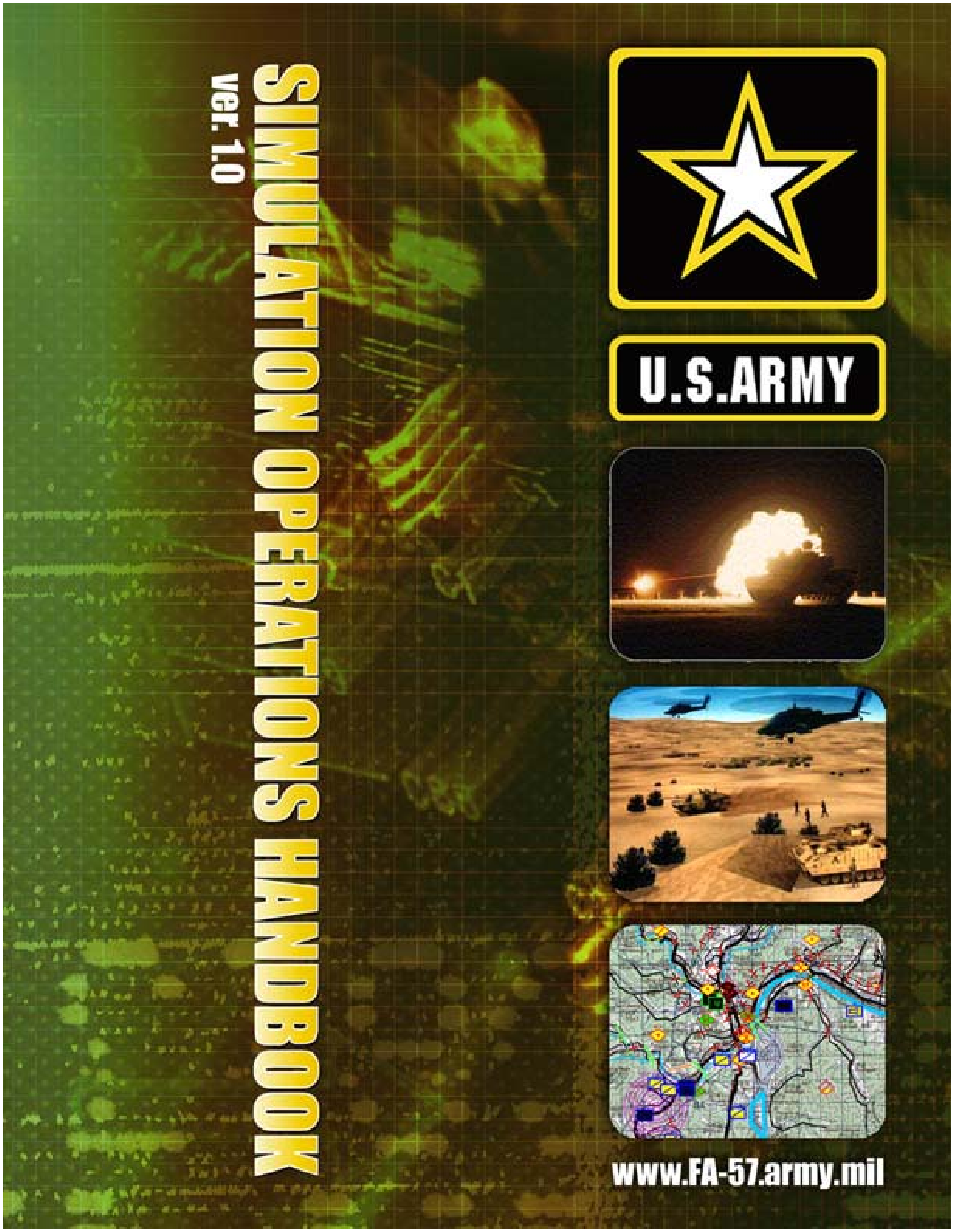
SIMULATION OPERATIONS HANDBOOK
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EXECUTIVE SUMMARY

This Simulation Operations Handbook (SOH) has been designed to be a multi-faceted M&S reference tool. This first edition of the SOH has been designed to serve as a primary course reference tool for students attending the Simulation Operations Course (SOC). The SOC has been designed to include progressive classroom coverage of key M&S issues and concepts, augmented by practical exercises and case studies that reinforce key learning objectives. Beyond SOC use, however, it is envisioned that the SOH will become a valuable desktop reference for all Army personnel engaged in M&S activities. This overview is meant to provide the reader with a top-level view of the SOH—its structure, contents and intended usage in support of Army M&S operations.

