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Training Community Modeling and Simulation Business Plan: 2008 Edition

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December 2009

IDA Document D-3934
Log: H 09-001270

This work was conducted under contract DASW01-04-C-0003, Task AK-2-2924, for the OUSD (AT&L)/Modeling and Simulation Coordination Office and OUSD (P&R). The publication of this IDA document does not indicate endorsement by the Department of Defense, nor should the contents be construed as reflecting the official position of that Agency.

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Preface

The 2008 Training Community Modeling and Simulation Business Plan (TMSBP) was prepared by the Institute for Defense Analyses (IDA) under the "Business Plan for Modeling & Simulation," task, which is funded by the Modeling and Simulation Steering Committee for the training community led by the Office of the Under Secretary of Defense for Personnel and Readiness (OUSD(P&R)). The task was executed by the Modeling and Simulation Coordination Office (M&S CO), with oversight from the Director of Readiness and Training Policy and Programs (RT&PP) and the training stakeholders as represented by the Training Transformation (T2) Senior Advisory Group (SAG) and the T2 Executive Steering Group (ESG) members.

The 2008 TMSBP is an update to the 2007 TMSBP, which was prepared in two volumes. This document is prepared in one volume, which references the detailed data and survey material contained in Volume II of the previous work. The update reflects evolutionary changes in the training needs and M&S capabilities since publication of the 2007 TMSBP. The underpinning analysis framework and a baseline of training needs and capabilities as published in the July 2004 Training Capabilities Analysis of Alternatives (TC AoA) provided a logical start point for this effort and will be carried forward in the 2009 TMSBP update.

IDA led the effort to prepare this document, with significant contributions from the broad training community stakeholders. The 2007 TMSBP pulled together the training needs (gaps) as presented in the TC AoA and incorporated a survey that enabled training stakeholders to update their training tools/capabilities baseline. Mr. Philip A. (Andy) Sargent, Northrop Grumman, supporting OUSD (P&R), has provided an update to the baseline with a Capabilities Landscape found in Section 5 of this document. This landscape will form the new baseline for the 2009 TMSBP update.

We appreciate the excellent advice and material contributions of dozens of members of the defense training community, to include those Service and Major Command representatives who reviewed the coordination draft. In particular, the authors acknowledge the significant support and guidance of Mr. Daniel Gardner, Director, RT&PP, and

Mr. Robert Halayko of his office in their role as training community modeling and simulation (M&S) managers.

The authors wish to thank the reviewers, Dr. Robert Richbourg and Mr. Jason Dechant of IDA, and John Everett of IDA for editing the document.

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Executive Summary

The purpose of the Training Community Modeling and Simulation Business Plan (TMSBP) is to provide a link between the training functional stakeholders (as represented in the Training Transformation (T2) Senior Advisory Group (SAG) and Executive Steering Committee (ESG)) and the Department of Defense (DoD) larger modeling and simulation (M&S) strategic vision and goals. The intent of this document is to provide a transition that updates the content of the 2007 TMSBP with improvements in training needs and capabilities since 2007 and to provide a reference document for training and M&S stakeholders' inputs as we begin the major TMSBP document update for 2009. This 2008 TMSBP provides an incremental update of the 2007 TMSBP. The next major update is underway for publication in the spring of 2010.

Background

In 2004, the training community conducted a relatively far-reaching Training Capabilities Analysis of Alternatives (TC AoA), which listed training gaps (training needs) and M&S capabilities to fill those gaps. The 2007 TMSBP provided an update of the training needs as they were derived and validated by the TC AoA published in July 2004. The initial list of 35 training gaps was updated with the stakeholders by the U.S. Joint Forces Command (JFCOM) at the Joint M&S Training Gaps Analysis Forum (TGAF) in November 2008.

At the TGAF, training stakeholders (the combatant commands (COCOMs), Services, and Defense Agencies)) provided a short list of three top training M&S issues and voted to arrive at an overall list of "Top Five" issues to influence near-term training R&D funding. Also at the TGAF, the training stakeholders voted to revise the priority order of the original 35 TC AoA training gaps and provided comments on a draft combined list of 10 training gaps by providing logical groupings for similar training needs. The training groups reflect the top TGAF issues and the updated priority order of the 35 training needs. The TGAF process for determining near term training issues and training needs will be discussed in more detail in the 2009 TMSBP. The updated training needs list is linked back to the original 35 TC AoA training gaps. This list of training needs forms a training requirements baseline that is broader than the M&S capabilities tool set can handle, and specific training needs may be filled by other training tools or learning content.

A corresponding baseline of training M&S capabilities has been updated from the material provided in the TC AoA Final Report, Chapter V, "Assessing Effectiveness." This updated baseline detailed those training models and federations identified by the training stakeholders as being relevant to training contained in the most commonly used M&S training federations.

References to the TC AoA are maintained within this document to ensure continuity and for historic reference. The TGAF has addressed updates to training needs as well as vocabulary and terms that have changed since the TC AoA was published in July 2004.

Approach

Since training needs and technology are constantly changing, the TMSBP will continue to evolve as a living document. The 2007 TMSBP provided the training community "investment strategies" for participation in the M&S Steering Committee (M&S SC) project call for Fiscal Year (FY) 09 and FY 10 M&S projects. The intent of future versions of the TMSBP is to further address the mid- to long-term efforts and provide justification for major investments in training capabilities funded by future M&S in future Program Objective Memorandum (POM) submissions.

In a like manner, the 2009 TMSBP will help inform the FY 11 programs to enhance training capabilities and also recommend enterprise-level efforts for DoD corporate actions. The TMSBP identifies capabilities that the training community can leverage to achieve interoperability, reuse, and efficiencies at the enterprise-level and among the other communities enabled by M&S. The 2009 TMSBP will update the list of training needs and M&S training capabilities necessary to respond to the changing operational context for our DoD forces. The M&S Coordination Office (M&S CO) provided a community business plan guidance document that will shape the six 2009 M&S Business Plans for each of the communities enabled by M&S.

The TMSBP describes the process used by the study team and the training community to analyze those M&S capability improvements that are most needed to enhance joint training. It defines a logical, iterative process that began with the 2004 TC AoA, which analyzed the top training gaps and how the training community developed the final recommended investment strategies to fill those gaps. The process continues through the series of TMSBP updates. This plan leverages the M&S efforts, key enablers, and joint federations previously defined and currently being used in training.

Key Findings

- The TC AoA training gaps (needs) are out of date and need to be updated with the assistance of training stakeholder organizations. Several of the training needs have been addressed during the last 5 years, and new needs have emerged to change the priorities of the 2004 gaps.
- Training capabilities as described in the TC AoA and 2007 TMSBP were limited to those primary constructive simulation federations used for joint training.
- Several long-standing training needs previously identified are being progressively corrected by joint and Services development programs, while other functional areas remain as unfunded issues.
- The use of M&S in training continues to evolve to provide improved training capabilities and to prepare forces for operational missions.

Recommendations

- Continue the update process initiated in the Joint M&S TGAF conducted by JFCOM in November 2008 to arrive at formal coordination and validation of training needs at senior leadership levels in each stakeholder organization.
- Use the Office of the Secretary of Defense (OSD)-provided training capabilities as the start point for 2009 TMSBP capabilities baseline.
- Work to resolve long-standing training issues surfaced by the TGAF to include integrated air and missile missions, Cross-Domain Information Sharing (CDIS), and integrated joint logistics.
- Continue to fund the research and development (R&D) efforts at JFCOM to facilitate support for large joint training exercises. The TGAF identified a series of these issues that have been grouped as exercise design and integration.
- The 16 investment strategies in Section 5 (see Table 5-1) of this TMSBP should serve as a starting point for the update to be published in the 2009 TMSBP.
- The training stakeholders should participate with the Joint Staff (JS) Joint Training Directorate (J7) to update the list of TC AoA training gaps, which would serve as an updated requirements baseline for future training M&S efforts.
- After the needs update, conduct a workshop with training stakeholders to translate the needs and capabilities into specific proposals for either the training community or the M&S SC for enterprise-level funding in FY 09 and beyond.
- Ensure that future training M&S efforts are consistent and interoperable with the net-centric enterprise services and net-enabled command and control (C2) data strategies being developed in the Defense Information Systems Agency (DISA) Global Information Grid (GIG) programs.

1. Background

1.1 Purpose

In 2007, the Department of Defense (DoD) adopted a new strategic vision for DoD modeling and simulation (M&S). To achieve the goals of that vision, each of the six DoD communities enabled by M&S was tasked to develop and maintain updates for individual community M&S business plans that would promote M&S activities and help achieve corporate level and crosscutting M&S needs and capabilities. The 2007 Training Community Modeling and Simulation Business Plan (TMSBP) was published in April 2008, with a revised document (released in February 2009) that was "Approved for public release; distribution unlimited."

The intent of the 2008 TMSBP is to provide a transition document that augments the content of the 2007 TMSBP with updates in training needs and capabilities and provides a coordination document for staffing to solicit training and M&S stakeholders inputs in preparation for the major 2009 TMSBP document update. Figure 1-1 illustrates how the training community business plans are based on the needs and capabilities analyses of the 2004 Training Capabilities Analysis of Alternatives (TC AoA) (see also Appendix A of this document) and iteratively developed to serve as a living document for informing the Office of the Secretary of Defense (OSD) M&S stakeholders about training investment strategies. The next major update to the TMSBP is ongoing and will be published in March 2010, consistent with the M&S Coordination Office (CO) *2009 Community M&S Business Plan Guidance* document. The 2009 TMSBP update will be coordinated with and will follow M&S CO guidance concerning format and content. The six 2009 community plans will serve collectively to inform the *2010 Corporate and Crosscutting M&S Business Plan*.

The objective of this TMSBP is to identify ways to improve and update the M&S contribution to the ongoing enhancements for joint training. The TC AoA observed that operational requirements and training needs are constantly evolving. Because of the rapidly changing needs and evolving technological capabilities, the TMSBP is recognized as a living document. M&S is a key part of improving the DoD training capability and includes Service-oriented architectures, network-centric data integration, and distributed

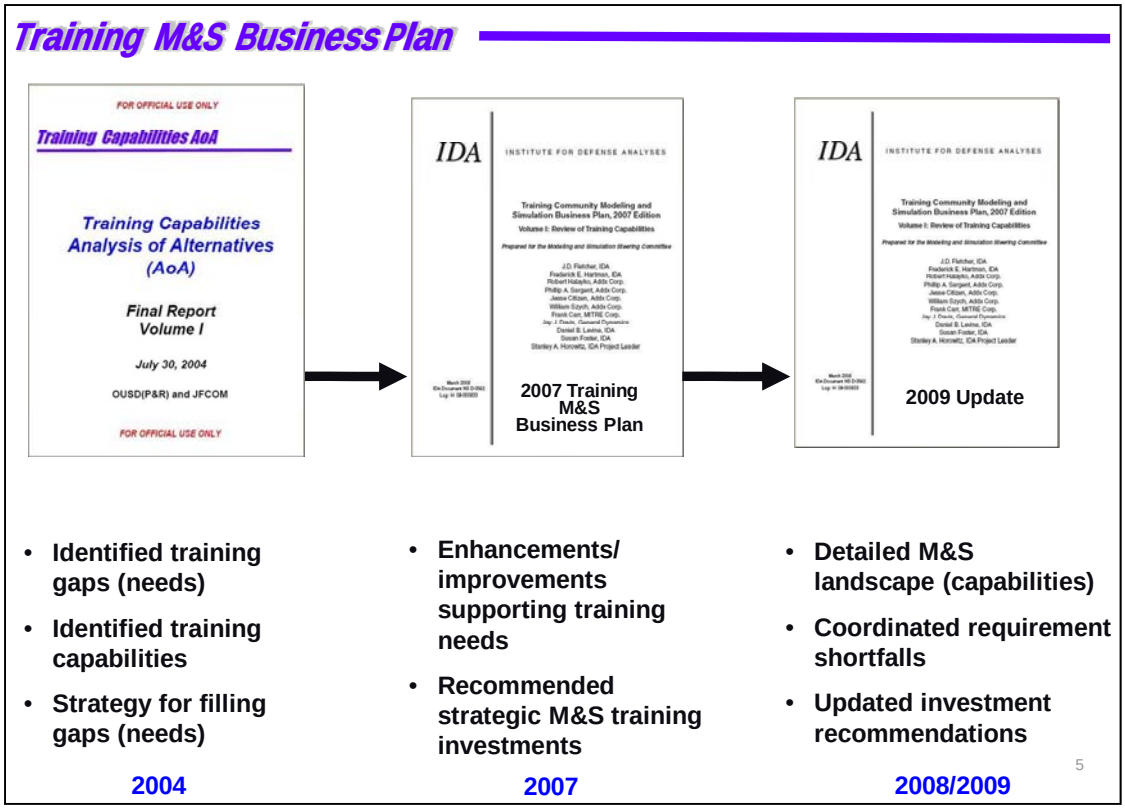

Figure 1-1. TMSBP Updates

environments that will allow live, virtual, and constructive (LVC) training capabilities to interoperate seamlessly across a wide spectrum of users and training applications.

This document contributes to training objectives by

- Incorporating a vision of joint training
- Assessing the current M&S capabilities and the gaps between current M&S capabilities and needs
- Describing M&S efforts currently underway to fill the gaps
- Providing a roadmap of management, investment, and technical strategies for identifying new M&S investments designed to help fill any remaining training gaps.

1.2 Joint Training Vision

"Training," as used in this business plan, includes training, education, and job-performance aiding. Several years ago, the National Defense Strategy (NDS) directed that military training be transformed in parallel with the ongoing transformation of U.S. forces and missions. It established goals for accomplishing this transformation, and, to carry out these goals, it directed that joint training take the following steps:

- Support a broad range of roles and responsibilities in joint, interagency, intergovernmental, and multi-national contexts
- Be flexible and operationally effective
- Be capable of assessing and reporting training readiness for traditional and emerging joint operations
- Employ war games and simulations to multiply the effects of field exercises and experiments.

The June 2008 publication of the *National Defense Strategy*[1] highlights the importance of training in transforming the U.S. force and working our international partners: "We must also work with longstanding friends and allies to transform their capabilities. Key to transformation is training, education and, where appropriate, the transfer of defense articles to build partner capacity" (p. 16).

The February 5, 2009, edition[2] of the *Strategic Plan for Transforming DoD Training* provided an update to the May 8, 2006, edition[3] of the document, which had responded to the NDS by calling for the creation of an LVC training environment that will serve as an enabler for transforming U.S. forces and missions: "Provide dynamic, capabilities-based training for the Department of Defense in support of national security requirements across the full range of integrated operations."[4] In 2007, the DoD began a new planning approach that has had a profound effect on training practices, processes, and resources. The Guidance for Development of the Force (GDF) and Guidance for Employment of the Force (GEF) combine with the Joint Strategic Capabilities Plan (JSCP) to provide a comprehensive approach to planning within a resource-constrained environment.

The LVC training environment as depicted in Figure 1-2 includes the use of M&S systems to create warfighting conditions through a networked collection of interoperable training sites and nodes and interconnected simulations and training tools. This environment must provide affordable and effective capabilities for training U.S. forces in the joint mission essential tasks (JMETs) and Service mission essential tasks (METs) to meet the needs of the component commanders, Joint Task Force (JTF) staffs, standing joint

1 See http://www.defenselink.mil/news/2008%20national%20defense%20strategy.pdf.

2 See http://www.defenselink.mil/prhome/docs/T2_STRAT_PLAN_Final_Feb2009.pdf.

3 See http://www.t2net.org/downloads/FinalTrainingTransformationStrategic2006.pdf.

4 This statement appears on p. 12 of the 2008 edition and p. 8 of the 2009 edition.

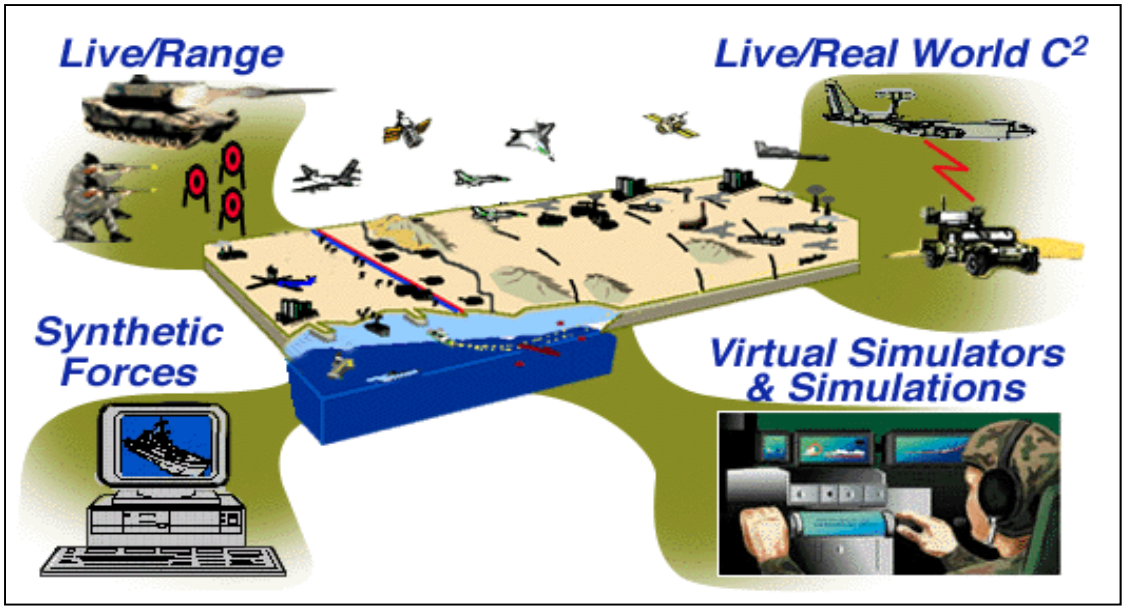

Figure 1-2. The LVC Training Environment

force headquarters, component commands, and the military Services. The ultimate goal in training U.S. joint forces to meet operational performance objectives is to prepare forces for the environments in which they are intended to operate. The LVC training environment provides enhanced training situations and, through the use of the Joint Training Experimentation Network (JTEN), the ability to "train from home station"—as recommended over the last 2 decades but only recently realized on a large scale as the United States prepares its forces for deployment to areas of operation around the globe.

New training challenges have resulted from the changes in forces and organizations as the U.S. military transforms to support the Global War on Terror (GWOT). The military is shifting to support smaller, highly distributed joint and combined forces and standing joint force headquarters that integrate Service capabilities at the lowest levels.

The United States must train forces to seize opportunities and meet challenges of rapidly evolving threat situations by employing advances in technology. Training must support integrated joint and Service operations. The new training environment must not only use the traditional live ranges found in the test and training facilities, but must also integrate these facilities with other areas of defense planning, such as acquisition, logistics, personnel, professional development, and command and control (C2) processes.

The Training Transformation (T2) program must have the global presence that will allow training and education to be provided anytime and anywhere to a wide spectrum of training needs and audiences. Some of the key T2 program enablers that will help establish the persistent global training and education presence are as follows:

- **Joint Knowledge Development and Distribution Capability (JKDDC).** This T2 capability provides a knowledge management training capability that has real-time reachback between individual warfighters, operational staff, and key information sources. These sources include joint professional military education, data warehouses, and the knowledge management capabilities enabled by the Global Information Grid (GIG).
- **Global Knowledge Network.** This overarching, open-architecture M&S environment will provide plug-and-play interoperability over a full range of LVC training. It will offer critical elements such as online interactive instruction, comprehensive content repositories, and the emerging GIG.
- **Joint National Training Capability (JNTC).** This T2 capability is primarily focused on building the global LVC training environment for collective training. It is responsible for integrating components of the Joint Live Virtual Constructive Training Environment (JLVC-TE) for leveraging Service capabilities and developments, establishing the connecting communications infrastructure, and sustaining the infrastructure to benefit not only joint training, but also Service Title X training when resources permit.
- **LVC training.** The integrated LVC training environment enabled by the JNTC. It is designed to create joint warfighting conditions through a networked collection of interoperable training sites and nodes that synthesize personnel, doctrine, and technology to meet the training needs of the combatant commanders (CCDRs) and the Services. The LVC environment melds existing operational and strategic facets of exercises with live forces and with those training in simulators to create a more robust and realistic experience. It supports a wide spectrum of training simulations and tools.
- **Joint Assessment and Enabling Capability (JAEC).** This T2 capability is responsible for developing an enterprise-level assessment of T2 in coordination with the operative training components. This assessment will be conducted on a continuing basis (vs. performing formal "block assessments" every 2 years).

1.3 M&S Vision

This TMSBP contributes to the Strategic Vision for DoD Modeling and Simulation,[5] which includes *empowering DoD with the modeling and simulation capabilities that effectively and efficiently support the full spectrum the Department's activities and operations.*

5 See http://www.msco.mil/StrategicVision.html.

The goals of DoD M&S efforts are to provide

- Standards, architectures, networks, and environments
- Policies at the enterprise level
- Management processes for M&S content and data
- Tools in the form of M&S and authoritative data
- Well-trained people.

1.4 Training and M&S Governance

The training community's T2 Executive Steering Group (ESG) and Senior Advisory Group (SAG) oversee the development and execution of T2. Their oversight purview includes the resolution of training issues, all training M&S activities and capabilities, and the allocation, transfer, and execution of all training resources. Figure 1-3 graphically depicts T2 management and oversight bodies, with relevant stakeholder organizations at each level.

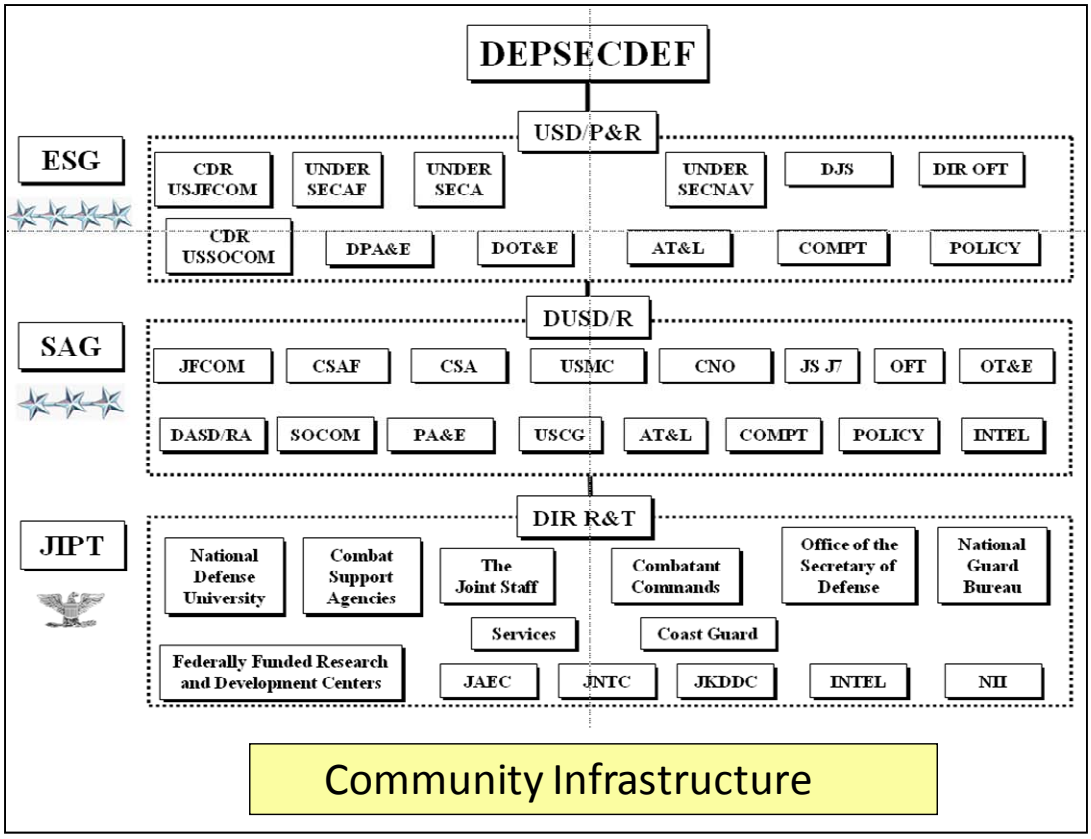

Figure 1-3. T2 Management and Oversight

The T2 Joint Integrated Process Team (JIPT) is the primary forum for providing input to the ESG and SAG and for shaping issues in response to their guidance. The JIPT

is chaired by the Director of Readiness and Training Policy and Programs Directorate. It consists of senior analysts, planners, and action officers from the combatant commands (COCOMs), the Services, the Combat Support Agencies (CSAs), the Joint Staff (JS), and the other DoD staffs and agencies that contribute to DoD T2.

In addition to the training community governance processes, Department of Defense Directive (DoDD) 5000.59, *DoD Modeling and Simulation (M&S) Management*, dated August 8, 2007,[6] has established a Modeling and Simulation Steering Committee (M&S SC) for management at the department level. The training projects funded by M&S SC through FY 08 are briefly discussed in Section 5.

The following goals for M&S management are extracted from the Strategic Vision for DoD Modeling and Simulation.[7] The management goal of DoD's M&S efforts is to provide *management processes for models, simulations, and data that (1) enable M&S users and developers to easily discover and share M&S capabilities and provide incentives for their use, (2) facilitate the cost-effective and efficient development and use of M&S systems and capabilities, and (3) include practical validation, verification, and accreditation guidelines that vary by application area.*

6 See http://www.dtic.mil/whs/directives/corres/pdf/500059p.pdf.

7 See http://www.msco.mil/StrategicVision.html.

2. Assessment of Current M&S Capabilities

This section describes training activities, the functions to perform these activities and the M&S tools used by the functions that various training organizations perform for the training community. This section also addresses M&S data and services used by the training community for cross-community information sharing.

An updated list of training capabilities as described by constructive training simulations, virtual simulators, and command, control, communications, computer and intelligence (C4I) is found in a series of tables in Section 4 as an update to the capabilities baseline. The updated list of capabilities includes the interfaces and stimulators used in our large training federations and the traditional listing of virtual and constructive simulations. This section will be expanded in the 2009 TMSBP.

2.1 Training Activities

The training community must ensure that the deploying forces are trained for operations before arriving at their destination and that learning continues while the forces are employed in the area of responsibility (AOR). To conduct joint operations across all campaign phases and operations, CCDRs have well-trained individuals, units, and staffs. Among the M&S capabilities needed to facilitate these needs are

- Rapid scenario generation for geospatial, force structure, readiness, weather, intelligence, logistics, and other relevant scenario-specific data
- The ability to interface with—and train on—real-world command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems
- Standardized interfaces for systems to access the LVC training environments
- The ability to train in multi-level, secure environments for interagency and multi-national events.

2.2 Functions

In building the JLVC-TE, the JNTC employs M&S to create and integrate training environments that are live (real people in real locations using real equipment), virtual (real people in simulators), and constructive (real people and simulated entities in a simulated environment). The JLVC-TE creates joint warfighting conditions through a networked collection of interoperable training sites and nodes that synthesize personnel,

doctrine, and technology to meet the training requirements of CCDRs and the Services. The LVC environment melds existing operational and strategic facets of exercises with live forces to create a more robust and realistic experience. It strives for realistic combat training by using adaptive and credible opposing forces (OPFORs), establishing common ground truth, and providing high-quality feedback. Events include Service-to-Service training to improve interoperability and joint operation (horizontal training), strategic-to-tactical joint training to improve vertical command integration (vertical training), enhancement of existing joint exercises to address joint interoperability training in a joint context (integrated training), and a dedicated joint training environment to train to specific warfighting capabilities and complex joint tasks (functional training). Training is enhanced through experimentation and testing and by extending joint training globally into local training venues of the Total Force.

2.3 M&S Tools

For this document, M&S tools are defined as *the development, management, and use of software that enables the creation and execution of simulated environments and the analysis of the simulation results.*

A series of initiatives have been underway by the COCOMs and Services following the TC AoA. The Joint Forces Command (JFCOM) Joint Training Directorate (J7) has provided several enhancements and M&S products in the last 5 years, some of which are highlighted below. The following list of capabilities will be updated and discussed in more detail in the 2009 TMSBP:

- **Joint Multi-Resolution Model (JMRM) federation.** The JMRM is a composable federation that uses the Joint Theater Level Simulation (JTLS) and the Joint Conflict and Tactical Simulation (CATS) as the "core" models in the federation. The JMRM's name and capability are derived from the need to provide both high-level aggregation simulations to support the JTF-level training and to provide entity-level representations to simulate the tactical force components of the JTF. The JMRM provides a low-cost, low-overhead operational staff training capability combined with the high-resolution, tactical-level-training JTLS and CATS. Use of the JMRM is gradually phasing down as enhanced capabilities are built into the JLVC federation.
- **JLVC federation.** The JLVC federation is focused on seamlessly integrating constructive entity-level stimuli with virtual and live simulations and simulators in a near-real-time synthetic environment. This federation provides a multi-echelon, distributed joint training environment that comprises entity-level models and simulations with representations of Service combat,

intelligence, and logistic systems, including CATS, Joint Semi-Automated Forces (JOSEF), Air Warfare Simulation (AWSIM), Air and Space Collaborative Environment Information Operations Suite (ACE-IOS), Tactical Simulation (TACSIM), National Wargaming Simulation Next Generation (NWARS-NG), and Joint Deployment Logistics Model (JDLM). The federation enables the integration of virtual simulators and live range instrumentation to support training of COCOM staff and Service components, down to tactical units and individual/crew trainers. The JLVC federation is gaining more widespread use to support joint training.

