| REPORT DOCUMENTATION PAGE | Form Approved OMB No. 0704-0188 |
|---|---|



| 1. REPORT DATE (DD-MM-YYYY) | 2. REPORT TYPE | 3. DATES COVERED (From - To) |
|---|---|---|
| 21062013 | Final | 31052012-21062013 |

**4. TITLE AND SUBTITLE**
Executable Architecture Systems Engineering (EASE)

**5a. CONTRACT NUMBER**

**5b. GRANT NUMBER**

**5c. PROGRAM ELEMENT NUMBER**

**6. AUTHOR(S)**
Mr. Gene Lesinski
Mr. Chris Gaughan
COL Daniel McCarthy

**5d. PROJECT NUMBER**

**5e. TASK NUMBER**

**5f. WORK UNIT NUMBER**

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**
USMA Operations Research Center (ORCEN), West Point, NY
Simulation Training and Technology Center (STTC), Orlando, FL

**8. PERFORMING ORGANIZATION REPORT NUMBER**
DSE-R-1305

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
Army Research Lab

**10. SPONSOR/MONITOR'S ACRONYM(S)**

**11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

**12. DISTRIBUTION/AVAILABILITY STATEMENT**
A- Approved for Public Release; Distribution Unlimited

**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**

The EASE development team commissioned this study in order to focus planned improvements to EASE, based on a comprehensive study of the needs and preferences of potential users and other stakeholders to determine the most important functions and attributes for the product. In this work, we conduct a detailed stakeholder analysis, looking very broadly at the various stakeholders and the desired functions of EASE, in order to devise and prioritize possible additions or improvements for the development team to include in future versions. We utilize both the Systems Decision Process (SDP) and Value-Focused Thinking (VFT) to gather and analyze stakeholder feedback. User feedback is clustered and organized into Findings, Conclusions, and Recommendations (FCR) to highlight trends, capability gaps, and major issues. The FCR tables and stakeholder feedback are then used as the foundation of a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. Finally, the SWOT analysis and stakeholder feedback are translated into an EASE future development strategy; a series of recommendations regarding: stakeholder solution space focus, specific M&S organizations with interest, prioritized EASE improvements, prioritized list of EASE enhancements, and potential use

**15. SUBJECT TERMS**
Executable Architecture, Federated Simulation, Combat Simulation, Software Design Description, Modeling and Simulation, EASE

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT | b. ABSTRACT | c. THIS PAGE | | | COL Daniel McCarthy |
| Unclassified | Unclassified | Unclassified | UL | 71 | 19b. TELEPHONE NUMBER (Include area code) 845-938-4893 |

**OPERATIONS RESEARCH CENTER**
United States Military Academy
West Point, New York 10996

**June 2013**

# Stakeholder Analysis of an Executable Architecture Systems Engineering (EASE) Tool

**Prepared By**
Mr. Gene Lesinski, MS
COL Dan McCarthy, PhD
Mr. Chris Gaughan

**Prepared For**
Simulation Technology and Training Center
Orlando, Florida

**DSE-R-1305**

## Disclaimer

Administratively, this study was funded by the Army Research Lab as part of a year-long effort in support of the Statement of Work entitled, “EASE Stakeholder Analysis.” The U.S. Government is authorized to reproduce and distribute reprints for governmental purposes notwithstanding any copyright annotation thereon. The views and conclusions contained herein are those of the authors and should not be interpreted as representing the official policies or endorsements, either expressed or implied, of the ARL, USMA, or the U.S. Government.

# Executive Summary

Modeling and Simulation (M&S) plays a major role in the mission performance of the Department of Defense (DOD). DOD spends more than $3 billion per year on M&S to support acquisition, training, experimentation, planning, testing and analysis. M&S uses are varied and include: analysis of cost-mission trades for new weapon systems, developmental or operational tests of new systems, analysis of force structure, training, and effectiveness analysis of weapon systems. Each M&S organization has unique missions, purpose, and requires varying levels of analytical fidelity as their work supports different categories of decisions (acquisition, design, training, etc.). This decentralized procurement, development, and use of combat simulation models and tools presents many challenges.

The research team at STTC has attempted to holistically address many of these challenges via a web-based tool; Executable Architecture Systems Engineering (EASE). EASE is a Systems Engineering tool that allows development and management of distributed simulation models throughout the M&S life cycle from identification of event objectives through cloud-based deployment. As a web-based application, EASE provides an easy to use interface to allow M&S users to more easily configure and execute M&S on a cloud-based set of computing resources. EASE allows M&S users to customize execution of a simulation event based on an interview process that identifies system-wide functional and technical requirements and then determines which applications and hardware allocations are necessary for execution to achieve these functional and technical requirements. EASE automatically configures the network and necessary supporting software in order to execute the applications on virtual machines using a Platform as a Service architecture.

The EASE development team commissioned this study in order to focus planned improvements to EASE, based on a comprehensive study of the needs and preferences of potential users and other stakeholders to determine the most important functions and attributes for the product. Specifically, conduct a detailed stakeholder analysis, looking very broadly at the various stakeholders and the desired functions of EASE, in order to devise and prioritize possible additions or improvements for the development team to include in future versions.

We utilize both the Systems Decision Process (SDP) and Value-Focused Thinking (VFT) to gather and analyze stakeholder feedback. User feedback is clustered and organized into Findings, Conclusions, and Recommendations (FCR) to highlight trends, capability gaps, and major issues. The FCR tables and stakeholder feedback are then used as the foundation of a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. Finally, the SWOT analysis and stakeholder feedback are translated into an EASE future development strategy; a series of recommendations regarding: stakeholder solution space focus, specific M&S organizations with interest, prioritized EASE improvements, prioritized list of EASE enhancements, and potential use cases.

**EASE Strengths.** Most notably, stakeholders were not aware of another “EASE-like” product in use or under development. They value EASE capability to document and archive model architecture and interoperability requirements. Stakeholders saw the ability to maintain and reuse previous combat simulation scenarios and runs as a clear strength. The surrogate

capability provided in EASE was highlighted as unique and positive. Lastly, EASE has potential to both reduce their hardware and software footprint as well as provide a back-up capability.

**EASE Weaknesses.** Stakeholders were concerned about having a lack of in-house, EASE expertise; potentially creating a single point of failure. They note that they lack the manpower, expertise, and experience required to build SDDs that would properly function within EASE. Because only a few models, scenarios, and supporting SDDs are currently represented in EASE, stakeholders feel that EASE would not provide any additional advantage over the current way of doing M&S business and would make it difficult to" sell" to their managers and fellow M&S users. Lastly, the perceived risk associated with not being a Program of Record (POR) was highlighted as a major weakness.

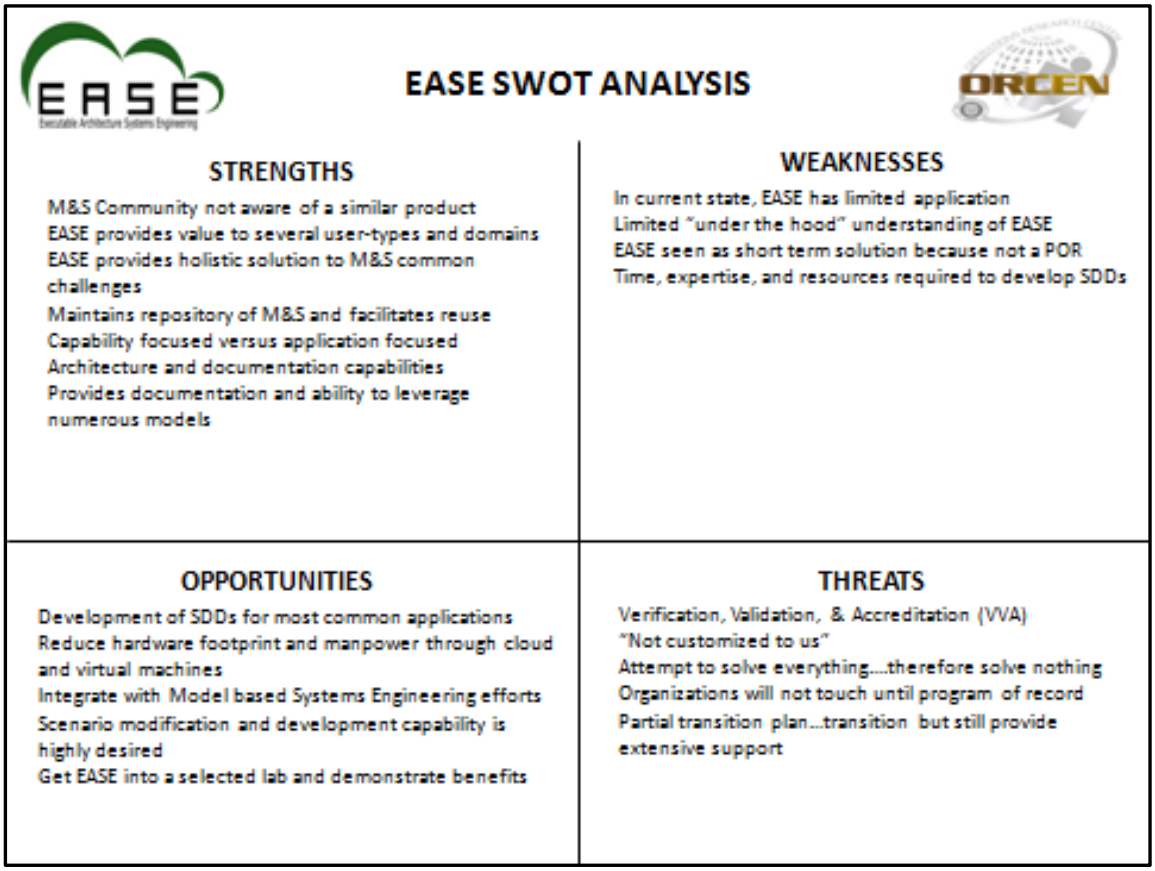



**Figure A. EASE SWOT Analysis**

**Recommended EASE Enhancements.** A common stakeholder recommended high priority enhancement is integration of EASE with current Mission Command and C2 Systems. Stakeholders also recommended adding many more scenarios, models, and supporting SDDs for the most commonly used combat simulation models and tools. An EASE linkage to Force Builder was mentioned as a medium priority recommended enhancement. Low priority

recommended enhancements include a robust report and analysis capability and linkage of terrain to the application line-up.

A recommended Stakeholder-Organization-Capability-M&S Phase-Application focus for future EASE developments and enhancements are highlighted in Figure B below (Priorities highlighted in Green). In general, prioritized EASE improvements should focus on scenario development/modification capability, increasing the ease of integrating disparate models, establishing linkages to authoritative data sources, and continuing to populate the application database with accompanying SDDs. The EASE development team can assist the M&S community the most by focusing improvements and enhancements on efforts that provide value to the Systems Engineering and Development phases of the M&S lifecycle. We recommend adding VBS2, Night Vision Tool Kit, and JCATS to the application database and line-up with appropriate supporting SDDs.

A final general recommendation is to identify an appropriate VV&A authority, discuss the specific VV&A requirements as they pertain to EASE, and begin action on those VV&A related tasks that can be completed now. Highest priority should be given to EASE enhancements that are highlighted in green.

| Stakeholder | Organizations | Capabilities | Phase | Applications |
|---|---|---|---|---|
| RDA | MSCoE | Scenarios | SE | VBS2 |
| TEMO | USMA | Integration | Development | NVTK |
| ACR | FT Benning MTC | Data Linkage | Data Engineering | JCATS |
| Program | FT Hood MTC | C2 Integration | Test | Combat XXI |
| Community | TENA | CBRN | Execution | FIRESIM |
| Enterprise | AMSAA | Cyber | Analysis | |
| User | FT Stewart MTC | Intel | | |
| Developer | FT Campbell MTC | IEDs | | |
| SE | TRAC | Sensors | | |
| | ARCIC | UAS | | |
| | | Non-Lethal | | |

**Figure B. Recommended EASE Enhancement Focus**

We recommend two use cases to demonstrate the valuable and innovative capabilities of EASE:

**MSCoE.** Utilize EASE to support their upcoming SIMEX. EASE can improve MSBL execution of simulation both in the short term as well as the long term. In the short term, EASE could facilitate the automation of execution of M&S across their lab assets. EASE would capture the technical complexity of their simulation environment and provide a simple interface to execute M&S as well gather AAR products through a single web interface. In the long term, EASE could be used to link simulation capabilities with low level technical design details. This will ultimately lead to better reuse and interoperability providing cheaper and more accurate MSBL M&S usage.

**USMA.** Utilize EASE to facilitate DSE work in support of their Squad X and Deployable Force Protection (DFP) projects. Specifically, use EASE to help develop system of system federations that support each program. Key capabilities required will be systems engineering analysis, federation management and start/stop, and data collection. DSE would like to assess EASE ability to build command and control data models and simulation federates that pass federation data to command and control systems used for both DFP and Squad X. Additionally, once loaded in DSE labs, EASE could be used to support the combat simulation and architecture courses.

Lastly, a value hierarchy and proposed set of metric to calculate the value of EASE in Return on Investment (ROI) discussions was developed and highlighted in Figure C below.

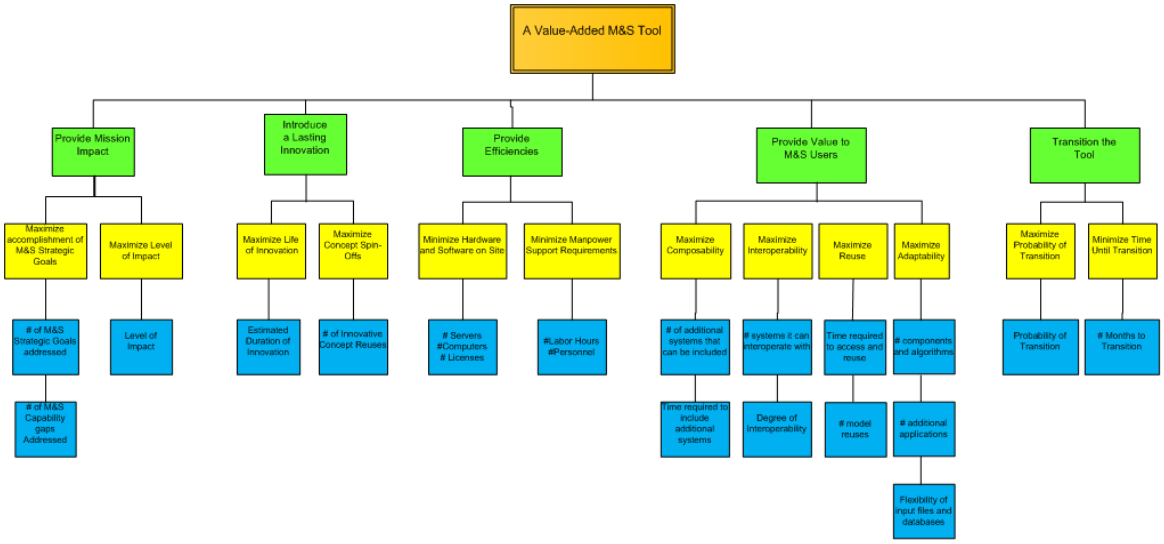



**Figure C. EASE Value Hierarchy and Metrics**

## 1.0 Introduction

Modeling and Simulation (M&S) plays a major role in the mission performance of the Department of Defense (DOD). DOD spends more than $3 billion per year on M&S to support acquisition, training, experimentation, planning, testing and analysis.[1] M&S uses are varied and include: analysis of cost-mission trades for new weapon systems, developmental or operational tests of new systems, analysis of force structure, training, and effectiveness analysis of weapon systems. The strategic vision for DOD modeling and simulation is to "empower DOD with Modeling and Simulation capabilities that effectively and efficiently support the full spectrum of the department's activities and operations."[2]

## 1.1 Background

Each M&S organization has unique missions, purpose, and requires varying levels of analytical fidelity as their work supports different categories of decisions (acquisition, design, training, etc.). Because of these unique missions and analytical requirements, each laboratory or analytical organization utilizes their own collection of M&S tools and in-house scripts. Additionally, there is not a one size fits all combat simulation software package. Rather, there are approximately 600 combat simulation models and tools all developed independently for a unique analytical purpose. This decentralized procurement, development, and use of combat simulation models and tools presents many challenges.

Model and tool documentation is typically non-existent or lacking which prevents an organization from using another's models or tools. Organizations have created in-house add-ons required to pre and post process data and information for their specific needs. No central repository exists where a lab could possibly leverage (check out) one of these 600 M&S tools. Version management and control is a persistent problem. A new version of a model, tool, or operating system introduced into a lab or analytical agency creates new configuration issues and runtime errors. There is tremendous redundancy in combat functions represented within models. For example, direct and indirect fire effects are incorporated into almost every combat simulation model. A tremendous amount of resources including hardware, software, laboratory space, and personnel are required to prepare and maintain appropriate hardware and software and these resources are duplicated from lab to lab. Instead of looking, unsuccessfully, for a combat simulation model that meets all of their unique requirements, most labs and analysis agencies are creating federations of numerous model components.

Research efforts over the last several years have focused on addressing many of these challenges, individually, but not as a whole. DOD has encouraged migration of software to the "cloud" and use of virtual machines (VM) to reduce the Enterprise hardware and software footprint.

[1] Shaffer, The Value of Modeling and Simulation for the Department of Defense. M&S Journal, Fall 2012, p.2
[2] Office of the Director of Defense research and Engineering. 2007. Retrieved from http://www.msco.mil

Numerous research organizations have had varying degrees of success with federation of models and supporting architecture.
Modeling Architecture for Technology Research and Experimentation (MATREX), a composable Modeling & Simulation (M&S) environment, appears the most successful recent attempt. The Modeling and Simulation Coordination Office (MSCO) has attempted to catalog and document the myriad of models and tools in the M&S community. The research team at STTC has attempted to holistically address many of these challenges via a web-based tool; Executable Architecture Systems Engineering (EASE), which facilitates development and management of distributed simulation models throughout the M&S life cycle.

## 1.2 What is EASE

Executable Architecture Systems Engineering (EASE) is a Systems Engineering tool that allows development and management of distributed simulation models throughout the M&S life cycle from identification of event objectives through cloud-based deployment. As a web-based application, EASE provides an easy to use interface to allow M&S users to more easily configure and execute M&S on a cloud-based set of computing resources. EASE allows M&S users to customize execution of a simulation event based on an interview process that identifies system-wide functional and technical requirements and then determines which applications and hardware allocations are necessary for execution to achieve these functional and technical requirements. EASE automatically configures the network and necessary supporting software in order to execute the applications on virtual machines using a Platform as a Service architecture.

As highlighted in Figure 1 below, EASE provides multiple, integrated interfaces for users, integrators, developers, and system engineers to accomplish the typical M&S tasks associated with their user-category.

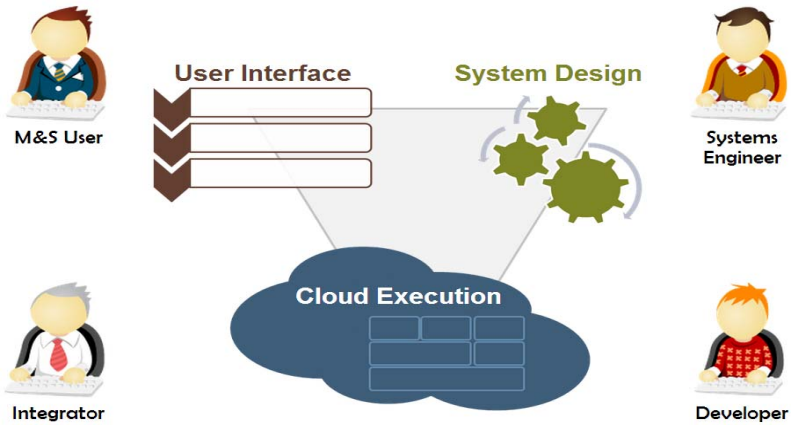



**Figure 1. EASE User-level Interfaces**

The major components of EASE are the Software Design Description (SDD), EASE Interview, Deployment Management System, and EASE Coordinator. Figure 2 below illustrates the relationship between these major components and the user-categories.

The SDD captures the systems engineering information on the available simulation applications, their capabilities and how they interoperate in a simulation environment. The SDD also allows the system engineering user to add new simulation applications.

The EASE Interview System allows the user to traverse captured system engineering information to select and compose a simulation system. The user is presented with a list of options based upon scenario criteria and functional capabilities and has the ability to customize components of the scenario. Additional advanced capabilities allow the user to inject custom properties and create surrogates to fill in specific capabilities.

Once the scenario has been designed and the components chosen, The EASE Deployment Management System determines the necessary assets for execution and deploys software and configuration files. It employs Platform as a Service (PaaS) to utilize virtual and hardware assets in support of a simulation exercise. Its tasking service then determines how and when to run a simulation execution.

Finally, the EASE Coordinator is responsible for the actual execution of the simulation exercise. The Coordinator handles the Time Sequence of Events provided by the tasking system and controls the launch, initialization, shutdown and cleanup of each process. The Coordinator is also responsible for progression of the overall simulation execution ensuring all processes perform the necessary tasks at the proper time.

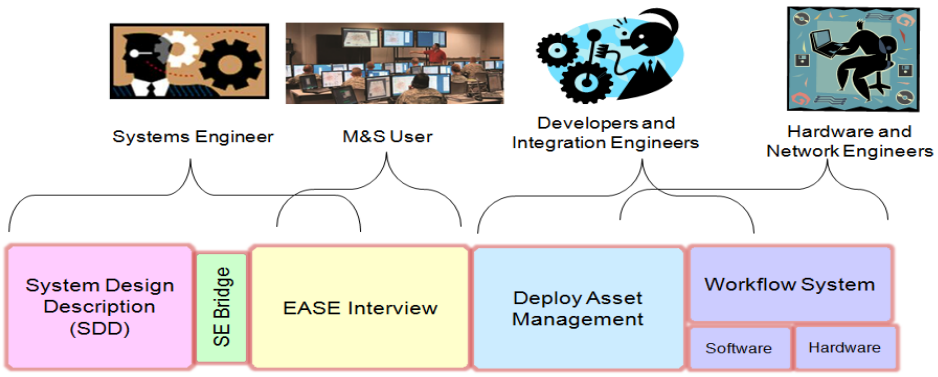



**Figure 2. EASE Major Components**

The fundamental goals of EASE are to manage the requirements and design process, maximize the reuse of models and streamline software and hardware management during all M&S development phases.