The Army modeling and simulation community continues to evolve and adapt to the many challenges and opportunities presented by rapid technological growth and increasingly complex mission requirements. This fast-paced environment, accompanied by a significant turnover in personnel within the M&S community, requires an enhanced level of common understanding among the various members of this community. On-going training, continuing education and relevant reference materials are critical links to achieving the desired level of common understanding. The SOH represents one facet of the Army's desire to meet the need for readily available reference material. Over the past several years, many suggestions were voiced for a handy, current, M&S desktop reference. This book is intended to meet this requirement by providing readily available information on the most common M&S concepts, capabilities, systems, organizations, and issues of interest to Army M&S decision makers, practitioners, and support staff.

It is hoped that the SOH will be an important element in supporting the tenets contained in various official Army publications. For example, the SOH should be a useful tool for focusing M&S to provide the best support possible in addressing Army requirements outlined in FM 3-0 "Operations," (e.g., to enhance leader, unit, and soldier performance, as well as the ability of Army forces to conduct full spectrum operations in peace, conflict, and war); FM 7-0 "Training the Force," (e.g., to enhance Army training and education programs through use of live, virtual and constructive M&S tools to better ensure the accomplishment of leader, soldier, combat team and battle staff professional development objectives); and the DoD "Training Transformation (T2)," (e.g., to enhance Army contributions with respect to the three foundational T2 capabilities--joint knowledge development and distribution capability, joint national training capability, and joint assessment and enabling capability).

The contents of the SOH have been arranged to permit ease of reference and a logical presentation of the various items of information:

> **Chapter 1 focuses on "Basic Concepts,"** to include: overarching Army Training Doctrine (Army Vision 2020 and the Army Training & Education Vision); basic M&S concepts (systems theory, model types, simulation concepts, representation, interoperability, and Army M&S domains); and M&S organizations (key Army M&S organizations, key DoD M&S organizations, and other Services M&S organizations).

Chapter 2 focuses on how to "Create M&S," to include: developing simulation requirements (identifying the requirements, validating the requirements, and scoping the requirement); technical development of the simulation (identifying key programming aspects, data management planning, and characteristics of programming languages); and preparing to use a simulation (documentation and user accreditation).

Chapter 3 focuses on "M&S Applications," to include: specific simulations and attributes, and a brief discussion of selected Army simulation tools; interoperability of simulations (with other simulations, and with real world equipment); and specific Army, Joint, and other service simulation applications and technical descriptions (developing a strategy to meet requirements, and identifying simulation tools to meet requirements).

Chapter 4 focuses on "M&S Integration," to include: developing the training environment (identifying training objectives, designing an architecture based on objectives, and refining objectives with defined outcomes); simulation in the training environment (defining the observation process, developing the timeline structure for integration, and conducting pre-integration/integration activities); and observation of the training environment (collecting observations and providing feedback based upon observation).

Chapter 5 focuses on "Evaluation Design," to include: developing measurement of outcomes (development of evaluation methodology and tools); execution of the evaluation (collection methodology); and the assessment of the evaluation.

Chapter 6 focuses on "M&S Modification," to include: determining the need to change a simulation (validating requirements to rectify the shortfalls), assessment of changes to a simulation (conducting testing of a modified simulation); and creating a new M&S (identifying a new requirement, validating a new requirement, and incorporating a requirement into the Research, Development and Acquisition [RDA] domain).