- **JTEN.** The JTEN is a global network providing the backbone and connectivity for the LVC simulation components to support a wide spectrum of joint and Service training requirements.
- **Joint Training Information Management System (JTIMS).** The JTIMS is a Web-based system designed to provide automated support in the application of the Joint Training System (JTS) in joint, agency, and Service training programs.

2.4 M&S Data

For this document, M&S data are defined as *a representation of real-world facts or concepts in a format that can be used by M&S.*

The use of data is extremely important for M&S-supported training. A labor-intensive but important step in the training process is the ability to generate the scenario rapidly so that realistic training can be performed. Several DoD initiatives are underway to enable net-centric data integration in a Service-oriented architecture that will be supported by the Net-Centric Enterprise Services (NCES) program of the GIG. The Joint Data Alternatives (JDA) Study was completed in October 2007 but was not incorporated into the TMSBP data call or considered in the subsequent analysis. The work of that cross-community study team and the follow-on JDA effort is referenced in Section 5 of this report.

The JDA Study identified several alternative methods for handling data resources for the M&S community in a net-centric environment. The study identified anticipated actions needed to implement the Net-Centric Data Strategy to support a shared data environment leveraging GIG and Defense Information Systems Agency (DISA) programs. Among the training community data efforts are the following:

- **Defense Readiness and Reporting System (DRRS).** The DRRS is an automated system developed to establish a mission-focused, capabilities-based, common framework that provides the CCDRs, military Services, Joint Chiefs

of Staff (JCS), and other key DoD users the data-driven environment and tools needed to evaluate, in near-real time, the readiness and capability of U.S. Armed Forces to carry out assigned and potential tasks. The DRRS will be the authoritative data source for the JMETs and potentially for unit and force structure data for use in the JTS and for building scenarios for training M&S applications.

- **Joint Training Data Services (JTDS).** The JTDS demonstrations continue to provide solutions to important data issues for joint and Service training events. The JTDS is a Web-based set of scenario-generation and data tools that address enterprise-wide training data challenges. It provides for the definition, design, development, and support of an integrated system for identifying, collecting, manipulating, capturing, storing, and retrieving geospatial/environmental (physical, natural, forces, order of battle (OOB), target, intelligence, visual, and so forth)) data. The JTDS has reduced the time and the cost of data preparation for training events and allows scenarios to be reused in support of short-notice mission rehearsals.
- **JDA Study.** The thrust of the JDA effort was to inform the multiple communities enabled by M&S of the relevant issues as DoD moves to the future of net-centric data strategies supporting the GIG and related DISA programs. The purpose of the JDA Study, which was supported and funded by the M&S SC, was to (1) identify recommended methods for handling data resources for the DoD M&S community in a net-centric environment and (2) identify anticipated actions needed to implement the Net-Centric Data Strategy to support a shared data environment. This effort complements the separate training-funded data efforts untaken in the JTDS and Joint Rapid Scenario Generation (JRSG) programs. The JDA Study team gathered multiple communities enabled by M&S to discover evidence of prior and current M&S data efforts, defined the scope of the implied and explicit gaps in the area of simulation data interoperability, and documented a set of crosscutting use cases for data applicability to support M&S core capabilities across multiple functional applications. The JDA Study team produced several discrete and stand-alone deliverables. For a full list of deliverables, see the JDA final report. These deliverables are individual documents that (when considered in the whole) represent the study team's final report products. The JDA library of documents will be considered as relevant research in the updated TMSBP.

2.5 M&S Services

Additional training community activities enhance the work performed by the training components. The following list shows M&S services for the joint training community:

- Increasing the shared capabilities and reuse
- Focusing greater visibility on M&S requirements
- Integrating M&S requirements
- Sharing community and component successes
- Conducting effective and efficient validation, verification, and accreditation (VV&A) for M&S
- Heightening the availability of M&S resources, best practices, and supporting tools
- Developing education programs coordinated and integrated across DoD.

3. Assessment of M&S Training Gaps

The first step for improving M&S training is to recognize the deficiencies in joint training—the gaps between the current capabilities and the ultimate goals, which resulted from the needs analysis. The goals are determined by analyzing the requirements of the operational forces and, from these requirements, deriving the training needs based on priorities within each of the stakeholder organizations. Current capabilities are determined from the list of existing M&S capabilities (see Section 2). The M&S training needs are the difference between the goals and current capabilities.

The 2009 TMSBP (see Figure 3-1) will explore, in detail, the training needs update process to include input from training stakeholders in the Training Gaps Analysis Forum (TGAF) issues and updating the traditional TC AoA training gaps. The new, validated list of 35 training needs will form the basis for the 2009 TMSBP needs assessment.

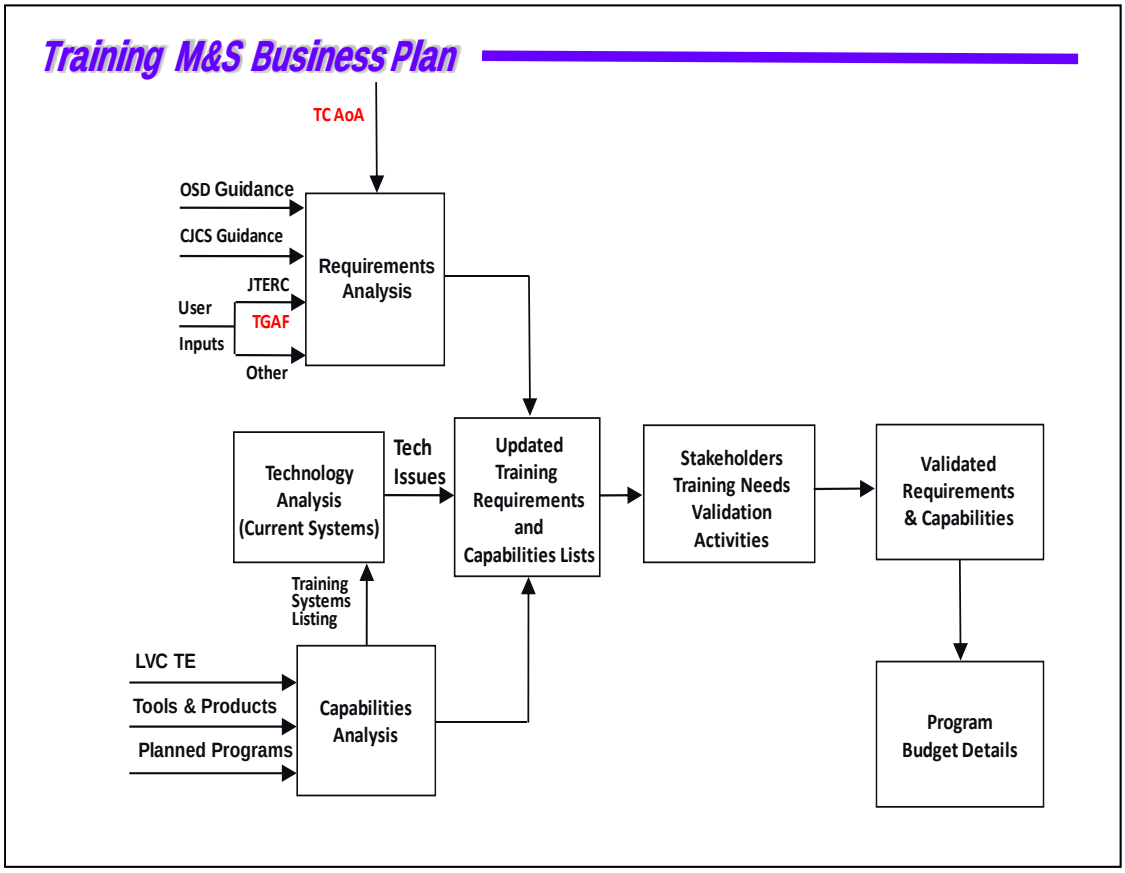

Figure 3-1. Training Needs Update Process

This section presents two analyses of training gaps that collectively indicate the need for improvement in our M&S capabilities. Both analyses are based on the 35 gaps identified by the 2004 TC AoA. The AoA and the 35 gaps are described in Section 3.1 and Table 3-1. Section 3.2 describes the AoA's analysis of the 10 gaps that need immediate attention (see also Appendix B of this document). Section 3.3 presents an analysis of the full 35 gaps. It is based on a data call that solicited information on the ability of a sample of M&S federates to fill the gaps. Because of the constantly evolving nature of training needs and of M&S technologies, the TC AoA is now dated in several regards, and the analysis will be updated in the 2009 TMSBP.

3.1 2004 TC AoA

The foundation of the training community's analysis of gaps and capabilities stemmed from the 2004 TC AoA's analysis of joint and Service training. The TC AoA analyzed the ability to meet joint training needs, as determined from the following sources:

- JMETs identified by the COCOMs and Services.
- Higher level guidance and directives, such as the Quadrennial Defense Review (QDR) (the updated list now includes the GDF, the GEF, and the Chairman's list of High-Interest Training Issues (HITIs)). The HITIs are listed and defined in the Chairman of the Joint Chiefs of Staff (CJCS) Notice 3500.01, *2009–2010 Chairman's Joint Training Guidance*, dated 8 September 2008.[8]
- Training requirements and capabilities identified by the Joint Training Review Group (JTRG). The JTRG is now known as the TGAF.
- The Requirements/Alternatives Business Game and the Senior Steering Group (SSG) meeting conducted in January 2004.
- Data gathered by the JFCOM and the Services.

The AoA study team initially defined 13 gaps between training capabilities and requirements. These gaps were reviewed further by a "Tiger Team" composed of people from the JS J7, the COCOMs, and the Services. This review led to an expansion of the gaps to 35. Table 3-1 lists these 35 gaps in order of decreasing priority as determined by the Tiger Team.[9]

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8 See http://www.dtic.mil/cjcs_directives/cdata/unlimit/n350001.pdf.

9 The Tiger Team divided the gaps into two tiers. Tier I comprises the first 30 gaps, which were identified as transformational and influenced Program Objective Memorandum (POM) 2006 and received

Table 3-1. Training Gaps Identified by the 2004 TC AoA

Gap No.	Gap Description
1	Train combined Joint Task Force (JTF) staffs (includes need for Individual joint training)
2	Train standing joint force headquarters staff (includes need for Individual joint training)
3	Train on crisis action planning and deployments
4	Provide faster/higher fidelity mission rehearsal
5	Train forces on joint urban operations (JUO)
6	Train forces on information operations (IO) (including information warfare, computer network exploitation, computer network defense, and computer network attack)
7	Train forces in a joint interagency intergovernmental, multi-national environment (including intelligence community participants)
8	Provide homeland defense training
9	Provide multi-command missile defense training
10	Train forces in enemy CBRNE exploitation and destruction
11	Train to operate in CBRNE environments
12	Train on effects-based planning and EBO
13	Train theater/strategic forces to conduct C4I operations using collaborative information environment
14	Train forces on realistic logistics requirements (including reception, staging, onward movement, and integration)
15	Practice Active Component/Reserve Component integration and mobilization training
16	Train forces on stability and support operations (SAS)
17	Train forces on military assistance to civilian authorities operations
18	Train Special Operations Forces (SOF) and conventional forces for integrated operations
19	Train forces (operational and tactical level) to use national intelligence systems
20	Train routinely with the Joint Operation Planning and Execution System (JOPES)
21	Train routinely with new adaptive planning and deployment system
22	Train intelligence community as they fight (including all levels as a tactical participant)
23	Train the Joint Interagency Coordination Group (JIACG)
24	Train staff to coordinate personnel recovery operations (PRO)
25	Train global ballistic missile defense (BMD)
26	Conduct global strike training
27	Train critical infrastructure protection
28	Operations/intelligence center training, integration, and command education
29	Strategic information assurance
30	Continuity of operations
31	Train on operational systems (dedicated bandwidth)
32	Train on consequence-management operations
33	Provide special operations crisis action procedures training
34	Provide intelligence community SOF-specific training at the operational level
35	Plan, coordinate, and practice mission assurance

initial or increased funding. Tier II comprises the remaining 5 gaps, which were judged deserving of support at their current levels and increases in funding as needed beginning in FY 08.

3.2 The 10 Areas of Training Deficiency

The AoA presented an analysis of 10 of the initial 13 gaps that were regarded as especially needful of funding. A more complete discussion of these gaps is presented in Appendix B of the this document. These gaps are listed below, followed by a brief summary of problems that must be overcome in filling the gaps:

1. Mission rehearsal capability
2. Adaptable constructive training systems
3. Replication of the ability to train non-kinetic processes and activities
4. Multi-level security (CDIS)
5. Multi-echelon training
6. Strategic context
7. Emerging concepts
8. Emerging missions
9. Embedded training capability
10. Synthetic natural environment (SNE) improvement.

3.2.1 Mission Rehearsal Capability

Preparing mission rehearsals is a time-consuming process. Planning and executing major exercises and rehearsals normally take a year or more. For example, the goal at one point was the ability to develop a large multi-corps (unified-endeavor-type exercise) SNE and scenario database within 96 hours (assuming that source data are readily available) using 8 qualified database builders. Achieving this goal required two actions: developing a capability to generate databases rapidly and taking steps to shorten the joint event life cycle (JELC). A point well taken by the study team was provided by one of the study reviewers. Any discussion of the 96-hour goal for database build is incomplete without also describing some of the fidelity and accuracy needed for the specific training event or exercise. This topic, however, remains a high-priority in the training community because delays in preparing scenario databases can delay the goals of timely and relevant training and because inaccurate or incomplete databases can produce negative training. This situation presents a problem when conducting mission rehearsal exercises (MRXs), where timely and accurate depictions of the mission area are necessary.

3.2.1.1 Rapid Database Generation

Major exercise planning is time consuming because the process is manpower intensive. We lack the ability to standardize and reuse the data repositories. Each component model of the Joint Training Confederation (JTC) has its own unique database that has been built according to its format. A change in one model's database can cause changes in the other models.

One approach to automating this process may involve the following steps:

- Standardizing the format and structure of databases so the data from each component of the simulation or federation can be recognized by all the other components
- Developing a common set of tools that have automatic features such as "drag and drop" and "cut and paste" to automate the archiving, cross checking, manipulating, retrieving, and transferring of data across the various databases
- Developing the ability to generate distributed databases through an Internet-based repository that would be accessible by multiple sites and through a merge capability to "stitch together" multiple inputs
- Developing the ability to train for rapid mission rehearsal, crisis action planning, and deployment.

3.2.1.2 Shortening the JELC

Shortening the JELC requires efforts to shorten exercise planning, which typically takes three planning conferences, three database tests, and a host of other activities. Time can be shortened by the following efforts:

- Streamlining and compressing preparatory events
- Developing a common tool set to automate the five-phase JELC
- Developing interoperability with the Joint Planning and Execution System (JOPES) so exercise planners can directly access courses of action (COAs) that CCDRs have chosen to accomplish their missions.

3.2.2 Adaptable Constructive Training Systems

We need to design constructive simulations to support training instead of building a capability and then adapting the training program to the simulation. Future constructive training simulations should possess all/some of the following characteristics:

- **Be evolutionary instead of revolutionary.** Leverage existing systems and provide new capability through spiral development

- **Have high reliability, availability, and maintainability.** Apply reliability, availability, and maintainability requirements to all elements of all simulations and federations (e.g., system hardware, software, and High Level Architecture (HLA))
- **Be flexible and composable.** Provide features to allow exercise designers to tailor federations to meet the needs of the training audience: object-oriented design to enhance modularity and ease of modification; open architectures and operating systems; representations of the joint operational environment; ease of upgrade and enhancement; standardized tools that are applicable across federates; interface interoperability with existing C4I systems and networks; links to live entities, ranges, and virtual simulators; and links to the JTS (via JTIMS or its follow-on system)
- **Be scalable.** Build training systems that are able to support large numbers of complex objects and interactions while maintaining timeliness and spatial consistency
- **Be aggregable.** Ensure that simulations can group entities while preserving their individual effects and interactions
- **Be distributable.** Ensure that simulations are capable of distributing the exercise better to "move electrons instead of people"
- **Be user friendly.** Use graphical user interfaces (GUIs), help menus, and overall construction to make simulations easy to use without extensive user training
- **Be size friendly.** Manage the growth of bandwidth and throughput of the communications infrastructure
- **Be interoperable.** Be able to simulate and interoperate with interagency and C4I systems, GIG services, the DRRS, and other training management and reporting systems
- **Be operationally capable.** Be able to integrate with C2 services in-theater
- **Have a multi-national interoperability.** Be capable of independently interfacing with training systems of U.S. allies and coalition partners
- **Be able to adapt to doctrinal changes.** Allow rapid integration of training, doctrine, and lessons learned.

3.2.3 Replication of the Ability To Train Non-Kinetic Processes and Activities

Legacy simulations have done well in representing traditional warfighting but are not suited for modeling non-kinetic processes. Because these capabilities are growing in importance, the training community must remedy the following shortfalls:

- **Information operations (IO)/information warfare.** The globalization of networked communications creates vulnerabilities in our information infrastructure, and new simulations must include IO and warfare threats to give training audiences experience in offensive and defensive information warfare. New capabilities should include the ability to
  - Simulate actions (such as disabling computer networks or corrupting essential databases) that would be unacceptable in the real world (for a computer network defense and attack)
  - Portray Psychological Operations (PSYOP) and deception activities
  - Represent the effects of conventional weapons on information grids and networks
  - Portray electronic attacks to disrupt our information systems with jamming, broadcasting false signals, or generating bursts of electromagnetic pulse.
- **Space operations.** An expansion of existing capabilities is required to train warfighters to be fully prepared to use all space systems. Additional capabilities are needed in
  - Depiction of orbiting platforms in the battlespace to allow portrayal of counter-space activities (kinetic kill vehicles or electromagnetic and laser-based systems).
  - Better representation of the effects of disruption or denial of space-based capabilities in surveillance and reconnaissance, communications, environmental sensing, navigation, and theater missile warning
  - Better representation of ballistic missile launch processes and trajectories, including indications and warnings that would be available to a training audience in a real-world situation
  - Better representation of ballistic missile warning—space-based and terrestrial systems that detect, track, and report on ballistic missile launches that pose potential threats to North America, geographic theaters of operation, and space-based assets.
- **Battle damage assessment (BDA).** The battlespace and intelligence federates require enhancement to be able to fully train the ability to identify and prioritize critical targets and conduct realistic BDA.
- **Intelligence, surveillance, and reconnaissance (ISR).** While some simulations of aspects of our intelligence capabilities are good, we have a need for enhancement in the following areas:
  - Representation of the entire intelligence cycle at the national, joint, theater, and tactical levels

  - Higher fidelity simulation of tactical and national intelligence assets and behaviors
  - Better integration of ISR products to produce fused and JTF-level and higher formatted intelligence reports
  - Better portrayal of human intelligence (HUMINT) and measurement and signal intelligence (MASINT) capabilities.

- **Defense support to civilian authority.** The new emphasis on homeland security has generated a need for simulations to train staffs for man-made disasters and for providing assistance for civil disturbances, counterterrorism, and so forth.
- **Mobilization/deployment/redeployment.** A more comprehensive depiction of these activities is needed for joint training. Future simulations must incorporate the following features:
  - Automated Joint Logistics Over-the-Shore (JLOTS) operations
  - Automated Maritime Pre-positioned Force (MPF) operations
  - Depiction of individual transportation vehicles moving equipment, personnel, and supplies between origins, ports of embarkation (POEs), ports of debarkation (PODs), and final destinations
  - Airport and seaport throughput capabilities and operational activities, as affected by combat events
  - Environmental factors that can impede the movement of equipment, personnel, and supplies
  - All phases of redeployment, including reconstitution, movement to POEs, strategic lift, reception at PODs, and joint reception, staging, onward-movement, and integration (JRSOI)
  - Rapid alteration of time-phased force and deployment data (TPFDD) in response to ever-changing circumstances
  - Depiction of appropriate level of detail in TPFDD in the simulation battlespace.
- **Sustainment.** Simulations must provide a more realistic treatment of global and in-theater sustainment, including health services; transportation and supply; maintenance, repair, and salvage; and engineering and communication systems. The 2009 TMSBP will expand on this area, consistent with the priorities of the TGAF. Part of this capability will be the inclusion of the Defense Logistics Agency (DLA) and the United States Transportation Command's (USTRANSCOM) Deployment Distribution Operations Center (DDOC).

- **JRSOI.** Future simulations must more accurately portray moving forces all the way from reception at PODs to integration with parent organizations at combat sites. Reception, staging, onward movement, and integration (RSOI) should be modeled in ways that are transparent to the training audience, and require little or no human-in-the-loop (HITL) by exercise control people.

3.2.4 Multi-Level Security (Cross-Domain Information Sharing (CDIS))

Security access continues to limit the ability to train with our interagency and multi-national partners, and the TC AoA validated the need and importance of addressing multi-level security issues. Current operations and the stakeholders' input through the TGAF have redefined this area as CDIS, which currently is Training Group #3, and includes a total of five training needs. The 2009 TMSBP will address this persistent need in more detail. This area also includes the disclosure of U.S.-sensitive information to foreign national partners in training events.

3.2.5 Multi-Echelon Training

The future constructive system must be capable of providing an environment that will allow end-to-end training—from the functional command element to tactical units in the field and involving C2 elements at every level in between. The 2009 TMSBP will address the training need in greater detail since significant progress has been made in this area in the 5 years since publication of the TC AoA.

3.2.6 Strategic Context

This issue involves national-level collaboration on joint training events to support the national military strategy and the GWOT. Such training would also be used as a stepping-stone to focus the interagency training program on COCOM requirements.

3.2.7 Emerging Concepts

Legacy constructive systems have not kept pace with new warfighting capabilities and concepts. During the last 5 years, the training community has made progress in recognizing the emergent threats as they were discussed in the TC AoA. As a result, this section will be rewritten in the 2009 update to include the most current terminology and vocabulary used to discuss the threat areas, the training needs, and the enhanced M&S capabilities required. The following list has been brought forward for the TMSBP updates almost directly from the TC AoA:

- **Operational net assessment.** Operational net assessment is a tool to give JTF commanders the knowledge of an adversary's full warmaking characteristics—political, military, economic, social, infrastructure, and information. Future constructive simulations will require a comprehensive representation of operational net assessment capabilities.
- **Effects-based operations (EBO).** Future simulations must be capable of portraying a broad range of outcomes that could result from EBO. Improvements include portrayal of the following features:
  - Positioning of targets in the SNE and the civil environment
  - Enemy infrastructure (e.g., communication and electrical grids, gas and oil pipelines, rail and road lines, and C2 centers)
  - Psychological effects caused by conventional military operations or PSYOPS
  - Weapons capabilities and their lethal and non-lethal effects on intended targets
  - Cumulative effects resulting from the aggregation of direct and indirect effects at varying levels of war
  - Cascading effects that can ripple through an adversary's target system and influence other related target systems
  - Assessing damage to targets for BDA.
- **Collaborative information environment.** Collaborative tools will help CCDRs and joint staffs plan and disseminate operations, link the staffs to subject matter experts (SMEs), and integrate the joint force with allies and other partners.
- **Joint urban operations (JUO).** Since urban centers are becoming more common as sites of conflict throughout the world, constructive simulations must be able to portray JUO in enough resolution to depict forces in varied urban environments.
- **Joint fires.** Destroying enemy forces before they can be used against friendly forces puts a premium on training the synchronization of intelligence, air operations, ground operations, maritime operations, and logistics in time and space.
- **Stability operations.** Simulations are needed to train JFCOM personnel to estimate the time and forces needed to control civilian populations through riot control and non-lethal munitions and techniques.
- **Joint close air support (JCAS).** The complexity of JCAS mandates that the cross-federate interactions within the simulation battlespace be seamless and realistic.

- **Integration of SOF with conventional forces.** Few M&S tools adequately depict SOF. At a minimum, simulations should consider SOF mission areas such as combating terrorism and PSYOPS, and collateral activities such as coalition support and foreign humanitarian assistance.
- **SOF-specific platforms and communications.** Operations in Afghanistan and Iraq indicate a growing need to train the integration of SOF and conventional forces.
- **Chemical, biological, radiological, nuclear, and high-yield explosives (CBRNE) operations, exploitation and destruction.** The 9/11 attacks against the United States highlighted interest by our adversaries in asymmetric attacks against undefended targets, as opposed to direct conventional military confrontations. Therefore, future training simulations must incorporate a realistic portrayal of CBRNE operations in military and domestic scenarios, which would include aspects of crisis management and consequence management.
- **Personnel recovery operations (PRO).** Simulations should be capable of portraying PRO to recover captured, missing, or isolated personnel from harm's way.
- **Ability to train to force protection requirements.** Simulations should be capable of training how to improve the security of our forces against terrorist activities.
- **Test/training/experimentation environments.** Although the COCOMs and Services want training simulations to be capable of supporting the testing and experimentation communities, this capability is of secondary importance. The resources spent on delivering it should be limited.

3.2.8 Emerging Missions

DoD must be capable of providing training for new emerging missions, such as the U.S. Strategic Command (STRATCOM) (e.g., global strike and global BMD), U.S. Special Operations Command (SOCOM) (e.g., GWOT), and U.S. Northern Command (NORTHCOM) (e.g., homeland security) to reduce U.S. vulnerability to terrorism and to minimize the damage from possible future attacks. Training for the homeland security mission requires

- Countering CBRNE
- Providing a C2 capability that ranges from interagency communications to communications with local law enforcement and other first responders

- Providing the civil environment (transportation, utilities, electrical grids, community water systems, pipelines, and so forth) enough detail to support training for critical infrastructure protection
- Providing intelligence and warning capabilities representative of real-world capabilities tailored for the homeland defense mission
- Portraying the activities and behaviors of Coast Guard, law enforcement, first-responder units, non-governmental organizations (NGOs), and so forth within the simulated environment
- Linking into the LVC environment
- Providing training in the areas of consequence management and media relations.

3.2.9 Embedded Training Capability

Newly acquired real-world systems should possess embedded training capabilities that are interoperable with other systems in the LVC training environment.

3.2.10 SNE Improvement

The SNE provides simulations with the representation of natural features (e.g., terrain, atmosphere, ocean, space, and weather) and some man-made entities (e.g., nuclear, chemical, and biological contamination). These features are often included during runtime by controller modification.

3.3 Subsequent Analysis of the 35 AoA Gaps

This section describes the second, more recent analysis of the AoA gaps mentioned in the introduction to Section 3. The purpose of this analysis was to review the extent to which current M&S federates can fill each of the 35 TC AoA. The analysis also determined how well the current and planned capabilities serve various training audiences.

Information for the analysis was obtained through a data call to major joint and Service training organizations. These respondents were asked to provide information on several of the federates they manage. Section 3.3.1 describes the data call, and Section 3.3.2 presents the analysis.

An assumption underlying this analysis is that joint training needs and capabilities continually change and that identifying joint training gaps is properly viewed as a process rather than a single product. This assumption suggests that the gaps analyses performed for the TC AoA and for this later analysis should be routinely repeated to sustain open

and active communication between the joint training and operations communities. The frequency, structure, and content of these analyses should also be topics for periodic review.

3.3.1 Data Call

An initial review identified 130 existing simulations and simulation tools that might address one or more of the TC AoA gaps. Analyzing all these tools was beyond the scope of the analysis. Instead, a sample of federations of simulations and simulation tools was selected for analysis. It seems unlikely, however, that examining all available simulations and simulation tools would have led to substantially different conclusions and investment recommendations.

Eight training federations were provided by the stakeholders and selected for review. They are described in Appendix C of this document and Volume II of the 2007 TMSBP. The eight federations are listed below under the organizations that maintain them and that responded to the data call:

- Joint Warfighting Center (JWFC) J7
  1. Joint Live Virtual Constructive (or JLVC)
  2. Joint Multi-Resolution Model (or JMRM)
- Army Program Executive Office for Simulation, Training, and Instrumentation (PEO STRI)
  3. Joint Land Component Constructive Training Capability (JLCCTC) Multi-Resolution Federation (MRF)
  4. Joint Land Component Constructive Training Capability (JLCCTC) Entity Resolution Federation (ERF)
- Navy Fleet Forces Command (Training Operations Directorate)
  5. Battle Force Tactical Trainer (BFTT)
  6. Navy Continuous Training Environment (NCTE)
- Marine Corps Training and Education Command (TECOM)
  7. Marine Corps Deployable Virtual Training Environment (DVTE)
- Air Force Agency for Modeling and Simulation (AFAMS)
  8. Air and Space Constructive Environment (ACE).

The data call described the 35 TC AoA gaps and asked each respondent for information on the following five questions, which were designed to indicate how well each of the federates under their purview fills the needs of each of the 35 gaps:

1. What major training M&S enhancements have occurred since 2004?
2. How well—high, medium, low, or not applicable[10]—do the enhancements serve each of five training audiences[11]?
3. What are the major remaining shortfalls in filling each gap?
4. What solutions might be pursued to address these remaining shortfalls?
5. Are there any comments you wish to add?