## 1.3 Problem Statement.

The EASE development team commissioned this study in order to focus planned improvements

to EASE, based on a comprehensive study of the needs and preferences of potential users and other stakeholders to determine the most important functions and attributes for the product. Specifically, **conduct a detailed stakeholder analysis, looking very broadly at the various stakeholders and the desired functions of EASE, in order to devise and prioritize possible additions or improvements for the development team to include in future versions.**

## 1.4 Study Objectives.

The major study objectives that support the problem statement highlighted above are:

- Identify M&S community capability gaps
- Gather hands-on feedback on EASE
- Recommend potential EASE improvements and enhancements
- Recommend strategy for continued advancement of EASE
- Develop a set of metrics that can be used to reflect the value created by EASE or other M&S initiatives
- Identify potential use case for further development

## 1.5 Related Research and Efforts

**MATREX.** MATREX, developed by the Army Research Lab (ARL), is a composable M&S environment wherein a collection of multi-fidelity models, simulations and tools are integrated into an established architecture to conduct analyses, experimentation and technology trade-offs for the Research, Development, & Engineering Command (RDECOM) and others.[3] Many of the innovations and foundational concepts behind EASE were first developed in the MATREX program.

**FACT.** The Framework for Assessing Cost and Technology (FACT) is an open architecture web services based environment, developed by the Marine Corps Systems Command, that enables the interconnecting of models to provide a rapid exploration of the design tradespace in support of systems engineering analysis. FACT is model agnostic and capable of linking disparate models and simulations of both government and commercial origin through the application of community established data interoperability standards. FACT facilitates rapid

[3] Hurt, Tom, Tim McKelvy, & McDonnell, Joe. The Modeling Architecture For Technology, Research, and Experimentation.

analysis of alternative technology and materiel using surrogate models, or equation regression representations of more complex M&S tools.[4]

**C2WindTunnel.** C2 WindTunnel is a software test bed developed by George Mason for Command and Control (C2) systems. The software facilitates the coupling of disparate models and simulation engines; enabling the use of real world data across multiple models expressed in different modeling languages. The C2WT framework uses the discrete event model of computation as the common semantic framework for the precise integration of an extensible range of simulation engines. These simulators are integrated with the Run-Time Infrastructure (RTI) of the HLA platform. Each simulation model, when incorporated into the overall simulation environment of C2WT, requires integration on two levels: the API level and the interaction level.5

**MITRE's Executable Architecture.** A MITRE research team imported key products of the DoD Architecture Framework into an executable form to conduct a dynamic analysis of the Command and Control (C2) system or capability represented by the architecture. The team made a three-way link between a business process model, a communications network model, and a combat simulation representing the system's operational environment. The models were linked together via the Runtime Infrastructure (RTI) of the High Level Architecture (HLA).[6]

## 2.0 Methodology

We utilize both the Systems Decision Process (SDP) and Value-Focused Thinking (VFT) to gather and analyze stakeholder feedback. First, stakeholder perspectives, user-types, and domains are analyzed to illustrate the stakeholder solution space. Next, manager interviews, user surveys, and workshop comments are gathered to triangulate stakeholder feedback to insure we capture the different perspectives, user-types, and domains. User feedback is clustered and organized into Findings, Conclusions, Recommendations (FCR) to highlight trends, capability gaps, and major issues. The FCR tables and stakeholder feedback are used as the foundation of a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. Finally, the SWOT analysis and stakeholder feedback are translated into a series of recommendations regarding: stakeholder solution space focus, specific M&S organizations with interest, prioritized EASE improvements, prioritized list of EASE enhancements, and potential use cases.

---

[4] O'Neal, Michael. 2012. Modeling and Simulation Tool for Decision Makers: Framework for Assessing Cost and Technology Project, U.S. Marine Corps Systems Command.

[5] Roth, Karen; Barrett, Shelby. 2009 (July). Command and Control Wind Tunnel Integration & Overview. Tech. Report. AFRL-RI-RS-TP-2009-14. Air Force Research Lab.

[6] Pawlowski, Tom; Barr, Paul; Ring Steven. 2004a (June). Applying Executable Architectures to Support Dynamic Analysis of C2 Systems. Tech. rept.The MITRE Corporation.

## 3.0 Stakeholder Identification, Categorization, and Gathering Feedback.

In this study, we conduct a thorough stakeholder analysis to gain an understanding of the current state of M&S, challenges, capability gaps, and EASE user-level feedback. As with all complex systems, there are numerous stakeholders that have an interest in or are impacted by M&S. Figure 3 highlights the major stakeholders within the M&S community. The organizations highlighted in light green are those that we consulted and collaborated with throughout the analysis effort.

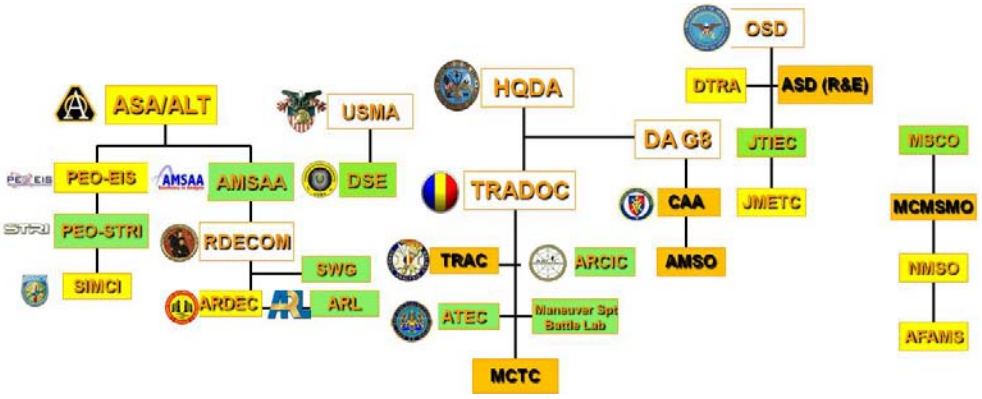



**Figure 3. Major Modeling and Simulation Stakeholders.**

## 3.1 Stakeholder Classification

Stakeholder feedback will typically vary depending on the stakeholder's organizational perspective, specific domain, and duty position. A simulation user has different needs than a systems engineer or manager of an analytic agency. An analyst in a battle lab has different combat simulation requirements than an analyst that supports collective training exercises. Specifics about M&S domains, organizational perspectives, and user-types are discussed in the sections that follow.

### 3.1.1 Domains.

The M&S community is currently organized into three domains. The uses of modeling and simulation within each domain vary in scope, required fidelity, accuracy, and purpose. For example, a combat simulation model used to support a major weapon system purchase decision demands a higher level of fidelity and accuracy than one designed for individual or collective training. Each domain purpose and associated supporting tasks are discussed below and highlighted in Figure 4.

**Training Exercises and Military Operations (TEMO).** The primary focus of the TEMO domain is to prepare/train the warfighter. TEMO domain activities include individual and collective training, Joint and combined exercises, mission rehearsals, and operations planning.

**Research, Development, and Acquisition (RDA).** The primary focus of the RDA domain is to prepare/train the warfighter. RDA domain activities include basic applied research, test and evaluation, and weapon system development.

**Advanced Concepts and requirements (ACR).** The primary focus of the ACR domain is to analyze future concepts and develop doctrine. ACR domain activities include force design, Warfighting experiments, Operational requirements, and analysis of alternatives.

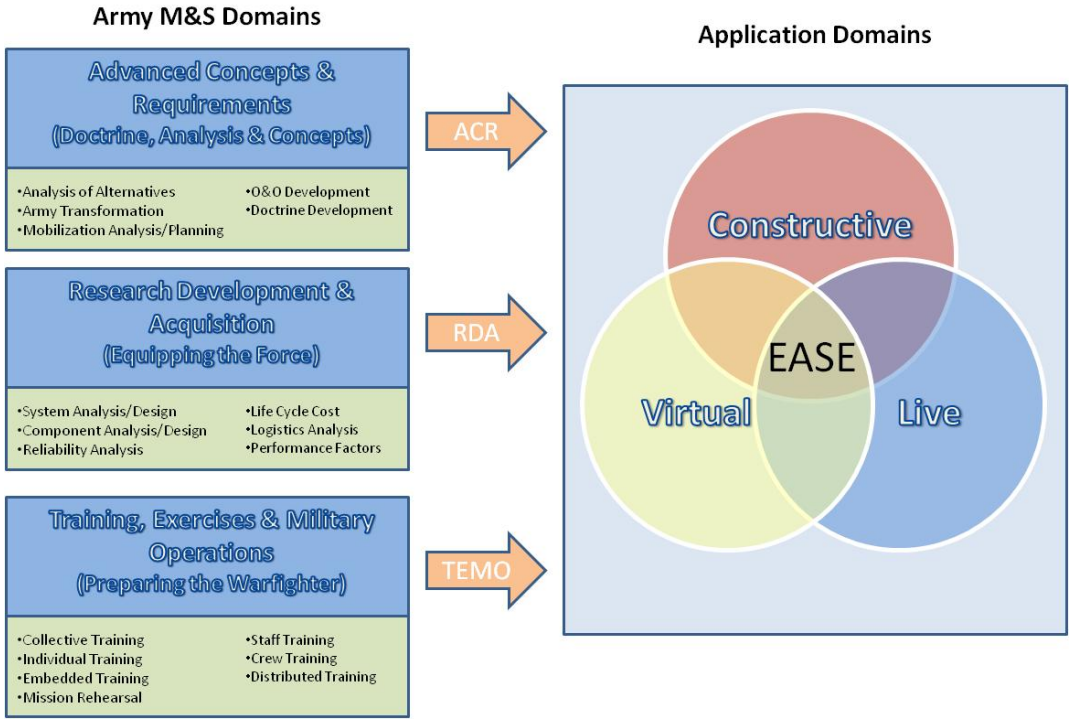



**Figure 4. M&S Domains and Supporting Tasks**

## 3.1.2 Stakeholder Perspectives.

Stakeholder feedback also varies based upon organizational perspective. The M&S concerns at the Enterprise level are much different than those at the Program level. For example, Enterprise-level concerns are focused on M&S policy and creating efficiencies across the Enterprise. At the

program-level concerns are focused on analytical soundness and credibility. The three M&S perspectives are discussed in more detail below.[7]

**Program.** Stakeholder organizations that would be considered Program-level include: Maneuver Support Battle Labs, TRADOC Analysis Centers (TRAC), Army Material Systems Analysis Agency (AMSAA), and ACAT1 programs. They are primarily concerned with affordability, credibility, analytic soundness, interoperability and portability.

**Community.** The planning, testing, training, acquisition, analysis, and experimentation communities would include such organizations as Defense Office of Test& Evaluation (DOT&E), Joint Forces Command (JFCOM), Army Modeling and Simulation Working group (AMSWG), and Program Analysis and Evaluation (PAE). Community stakeholders are primarily concerned with managing M&S within their respective areas.

**Enterprise.** Stakeholders that would be considered Enterprise-level include: Service Modeling and Simulation Coordination Offices (MSCO), OSD Research, Development & Experimentation (RDE), M&S planners and Integrated Planning Teams (IPTs). The primary focus at the Enterprise level includes policy, planning, standards, M&S management, and collaboration across communities and programs.

### 3.1.3 Stakeholder User-Types.

Stakeholder feedback will also vary depending on the stakeholder's duty position or user-level. A simulation user has different needs than a systems engineer or manager of an analytic agency.

**User.** The typical M&S user would utilize combat simulation models and tools on a daily or weekly basis in the performance of their duties. The user is primarily concerned with effectiveness, maintainability, applicability, re-usability, and interoperability.

**Developer.** A developer creates, modifies, and maintains the organizations combat models and tools. A developer's primary concerns might include ease of maintenance, updates, and modifications.

**Systems Engineer.** A systems engineer develops the appropriate architectures and interfaces to facilitate addition and/or federation of new models or tools.

The graphic in Figure 5 below highlights the stakeholder solution space which includes domains, perspectives, and user-types.

[7] Aegis Technologies, pp 39-42.

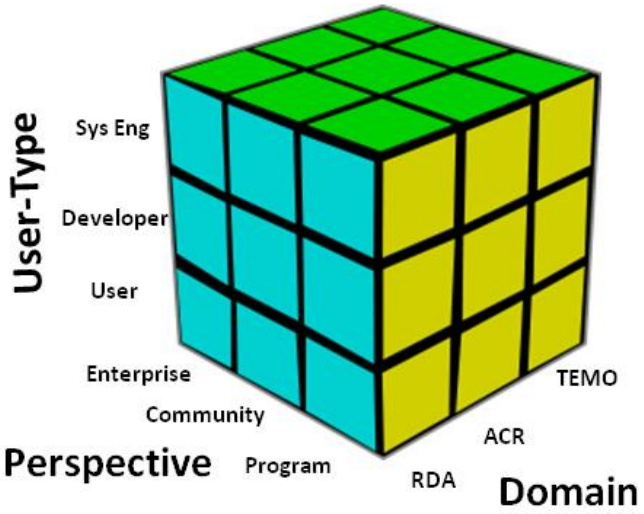



**Figure 5. Stakeholder Solution Space**

## 3.2 "Triangulating" Stakeholder Feedback.

We utilized a combination of feedback techniques to triangulate stakeholder feedback. Techniques included manager interviews, a workshop, and a user-level survey as highlighted in Figure 6 below. The combination of techniques allowed us to gather feedback from the differing perspectives, user-types, and domains.

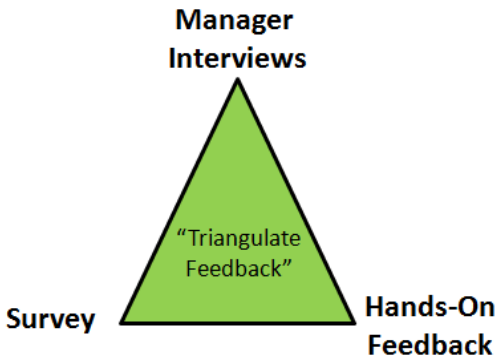



**Figure 6. Methods to Gather and Triangulate Feedback**

### 3.2.1 Manager Interviews.

A series of interviews were conducted with M&S managers from the following organizations: Defense Threat reduction Agency (DTRA), Army Material Systems Analysis Agency

(AMSAA), Modeling and Simulation Coordination Office (MSCO), Department of Systems Engineering, and Army capabilities Integration Center (ARCIC). The interviews were conducted either by phone or in person and the series of questions asked are included in Appendix F. Interview responses were used to develop the workshop objectives and refine user survey questions.

### 3.2.2 EASE Workshop.

The second method of gathering EASE user-level feedback was a workshop hosted in Orlando from 24-26 October. The objectives of the workshop were to: Expose M&S community representatives to the EASE prototype and the technological concept behind it (Executable Architecture), Gather participant feedback on the EASE prototype and M&S in general, Identify organizations with the most interest in utilizing EASE and participating in its future development, Prioritize EASE improvements and future extensions, and Provide a forum for M&S user-level professionals to collaborate.

. The organizations listed below sent representatives to participate.

| | | |
|---|---|---|
| FT Benning MTC | FT Stewart MTC | USMA |
| FT Hood MTC | ARCIC | AMSAA |
| FT Campbell MTC | TRAC-FLVN | TENA |

Each participant presented a mini organization brief that highlighted their organization's mission, M&S challenges, and other topics. A copy of the organization briefs can be found in Appendix A. Additionally, participants received an overview of EASE and its capabilities, utilized EASE to modify and run a scenario, and were asked to provide EASE feedback and recommendations for improvement/enhancement.

### 3.2.3 User-Level Survey.

A user –level survey was developed and distributed to the modeling and simulation community. Efforts were made to ensure that all M&S domains participated in the survey. The survey was accompanied by a short demo video of EASE to facilitate feedback on the value of the fundamental concepts behind EASE. Survey topics included: frequency and importance of M&S, survey of M&S tools used, duration of typical modeling and simulation events, manpower requirements, M&S tool characteristics and their importance, scenario development and modification, and EASE feedback. The survey instrument can be found in Appendix B.

## 4.0 Stakeholder Feedback Analysis.

The manager interview, workshop, and survey feedback were analyzed to identify common themes and points of emphasis. The major takeaways from each feedback mechanism are highlighted below. The results are consolidated and organized into major findings, conclusions, and recommendations and are highlighted in Section 4.4 and included in Appendix G.

## 4.1 Manager Interview Feedback

Not surprisingly, managers were concerned about slightly different issues than analysts and simulation users**.** The key points from the manager interviews are discussed below.

**Inefficiencies and Duplication.** Managers acknowledged that there are numerous redundancies in the models and tools used both within and across M&S domains. Additionally, there is no capability to quickly access and leverage the myriad of models used throughout the community. They agree that some well managed central repository could provide value to the M&S community.

**No real centralized management.** Managers voiced significant concern with the lack of centralized planning, strategy, guidance, and synchronization of major efforts that impact the M&S domains. They note that MSCO and AMSO have made recent attempts to improve planning and synchronization but highlight that most efforts have fallen short.

**VV&A.** Managers expressed hesitation in adopting EASE or other new tools due to restrictions requiring use of only "VV&A" models although they acknowledge that VV&A has a very loose definition and vague standards.

**Budget.** Given the current economic environment, managers welcome any effort that could reduce their hardware and software footprint and decrease manpower dedicated to managing them. They highlighted the significant resources devoted to routing maintenance and updates.

## 4.2 Workshop Feedback

After familiarizing with the concepts behind EASE and a day of hands-on EASE application, workshop participants were asked about general M&S limitations, strengths of EASE, weaknesses of EASE, recommended EASE enhancements, and level of interest in EASE.

**M&S Limitations.** The M&S limitations highlighted by workshop participants are very similar to those provided by survey respondents (discussed in Section 4.3 below). The most common limitations mentioned by workshop participants were:

**Terrain.** There is a lack of common, standardized, correlated terrain. Additionally, terrain formats and accuracy vary from model to model. Lastly, there are several important geographic regions that lack sufficient terrain data suitable for M&S use.

**Interoperability.** Because there is not a combat simulation model that meets everyone's needs yet, there is functionality in many models that, if federated with other models could greatly enhance research and analysis efforts. However, integrating disparate models takes tremendous time, expertise, and manpower.

**Training Requirements.** Most combat simulation models and tools require a significant amount of training to just become proficient at a basic level. Most day-to-day research and analysis work requires a much higher level of proficiency in manipulating individual models and integrating them with other models, tools, or scripts.

**Execute Rapid Changes.** Overly complex combat simulation software and intricate interfaces make minor model or scenario changes non-trivial and time consuming. Even re-running previous experiments is problematic because of ever changing software and hardware configurations and profiles.

Figure 7 below highlights the workshop participant organization mission and their biggest M&S limitations.

| Organization | Mission | Biggest M&S Shortfalls |
|---|---|---|
| Ft. Hood Mission Command Training Center | Support unit training objectives using the Army's Mission Command Systems | Maintaining relevancy with the training unit requirements. Changes in MCS. Scenarios (terrain, equipment). |
| Ft. Benning Maneuver Battle Lab | Recommend DOTMLPF solutions based on LVCAR&G experiments | Inability to provide an integrated, comprehensive Common Operating Picture (COP) to all Joint Mission Command Systems in the current Simulation Architecture. Applies to Air and Missile Defense Workstation (AMDWS), Forward Area Air Defense – Engagement |
| USMA Department of Systems Engineering | Educate West Point cadets | Technical knowledge and talent availability / reliance on small staff. |
| Ft. Stewart Mission Training Complex | Training and facility support to units in LVC simulation exercises at all levels | M&S Terrain availability to match terrain used in Mission Command systems. Interoperability across all M&S systems. |
| Ft. Leavenworth TRADOC Analysis Center (TRAC) | Operations analysis to inform decisions across the spectral (conepts to operations) | Mission Command and Cultural Effects |
| Army Capabilities Integration Center (ARCIC) | Development and integration of force capabilities across the DOTMLPF | Representing all current and future Warfighting Functions accurately enough (entity level) while addressing higher echelon concepts (Div & JTF) |
| Test and Training Enabling Architecture | Architecture and software necessary to enable testing and training on ranges | Lack of full suite of object models. DDM support. |
| Ft. Campbell Mission Training Complex | Mission Command digital training for multi-echelon combined arms operations | Scenario generation timelines. Formal system training. Funding challenges with respect to class availability such as terrain building and scripting. Integration between current simulations |
| Army Materiel Systems Analysis Activity (AMSAA) | Conduct analyses across Materiel Life Cycle informing Army decisions | Maintaining supporting infrastructure for a broad array of specific systems' operating requirements, data storage and retrieval, and search engine to enable study development and M&S tool upgrades |
| USAOTC Test Technology Directorate (TTD) | Support for test directorates in execution of operational test in joint environments | Nonfunctional analysis (e.g., performance, scalability) of M&S system of systems in relation to system under test. |

**Figure 7. Workshop Participant Organizational M&S Shortfalls**

**EASE Strengths.** Figure 8 below highlights EASE strengths identified by workshop participants. Most notably, participants were not aware of another "EASE-like" product in use or under development. They value EASE capability to document and archive model architecture and interoperability requirements. Workshop participants see the ability to maintain and reuse previous combat simulation scenarios and runs as a clear strength. The surrogate capability provided in EASE was highlighted as unique and positive. Lastly, workshop participants note that EASE has potential to both reduce their hardware and software footprint as well as provide a back-up capability.

