Baseline Development

▪ **Managing Divergence**

- M&S Tool Manager should evaluate costs and risks of accepting externally-developed enhancements
- If funding/scope exists to accept multi-source enhancements, a CCB of technical experts (see previous slide) is in order
- In absence of sufficient funding, a plug-in framework could allow user enhancements without endangering code baseline stability
- Any experimental excursion should have a plan, including M&S tool elements affected, and process for incorporating modifications in baseline

▪ **Incorporating Externally-Developed Enhancements**

- Use CCB to assess desirability of submitted enhancements
- Publish the process for assessing enhancements (criteria, schedule)

▪ **Coding Standards**

- Include style guide, fidelity considerations, algorithm documentation

Best Management Practices – Testing, Quality Assurance, and V&V (1 of 2)

▪ **Quality Assurance Process**

- Each release should have requirements at start, updated as needed
- QA Plan (including V&V) should be developed soon after work begins
- A test database should be developed that supports V&V
- Design meetings/reviews should be conducted and documented
- Testing should include unit testing prior to integration testing
- Acceptance test cases should be documented with expected outcomes, and results compared; test cases to test known defects should be included
- A QA report documenting test activities should be written for each release
- Consider the following for experienced user base / co-development agreement:
 - User representatives / co-developers participation in review meetings
 - Supplemental testing by expert users prior to each release
- Consider the following for models/simulations with multiple constituencies:
 - Supplemental validation testing by subject matter experts (SMEs)
 - V&V by an independent third party

Best Management Practices – Testing, Quality Assurance, and V&V (2 of 2)

▪ Regression Testing

- When new releases are funded by users seeking new functionality, the M&S Tool Manager should obtain funding from these users for regression testing
- The QA plan for each release should include regression tests evaluated for cost-effectiveness based on scope of modifications
- For incremental developments, regression testing should be performed incrementally
- Regression testing should include expected multiple operating system / computing system environments
- In conjunction with new functionality, regression tests to ensure that the functionality is maintained in future releases should be developed
- For a regression test program across multiple releases:
 - The M&S Tool Manager should advocate for a recurring funding stream to permit ongoing regression testing
 - A cumulative set of regression tests across all releases, with documentation of functionality each regression test is designed to address, should be maintained

Best Management Practices – Baseline Maintenance

- **Software Baseline Maintenance Funding**
 - The M&S tool manager needs to receive a funding stream for baseline maintenance that is:
 - Adequate for the required level of effort
 - Dependable
 - Dedicated to baseline maintenance

Best Management Practices – Customer Support

■ Technical Documentation

- Software engineering documentation should be a mandated part of the software development process; each release should include “release notes” documenting changes made to the previous release, including defects fixed and features added
- User documentation should be produced by users of the tool rather than developers, and should include constraints, assumptions, and limitations
- Mechanisms for discovery of the M&S tool and awareness of its capabilities need to be leveraged or developed

■ Help Desk

- Modern technology should be used to minimize cost (e.g., “virtual” help desk)
- The first level of static information can be distributed via a website
- The second level of dynamic information can be accessed via a website form or phone number
- Queries without “off-the-shelf” answers can be forwarded to a list of expert developers and users

Recommended Action Items

- **Publish and promulgate a Recommended Practices Guide for the management of broadly-needed M&S tools**
- **Identify and establish a limited number of short-term (up to two years in duration) pilot efforts for selected existing broadly-needed DoD-supported M&S tools, to verify the merits of the recommended best practices**
 - **See study report for specific actions to aid pilot programs**
- **Establish and maintain an effective M&S tool catalog / registry with metadata to support discovery and potential reuse of M&S tools**
 - **Note: this is underway in DoD, and considered important to the management of broadly-needed M&S tools**



Questions



Backup Slides

M&S Tool Management Success Attributes

(1 of 3)

M&S Tool Management Success Attributes: "The M&S Tool Manager ..."	Meeting Foreseeable Needs	Integrating Externally- Developed Enhancements	Model Accuracy (V&V)	Customer Support
1. Successfully solicits recommendations from users for new capabilities.	X			
2. Actively communicates with, and engages, users / external developers on a consistent basis concerning tool efficacy and applicability.	X			X
3. Has a process for managing the tool baseline(s) that prevents irreconcilable divergence.	X	X		
4. Has implemented into the baseline tool enhancements agreed upon by a peer / user review process.	X	X		
5. Provides / publishes justification for not including any suggested tool enhancements that were not included in the new baseline tool.	X	X		X

M&S Tool Management Success Attributes (2 of 3)

M&S Tool Management Success Attributes: "The M&S Tool Manager ..."	Meeting Foreseeable Needs	Integrating Externally- Developed Enhancements	Model Accuracy (V&V)	Customer Support
6. Has implemented a process to acquire and assess (using a peer / user review process) externally developed capabilities for inclusion into the baseline tool.		X		
7. Publishes a coding standards and style guide with which all externally developed capabilities are required to comply.		X		X
8. Has developed and implemented a quality assurance process that rigorously evaluates each new baseline tool implementation before final product release.			X	
9. Receives and expends the funds necessary to conduct verification and validation tests on all new enhancements, and thorough regression tests on all new baseline releases to ensure past functionality has not been compromised.			X	

M&S Tool Management Success Attributes

(3 of 3)

M&S Tool Management Success Attributes: "The M&S Tool Manager ..."	Meeting Foreseeable Needs	Integrating Externally- Developed Enhancements	Model Accuracy (V&V)	Customer Support
10. Updates the User's Guide and / or Technical Reference Manual with each baseline enhancement release, including constraints and limitations.			X	X
11. Receives consistent and adequate funding to conduct tool baseline maintenance, exclusive of baseline enhancements, to ensure the tool remains compatible with current software and hardware products used within the M&S community.				X
12. Provides timely customer support upon receiving a request for assistance (e.g., a competent and adequately staffed Help Desk).				X