The focus was on M&S training capabilities that are either currently available or that are planned to be available by the end of FY 08. Responses to these questions summed across all responding federations are shown in Volume II, Appendix D of the 2007 TMSBP.

3.3.2 Analysis

3.3.2.1 How Well Do Federates Support the Training Audiences?

Table 3-2 shows the results of the query regarding the second question above. Responses were received for the eight federations, so that the entries in the high, medium, and low ratings for each of the 5 training audiences sum to 280—the number of federations (8) multiplied by the number of gaps (35). The figures indicate that the sponsoring organizations felt that the federates were doing a good job of meeting the training needs of Training Audience 1. If we ignore the not applicable rating, fully 83% (161/193) of the federation-gap responses were in the high and medium category. The results for Training Audiences 2–4 are similar, but Training Audience 5 (Crew and Individual) trainees are covered to a much lower extent—only 47% high and medium ratings, or a little more than half of the 77–85% for the other training audiences.

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10 **High:** The federation fully (or nearly so) supports the training audience. **Medium:** The federation supports the training audience. **Low:** The federation supports the training audience to a minor degree. **Not Applicable:** The federation does not support the training audience.

11 **Training Audience Level 1:** Regional COCOM or Multi-COCOM. **Training Audience Level 2:** JTF (Operational). **Training Audience Level 3:** Service Components (Operational). **Training Audience Level 4:** Service (Tactical). **Training Audience Level 5:** Crew/Individual (Tactical).

Table 3-2. Reported Extent of Training Audience Support Summed Over the Data Call Federations

Ratings	TA(1) Regional COCOM or Multi-COCOM	TA(2) JTF (Operational)	TA(3) Service Components (Operational)	TA(4) Service (Tactical)	TA(5) Crew and Individual (Tactical)
High	108	117	104	69	26
Medium	53	54	54	100	37
Low	32	31	46	30	71
Not Applicable	87	78	76	81	146
Total	280	280	280	280	280
High + Medium	161	171	158	169	63
High + Medium + Low	193	202	204	199	134
High and Medium (%)	83%	85%	77%	85%	47%

3.3.2.2 What Are the Major Shortfalls in Filling the Gaps?

Table 3-3 indicates how well federates are addressing the various AoA gaps (see the third question on p. 3-14). It lists the gaps in the upper and lower quartiles of support, along with their TC AoA priorities.

Table 3-3. Ability of Federates To Address TC AoA Priorities

TC AoA Priority	Upper Quartile
1	Train Combined JTF staffs (although more attention to individual joint training may still be needed)
2	Train standing joint force headquarters staff (again, more attention to Individual joint training may be needed)
4	Provide faster/higher fidelity mission rehearsal
7	Train forces in a joint interagency intergovernmental, multi-national environment (including intelligence community participants
8	Provide homeland defense training
22	Train intelligence community as they operate (including all levels as a tactical participant)
24	Train staff to coordinate personnel recovery operations (PRO)
28	Operations/intelligence center training, integration, and command education
TC AoA Priority	**Lower Quartile**
11	Train to operate in chemical, biological, radiological, nuclear, and electromagnetic environment
15	Practice Active Component/Reserve Component integration and mobilization training
17	Train forces on military assistance to civilian authorities operations
21	Train routinely with new adaptive planning and deployment system
23	Train the JIACG
29	Strategic information assurance
30	Continuity of operations
35	Plan, coordinate, and practice mission assurance

4. Training Capabilities Baseline

Consistent with the theme of constantly evolving threats and needs, the training community has continued to improve the suite of capabilities for conducting joint training. The 2004 TC AoA identified models and federations that the Services, JFCOM, and the intelligence community regarded as relevant to joint training requirements. As discussed previously, the operational and training needs and the technologies as captured in the TC AoA are constantly evolving. The training community has progressed from the baseline described here to include many of the desired capabilities. However, much remains to be done (e.g., providing robust simulations to capture the integrated air and missile missions for training, CDIS, and joint logistics) in several long-term functional areas.

4.1 TC AoA Base Case

The "TC AoA Base Case," includes the following:

- Logistics Federation (LOGFED)
- Warfighters Simulation (WARSIM)
- One Semi-Automated Force (OneSAF)
- Army Constructive Training Federation (ACTF)
- Deployable Simulation for Collaborative Operations (DISCO)
- Adaptive Communications Reporting Simulation (ACRES)
- Information Warfare Effects Generator/Dynamic Communications Environment (IWEG/DCE)
- National Wargaming Simulation Next Generation (NWARS-NG)
- Air Force Modeling and Simulation Training Toolkit (AFMSTT)
- Air Force Synthetic Environment for Reconnaissance and Surveillance/Multiple Unified Simulation Environment (AFSERS/MUSE)
- Suite of five computer simulation models for warfare C2 (JQUAD+)[12]
- Joint Semi-Automated Forces (JOSEF)

[12] JQUAD+ consists of four related sub-models: Joint Electronic Combat Electronic Warfare Simulation (JECEWSI), JCAS, Joint Operations Information Simulation (JOISIM), and Joint Network Simulation (JNETS).

- Joint Theater Level Simulation (JTLS)
- Joint Conflict and Tactical Simulation (CATS).

Chapter V of the TC AoA, "Assessing Effectiveness," rated each of these simulations for its contribution in removing the training gaps listed in Chapter III of the report. One observation was that "taken together, current simulations have significant capability for removing the TC AoA training gaps." Although the 2004 TC AoA is a good reference document, many of the simulations and federations listed previously have evolved over the last 5 years. A current base case will be validated for the 2009 TMSBP.

Keeping the update of our training capabilities in the context of the detailed analysis found in the TC AoA is useful. Since the summer of 2004, several efforts have been funded to enhance the previous base-case simulations to close the gaps further. In addition, after the publication of the 2004 TC AoA, an OSD Program Decision Memorandum (PDM) identified $94 million in funding across FY 06–11 for work in 3 of the alternatives the AoA recommended:

- **Alternative #3, Modeling and Simulations.** The TC AoA recommendation for achieving the objectives defined in the Alternative 3 COA is to produce a joint M&S LVC toolkit. The toolkit will consist of existing programs of record that can be tailored to meet the needs of the joint user. Enhancements to these existing capabilities will be designed to close the functional gaps in joint training requirements. A major advantage of this approach is that it gives DoD the ability to insert an emerging technology or existing system (e.g., specialized models for homeland security training and for joint C2 COCOM training) into the architecture. The functional capability of the M&S tools in the toolkit, the needs of the training audience, and the training objectives will drive the composition of a simulation federation.

  Alternative #3 was funded at $43 million across FY 06–11.

- **Alternative #4, Innovative Acquisition.** The AoA SSG directed a prototype activity to determine the viability of the business model described in Alternative 4. The focus of the prototype is to explore the alternative business approach to acquiring training. In simple terms, the prototype is about business efficiencies for providing training. Although the activities funded under this alternative were intended to examine the business aspects of purchasing training products and services, the functional training content provided to sponsoring COCOMs will also address one or more TC AoA training gaps.

  Alternative #4 was funded at $14 million across FY 06–11

- **Alternative #5, Reengineering Training.** This alternative requires the DoD to initiate revolutionary changes in the joint training construct. The near-term objective is to provide COCOMs the personnel, funding, and the joint training technology alternatives required to meet joint individual and staff training requirements. The joint training technology alternatives identified in Alternative 5 provide the on-demand and composable capability required by COCOMS to conduct training for individuals and staff serving in joint force headquarters from component commands through COCOMs. Several of the alternative technologies are currently being funded in efforts led by the JFCOM:
  - Lightweight simulations/federations
  - Massively multi-player gaming
  - Story-driven training
  - Joint-community-unique federates
  - Instructor support tools
  - Embedded training.

  The alternative technologies (Alternative #5), which are defined in Chapter IV of the 2004 TC AoA, were funded at $37 million across FY 06–11.

In addition to this list of projects funded in response to the TC AoA, changes to the federates have resulted because of new requirements articulated by stakeholders and sponsors and because of continuing enhancements under existing Service and JFCOM programs.

4.2 Updated Training Capabilities Baseline

In 2008 and early 2009, the OSD JAEC office undertook an update of the TC AoA capabilities base case to produce a "Capabilities Landscape." That work expanded from the previous list of constructive simulations to include the virtual simulators and the C4I capabilities needed to enable a more robust play of these functions during training exercises. The C4I M&S representations, stimulations, and interfaces are an important aspect of training in support of large training exercises.

The federations that currently form the training capabilities baseline (with the Sponsor in parentheses) include

- Joint Live Virtual and Constructive (JLVC) federation (Joint)
- Joint Multi-Resolution Model (JMRM) federation (Joint)
- Entity Resolution Federation (ERF) (Army)

- Multi-Resolution Federation (MRF) (Army)
- Air, Space, and Cyber Constructive Environment (ASCCE) (Air Force)
- Distributed Mission Operations Center (DMOC) (Air Force)
- Navy Continuous Training Environment (NCTE) (Navy)
- Marine Corps Federation (MCFED) (Marine Corps)
- Deployable Virtual Training Environment (DVTE) (Marine Corps)
- Joint Training Support Center (JTSC) (Special Operations Forces (SOF)).[13]

These federations have been decomposed in Tables 4-1–4-9 to indicate the detailed constructive simulations, virtual simulators, and C4I simulators and devices that are included in each. Refer to Appendix D of this document for a short description of these federations.

This section will be expanded in the 2009 TMSBP to indicate tangible progress to achieve many of the early capabilities goals as described in the TC AoA and updated training needs assessments.

13 The JTSC is not a federation in the same sense as the others listed. It is an independent training facility and network providing C4I capabilities.

Table 4-1. Constructive Simulations

Sponsor	Product	Purpose	JLVC(J)	JMRM(J)	ERF(A)	MRF(A)	ASCCE(AF)	NCTE(N)	McFed(MC)	DVTE(MC)	DMOC(AF)	JTSC (SOC)
NSA	ACRES	SIGINT modeling										
AF	ASCCE-IOS	Air Intel										
	ASSET	Elint Simulation										
Navy	ATLOS	Propagation										
AF	AWSIM	Air Power										
MC	CACCTUS	Ground maneuver-Entity										
Army	CB Sim Suite	CBRNE effects										
Army	CBS	Maneuver-Aggregate										
Army	EADSIM	Air, missile, space warfare										
Army	FIRESIM	Artillery										
AF	GEG	GPS Environment Generator										
Army	IEWTPT	Intel Model										
Joint	JCATS	Joint Maneuver-entitiy										
Joint	JLOD	Wrap around										
Army	JNEM	Non Knetic										
Navy	JSAF	Maritime Power										
Joint	JTLS	Joint Maneuver-Aggregate										
Army	LOGFED/JDLM	Logistics Simulations Model										
MDA	MDST	Missile defense										
	ModSAF	Entity Level Maneuver										
MC	MTWS	Amphibious Ops										
AF	MUSE/AFSERS	UAV										
AF	NGTS	High Fidelity Constructive Aircraft										
NRO	NWARS NG	National Intel										
Army	OneSAF	Ground maneuver-Entity										
	OTB	OneSAF Test Bed										
MDA	RE	Threat Ballistic Missile Flyout										
Navy	RESA	Naval Power										
MC	Shadow UAV	UAV										
AF	SSG	Space Order of Battle										
Army	TACSIM	Ground Intel										
MC	VBS 2	Ground maneuver-Entity										
N/A	VRSG	Visuals										
Army	WARSIM	Ground maneuver-Aggregate										
Army	WIM	Intel Model										

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Table 4-2. C4I Interfaces See Note 1

Sponsor	Product	Purpose	JLVC(J)	JMRM(J)	ERF(A)	MRF(A)	ASCCE(AF)	NCTE(N)	McFed(MC)	DVTE(MC)	DMOC(AF)	JTSC (SOC)
AF	ASCCE-CSI	C2 to Constr interface										
Navy	C4I Gateway	OTH-Gold Interface										
Army	eTSIU	EADConstr msg translator										
Army	ExCIS	AFATDS interface										
Army	HDC	HLA/DIS Gateway										
Navy	HLA/DIS Gateway	DIS/HLA Gateway										
AF	JDT	Reporting Responsibility (TADIL)										
Joint	JECS	Data manipulator/C4I interface										
Joint	JLVCDT/JBUS	Gateway										
MC	LVC Game	HLA/DIS Gateway										
Navy	MLST3	Link Interface										
	Rialto	Lower-to-Middle Enclave Guard										
	RM	Lower-to-Middle Enclave Guard										
Army	RTM	Stimulates ABCS										
Army	SIMPLE	C4I Interface										
	SMART	Middle-to-Upper Enclave Guard										
	TCSP	Upper Enclave Guard										

Note 1 for Table 4-2: *Interface: Connects different simulation architectures or connects training systems to operational C4ISR devices.*

Table 4-3. Tools See Note 1

Sponsor	Product	Purpose	JLVC(J)	JMRM(J)	ERF(A)	MRF(A)	ASCCE(AF)	NCTE(N)	McFed(MC)	DVTE(MC)	DMOC(AF)	JTSC (SOC)
Army	AARS	AAR										
AF	AAT	Analysis										
Army	ARCHER	AAR										
Army	BICM	Intel										
Joint	EDCSS	METOC scenario dev interface										
Army	FMT-R	Federation management tool										
AF	GEO VIZ	AAR										
AF	GIAC	GUI										
Army	ISM	MSEL inject to C4I										
Joint	JAAR RL	AAR										
Joint	JDAAR	Analysis Tool										
Joint	JSPA	HLA data analyis										
Joint	JTDS	Scenario Generation										
AF	LOGSIM	AF Logistics										
Navy	OASES	Weather tool										
Army	SASS	Network security admin										
AF	SGS	Rapid Database Generation										
Joint	SITH	Analysis										
AF	STAGE	Environmental generator										

Note 1 for Table 4-3: Tool: A federate that monitors, manipulates, stores, or retrieves simulation data or information but is not a simulation.

Table 4-4. U.S. Air Force Virtuals

Product	Purpose	JLVC(J)	NCTE(N)	DMOC(AF)	JTSC(SOC)
A-10	Aircraft				
AWACS	Aircraft				
B-1	Aircraft				
B-52	Aircraft				
C-17	Aircraft				
C17A	Aircraft				
CRC	Ground based control center				
F-15C	Aircraft				
F-15E	Aircraft				
F-16 Block 40	Aircraft				
F-16 Block 50	Aircraft				
F-22	Aircraft				
IFACT	CAS/CFF Trainer				
JSTARS	Aircraft				
JTC-TRS	CAS/CFF Trainer				
Raven	UAV				
RC 135 RJ	Aircraft				

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Table 4-5. U.S. Army Virtuals

Product	Purpose
AVCATT	Collective Helicopter Training
CCTT	Mech and Armor Collective Training
CFFT	Indirect Fires and CAS Training
Dismounted Soldier	Collective Dismounted Training
EST 2000	Marksmanship Training
RVTT/RVS	Convoy & Wheeled Vehicle Training

Table 4-6. U.S. Marine Corps Virtuals

Product	Purpose	JLVC(J)	DVTE(MC)
AH-1W	Helicopter		
AV-8B	Aircraft		
CH-46	Helicopter		
CH-53	Helicopter		
EA-6B	Aircraft		
F/A-18	Aircraft		
KC-130	Aircraft		
MAST	CFF Trainer		
MV-22	Aircraft		
UH-1	Helicopter		

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Table 4-7. U.S. Navy Virtuals

Product	Purpose	JLVC(J)	NCTE(N)	DMOC(AF)
Aegis	Ship			
BFTT	Ship Trainer			
E-2C	Aircraft			
EA-6B	Aircraft			
EFAAS	Ship Trainer			
EP-3 MAST	Aircraft			
F-18	Aircraft			
FAST	Aircraft			
H-60B	Helicopter			
H-60E	Helicopter			
H-60R	Helicopter			
H-60S	Helicopter			
MRT3	Helicopter			
P-3C	Aircraft			
SMMTT	Submarine			
TSTS	Ship Trainer			
V-ASTAC	Ship Trainer			

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Table 4-8. U.S. SOCOM Virtuals

Product	Purpose	JLVC(J)	DVTE(MC)	DMOC(AF)	JTSC(SOC)
AC-130C	Aircraft				
AC-130H/E	Aircraft				
ASDS	Advanced Seal Delivery System				
CV-22	Aircraft				
JMPRS	Mission planning and rehearsal				
MC-130H	Aircraft				
MC-130H/E	Aircraft				
MH-47	Helicopter				
MH-6	Helicopter				
MH-60	Helicopter				
MH-53	Helicopter				
SAGIS	CAS/CFF Trainer				
SVS	Ground				
TSS	Tower Simulator System				
UAS	UAV				

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Table 4-9. C4I Virtuals

Product	Purpose	JLVC(J)	JMRM(J)	ERF(A)	MRF(A)	ASCCE(AF)	NCTE(N)	McFed(MC)	DVTE(MC)	CACCTUS(MC)	DMOC(AF)	JTSC(SOC)
AADC	Air Defense Planning	■										
ADSI	Tactical Data Link (TDL) Picture	■	■	■		■					■	
AFATDS	Fire Support information exchange	■		■	■		■	■	■	■		
AMDWS	Air and Missile C2	■		■								
ASAS-L	Intel C2	■		■								
BCS3	Logistics C2	■		■		■						
BVI	Intelligence Fusion	■										
C2BMC	Missile Defense											
C2PC	Common Operating Picture Interface	■	■			■		■	■	■	■	
C2PC	COP distribution	■										
CAMPS	Strategic Air Lift Planning	■		■	■							
CCD	Link	■				■					■	
CFAST	Campaign planning tool											
CPOF	Integrated C2	■		■								
CSP	AUTODIN Message Traffic	■				■						
DCGS	Intelligence Fusion	■										
D-DACT	Communications terminal								■			
ESTAT	Execution Status and Monitoring					■					■	
EX SMS	In transit visibility	■										
Falcon View	Mission Planning/C2	■				■						■
FBCB2	Positioning and communication device	■		■					■			
GALE Lite	Intel Fusion	■										
GCCS-A	C2 system	■		■		■						
GCCS-J	Joint C2	■	■			■						
GCCS-M	Maritime C2	■				■		■			■	
GDSS	Force Flow	■										
GES	Force Flow	■										
IMOM	Improved Many on Many	■										
IOSv1	Situational Awareness	■						■				
IOSv2	Intel Fusion	■						■				
IPL	Intel Imagery	■				■						
ITS	Target BDA	■										
JADOCS	Deep Operations C2	■									■	
JOPES	Planning System										■	
JSWS	Intel Imagery	■		■								
MCS	COP distribution	■		■		■						
MCS-L	Situational Awareness	■										
M-DACT	Mobile Communications Terminal								■			
PSS-SOF	Fire Support information exchange											■
SBIRS	Ballistic Missile Early Warning	■				■						
SOMPE	Mission Planning											■
TBMCS	Air Campaign Planning	■				■	■				■	
TIGER AWARE	Intel Fusion	■										
TLDHS	Locate, designate and handoff targets											

■ Integrated System

5. Roadmap for the Future

5.1 Introduction

Section 3 of this report addressed the broad areas in which current and programmed capabilities fail to meet the requirements of joint training. Section 4 discussed M&S efforts that are currently underway. This section discusses progress on the strategies for making future M&S improvements to meet the requirements. The discussion of these strategies includes short descriptions of the FY 06–08 projects that were funded by M&S CO and sponsored by the training community.

Seven of the 16 strategies recommended in the 2007 TMSBP have been addressed, at least in part, by FY 06–08 projects funded by M&S CO. Some of the projects address part of, or serve as an enabler for, one or more of the strategies. Each is summarized below in the context of the strategy it most closely addresses. The detailed study project details and documents are accessible through the M&S CO. Tables 5-1 and 5-2 (see the end of Section 5) have been updated to show which strategies and training gaps have been addressed by these projects. Table 5-3 (see the end of Section 5) has been added to list the FY 06–08 TC projects funded by M&S CO, with the strategy each most closely addresses, the estimated project end date, other communities of interest, and funding.

Not included are projects outside the set funded by M&S CO in FY 06–08, with oversight by the training community. The 2009 TMSBP will include an updated assessment that will identify the M&S capabilities beyond those implemented in FY 06–08 under M&S CO funding. Based on this document (i.e., the 2009 TMSBP), future update and refinement of needs and capabilities assessment will be performed. Also, new strategies will be recommended in the 2009 TMSBP.

5.2 Investment Strategies

This section revisits the 16 investment strategies recommended in the 2007 TMSBP. The recommendations for these investment strategies are based on the information obtained in the data call analyzed previously—the training audience and gap analysis, enhancements to the federates, major remaining shortfalls, and proposals by the organizations who responded to the data call.

The investment strategies are listed below in order of priority. This list is followed by detailed descriptions of the strategies in Sections 5.2.1–5.2.16. Section 5.3 analyzes them by specifying which of the 35 AoA gaps they are intended to fill.

1. Common object model
2. Rapid correlated terrain data
3. Rapid scenario-based individual and small team training
4. Operational environments
5. Logistics and infrastructure
6. Cross-domain security and multi-national information sharing
7. Forces – unit and electronic OOB
8. Common general-purpose interface
9. Mission environment – economic, diplomatic, political, and indigenous civilian
10. Human Intelligence (HUMINT)
11. Mission environment – medical, public health, and related
12. Information operations (IO)
13. Network warfare – net-centric environments
14. Second-order effects for effects-based planning and EBO
15. Electronic warfare (EW) and information warfare
16. CBRNE detection and effects.

5.2.1 Common Object Model

A common object model is software that provides a commonly understood mechanism for specifying the exchange of public data and the general coordination among members of a federation of simulations. Its purpose is to improve interoperability and communication between objects in distributed operating systems and protocols (heterogeneous networks) in the exercise. It also improves the reuse of these objects in other simulations. The model should operate independently of hardware type and facilitate users' compatibility with all other devices.

Development of a common object model would facilitate realistic training in rapidly evolving environments that require a continual assessment of plans, policies, and procedures for lessons-learned reviews. It would also advance the development of simulation training for individuals and staffs across most—if not all—TC AoA gaps that can

be addressed by joint training M&S. It would be especially important in training that requires communication and interoperability among federated simulations, such as staff operations; interagency, intergovernmental, and multi-national operations; C4I; logistics; Active Component/Reserve Component integration; global strike; and other continuing operations.

Project: The FY 08 Joint Composable Object Model (JCOM) project, which was funded by M&S CO, led by the JFCOM, and executed by the Johns Hopkins University (JHU) Applied Physics Lab (APL), General Dynamics Information Technology (GDIT) and MITRE, is aimed at standardizing a set of common object models that will provide a neutral mechanism for documenting object models at the conceptual level. The project team is also implementing a pilot object model library to determine its potential for rationalizing investments across DoD by promoting reuse across different architectures. The estimated completion date for this project is October 2009.

5.2.2 Rapid Correlated Terrain Data

Capabilities being developed in this area are designed to shorten the time to incorporate new terrain data into simulations, thus making it possible to shorten the JELC and train individuals and small teams more quickly in crisis-action planning and JUO. Preparing visual terrain data is typically a manual process in which development teams spend several months and thousands of dollars creating small sections of a simulated environment. Techniques for rapidly producing correlated data, which may cover land terrain, ocean, air, and space, are especially important in distributed simulations, where each node is responsible for maintaining its own model of the environment. Inconsistent data among the separate nodes can produce unrealistic simulations and interfere with training operations and interoperability. Improvement in this area will provide faster, more agile mission rehearsals, level the training field for all participants at all levels, and allow more ready use of national intelligence systems.

Projects:

1. The FY 07 Space Environment Impact System (SEIS), which was funded by M&S CO, led by the U.S. Air Force, and executed by the National Geophysical Data Center (NGDC), is a Web-based tool. It merged space weather data with impact rules to create an effects matrix that can be accessed by simulations to replicate space-based systems and performance. This project was completed in May 2008.
2. The FY 08 Common LVC Terrain Database Evolution project team, which was funded by M&S CO, is continuing to modify the Rapid Unified

Generation of Urban Databases (RUGUD) and develop the Objective Terrain Format (OTF) database. RUGUD is a government off-the-shelf (GOTS) data processing framework capable of exporting correlated and formatted data, including OTF, for representing the SNE used by the OneSAF Objective System (OOS). This effort is led by the PEO STRI and executed by PEO STRI Project Manager for Training Devices (PM TRADE). The estimated completion date was to be June 2009.

3. The FY 08 Training for Aviation Urban Operations (TAUO), which was funded by M&S CO, promotes the development of standards, architectures, networks, environments, and methodology for developing common databases that are critical to providing the detail necessary for replicating warfare in complex urban environments. This project is led by the U.S. Coast Guard and executed by the Scientific Research Corporation (SRC) and Lockheed Martin Corporation (LMC). The estimated completion date is December 2009.

5.2.3 Rapid Scenario-Based Individual and Small Team Training

Capabilities being developed in this area should improve the ease with which local staffs in garrison and theater can author or edit types of scenarios and, to some extent, simulations to meet special, local, and short-fuse training needs. These capabilities will provide more realistic training in rapidly evolving environments, such as crisis action planning and local and joint urban operations.

Projects:

1. The FY 06 JDA Phase I project team, which was funded by M&S CO, produced 10 recommendations in its final report delivered in September 2007:

   a. *Recommendation 1.* Conduct an M&S SC survey and analysis to review ongoing data initialization programs and capabilities in the M&S and C4ISR communities

   b. *Recommendation 2.* Conduct an M&S SC survey and analysis of data related tools and utilities

   c. *Recommendation 3.*Adopt a Service-oriented architecture (SOA) for JDA solution integration framework

   d. *Recommendation 4.*Develop the JDA solution using a series of short (6- to 9-month) spirals of evolving capabilities

   e. *Recommendation 5.*Develop the JDA solution as part of a comprehensive community of interest (COI) activity, subject to DoD Net-Centric Data Strategy, GIG, and other pertinent DoD issuances

f. *Recommendation 6.* Establish a JDA solution governance body to set M&S data capability vision and to oversee M&S data capability development

g. *Recommendation 7.* Involve C2 programs and communities in governance of a JDA solution capability

h. *Recommendation 8.* Define a JDA solution roadmap to outline near-term solution capabilities and policies

i. *Recommendation 9.* Focus JDA solution investments on those services critical to—not duplicative of—DoD, M&S community, and C4ISR data management and initialization efforts

j. *Recommendation 10.* Establish a Joint Program Executive Office (JPEO) for sourcing and management of M&S data capability and infrastructure.

Five of these recommendations are being developed in Phase II.

2. The FY 08 JDA Phase II project was funded by M&S CO, led by the U.S. Army, and executed by MITRE and the Institute for Defense Analyses (IDA). The first five recommendations from the JDA Phase I are being implemented by the JDA Phase II project team. The estimated JDA Phase II project completion date was to be May 2009.

5.2.4 Operational Environments

This investment strategy focuses on data and the specification of common procedures for initializing data for simulations. Proper data initialization supports the declaration of sharable objects and their management across federates. As the practice of federating simulations grows, the need for initialization processes common to all simulations grows. The challenge is that military simulations development is customized based on the tools, architectures, and programming languages preferred by the designers and developers. This approach often results in the same data being processed multiple times because data initialized for one simulation cannot be used in another simulation that has different data initialization requirements. Even if a data model is used as a common reference model for information exchange, composites and aggregates may not be explicit in it. Other data-related issues arise in simulations from omitting variables, lacking relevant data, using inappropriate data, and using data beyond its applicable range. Another serious issue is lack of documentation about data and data sources.

The development of an HLA, with its standard object model template, simulation object model, and federation object model, was an important step forward. However, a more comprehensive architecture is needed—one that transforms data (numerical,

textual, or graphical) for use in distributed, federated applications. This capability would advance data initialization for individual or staff simulation training and would allow more realistic training in rapidly evolving environments that require rehearsals to perform collective C2 tasks by component command staffs. It would also enhance training in logistics for staging and onward movement, adaptive planning and deployment systems, global strike, and continuity of operations.

Projects: The FY 06 and FY 08 Live, Virtual, and Constructive Architecture Roadmap (LVCAR), which was funded by M&S CO, is a multi-phase project led by JFCOM J7 and executed by JFCOM, IDA, JHU APL, and PEO STRI. Phase I, funded in FY 06, produced an April 2008 mid-project report that mapped user requirements, compared the middleware functionality and business models of existing LVC architectures, and contrasted standard management processes for LVC architecture evolution. Phase II, funded in FY 08, produced a final November 2008 report that included a notional definition of the desired future architecture standard, the desired business models, and the manner in which standards should be evolved and compliance evaluated.