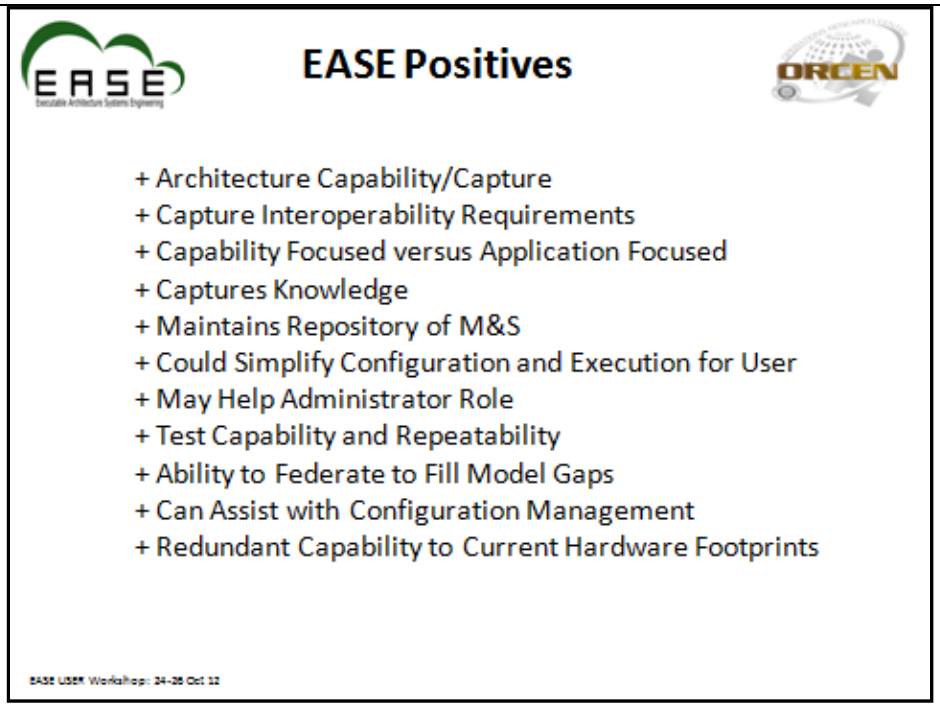



**Figure 8. EASE Strengths Identified by Workshop Participants**

**EASE Weaknesses.** Figure 9 below highlights EASE weaknesses identified by workshop participants. Workshop participants were concerned about having a lack of in-house, EASE expertise; potentially creating a single point of failure. They note that they lack the manpower, expertise, and experience required to build SDDs that would properly function within EASE. Because only a few models, scenarios, and supporting SDDs are currently represented in EASE, workshop participants feel that EASE would not provide any additional advantage over the current way of doing M&S business and would make it difficult to" sell" to their managers and fellow M&S users. Lastly, the perceived risk associated with not being a Program of Record (POR) was highlighted as a major weakness.

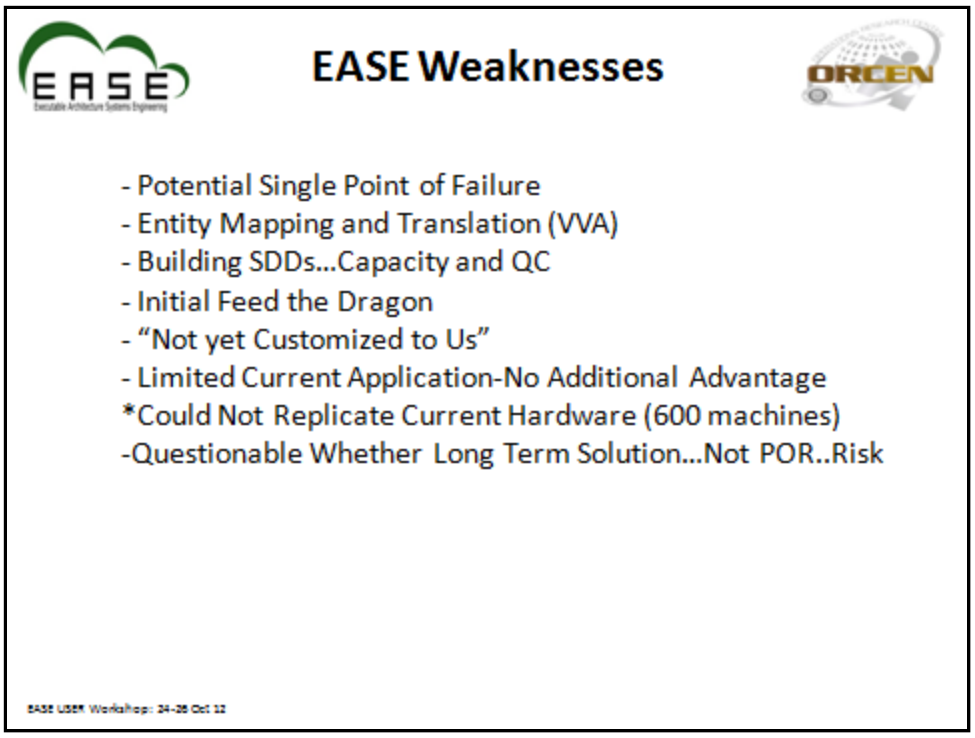



**Figure 9. EASE Weaknesses Identified by Workshop Participants**

**Recommended EASE Enhancements.** Figure 10 below highlights recommended EASE enhancements identified by workshop participants. EASE enhancements were binned by priority as recommended by workshop participants. A common topic throughout the workshop and a recommended high priority enhancement is integration of EASE with current Mission Command and C2 Systems. Workshop participants also recommended adding many more scenarios, models, and supporting SDDs for the most commonly used combat simulation models and tools. An EASE linkage to Force Builder was mentioned as a medium priority recommended enhancement. Low priority recommended enhancements include a robust report and analysis capability and linkage of terrain to the application line-up.

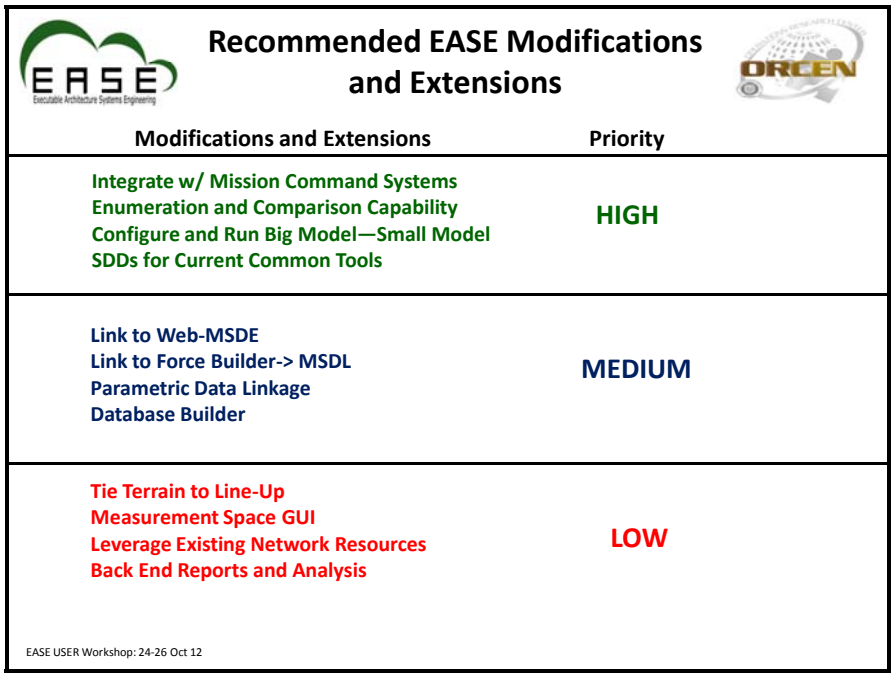



**Figure 10. Recommended EASE Enhancements from Workshop Participants**

**Level of Interest in EASE.** Workshop participants were asked to quantify their organization's level of interest in using EASE. Figure 11 below highlights the continuum of workshop participant interest in EASE. Those highlighted with an asterisk had interest in only portions of EASE. FT Benning MTC has the highest level of interest in EASE and its unique capabilities. FT Hood MTC, USMA, and TENA have mild to strong interest. TRAC and ARCIC have the least amount of interest in EASE. Their hesitancy is primarily attributed to a lack of EASE VV&A credentials and applicability to their day-to-day work.

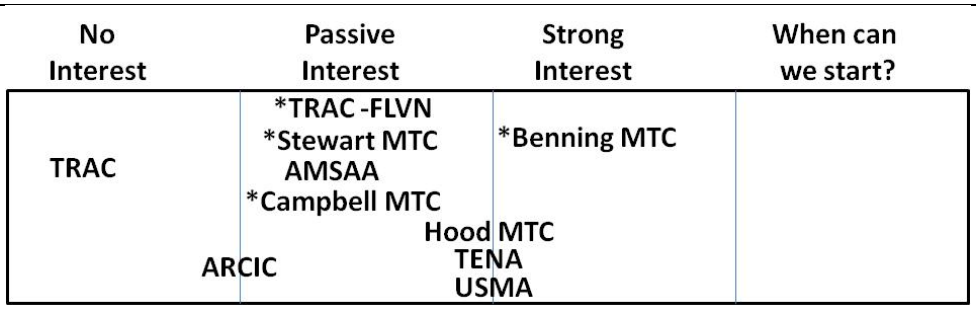



**Figure 11. Workshop Participant Interest in EASE**

## 4.3 User Survey Feedback.

As highlighted earlier, a survey was developed and distributed to the TEMO, ACR, and RDA M&S communities. Approximately 100 M&S users from across all domain responded to the survey. The survey instrument is included at Appendix B. A complete description of all survey results is included in Appendix C, however the key points from the survey are discussed below.

**Frequency and importance of M&S.** Survey respondents were asked to quantify how frequently the utilized M&S in the course of their work and the importance of M&S relative to other tolls or techniques. 71% of respondents stated that they use M&S on a daily basis and over 90% classify M&S as important or very important to the work of their organization.

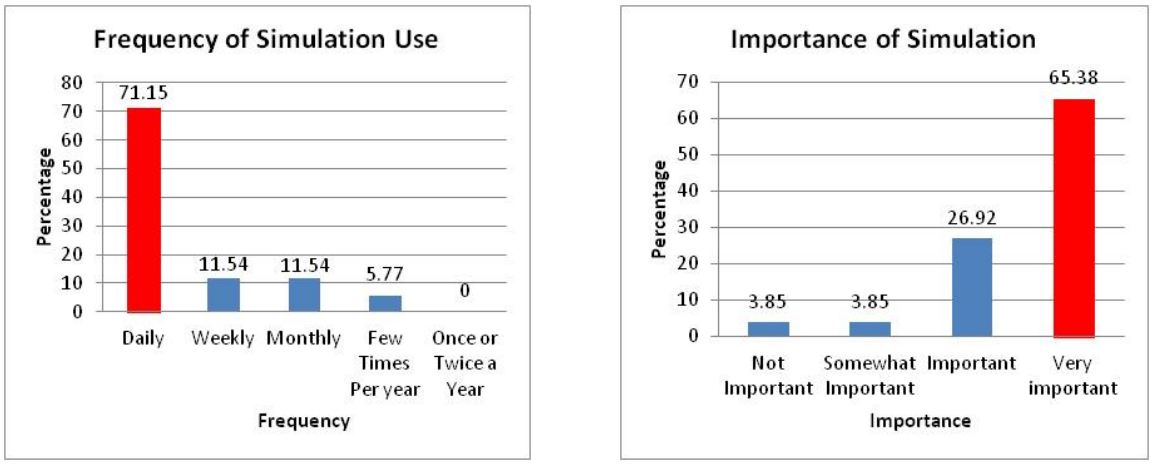



**Figure 12. Frequency and Importance of Simulation Use**

**Most common combat simulation models and tools.** Survey respondents were asked to list combat simulation models and tools they use. As expected, there are a wide variety of tools used across and within M&S domains. The top four combat simulation software packages used by survey respondents were JCATS, VBS2, OneSAF, and Combat XXI.

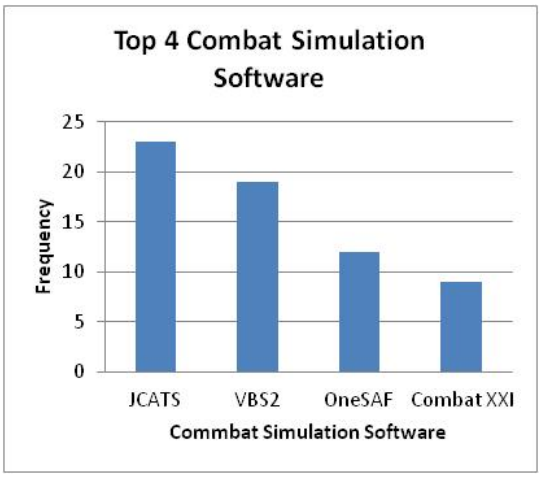



**Figure 13. Top Combat Simulation Software Used**

**Current M&S limitations.** Respondents were asked to list the limitations of current combat simulation models and tools. The most common limitations listed in priority order include:

- Validity and available of data
- Interoperability with other models and tools
- Trained users
- Lack of tools to quickly create or modify a scenario
- Keeping hardware and software current
- Common, correlated terrain
- Cumbersome user interfaces

**Typical duration of M&S event.** Survey respondents were asked to quantify the time typically spent during each phase of a simulation event; Systems Engineering, Development, Data Engineering, Testing, Execution, and Analysis. Survey respondents reported that Testing, Execution, and Analysis phases take the least amount of time lasting between 2 days and 2 weeks. The Development and Systems Engineering phases are typically the longest. The Development phase is generally greater than 2 weeks in duration and has the greatest variation of the M&S event phases.

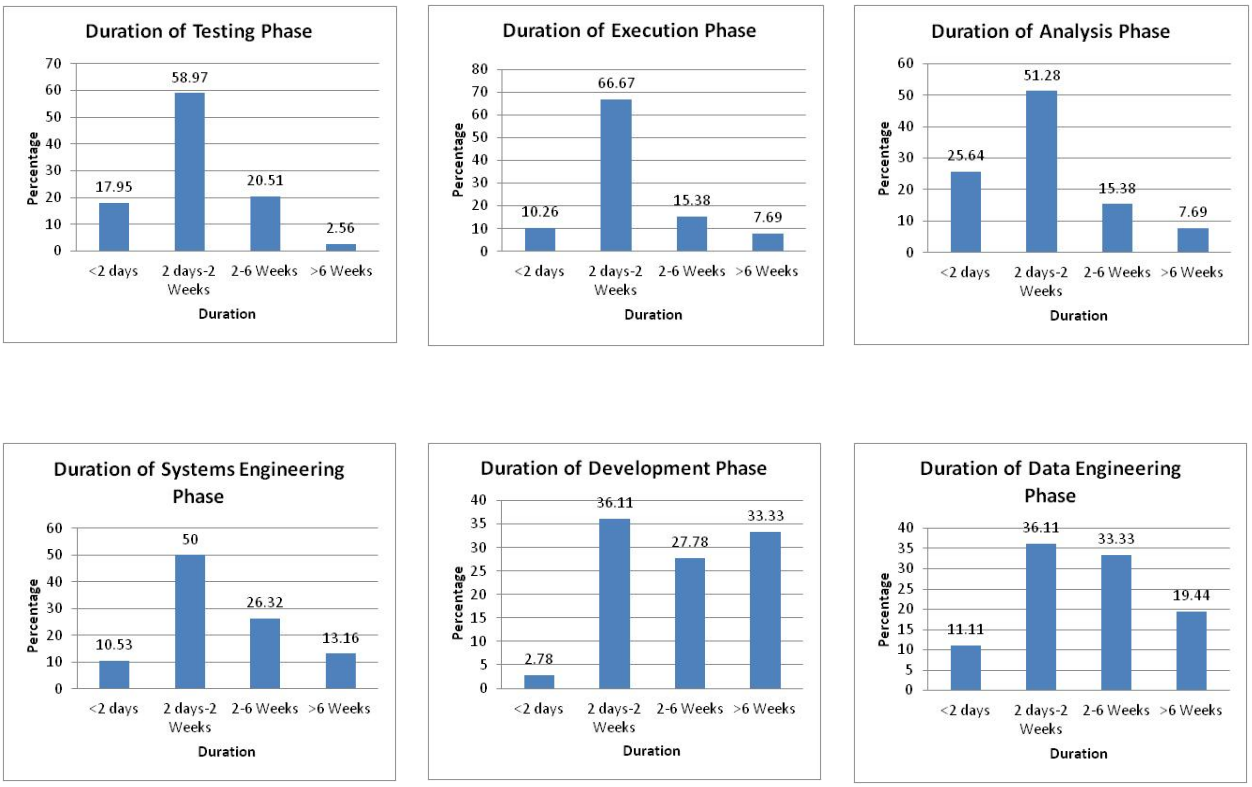



**Figure 14. Duration of Simulation Event Phases**

**Verification, Validation, and Accreditation (VV&A).** Respondents were asked about the importance of utilizing only models and tools that were VV&A as well as the proportion of their organization's models and tools that are actually VV&A.

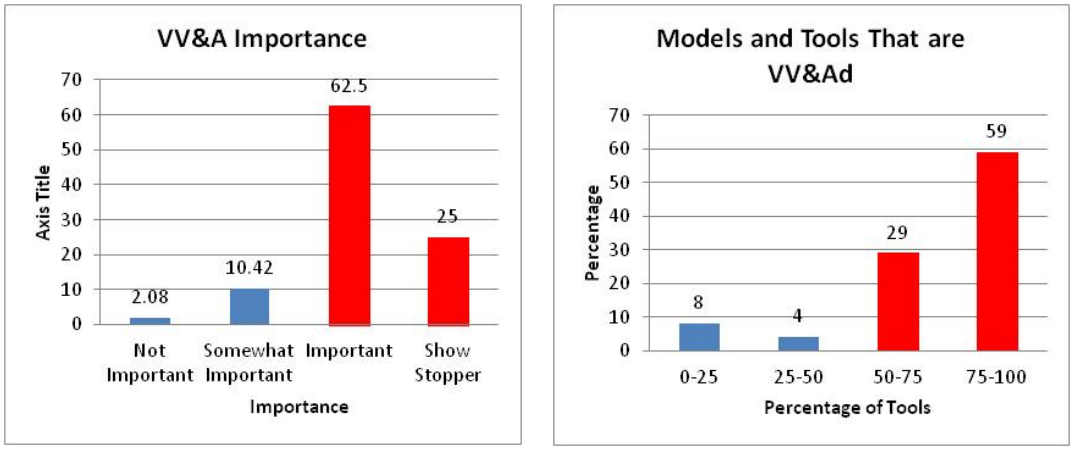
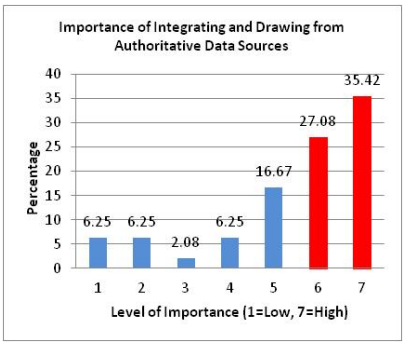
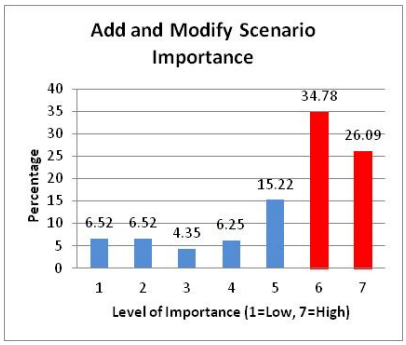


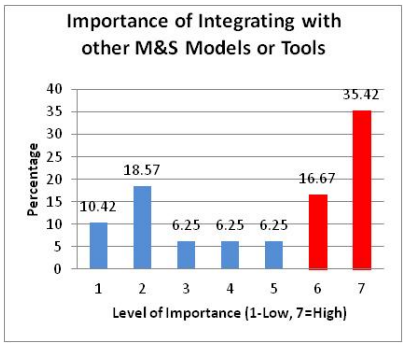

**Figure 15. VV&A Importance**

**M&S important characteristics.** Survey respondents were asked to rate the importance as well as the relative comparison of the characteristics listed below.

- Low barrier to use for varying M&S skill levels
- Ability to access and run from anywhere
- Integrates with other commonly used M&S packages and scripts
- Customizable output graphics and statistics
- Front end DOE capability to plan and customize experiments
- Ability to add and modify scenarios
- Ability to interface and draw from authoritative data sources



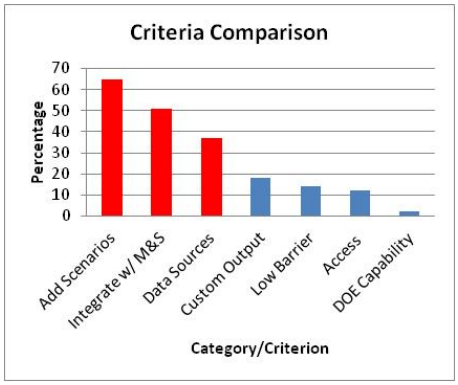




**Figure 16. Comparison of Important M&S Criteria**

The ability to add and modify scenarios and integrate with other M&S tools were highlighted as the most important characteristics. The ability to access and run from anywhere and a front end DOE capability to plan and customize experiments were rated as the least important of the criteria.

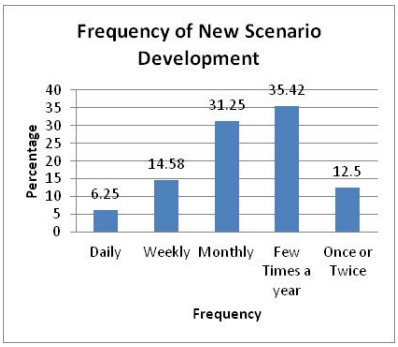
**Pre and Post-processing tools.** Survey respondents were asked to list pre and post-processing tools they use. Again, there is a wide variety of tools used across and within M&S domains. The tables below highlight the various pre and post processing tools used by the survey respondents.

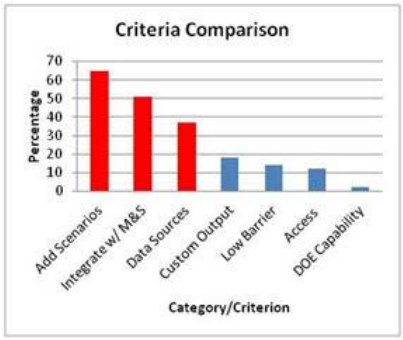
| Pre-processing |
|---|
| Order Of Battle Serves (OBS)JLCCTC Validational Tools |
| Joint Training Data Services |
| JTDS, Joint Remote Client |
| APE: AWARS Pre-processing Environment |
| IPR, MSEL Sync meeting, datbase creation, RTOC setup |
| LOD |
| Polaris |
| AMSAA Joint Data Center (JDC) |
| SAF |
| SIMPLE |
| COMBATXXI Preprocessor (AKA Scenario Integration Tool Suite) |
| AWARS uses two preprocessors: Ape and FSMP. |
| SQL, Excel |
| Electronic Data Request System (eDRS) |
| ArcGIS, TerraSim TerraTools |
| Open Office, data tools include MS Access and MS Excel |

| Post-processing |
|---|
| After Action Review System (AARS) that is part of JLCCTC ERF |
| AWARS Post-processor, SAS |
| AAR'S, ICE FORMS |
| LOD |
| GUI standard output packages |
| NSITE |
| In-house-developed data reduction software |
| Microsoft Excel, Microsoft Word, Microsoft SQL Server |
| Custom SQL Server-based post processor, Excel. |
| SAF/AAR |
| PASW (AKA Clementine), Excel, and SQL. |
| SQL Data base and Excel. |

**Figure 17. Pre and Post Processing Tools Commonly Used**

**Scenarios.** Survey respondents were asked how frequently scenarios are adjusted/updated, how often new scenarios are developed, and the time/manpower requirements typically required to develop and modify scenarios. The majority of survey respondents stated that new scenarios are typically developed monthly or a few times per year- most often requiring a minimum of 2 to 3 scenario developers. 25% of organizations noted that they require more than 5 scenario developers to generate a new scenario. Recall from the earlier survey results discussion, the ability to modify and develop scenarios was highlighted as the most desirable characteristic. Finally, feedback highlighted in Figure 19 illustrates that there is a wide variety of scenario formats used throughout the M&S community.



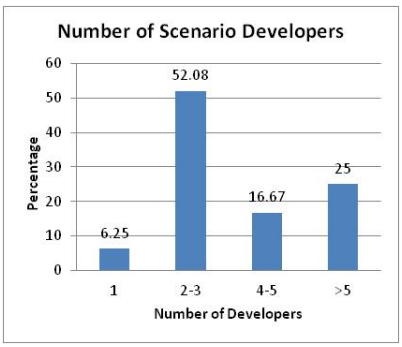




**Figure 18. Add and Modify Scenario Importance**

| Scenario Formats |
|---|
| Save scenarios in each federate (VBS2, OneSAF, etc...) |
| OBS V2.0 |
| MS Powerpoint/Word, Adobe Reader, C2PC (Command and Control Personal Computer) |
| CD |
| Disks, Sharepoint, |
| VBS2 Format |
| OneSAF - XML (BZIP'd) |
| SAF |
| JCATSVBS2 |
| RTF files or xml |
| XML |
| XML and odb (open office database). |
| Word and PowerPoint. |

**Figure 19. Scenario Formats Commonly Used**

**EASE feedback.** Based upon a brief video demo of EASE, survey respondents were asked to comment on the usefulness of EASE and highlight features/functionality that would increase the likelihood that they would use EASE. Results are highlighted in Figure 20 below.

| Functionality that would increase liklihood of EASE use |
|---|
| Easy to use information exchange and data mapping. |
| Interoperability with Army Mission Command Systems |
| Simplicity and the ability to customize scenarios to meet unit training objectives |
| Being User Friendly |
| Ability to incorporate standard data products. Ability to integrate with other sim tools. |
| Confidence that the data provided is accurate and can be understood by an outside agency. |
| AAR info |
| Providing interaction for Soldiers that reduce the resource requirement but allows a full range of usage |
| Must be user-friendly, handle classified, be V&V'd |
| Automatic configuration and Launching. |
| Native support for TENA |
| Easy to use execution and analytical tools for ~100 replications for each alternative within DoD compliant and approved |

**Figure 20. Desirable EASE Features**

## 4.4 Findings, Conclusions, Recommendations (FCR).

Complete FCR tables are included in Appendix G. Key FCR threads are discussed briefly below.

**Scenarios.** The ability to modify and develop scenarios was highlighted as the most desirable characteristic by survey respondents. The majority of survey respondents stated that new scenarios are typically developed monthly or a few times per year- most often requiring a minimum of 2 to 3 scenario developers. 25% of organizations noted that they require more than 5 scenario developers to generate a new scenario. User feedback also indicated that there is a wide variety of scenario formats used throughout the M&S community. Workshop participants expressed that rapid scenario modification and development were very desirable features of any combat simulation model or tool.

**Data.** Survey respondents identified the ability to integrate with and draw from authoritative data sources as a top three desirable characteristic. Workshop participants note that requested data often takes months to arrive. Additionally, significant amounts of time are devoted to validating this data prior to use. Often times there are compatibility issues with data used with multiple models. Terrain data is often lacking for particular geographic regions and it

is also not always compatible across models. We recommend adding terrain data sets to EASE within the line-up and providing the capability to integrate with common data sources.

**Hardware and Software Footprint**. Each combat simulation lab or analysis center maintains computers, servers, and specialized equipment to support M&S for experimentation, training, and analysis. FT Stewart MTC maintains a 53K sq ft facility and 35 servers. The maneuver battle lab at FT Benning maintains a 120,000 Sq. Ft. Constructive/Virtual/Gaming Simulation Facility with 450 desktop computers and 50 servers. These resources are replicated at each battle lab, MTC, and analysis center at great expense. Additionally, each battle lab, MTC, and analysis center maintains a massive suite of combat simulation software. A cloud – based solution has the potential to provide substantial cost savings across the M&S Enterprise.

**Interoperability/Integration.** With the fielding of new equipment and new threats, additional combat simulation models and tools are required. These new models and tools are not necessarily intended to work together however it is highly desirable to integrate multiple models. Stakeholders identified integration of multiple models or tools as very important and a top three characteristic. Consequently, EASE extensions should focus an increasing the timeliness and reducing manpower required to integrate multiple models. Additionally, the application line-up database and function vs. application focus are unique and positive aspects of EASE and should be leveraged.

**Reuse.** Stakeholders noted great value in the ability to access previously run simulations without the burden of new configuration work or software updates. Being able to access and rerun any simulation archived in EASE was seen as positive. Additionally, strategic M&S guidance lists reuse as an important Enterprise M&S characteristic.

**VV&A.** Managers expressed hesitancy in adopting EASE due to its lack of VV&A certification. 87% of survey respondents stated that VV&A of a combat simulation model or tool was very important within their organization. Most report that over 75% of the models and tools they use on a day-to day basis are VV&Ad. Stakeholders in the TEMO domain expressed less concern in VV&A than ACR and RDA domains. We recommend identifying an appropriate VV&A authority, discuss the specific VV&A requirements as they pertain to EASE, and begin action on those VV&A related tasks that can be completed now.

## 4.5 EASE SWOT Analysis

The user survey, workshop feedback , and the FCR are translated into a SWOT analysis which is highlighted in Figure 21 below.

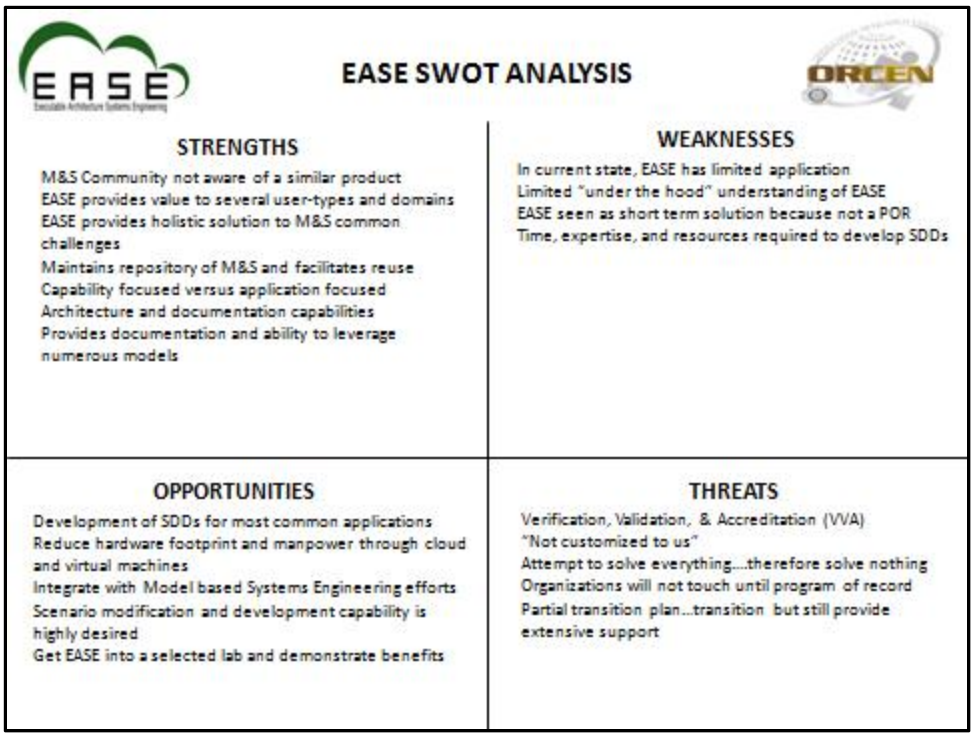



**Figure 21. EASE SWOT Analysis**

## 5.0 Recommendations and Conclusions

The objectives of this study were to: identify M&S community capability gaps, gather hands-on feedback on EASE, recommend potential EASE improvements and enhancements, recommend a strategy for continued advancement of EASE, develop a set of metrics that can be used to reflect the value created by EASE or other M&S initiatives, and identify a potential use case for further development. The conclusions related to each are discussed below.

**Current M&S limitations.** The most common limitations identified by M&S stakeholders, listed in priority order include:

- Validity and available of data
- Interoperability with other models and tools
- Trained users
- Lack of tools to quickly create or modify a scenario
- Keeping hardware and software current
- Common, correlated terrain
- Cumbersome user interfaces

**EASE Hands-On Feedback.** Workshop participants were not aware of another "EASE-like" product in use or under development. They value EASE capability to document and archive model architecture and interoperability requirements. They saw the ability to maintain and reuse previous combat simulation scenarios and runs as a clear strength. The surrogate capability provided in EASE was highlighted as unique and positive. Lastly, workshop participants note that EASE has potential to both reduce their hardware and software footprint as well as provide a back-up capability.

Workshop participants were concerned about having a lack of in-house, EASE expertise; potentially creating a single point of failure. They note that they lack the manpower, expertise, and experience required to build SDDs that would properly function within EASE. Because only a few models, scenarios, and supporting SDDs are currently represented in EASE, workshop participants feel that EASE would not provide any additional advantage over the current way of doing M&S business and would make it difficult to" sell" to their managers and fellow M&S users. Lastly, the perceived risk associated with not being a Program of Record (POR) was highlighted as a major weakness.

**Recommended EASE Enhancements.** Stakeholders recommended integration of EASE with current Mission Command and C2 Systems as a high priority enhancement. They also recommended adding many more scenarios, models, and supporting SDDs for the most commonly used combat simulation models and tools. An EASE linkage to Force Builder was mentioned as a medium priority enhancement. Low priority recommended enhancements include a robust report and analysis capability and linkage of terrain to the application line-up.

**EASE Strategy.** Our recommended EASE strategy includes Who and Where to focus future EASE efforts. Because the stakeholder solution space is so diverse, a tool that attempts to solve every problem will collapse under its own weight. Based upon workshop feedback and stakeholder solution space analysis we recommend the EASE development team focus its efforts on the Program-RDA-User-SE-Developer portion of the stakeholder solution space as highlighted in Figure 22 below.

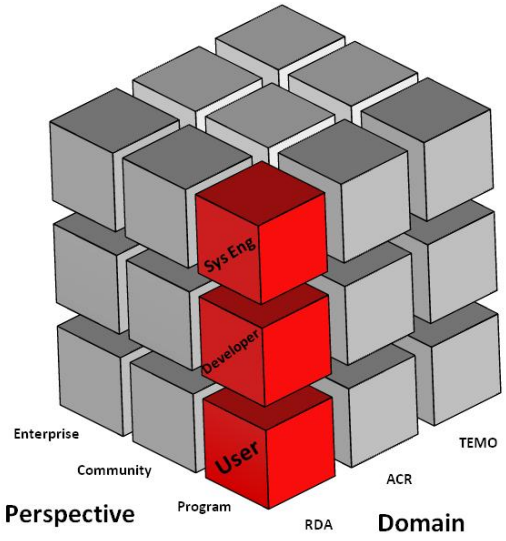



**Figure 22. Recommended Stakeholder Space Focus**

The high priority collaborative EASE partners include MSCoE, USMA, and FT Benning MTC since they have the highest Interest/Potential Applicability as highlighted in Figure23 below.

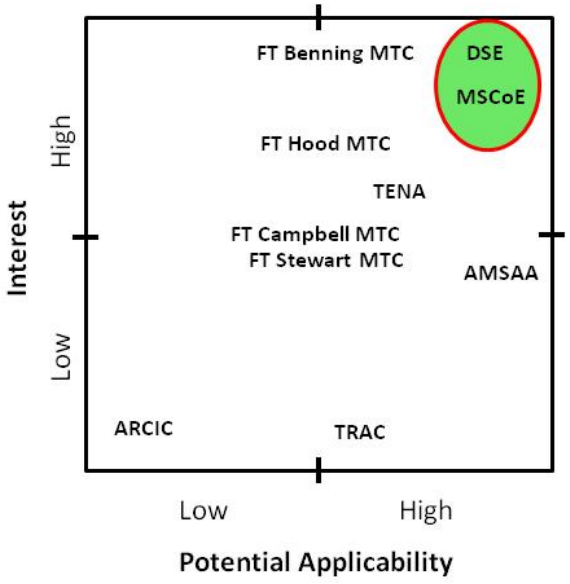



**Figure 23. High Priority EASE Collaborators**

In general, prioritized EASE improvements should focus on scenario development/modification capability, increasing the ease of integrating disparate models, establishing linkages to

authoritative data sources, and continuing to populate the application database with accompanying SDDs. The EASE development team can assist the M&S community the most by focusing improvements and enhancements on efforts that provide value to the Systems Engineering and Development phases of the M&S lifecycle. We recommend adding VBS2, Night Vision Tool Kit, and JCATS to the application database and line-up with appropriate supporting SDDs.

A final general recommendation is to identify an appropriate VV&A authority, discuss the specific VV&A requirements as they pertain to EASE, and begin action on those VV&A related tasks that can be completed now. Figure 24 below highlights the recommended areas of focus. Highest priority should be given to EASE enhancements that are highlighted in green.

| Stakeholder | Organizations | Capabilities | Phase | Applications |
|---|---|---|---|---|
| RDA | MSCoE | Scenarios | SE | VBS2 |
| TEMO | USMA | Integration | Development | NVTK |
| ACR | FT Benning MTC | Data Linkage | Data Engineering | JCATS |
| Program | FT Hood MTC | C2 Integration | Test | Combat XXI |
| Community | TENA | CBRN | Execution | FIRESIM |
| Enterprise | AMSAA | Cyber | Analysis | |
| User | FT Stewart MTC | Intel | | |
| Developer | FT Campbell MTC | IEDs | | |
| SE | TRAC | Sensors | | |
| | ARCIC | UAS | | |
| | | Non-Lethal | | |

**Figure 24. Recommended EASE Enhancement Focus**

We recommend two use cases to demonstrate the valuable and innovative capabilities of EASE:

**MSCoE.** Utilize EASE to support their upcoming SIMEX. EASE can improve MSBL execution of simulation both in the short term as well as the long term. In the short term, EASE could facilitate the automation of execution of M&S across their lab assets. EASE would capture the technical complexity of their simulation environment and provide a simple interface to execute M&S as well gather AAR products through a single web interface. In the long term, EASE could be used to link simulation capabilities with low level technical design details. This will ultimately lead to better reuse and interoperability providing cheaper and more accurate MSBL M&S usage.

**USMA.** Utilize EASE to facilitate DSE work in support of their Squad X and Deployable Force Protection (DFP) projects. Specifically, use EASE to help develop system of system federations that support each program. Key capabilities required will be systems engineering analysis, federation management and start/stop, and data collection. DSE would like to assess EASE ability to build command and control data models and simulation federates that pass federation data to command and control systems used for both DFP and Squad X. Additionally, once loaded in DSE labs, EASE could be used to support the combat simulation and architecture courses.

## 5.1 Metrics

Aegis, in their work entitled "Metrics for Modeling and Simulation (M&S) Investments" conduct an extensive analysis of potential metrics for M&S investments and return on Investment (ROI). Metrics were developed for each of the multiple user perspectives (i.e. Enterprise, Community, Program, etc.). and address both quality and monetary aspects. Below is a value hierarchy that synthesizes stakeholder feedback and selected AEgis metrics[8]. Metrics are defined in Appendix H.

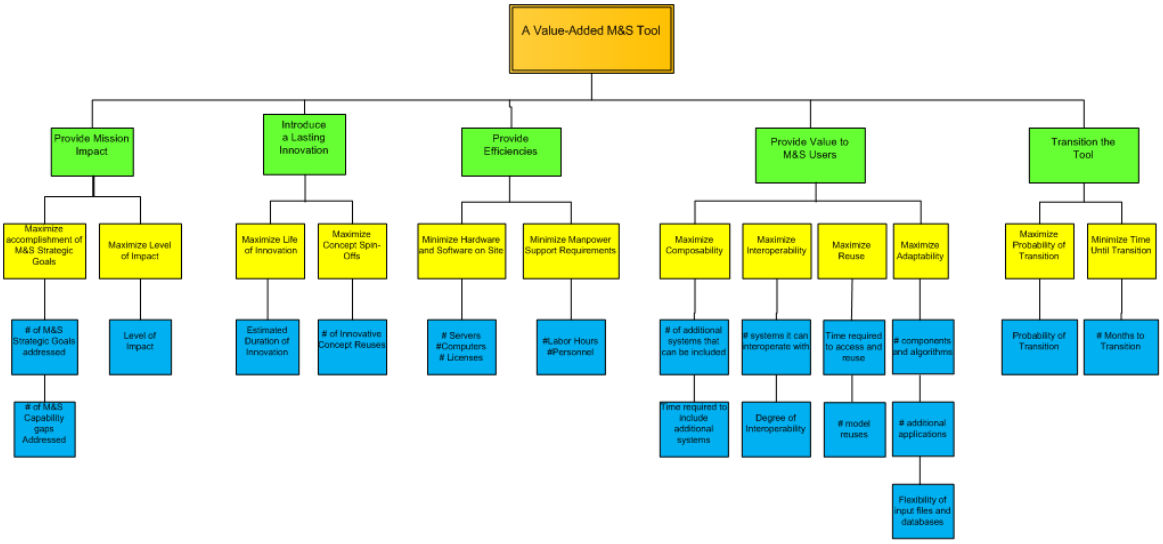



**Figure 25. EASE Value Hierarchy and Metrics**

[8] AEgis Technologies Group, Inc. 2008 (November2008). Metrics for Modeling and Simulation(M&S) Investments. Tech. rept. Report NumberTJ-042608-RRP013. AEgis.

# Appendix A. Workshop Organization Briefs

## Fort Hood Mission Command Training Center

### Mission

Provide the Fort Hood Soldiers and staffs the best training opportunities available anywhere. Fully support the III Corps Home Station Gated Training Strategy. Support unit training objectives using the Army's Mission Command Systems in state-of-the-art digital classrooms and facilities.

### How we use Simulation

Provide a training environment to support the Commander's training objectives. This environment can range from simple classroom to fully immersive.

### Most commonly used M&S tools

Joint Land Component Constructive Training Capability (JLCCTC)
- ERF (JCATS Based)
- MRF (WARSIM Based)

VBS2
Close Combat Tactical Trainer (CCTT)
Aviation Combined Army Tactical Trainer (AVCATT)
Army Low Overhead Training Toolkit (ALOTT)
- Homestation Enabling Lower Overhead Integrated eXercise (HELIX)
- Division eXercise Training Readiness System (DXTRS)
- Metis
- Urbansim

### Amount of Distributed and Federated Work

50-50 Depends on level of the event:
- Smaller (Classroom Like) events are not distribute
- Medium Size event typically done over LAN
- Large Size events typically done over WAN

### M&S Resource Footprint

(Sq Ft, Machines, M&S Budget, #Personnel)

55 Personnel
Budget is for personnel only – Overtime is an additional OAWT
5 Primary facilities
500 Common Hardware Machines
Two JLCCTC Server Suite
- ERF + WIM (Low and High)
- MRF-W (Stand Alone) plus Two Tech Fwd Suites

### Our biggest M&S shortfall

Maintaining relevancy with the training unit requirements
- Changes in MCS
- Scenarios (terrain, equipment)



## Maneuver Battle Lab- Fort Benning

### Mission

Conduct 'Human In The Loop' experiments in Live, Virtual, Constructive, and Gaming environments and Recommend DOTMLPF solutions in support of Force Development, BCT Modernization, and Future Force Concepts at the Brigade Combat Team through Soldier levels.

### How we use Simulation

- Analysis of Alternatives
- Requirements Generation
- Milestone Decisions
- Investment Strategy
- Transition to POR
- Military Utility
- 'Ground Truth' Assessment
- Force Design
- Force Structure
- Prototype Investment
- Doctrine
- Purchase Decisions
- TTP Development
- Transition Decisions

### Most commonly used M&S tools

*Simulations
- *One Semi-Automated Forces (OneSAF)
- *Advanced Concepts Research Tool (ACRT) (OneSAF-based)
- *Virtual Battlespace 2 (VBS2)
- *Infantry Warrior Simulation (IWARS)
- *Squad Synthetic Environment (SSE) (Immersive and Desktop)

*Mission Command
- *Command Post of the Future (CPoF)
- *Army Battle Command System (ABCS)
- * Joint MC Systems

*Federation Tools
- *HLA Toolkit
  - *DIS 4K HLA Gateway
  - *HLA Logger
  - *HLA Reporter
- *SUCSE OneSAF Node Status Tool (SONST) (OneSAF-based)
- *Collected Data Reduction software (developed in-house)
- *Joint Embedded Messaging System (JEMS)
- *Communication Realism Appliance (CRA)
- *Military Intelligence Common Operating Picture (MICOP)
- *Night Vision Toolset (NVToolset)

### Amount of Distributed and Federated Work

*Federated – M&S working individually contributing to a whole
*Distributed – M&S geographically separated

* Army Capabilities Integration Center (ARCIC) Army Concept Development Experiment Plan (ACDEP) Experiments – Fed & Dist
* Maneuver Center of Excellence (MCoE) Army Expeditionary Warrior Experiment (AEWE) – Fed
* Fires Center of Excellence (FCoE) Joint Fires Experiment (JFE) – Fed & Dist

### M&S Resource Footprint

*Facilities
- *120,000 Sq. Ft. Constructive/Virtual/Gaming Simulation Facility
- *McKenna Instrumented MOUT

*Machines (VCG)
- *14 Squad Synthetic Environment (SSE) Immersive Systems
- *24 Advanced Concepts Research Tools (ACRTs)
- *50 Virtual Battlespace 2 (VBS2)
- *50 Rack-mounted servers
- *450 Desktop computers

*Personnel
- *15 Civilian
- *10 Military
- *60-150 Contractors (including Surge)

### Our biggest M&S shortfall

Inability to provide an integrated, comprehensive Common Operating Picture (COP) to all Joint Mission Command Systems in the current Simulation Architecture.