The architectures included in the LVCAR analysis are the Aggregate-Level Simulation Protocol (ALSP), the Common Training and Instrumentation Architecture (CTIA), Distributed Interactive Simulation (DIS), HLA, and the Test and Training Enabling Architecture (TENA). The LVCAR project recommended that near- and mid-term solutions focus on reducing or eliminating the barriers to interoperability between the existing architectures and that the long-term strategy should be architecture convergence to produce a single unified architecture. The LVCAR further recommended that the DoD establish high-level management oversight of all existing distributed simulation architectures (as a unified resource) and architecture development activities. In FY 09, an M&S SC High-Level Task was approved to implement the LVCAR recommendations. The FY 09 LVCAR implementation project includes

- Managing the LVC environment
- Developing architecture-independent object model components (i.e., JCOM)
- Developing LVC architecture convergence design and implementation
- Developing common gateways and bridges
- Establishing common LVC capabilities.

5.2.5 Logistics and Infrastructure

M&S training capabilities should cover the full range of military operations—from humanitarian relief and peacekeeping to conventional war and stability and support missions; logistics planning and operations; and training for intelligence personnel that goes beyond the injection of scripted events into ongoing exercises. Development is needed to improve training in IO, including computer network warfare, information warfare, and effects-based planning and EBO.

Project: The FY 07 joint targeting and battle damage assessment (BDA) simulation capability, which was funded by M&S CO, led by the JFCOM Joint Transformation Command for Intelligence (JTC-I), and executed by Applied Research Associates (ARA) and General Dynamics (GD), provides the BDA training audience a simulation capability that can produce realistic and timely raw ISR and unmanned aerial vehicle (UAV) products actually used to conduct BDA in real-world combat operations. The ISR and UAV products represent post-strike damage generated from the physics-based analysis of weapon-target interactions as planned and executed by the training audience. This capability was delivered to the JFCOM JTC-I Joint Intelligence Laboratory (JIL) in October 2008 and was demonstrated in July 2009.

5.2.6 Cross-Domain Security and Multi-National Information Sharing

A key goal of T2 is the ability to perform joint, interagency, intergovernmental, and multi-national operations successfully. The ability to acquire and share sensitive, timely information across domains, agencies, and nations is vital in meeting this goal, but it remains a serious problem for distributed M&S. Some technical methods exist for sharing classified information across domains, but these methods tend to be inefficient, expensive, or difficult to use in federations. Investment in these capabilities will improve training in IO, realistic interagency or multi-national environments, homeland security, and use of national intelligence systems.

5.2.7 Forces – Unit and Electronic OOB

The training community needs M&S training databases that provide information about what other forces, personnel and equipment, participating units might encounter in operations. Such databases might include information on the composition, disposition, strength, training, tactics, logistics, effectiveness, history, and uniforms of other units, along with information on signals intelligence (SIGINT) and communications intelligence (COMINT) emitters, their geographic location or range of mobility, their signals,

and their likely role in the broader OOB. Electronic OOB information might indicate enemy unit movement, changes in command relationships, and increases or decreases in capability. It would provide more realistic and intense mission rehearsals (1) by using a collaborative environment to exchange information that employs national intelligence systems to identify adversary and friendly force capabilities and the probable COAs and (2) by integrating intelligence community training with other force components. Rapid production of these databases would facilitate mission rehearsal for local and short-fuse training needs.

5.2.8 Common General-Purpose Interface

Simulation-based training should not bog down in simulation operating procedures. One way to foster concentration on the training that M&S is providing—rather than on the M&S technology itself—is to develop and enforce common operating processes and procedures that provide joint training—in short, the development of a common, interoperable look and feel. The capability provided by this investment will apply to any TC AoA gap that can be met with M&S. It may prove particularly important in training individuals and small teams that do not have ready access to technical aids.

Project: The FY 07 DoD Standards Vetting Tool (SVT), which was funded by M&S CO, is a Web-based tool for managing, developing, and vetting M&S standardization documents and requirements in establishing new standards for joint, DoD and Services use. The development of the SVT was led by the Space & Naval Warfare Systems Center Pacific (SSC Pacific) and executed by SSC Pacific and the University of Central Florida Institute for Simulation and Training (UCF IST). It was delivered and became operational in September 2008.

5.2.9 Mission Environment (Economic, Diplomatic, Political, and Indigenous Civilian)

In the current environment, civilian factors seem inseparable from military operations and need to be included in joint training M&S. Doing so raises many new challenges for the M&S training community and requires new approaches, such as behavioral moderators and realistic models of culture, religion, civilian activities, reactions, and beliefs. The issues involved in creating these capabilities are quite different from those involving terrain and weather, and they are more diffuse and less constrained than military domains that involve unit capabilities, tactics, and operational plans.

Development of these capabilities will enhance joint training M&S for interagency operations, homeland defense, the full range of EBO involving civilian populations, stability and support operations (SASO), military assistance to civil authorities, and critical infrastructure protection.

5.2.10 Human Intelligence (HUMINT)

Defense efforts in intelligence have been criticized for emphasizing technological sources too much and human sources too little. The range of HUMINT sources includes military patrols, traveler debriefings, diplomatic reports, newspaper and magazine articles, and espionage. Because HUMINT has unique capabilities that can make contributions to the success of military operations, it should be included in joint training M&S.

M&S training capabilities that include HUMINT can enhance decision-making for IO, improve task force staff training, improve training at the operational and tactical level in using the national intelligence systems, help train intelligence community members and strengthen their participation in staff exercises, and better integrate training for operations and intelligence staffs.

Project: The FY 07 HUMINT Wargaming Trainer (HWT) was funded by M&S CO, led by JFCOM JTC-I, and developed by University of Texas at Dallas and GD as a culture and motion capture prototype game for use in intelligence training for asymmetric warfare. The game is a virtual representation of cultural, behavioral, and environmental elements for learning in the home base and the theater. Threat scenarios are downloaded to the game device on a periodic (weekly to monthly) basis, and capabilities' ratings are recorded for individual performance. The prototype software was delivered to the JFCOM JTC-I JIL in October 2008.

5.2.11 Mission Environment (Medical, Public Health, and Related)

Improved production of M&S databases covering medical and public health affects several training areas and, consequently, a variety of TC AoA gaps. These databases need to be developed and routinely integrated with other M&S capabilities to improve training for task force staffs, JUO, homeland defense, EBO, SASO, military assistance to civil authorities, coordinated personnel recovery operations, consequence-management operations, and critical infrastructure protection.

5.2.12 Information Operations (IO)

IO are defined as those operations that use integrated employment of EW, computer network operations, PSYOPS, military deception, and operations security (OPSEC). IO are used with supporting and related capabilities to influence, disrupt, corrupt, or usurp adversarial human and automated decision-making processes while protecting ours and those of our allies. In the TC AoA, these operations included information warfare, computer network exploitation, computer network defense, and computer network attack. They were specifically addressed in the TC AoA as the sixth highest rated gap.

Investment will improve training for EBO, homeland defense, SASO, consequence-management operations, and intelligence and special operations personnel who work with command staffs.

5.2.13 Network Warfare – Net-Centric Environment

Investment in network warfare is crucial because of the vulnerability and importance of networks. Network warfare includes network attack, defense, and exploitation. The focus is on computer networks but may cover other areas, such as telephone networks, which have their own computer networking capabilities. Training to address all three areas (i.e., attack, defense, and exploitation) relies on simulation, which provides the most realistic and credible representation of the network warfare environment. The network software can be used in various training environments, and the outer shell with which participants interact simulates environments in which decisions must be made about attacking, defending, exploiting, or dealing with the network.

Investment in net-centric M&S capabilities will improve training for information warfare, assist with training for homeland defense operations, crisis-management planning, EBO, SASO, and consequence-management operations, and help train intelligence forces and SOF working with command staffs.

5.2.14 Second-Order Effects for Effects-Based Planning and EBO

Development of capabilities will help train the full range of military operations, including humanitarian relief, peacekeeping and peacemaking, law enforcement, insurgency, and conventional war. These capabilities focus on the effects produced by military operations rather than the operations themselves, which helps establish a perspective for tracing and anticipating direct and indirect effects as they propagate through political, military, economic, sociological, and information infrastructures. Capabilities will also

enhance training for joint staffs and task forces; crisis management; JUO; information warfare; interagency, intergovernmental, and multi-national operations; homeland defense operations; intelligence center battle staff integration; and consequence-management operations.

5.2.15 EW and Information Warfare

IO use offensive and defensive techniques to shape, disrupt, and exploit adversarial use of the electromagnetic spectrum and to protect the friendly use of this spectrum. EW and information warfare includes electronic attack, electronic protection, and electronic security. Electronic attack uses electromagnetic energy to degrade, neutralize, or destroy enemy capability. Electronic protection involves actions taken to protect against allied or enemy use of electromagnetic energy that may degrade, neutralize, or destroy friendly capability. Electronic security allows an operational commander to locate, intercept, and identify intentional and unintentional sources of electromagnetic energy for immediate threat recognition and for planning and conducting operations.

Developing these capabilities will improve training for IO and related areas, such as staff activities, crisis actions, homeland defense, C4I using collaborative information, SASO, intelligence operations, critical infrastructure protection, and consequence-management operations.

5.2.16 CBRNE Detection and Effects

CBRNE events are concerned with the deliberate or inadvertent release of CBRNE devices that can cause massive damage and extensive human casualties. The number of nations, non-nation organizations, and even small groups of individuals that possess CBRNE devices and are capable of staging CBRNE events with little or no warning is steadily increasing. The need for training to manage and deal with CBRNE events is therefore increasing. The impact of such attacks may reach much further than the scene of the disaster. Injured and contaminated victims may depart the scene and return to their neighborhoods and residences.

Investment in M&S capabilities for CBRNE detection and effects will improve training in the detection, interdiction, isolation, or mitigation of CBRNE weapons and in the CBRNE environments. This investment will also help integrate CBRNE effects into other training, such as crisis-action planning, urban operations, intergovernmental and multi-national operations, homeland defense, military assistance to civil authorities, use of national intelligence systems, and consequence management.

5.3 Analysis of Investment Strategies

Table 5-1 lists the 16 investment strategies and the TC AoA gaps they are intended to address. The rankings in the second column are estimates of the importance of each strategy to improving training M&S as derived from the collective survey responses in priority order. Each investment strategy satisfies more than one of the TC AoA gaps (third column). Some of the strategies are concerned with kinetic warfare and some with non-kinetic warfare. Strategies 1 and 8 are applicable across all the TC AoA gaps.

Table 5-1. Investment Strategies, Ranks, and TC AoA Gaps Addressed

Strategy	Rank	TC AoA Gaps Addressed	FY 06–FY 08 Efforts Completed or Underway
1. Develop a standard common object model that defines unit objects played by entity and aggregate level simulations	1.5	ALL	JCOM
2. Develop techniques for rapidly producing correlated M&S data, which may cover atmosphere, ocean, space, and terrain	1.5	4, 19, 22	SEIS, LVC Terrain Database Evolution, TAUO
3. Develop scenario-based individual training and small team M&S development capabilities that allow locally usable, rapid simulation and scenario generation and/or editing	3	1, 2, 3, 4, 5	JDA
4. Develop M&S architecture specifications for common M&S data initialization of operational environments	4	1, 2, 14, 21, 26, 30	LVCAR
5. Develop M&S capabilities for rapidly producing initialization-ready, mission-environment databases that cover logistics, engineering infrastructure, networks, power lines, and information grids	6	6, 12, 16, 17, 22, 27, 34	BDA
6. Develop capabilities for cross-domain security and Multi-national Information Sharing in training M&S	6	6, 7, 8, 13, 19	–
7. Develop M&S capabilities for rapidly producing initialization-ready, mission-environment databases that cover unit and electronic OOB	6	4, 13, 19, 22	–
8. Develop specifications for a common, general-purpose interface that provides a common and interoperable “look and feel” across different simulations	8	ALL	SVT
9. Develop M&S capabilities for rapidly producing initialization-ready, mission-environment databases that cover economic, diplomatic, political, and other civilian population factors	9.5	7, 8, 12, 16, 17, 27	–
10. Develop M&S capabilities for representing non-kinetic warfare domains, including HUMINT	9.5	6, 18, 19, 22, 28	HWT
11. Develop M&S capabilities for rapidly producing initialization-ready, mission-environment databases that cover medical, public health facilities	12	1, 2, 6, 7, 8, 12, 16, 17, 27, 32	–

Table 5-1. Investment Strategies, Ranks, and TC AoA Gaps Addressed (Continued)

Strategy	Rank	TC AoA Gaps Addressed	FY 06–FY 08 Efforts Completed or Underway
12. Develop M&S capabilities for representing non-kinetic warfare domains, including IO	12	6, 8, 12, 16, 22, 34	–
13. Develop M&S capabilities for representing non-kinetic warfare domains, including network warfare	12	3, 6, 8, 12, 16, 22, 34	–
14. Develop M&S capabilities to portray second-order effects in effects-based planning and EBO at all levels (tactical, operational, and strategic)	14.5	1, 2, 3, 5, 6, 7, 8, 12, 28, 32	–
15. Develop M&S capabilities for representing non-kinetic warfare domains, including electronic warfare (EW)	14.5	3, 6, 8, 12, 13, 16, 19, 22, 27, 32	–
16. Develop CBRNE detection and effects capabilities for training M&S that include effects on civilian populations and infrastructure	16	9, 10, 11, 25, 32	–

Table 5-2 is the reverse of Table 5-1. It lists each AoA gap and identifies which strategies address it. This analysis does not indicate the extent to which these gaps are (1) filled by existing capabilities, (2) more properly regarded as exercise design issues than as needed M&S training capabilities, (3) training but not M&S issues, or (4) M&S gaps that have not received adequate attention.

Table 5-2. TC AoA Gaps Addressed by Candidate Investments

2004 TC AoA Gaps Listed in Order of TC AoA Priority	Investment Strategies	FY 06–FY 08 Efforts Completed or Underway
1. Train combined Joint Task Force (JTF) staffs (including individual joint training)	1, 3, 4, 8, 11, 14	JCOM, LVCAR, JDA, SVT
2. Train standing joint force headquarters staff (including individual joint training)	1, 3, 4, 8, 11, 14	JCOM, LVCAR, JDA, SVT
3. Train on crisis action planning and deployments	1, 3, 8, 13, 14, 15	JCOM, JDA
4. Provide faster/higher fidelity mission rehearsal	1, 2, 3, 7, 8	JCOM, SEIS, LVC Terrain Database Evolution, TAUO, JDA
5. Train forces on joint urban operations (JUO)	1, 3, 8, 14	JCOM, JDA
6. Train forces on IO (including information warfare, computer network exploitation, computer network defense, and computer network attack)	1, 5, 6, 8, 10, 11, 12, 13, 14, 15	JCOM, BDA, HWT
7. Train forces in a joint interagency intergovernmental, multinational environment (including intelligence community participants)	1, 6, 8, 9, 11, 14	JCOM

Table 5-2. TC AoA Gaps Addressed by Candidate Investments (Continued)

2004 TC AoA Gaps Listed in Order of TC AoA Priority	Investment Strategies	FY 06–FY 08 Efforts Completed or Underway
8. Provide homeland defense training	1, 5, 6, 8, 9, 11, 12, 13, 14, 15	JCOM, SVT
9. Provide multi-command missile defense training	1, 8, 16	JCOM
10. Train forces in enemy CBRNE exploitation and destruction	1, 8, 16	JCOM
11. Train to operate in CBRNE environments	1, 8, 16	JCOM
12. Train on effects-based planning and EBO	1, 5, 8, 9, 11, 12, 13, 14, 15	JCOM, BDA
13. Train theater/strategic forces to conduct C4I operations using collaborative information environment	1, 6, 7, 8, 15	JCOM
14. Train forces on realistic logistics requirements (including reception, staging, onward movement, and integration (RSOI))	1, 4, 8	JCOM, LVCAR, SVT
15. Practice Active Component/Reserve Component integration and mobilization training	1, 8	JCOM
16. Train forces on stability and support operations (SASO)	1, 5, 8, 9, 11, 12, 13, 15,	JCOM, BDA
17. Train forces on military assistance to civilian authorities operations	1, 5, 8, 9, 11	JCOM
18. Train Special Operations Forces (SOF) and conventional forces for integrated operations	1, 8, 10	JCOM, HWT
19. Train forces (operational and tactical level) to use national intelligence systems	1, 2, 6, 7, 8, 10, 15	JCOM, SEIS, LVC Terrain Database Evolution, TAUO, HWT
20. Train routinely with the Joint Operation Planning and Execution System (JOPES)	1, 8	JCOM
21. Train routinely with new adaptive planning and deployment system	1, 4, 8	JCOM, LVCAR, SVT
22. Train intelligence community as they fight (including all levels as a tactical participant)	1, 2, 5, 7, 8, 10, 12, 13, 15	JCOM, SEIS, LVC Terrain Database Evolution, TAUO, BDA, HWT
23. Train the Joint Interagency Coordination Group (JIAG)	1, 8	JCOM
24. Train staff to coordinate Personnel Recovery operations (PRO)	1, 8	JCOM
25. Train global ballistic missile defense (BMD)	1, 8, 16	JCOM
26. Conduct global strike training	1, 4, 8	JCOM, LVCAR, SVT
27. Train critical infrastructure protection	1, 5, 8, 9, 11, 15	JCOM

Table 5-2. TC AoA Gaps Addressed by Candidate Investments (Continued)

2004 TC AoA Gaps Listed in Order of TC AoA Priority	Investment Strategies	FY 06–FY 08 Efforts Completed or Underway
28. Operations/intelligence center training, integration, and command education	1, 8, 10, 14	JCOM, HWT
29. Strategic information assurance	1, 8	JCOM
30. Continuity of operations	1, 4, 8	JCOM, LVCAR, SVT
31. Train on operational systems (dedicated bandwidth)	1, 8	JCOM
32. Train on consequence-management operations	1, 8, 11, 14, 15, 16	JCOM
33. Provide special operations crisis action procedures training	1, 8	JCOM
34. Provide intelligence community SOF-specific training at the operational level	1, 5, 8, 12, 13	JCOM, BDA
35. Plan, coordinate, and practice mission assurance	1, 8	JCOM

Table 5-3 lists the FY 06-08 TC projects that were funded by M&S CO, with the strategy each most closely addresses, the estimated project end date, other communities of interest, and funding.

Table 5-3. FY 06–FY 08 TC Projects Funded by M&S CO

FY 06 Projects	Investment Strategies	Project End Date	Other M&S-Related Communities of Interest	Funding
LVCAR Phase I	4	May 2008	Acquisition, experimentation, testing	$1,485K
JDA Phase I	3	Sept. 2007	Analysis, acquisition, experimentation, planning, testing	$200K
FY 07 Projects	**Investment Strategies**	**Project End Date**	**Other M&S-Related Communities of Interest**	**Funding**
SEIS	2	May 2008	Analysis, acquisition, experimentation, planning, testing	$400K
Joint Targeting and BDA Simulation Capability	5	July 2009	Analysis, Services	$1,189K
HUMINT Wargaming Trainer	10	Oct. 2008	Analysis, experimentation	$248K
DoD SVT IV&V, Project 07-TR-131	8	Oct. 2008	Analysis, acquisition, experimentation, planning, testing	$40K

Table 5-3. FY 06–FY 08 TC Projects Funded by M&S CO (Continued)

FY 08 Projects	Investment Strategies	Project End Date	Other M&S-Related Communities of Interest	Funding
JDA Phase II	3	May 2009	Analysis, acquisition, experimentation, planning, testing	$990K
JCOM	1	Oct. 2009	Experimentation, testing	$875K
TAUO	2	Dec. 2009	Experimentation, testing	$970K
Common LVC Terrain Database Evolution	2	June 2009	Analysis, experimentation, testing	$650K
LVCAR Phase II	4	Nov. 2008	Acquisition, experimentation, testing	$515K

6. Findings and Recommendations

Executing this updated plan will play a key role as the baseline document for updating and publishing the 2009 TMSBP. The updates will continue to incorporate training capabilities to include those with Service-oriented architectures, network-centric data integration, and a distributed environment that will allow LVC training capabilities to interoperate seamlessly. This plan leverages the M&S efforts, key enablers, and joint federations currently underway.

The M&S investment strategies recommended in the 2007 TMSBP have supported a broad range of roles and responsibilities in joint, interagency, intergovernmental, and multi-national contexts. They responded to the *Strategic Plan for Transforming DoD Training* (8 May 2006) through significant enhancement of the LVC training environment that will serve as an enabler for transforming U.S. forces and missions across the full range of integrated operations. This LVC training environment will include M&S systems that create warfighting conditions through a networked collection of interoperable training sites and nodes and interconnected simulations and training tools.

The investment strategies identified in the 2007 TMSBP will provide an environment of more affordable and effective capabilities for training U.S. forces in the JMETs to meet the needs of the component commanders, JTF staffs, standing joint force headquarters, component commands, and the military Services. As operational performance objectives change (and with them, the proliferation of a variety of military missions), M&S capabilities can help train U.S. forces as they are intended to fight. M&S capabilities can help DoD train forces to meet the challenges posed by advances in technology and, in many cases, train in situations where it is not feasible to train in a live-only environment. M&S training capabilities contribute greatly to integrated joint and Service operations—not only for traditional test and training facilities, but also in integrating these facilities with other areas of defense planning, such as acquisition, logistics, personnel, professional development, and C2 processes.

Investing in M&S training capabilities will be a key factor in the T2 program goal of global presence: provide training and education anytime, anywhere, to a wide spectrum of training needs and audiences.

These investment strategies satisfy several crosscutting M&S capability gaps identified by the 2008 *Department of Defense Modeling and Simulation Corporate and Crosscutting Business Plan*. These strategies will play a key role in developing an integrated set of M&S capabilities that allow the DoD to employ M&S in the most effective and efficient manner—one that benefits the DoD total force.

The investment strategies set forth in this plan concentrate on these key areas for improvement:

- Common tools
- Common data
- Common interests within DoD, such as underlying standards, architectures, and VV&A processes.

Finally, executing this plan will help the DoD M&S SC focus future efforts on addressing the following capability gaps, as stated in the business plan noted previously:

- Simulation interoperability
- VV&A
- Systems, family of systems, and system of systems
- C2
- Human and organizational behavior
- Environmental representation
- Workforce development.

6.1 Key Findings

- The TC AoA training gaps (needs) are out of date and need to be updated with the assistance of training stakeholder organizations. Several of the training needs have been addressed during the last 5 years, and new needs have emerged to change the priorities of the 2004 gaps.
- Training capabilities as described in the TC AoA and 2007 TMSBP were limited to those primary constructive simulation federations used for joint training.
- Several long-standing training needs previously identified are being progressively corrected by joint and Services development programs, while other functional areas remain as unfunded issues.
- The use of M&S in training continues to evolve to provide improved training capabilities and to prepare forces for operational missions.

6.2 Recommendations

- Continue the update process initiated in the Joint M&S TGAF conducted by JFCOM in November 2008 to arrive at formal coordination and validation of training needs at senior leadership levels in each stakeholder organization.
- Use the OSD-provided training capabilities as the start point for 2009 TMSBP capabilities baseline.
- Work to resolve long-standing training issues surfaced by the TGAF to include integrated air and missile missions, CDIS, and integrated joint logistics.
- Continue to fund the research and development (R&D) efforts at JFCOM to facilitate support for large joint training exercises. The TGAF identified a series of these issues that have been grouped as exercise design and integration.
- The 16 investment strategies in Section 5 (see Table 5-1) of this TMSBP should serve as a starting point for the update to be published in the 2009 TMSBP.
- The training stakeholders should participate with the JS J7 to update the list of TC AoA training gaps, which would serve as an updated requirements baseline for future training M&S efforts.
- After the needs update, conduct a workshop with training stakeholders to translate the needs and capabilities into specific proposals for either the training community or the M&S SC for enterprise-level funding in FY 09 and beyond.
- Ensure that future training M&S efforts are consistent and interoperable with the net-centric enterprise services and net-enabled C2 data strategies being developed in the DISA GIG programs.

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Acronyms[14]

2D	two-dimensional
3D	three-dimensional
AADCS	Area Air Defense Command System
AAR	After Action Review
AARS	After Action Review System
AAT	Architecture Assessment Tool
ABCS	Army Battlefield Command System
ACC	Air Combat Command
ACE	Air and Space Constructive Environment
ACE-IOS	Air and Space Collaborative Environment Information Operations Suite
ACRES	Adaptive Communications Reporting Simulation
ACSIS	Aegis Combat System Interface Simulation
ACTD	Advanced Concept Technology Demonstration
ACTF	Army Constructive Training Federation
ADSI	Air Defense Simulation Integrator
AFAMS	Air Force Agency for Modeling and Simulation
AFATDS	Advanced Field Artillery Tactical Data System
AFB	Air Force Base
AFMSTT	Air Force Modeling and Simulation Training Toolkit
AFSERS	Air Force Synthetic Environment for Reconnaissance and Surveillance
AIS	Automated Identification System
ALSP	Aggregate-Level Simulation Protocol
AMC	Air Mobility Command
AMD	air and missile defense
AMDWS	Air and Missile Defense Workstation
AMPS	Automated Mission Planning System
AoA	Analysis of Alternatives
AOR	area of responsibility
API	Application Programmers' Interface
APL	Applied Physics Laboratory
APOD	airport of debarkation

14 This is a comprehensive acronym list for the main body of this report and for the appendixes.

ARA	Applied Research Associates
ARCHER	Archiving and Enhanced Retrieval System
ASAS	All Source Analysis System
ASAS-L	All Source Analysis System–Light
ASCC	Army Service Component Command
ASCCE	Air, Space and Cyber Constructive Environment
ASCCE-CSI	Air, Space and Cyber Constructive Environment–Command and Control Systems Interface
ASCCE-IOS	Air, Space and Cyber Constructive Environment–Information Operations System
ASCOT	Airspace Control and Operations Trainer
ASDA	Advanced Seal Delivery System
ASDS	Advanced Seal Delivery System
ASOC	air support operations center
ASSET	Automated Script Simulator Exercise Training
ASTI	Army Secure Tactical Initiative
ASUW	anti-surface warfare
ASW	anti-submarine warfare
AT&L	Acquisition, Technology, and Logistics
ATCCS	Army Tactical Command and Control System
ATLOS	Acoustic Transmission Loss Server
ATO	air tasking order Afloat Training Organization
AUTODIN	Automatic Digital Network
AVCATT	Aviation Combined Arms Tactical Trainer
AWACS	Airborne Warning and Control System
AWARE	Advanced Warfare Environment
AWSIM	Air Warfare Simulation
BCS	Battlefield Command System
BCS3	Battle Command Sustainment Support System
BCTP	Battle Command Training Program
BDA	battle damage assessment bomb damage assessment
BFA	battlefield functional area
BFTT	Battle Force Tactical Trainer
BFV	Bradley Fighting Vehicle
BG/BF	Battle Group/Battle Force
BICM	BCTP Intelligence Collection Model
BLOS	Beyond-Line-of-Sight

BMD	ballistic missile defense
BVI	Battlespace Visualization Initiative
C2	command and control
C2BMC	Command, Control, Battle Management, and Communications
C2C	Command and Control Constellation
C2ISR	command and control and intelligence, surveillance and reconnaissance
C2PC	Command and Control Personal Computer
C3I	command, control, communications and intelligence
C4I	command, control, communications, computers, and intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CACCTUS	Combined Arms Command and Control Training Upgrade Systems
CAMPS	Consolidated Air Mobility Planning System
CAN	Combined Arms Network
CAS	close air support
CB Sim Suite	Chemical, Biological Simulation Suite
CBDP	Chemical and Biological Defense Program
CBITS	Chemical Biological Instrumented Training System
CBRNE	Chemical, Biological, Radiological, Nuclear and Explosive
CBS	Corps Battle Simulator
CCD	Common Connectivity Device
CCDR	combatant commander
CCTT	Close Combat Tactical Trainer
CDIS	Cross-Domain Information Sharing
CDR	Commander
CDS	cross domain solution
CENTCOM	U.S. Central Command
CFACC	combined force air component commander
CFAST	Collaborative Force Analysis, Sustainment and Transportation
CFF	call for fire
CFFT	Call-for-Fire Trainer
CIDNE	Combined Information Data Network Exchange
CIS	Combat Intelligence System
CJCS	Chairman of the Joint Chiefs of Staff

CJCSM	Chairman of the Joint Chiefs of Staff Manual
CNO	Chief of Naval Operations
CO	coordination office
COA	course of action
COCOM	combatant command
COI	community of interest
COMINT	Communications Intelligence
COMJTF	Commander Joint Task Force
CONOPS	Concept of Operations
CONPLAN	Concept of Operations Plan
CONUS	Continental United States
COP	Common Operational Picture
COTP	common operational tactical picture
CPOF	Command Post of the Future
CRC	Control and Reporting Center
CROP	common relevant operational picture
CSA	Chief of Staff of the Army Combat Support Agency
CSAF	Chief of Staff, United States Air Force
CSI	Command and Control Simulation Interface
CSP	Communications Support Processor
CSSCS	Combat Service Support Control System
CTAPS	Contingency Theater Automated Planning System
CTIA	Common Training and Instrumentation Architecture
CTP	common tactical picture
CV/CVN	aircraft carriers
DACT	Data Automated Communications Terminal
DARPA	Defense Advanced Research Projects Agency
DASD/RA	Deputy Assistant Secretary of Defense (Reserve Affairs)
DCE	Dynamic Communications Environment
DCGS	Distributed Common Ground System
D-DACT	Dismounted Data Automated Communications Terminal
DDOC	Deployment Distribution Operations Center
DDS	Digital Data System
DEPSECDEF	Deputy Secretary of Defense
DIA	Defense Intelligence Agency
DICE	Distributed Incremental Compiling Environment
DIR	Director

DIR R&T	Director, Readiness and Training
DIS	Distributed Interactive Simulation
DISA	Defense Information Systems Agency
DISCO	Deployable Simulation for Collaborative Operations
DJS	Director of the Joint Staff
DLA	Defense Logistics Agency
DMO	Distributed Mission Operation
DMOC	Distributed Mission Operations Center
DMS	Defense Message System
DMT	Distributed Mission Training
DoD	Department of Defense
DoDD	Department of Defense Directive
DoDI	Department of Defense Instruction
DOT&E	Director, Operational Test and Evaluation
DPA&E	Director, Program Analysis and Evaluation
DRRS	Defense Readiness Reporting System
DTS	Defense Transportation System
DTSS	Digital Topographic Support System
DUSD/R	Deputy Under Secretary of Defense for Readiness
DVTE	Deployable Virtual Training Environment
EAC	Echelons Above Corps
EAD	Extended Air Defense
EADSIM	Extended Air Defense Simulation
EBC	Embedded Battle Command
EBO	effects-based operations
EDCSS	Environmental Data Cube Support System
EFAAS	Effective Active Acoustic Simulation
ELINT	electronic intelligence
EPLRS	Enhanced Position Location Reporting System
ERF	Entity Resolution Federation
ESC	Electronic Systems Center
ESG	Executive Steering Group
EST 2000	Engagement Skills Trainer 2000
ESTAT	Executing Status and Monitoring (Theater Battle Management Core System)
ETSIU	Enhanced Tactical Simulation Interface Unit
EW	electronic warfare
EWO	electronic warfare operations

ExCIS	Extensible C4I Instrument Suite
EXSMS	Exercise Single Mobility System
FAC	forward air controller
FAST	Fidelity Assessment Simulator Tool
FBCB2	Force XXI Battle Command, Brigade and Below
FIRESIM	Fires Simulator
FMT-R	Federation Management Tool–Reloaded
FO	forward observer
FOM	Federation Object Model
FY	Fiscal Year
GALE	Generic Area Limitation Environment
GCCS	Global Command Control System
GCCS-A	Global Command Control System–Army
GCCS-J	Global Command Control System–Joint
GCCS-M	Global Command Control System–Maritime
GD	General Dynamics
GDF	Guidance for Development of the Force
GDIT	General Dynamics Information Technology
GDSS	Global Decision Support System
GEF	Guidance for Employment of the Force
GEG	GPS Environment Generator
GES	GTN Exercise Server GTN Exercise Support
GIAC	Graphical Input Aggregate Control
GIG	Global Information Grid
GOTS	government off-the-shelf
GPS	Global Positioning System
GTN	Global Transportation Network
GUI	graphical user interface
GWOT	Global War on Terror
HazMat	hazardous materials
HDC	HLA-DIS Converter
HITI	High-Interest Training Issue
HITL	human-in-the-loop
HLA	High Level Architecture
HUMINT	Human Intelligence
HWT	HUMINT Wargaming Trainer
IAP	integrated air picture

IAS	Intelligence Analysis System
IBSS	Independent Basic Service Set
ICAO	International Civil Aviation Organization
ICCOG	Intelligence Community Coordination Group
IDA	Institute for Defense Analyses
IEW	intelligence electronic warfare
IEWTPT	Intelligence Electronic Warfare Tactical Proficiency Trainer
IFACT	Indirect Fire–Forward Air Control Trainer
IIR	Imagery Interpretation Report
IMETS	Integrated Meteorological System
IMOM	Improved Many on Many
IO	information operations
IOS	Information Operations Suite
IPB	intelligence preparation of the battlefield
IPE	individual protective equipment
IPIR	Initial Photo Interpretation Report
IPL	Imagery Product Library
IPT	Integrated Process Team
ISM	Independent Stimulation Module
ISO	Information Operations Suite
ISR	Intelligence, Surveillance, and Reconnaissance
ITK	Infantry Tool Kit
ITS	Interim Targeting Solution
ITV	In-Transit Visibility
IWEG	Information Warfare Effects Generator
J7	Joint Training Directorate
JAARRL	Joint AAR Resource Library
JADOCS	Joint Automated Deep Operations Coordination System
JAEC	Joint Assessment and Enabling Capability
JAOC	joint air operations center
JBUS	Joint Bus
JCAS	joint close air support
JCATS	Joint Conflict and Tactical Simulation
JCOM	Joint Composable Object Model
JCS	Joint Chiefs of Staff
JDA	Joint Data Alternatives
JDARS	Joint Distributed After-Action Review System

JDLM	Joint Deployment Logistics Model
JDT	Joint Data Translator
JECEWSI	Joint Electronic Combat Electronic Warfare Simulation
JECS	Joint Exercise Control System
JELC	joint event life cycle
JEM	Joint Effects Model
JFACC	joint force air component commander
JFAST	Joint Flow and Analysis System
JFC	joint force commander
JFCOM	Joint Forces Command
JHU APL	Johns Hopkins University Applied Physics Laboratory
JIACG	Joint Interagency Coordination Group
JIL	Joint Intelligence Laboratory
JIPT	Joint Integrated Process Team
JITC	Joint Interoperability Test Command
JKDDC	Joint Knowledge Development and Distribution Capability
JLCCTC	Joint Land Component Constructive Training Capability
JLOD	CATS Low Overhead Driver
JLOTS	Joint Logistics Over-the-Shore
JLVC	Joint Live Virtual and Constructive
JLVCDT	Joint Live Virtual Constructive Data Translator
JLVC-TE	Joint Live Virtual Constructive Training Environment
JMECS	Joint MSEL Event Control Station
JMECS-NS	Joint MSEL Event Control Station–No Sim
JMET	Joint Mission Essential Task
JMPRS	Joint Mission Planning and Rehearsal System
JMRM	Joint Multi-Resolution Model
JNEM	Joint Non-Kinetic Effects Model
JNETS	Joint Network Simulation
JNTC	Joint National Training Capability
JOEF	Joint Operational Effects Federation
JOISIM	Joint Operations Information Simulation
JOPES	Joint Planning and Execution System
JPEC	Joint Planning and Execution Community
JPEO	Joint Program Executive Office
JQUAD+	Suite of five computer simulation models (of which JQUAD is one) for warfare command and control[15]

[15] JQUAD+ consists of four related sub-models: JECEWSI, JCAS, JOISIM, and JNETS

JRE	Joint Range Extension
JRSG	Joint Rapid Scenario Generation
JRSOI	joint reception, staging, onward-movement, and integration
JS	Joint Staff
JOSEF	Joint Semi-Automated Force
JSCP	Joint Strategic Capabilities Plan
J-SIGSIM	Joint SIGINT Simulation
JSIMS	Joint Simulation System
JSPA	JLVC Simulation Protocol Analyzer
JSTARS	Joint Surveillance Target Attack Radar System
JSWS	JSTARS Work Station
JTC	Joint Training Confederation
JTC-I	Joint Transformation Command for Intelligence
JTC-TRS	Joint Terminal Control Training and Rehearsal System
JTDS	Joint Training Data Service
JTEN	Joint Training Experimentation Network
JTERC	Joint Training Environment Requirements Conference
JTF	Joint Task Force
JTIMS	Joint Training Information Management System
JTLS	Joint Theater Level Simulation
JTRG	Joint Training Requirements Group
JTS	Joint Training System
JTSC	Joint Training Support Center
JUO	joint urban operations
JWARN	Joint Warning and Reporting Network
JWFC	Joint Warfighting Center
LAN	Local Area Network
LCC	amphibious command ships
LHA	amphibious assault ships
LHD	amphibious assault ships
LLDR	Lightweight Laser Designator Rangefinder
LMC	Lockheed Martin Corporation
LOGFED	Logistics Federation
LOGSIM	Logistics Simulation
LVC	Live, Virtual, and Constructive
LVCAR	Live, Virtual, and Constructive Architecture Roadmap
M&S	Modeling and Simulation
M&S CO	Modeling and Simulation Coordination Office

M&S SC	Modeling and Simulation Steering Committee
MAF	Mobility Air Force
MAGTF	Marine Air-Ground Task Force
MASINT	Measurement and Signal Intelligence
MAST	Mission Avionics Systems Trainer
MCE	Modular Control Element
MCFED	Marine Corps Federation
MCS-L	MCS-Light
M-DACT	Mounted Data Automated Communications Terminal
MDST	Missile Defense Space Tool
MET	mission essential task
METOC	meteorology and oceanography
MOE	measure of effectiveness
MOUT	military operations on urban terrain
MPF	Maritime Pre-positioned Force
MRF	Multi-Resolution Federation
MRX	mission rehearsal exercise
MTACCS	Marine Corps Tactical Command and Control System
MTWS	MAGTAF Tactical Warfare Simulation
MUSE	Multiple Unified Simulation Environment
NATO	North Atlantic Treaty Organization
NCA	National Command Authorities
NCES	Net-Centric Enterprise Services
NCTE	Navy Continuous Training Environment
NDS	National Defense Strategy
NGDC	National Geophysical Data Center
NGO	non-governmental organization
NGTS	Next Generation Threat System
NII	Networks and Information Integration
NITF	National Imagery Transmission Format
NOFORN	Not Releasable To Foreign Nationals
NORTHCOM	Northern Command
NRO	National Reconnaissance Office
NWARS-NG	National Wargaming Simulation Next Generation
NWDC	Navy Warfare Development Command
OASES	Ocean, Atmosphere and Space Environmental Services
OFT	Office of Force Transformation
OneSAF	One Semi-Automated Force

OOB	order of battle
OOS	OneSAF Objective System
OPFOR	opposing force
OPLAN	Operation Plan
OPSEC	operations security
OSA	Operational Support Airlift
OSD	Office of the Secretary of Defense
OT&E	Operational Test and Evaluation
OTB	OneSAF Test Bed
OTF	Objective Terrain Format
OTH	over-the-horizon
OUSD(P&R)	Office of the Under Secretary of Defense for Personnel and Readiness
PA&E	Program Analysis and Evaluation
PC	personal computer
PDM	Program Decision Memorandum
PDU	portable data unit
PEO STRI	Army Program Executive Office for Simulation, Training, and Instrumentation
PFED	Pocket-Sized Forward Entry Device
PM TRADE	Project Manager for Training Devices
PM TRASYS	Program Manager for Training Systems
POE	port of embarkation
POD	port of debarkation
POM	Program Objective Memorandum
PRO	personnel recovery operations
PSS-SOF	Precision Strike Suite for Special Operations Forces
PSYOP	Psychological Operations
QDR	Quadrennial Defense Review
R&D	research and development
RDO	rapid decisive operations
RE	Remote Environment
RECCEXREP	Reconnaissance Exploitation Report
RESA	Research, Evaluation and System Analysis Simulation
REXREP	Radar Exploitation Report
RJ	Rivet Joint
RM	Radiant Mercury
ROE	rules of engagement
RSOI	reception, staging, onward movement, and integration

RT&PP	Readiness and Training Policy and Programs
RTI	Run-Time Infrastructure
RUGUD	Rapid Unified Generation of Urban Databases
RVS	Reconfigurable Vehicle Simulator
RVTT	Reconfigurable Vehicle Tactical Trainer
RWS	remote workstation
S&M	scheduling and movement
SA	situational awareness
SAAM	Special Assignment Airlift Mission
SAF	Semi-Automated Force
SAG	Senior Advisory Group
SAGIS	SOF Air Ground Interface Simulator
SASO	stability and support operations
SASS	System Administration Security Server
SBIRS	Space Based Intelligence, Reconnaissance, and Surveillance
SCI	Sensitive Compartmented Information
SCOPES	Space Common Operating Picture and Exploitation System
SDDC	Surface Deployment and Distribution Command
SEIS	Space Environment Impact System
SEP	System Evaluation Plan
SGS	Scenario Generation Server
Shadow UAV	Shadow unmanned aerial vehicle
SIGINT	Signals Intelligence
SIMPLE	Session Initiation Protocol for Instant Messaging and Presence Leveraging Extensions SimC4I Interchange Module for Plans, Logistics, and Exercises
SINCGARS	Single-Channel Ground and Airborne Radio System
SITH	Simulation Interface Test Harness
SITREP	situation report
SMART	Secure Message and Routing Terminal
SME	subject matter expert
SMMTT	Submarine Multi-Mission Team Trainer
SNE	synthetic natural environment
SOA	Service-oriented architecture
SOCOM	Special Operations Command
SOF	Special Operations Forces
SOMPE	Special Operations Mission Planning Environment

SPOD	seaport of debarkation
SPOTREP	spot report
SRC	Scientific Research Corporation
SSC Pacific	Space & Naval Warfare Systems Center Pacific
SSG	Senior Steering Group Space System Generator
STOW	Synthetic Theater of War
STRATCOM	Strategic Command
SVT	Standards Vetting Tool
T2	Training Transformation
TAA	Tactical Assembly Area
TACELINT	tactical electronic intelligence
TACREP	Tactical Report
TACSIM	Tactical Simulation
TADIL	Tactical Digital Information Link
TAIS	Tactical Airspace Integration System
TAUO	Training for Aviation Urban Operations
TBMCS	Theater Battle Management Core System
TC	Training Capabilities
TCO	Tactical Combat Operations
TCSP	Tactical Communications Support Processor
TDBM	Tactical Database Manager
TDL	Tactical Data Link
TE	training environment
TECOM	Marine Corps Training and Education Command
TENA	Test and Training Enabling Architecture
TFCC	Tactical Flag Command Center
TGAF	Training Gaps Analysis Forum
THS	Target Hand-Off Subsystem
TIFF	Tagged Image File Format
TIGER	Tactical Geographic Integrated Environment
TLDHS	Target Location, Designation and Hand-off System
TMSBP	Training Community Modeling and Simulation Business Plan
TPFDD	time-phased force and deployment data
TS	Top Secret
TSS	Tower Simulation System
TSTS	Total Ship Training System
TTP	tactics, techniques, and procedures

U.S.	United States
UAS	unmanned aerial system
UAV	unmanned aerial vehicle
UCF IST	University of Central Florida Institute for Simulation and Training
UCP	Unified Command Plan
UNDER SECA	Under Secretary of the Army
UNDER SECAF	Under Secretary of the Air Force
UNDER SECNAV	Under Secretary of the Navy
USCG	United States Coast Guard
USD P&R	Under Secretary of Defense for Personnel and Readiness
USMC	United States Marine Corps
USMTF	United States Message Text Format
USSOCOM	U.S. Special Operations Command
USTRANSCOM	United States Transportation Command
V-ASTAC	Virtual ASW/ASUW Tactical Air Controller Trainer
VBS2	Virtual Battlespace 2
VFST	Virtual Fire Support Trainer
VMF	variable message format
VRSG	Virtual Reality Scene Generator
VV&A	validation, verification, and accreditation
WAN	Wide Area Network
WARSIM	Warfighter's Simulation
WCCS	Wing Command and Control System
WIM	WARSIM Intelligence Module
WMD	weapons of mass destruction

Appendix A.
2004 Training Capabilities Analysis of Alternatives (TC AoA)

Note: Because of the constantly evolving nature of training needs and of modeling and simulation (M&S) technologies and as indicated in previous sections of this document, the TC AoA is now dated in several regards. The analysis in this appendix will be updated in the 2009 Training Community Modeling and Simulation Business Plan (TMSBP).

The TC AoA was directed by the Office of the Secretary of Defense (OSD) Program Decision Memorandum (PDM) 1, *Joint Simulation System (JSIMS),* dated 12 December 2002. The study plan was published in October 2003. This appendix discusses the analysis of the TC AoA that was referenced in this document and in Volume I of the 2007 TMSBP: the ability of current simulations to meet deficiencies, or gaps, in joint training. The analysis used information from these sources:

- Joint mission essential tasks (JMETs) identified by the combatant commands (COCOMs) and the Services
- Higher-level guidance and directives, such as the Quadrennial Defense Review (QDR)
- Training requirements and capabilities identified at the Joint Training Review Group (JTRG)
- The Requirements/Alternatives Business Game and the Senior Steering Group (SSG) meeting in January 2004
- Data gathered from Joint Forces Command (JFCOM), the COCOMs, and the Services.

The gaps selected for analysis changed during the study. The TC AoA study team initially defined 13 gaps between training capabilities and requirements. These gaps were reviewed further by a Tiger Team composed of people from the Joint Staff (JS) Joint Training Directorate (J7), the COCOMs, and the Services. This review expanded the number of gaps to 35. Table A-1 lists these 35 gaps in order of decreasing priority, as determined by the Tiger Team. The 10 areas of training deficiency (gaps) are discussed in detail in Appendix B of this document. The JS J7 reanalyzed the 35 gaps in 2006, which led to changes in the priority of some of the gaps and the addition of 5 new gaps. This effort was not formally staffed, however, so Table A-1 remains the current baseline.

Table A-1. Training Gaps Identified by the 2004 TC AoA Gaps

Gap No.	Gap
1	Train combined Joint Task Force (JTF) staffs (includes need for Individual joint training)
2	Train standing joint force headquarters staff (includes need for Individual joint training)
3	Train on crisis action planning and deployments
4	Provide faster/higher fidelity mission rehearsal
5	Train forces on joint urban operations (JUO)
6	Train forces on information operations (IO) (including information warfare, computer network exploitation, computer network defense, and computer network attack)
7	Train forces in a joint interagency intergovernmental, multi-national environment (including intelligence community participants)
8	Provide homeland defense training
9	Provide multi-command missile defense training
10	Train forces in enemy chemical, biological, radiological, nuclear, and electromagnetic exploitation and destruction
11	Train to operate in chemical, biological, radiological, nuclear, and electromagnetic environments
12	Train on effects-based planning and EBO
13	Train theater/strategic forces to conduct C4I operations using collaborative information environment
14	Train forces on realistic logistics requirements (including reception, staging, onward movement, and integration)
15	Practice Active Component/Reserve Component integration and mobilization training
16	Train forces on stability and support operations (SASO)
17	Train forces on military assistance to civilian authorities operations
18	Train Special Operations Forces (SOF) and conventional forces for integrated operations
19	Train forces (operational and tactical level) to use national intelligence systems
20	Train routinely with the Joint Operation Planning and Execution System (JOPES)
21	Train routinely with new adaptive planning and deployment system
22	Train intelligence community as they fight (including all levels as a tactical participant)
23	Train the Joint Interagency Coordination Group (JIACG)
24	Train staff to coordinate personnel recovery operations (PRO)
25	Train global ballistic missile defense (BMD)
26	Conduct global strike training
27	Train critical infrastructure protection
28	Operations/intelligence center training, integration, and command education
29	Strategic information assurance
30	Continuity of operations
31	Train on operational systems (dedicated bandwidth)
32	Train on consequence-management operations
33	Provide special operations crisis action procedures training
34	Provide intelligence community SOF-specific training at the operational level
35	Plan, coordinate, and practice mission assurance

The simulations chosen for analysis also evolved during the study. The TC AoA began by considering 12 models (referred to as "Use Cases"). It became apparent,

however, that these cases did not adequately represent the totality of use in joint and Service training. A list of 70 simulations, federations of simulations, and tools was first compiled for consideration. Some of the tools are listed in Table A-2 for information. The subset of 14 simulations listed in Table A-3 was eventually selected for analysis. (For convenience, we will use the term "simulations" for training models, tools, simulations, and federations of simulations.)

Table A-2. Some of the M&S Tools Analyzed in the TC AoA Base Case

Acronym	Name	User	Description
ABCS C4I Adapter	Army Battle Command System C4I Adapter	JFCOM	Interface for command, control, communications, computers, and intelligence (C4I).
ADSI	Air Defense Simulation Integrator	JFCOM	Display tracks from C4I.
ARCHER System	Archiving and Enhanced Retrieval System	U.S. Army	ARCHER captures data from the simulation and the C4I systems to answer the question relating to what happened during command post exercises.
ASCOT	Airspace Control and Operations Trainer	JFCOM	ASCOT is a Distributed Interactive Simulation (DIS)-compliant new radar systems trainer. It interfaces with the Airborne Warning and Control System (AWACS), the Modular Control Element (MCE) V1, the MCE V2, the Battle Force Tactical Trainer (BFTT), the Electronic Systems Center (ESC), the Aegis Combat System Interface Simulation (ACSIS), the Air Warfare Simulation (AWSIM), and Distributed Mission Training (DMT) to provide the theater air picture.
ASTI	Army Secure Tactical Initiative	U.S. Army	Radio communications
AWSIM	Air Warfare Simulation	JFCOM, U.S. Air Force	AWSIM simulates air warfare. It models all aspects of the forces that the Air Force employs (air and ground) and the targets and threats that it opposes. Administrative and logistics functions are modeled, in addition to warfare.
BFTT	Battle Force Tactical Trainer	U.S. Navy	An integrated system to tie in short trainers and certain classes of ships to allow realistic tactical training while ships are in port.
BICM	Battle Command Training Program (BCTP) Intelligence Collection Model	U.S. Army	The BICM provides Corps Battle Simulation (CBS) users the means to exercise all-source intelligence functions. It integrates meaningful intelligence functions into a free-play, force-on-force exercise.

Table A-3. Simulations Analyzed in the TC AoA

Acronym	Name	User
ACRES	Adaptive Communications Reporting Simulation	National Security Agency (NSA)
ACTF	Army Constructive Training Federation	U.S. Army
AFMSTT	Air Force Modeling and Simulation Training Toolkit	U. S. Air Force
AFSERS/MUSE	Air Force Synthetic Environment for Reconnaissance and Surveillance/Multiple Unified Simulation Environment	U. S. Air Force
DISCO	Deployable Intelligence Simulation for Collaborative Operations	Defense Intelligence Agency (DIA)
IWEG/DCE	Information Warfare Effects Generator/Dynamic Communications Environment	NSA
LOGFED	Logistics Federate	U.S. Army
CATS	Joint Conflict and Tactical Simulation	JFCOM
JQUAD+	Suite of five computer simulation models for warfare command and control (C2)	U.S. Air Force
JOSEF	Joint Semi-Automated Forces	U. S. Navy and JFCOM
JTLS	Joint Theater Level Simulation	JFCOM
NWARS-NG	National Wargaming Simulation Next Generation	National Reconnaissance Office (NRO)
OneSAF	One Semi-Automated Force	U.S. Army
WARSIM	Warfighter's Simulation	U.S. Army

Note for Table A-3: *JQUAD+ consists of four related sub-models: Joint Electronic Combat Electronic Warfare Simulation (JECEWSI), Joint Close Air Support (JCAS), Joint Operations Information Simulation (JOISIM), and Joint Network Simulation (JNETS).*

Table A-4 is a major result of the TC AoA gap analysis, in which a "stoplight" scale is used to describe how well the 14 simulations address the 35 training gaps.

Table A-4. How Well the Simulations Cover the Training Gaps

Priority	Job Training Requirement	LOGFED	WARSIM	OneSAF	ACTF	DISCO	ACRES	IWEG/DCE	NWARS-NG	AFMSTT	AFSERS/MUSE	JOSEF	JTLS	CATS	JQUAD+
1	Train combined Joint Task Force (JTF) staffs (includes need for Individual joint training)	●	●	●	●	○	●	●	●	●	○	●	●	●	○
2	Train standing joint force headquarters staff (includes need for Individual joint training)	●	●	●	●	○	●	○	●	●	○	●	●	●	○
3	Train on crisis action planning and deployments	●	○	○	●	○	●	○	○	○	○	●	●	●	○
4	Provide faster/higher fidelity mission rehearsal	●	●	●	●	○	●	●	●	●	●	●	●	●	●
5	Train forces on joint urban operations (JUO)	●	●	●	●	○	●	●	●	○	○	●	●	●	○
6	Train forces on information operations (IO) (including information warfare, computer network exploitation, computer network defense, and computer network attack)	○	●	●	●	○	●	●	○	○	●	●	○	○	●
7	Train forces in a joint interagency intergovernmental, multi-national environment (including intelligence community participants)	●	●	○	●	●	●	●	●	○	○	●	●	●	○
8	Provide homeland defense training	●	○	●	○	○	●	●	●	●	●	●	●	●	○
9	Provide multi-command missile defense training	○	●	○	●	○	○	○	○	○	○	●	●	●	○
10	Train forces in enemy chemical, biological, radiological, nuclear, and electromagnetic exploitation and destruction	○	●	●	●	○	●	●	●	○	○	●	●	●	○
11	Train to operate in chemical, biological, radiological, nuclear, and electromagnetic environments	○	●	●	●	○	●	●	●	○	○	●	●	●	○
12	Train on effects-based planning and EBO	●	●	●	●	○	●	●	●	○	○	●	●	●	○

Legend for Table A-4:

● – The simulation fully supports the training requirement.

● – The simulation partially supports the training requirement.

○ – The simulation does not support the training requirement.

Table A-4. How Well the Simulations Cover the Training Gaps (Continued)

Priority	Job Training Requirement	LOGFED	WARSIM	OneSAF	ACTF	DISCO	ACRES	IWEG/DCE	NWARS-NG	AFMSTT	AFSERS/MUSE	JOSEF	JTLS	CATS	JQUAD+
13	Train theater/strategic forces to conduct C4I operations using collaborative information environment	◐	◐	◐	◐	○	○	○	◐	○	○	●	●	●	◐
14	Train forces on realistic logistics requirements (including reception, staging, onward movement, and integration)	●	◐	◐	●	○	○	○	○	○	○	◐	●	◐	○
15	Practice Active Component/Reserve Component integration and mobilization training	○	◐	◐	○	○	◐	○	○	○	○	◐	●	◐	○
16	Train forces on stability and support operations (SASO)	◐	◐	○	◐	○	◐	◐	◐	○	○	○	○	●	○
17	Train forces on military assistance to civilian authorities operations	◐	○	●	◐	○	◐	◐	○	○	○	○	○	●	○
18	Train Special Operations Forces (SOF) and conventional forces for integrated operations	○	◐	○	◐	○	◐	◐	◐	○	○	◐	◐	●	○
19	Train forces (operational and tactical level) to use national intelligence systems	○	◐	○	◐	○	◐	◐	●	○	○	◐	◐	○	○
20	Train routinely with the Joint Operation Planning and Execution System (JOPES)	◐	◐	○	◐	○	○	○	○	○	○	◐	●	○	○
21	Train routinely with new adaptive planning and deployment system	●	◐	◐	◐	○	○	○	○	○	○	◐	●	○	○
22	Train intelligence community as they fight (including all levels as a tactical participant)	○	◐	○	◐	◐	◐	◐	◐	○	○	◐	◐	◐	○
23	Train the Joint Interagency Coordination Group (JIACG)	○	○	◐	○	○	◐	◐	○	○	○	◐	○	◐	○
24	Train staff to coordinate personnel recovery operations (PRO)	○	◐	○	●	○	◐	◐	◐	○	○	◐	◐	●	○

Legend for Table A-4:

● – The simulation fully supports the training requirement.

◐ – The simulation partially supports the training requirement.

○ – The simulation does not support the training requirement.

Table A-4. How Well the Simulations Cover the Training Gaps (Continued)

Priority	Job Training Requirement	LOGFED	WARSIM	OneSAF	ACTF	DISCO	ACRES	IWEG/DCE	NWARS-NG	AFMSTT	AFSERS/MUSE	JOSEF	JTLS	CATS	JQUAD+
25	Train global ballistic missile defense (BMD)	○	○	○	○	○	○	○	○	○	●	●	●	●	○
26	Conduct global strike training	○	○	○	○	○	○	○	●	○	○	●	◉	●	○
27	Train critical infrastructure protection	○	○	○	○	○	●	●	○	○	○	●	●	●	○
28	Operations/intelligence center training, integration, and command education	○	○	○	●	●	●	●	●	●	●	●	●	◉	●
29	Strategic information assurance	●	○	●	○	○	●	○	○	○	○	○	○	○	○
30	Continuity of operations	○	○	○	○	○	○	○	○	○	○	○	○	○	○
31	Train on operational systems (dedicated bandwidth)	○	●	●	◉	●	●	●	●	●	●	●	◉	◉	●
32	Train on consequence-management operations	●	○	●	○	○	●	●	○	○	○	●	●	●	○
33	Provide special operations crisis action procedures training	●	○	●	●	○	●	●	○	○	○	○	●	◉	○
34	Provide intelligence community SOF-specific training at the operational level	○	○	○	●	○	●	●	○	○	○	●	●	◉	○
35	Plan, coordinate, and practice mission assurance	○	○	○	○	○	●	●	○	○	○	○	●	◉	○

Legend for Table A-4:

◉ – The simulation fully supports the training requirement.

● – The simulation partially supports the training requirement.

○ – The simulation does not support the training requirement.

Appendix B.
The 10 Areas of Training Deficiency Analyzed by the 2004 Training Capabilities Analysis of Alternatives (TC AoA)

Note: Because of the constantly evolving nature of training needs and of modeling and simulation (M&S) technologies and as indicated in previous sections of this document, the TC AoA is now dated in several regards. The analysis in this appendix will be updated in the 2009 TMSBP.