Applies to Air and Missile Defense Workstation (AMDWS), Forward Area Air Defense – Engagement Operations (FAAD-EO), Tactical Air Control Party – Close Air Support (TACP-CAS), Air Defense System Integrator (ADSI), and others.

## Appendix A. Workshop Organization Briefs

### Department of Systems Engineering

**Mission**
**Educate West Point Cadets**

**How we use Simulation**
- Teach classes covering:
  - Monte Carlo simulation
  - Discrete Event Simulation
  - Combat Modeling
  - System Dynamics
- Defense sector combat modeling projects

**Most commonly used M&S tools**
OneSAF (w/MATREX & BCMS tools)
VBS2
IWARS
Night Vision Toolkit

**Amount of Distributed and Federated Work**
Project driven-distributed and federated simulation is a large part of one of our current projects

**M&S Resource Footprint**
(Sq Ft, Machines, M&S Budget, #Personnel)

Approximately 2000 sq ft of lab space
39 Machines
4 military, 4 civilians
M&S Budget is project driven

**Our biggest M&S shortfall**
Recently lost our programmer, which makes the federation piece more difficult

EASE USER Workshop: 24-26 Oct 12

### Fort Stewart Mission Training Complex

**Mission**

Provide training and facility support to units in Live, Virtual, and Constructive simulation exercises at all levels

**How we use Simulation**
Develop and sustain digital war-fighter skills
Stimulate Mission Command Systems
Unit Collective Training (STAFFEX, CPX, MRX)
Company and below mission rehearsals
Troop Leading and Convoy Procedures

**Most commonly used M&S tools**

JCATS
Reconfigurable Vehicle Simulator (RVS)
VBS-2
MUSE-UAS

**Amount of Distributed and Federated Work**

17-22 Battalion and above exercises per year
Exercises last from 3 days to 3 weeks

**M&S Resource Footprint**
(Sq Ft, Machines, M&S Budget, #Personnel)

Sq Ft – 53, 968; majority is CCTT and RVS
Machines – Up to 35 servers; number of clients depend on exercise design
Budget – $600k
Personnel – 70; includes DAC and Contractors

**Our biggest M&S shortfall**

M&S Terrain availability to match terrain used in Mission Command systems
Interoperability across all M&S systems

EASE USER Workshop: 24-26 Oct 12

## Appendix A. Workshop Organization Briefs

### TRADOC Analysis Center – Fort Leavenworth

**Mission**
Lead and conduct relevant, credible operations analysis to inform decisions in support of joint and Army concept development, organizational design, capabilities development, materiel acquisition, and current operations.

**How we use Simulation**
- Provide operational effectiveness analysis using force-on-force simulation at all echelons
- Work Program includes: Analyses of Alternatives; Force Design / Force Mix Studies; Support to Current Operations; etc.

**Most commonly used M&S tools**

Models:
- AWARS
- Combat XXI
- OneSAF

Other Tools:
- ARENA
- PAVE

**Amount of Distributed and Federated Work**
- Limited
- IW Tactical Wargame
- Network Integrated Evaluation (NIE)

**M&S Resource Footprint**
- 50+ personnel committed to model development, wargaming, and analytic tools
- 100+ machines (NIPR, SIPR, MCN-S, BLCSE)
- ~1000 sq ft

**Our biggest M&S shortfall**
- Mission Command
- Cultural Effects

EASE User Workshop: 24-26 Oct 12

### Army Capabilities Integration Center (ARCIC)

**Mission**
The US Army Training and Doctrine Command (TRADOC) Army Capabilities Integration Center (ARCIC) leads the development and integration of force capabilities across the Doctrine, Organization Training, Materiel, Leadership and Education, Development, Personnel and Facilities (DOTMLPF) for the Army within a Joint and Multinational environment to support Joint Force Commanders

**How we use Simulation**
ARCIC uses a distributed HLA federation and stimulates Mission Command systems to represent current and future Army doctrine, concepts, organizations, and materiel equipment in order to answer Army Learning Demands and to inform Army Warfighting Challenges.

**Most commonly used M&S tools**

| | | |
|---|---|---|
| MATREX RTI | OneSAF | CPoF |
| | FireSIM | GCCS-A |
| | ATCOM | FBCB2 |
| | EADSIM | Google Earth |
| | AWSIM | C2PC |

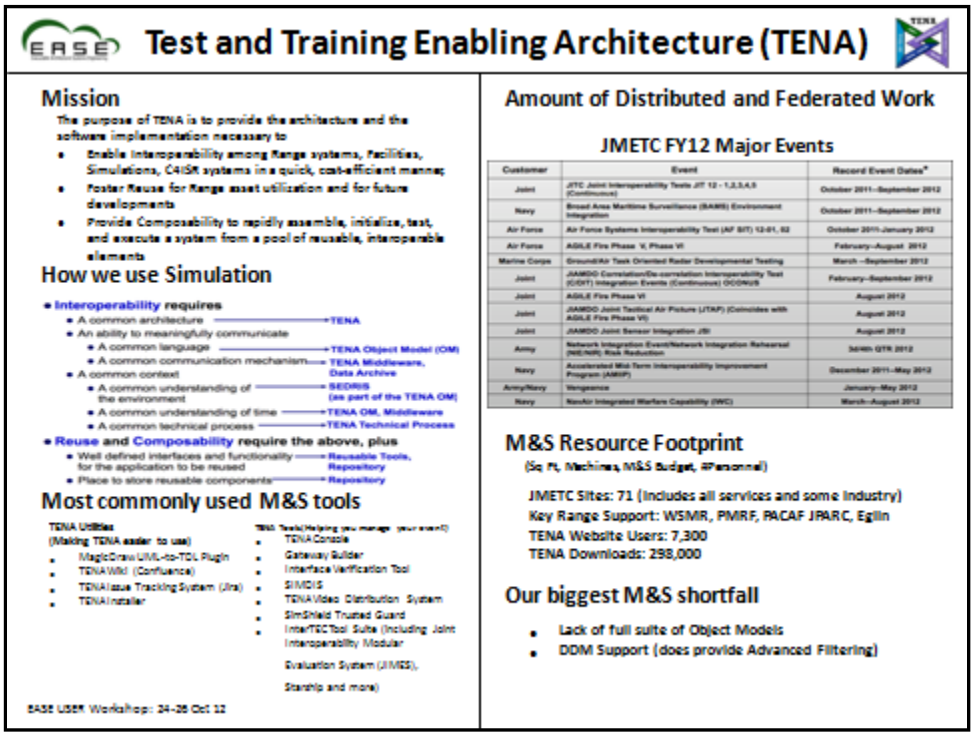
**Amount of Distributed and Federated Work**
Historically, 2-5 distributed Simulation Exercises per calendar Year, with entity counts ranging from 10-40k (Brigade Combat Team to JTF/Corps level operations)

**M&S Resource Footprint**
(Sq Ft, Machines, M&S Budget, #Personnel)
- No set footprints
- Largest scale events include:
  - 10+ distributed sites
  - 300+ personnel (Tech Control, Sim operators, role players, and analysts)
  - 300+ computing platforms (Sim, MC, infrastructure, etc)

**Our biggest M&S shortfall**
- Representing all current and future Warfighting Functions accurately enough (entity level) while addressing higher echelon concepts (Div & JTF)

EASE User Workshop: 24-26 Oct 12

## Appendix A. Stakeholder Feedback



# Test and Training Enabling Architecture (TENA)

### Mission

The purpose of TENA is to provide the architecture and the software implementation necessary to

- Enable interoperability among Range systems, Facilities, Simulations, C4ISR systems in a quick, cost-efficient manner
- Foster Reuse for Range asset utilization and for future developments
- Provide Composability to rapidly assemble, initialize, test, and execute a system from a pool of reusable, interoperable elements

### How we use Simulation

- **Interoperability** requires
  - A common architecture → TENA
  - An ability to meaningfully communicate
    - A common language → TENA Object Model (OM)
    - A common communication mechanism → TENA Middleware, Data Archive
  - A common context
    - A common understanding of the environment → SEDRIS (as part of the TENA OM)
    - A common understanding of time → TENA OM, Middleware
    - A common technical process → TENA Technical Process
- **Reuse** and **Composability** require the above, plus
  - Well defined interfaces and functionality for the application to be reused → Reusable Tools, Repository
  - Place to store reusable components → Repository

### Most commonly used M&S tools

TENA Utilities (Making TENA easier to use)

- MagicDraw UML-to-TDL Plugin
- TENA Wiki (Confluence)
- TENA Issue Tracking System (Jira)
- TENA Installer

TENA Tools (Helping you manage your event)

- TENA Console
- Gateway Builder
- Interface Verification Tool
- SIMDIS
- TENA Video Distribution System
- SimShield Trusted Guard
- InterTEC Tool Suite (including Joint Interoperability Modular Evaluation System (JIMES), Starship and more)

EASE User Workshop: 24-26 Oct 12

### Amount of Distributed and Federated Work

**JMETC FY12 Major Events**

| Customer | Event | Record Event Dates* |
|---|---|---|
| Joint | JITC Joint Interoperability Tests JIT 12 - 1,2,3,4,5 (Continuous) | October 2011--September 2012 |
| Navy | Broad Area Maritime Surveillance (BAMS) Environment Integration | October 2011--September 2012 |
| Air Force | Air Force Systems Interoperability Test (AF SIT) 12-01, 02 | October 2011-January 2012 |
| Air Force | AGILE Fire Phase V, Phase VI | February--August 2012 |
| Marine Corps | Ground/Air Task Oriented Radar Developmental Testing | March --September 2012 |
| Joint | JAMDO Correlation/De-correlation Interoperability Test (C/DIT) Integration Events (Continuous) GCCMUS | February--September 2012 |
| Joint | AGILE Fire Phase VI | August 2012 |
| Joint | JAMDO Joint Tactical Air Picture (JTAP) (Coincides with AGILE Fire Phase VI) | August 2012 |
| Joint | JAMDO Joint Sensor Integration JSI | August 2012 |
| Army | Network Integration Event/Network Integration Rehearsal (NIE/NIR) Risk Reduction | 3d/4th QTR 2012 |
| Navy | Accelerated Mid-Term Interoperability Improvement Program (AMIIP) | December 2011--May 2012 |
| Army/Navy | Vengeance | January--May 2012 |
| Navy | NavAir Integrated Warfare Capability (IWC) | March--August 2012 |

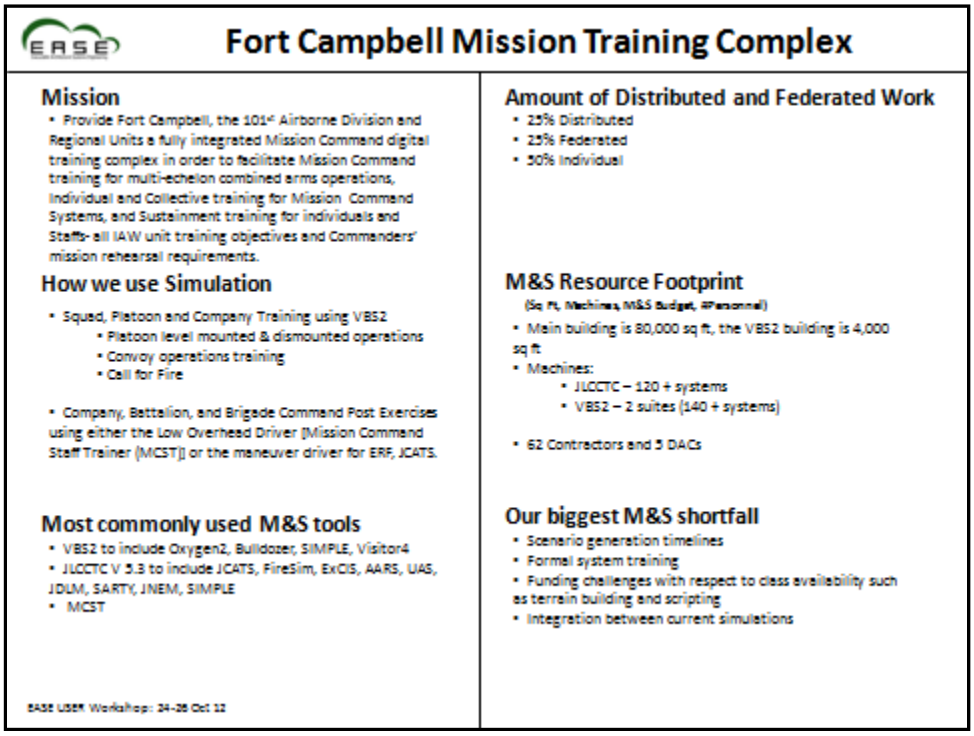
### M&S Resource Footprint

(Sq Ft, Machines, M&S Budget, #Personnel)

JMETC Sites: 71 (Includes all services and some industry)
Key Range Support: WSMR, PMRF, PACAF JPARC, Eglin
TENA Website Users: 7,300
TENA Downloads: 298,000

### Our biggest M&S shortfall

- Lack of full suite of Object Models
- DDM Support (does provide Advanced Filtering)



# Fort Campbell Mission Training Complex

### Mission

- Provide Fort Campbell, the 101st Airborne Division and Regional Units a fully integrated Mission Command digital training complex in order to facilitate Mission Command training for multi-echelon combined arms operations, Individual and Collective training for Mission Command Systems, and Sustainment training for individuals and Staffs- all IAW unit training objectives and Commanders' mission rehearsal requirements.

### How we use Simulation

- Squad, Platoon and Company Training using VBS2
  - Platoon level mounted & dismounted operations
  - Convoy operations training
  - Call for Fire
- Company, Battalion, and Brigade Command Post Exercises using either the Low Overhead Driver (Mission Command Staff Trainer (MCST)) or the maneuver driver for ERF, JCATS.

### Most commonly used M&S tools

- VBS2 to include Oxygen2, Bulldozer, SIMPLE, Visitor4
- JLCCTC V 5.3 to include JCATS, FireSim, ExCIS, AARS, UAS, JDLM, SARTY, JNEM, SIMPLE
- MCST

EASE User Workshop: 24-26 Oct 12

### Amount of Distributed and Federated Work

- 25% Distributed
- 25% Federated
- 50% Individual

### M&S Resource Footprint

(Sq Ft, Machines, M&S Budget, #Personnel)

- Main building is 80,000 sq ft, the VBS2 building is 4,000 sq ft
- Machines:
  - JLCCTC – 120 + systems
  - VBS2 – 2 suites (140 + systems)
- 62 Contractors and 5 DACs

### Our biggest M&S shortfall

- Scenario generation timelines
- Formal system training
- Funding challenges with respect to class availability such as terrain building and scripting
- Integration between current simulations

## Appendix B. EASE Survey


**EASE**

Page 3 of 7

Adminstrative Information

1. How many years of experience do you have using combat simulations?*
   1-3 Years

2. Which best describe your current role as it relates to M&S.*
   Select up to two choices
   - [x] Simulation User
   - [ ] Manager of Simulation Users
   - [ ] Simulation Developer
   - [ ] Simulation Data Provider
   - [ ] Systems Engineer
   - [ ] Scenario Developer
   - [ ] Federation Integrator

3. Please select your organization from the list below:*
   Other

4. If your organization was not listed in item 3 above and you selected "other", please enter it below.

Back Next Cancel


**EASE**



## Organization Simulation Use

Based on your Simulation experience in your current organization....

**5.** How frequently does your organization use simulation?

| | Daily | Weekly | Monthly | A Few times per Year | Once or Twice a Year |
|---|---|---|---|---|---|
| Frequency of Simulation Use | ◉ | ○ | ○ | ○ | ○ |

**6.** How would you classify the importance of combat simulation to the accomplishment of your organization's day to day mission?

| | Not Important | Somewhat Important | Important | Very Important |
|---|---|---|---|---|
| M&S Importance | ◉ | ○ | ○ | ○ |

**7.** What best describes the primary use of M&S for your organization?

- ◉ Mission Planning and Assessment
- ○ Training
- ○ Experimentation
- ○ Research or Tradespace Analysis
- ○ Other, please specify

**8.** What models, simulations, and associated tools does your current organization use?

. .

**9.** What are the biggest limitations of the models, simulations, and associated tools you currently use?

. .

**10.** What is the typical duration of Modeling and Simulation phases for an M&S event?

| | <2 days | 2 Days - 2 Weeks | 2 - 6 Weeks | >6 Weeks |
|---|---|---|---|---|
| Systems Engineering | ◉ | ○ | ○ | ○ |
| Development | ○ | ◉ | ○ | ○ |
| Data Engineering | ○ | ○ | ○ | ○ |
| Testing | ○ | ○ | ◉ | ○ |
| Execution | ○ | ○ | ○ | ◉ |
| Analysis | ○ | ○ | ○ | ◉ |

**11.** Has your organization ever used a distributed simulation approach?

○ Yes
◉ No

**12.** How frequently does your organization use DISTRIBUTED simulation?

| | Daily | Weekly | Monthly | A Few times per Year | Never |
|---|---|---|---|---|---|
| Frequency of Distributed Simulation Use | ◉ | ○ | ○ | ○ | ○ |

**13.** What is the typical Classification level at which your organization conducts M&S work?

| | Unclassified | FOUO | Secret | Above Secret Level |
|---|---|---|---|---|
| Classification | ◉ | ○ | ○ | ○ |

**14.** How Important is Verification, Validation, & Accreditation with respect to your organization's use of M&S?

| | Not Important | Somewhat Important | Important | Show Stopper |
|---|---|---|---|---|
| VV&A Importance | ○ | ○ | ◉ | ○ |

**15.** What percentage of the models, simulations, and associated tools you currently use are Verified, Validated, & Accredited?

○ 0-25 Percent ○ 25-50 Percent ◉ 50-75 Percent ○ 75-100 Percent

**16.** From your perspective, rank order the importance of the following criteria with respect to a combat simulation package (1 being least important,7 being most important):

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Low barrier to use for varying M&S skill levels | ◉ | ○ | ○ | ○ | ○ | ○ | ○ |
| Ability to Access and Run from anywhere | ◉ | ○ | ○ | ○ | ○ | ○ | ○ |
| Integrates with other commonly used M&S Packages or Scripts | ◉ | ○ | ○ | ○ | ○ | ○ | ○ |
| Powerful and customizeable output graphics and statistics | ○ | ◉ | ○ | ○ | ○ | ○ | ○ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Front end DOE capability to plan and customize experiments | ○ | ◉ | ○ | ○ | ○ | ○ | ○ |
| Ability to add and modify scenarios | ○ | ◉ | ○ | ○ | ○ | ○ | ○ |
| Ability to interface with and draw from authoritative data sources | ○ | ◉ | ○ | ○ | ○ | ○ | ○ |

**17.** From your organization's perspective, select the TWO most important considerations in selecting a most appropriate combat simulation program.
Please select 2 choices

- [x] Low barrier to use for varying M&S skill levels
- [x] Ability to Access and Run from anywhere
- [ ] Integrates with other commonly used M&S Packages or Scripts
- [ ] Powerful and customizeable output graphics and statistics
- [ ] Front end DOE capability to plan and customize experiments
- [ ] Ability to add and modify scenarios
- [ ] Ability to interface with and draw from authoritative data sources

**18.** What M&S PRE-processing tools do you commonly use?

- -

**19.** What M&S POST-processing tools do you commonly use?

- -

**20.** How many simulation engineers are involved in your typical simulation event?

| | 1 | 2-5 | 6-19 | 20+ |
|---|---|---|---|---|
| Number of Engineers | ○ | ◉ | ○ | ○ |

**21.** How often are your models, simulations, and associated tools CHANGED (including data, configuration, design, or algorithms)?

| | Daily | Weekly | Monthly | A Few times per Year | Once or Twice a Year |
|---|---|---|---|---|---|
| Simulation Changes | ○ | ◉ | ○ | ○ | ○ |

**22.** How often do you develop NEW SCENARIOS for your simulations?

| | Daily | Weekly | Monthly | A Few times per Year | Once or Twice a Year |
|---|---|---|---|---|---|
| New Scenario Development | ◉ | ○ | ○ | ○ | ○ |

**23.** How many people are typically involved in creating new scenarios?

| 1 | 2-3 | 4-5 | More than 5 |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Scenario Development | ◉ | ○ | ○ | ○ |

**24.** What standard/format is used to digitally save your scenarios (include version if known)?

. .

**25.** Are humans required to interact with your typical simulation during its run for pucking, monitoring, etc?

- ○ Yes
- ◉ No

**26.** What percentage of your organization's modeling and simulation tools require human in the loop interaction?

○ 0 ◉ <25% ○ 25 -75% ○ 75 - 99% ○ 100%

**27.** How much time is does it typically take to INITIALIZE a simulation once it has been developed for use (assumes data already loaded)?

| | <10 Minutes | 10-30 Minutes | 30-60 Minutes | 1 or More Hours |
|---|---|---|---|---|
| Simulation Initialization | ◉ | ○ | ○ | ○ |

**28.** How much time is does it typically take to CONFIGURE a simulation once it has been developed for use (assumes data already loaded)?

| | <10 Minutes | 10-30 Minutes | 30-60 Minutes | 1 or More Hours |
|---|---|---|---|---|
| Simulation Configuration | ◉ | ○ | ○ | ○ |

**29.** How are your Simulations executed?

- ○ Single Machine
- ◉ Local Area Network (LAN)
- ○ Wide Area Network (WAN)
- ○ Other, please specify

Back Next Cancel




## EASE Feedback

**30.** How would EASE meet some of your organization's M&S needs?

**31.** From your perspective, incorporation of what features or functionality into EASE would increase your likelihood of use?

**32.** What specific M&S representations (i.e. CBRN, Cyber, etc.) would your organization like to see incorporated into EASE?

**33.** Are you aware of any other organization or agency working on an effort similar to EASE?

- Yes
- No
- If Yes, Who or What Project?

**34.** EASE can incorporate the use of surrogates in a simulation. Surrogates are plug and play modules that replicate essential model components that are currently not available. How could you use the surrogate functionality?