The TC AoA initially identified 13 gaps in which the then-current and programmed training capabilities failed to meet COCOM and Services training needs. The TC AoA analyzed 10 of these gaps in detail, and this appendix summarizes that analysis.

B.1 Mission Rehearsal Capability

Some contingencies develop rapidly in time, so that deploying forces requires mission rehearsal exercises (MRXs) that must be constructed in far less time than the year or more of the historical joint event life cycle (JELC). Developing this capability requires improvements in two shortfall areas:

- Rapid database development.
- A shortened JELC. The current JELC process used for planning and executing a joint training event usually involves three planning conferences, three database tests, and a host of other activities that normally span upwards of a year or more. Joint and Service trainers need the capability to rapidly construct rehearsal exercises. The following steps would be instrumental:
  - Changes in the JELC process to streamline and compress preparatory events leading up to an exercise or rehearsal.
  - Having a common tool set that automates the JELC process.
  - Achieving interoperability with Joint Planning and Execution System (JOPES). JOPES is the integrated, joint, command and control (C2) system that the Joint Planning and Execution Community (JPEC) uses to conduct planning, execution, deployment and monitoring activities. It includes people, procedures, policies, communications, and supporting information system software. JOPES supports senior-level decision-makers and their staffs at the National Command Authorities (NCA) and throughout the JPEC. Combatant commanders (CCDRs) use JOPES to determine the best course of action (COA) to accomplish the mission.

Interoperability with JOPES (or its follow-on system) will allow exercise planners to directly access COAs and other planning information with which to design the rehearsal exercise.

B.2 Adaptable Constructive Training Systems

We should "think training first" in designing training simulations, which means building a simulation to support training requirements as opposed to building a capability and then trying to adapt the training program to the simulation. To meet this objective and the general goals of effectiveness and efficiency, future constructive simulations should possess these characteristics:

- **Evolutionary instead of revolutionary.** The development of new capabilities should leverage existing systems to the extent possible and provide new training capabilities through an incremental, spiral development process.
- **High reliability, availability, and maintainability.** These requirements should be applied to all networks of the joint training architecture (i.e., system hardware, software, command, control, communications, computers, and intelligence (C4I) adapters, High Level Architecture, (HLA), and run-time infrastructure. The architecture includes all components of the federation, although the reliability, availability, and maintainability requirements for a given simulation will depend on the architecture and configuration.
- **Flexible and composable.** The simulation system should allow the exercise designer to tailor the federation to best meet the objectives of the training audience. This involves a wide variety of attributes:
  - Object-oriented design to enhance modularity and ease of upgrade and enhancement
  - Open architectures and operating systems
  - Complete representation of the joint operational environment
  - Standardized tools effective across federates, where applicable
  - Transparent interface and interoperability with existing C4I systems and networks
  - Links to live entities, ranges, and virtual simulators.
- **Scalable.** A simulation should be able to support large numbers of complex objects and accompanying interactions, while still maintaining time and spatial consistency. At a minimum, the simulation should be able to scale sufficiently to support an Ulchi Focus Lens multi-corps exercise without suffering performance degradation. It should also be able to accommodate growth of bandwidth and throughput.

- **Aggregable.** The simulation must be able to group entities while preserving the effects of entity behavior and interaction while grouped. The ability to aggregate is essential to reducing the total number of controllers required for a joint exercise.
- **Distributable.** The simulation must be capable of being distributed to the exercise audience. Moving electrons is easier than moving people.
- **User friendly.** Graphical user interfaces (GUIs), help menus, and the overall construction design should be used to promote ease of use. The training audience should be able to use the simulation without extensive prior expertise or training.
- **Multi-Agency.** The simulation should be able to stimulate and interoperate with interagency and Department of Defense (DoD) C4I systems and the Global Information Grid (GIG).
- **Operationally capable.** The simulation must be able to integrate with the C2 system and services used in the theater of operations.
- **Multi-national interoperable.** The simulation should be capable of interfacing (e.g., exchanging data) with allied and coalition systems.
- **Adaptable to doctrinal changes.** The simulation must be able to rapidly accept integration of training, doctrine, and lessons learned.
- **Interoperability.** The simulation must be able to be easily linked with other training management and reporting systems such as the Defense Readiness and Reporting System (DRRS) and the Joint Training System (JTS) via the Joint Training Information Management System (JTIMS) or its follow-on system.

B.3 Replication of the Ability To Train Non-kinetic Processes and Activities

In general, legacy simulation systems have had good capability in representing the warfighting capabilities of the Services. What has been lacking is the ability to represent capabilities that are non-kinetic in nature. Current events suggest that these capabilities are growing in importance and that M&S designers must incorporate them in future systems of simulations. The following is a discussion of these non-kinetic shortfalls:

- **Information operations (IO)/information warfare.** U.S. global communication networks have become vulnerable to unwanted worldwide access to information infrastructure. IO/information warfare involves a wide range of (1) hostility levels (from peacetime to wartime), (2) adversary types (from hacker to foreign intelligence service or military), and (3) adversary options (unauthorized access through use of conventional weapons). The new simulation system must represent these threats with enough realism to provide

training audiences the experience in defending against attacks or using IO/ information warfare to their benefit. Representation should include the following:

- Computer network defense and attack. Simulations offer the ability to train for threats that would be difficult to replicate in the real world (i.e., disabling computer networks or destroying essential databases). Any solution must be able to be tailored to the training objectives, be cost effective to produce, and have no impact on command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) systems outside of the training environment. Actions must be equally applicable against Blue force and opposing force (OPFOR) systems.
- Portrayal of Psychological Operations (PSYOP) and deception activities and their outcomes.
- Better representation of the effects of conventional weapons attacks on information grids and networks.
- Better portrayal of electronic threats (e.g., jamming, broadcasting false signals, or generating bursts of electromagnetic pulse) to information systems.

- **Space operations.** Training warfighters in the use of space systems requires the incorporation of the following objects and systems in our system of simulations:
  - Orbiting platforms as objects in the battlespace to allow portrayal of counter-space activities through kinetic kill vehicles or electromagnetic and laser-based systems.
  - Disruption or denial of space-based capabilities in surveillance and reconnaissance, communications, environmental sensing, navigation, and theater missile warning.
  - Ballistic missile launch processes and trajectories, including indications and warnings that would be available to a training audience in a real-world situation.
  - Space-based systems and terrestrial sensors that detect, track, and report on ballistic missile launches that pose potential threats against North America, geographic theaters of operation, and space-based assets. Ballistic missile warnings provide critical information essential for training at the NCA, combatant commands (COCOMs), and Joint Task Force (JTF)/joint force air component commander (JFACC) levels when conducting counter-air operations during global or theater ballistic missile defense (BMD).

- **Battle damage assessment (BDA).** As an adjunct to effects-based targeting and effects-based operations (EBO), the battlespace and intelligence federates need to be enhanced to represent the real-world capabilities necessary to identify and prioritize critical targets so that the JFCOM can achieve its operational goals in a timely fashion. The simulation system must enable the training audience to conduct realistic BDAs linked to combat events taking place in the synthetic battlespace.
- **Intelligence, surveillance, and reconnaissance (ISR).** While we have good simulations of aspects of our intelligence capabilities, we need a more comprehensive representation in the following areas:
  - The entire intelligence cycle at the national, joint, theater, and tactical levels.
  - Higher fidelity simulation of tactical and national intelligence assets and behaviors. This simulation becomes more important as the intelligence community is integrated into the training audience and receives ISR feeds from the synthetic battlespace.
  - Better integration of ISR products to produce fused and aggregated JTF-level and higher formatted intelligence reports.
  - Better portrayal of human intelligence (HUMINT) and measurement and signal intelligence (MASINT) capabilities.
- **Military assistance to civilian authority.** New emphasis on homeland security has generated a need for simulations to train staffs in military assistance to civilian authority. These simulations must be capable of representing natural and man-made disasters and DoD assistance for civil disturbances, counter-drug operations, sensitive support, counterterrorism, and law enforcement. This effort will involve simulating civilian systems that are needed to operate the economy and government (e.g., telecommunications, energy, banking and finance, transportation, water systems, and emergency services, both governmental and private).
- **Mobilization, deployment, and redeployment.** These activities require better representation than our current training system of simulations provide. Current events are causing shift in focus toward adaptive regional planning to provide more options for decision-makers. The role of the CCDRs in the planning process continues to expand. More than ever, the strategy is based on developing forces that are ready to move either from the Continental United States (CONUS) or forward-deployed locations to the scene of a crisis. Successful execution gives the CCDR the ability to mass overwhelming force to terminate crises swiftly and decisively. To portray these movements, the future system of simulations must incorporate the following systems and activities:

- Automated Joint Logistics Over-the-Shore (JLOTS)
- Automated Maritime Pre-positioned Forces (MPFs)
- Individual transportation vehicles moving forces (equipment, personnel, supplies) from origins to ports of embarkation (POEs), from POEs to ports of debarkation (PODs), and from PODs to final destinations
- Airport and seaport throughputs and activities, as affected by combat events
- Environmental factors that impede the movement of forces, equipment, and supplies
- All phases of redeployment, including
  - Reconstitution for strategic movement
  - Movement to redeployment assembly areas
  - Movement to POEs
  - Strategic lift
  - Reception at PODs
  - Joint reception, staging, onward-movement, and integration (JRSOI) (as defined below).
- Dynamic time-phased force and deployment data (TPFDD). TPFDD are ever-changing to reflect the decision-maker's desires and the events within the simulation battlespace. Environmental factors and enemy action can damage, delay, and divert air and sea transports and their cargo and passengers. Airports and seaports may be blockaded, damaged, or destroyed. These factors cause planners to adjust port throughput databases, to delete damaged, destroyed, or delayed lift assets, and to reschedule missions. Rescheduling missions will lead planners to update the GTN Exercise Support (GES)[1] system database and issue new movement orders to the forces. The training simulation should also allow joint force commanders (JFCs) to explore "what if" scenarios so they can make better decisions regarding joint deployment and missions. Implementing a dynamic TPFDD capability might be done best through federating simulations that accommodate these features with the United States Transportation Command (USTRANSCOM) Analysis of Mobility suite of models or through a new, organic capability built into a legacy system. However it is done, the simulation battlespace should incorporate the appropriate level data in the TPFDD.

[1] GTN = Global Transportation Network

- **Sustainment.** Sustainment means providing provisions and other support to maintain personnel and equipment during prolonged combat or other operations. U.S. sustainment models must provide more realistic simulations of sustainment activities, including the following:
  - Health services and patient evacuation
  - Procurement, transportation, and supply in foreign theaters
  - Maintenance, repair, and salvage operations
  - Engineering activities
  - Communications system support, security assistance, host-nation support, and related logistic activities.
- **Joint reception, staging, onward-movement, and integration (JRSOI).** Future M&S models dealing with deployment must simulate reception, staging, onward-movement, and integration (RSOI) operations: the process of receiving personnel who have deployed into a contingency theater, connecting them with their unit equipment and materiel, and forming them into forces capable of carrying out operational missions. These actions involve
  - Receiving personnel, equipment and materiel at airports of debarkation (APODs) and seaports of debarkation (SPODs)
  - Convoying them to dismount points or railheads
  - Moving them from dismount points and railheads to staging areas
  - Joining personnel with their unit equipment and materiel
  - Providing personnel the supplies, services, and life support necessary to achieve readiness for onward movement
  - Integrating the unit with its parent organization.

RSOI requires robust logistics forces to perform the support tasks. It should be capable of portraying these operations in a transparent, realistic manner to the training audience and require little or no human-in-the-loop (HITL) interaction by exercise control group personnel to achieve training objectives.

B.4 Multi-Level Security (Cross-Domain Information Sharing (CDIS))

Multi-level security entails people at a variety of sensitivity levels handling information without disclosing it to unauthorized people. It usually involves mechanisms that only allow data to flow upward in terms of sensitivity. Modern notions of “information dominance” and “sensor to shooter,” however, involve downward flow: intelligence assets identify targets and pass the information to mission planners, who assemble a

mission and pass the mission details to tactical assets, who may, in turn, share details with support and maintenance assets. The problem is becoming more complex as multi-national involvement brings more foreign nationals into U.S. training events. The system must therefore differentiate between NOFORN (Not Releasable To Foreign Nationals) and North Atlantic Treaty Organization (NATO) releasability markings and between these categories and the normal U.S. classifications. Workstation accessibility is also an issue when classified databases are used because protections are required to prevent unauthorized access by foreign nationals who may be acting in role-player positions. The challenge, therefore, is to develop a multi-level security system that prevents the disclosure of sensitive information to unauthorized individuals without impeding the legitimate flow of information that people need to carry out their missions.

B.5 Multi-Echelon Training

Since combat operations are typically multi-echelon (i.e., between functional command elements and tactical units in the field and every C2 element in between), training must also be multi-echelon. Training end-to-end communication and coordination is needed to achieve the benefits of information superiority operations and network-centric warfare. Multi-echelon training is also a necessary requirement if the full benefit of an integrated live, virtual, and constructive (LVC) environment is to be realized. The simulation must be able to feed realistic battlespace scenario information at the proper level of resolution through these real-world systems and in a way that is completely transparent to the training audience.

B.6 Strategic Context

This issue involves national-level collaboration on joint training events to support the national military strategy and the Global War on Terror (GWOT). Strategic national-level training involving cross-COCOM and national command structure participation in training events is at the heart of the issue. Such training would also be used as a stepping-stone to helping the interagency training program meet COCOM requirements.

B.7 Emerging Concepts

Unless legacy constructive simulations are upgraded to train new concepts, man-power-intensive workarounds will have to be used to meet training objectives. The future system of simulations must have the ability to represent the following emerging war-fighting concepts and capabilities:

- **Operational net assessment.** Operational net assessment means identifying key links and nodes—political, military, economic, social, infrastructure, and information—in an adversary's capability for war. Operational net assessment helps commanders identify operations to deter or defeat the adversary. The future system of constructive simulations must represent the full gamut of adversary political, military, economic, social, infrastructure, and information capabilities within the synthetic battlespace. The simulation must relay that information directly to the training audience through normal intelligence gathering and C4ISR processes or indirectly through the appropriate role players or response cells. Operational net assessment is a critical enabler for achieving rapid decisive operations.
- **Effects-based operations (EBO).** Portraying EBO processes will challenge the state-of-the-art M&S. Simulation will have to include a variety of factors in many different domains (e.g., the synthetic natural environment (SNE), the civil environment, the electromagnetic environment, and theater communications)). Since data are critical in these processes, the training community should take steps to standardize and improve the quality of the data used in the various databases. The range of factors includes the following:
  - Representation and positioning of targets within the SNE and civil environment
  - Enemy infrastructure, such as communications and electrical grids; gas and oil pipelines; rail lines, roads, and other transportation features; higher headquarters; and other C2 centers.
  - Psychological effects—the kinds that would be obtained either through conventional military operations or PSYOP missions
  - Weapons effects (lethal and non-lethal) on intended targets (first-order effects)
  - Cumulative effects from the aggregation of direct and indirect effects at varying levels of war
  - Cascading effects that can ripple through an adversary's target system and also influence other target systems
  - Replication of the means for assessing target damage to ascertain true BDA.
- **Joint interactive planning.** Joint interactive planning, which was formerly called collaborative information environment, addresses C2 infrastructure and battlespace awareness issues that are critical to enabling the common relevant operational picture (CROP)/rapid decisive operations (RDO) concepts. The hypothesis underlying joint interactive planning is as follows: If the ability to plan the various elements of joint operations in parallel rather

than in sequence can be increased, commanders will be able to decide and act faster than the adversary. The exact manner in which a constructive simulation system would interact with such an environment (e.g., response-cell/role-player interaction with the training audience via the collaborative environment) has yet to be determined. The joint interactive planning vision is as follows:

- Commanders and joint force staffs plan operations, using advanced, automated planning and decision-support tools.
- The JFC's intent is disseminated to all levels and at all times.
- The staffs are globally linked to virtual collaborations of subject matter experts (SMEs), expert organizations, and support establishments.
- Virtual organizations are also formed to support any joint-force-unique requirements for the mission.
- The joint force is fully integrated with allies and other partners across the full range of military operations.
- Planning and execution are continuous, simultaneous, and mutually supportive to shorten the observe, orient, decide, and act loop.

- **Joint urban operations (JUO).** JUO are operations conducted in civilian surroundings, where the density of non-combatants is usually high. Achieving military objectives with minimum own casualties and collateral damage is a goal. Weapons used in JUO include non-lethal weapons and precise weapons. Achieving situational awareness (SA) via surveillance and communication is critical. The operational advantage that heavy, long-range, and high-technology weapons give U.S. forces is significantly reduced in urban environments, so the weapon of choice for JUO is the individual combatant working within a small unit in Army and Marine light forces at echelons of battalion and below.

  Since urban centers are rapidly becoming sites of conflict throughout the world, constructive simulations that can portray JUO must be constructed. They must have enough resolution to depict forces at the entity level and operating in urban environments of varying size, building, and street patterns, industrialization, lines of communication, and mobility corridors. The environment must be three-dimensional (3D), including subterranean, ground-level, building-level, and above-ground features. JUO functionality requires civil environment development of population demographics, political and socioeconomic factors, and urban infrastructure features such as telecommunications and power grids. Intelligence models should also be capable of providing appropriate reports and analyses to allow the training audience to develop COAs and conduct suitable intelligence preparation of the battlefield tailored for the urban environment.

- **Joint fires.** Joint fires (lethal or non-lethal) are used to support attack by two or more components on enemy air, sea, and land forces before they can attack U.S. forces. Synchronization is critically important in achieving success without friendly losses. This synchronization requires simultaneous integration of intelligence, air operations, ground operations, maritime operations, and logistics. Fires can be used against a variety of targets:
  - Leadership
  - Infrastructure and key production components (transportation, energy, C4I)
  - Nuclear, biological, and chemical (also known as weapons of mass destruction (WMD))
  - Theater ballistic missiles
  - War-making industries
  - Non-lethal methods targeted at the population.

  Use of joint fires is closely tied with EBO, and many of the data requirements needed for depicting EBO in the synthetic battlespace also apply to joint fires: representation and positioning of targets within the SNE and civil environment, portrayal of enemy infrastructure and capabilities within the civil environment, and the socioeconomic and demographic characteristics of the population. Accurate across-domain or cross-simulation interactions among federates is a must. Time management within the simulation to maintain the cause-and-effect relationship is also required, although this detail may be difficult to achieve if the simulation solution involves loose federations or use in a combined LVC environment.
- **Stability operations.** Security forces carry out stability operations (military, paramilitary, and police) to restore and maintain order. The realities of the post-Cold War environment indicate that JFCs will be conducting extended "peace operations" that have complex and changing relationships within the military, political, and cultural contexts. It is important to provide JFCs the training required to anticipate the force sizes, capabilities, and application times necessary to restore and maintain order in a failed state. The future system of simulations must be capable of portraying these political and cultural factors in a realistic and scenario-dependent manner. Also required is the ability to portray multiple sides and factions, their relationships to each other, and the rules of engagement (ROE). Knowledge of population control via riot-control measures and use of non-lethal munitions is also required.
- **Joint close air support (JCAS).** JCAS refers to close air support (CAS) operations across components. Army pilots flying Army aircraft in support of Army ground forces, for example, is not considered JCAS. CAS requires an

integrated, cross-component C2 structure to process CAS requirements, assign assets, communicate tasking, deconflict fires and routing, coordinate support, establish airspace control measures, and update or warn of threats to CAS assets. The JFCOM normally exercises operational control through Service component commanders. The JFCOM, through the JFACC, tasks air assets made available for joint tasking through these Service component C2 systems. CAS in joint operations is planned via the joint air operations center (JAOC) using a host-component, organic C2 architecture. The air support operations center (ASOC) is the primary control agency component of the theater air control system for the execution of CAS. The CAS requests may be either preplanned or immediate. Preplanned requests normally do not include detailed target information and may not include detailed timing information because of the lead time involved. Immediate requests, on the other hand, arise from situations that develop once the battle is joined. Immediate requests cannot be identified early enough to allow detailed coordination and planning. The complexity of JCAS mandates that the cross-federate interactions within the simulation battlespace are seamless and realistic. Interactions among all players in the JCAS process, whether they are part of the training audience or a role player/response cell, must also be realistically portrayed over organic C2 devices. JCAS missions can be conducted using a variety of aircraft (attack helicopters, attack fixed-wing aircraft, AC-130 gunships, and so forth) and a variety of weapons (guns, gravity weapons, and powered weapons—either "smart" or "dumb").

- **Integration of Special Operations Forces (SOF) with conventional forces.** SOF operations in Afghanistan and Iraq have led to a growing trend of increasing the integration of SOF with conventional forces to leverage the SOF's specialized capabilities. SOF operations are not represented in the current inventory of M&S tools, however. The future training simulation systems must be capable of portraying integrated operations in a realistic way and in a way that is consistent with joint doctrine. SOF operations could be incorporated into the future system of simulations either by directly including them into an existing simulation or by developing a new federate containing specific SOF models. At minimum, the simulation should include high-resolution portrayal of the following features:
  - *Nine Special Operations principal mission areas.* The missions that SOF are organized, trained, and equipped specifically to accomplish:
    - Direct action
    - Combating terrorism
    - Foreign internal defense
    - Unconventional warfare

- – Special reconnaissance
- – PSYOP
- – Civil affairs
- – Counter-proliferation of WMD
- – IO.

– *Seven Special Operations collateral activities.* These missions include those that will shift more readily because of the changing international environment. SOF are not manned, trained, or equipped for collateral activities but, rather, conduct these activities using the capabilities that have been developed for the primary missions.

- – Coalition support
- – Combat search and rescue
- – Counter-drug activities
- – Countermine activities
- – Foreign humanitarian assistance
- – Security assistance
- – Special activities.

– *Chemical, biological, radiological, nuclear, and high-yield explosives (CBRNE) operations, exploitation, and destruction.* The 9/11 attacks are examples of adversaries' attempts to counter the preeminence of U.S. power (cultural, diplomatic, economic, and military) through asymmetric attacks against undefended targets, rather than through conventional military confrontations. CBRNE terrorism by states and non-state actors presents to government and military leadership unprecedented challenges that have not been adequately addressed in training simulations. The future systems of training simulations must incorporate realistic portrayals of CBRNE operations in military and domestic scenarios, and these portrayals must focus primarily on the crisis-management and consequence-management aspects of such an attack. Desired portrayal should include the following:

- – Intelligence capabilities, processes, and products that may provide indications and warnings of CBRNE attack
- – Terrorist activities at entity level
- – Weapons effects: immediate (blast, electromagnetic pulse, radiation, and so forth) and delayed (site contamination/denial, incubation rates, rates of disease, cross-contamination, and so forth)

- – Monitoring and detection capabilities that would alert a JFC of an attack
- – Environmental impacts on weapon effects (winds, rain, and so forth)
- – Impact of CBRNE attack on civil infrastructure, economy, and populace (e.g., loss of utilities, stock market disruption, mass casualties, panic, and so forth)
- – Ability of military, federal, or local fire-fighter/hazardous materials (HazMat) teams to decontaminate sites, equipment, and personnel.

– **Personnel recovery operations (PRO).** Personnel recovery is the umbrella term for the military, civil, and political efforts to recover captured, missing, or isolated personnel from hostile environments. Recoveries might be conducted by U.S., allied, coalition, or friendly military or paramilitary forces or through diplomatic initiatives as designated by the NCA. Personnel recovery includes, but is not limited to, the following missions: combat search and rescue; survival, evasion, resistance, and escape; and the coordination of negotiated and forcible recovery options. The future simulation system should be capable of portraying these operations in a transparent, realistic manner to the training audience.

– **Ability to train force protection.** Force protection means protecting military personnel, civilians, family members, facilities, and equipment in all locations and situations. It is accomplished through antiterrorism activities, physical security, operations security (OPSEC), and personal protective services supported by intelligence, counterintelligence, and other security programs. The simulation system should be capable of representing an improved resistance to attack resulting from actions taken by a JFCOM to improve the security of the force. Although the exact means to achieve this scenario has not yet been fully determined, it could include explicit portrayal of terrorist activities; checkpoints along roads, patrols, and so forth; or by implicit representation of an adjustable degree of resistance to attack based on actions taken by the JFCOM and the level of threat.

– **Test/training/experimentation environments.** The COCOMs and Services want the simulation system to be capable of supporting the testing and experimentation communities, as well as training. This capability is of secondary importance, however, and should not result in excessive development costs or delays in the delivery of the required training capabilities.

B.8 Emerging Missions

The future simulation system must be capable of training new, emerging missions resulting from Unified Command Plan (UCP) reorganizations or current events, such as the following:

- Global strike and global BMD—the new Strategic Command (STRATCOM) mission
- GWOT—the new Special Operations Command (SOCOM) mission
- Irregular warfare
- The new U.S. Northern Command (NORTHCOM) homeland security missions:
  - Prevent terrorist attacks within the United States
  - Reduce America's vulnerability to terrorism
  - Minimize the damage of terrorism; promote the recovery from attacks that do occur.

To train to this mission, the simulation system must:

- Train to CBRNE as discussed previously
- Provide a C2 capability ranging from high-level interagency communications to low-level communications with local law enforcement and other first-responder units
- Portray the civil environment (transportation systems, utilities, electrical grids, community water systems, pipelines, and so forth) in enough detail to train personnel in protecting critical infrastructure
- Provide intelligence and warning capabilities representative of real-world capabilities tailored for the homeland defense mission
- Portray the activities of the Coast Guard, law enforcement, first-responder units, non-governmental organizations (NGOs) and so forth within the simulated environment.
- Link into the LVC environment
- Provide the means to train consequence management and media relations.

B.9 Imbedded Training Capability

When appropriate and cost effective, newly acquired real-world systems should possess embedded training capabilities that are interoperable with other systems.

B.10 SNE Improvement

SNE models provide simulations that include data on natural and some man-made entities. These data include over 50 features regarding terrain (elevations, roads, forests), atmosphere (temperature, fog, nuclear, chemical, and biological contamination), ocean (sea state, acoustic propagation), space (communication and navigation satellites, vehicles), and weather (rainfall, icing). As this list suggests, the SNE models react to events that occur in the battlespace, such as nuclear, chemical, and biological contamination. These models allow exercise controllers to retrieve, modify, update, and delete various types of information during runtime.

Appendix C.
Federations

Eight federations were selected for review in the 2007 Training Community Modeling and Simulation Business Plan (TMSBP):

1. Joint Live Virtual Constructive (JLVC)
2. Joint Multi-Resolution Model (JMRM)
3. Joint Land Component Constructive Training Capability (JLCCTC) Multi-Resolution Federation (MRF)
4. Joint Land Component Constructive Training Capability (JLCCTC) Entity Resolution Federation (ERF)
5. Battle Force Tactical Trainer (BFTT)
6. Navy Continuous Training Environment (NCTE) Federation
7. Marine Corps Deployable Virtual Training Environment (DVTE) federation
8. Air and Space Constructive Environment (ACE).

C.1 Joint Live Virtual Constructive (JLVC)

The JLVC core provides an integrated backbone for training combatant command (COCOM) staff and Service components down to tactical units and individual/crew trainers. It provides COCOM/Joint Task Force (JTF) training in Tiers 1 and 2, and Tiers 3–5 in several specific gap areas. It is composed of three major capabilities: planning, exercise control, and after action review (AAR).

JLVC integrates constructive simulations with virtual simulators and live range instrumentation in a near-real-time synthetic environment. It consists of entity-level models and simulations that represent Service combat, intelligence, and logistic systems. It also provides training for a range of joint interagency, intergovernmental, and multinational audiences, allowing Active Components, Reserve Components, State Police, Red Cross, and other national and state agencies to train together with joint and Service battle staffs.

JLVC employs the following simulations, sublevel federates, and tools:

- Session Initiation Protocol for Instant Messaging and Presence Leveraging Extensions (SIMPLE)

- Air and Space Collaborative Environment Information Operations Suite (ACE-IOS)
- Air Warfare Simulation (AWSIM)
- Joint Conflict and Tactical Simulation (CATS)
- Joint Deployment Logistics Model (JDLM)
- Joint Semi-Automated Forces (JOSEF)
- Missile Defense Space Warning Tool (MDST)
- National Wargaming Simulation Next Generation (NWARS-NG)
- CATS Low Overhead Driver (JLOD)
- Tactical Simulation (TACSIM)
- Joint Theater Distribution System
- Multiple Unified Simulation Environment/Air Force Synthetic Environment for Reconnaissance and Surveillance (MUSE/AFSERS)
- Joint Distributed After-Action Review System (JDARS).

C.2 Joint Multi-Resolution Model (JMRM)

The JMRM uses the Joint Theater Level Simulation (JTLS) and the Joint Conflict and Tactical Simulation (JCATS) as its core models. The JMRM has been used to validate the concept of federate selection based on user functional requirements. Its name and capabilities derive from the need to simultaneously provide high-level aggregate simulations to support JTF training events and entity-based representations to simulate tactical forces. The Joint Forces Command (JFCOM) is integrating other federates into the JMRM Federation. An entity-level server aggregates units to provide a common template for intelligence federates while off-loading some of the entity-level representation requirements from CATS.

JMRM employs the following sub-federates and tools:

- JTLS
- CATS
- JDLM.

C.3 Joint Land Component Constructive Training Capability (JLCCTC) Multi-Resolution Federation (MRF)

JLCCTC-MRF is one of two federations in the Army Constructive Training Federation (ACTF). It is a medium-resolution federation designed for training audiences at

the division and corps levels, including JTF commanders and battle staffs. If used in a smaller composition, MRF can also be used for training brigade combat teams and functional and multi-functional support brigades that include intelligence, fires, aviation, air defense, and sustainment. The collection of simulations, interface devices, security systems, and communication nodes in JLCCTC-MRF allows for battle command training over a distributed network or at individual nodes. It enables stimulation of the Army Battle Command Systems (ABCS) and provides a digital common operational picture (COP). It allows small units to realistically replicate high-resolution combat activities and features a non-kinetic event model. It supports detailed logistical and intelligence play.

JLCCTC-MRF employs the following federates and tools:

- Corps Battle Simulation (CBS)
- JDLM/Logistics Federation (LOGFED)
- Joint Non-Kinetic Effects Model (JNEM)
- Independent Stimulation Module (ISM)
- WARSIM Intelligence Module (WIM)
- CATS
- TACSIM
- NWARS
- MUSE
- After Action Review System (AARS).

C.4 Joint Land Component Constructive Training Capability (JLCCTC) Entity Resolution Federation (ERF)

JLCCTC-ERF is a high-resolution federation designed for training brigade combat team commanders and battle staffs serving in a JTF. It is also suitable for training functional and multi-functional support brigades that include intelligence, fires, aviation, air defense, and sustainment. It can support limited training for brigade internal operations, with representation of supported units only as necessary to create Service "demands." It is a collection of constructive simulations, interface devices, security systems, and communication nodes designed to allow for battle command training over a distributed network or at individual nodes. It provides a digital COP and allows for battle command training, including stimulation of ABCS. It also includes a reduced overhead training system for delivering routine digital training of battle staffs at all levels.

JLCCTC-ERF provides interfaces and models that enable company, battalion, and brigade training audiences to meet their command and control (C2) training objectives in a joint, combined environment. It allows realistic replication of military operations in urban terrain and includes detailed intelligence play and fairly robust logistics representation.

JLCCTC-ERF employs the same federates and tools as JLCCTC-MRF.

C.5 Battle Force Tactical Trainer (BFTT)

BFTT supports training and mission rehearsal across all warfare areas and all naval force elements ranging from "deck plate" operators and decision-makers to commanding officers, to Afloat Training Organization (ATO) and Battle Group/Battle Force (BG/BF) commanders. It employs a distributed, simulation-based architecture that networks on-board and embedded training systems. It supports training of integrated forces or independent ships worldwide across the full command and decision line, including multiple warfare areas for vessels in port and staffs ashore or embarked. Shipboard subsystem training capabilities are organic and designed around existing onboard/embedded trainer configurations. Simulation of the combat system is transparent to the operators. All controls and displays are in a tactical mode. Combat system monitoring devices are non-intrusive and do not have a negative impact on system operation.

BFTT collects selected data to provide real-time and post-event feedback of operator and team performance and transmission in real or near-real time to a shore site for further processing after a training event. Performance assessment reports cover all command levels from the BG commander through individual operators aboard ship.

BFTT employs the JOSEF federate.

C.6 Navy Continuous Training Environment (NCTE)

NCTE and the JFCOM's Joint Training and Experimentation Network (JTEN) enable real-time battle simulation for top-level staff training aboard ships, with optional links to Air Force and Army training simulators.

NCTE employs the following federates and tools:

- BFTT
- JOSEF
- Submarine Multi-Mission Team Trainer (SMMTT)

- High Level Architecture (HLA) analyzer
- ANALYSIM.

C.7 Marine Corps Deployable Virtual Training Environment (DVTE)

The Combined Arms Command and Control Training Upgrade Systems (CACCTUS) is an upgrade to the Marine Corp's Combined Arms Staff Trainer (CAST). The original CAST was a highly detailed physical model of a terrain board, and it simulated radio communications links employed to train the combined arms staff as a team. CACCTUS replaced the physical model with a constructive simulation using One Semi-Automated Force (OneSAF) as the core to provide accurate model of Marine Air-Ground Task Force (MAGTF) forces, synthetic terrain and weather, two-dimensional (2D) and three-dimensional (3D) visualizations, interfaces to tactical command, control, communications, computer and intelligence (C4I) systems, and a robust AAR capability. The concept of employment for training with CACCTUS is to immerse the training audience in a realistic, scenario-driven environment to enable commanders and their battle staffs to train and rehearse combined arms tactics, techniques, and procedures (TTP) and to exercise the tactical decision-making process.

DVTE employs the following federates:

- Virtual Battlespace 2 (VBS2)
- Shadow unmanned aerial vehicle (Shadow UAV).

C.8 Air and Space Constructive Environment (ACE)

ACE is the constructive element and integrator for the Air Force's Distributed Mission Operations[1] capability. It is a collection of modeling and simulation (M&S) capabilities that provide the foundation for Air Force live, virtual, and constructive (LVC) components in a distributed mission operations environment. It combines LVC simulations to support training, mission rehearsal, and operations.

ACE provides air and space simulation of a full theater of war environment. It provides the air and space power representation within a Joint National Training Capability (JNTC). It enables joint air component headquarters and other elements of the C2 constellation to create an air and space synthetic environment for training and operations.

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1 Distributed Mission Operations is the Air Force initiative supporting the Department of Defense (DoD) Strategic Plan for Training Transformation.

ACE employs the following federates and tools:

- Air Warfare Simulation (AWSIM)
- Information Operation Suite (IOS)
- Logistics Simulation (LOGSIM)
- Air Force Synthetic Environment for Reconnaissance and Surveillance (AFSERS)
- Graphical Input Aggregate Control (GIAC)
- Command and Control Simulation Interface (CSI)
- Architecture Assessment Tool (AAT).

Appendix D.
Glossary

Acoustic Transmission Loss Server (ATLOS). Used to model acoustic effects in a sonar environment.

Adaptive Communications Reporting Simulation (ACRES). Formerly part of Joint SIGINT Simulation (J-SIGSIM), ACRES simulates signals intelligence (SIGINT) collection and dissemination and provides SIGINT product reports via means defined in the event planning. Does not output portable data units (PDUs) but requires Entity State, Transmitter, Electromagnetic Emitter, and Signal PDUs on the Top Secret/Sensitive Compartmented Information (TS/SCI) Distributed Interactive Simulation (DIS) Local Area Network (LAN) from environment generators such as Air Warfare Simulator (AWSIM), Information Warfare Effects Generator/Dynamic Communications Environment(IWEG/DCE), and Distributed Incremental Compiling Environment (DICE).

Advanced Seal Delivery System (ASDA). Simulates a submarine training system for providing stealthy submerged transportation for insertion into Special Operations Forces (SOF) teams during covert operations.

Advanced Field Artillery Tactical Data System (AFATDS). A network of computer workstations that process and exchange information from the forward observer (FO) to the fire support element for all fire support assets (field artillery, mortars, naval gunfire, attack helicopters, and close air support (CAS)). Features include automatic processing of fire requests, generation of multiple tactical fire solutions for missions, monitoring of mission execution, and support for the creation and distribution of fire plans.

After Action Review System (AARS). Collects data from the Entity Resolution Federations (ERFs). Provides the AARS operators the ability to manage (reduce and analyze) the collected data and develop visual products (slides, charts, graphs) that provide useful information to facilitate the commanders' AAR process.

Aggregation. The ability to group entities while preserving the collective effects of entity behavior and interaction.

Air and Missile Defense Workstation (AMDWS). A digitized tool for monitoring and managing air and missile defense (AMD) operations. Allows integration of the AMD plan with the ground scheme of maneuver. Receives air situational information from the Air Defense System Integrator (ADSI). Ground situation and intelligence information are received from the Maneuver Control System (MCS), All Source Analysis System (ASAS) remote workstation, and other sources. Maintains a comprehensive

database of the tactical situation and also has mission-planning capabilities that can provide overlays of sensor and weapons coverage, airspace control measures, threat locations, and planned unit positions. AMDWS are integrated into air defense command and control (C2) systems at all echelons.

Air Defense Systems Integrator (ADSI). Provides Tactical Data Link (TDL) picture (i.e., Link 11/Link 11B, Link 16, Beyond-Line-of-Sight (BLOS) Link 16 (Satellite Tactical Digital Information Link (TADIL) J, Joint Range Extension (JRE)) to other locations aboard CV/CVN/LCC/LHA/LHD class ships (e.g. Tactical Flag Command Center (TFCC), Flag Plot, Warfare Cell) for a fused situational awareness (SA) capability to the strike group staff. ADSI also provides TDL information to Global Command Control System–Maritime (GCCS-M) for generation of the common operational tactical picture (COTP)/SA that can be disseminated to the participants of a common operational picture (COP) network.

Air, Space, and Cyber Constructive Environment–Command and Control Systems Interface (ASCCE-CSI). Provides automated support for loading a Theater Battle Management Core System (TBMCS) air tasking order (ATO) into AWSIM, producing AWSIM mission order stacks and a mission editing capability. CSI also supports the communication of mission takeoff times, landing times, and mission results from AWSIM to TBMCS.

Air, Space, and Cyber Constructive Environment–Information Operations Simulation (ASCCE-IOS). A suite of multiple simulations that provide the information operations (IO) portion of ASCCE, which is the constructive foundation that supports and integrates with Air Force Live, Virtual, and Constructive (LVC) components in a Distributed Mission Operation's (DMO) environment and the Joint National Training Capability (JNTC). ASCCE-IOS provides the IO supporting Air Force LVC and JNTC during joint/Service battle staff training exercises. The current ASCCE-IOS component models consist of the electronic warfare (EW) module, C2 module, network module, sensor module, ground game module, virtual message editor and distributor, Space Common Operating Picture and Exploitation System (SCOPES), and the Joint Data Translator (JDT). Integrates and facilitates the constructive command and control and intelligence, surveillance and reconnaissance (C2ISR) components within the training environment. Simulates electronic warfare operations (EWO), space, ground and surface orders of battle (OOBs), IO, fixed targeting adjudication, bomb damage assessment (BDA), and provides intelligence reports and data feeds on these effects using real-world command, control, communications, computers, and intelligence (C4I) systems and devices. Also models air-breathing sensors (Rivet Joint, U2, Global Hawk, Predator, EP-3), national sensors, sensor coverage and limitations, and produces intelligence products.

Air, Space, and Cyber Constructive Environment (ASCCE). The constructive element and integrator for the Air DMO capability, which combines LVC simulations to support training, mission rehearsal, and operations. Provides air and space

simulation of a full theater of war environment. A collection of modeling and simulation (M&S) capabilities that provide the foundation for Air Force LVC components in a DMO environment.[1] Provides the air and space power representation and enables joint air component headquarters and other elements of the Command and Control Constellation (C2C) to create an air and space synthetic environment for training and operations.

Air Warfare Simulation (AWSIM). Models all aspects of Air Force employment (air and ground) and the targets and threats that it opposes.

All Source Analysis System–Light (ASAS-L). The ASAS is the Department of Army intelligence management system. ASAS is not just one system but a family of systems and components that allow large amounts of intelligence data to be gathered, correlated, and processed. ASAS-L is a variant of the standard ASAS remote workstation (RWS). It provides intelligence support to Battalion S-2, the intelligence and EW component of the Army Battle Command System (ABCS). Automates intelligence electronic warfare (IEW) asset management, intelligence preparation of the battlefield (IPB), and dissemination of intelligence.

Architecture. The structure of components in a program/system, their interrelationships, and principles and guidelines governing their design and evolution over time.

Archiving and Enhanced Retrieval System (ARCHER). Captures data from the simulation and the C4I systems to answer the question relating to what happened during command post exercises.

Automated Scripter Simulator Exercise Training (ASSET). Personal computer (PC)-based electronic intelligence (ELINT) simulator that simulates national source tactical electronic intelligence (TACELINT) reports or a scripted ELINT OOB as from a generic satellite constellation collector. Will inject scripted TACELINT messages into the broadcast system. Can generate Automated Identification System (AIS) reports for transmission via an Independent Basic Service Set (IBSS).

Aviation Combined Arms Tactical Trainer (AVCATT). A mobile, transportable, multi-station virtual simulation device designed to support unit collective and combined arms training. Provides six cockpits that can be configured to any combination of attack, reconnaissance, lift, and/or cargo helicopters. Also has four role-player stations for battalion/squadron staff or combined arm elements, integrated threat and friendly semi-automated forces (SAF); and exercise record/playback and simultaneous AAR.

Base Case. A list of those joint and Service federations that best describe current training capabilities.

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[1] DMO is the Air Force initiative supporting the Department of Defense (DoD) Strategic Plan for Training Transformation.

Battle Command Sustainment Support System (BCS3). A technological insertion into the Combat Service Support Control System (CSSCS). Technical insertion is created by merging limited aspects of CSSCS functionality with the current functionality of the Joint Deployment Logistics Model (JDLM) and In-Transit Visibility (ITV), dramatically enhancing improvements in database management.

Battle Command Training Program (BCTP). Intelligence Collection Model (BICM). Provides Corps Battle Simulation (CBS) users the means to exercise all-source intelligence functions. Integrates meaningful intelligence functions into a free-play, force-on-force exercise.

Battle Force Tactical Trainer (BFTT). An integrated simulation system to tie in shore trainers and certain classes of ships to allow realistic tactical training while the ships are in port.

Business Strategy. The approach designed to achieve the most effective use of resources and the best return on investment. Includes an emphasis on modern business practices to make the most of available defense dollars. Included in this is use of competitive sourcing.

Call-for-Fire Trainer (CFFT). A lightweight, rapidly deployable, observed fire training system that provides simulated battlefield training for fire support specialists, joint fires observers, and soldiers at the institutional and unit level.

Chemical Biological Simulation Suite (CB Sim Suite). Serves to integrate LVC systems to help meet identified capability gaps and deficiencies in the chemical, biological, radiological, nuclear, and high-yield explosives (CBRNE) training environment. At the completion of the project, CBRNE M&S tools will be integrated with the Joint Live Virtual Constructive (JLVC) simulation federation, live range instrumentation as part of a mobile Chemical Biological Instrumented Training System (CBITS), and the DoD Chemical and Biological Defense Program (CBDP) programs of record: the Joint Warning and Reporting Network (JWARN), the Joint Effects Model (JEM), and in the future for the Joint Operational Effects Federation (JOEF) (to include sensors and individual protective equipment (IPE) that the CBDP is transitioning to the warfighter)).

Close Combat Tactical Trainer (CCTT). A family of virtual, DIS for collective training. Supports the training of armor, mechanized infantry, and cavalry units from platoon through battalion echelon, including the staff. The primary training audience operates from full-crew simulators, mock command posts, and live battalion command posts to accomplish their combined arms training tasks.

Collaborative Force Analysis, Sustainment, and Transportation (CFAST). A collaboration tool that incorporates campaign planning, forecast predictions, information management, and rapid execution.

Combined Arms Command and Control Training Upgrade Systems (CACCTUS). Provides a capability to create a training event that facilitates effective realistic fire support training for more than a single echelon of command or element of the Marine Air-Ground Task Force (MAGTF).

Command and Control Personal Computer (C2PC). A Windows-based client software application designed to facilitate military C2 functions by improving SA and to enhance operational and tactical decisions. When connected to a network, exchanges position tactical track data with UNIX-based Tactical Database Manager (TDBM) systems such as the Tactical Combat Operations (TCO) system, the Intelligence Analysis System (IAS), and the Global Command Control System (GCCS) and provides a complete geographically based SA capability, including the capability to display the GCCS COP data. Features include a robust TrackPlot, Routes Planning, and Overlay Edit capability and the ability to embed ActiveX objects (MS Word, MS PowerPoint, sound files, and so forth) into the tactical map display.

Command Post of the Future (CPOF). Executive-level decision support system that provides SA and situational understanding for the commander and his staff. Can be tailored to fit specific visualizations and user needs across all warfighting functions and organizations from corps to battalion.

Key CPOF capabilities include the following:

- **Information visualization.** Two-dimensional (2D) and three-dimensional (3D)
- **Information liquidity.** Drag and drop information analysis across visualization products
- **Topsight.** Visibility of evolving understanding among distributed subordinates and team members.

Key CPOF design concepts include the following:

- **Composability.** Commanders can access, view, configure, and tune data, visualizations, and workspace.
- **Collaboration.** Commanders and staff have the ability to collaboratively generate, share, and evaluate visual courses of action (COAs).
- **Operation orders, commanders orders, and more.** The visual workspace supports self-synchronization with little interruption, allowing the commander and his/her staff to manage, maintain, and share their C2 resources and expertise.
- **Visualization.** Users work with live operational data that moves easily across visualization products, automatically taking the appropriate form (geospatial, temporal, textual, and so forth). Information is displayed the way each user thinks about it.

Key CPOF system interfaces include the following:

- AFATDS
- AMDWS
- Automated Mission Planning System (AMPS)/Falcon View
- ASAS
- Battlefield Command System (BCS)
- BCS3
- C2PC
- Combined Information Data Network Exchange (CIDNE)
- DCGS-A (DCGS = Distributed Common Ground System)
- Digital Data System (DDS)
- Digital Topographic Support System (DTSS)
- Force XXI Battle Command, Brigade and Below (FBCB2)
- Global Combat Control System–Army (GCCS-A)
- Global Combat Control System–Joint (GCCS-J)
- GCCS-M
- Information Operations Suite (IOS)
- Integrated Meteorological System (IMETS)
- MCS
- Tactical Airspace Integration System (TAIS)
- TBMCS.

Consolidated Air Mobility Planning System (CAMPS). As the Air Mobility Command's primary C2 planning and scheduling system, provides mobility mission planners an integrated view for airlift and air refueling requirements management, planning, and scheduling of Air Mobility Command (AMC)/Mobility Air Force (MAF) air mobility resources to support peacetime, contingency, humanitarian, and wartime operations. Provides separate unclassified and classified requirements, planning, and scheduling capabilities and also provides advanced user capabilities for operational planning and allocation management. Provides a joint capability to gather and manage mobility requirements for all aerial refueling missions, special assignment airlift missions, and U.S. Central Command (CENTCOM) airlift requirements.

Constructive Model or Simulation. Models and simulations that involve simulated people operating simulated systems. Real people stimulate (make inputs) to such simulations but are not involved in determining the outcomes.

Corps Battlefield Simulation (CBS). A constructive simulation system that portrays ground battle scenarios for theater, corps and division-level training events. Models all battlefield operating systems including Psychological Operations (PSYOP), rotary-wing and fixed-wing operations, logistics, and multi-sided play. Is the cornerstone of the Joint Land Component Constructive Training Capability (JLCCTC) Multi-Resolution Federation (MRF). In the JLCCTC-MRF, is linked with other constructive simulations to provide a realistic presentation of joint battlefield operations.

Data Automated Communications Terminal (DACT). Sometimes called the Defense Message System/Data Automated Communications Terminal (DMS/DACT) input/output battlefield SA system and communication terminal, handles positional and messaging information for company-sized units and below. Two types of DACT systems are available: the Mounted (M-DACT) for vehicle installations and the Dismounted (D-DACT) for the foot-mobile warfighter. Will be used to receive, store, create, change, and transmit map overlays, tactical messages, and situation reports via tactical radios. Will provide the Marine Corps an increased digital communications capability at battalion/squadron levels and below for general-purpose data communications and SA. Will use a digital message system to send and receive messages using digital bursts and will provide an internal position location capability. The primary mission is to communicate tactical information directly to and from subscribers within the Marine Corps Tactical Command and Control System (MTACCS) network.

Database. A collection of interrelated data, often with controlled redundancy, organized according to a schema to serve one or more applications. The information is stored so that these data can be used by different programs without concern for the data structure or organization. A common approach is to add new data and modify and retrieve existing data.

Definitive Priority List. A product of work accomplished by the Training Capabilities Analysis of Alternatives (TC AoA) Tiger Team. The purpose of the Definitive Priority List is to identify and prioritize joint training requirements, joint training capability requirements, and baseline current funding levels that support joint training. A memorandum from the Director, Joint Staff (JS) to the combatant commands (COCOMs) initiated the Tiger Team effort by requesting individual COCOM input on a set of joint training areas. The COCOM inputs were assembled, documented, and consolidated into identified areas of prioritization by the JS Joint Training Directorate (J-7) and subsequently presented to the members of the Tiger Team as a departure point for further definition and analysis.

Deployable Virtual Training Environment (DVTE). A first-person skills sustainment trainer that trains Marines from the individual to battalion staff level by using a simulation network with reconfigurable workstations capable of emulating a vast array of training scenarios. Is a flexible, deployable, training system that provides combined arms, MAGTF and Naval Integration training. The DVTE, which is currently a prototype desktop training network, addresses a significant subset of Marine Corps combined arms training. Provides a custom-built stand-alone Combined Arms Network (CAN) covering most Marine ground and air weapons systems and is a Marine Corps capability for providing interoperability with other Joint National Training Center participants. This interoperability will also enable distributed interactive unit training for widely separated units. Is made up of two components. The first is the Infantry Tool Kit (ITK), which contains several Tactical Decision-making Simulations (TDS). The second is the Combined Arms Network (CAN), which is a set of PC-based simulators (FO, FAC, AAV, M1, LAV, AH-1) connected to Joint Semi-Automated Forces (JOSEF). The Program Manager for Training Systems (PM TRASYS) recently delivered the Virtual Fire Support Trainer (VFST), which incorporates much of the CAN functionality. VFST interfaces JOSEF with AFATDS and the Pocket-Sized Forward Entry Device (PFED) to facilitate training of a variety of fire support platforms using Marine Corps gear. In addition, DVTE can use this virtual environment and the semi-autonomous force model to train other individual MAGTF skills.

Distributed Mission Operations Center (DMOC). Not a training federation but a training center located at Kirkland Air Force Base (AFB) (New Mexico). The DMOC's mission is to develop and support tactical-level synthetic battlespace events for combat air forces. Serves as the Air Combat Command's (ACC) tactical-level synthetic battlespace hub by integrating and scheduling resources, developing scenarios, providing virtual adversary support, linking to operational and strategic-level simulations, and performing lead agent responsibilities for ACC Synthetic Battlespace inter-team training events.

Embedded Training. Training capability (e.g., a simulation embedded in a C2 system for battle staff training or a simulation embedded in a weapon system for gunnery training) that is an inherent part of an operational system. Embedded training capabilities can be linked with each other or with external simulations/training capabilities to support joint training. Recently updated DoD acquisition regulations encourage the use of embedded training to avoid the added expense of separate training systems. However, few current systems have embedded training capability, and it is not a viable solution for the AoA.

Engagement Skills Trainer 2000 (EST 2000). A unit/institutional, indoor, multi-purpose, multi-lane, small arms, crew-served and individual anti-tank training simulation. Enables training across three different modes: individual marksmanship; small unit (collective) gunnery and tactical training; and judgmental use of force (shoot/don't shoot), which includes escalation of force/graduated response scenarios.

Enhanced Tactical Simulation Interface Unit (ETSIU). A two-way link (interface) between simulations and tactical C4I systems. Translates simulation-based activities into tactical events.

Entity Resolution Federation (ERF). JLCCTC-ERF is a high-resolution federation designed for use at the brigade combat team level and below. Is suitable for training functional and multi-functional support brigades that include intelligence, fires, aviation, air defense, and sustainment. The primary training audiences for JLCCTC–ERF are brigade combat team commanders and battle staffs serving in a Joint Task Force (JTF). Can support limited training for brigade internal operations, with representation of supported units only as necessary to create service "demands." ERF is a collection of constructive simulations, interface devices, security systems, and communication nodes designed to allow for battle command training over a distributed network or at individual nodes. It enables stimulation of ABCS, provides a digital COP, and allows for battle command training. Includes a reduced-overhead training system for delivering routine digital training of battle staffs at all levels. Also provides interfaces and models that enable company, battalion, and brigade training audiences to meet their C2 training objectives in a joint, combined environment. Allows realistic replication of military operations on urban terrain (MOUT) and includes detailed intelligence play and fairly robust logistical representation.

Entity. A distinguishable person, place, unit, thing, event, or concept about which information is maintained for simulation representations.

Environmental Data Cube Support System (EDCSS). Generates and provides a consistent environmental scenario. An EDCSS distributor makes these products available through a Web service and/or Web page. An EDCSS plug-in to Joint Live Virtual Constructive Data Translator (JLVCDT)/Joint Bus (JBUS) publishes weather products to High Level Architecture (HLA) and/or DIS Federates. Is also available as a service through the Joint Training Data Service (JTDS).

Exercise Single Mobility System (EXSMS). Exercises C2/ITV AIS that replicates functions of a single mobility system in an exercise environment. Provides training audience with the transportation information they need to manage logistics. In an exercise environment, provides for planning, visibility of requirements and missions (scheduled and unscheduled), and data visualization. Enables visibility of airlift missions, including the Special Assignment Airlift Mission (SAAM), Channel (periodic logistical) Missions, Operational Support Airlift (OSA), Contingency Missions, the Denton Program,[2] Opportune Rescheduling System for Military Airlift Command Cargo, and Exercises and Training Missions. Also provides visibility of ship schedules, booked and manifested cargo, planning tools, Surface Deployment and Distribution Command (SDDC) situation reports (SITREPS) and spot reports

[2] The Denton Program allows donors to use space available on U.S. Military cargo planes to transport humanitarian goods and equipment to countries in need).

(SPOTREPS), port data and decision support tools (e.g., cost calculators, port locators, station and International Civil Aviation Organization (ICAO) workloads)) and monitors air, land, and sea conveyances. Provides visualization and analysis of the Joint Operation Planning and Execution System (JOPES) data, exercise planning actions, force movement tracking, leading indicators for performance, executive management visualizations, tools for metrics and monitoring the state of the enterprise. Integrates supply, cargo, forces, and passengers with airlift, air refueling, and sealift schedules and movements.

Extended Air Defense Simulation (EADSIM). Models the effectiveness of ballistic missiles, surface-to-air missiles, aircraft, and cruise missiles in a variety of scenarios. Provides intelligence, surveillance, and reconnaissance (ISR) and target acquisition information to various ABCS.

Extensible C41 Instrumentation Suite (ExCIS). Translates communications between Fire Simulation (FIRESIM) fire support simulation and AFATDS and other legacy fire support systems located in the tactical operations center or fire direction center.

Federate. A member of an HLA federation. All applications participating in a federation are called federates. This may include federation managers, data collectors, real-world ("live") systems (e.g., C4I systems, instrumented ranges, sensors), simulations, passive viewers, and other utilities.

Federation Management Tool–Reloaded (FMT-R). Manages and monitors HLA federates and monitors the DIS LAN federates. Allows exercise control to know when specific federates are connected to the federation.

Federation Object Model (FOM). An identification of the essential classes of objects, object attributes, and object interactions that are supported by an HLA federation. In addition, optional classes of additional information can also be specified to achieve a more complete description of the federation structure and behavior.

Federation. A named set of interacting federates, a common federation object model, and supporting runtime infrastructure that are used as a whole to achieve some specific objective.

Fires Simulation (FIRESIM). Simulates the target acquisition, command, control, communications and intelligence (C3I), weapons/target allocation, logistics, firing platforms and munitions to a high level of detail.

Force XXI Battle Command, Brigade and Below (FBCB2). A digital battle command information system intended to provide commanders, leaders, and soldiers—from brigade to individual soldier and across all the battlefield functional areas (BFAs)—improved C2 and enhanced SA information. Systems with existing computers capable of hosting FBCB2 software will receive the Embedded Battle Command (EBC) software (a subset of FBCB2). Embedded systems for the near term include the M2A3 Bradley Fighting Vehicle (BFV), the M1A2 System Evaluation Plan (SEP) ABRAMS Tank, and the Army Tactical Command and Control System (ATCCS).

FBCB2's primary functions are to send and receive automatic position-location reports derived from its interface with the Global Positioning System (GPS) and to send and receive C2 message traffic via digital over-the-air radio transmissions. The Tactical Internet is the network of radios and routers that provide linkages to connect the myriad FBCB2 platforms (both vertically and horizontally) across the combined arms force. The Tactical Internet consists of the Enhanced Position Location Reporting System (EPLRS), the Single-Channel Ground and Airborne Radio System (SINCGARS), and the Internet controller router. FBCB2 and the Tactical Internet perform as a network within brigade-sized and smaller units. At the brigade and battalion tactical operations centers, the Tactical Internet interfaces with the ATCCS, an Ethernet-based LAN of computers representing the functional areas of intelligence, maneuver, air defense, combat service support, and fire support. This interface permits information collected and disseminated via ATCCS systems to be passed rapidly through the Tactical Internet to FBCB2 computers. Likewise, the position reports of individual and unit locations are passed upwards through the FBCB2 and Tactical Internet into the ATCCS system for dissemination throughout the force.

Functional Requirements. A description of the end product from the user's perspective, including how the system will be used.[3]

Gaps. The difference between current requirements and existing capabilities.