**35.** Would you need a new Certificate of Networthiness to run something like EASE?

Yes
No

**36.** After EASE is fully developed, who do you think is the most appropriate organization to "own" and maintain it.

Back Next Cancel


**EASE**



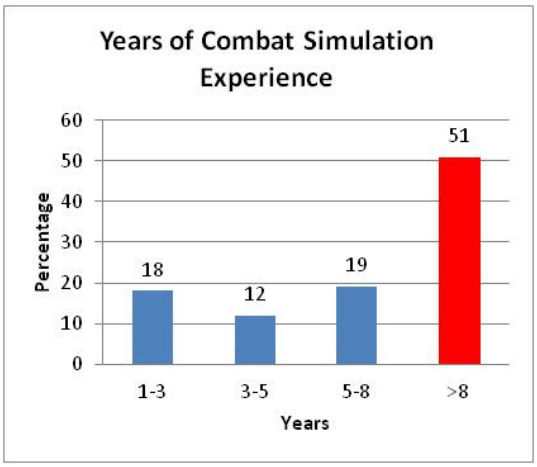
**Last chance...**

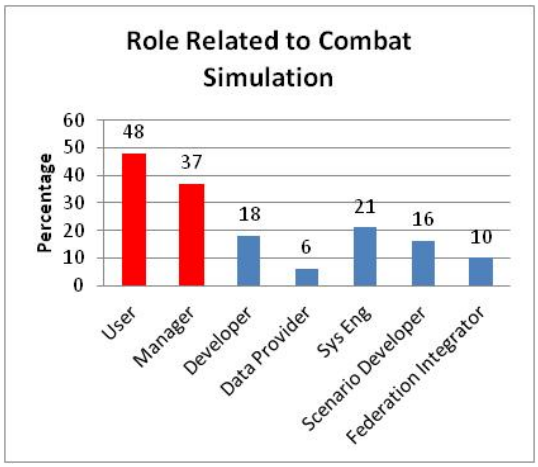
**37.** If you would like to make any comments on the topics of this survey or any other M&S topic of interest to you and/or your organization that were not addressed in this survey, please type them in the space below.

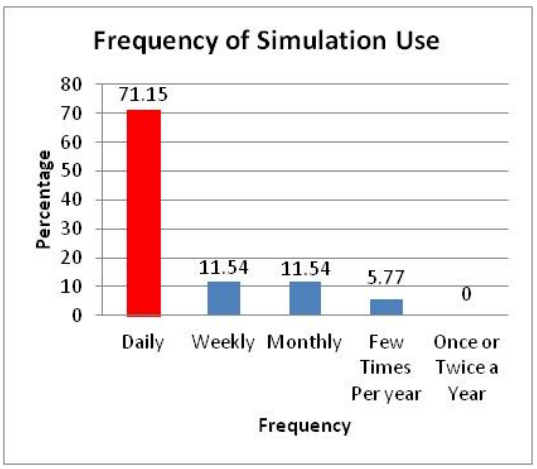
For further information about this project:
Gene Lesinski
Operations Research Center
Department of Systems Engineering
United States Military Academy
ATTN: ORCEN
Building 752 Mahan Hall Room 4th Floor
West Point, NY 10996
TELEPHONE: Commercial (845) 938-5897 DSN 688-5897 EMAIL: Eugene.Lesinski@usma.edu

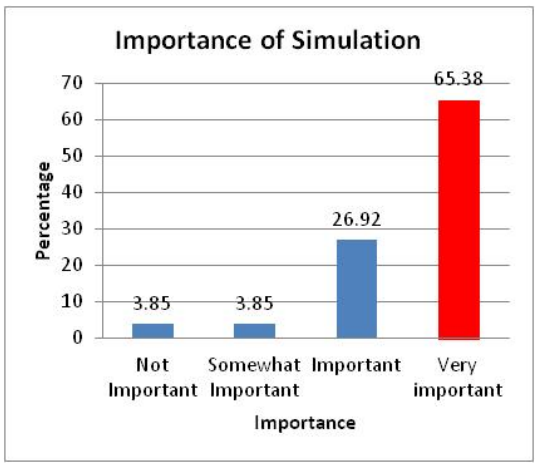
Back Done Cancel

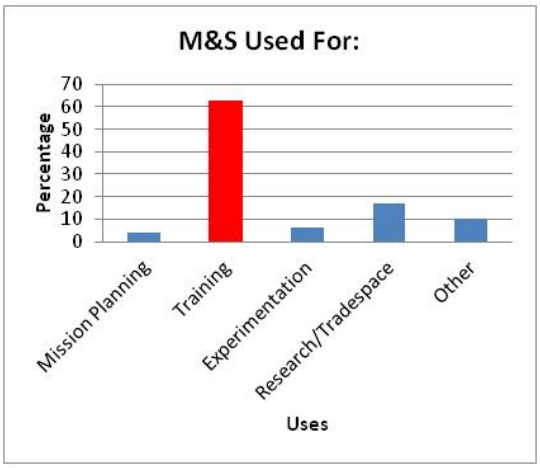
## Appendix C. EASE Survey Results

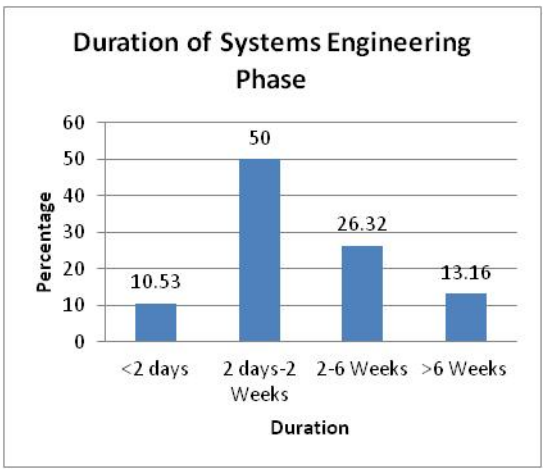


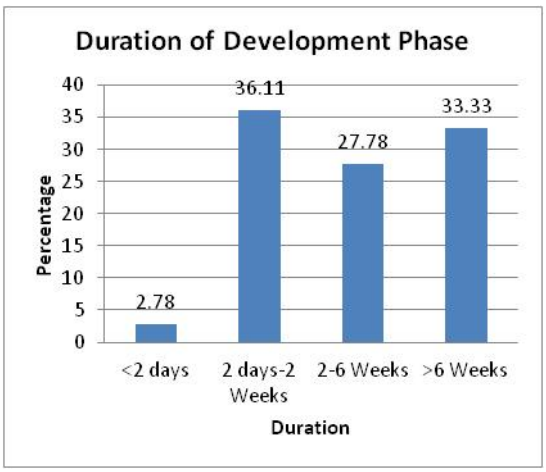



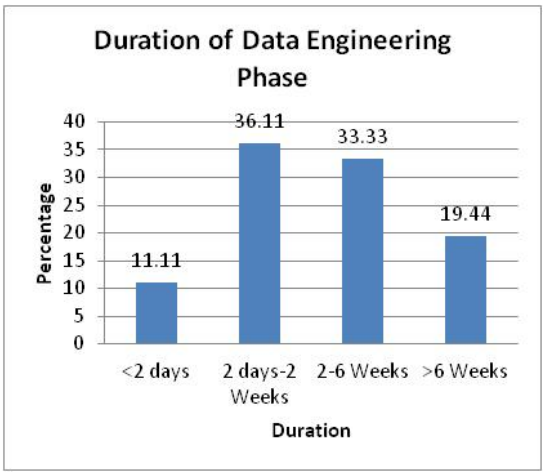



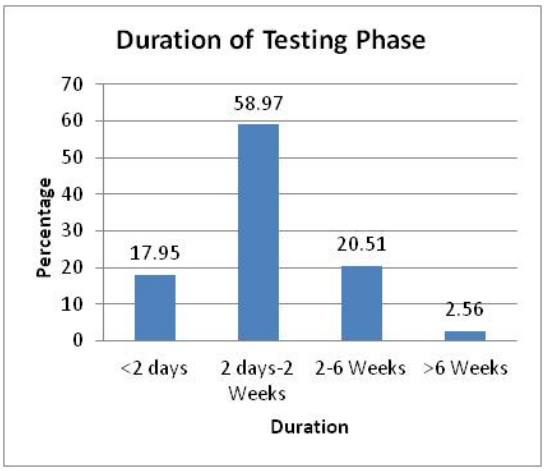



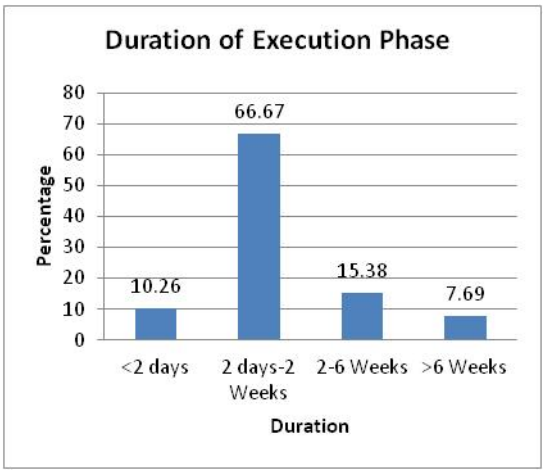



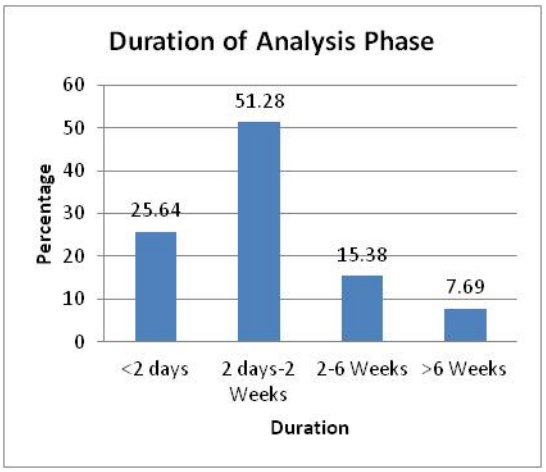

Duration of Systems Engineering Phase
Percentage
60
50
40
30
20
10
0
10.53
50
26.32
13.16
<2 days
2 days-2 Weeks
2-6 Weeks
>6 Weeks
Duration

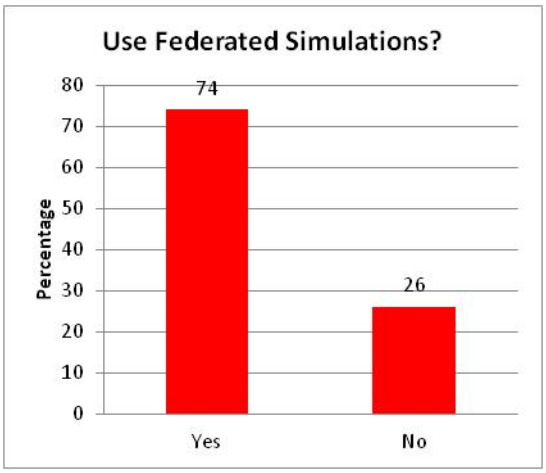

Duration of Development Phase
Percentage
40
35
30
25
20
15
10
5
0
2.78
36.11
27.78
33.33
<2 days
2 days-2 Weeks
2-6 Weeks
>6 Weeks
Duration

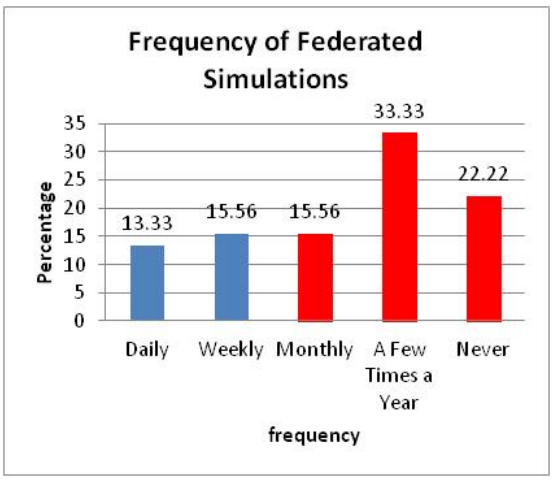

Duration of Data Engineering Phase
Percentage
40
35
30
25
20
15
10
5
0
11.11
36.11
33.33
19.44
<2 days
2 days-2 Weeks
2-6 Weeks
>6 Weeks
Duration

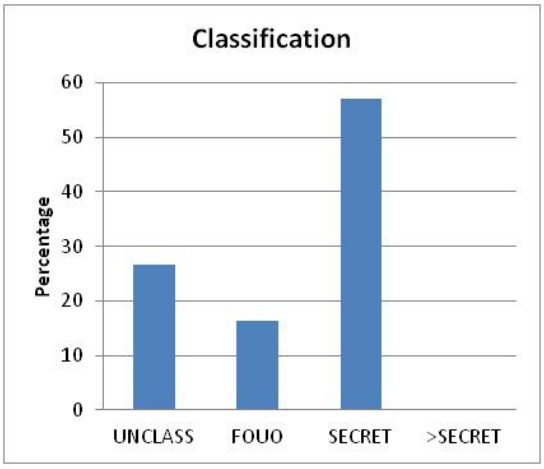

Duration of Testing Phase
Percentage
70
60
50
40
30
20
10
0
17.95
58.97
20.51
2.56
<2 days
2 days-2 Weeks
2-6 Weeks
>6 Weeks
Duration

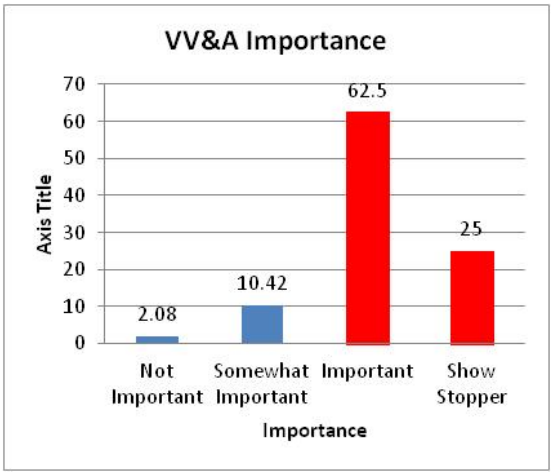

Duration of Execution Phase
Percentage
80
70
60
50
40
30
20
10
0
10.26
66.67
15.38
7.69
<2 days
2 days-2 Weeks
2-6 Weeks
>6 Weeks
Duration

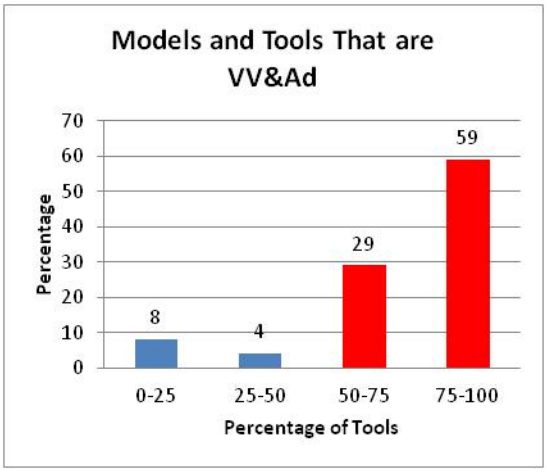

Duration of Analysis Phase
Percentage
60
50
40
30
20
10
0
25.64
51.28
15.38
7.69
<2 days
2 days-2 Weeks
2-6 Weeks
>6 Weeks
Duration

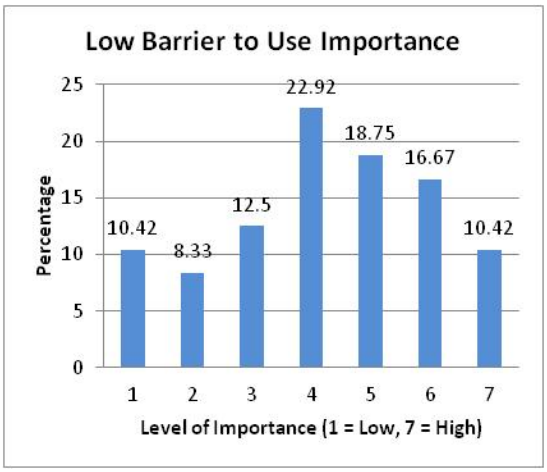

Use Federated Simulations?
Percentage
80
70
60
50
40
30
20
10
0
74
26
Yes
No

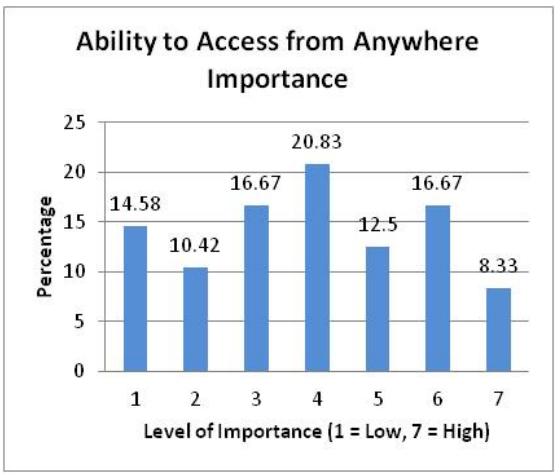

Frequency of Federated Simulations
Percentage
35
30
25
20
15
10
5
0
13.33
15.56
15.56
33.33
22.22
Daily
Weekly
Monthly
A Few Times a Year
Never
frequency

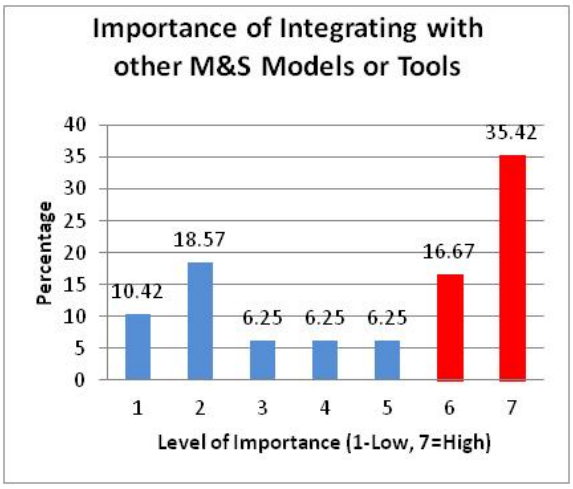

Classification
Percentage
60
50
40
30
20
10
0
UNCLASS
FOUO
SECRET
>SECRET

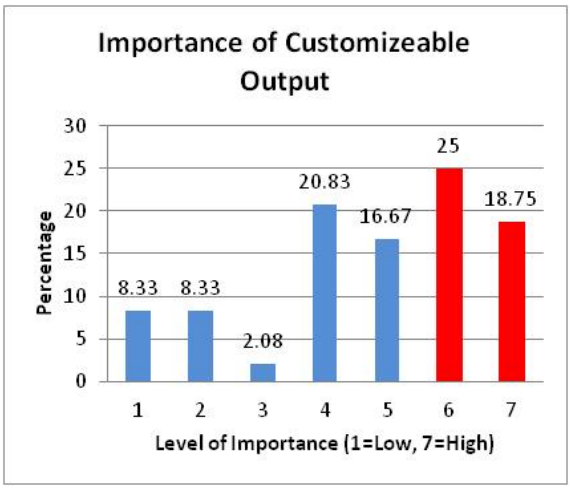

VV&A Importance
Axis Title
70
60
50
40
30
20
10
0
2.08
10.42
62.5
25
Not Important
Somewhat Important
Important
Show Stopper
Importance

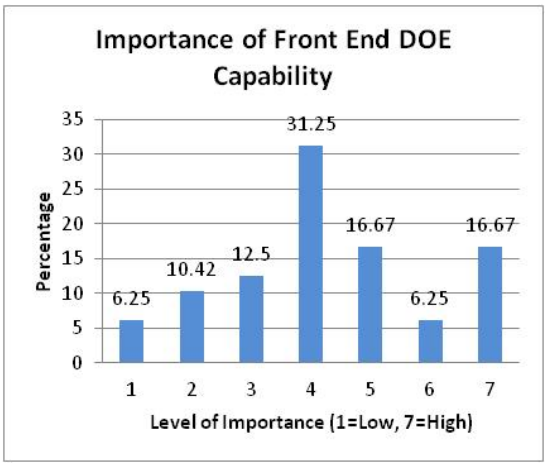

Models and Tools That are VV&Ad
Percentage
70
60
50
40
30
20
10
0
8
4
29
59
0-25
25-50
50-75
75-100
Percentage of Tools

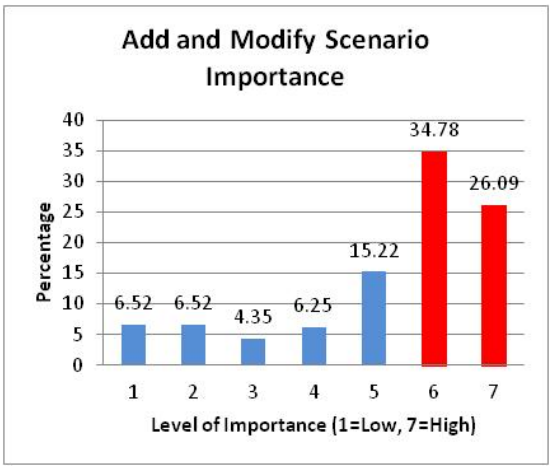

Low Barrier to Use Importance
Percentage
25
20
15
10
5
0
10.42
8.33
12.5
22.92
18.75
16.67
10.42
1
2
3
4
5
6
7
Level of Importance (1 = Low, 7 = High)

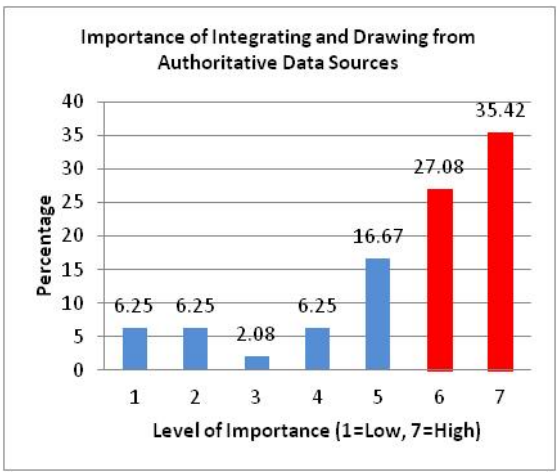

Ability to Access from Anywhere Importance
Percentage
25
20
15
10
5
0
14.58
10.42
16.67
20.83
12.5
16.67
8.33
1
2
3
4
5
6
7
Level of Importance (1 = Low, 7 = High)

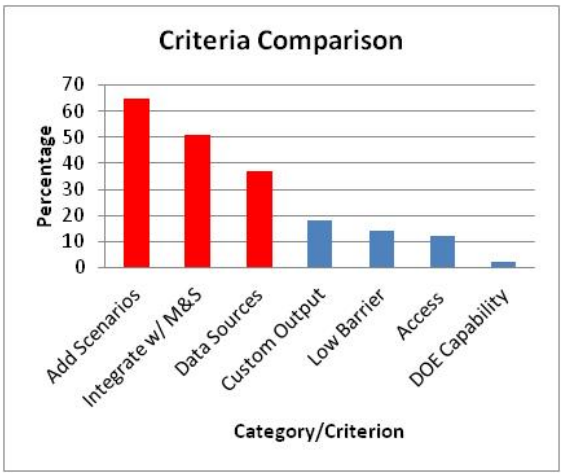

Importance of Integrating with other M&S Models or Tools
Percentage
40
35
30
25
20
15
10
5
0
10.42
18.57
6.25
6.25
6.25
16.67
35.42
1
2
3
4
5
6
7
Level of Importance (1-Low, 7=High)

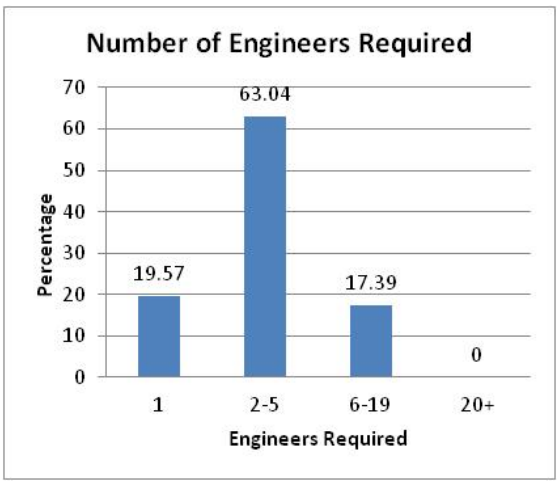

Importance of Customizeable Output
Percentage
30
25
20
15
10
5
0
8.33
8.33
2.08
20.83
16.67
25
18.75
1
2
3
4
5
6
7
Level of Importance (1=Low, 7=High)

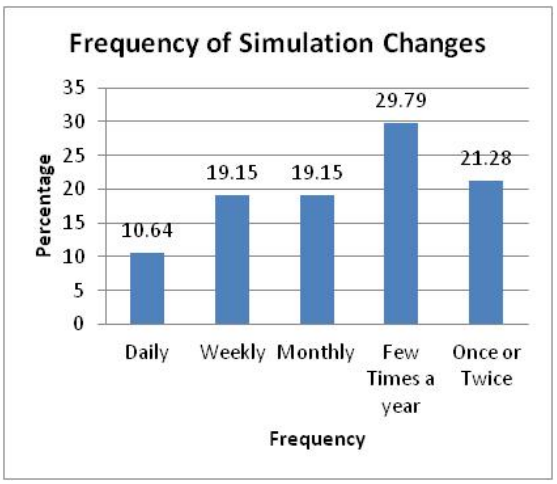

Importance of Front End DOE Capability
Percentage
35
30
25
20
15
10
5
0
6.25
10.42
12.5
31.25
16.67
6.25
16.67
1
2
3
4
5
6
7
Level of Importance (1=Low, 7=High)

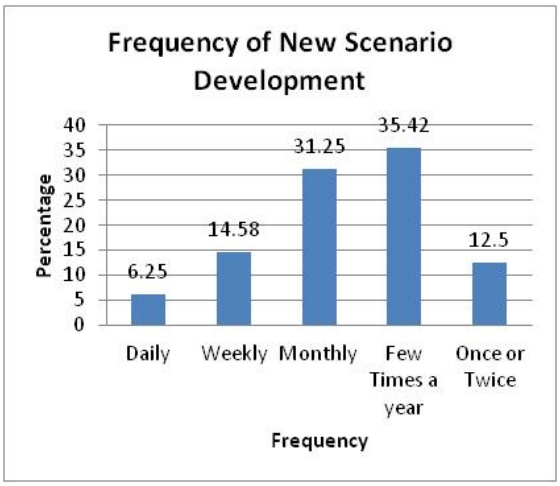

Add and Modify Scenario Importance
Percentage
40
35
30
25
20
15
10
5
0
6.52
6.52
4.35
6.25
15.22
34.78
26.09
1
2
3
4
5
6
7
Level of Importance (1=Low, 7=High)

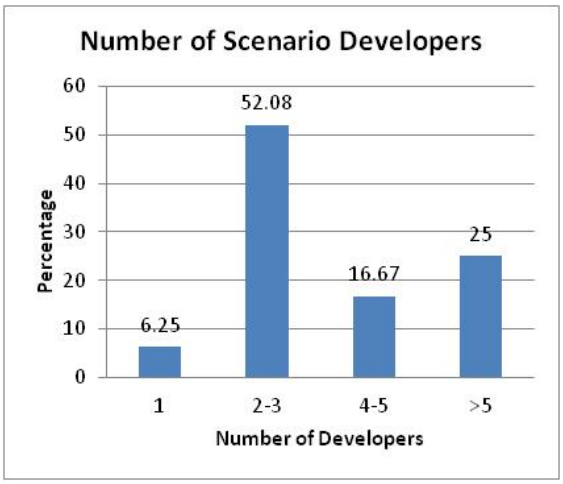

Importance of Integrating and Drawing from Authoritative Data Sources
Percentage
40
35
30
25
20
15
10
5
0
6.25
6.25
2.08
6.25
16.67
27.08
35.42
1
2
3
4
5
6
7
Level of Importance (1=Low, 7=High)

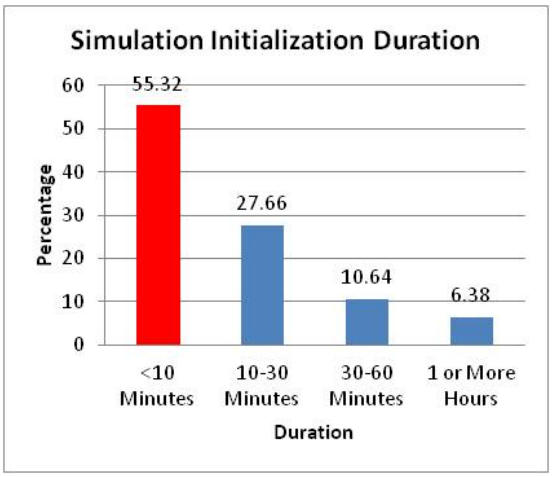

Criteria Comparison
Percentage
70
60
50
40
30
20
10
0
Add Scenarios
Integrate w/ M&S
Data Sources
Custom Output
Low Barrier
Access
DOE Capability
Category/Criterion

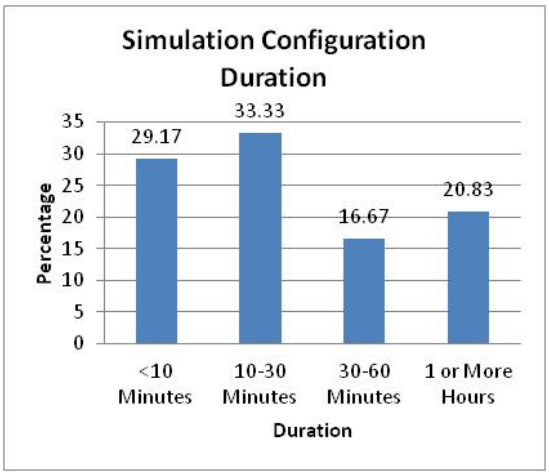

Number of Engineers Required
Percentage
70
60
50
40
30
20
10
0
19.57
63.04
17.39
0
1
2-5
6-19
20+
Engineers Required

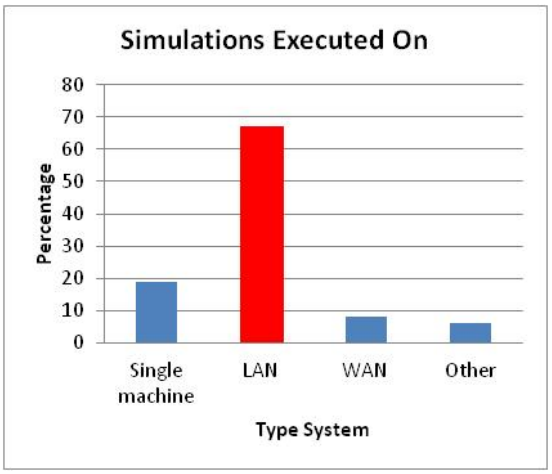

Frequency of Simulation Changes
Percentage
35
30
25
20
15
10
5
0
10.64
19.15
19.15
29.79
21.28
Daily
Weekly
Monthly
Few Times a year
Once or Twice
Frequency


Frequency of New Scenario Development
Percentage
40
35
30
25
20
15
10
5
0
6.25
14.58
31.25
35.42
12.5
Daily
Weekly
Monthly
Few Times a year
Once or Twice
Frequency

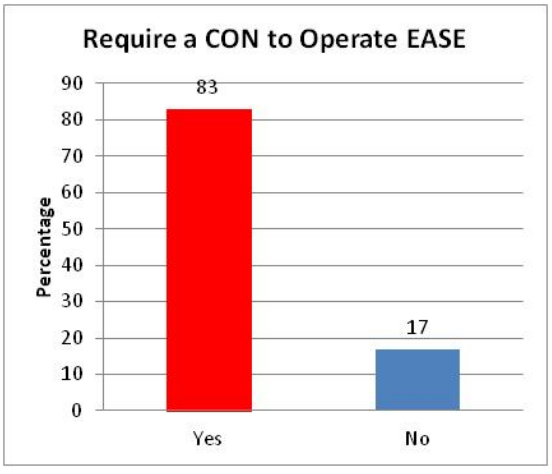

Number of Scenario Developers
Percentage
60
50
40
30
20
10
0
6.25
52.08
16.67
25
1
2-3
4-5
>5
Number of Developers


Simulation Initialization Duration
Percentage
60
50
40
30
20
10
0
55.32
27.66
10.64
6.38
<10 Minutes
10-30 Minutes
30-60 Minutes
1 or More Hours
Duration


Simulation Configuration Duration
Percentage
35
30
25
20
15
10
5
0
29.17
33.33
16.67
20.83
<10 Minutes
10-30 Minutes
30-60 Minutes
1 or More Hours
Duration


Simulations Executed On
Percentage
80
70
60
50
40
30
20
10
0
Single machine
LAN
WAN
Other
Type System


Aware of Others With EASE-Like Product
Percentage
120
100
80
60
40
20
0
3
97
Yes
No


Require a CON to Operate EASE
Percentage
90
80
70
60
50
40
30
20
10
0
83
17
Yes
No

| Sims, Models,Tools | Freq |
|---|---|
| JCATS | 23 |
| VBS2 | 19 |
| OneSAF | 12 |
| Combat XXI | 9 |
| ERF | 8 |
| FIRESIM | 7 |
| JDLM | 7 |
| LOD | 6 |
| AWARS | 6 |
| CPOF | 5 |
| TIGR | 4 |
| SIMPLE | 4 |
| MRF | 3 |
| UAS | 3 |
| JCR | 3 |
| WARSIM | 2 |
| IWARS | 1 |
| NV Toolkit | 1 |
| JBUS | 1 |
| BCMS | 1 |
| HELIX | 1 |
| URBANSIM | 1 |
| JSAF | 1 |
| JIMM | 1 |
| CoIST | 1 |

| What apears to be useful about EASE |
|---|
| Easy to configure Federates that are Correlated |
| Low overhead driver to stimulate Army mission Command Systems |
| Interact with Army Mission Command Systems |
| Increase Output data from other M&S |
| Identify outdated simulations which could be replaced |
| Interoperability between M&S systems |
| Use as a screening tool for more high resolution tools |

| Desired Additional Capabilities | |
|---|---|
| CBRN | 4 |
| Cyber | 3 |
| C2 | 2 |
| Intel | 2 |
| Direct and indirect fire | 2 |
| IEDs | 1 |
| Sensors | 1 |
| UAS | 1 |
| Non-Lethal | 1 |

| What Would Increase Chances of Using EASE |
|---|
| Easy to use information exchange and data mapping |
| Interoperability with Army MCS |
| Ability to customize/change scenarios |
| Ability to integrate with other M&S |
| Provide AAR info |
| Produces accurate data |
| Ease of use |
| Auto configuration and launching |
| Native support for TENA |
| Adjust rapidly to new code, behaviors, and data |

| Pre-processing |
|---|
| Order Of Battle Serves (OBS)JLCCTC Validational Tools |
| Joint Training Data Services |
| JTDS, Joint Remote Client |
| APE: AWARS Pre-processing Environment |
| IPR, MSEL Sync meeting, datbase creation, RTOC setup |
| LOD |
| Polaris |
| AMSAA Joint Data Center (JDC) |
| SAF |
| SIMPLE |
| COMBATXXI Preprocessor (AKA Scenario Integration Tool Suite) |
| AWARS uses two preprocessors: Ape and FSMP. |
| SQL, Excel |
| Electronic Data Request System (eDRS) |
| ArcGIS, TerraSim TerraTools |
| Open Office, data tools include MS Access and MS Excel |

| Post-processing |
|---|
| After Action Review System (AARS) that is part of JLCCTC ERF |
| AWARS Post-processor, SAS |
| AAR'S, ICE FORMS |
| LOD |
| GUI standard output packages |
| NSITE |
| In-house-developed data reduction software |
| Microsoft Excel, Microsoft Word, Microsoft SQL Server |
| Custom SQL Server-based post processor, Excel. |
| SAF/AAR |
| PASW (AKA Clementine), Excel, and SQL. |
| SQL Data base and Excel. |

| Scenario Formats |
|---|
| Save scenarios in each federate (VBS2, OneSAF, etc...) |
| OBS V2.0 |
| MS Powerpoint/Word, Adobe Reader, C2PC (Command and Control Personal Computer) |
| CD |
| Disks, Sharepoint, |
| VBS2 Format |
| OneSAF - XML (BZIP'd) |
| SAF |
| JCATSVBS2 |
| RTF files or xml |
| XML |
| XML and odb (open office database). |
| Word and PowerPoint. |

## Appendix D. Workshop Biggest M&S Shortfalls

| Organization | Mission | Biggest M&S Shortfalls |
|---|---|---|
| Ft. Hood Mission Command Training Center | Support unit training objectives using the Army's Mission Command Systems | Maintaining relevancy with the training unit requirements. Changes in MCS. Scenarios (terrain, equipment). |
| Ft. Benning Maneuver Battle Lab | Recommend DOTMLPF solutions based on LVCAR&G experiments | Inability to provide an integrated, comprehensive Common Operating Picture (COP) to all Joint Mission Command Systems in the current Simulation Architecture. Applies to Air and Missile Defense Workstation (AMDWS), Forward Area Air Defense – Engagement |
| USMA Department of Systems Engineering | Educate West Point cadets | Technical knowledge and talent availability / reliance on small staff. |
| Ft. Stewart Mission Training Complex | Training and facility support to units in LVC simulation exercises at all levels | M&S Terrain availability to match terrain used in Mission Command systems. Interoperability across all M&S systems. |
| Ft. Leavenworth TRADOC Analysis Center (TRAC) | Operations analysis to inform decisions across the spectral (conepts to operations) | Mission Command and Cultural Effects |
| Army Capabilities Integration Center (ARCIC) | Development and integration of force capabilities across the DOTMLPF | Representing all current and future Warfighting Functions accurately enough (entity level) while addressing higher echelon concepts (Div & JTF) |
| Test and Training Enabling Architecture | Architecture and software necessary to enable testing and training on ranges | Lack of full suite of object models. DDM support. |
| Ft. Campbell Mission Training Complex | Mission Command digital training for multi-echelon combined arms operations | Scenario generation timelines. Formal system training. Funding challenges with respect to class availability such as terrain building and scripting. Integration between current simulations |
| Army Materiel Systems Analysis Activity (AMSAA) | Conduct analyses across Materiel Life Cycle informing Army decisions | Maintaining supporting infrastructure for a broad array of specific systems' operating requirements, data storage and retrieval, and search engine to enable study development and M&S tool upgrades |
| USAOTC Test Technology Directorate (TTD) | Support for test directorates in execution of operational test in joint environments | Nonfunctional analysis (e.g., performance, scalability) of M&S system of systems in relation to system under test. |

**Page Intentionally Blank**

## Appendix E. EASE Workshop Feedback Comments

### EASE Positives:

Capture interoperability requirements between simulations/tools
Captures technical knowledge
Maintains repository of M&S (local and central)
Simplify the process of configuring and running applications like Combat XXI (currently takes several hundred lines of code)
Administrative side: Central management tool to launch multiple apps from a central point - will help administrators' jobs like turning on boxes managing OS updates, configurations, etc.
Stair-step approach at training facility to test/retest not possible because tech staff gone so having EASE capture test results for rerunning the test (regression testing) - repeatability to tests
- testing errors based on modifications
Butler: See potential but still need to look at a lot of things for ARCIC environment
Dison: If it could identify capability gaps within current model, find other models in environment, bring other application in to fill gap. Zinser: Only applicable if system at DoD level.
Saluto: At DoD level, it could find redundancies to and remove them.
Butler: How does EASE interview know which model is correct per use. (How to distinguish between OneSAF and JSAF - both entity models, but what are the important differences to show to the user)
Bayer: Need filtering to distinguish between capabilities. Should allow for political drivers - "You will use OneSAF"
Dison: With every study requirement, they do workshops with users "measurement space workshop" to work out issues they're trying to analyze, alternatives of models, scenarios, etc. Be nice if EASE could help with the measurement space paring down. EASE could help with the process - right now the process is BOGSAT and Microsoft Office products. (low priority)
Wood: Building simulations around capabilities rather than applications is a positive. Also, the architecture capture aspect of the SDD
Excitement about virtual machine usage/management.

### EASE Negatives:

Bayer: Single point of failure if something happens to the server. Answer: Automatic backups - distributed configuration repository...could be off-site backup. Enterprise investment in the technology through the rapid changes in the industry. DISA / DIACAP / CON / ATOs approval will drive this in future.
Bayer: Not certain that entity mapping will translate in the interoperability. Platform enumerations translation between systems verification.
Butler: Terrain correlation between simulations.
Bayer: What about gateway mappings making this more cumbersome?
Saluto: Time and effort to initially get currently used systems/tools into the left-side of EASE (SDD, test cases, etc.)
Zinser: Nobody except for the systems developer could fill in the SDD details. Both knowledge and time/capacity.
Bolton: They get systems as black boxes (even as disk images instead of DVDs) that they don't really understand the details of how they work - can't start putting details into SDD.
Zinser: What if an Army regulation for M&S developers were to provide all the systems engineering details in their development schedule - they're required to get the details in a format that EASE could take advantage of
Saluto: Linked VBS2 and LaserShot - difficult even with developers available, but this is a one-off. Tough to find the right middle ground between getting too much detail and too little detail

Bolton: Already have working system, don't need EASE to help. It is what it is and they have the necessary support already
Bayer: Current EASE deployment mechanism won't support deploying to specific IP addresses - current hardware setup (show-stopper so should be high priority)
Saluto: Configuration management help? Answer: EASE certainly helps with capturing systems as parts rather than CD black boxes
Dison: Aside from up-front work, trust that this will be the long-term solution because TRAC is a one-stop-shop so to relinquish control to EASE and then something happens like breaking, lack of funding/support, etc. then the negative would be a severe impact. Would be nice if DoD-backed / mandated projects. (organizational risk of drastically changing process and technical solutions).
Saluto: If I were PM ConSim, push for business practices - implement ourselves for others to take advantage of - since PM ConSim institutionalizing EASE, confidence is higher that the system 1) works and 2) will be around for awhile.
Bayer: A lot of free-form in the SDD (english text) and not strict. Software system should have a requirement to meet a certain depth requirement of data - should have controlling body / accountability / quality control for SDD data entry.

Need to address multiple object models in the SDD (same version)

**EASE Improvement / Extension Ideas:**

Zinser: Parametric data linking - fair fight issues - systems engineering tool to determine Ph/PK table good enough (medium)
Zinser: Enumeration comparison / mapping capability (high priority) [JG: We could help with the mapping output file a la pub/sub matrix for visual comparison]
Bolton: Could sell EASE better if it could leverage network in place compared to hub-spoke concept. How to manage business model / politics of linking across larger organization (low)
Carr: Information not very good coming out of OneSAF artifacts. How could EASE allow for better definition of output metrics / analysis aids (what data / views to grab) - customizable output for study. (low)
Sipp: Tie in global URN / task organization (force builder) for entity building for easy scenario. Specific icons on display, not generic tanks. (medium priority)
Saluto: Chris Black under SIMCI - UT. C3T tried to do something with ASIS products to have LDIF data into simulation (JCATS) - correct LDIF to show up on the COP display. Not an EASE target...database target that many have tried to resolve - so far not there.
Bayer: Should be aligned with scenario development products. Force builder to generate LDIF specific to an organization (Paul Monday willing to look into this) (medium)
Dison: Use case would be for a study / scenario using large scale model like Combat XXI, zooming into smaller area for urban environment - dynamically change model representations for dynamic resolution changes via switching models. Other models integrated in to look at cultural affects, etc....results into aligned data afterwards. (high priority)
Saluto: Tried by several - but never knocked true interoperability issues
Link to WebMSDE (medium priority because nobody uses MSDE even in future they'll use different tools)
SDDs for common tool - pick some common items like JCATS, RPR, etc. maybe by picking a domain and starting there. (high priority)
Bayer: Combine getting other apps and representing their details in the SDD
Saluto: Do SDD for OneSAF and WarSim and go show ConSim. Other organizations and their respective models also. Show other organizations value from previously done domains. Would need to do this as a federation and/or view something like OneSAF as a tool – SDD adjustments. Need to get high-level buy-in, not in a lab without much influence on the community. This needs to be considered when STTC decides where to deploy an initial case of EASE.

## Appendix F. Manager Interview Questions

Before Describing EASE Stakeholder Questions

- Organization
  - What is your organization's mission?
  - How does M&S support the mission?
  - How frequently do you use M&S?
  - How long is each M&S event including the entire lifecycle? (1 day, week, month, etc.)
  - What are the biggest limitations of the tools that you currently use?
- Execution
  - Have you ever used a federated simulation and if so, how often?
  - If you were going to compare two simulation models what criteria would you use?
  - What are your V&V requirements?
  - What classification level(s) do you execute at?