Generic Area Limitation Environment-Lite (GALE-LITE). A subsystem of the Generic Area Limitation Environment (GALE). A client-/server-based analysis and exploitation system for intelligence data. Includes end-to-end processing from the reception, parsing, and storing of contact reports through extensive interactive analysis tools and report generation. The purpose of this interface is to provide GCCS-J/COP the capability to access and analyze the intelligence data provided by the GALE-LITE system.

Global Combat and Control System–Army (GCCS-A). An integrated C2 system that supports the C4I for the Warrior objectives set forth by the JS. Provides an integrated and automated C2 system to Army strategic and theater commanders, to corps, and to divisions when they perform task force or Army Service Component Command (ASCC) responsibilities in support of joint operations.

Global Command and Control System–Joint (GCCS-J). Provides an infrastructure that effectively controls the flow and processing of information to implement C2 over national agencies and military forces and to facilitate coordination with allies throughout the force projection cycle. This capability extends from the DoD to the combatant commanders (CCDRs), between the supported and supporting CCDRs, from the supported CCDR to the Commander Joint Task Force (COMJTF), and from the COMJTF to the component commands.

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3 Ivar Jacobson, *Object-Oriented Software Engineering* (New York: Addison-Wesley, 1992), 119.

Global Command and Control System–Maritime (GCCS-M). The C2 component of the Navy's command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems. Supplies information that aids Navy commanders in a full range of tactical decisions. In functional terms, fuses, correlates, filters, and maintains raw data and displays image-building information as a tactical picture. Operates in near-real time and constantly updates unit positions and other SA data.

Global Decision Support System (GDSS). A United States Transportation Command (USTRANSCOM)-funded system that provides MAF C2 information for the Defense Transportation System (DTS) to CCDRs throughout the full spectrum of military operations. The operational imperative is to deliver robust capabilities to MAF C2 forces using a net-centric environment that allows access and information sharing across classified and unclassified domains. Will interoperate with Air Force/Army/joint C2 systems, and is an integral part of the USTRANSCOM's DTS.

GTN Exercise Server (GES). Exercises C2/ITV AIS that replicates functions of the Global Transportation Network (GTN) in an exercise environment. Provides the training audience the transportation information they need to manage logistics. In an exercise environment, integrates supply, cargo, forces, and passengers with airlift, air refueling, and sealift schedules and movements. Passes information to the GCCS and the JOPES scheduling and movement (S&M) module.

GPS Environment Generator (GEG). Creates a machine-to-machine interface through which distributed exercise simulations and players can receive realistic navigational accuracies and damage assessment reports in real time. Is designed to take query PDUs from weapons systems and provide data PDUs to the weapons systems. These data PDUs include navigational accuracy information based on an electronic combat jamming environment.

Graphical Input Aggregate Controller (GIAC). A distributed visualization C2 environment for constructive simulations applications. Creates a distributed environment that uses distributed databases to capture and disperse simulation objects to provide information in a timely manner and to accurately reflect the simulation environment.

High Level Architecture (HLA). Major functional elements, interfaces, and design rules pertaining, as feasible, to all DoD simulation applications. Provides a common framework within which specific system architectures can be defined.

Imagery Product Library (IPL). Supports the storage and dissemination of imagery and imagery products, providing a library of information to imagery customers worldwide. Uses a standard Intelink[4] or Intelink-S[5] client to provide user access to this library, and supports both data push and data pull through user profiling. The IPL

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4 The classified and highly secure intranet used by the U.S. intelligence community.

5 The secret-level variant of Intelink.

stores imagery in National Imagery Transmission Format (NITF) Version 2.0, the Tagged Image File Format (TIFF), and other formats.

Independent Stimulation Model (ISM). Provides a comprehensive, integrated tool set for full life-cycle support of simulation-driven, Master Scenario Events List (MSEL)-supported training events.

Intelligence Community Coordination Group (ICCOG). Serves as the intelligence community's forum for M&S exchange, fostering improved communication among community and other government agencies and industry. Promotes the sharing of programs, methodologies, tools, techniques, data, and other information.

Joint Automated Deep Operations Coordination System (JADOCS). A joint mission-management software application. Provides a suite of tools and interfaces for horizontal and vertical integration across battlespace functional areas. Originating as a Defense Advanced Research Projects Agency (DARPA) Program, has evolved into the "go-to-war" automated support system for deep operations in several theaters. Is currently installed on over 900 systems worldwide.

Joint Community Unique Simulations. Simulations that specifically target only those functions required to train a joint force commander (JFC) and staff, as opposed to creating a JFC training capability by federating several Service simulations. Depending on the overall training objectives of the exercise, can be used stand-alone or federated with Service simulations. The idea is to create separate simulations for the joint community where possible, reducing the dependence on large Service simulations at the tactical level, which necessitate larger exercises and complicate configuration management and acquisition. Joint community-unique simulations, such as the Joint Theater Level Simulation (JTLS), are a subset of large constructive simulations/federations and light simulations/federations.

Joint Conflict and Tactical Simulation (CATS). A high resolution, multi-sided, multi-Service, entity level simulation with integrated capabilities used for training, analysis, planning and mission rehearsal. Provides an interactive conflict simulation that models joint, multi-sided air, ground and sea combat on a high/low resolution digitized polygonal terrain. Also models the use of non-lethal weapons and urban environments.

CATS Low Overhead Driver (JLOD). Provides the low-overhead driver signatures and/or clutter that are generated in the non-kinetic and kinetic exercise support roles.

Joint Flow and Analysis System (JFAST). Used by regional COCOMs and the USTRANSCOM to determine transportation feasibility, analyze the transportation requirements for the execution of operations, crisis action plans, Operation Plans (OPLANs), Concept of Operations Plans (CONPLANs) with time-phased force and deployment data (TPFDD), course of action (COA) development, "what-if" scenarios, and exercises. From mobilization to Tactical Assembly Area (TAA), projects full end-to-end delivery profiles of troops and equipment by all air, land, and sea

modes of transportation. Also generates the sustainment required by deployed forces and then determines the transportation requirements for that sustainment. Designed for use by the Joint Planning and Execution Community (JPEC), is the only Joint Strategic Capabilities Plan (JSCP)-approved program to determine transportation feasibility.

Joint Live Virtual Constructive (JLVC) Federation. Integrates constructive entity-level stimuli with virtual and live simulations and simulators in a near-real-time synthetic environment. Its entity-level models and simulations represent Service combat, intelligence, and logistic systems. Enables the integration of virtual simulators with live range instrumentation to support training from COCOM staff and Service components down to tactical units and individual/crew trainers. Also provides training for a range of joint, interagency, intergovernmental, and multi-national audiences, allowing Active Components, Reserve Components, the State Police, the Red Cross, and other national and state agencies to train with joint and Service battle staffs.

Joint Live Virtual Constructive Data Translator (JLVCDT/JBUS). A high-performance, low-cost, open-architecture framework for developing data translators that allow users to easily extend functionality via a public Application Programmers' Interface (API).

Joint Exercise Control System (JECS). A suite of tools that can be used with an LVC simulation federation. Provides a land, air, and maritime COP feed to GCCS, simulation archive and playback, after action review (AAR)/analysis capability, HLA/DIS simulation analysis and troubleshooting, MSEL management and synchronization, simulation enumeration checking, and the ability to provide remote-order entry to constructive simulations. Consists of the JLVC Simulation Protocol Analyzer (JSPA), Joint Distributed After Action Review System (JDARS), Joint MSEL Event Control Station (JMECS), and other tools for managing object enumerations and other federation data. In addition, has a stand-alone, no-simulation-required C4I interface in the Joint MSEL Event Control Station–No Sim (JMECS-NS), which combines MSEL support and C4I reporting with no simulation required to provide COP feeds.

JLVC Simulation Protocol Analyzer (JSPA). Monitors both HLA and DIS networks and is used to assist in troubleshooting simulation issues and to manage the federation. Has the ability to display network data, filter simulation traffic, capture logs, and conduct playback.

Joint Mission Planning and Rehearsal System (JMPRS). A game-based virtual application linked to the Specal Operations Command (SOCOM) mission planning system.

Joint Multi-Resolution Model (JMRM) Federation. Uses the JTLS and the CATS as its core models. Has been applied to validate the concept of federate selection based

on user functional requirements. An entity-level server aggregates units to provide a common template for intelligence federates while offloading some of the entity-level representation requirements from CATS. Its name and capabilities derive from the need to simultaneously provide high-level aggregate simulation to support JTF training events and entity-based representation to simulate tactical forces. The Joint Forces Command (JFCOM) is integrating other federates into the JMRM federation.

Joint Non-Kinetic Effects Model (JNEM). A simulation that models the satisfaction levels of different population groups relative to specific concerns, calculates the overall mood based on these levels, and causes reactive events based on the results.

Joint Operational Planning and Execution System (JOPES). An integrated C2 system used to support joint conventional military operation planning, to include the theater-level nuclear and chemical planning activities and the monitoring requirements for mobilization, deployment, employment, and sustainment. Provides senior-level decision-makers and staffs of the National Command Authorities (NCA), the Joint Chiefs of Staff (JCS), CCDRs, component commands, military Services, and agencies of the DoD an enhanced capability to plan, coordinate, and conduct joint military operations. Has the capability for supported commanders to identify between requirements and capabilities and procedures to conduct risk analysis, resolve shortfalls, and redefine strategic concepts if risks are too great.

Joint Semi Automated Forces (JOSEF). A U.S.-government-owned and -developed simulation system widely used in training and experimentation. Current users include JFCOM, the Navy Warfare Development Command (NWDC), and the Marine Corps DVTE program. Was originally developed as part of the DARPA Synthetic Theater of War (STOW) Advanced Concept Technology Demonstration (ACTD).

Joint Theater Level Simulation (JTLS). An interactive, Web-enabled, multi-sided wargaming system that models a joint and coalition force in a total air, land, and naval warfare environment. Consists of six major programs and numerous smaller support programs that work together to prepare the scenario, run the game, and analyze the results. Operates on a single computer or on multiple computers, either at a single or at multiple distributed sites. Model features include Lanchester attrition algorithms, detailed logistic modeling, and explicit air, ground, and naval force movement.

Joint Training Data Service (JTDS). A set of Web-based scenario-generation services developed to support the needs of the DoD M&S training community. Saves time and money by producing correlated databases used by simulations and federations to support training events and includes OOB, terrain, and weather effects services.

Joint Training Support Center (JTSC). Is not a training federation but an independent SOF training facility and network that provides the C4I necessary to enable pre-deployment training and operational mission rehearsal. The primary objective is to

train by enabling SOF C2 elements and warfighters to reach, maintain, and improve combat readiness and to conduct mission rehearsals in realistic operational environments in conjunction with conventional forces when necessary.

Large Constructive Simulations/Federations. Are those constructive simulations and federations typically used to support large training exercises (e.g., Ulchi Focus Lens). These simulations/federations provide functionality and fidelity but normally require a large amount of time and resources to develop, configure, operate, and maintain.

Light Federation. A group of light simulations federated together to provide the necessary fidelity and functionality to support a given purpose. Are flexible and responsive in that federates can be added and deleted and new technologies can be injected with relative ease, allowing diverse users to customize the federation for their unique needs. Like the light simulations, should be used to provide a targeted functionality or less fidelity than that of a large constructive simulation federation.

Light Simulations. Provide targeted functionality or less fidelity than a large, complex, general-purpose simulation system. Require significantly less time and resources to develop, configure, operate, and maintain.

Live Simulations. Involve real people operating real systems.

Live, Virtual, and Constructive (LVC) Simulation. A broadly used taxonomy for classifying simulation types. The categorization of simulation into live, virtual, and constructive is problematic because no clear division exists between these categories. The degree of human participation in the simulation is infinitely variable, as is the degree of equipment realism. This categorization of simulations also suffers by excluding a category for simulated people working real equipment (e.g., smart vehicles).

Logistics Federation/Joint Deployment Logistics Model (LOGFED/JDLM). The logistics component constructive simulation model of the Army's JLCCTC and the JLVC federation. Provides commanders and their staffs the complete array of combat support and combat service support functionality required to meet integrated logistics training requirements.

Logistics Simulation (LOGSIM). A computer model that enhances logistics training in computer-assisted exercises. Provides added realism to AWSIM by modeling the constraining effects of aircraft maintenance on air operations, without impeding exercise training objectives.

Maneuver Control System (MCS). Automates the creation and distribution of the common tactical picture (CTP) of the battlefield. Also creates and disseminates operations plans and orders for combined arms maneuver commanders.

MAGTF Tactical Warfare Simulation (MTWS). Simulates all the Marine Corps' combat activities. Models amphibious landings, ground warfare, and Marine air warfare (rotary and fixed wing).

Marine Corps Federation (MCFED). Provides interactive, multi-sided, force-on-force, real-time modeling and simulation with stand-alone tactical combat scenarios for air, ground, surface, and amphibious operations. With interfaces to fielded Marine Corps C4I systems such as C2PC and IOS, provides the battle staff the ability to seamlessly train with and use their C4I systems during the execution on an MTWS-supported training event. Through the implementation of an HLA interface between MTWS and the entity-level CATS system, high-resolution tactical objectives can be simulated in CATS and reflected within the context of a larger operational scenario conducted in MTWS.

Massively Multi-player Games. On-line simulated environments that allow large numbers of players/trainees to interact while striving to achieve individual or group objectives. Can range from an environment for users to interact in an unstructured manner to games with strictly defined player roles, rules, and game objectives. The chief advantage is the ability to provide a continuous, distributed, online training environment for a potentially large number of trainees. Trainees learn through interactions with each other and the simulated environment. Often use light simulations as the "gaming engine."

Measure of Effectiveness (MOE). A qualitative or quantitative measure of the performance of a model or simulation or a characteristic that indicates the degree to which it performs the task or meets an operational objective or requirement under specified conditions.

Missile Defense Space Tool (MDST). Provides real-time interactive software for simulation of space-based launch detection and early warning assets in a networked simulation environment. Includes the capability to receive threat input messages from external sites and to output messages using operational formats to external sites for exercise purposes.

Model. A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process.

Multiple Link System Test and Training Tool (MLST3). Generates tactical data link messages and outputs them—as a complete tactical exercise scenario—to the system under test. Then receives and interactively processes and displays the output of the system under test. If the interactions comply with the appropriate specifications, the system under test is considered interoperable. By generating data link messages representing a complete battle scenario, provides realistic training exercises that sharpen the skills of the combat system teams. The system's DIS protocols enable participation in geographically distributed exercises.

Multiple Unified Simulation Environment/Air Force Synthetic Environment for Reconnaissance and Surveillance (MUSE/AFSERS). A visualization model that provides a realistic aerial view of the area of operations as seen from an unmanned aerial vehicle (UAV). Gives real-world view of the exercise (simulation) terrain and permits the UAV operator to obtain intelligence and assist in target acquisition.

Multi-Resolution Federation (MRF). JLCCTC-MRF is a medium-resolution federation designed for use at division level and above, including JTFs. Suitable for training functional and multi-functional support brigades that include intelligence, fires, aviation, air defense, and sustainment. Primary training audiences are divisions and corps commanders and their battle staffs. If used in a smaller composition, can also support training for brigade combat teams. The JLCCTC-MRF's collection of simulations, interface devices, security systems, and communication nodes is designed to allow for battle command training over a distributed network or at individual nodes. Enables stimulation of ABCS and provides a digital COP. Allows selected small units to realistically replicate high-resolution combat activities, including a non-kinetic event model, and supports detailed log and intelligence play.

National Wargaming Simulation Next Generation (NWARS-NG). Simulates the tasking and reporting of information from National Intelligence collection assets for training and exercise support. NWARS-NG reports are in a standard United States Message Text Format (USMTF) and can be released through the Communication Support Processor (CSP). Provides C2 stimulation with or without the federation. Allows planners and trainers to shape the environment by setting realistic conditions on organic unit C2 devices.

Navy Continuous Training Environment (NCTE). A federation consisting of multiple versions of the JOSEF simulation, which represents Navy surface, subsurface, air assets, Navy intelligence simulations, and interfaces to Navy battle command systems.

Radiant Mercury (RM). Automatically sanitizes, guards, and downgrades multi-level classified, formatted information, to allow its release to users (primarily tactical level) not authorized access to highly classified data.

Reconfigurable Vehicle Tactical Trainer (RVTT)/Reconfigurable Vehicle Simulator (RVS). Mobile simulators that provide virtual mounted-maneuver training of medium and light forces for selected wheeled combat and support vehicles. Key features are 360-degree field of view; weapon systems that allow shoot-on-the-move; communications via simulated voice and digital systems; the ability to reconfigure between variants in under 2 hours; enhanced night vision; the ability to operate independently of CCTT fixed or mobile sites. RVTT has its own master control console, power generation, and AAR systems.

Remote Environment (RE). A constructive simulation used to model threat ballistic missile flyouts. Uses a distributed architecture, with the master RE located at

Schriever AFB (Colorado). Subordinate REs will be located at other locations that require an inject of the threat missile fly out.

Requirements. Operational needs needed to perform a future military operation or to perform a current military operation better. Speak to capabilities, which are attained through changes to or development of new doctrine, organization, training, materiel, leadership and education, personnel, and facilities, or a combination thereof. (see the Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3170.01A, *Operation of the Joint Capabilities Integration and Development System*, dated 12 March 2004)).

Research, Evaluation, and System Analysis Simulation (RESA). Simulates naval warfare by modeling all Navy objects (surface, subsurface, and air) and all their threats and targets.

Resolution. The degree of aggregate detail and precision (i.e., granularity) used in the representation of real-world aspects in a model or simulation.

Rialto. A component of a cross domain solution (CDS) that is used in an HLA distributed simulation environment. A high-performance HLA federate that receives and publishes simulation (and simulation management) data via the HLA Run-Time Infrastructure (RTI) API.

Run-Time Infrastructure (RTI). The general-purpose distributed operating system software that provides the common interface services during the runtime of an HLA federation.

Scalability. The ability of a distributed simulation to maintain time and spatial consistency as the number of entities and accompanying interactions increase.

Scenario Generation Server (SGS). A rapid database generation baseline capability for scenarios to support training. Addresses the need to develop and manage complex data interactions between, within, and throughout simulation models and real-world C2 and C4ISR within the training.

Secure Messaging and Routing Terminal (SMART). Provides classified message distribution throughout the command's organization. Enables the users to send and receive e-mail-like messages to and from the Automatic Digital Network (AUTODIN) over existing networks with complete privacy. Also satisfies the required DoD DMS security services.

SimC4I Interchange Module for Plans, Logistics, and Exercises (SIMPLE). An interface between the virtual battlefield environment in a simulation and the real-world C2 systems used by the military. Provides a database that maps simulation units, platforms, munitions, and supplies to real-world units, platforms, munitions, and supplies. Also contains a message module that correctly generates the tactical messages required by the military C4I systems to report on these units, platforms, and so forth.

Space System Generator (SSG). Provides a space OOB through a DIS interface that leverages the SCOPES to stimulate DMO exercise and training events. Currently has the capability to provide a space OOB and the status of the constellations in the DIS environment using entity state PDUs. Ongoing development will include interaction with collision/detonate PDUs, space launch, and ground sensors.

Special Operations Mission Planning Environment (SOMPE). Designed to assist Army SOF in mission planning. A system of common government and commercial hardware and software brought together for mission planning. Includes four computers, a scanner, a printer, a projector, a networking switch, and a transport case. Also incorporates Falcon View (a software package used as the mapping tool) and a variety of other software.

Spirals. Discrete development periods (or increments) when requirements for a system are refined through demonstration and risk management, with continuous user feedback—all designed to provide the user with the best possible capability. (See Department of Defense Instruction (DoDI) 5000.02, *Operation of the Defense Acquisition System*, dated December 2, 2008.))

Standard. A rule, principle, or measurement established by authority, custom, or general consent as a representation or an example.

Story-Driven Training. A computer-based training environment that immerses the trainee in a situation or series of situations (i.e., a "story") designed to achieve specific training objectives. Can be either video-based or computer-generated imagery-based and is primarily used for training individuals or small teams. Particularly well-suited for training aspects of military operations that require cognitive skills, decision-making, and human interaction, such as those that are currently trained with seminar games, political/military games, and so forth.

System Administration Security Server (SASS). A security system designed to meet Defense Information Systems Agency (DISA) requirements for a domain controller, systems audit, and systems backup.

Tactical Communications Support Processor (TCSP). Used by the intelligence community at unified, specified, and major commands worldwide. A DMS architecture migration system for secure messaging. The DMS target architecture provides a wide range of interoperable and secure writer-to-reader transactions.

Tactical Simulation (TACSIM). A simulation designed to provide training to intelligence staffs, collection managers, and analysts in a simulated land combat situation. A high-fidelity simulation of intelligence activities that supports training from large-scale joint exercises to specific intelligence section tasks. Uses interactive computer-based simulation to support intelligence training from MI Battalion through Echelons Above Corps (EAC). Accomplishes this mission by simulating intelligence operations and/or stimulating the entire spectrum of intelligence operations, with the exception of human intelligence (HUMINT). Stimulates the ASAS with a scripted

scenario database. Has operated in intelligence missions over enemy forces and has generated reports in USMTF that were provided to ASAS at multiple classification levels. TACSIM generates intelligence messages in standard USMTF format. These messages include Tactical Reports (TACREPs), tactical electronic intelligence (TACELINT), Reconnaissance Exploitation Reports (RECCEXREPs), Radar Exploitation Reports (REXREPs), and Imagery Interpretation Reports (IIRs)/Initial Photo Interpretation Reports (IPIRs).

Target Location, Designation, and Hand-off System (TLDHS). An integrated, modular, team-portable equipment suite that will provide the FOs/forward air controllers (FACs) the capability to quickly and accurately locate and acquire enemy ground forces and to designate targets for laser-guided munitions. Also provides digital transmission capability to Army and Navy fire support nodes. Consists of two major components: the Lightweight Laser Designator Rangefinder (LLDR) and the Target Hand-Off Subsystem (THS). Uses variable message format (VMF) messages to accomplish its mission. Joint Interoperability Test Command (JITC) effort focuses on certifying specific interfaces for applicable message sets to interim VMFs.

Taxonomy. A classification system that provides the basis for classifying objects for identification, retrieval, and research purposes.

Theater Battle Management Core System (TBMCS). Provides joint and Service Combat Air Forces automated C4I systems to plan and execute theater-level air campaigns. An Air Force lead program with joint and allied participation. Is the theater air module of the GCCS and includes the Force and Unit Contingency Theater Automated Planning System (CTAPS), Combat Intelligence System (CIS), Wing Command and Control System (WCCS), and the air support operations center (ASOC) top-level applications. Elements of TBMCS are planned for every theater air C2 and air weapons system from the joint force air component commander (JFACC) to the executing aircraft squadron. Mission at the force level is to provide the JFACC and the combined force air component commander (CFACC) the automated tools necessary to effectively and efficiently plan, monitor, and execute the air campaign. This capability includes planning and issuing the ATOs and air control orders that ensure the theater commander's intent is supported through the application of airpower using the latest intelligence. Capabilities should also ensure that air operations are deconflicted. Mission at the unit level is to provide the wing and base commanders and their battle staffs timely and accurate information for effective decision-making. Is also supposed to provide the secure, automated, deployable, and distributed WCCS connectivity to force-level TBMCS systems. Contributes to joint vision by providing information superiority through the integration and distribution of information relevant to the planning and execution of theater air operations. Through the extension of TBMCS to the Army, Navy, Marines, and Allied nations' air forces, the integration of joint and coalition capabilities is also achieved. The scalability and modularity of TBMCS supports rapid strategic mobility while the theater airlift application provides connectivity with theater mobility capabilities.

One of the TBMCS applications provides an integrated air picture (IAP) updated from several theater and strategic sensors and organizations. This IAP, along with the fused intelligence provided by interaction with other Service intelligence systems, supports increased situation awareness.

Training. Used within the TC AoA to define the scope of the effort and based upon direction from the Senior Steering Group (SSG), is focused on those M&S systems and tools that support collective and staff functional capabilities. The level of staff training addressed is at the operational/JTF level. The scope of the staff training ranges from one level up (COCOM staff) and two levels down from the operational/JTF to the extent necessary to provide the appropriate context and stimulation supporting the operational/JTF level of training. As used in the context of the TC AoA, does not include entry-level Service/agency training, individual or operator training, or professional military education. These efforts are focused on individual skill proficiency and education that each Service/agency must provide to ensure trained individuals, crews, and leaders. More specific training definitions are as follows:

- **Joint training.** "Training, including mission rehearsals, of individuals, units, and staffs using joint doctrine or tactics, techniques, and procedures to prepare joint forces or joint staffs to respond to strategic, operational, or tactical requirements that the CCDRs consider necessary to execute their assigned or anticipated missions."[6]
- **Military training.** 1. The instruction of personnel to enhance their capacity to perform specific military functions and tasks. 2. The exercise of one or more military units conducted to enhance combat readiness.[7]
- **Service training.** Military training based on Service policy and doctrine to prepare individuals and interoperable units. Service training includes basic, technical, operational, and interoperability training in response to operational requirements deemed necessary by the COCOMs to execute assigned missions.[8]

Use Case. A use case defines a goal-oriented set of interactions between external users and the system under consideration or development. Use cases have become a widespread practice for capturing functional requirements in software design, especially in the object-oriented community where they originated, but their applicability is

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6 DoDD 1322.18, *Military Training*, dated 13 January 2009.

7 Joint Publication 1-02, *Department of Defense Dictionary of Military and Associated Terms*, dated 12 April 2001, as Amended Through 19 August 2009.

8 CJCSI 3500.01C, *Joint Training Policy and Guidance for the Armed Forces of the United States*, dated 15 March 2006

much wider.[9] For the TC AoA, a use case is a joint or Service training requirement, represented by the exercise, which is designed to meet that requirement.

Virtual Battlespace 2 (VBS2). A first-person shooter simulation, incorporated into the Marine Corps' DVTE ITK, with the objective of helping warfighters focus on thought processes, logic, and decision-making skills in support of individual Service training or collective joint training exercises. A PC-based simulation that can be networked to include several players. Participants can operate virtual personal weapons, weapons stations, vehicles, and aircraft in either a stand-alone mode using artificially intelligent opposing forces (OPFORs) or distributed across a LAN, a Wide Area Network (WAN), and with a combination of artificially intelligent and/or a real OPFOR. Is capable of displaying terrain objects (e.g., buildings, vegetation, diurnal rotation of the earth (day/night), weather patterns, and celestial objects)). Also has data logging/AAR functionality and capability.

Virtual Reality Scene Generator (VRSG). Real-time 3D computer image generator that enables the user to visualize geographically expansive and detailed virtual worlds on Windows PCs. Provides real-time, single- or multiple-channel visualization of virtual environments, dynamic moving models, and special effects, using Microsoft DirectX commercial standards.

Virtual Simulation. A simulation involving real people operating simulated systems. Injects a human-in-the-loop (HITL) in a central role by exercising motor control skills (e.g., flying an airplane), decision skills (e.g., committing fire-control resources to action), or communication skills (e.g., as members of a C4I team).

9 Geri Schneider and Jason. P. Winters, *Applying Use Cases: A Practical Guide* (Pearson Education, 2001).

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

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1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED *(From–To)*
December 2009	Final	February 2008 – April 2009

4. TITLE AND SUBTITLE

Training Community Modeling and Simulation Business Plan: 2008 Edition

5a. CONTRACT NUMBER
DASW01 04 C 0003

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

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5d. PROJECT NUMBER

5e. TASK NUMBER
AK-2-2924

5f. WORK UNIT NUMBER

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

Institute for Defense Analyses
4850 Mark Center Drive
Alexandria, VA 22311-1882

8. PERFORMING ORGANIZATION REPORT NUMBER

IDA Document D-3934
Log: H09-001270

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

OUSD(AT&L)/Modeling and Simulation Coordination Office
1901 N. Beauregard Street, Suite 500
Alexandria, VA 22311

10. SPONSOR/MONITOR'S ACRONYM(S)

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

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited. (1 December 2009)

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The purpose of the Training Community Modeling and Simulation (M&S) Business Plan (TMSBP) is to provide linkages between the training functional stakeholders as represented in the Training Transformation (T2) Senior Advisory Group (SAG) and Executive Steering Committee (ESG) to the Department's larger M&S strategic vision and goals. Since needs and technology are constantly evolving, the TMSBP will continue to evolve as a living document. The 2008 Edition of the TMSBP is provided to inform the M&S Steering Committee (MS SC) project call for M&S projects, and to provide justification for major investments in training capabilities enabled by M&S in future Program Objective Memoranda (POM) submissions. It will also identify capabilities that the training community can contribute to greater interoperability, reuse and efficiencies among the cross-cutting community. The next update for this document (2009 Edition) will update needs/requirements and M&S training capabilities to respond to changing war fighting training needs.

15. SUBJECT TERMS

Training, Modeling and Simulation, Simulation Technology, Training Transformation, Training Gaps, Training Needs, Modeling and Simulations Gaps

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 Michael J. Sanders
Uncl.	Uncl.	Uncl.	SAR	136	19b. TELEPHONE NUMBER *(include area code)* 703-681-6607

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

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