After Describing EASE Stakeholder Questions

- How could you use a tool like this?
- What is missing and required for you to use EASE?
- What interface would be required to facilitate your use of simulation?
- Are you aware of anyone doing something similar?
- What functionality sounds most useful?
- Would you use the surrogate functionality
- Will you need a new CON to use and how hard will it be to get one?
- Once developed, who should own it?
- Technical (as applicable and interest high enough)
  - Describe the life cycle of an M&S execution. How long does each phase typically last? (i.e. 4 weeks systems engineering, 12 weeks development, 10 weeks data engineering, 2 weeks testing, 1 week execution)
  - How many engineers are involved?
  - How often are models changed (including data, configuration, design or algorithms)?
  - Describe your pre-processing and post-processing tools and processes
  - How are scenarios developed and captured/represented?
  - Describe the system initialization / startup process
  - Are humans required to interact with the M&S for training, pucking, monitoring, etc.?
  - Is specialized hardware-in-the-loop required?
  - For distributed simulation, what protocols are used?
  - Do you execute locally or over a Wide Area Network?

**Page Intentionally Blank**

# Appendix G Findings, Conclusions, and Recommendations

## Scenarios

| Finding | Conclusion | Recommendation |
|---|---|---|
| Ability to modify or develop a new scenario identified as the most important characteristic by survey respondents and workshop participants | | |
| Scenarios are created and saved in a variety of formats to include: OBS V2.0, MS, Powerpoint/Word, Adobe Reader, C2PC (Command and Control Personal Computer), OneSAF - XML (BZIP'd), and others | Need exists to increase speed and ease of scenario changes and development in a standard format | EASE enhancements include rapid scenario modification and development capability |
| Scenarios are typically changed monthly or a few times per year | | |
| Typically takes 2-3 scenario developers and in some cases more than 5 | Scenario modifications are currently time and resource intensive | |
| 25% of organizations noted that they require more than 5 scenario developers to generate a new scenario. | | |
| Typically takes several weeks to develop a new scenario | | |

## Data

| Findings | Conclusions | Recommendations |
|---|---|---|
| Requested data often takes months to be delivered. | | |
| A lot of time and resources are devoted to validating input data | Authoritative input data is difficult and time consuming to obtain | EASE enhancements include the capability to integrate and draw from authoritative data sources |
| The ability to integrate and draw from authoritative data sources was highlighted as a top 3 characteristic | | |
| There are often issues of data compatability between models and tools | | |
| There is a diverse array of in-house scripts and tools used to process data prior to and after simulation execution | | |
| Battle labs report a lack of data and scenarios that highlight differences between alternatives. | | |
| Terrain data is not available for particular geographic regions for all models | Terrain data availability and compatability are an issue | Increase the EASE terrain availability in the line-up |
| Terrain data is does not correlate or is not compatable from model to model | | |

# Hardware & Software Footprint

| Findings | Conclusions | Recommendations |
|---|---|---|
| Each combat simulation lab or analysis center maintains computers, servers, and specialized equipment to support M&S for experimentation, training, and analysis. | | |
| 76% of survey respondents stated that they execute on a single machine or LAN with 67% operiating on the LAN | | |
| FT Stewart MTC maintains a 53K sq ft facility and 35 servers. | There is tremendous redundancy in hardware and software across the M&S Enterprise | A cloud –based solution with virtual machines has the potential to provide substantial cost savings across the M&S Enterprise. |
| The maneuver battle lab at FT Benning maintains a 120,000 Sq. Ft. Constructive/Virtual/Gaming Simulation Facility with 450 desktop computers and 50 servers. | | |
| ARCIC has no standard footprint but their largest exercise requires 300+ computing platforms (Sim, MC, infrastructure, etc) | | |
| Similar hardware and software is replicated at every lab, MTC, or analysis center | | |

# VV&A

| Findings | Conclusions | Recommendations |
|---|---|---|
| Managers expressed concern with adopting EASE due to its lack of VV&A certification | | |
| The specific requirements for VV&A of a combat simulation model are general and somewhat vague | VV&A is an important consideration and a potential roadblock to transition and POR status | |
| Users are generally less concerned with VV&A requirements than managers | | Identify an appropriate VV&A authority and discuss the specific VV&A requirements as they |
| 87% of survey respondents stated that VV&A was very important within their organizations | | |
| Most report that over 75% of the models and tools they use on a day-to day basis are VV&Ad. | | Begin action on those VV&A related tasks that can be completed now. |
| The TEMO domain VV&A is less concerned with VV&A than ACR and RDA domains. | Emphasis regarding VV&A varies amongst domains | |

# Inteoperability

| Findings | Conclusions | Recommendations |
|---|---|---|
| Numerous combat functions are replicated between combat simulation models and tools | There are redundancy in functions replicated in models | |
| With the fielding of new equipment and new threats additional combat simulation models and tools are required | | The application line-up database and function vs. application focus are unique and positive aspects of EASE and should be leveraged |
| Combat simulation models and tools were not necessarily intended to work together however there is a requirement to integrate multiple models | Federation of multiple combat simulation models and tools is increasingly important | |
| Ability to integrate multiple models and tools was classified as very important and listed as a top three characteristic | | |
| Integrating multiple models or tools is time and resource intensive and requires specialized experience. | Federation of multiple combat simulation models and tools is difficult and requires specialized expertise | EASE extensions should focus an increasing the timliness and reducing manpower required to integrate multiple models |

# Reuse and Version Control

| Findings | Conclusions | Recommendations |
|---|---|---|
| Stakeholders note that there are continuing challenges with configuration due to changing versions of M&S and supporting software | | |
| Each combat simulation lab or analysis center maintains an extensive staff to update software | Sotware updates and version control are not systematic and are problematic | Recommend some form of Reconfiguration savings be used as an EASE ROI metric |
| Stakeholders identified difficulty with keeping software and hardware updated. | | |
| Software versions are developed independently of M&S Enterprise or Program integration requirements and generally cause issues after the fact | Updating versions of combat simulation models and supporting software is resource and time intensive | Highlight EASE ability to archive previous working models with appropriate configurations and versions |
| Stakeholders noted great value in the ability to access previously run simulations without the burden of new configuration work or software updates. | | |
| M&S strategic guidance lists reuse as an important Enterprise M&S characteristic. | | Recommend some form of Reuse be used as an EASE ROI metric |
| Stakeholders state that the ability to access and rerun any simulation archived in EASE is valuable and potentially a tremendous time saver. | | |

# Manpower

| Findings | Conclusions | Recommendations |
|---|---|---|
| Each combat simulation lab or analysis center maintains an extensive staff to maintain hardware and software | | |
| Survey respondents stated that they spend a tremendous amount of time maintaining hardware and software to support M&S in ther labs | There is tremendous redundancy in supporting manpower across the M&S Enterprise | A cloud –based solution with virtual machines has the potential to provide substantial cost savings across the M&S Enterprise. |
| FT Hood, FT Stewart, and FT Benning MTC maintains a staff of between 35-70 personnel to maintain and operate M&S software and hardware | | |
| TRAC-FLVN has a staff of 50+ personnel devoted to model development, wargaming and analytic tools | Operating and Maintaining M&S manpower intensive | Reuse or access to previous M&S information could save manpower and time |
| For major events, ARCIC has up to 300 personnel devoted to technical control, simulation operation, role playing and analysis | | |
| Similar personnel resources are replicated at every lab, MTC, or analysis center | | |

# Appendix H. EASE Metrics

| Term | Definition | Quality | Monetary |
|---|---|---|---|
| Impactful | Inputs, processes, and outcomes relative to the mission's goal or application use | # of M&S strategic goals addressed<br><br># of M&S capability gaps addressed<br><br>Organization level of impact (i.e. Enterprise, Community, Program, Lab)<br><br>• System effects the accomplishment of the mission or activity | Cost savings when impacts promote efficiencies<br><br>Cost avoidance when impacts obviate expenditures |
| Innovative | Includes significant new capabilities or provides functionality in an exceptional way | Duration of innovation life<br><br># of innovation concept reuses<br><br>• Analytic functions and implementation are unique | Cost savings when innovations reduce labor, runtime, etc.<br><br>Cost avoidance through reduction in factors not included |
| Resource Efficiencies | Resources needed (manpower, equipment, and software) to run M&S | # of servers, computers, licenses reduced<br><br># of personnel reduced<br><br># of labor hours reduced<br><br>• System requires fewer resources to run/maintain | Cost savings from reduced equipment, software purchases and upgrades<br><br>Cost avoidance from labor reduction |
| Composability | Can be quickly reconfigured and federated with others via automated tools | # of additional systems that can be included<br><br># time required to include additional systems<br><br>• System, architecture, and meta-data allow automated federation | Cost savings from combining systems vice new<br><br>Cost avoidance from reduced labor to interoperate systems |
| Interoperability | Has the ability to be modified in a timely manner to pass/ receive results/data, syntactic, semantic information | # of systems it can interoperate with<br><br>Degree of interoperability<br><br>• System has stable and defined interfaces and | Cost savings from not having to develop internal modules<br><br>Cost avoidance from reduced labor to add functions |

| | | | |
|---|---|---|---|
| | | can exchange data | |
| Reuse | Previous models can be retrieved and rerun yielding the same results when input conditions are the same | Time required to access and rerun previous model<br><br># of model reuses<br><br>• System allows rerun of previous model while preserving previous configuration and software versioning | Cost savings from automated repetition<br><br>Cost avoidance from reduced labor - not having to recreate and reconfigure a previous model |
| Adaptability | Source code can be changed and updated, can be used in a different application area, and can be altered to run on other systems/hardware | # of components and algorithms<br><br># of additional applications<br><br>Flexibility of input files and databases<br><br>System can be modified to address additional requirements and add functionality; run on other systems | Cost savings from not having to develop a new system<br><br>Cost avoidance from reduced time to update, simplified re-hosting, and labor –reduction in new uses |
| Transition | Ownership of the application is successfully transferred to an agency outside STTC | Probability of Transition<br><br># of Months to Transition<br><br>• System ownership is successfully transferred to organization outside STTC and requires rare and minor assistance | N/A |

## Nomenclature

| | |
|---|---|
| ACR | Advanced Concepts and Requirements |
| AMRDEC | Aviation and Missile Research and Development Center |
| AMSAA | Army Material Systems Analysis Agency |
| AMSO | Army Modeling and Simulation Office |
| ARCIC | Army Capabilities and Integration Center |
| ARL | Army Research Laboratory |
| ATEC | Army Test and Evaluation Command |
| BLCSE | Battle Laboratory Collaborative Simulation Environment |
| BMC | Brigade Modernization Command |
| C2 | Command and Control |
| C2WT | C2 WindTunnel |
| DEVS | Discrete Event System Specification |
| DIS | Distributed Interactive Simulation |
| DOD | Department of Defense |
| DODAF | Department of Defense Architecture Framework |
| DSE | Department of Systems Engineering |
| EASE | Executable Architecture Systems Engineering |
| FACT | Framework for Assessing Cost and Technology |
| FCR | Findings, Conclusions, and Recommendations |
| FOM | Federation Object Model |
| HLA | High Level Architecture |
| IWARS | Infantry Warrior Simulation |
| JCATS | Joint Conflict and Tactical Simulation |
| JSAF | Joint Semi-Automated Forces |
| MATREX | Modeling Architecture for Technology Research and Experimentations |
| M&S | Modeling and Simulation |
| MDA | Missile Defense Agency |
| MSBL | Maneuver Support Battle Lab |

| | |
|---|---|
| MSCO | Modeling and Simulation Coordination Office |
| MSCoE | Maneuver Support Center of Excellence |
| OneSAF | One Semi-automated Forces |
| ORCEN | Operations Research Center |
| PaaS | Platform as a Service |
| PEO STRI | Program Executive Office Simulation Training and Research Integration |
| RDA | Research Development and Acquisition |
| RDECOM | Research Development and Engineering Command |
| RID | Requirements Integration Directorate |
| RTI | Run Time Interface |
| SDD | Software Design Description |
| SDP | Systems Decision Process |
| SOSI | System of Systems Interoperability |
| STTC | Simulation and Training Technology Center |
| SWOT | Strengths, Weaknesses, opportunities, and Threats |
| TENA | Test and Training Enabling Architecture |
| TEMO | Training, Exercise, and Military Operations |
| TOC | Tactical Operations Command |
| TRAC | TRADOC Analysis Center |
| TRADOC | Training and Doctrine Command |
| USMA | United States Military Academy |
| VBS2 | Virtual Battle Space 2 |
| VFT | Value Focused Thinking |
| VV&A | Verification, Validation and Accreditation |

## References


[1] AEgis Technologies Group, Inc. 2008 (November2008). Metrics for Modeling and Simulation(M&S) Investments. Tech. rept. Report NumberTJ-042608-RRP013. AEgis.

[2] Allen, G. 2012. Live, Virtual, Constructive Architecture Roadmap Implementation Project. JointTraining Integration and Evaluation Center.

[3] Department of the Army. 2005. AR 5-11: Management of Army Models and Simulations.

[4] Department of the Army. 2012. Army Modeling &Simulation Strategy (Draft).

[5] Gallant, Scott, Metivier, Christopher, & Gaughan,Chris. Systems Engineering an Executable Architecture for M&S.

[6] Harrigan, Ashford; Montgomery, Jesse; Reckner Robert; Szymczak William. 2013 (May). Assessing Distributed Simulation Tools. Tech. rept. DSE-C-1305. United States Military Academy.

[7] Kewley, Robert; Cook, James; Henderson Dale;Teague Edward. 2008. Federated Simulations ForSystems of Systems Integration. Proceedings of the2008 Winter Simulation Conference.

[8] O'Neal, Michael. 2012. Modeling and Simulation Tool for Decision Makers: Framework for Assessing Cost and Technology Project, U.S. Marine Corps Systems Command.

[9] Oswalt, Ivar. 2012. Calculating Return on Investmentfor U.S. Department of Defense Modeling and Simulation. M&S Journal, Fall 2012, 415.

[10] Parnell, Gregory S., Driscoll, Patrick J., & Henderson, Dale L. (eds). 2011. Decision Making in Systems Engineering and Management. Second edn. Wiley Series in Systems Engineering and Management. John Wiley & Sons, Inc.

[11] Pawlowski, Tom; Barr, Paul; Ring Steven. 2004a (June). Applying Executable Architectures to Support Dynamic Analysis of C2 Systems. Tech. rept.The MITRE Corporation.

[12] Pawlowski, Tom. 2004b. Executable Architecture Methodology for Analysis. MITRE, http://www.mitre.org/news/events/tech04/briengs/729.pdf.

[13] Sargent, Robert G. 1998. Verification and Validation of Simulation Models.

[14] Shafer, Alan. 2012. The Value of Modeling and Simulation for the Department of Defense. M&S Journal, Fall 2012, 2-3.

[15] Thomas, John. 2012. Research, Development and Acquisition (RDA) Domain Update. Army Material Systems Analysis Activity.

[16] Tolk, Andreas. 2012. Engineering Principles of Combat Modeling and Distributed Simulation. Third edn. John Wiley & Sons, Inc., Hoboken, New Jersey.

# Distribution List

The list indicates the complete mailing address of the individuals and organizations receiving copies of the report and the number of copies received. Due to the Privacy Act, only use business addresses; no personal home addresses. Distribution lists provide a permanent record of initial distribution. The distribution information will include the following entries:

| NAME/AGENCY | ADDRESS | COPIES |
|---|---|---|
| **Author(s)** | **Department of Systems Engineering<br>Mahan Hall<br>West Point, NY 10996** | **2** |
| **Client** | **Simulation Training and Technology Center<br>12423 Research Parkway<br>Orlando, FL 32826** | **2** |
| **Dean, USMA** | **Office of the Dean<br>Building 600<br>West Point, NY 10996** | **1** |
| **Defense Technical Information Center (DTIC)** | **ATTN: DTIC-O<br>Defense Technical Information Center<br>8725 John J. Kingman Rd, Suite 0944<br>Fort Belvoir, VA 22060-6218** | **1** |
| **Department Head-DSE** | **Department of Systems Engineering<br>Mahan Hall<br>West Point, NY 10996** | **1** |
| **ORCEN** | **Department of Systems Engineering<br>Mahan Hall<br>West Point, NY 10996** | **5** |
| **ORCEN Director** | **Department of Systems Engineering<br>Mahan Hall<br>West Point, NY 10996** | **1** |
| **USMA Library** | **USMA Library<br>Bldg 757<br>West Point, NY 10996** | **1** |

## REPORT DOCUMENTATION PAGE

*Form Approved*
*OMB No. 0704-0188*



**PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

| 1. REPORT DATE *(DD-MM-YYYY)* | 2. REPORT TYPE | 3. DATES COVERED *(From - To)* |
|---|---|---|
| 21062013 | Final | 31052012-21062013 |

**4. TITLE AND SUBTITLE**

Executable Architecture Systems Engineering (EASE)

**5a. CONTRACT NUMBER**

**5b. GRANT NUMBER**

**5c. PROGRAM ELEMENT NUMBER**

**6. AUTHOR(S)**

Mr. Gene Lesinski
Mr. Chris Gaughan
COL Daniel McCarthy

**5d. PROJECT NUMBER**

**5e. TASK NUMBER**

**5f. WORK UNIT NUMBER**

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**

USMA Operations Research Center (ORCEN), West Point, NY
Simulation Training and Technology Center (STTC), Orlando, FL

**8. PERFORMING ORGANIZATION REPORT NUMBER**

DSE-R-1305

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**

Army Research Lab

**10. SPONSOR/MONITOR'S ACRONYM(S)**

**11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

**12. DISTRIBUTION/AVAILABILITY STATEMENT**

A- Approved for Public Release; Distribution Unlimited

**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**

The EASE development team commissioned this study in order to focus planned improvements to EASE, based on a comprehensive study of the needs and preferences of potential users and other stakeholders to determine the most important functions and attributes for the product. In this work, we conduct a detailed stakeholder analysis, looking very broadly at the various stakeholders and the desired functions of EASE, in order to devise and prioritize possible additions or improvements for the development team to include in future versions. We utilize both the Systems Decision Process (SDP) and Value-Focused Thinking (VFT) to gather and analyze stakeholder feedback. User feedback is clustered and organized into Findings, Conclusions, and Recommendations (FCR) to highlight trends, capability gaps, and major issues. The FCR tables and stakeholder feedback are then used as the foundation of a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis. Finally, the SWOT analysis and stakeholder feedback are translated into an EASE future development strategy; a series of recommendations regarding: stakeholder solution space focus, specific M&S organizations with interest, prioritized EASE improvements, prioritized list of EASE enhancements, and potential use

**15. SUBJECT TERMS**

Executable Architecture, Federated Simulation, Combat Simulation, Software Design Description, Modeling and Simulation, EASE

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT | b. ABSTRACT | c. THIS PAGE | | | COL Daniel McCarthy |
| Unclassified | Unclassified | Unclassified | UL | 71 | 19b. TELEPHONE NUMBER *(Include area code)* 845-938-4893 |

Reset

## INSTRUCTIONS FOR COMPLETING SF 298

**1. REPORT DATE.** Full publication date, including day, month, if available. Must cite at least the year and be Year 2000 compliant, e.g. 30-06-1998; xx-06-1998; xx-xx-1998.

**2. REPORT TYPE.** State the type of report, such as final, technical, interim, memorandum, master's thesis, progress, quarterly, research, special, group study, etc.

**3. DATES COVERED.** Indicate the time during which the work was performed and the report was written, e.g., Jun 1997 - Jun 1998; 1-10 Jun 1996; May - Nov 1998; Nov 1998.

**4. TITLE.** Enter title and subtitle with volume number and part number, if applicable. On classified documents, enter the title classification in parentheses.

**5a. CONTRACT NUMBER.** Enter all contract numbers as they appear in the report, e.g. F33615-86-C-5169.

**5b. GRANT NUMBER.** Enter all grant numbers as they appear in the report, e.g. AFOSR-82-1234.

**5c. PROGRAM ELEMENT NUMBER.** Enter all program element numbers as they appear in the report, e.g. 61101A.

**5d. PROJECT NUMBER.** Enter all project numbers as they appear in the report, e.g. 1F665702D1257; ILIR.

**5e. TASK NUMBER.** Enter all task numbers as they appear in the report, e.g. 05; RF0330201; T4112.

**5f. WORK UNIT NUMBER.** Enter all work unit numbers as they appear in the report, e.g. 001; AFAPL30480105.

**6. AUTHOR(S).** Enter name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. The form of entry is the last name, first name, middle initial, and additional qualifiers separated by commas, e.g. Smith, Richard, J, Jr.

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES).** Self-explanatory.

**8. PERFORMING ORGANIZATION REPORT NUMBER.** Enter all unique alphanumeric report numbers assigned by the performing organization, e.g. BRL-1234; AFWL-TR-85-4017-Vol-21-PT-2.

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES).** Enter the name and address of the organization(s) financially responsible for and monitoring the work.

**10. SPONSOR/MONITOR'S ACRONYM(S).** Enter, if available, e.g. BRL, ARDEC, NADC.

**11. SPONSOR/MONITOR'S REPORT NUMBER(S).** Enter report number as assigned by the sponsoring/ monitoring agency, if available, e.g. BRL-TR-829; -215.

**12. DISTRIBUTION/AVAILABILITY STATEMENT.** Use agency-mandated availability statements to indicate the public availability or distribution limitations of the report. If additional limitations/ restrictions or special markings are indicated, follow agency authorization procedures, e.g. RD/FRD, PROPIN, ITAR, etc. Include copyright information.

**13. SUPPLEMENTARY NOTES.** Enter information not included elsewhere such as: prepared in cooperation with; translation of; report supersedes; old edition number, etc.

**14. ABSTRACT.** A brief (approximately 200 words) factual summary of the most significant information.

**15. SUBJECT TERMS.** Key words or phrases identifying major concepts in the report.

**16. SECURITY CLASSIFICATION.** Enter security classification in accordance with security classification regulations, e.g. U, C, S, etc. If this form contains classified information, stamp classification level on the top and bottom of this page.

**17. LIMITATION OF ABSTRACT.** This block must be completed to assign a distribution limitation to the abstract. Enter UU (Unclassified Unlimited) or SAR (Same as Report). An entry in this block is necessary if the abstract is to be limited.


**OPERATIONS RESEARCH CENTER**
United States Military Academy
West Point, New York 10996