In conclusion, it should be noted that the material used in this handbook was obtained from open, unclassified, public sources. Every effort has been made to use material provided by the organization or activity responsible for the specific M&S subject being discussed. In selected instances, SOH authors developed wording that more easily conveys complex M&S concepts for the benefit of the layman. The SOH comprises a snapshot of a dynamic and evolving range of technical support activities. The SOH provides the most accurate and up-to-date information available at the time of publication; however, references in this handbook to web sites, email addresses, and other perishable information are subject to change without notice. User feedback is critical to keeping the SOH relevant. To correct any inadvertent errors or oversights, or to suggest other areas that should be considered for inclusion in future versions, please contact the Simulations Operations Proponent Office (e-mail: sim-ops@hqda.com).

Chapter 1: Basic Concepts

1.A Introduction to Models and Simulations

This section provides an historical perspective of Army models and simulations (M&S). The first two subsections, 1.B.1 and 1.B.2, provide information on how the Army defines and classifies models and simulations and provide illustrative examples of why, how and where Army models and simulations are used. The last subsection, 1.B.3, provides an overview of the Army's M&S process.

Models and simulations have a long military history. The earliest models consisted of little more than lines drawn in the sand, with objects such as stones and twigs used to represent terrain features, fortifications, encampments, and troops. Despite their simplicity, these early models served the same purpose that more advanced combat models serve today, that is planning and analysis, mission rehearsal, and re-enactment (e.g., After Action Review [AAR], and training).

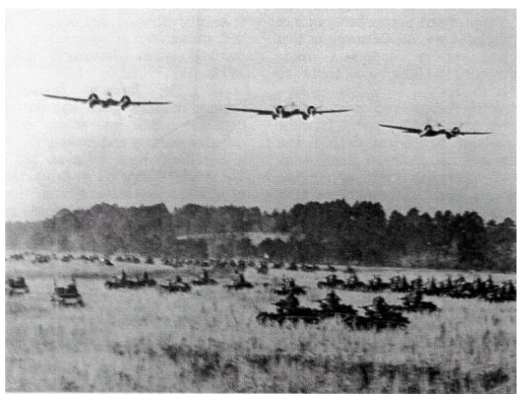
Chaturanga, a four-sided Hindu game resembling chess, was played in Iraq as early as 3000 BC and is the oldest documented model. [McHugh as cited in Manago, 2003] Throughout the centuries, games grew in size and complexity. By the late 1600s, the *Kings Game* was used to train royalty in the art of war. A variation on chess, it was played on an enlarged game board with 30 pieces per side. By the 1780s game pieces had evolved to represent aggregate forces (e.g., battalions and cavalry units); terrain boards increased in size to 1666 squares with color-coded terrain features (e.g., water, marshes, forests, buildings, mountains etc.); and the notion of a Game Director was introduced along with more refined rules and calculations. [McHugh as cited in Manago, 2003] The German game *Kriegspiel* (1811) is an example of the new class of wargames to surface during this period.

The mid to late 1800s were marked by more development and wider use of models and simulations. *Kriegspiel* was moved from the sandbox to the map board, and rules were adjusted to more accurately reflect Germany's experiences in the Prussian-Austrian war. Livermore modified *Kriegspiel* to include tracking of consumables and human factors like fatigue; his book "American Kriegspiel" (1898) is cited as the first U.S. contribution to wargaming. The U.S. Army adopted British and German wargaming techniques in 1879, with the U.S. Naval War College following suit in 1887. [McHugh as cited in Manago, 2003] Both continued to refine and use dual, tactical, and strategic board games through World War II (WWII).

Before entering WWII, the U.S. Army conducted the Louisiana Maneuvers, a series of live wargames, for the express purpose of preparing American forces for possible involvement in Europe. These exercises, which integrated tanks with cavalry and infantry units on a simulated battlefield covering most of the Southern U.S., allowed Army strategists to test the effectiveness of conventional defenses and armored attack, and to identify and fix troop supply and reconnaissance problems before the U.S. entered the war. [Louisiana Maneuvers, 2003]


(Image Source: US Army)

One example of the use of M&S during WWII, is taken from the history of the U. S. Ninth Army. "After the Ardennes fighting of December 1944, the Ninth Army was transferred from Omar Bradley's Twelfth Army Group to the command of Montgomery's Twenty-first Army Group. As part of the process of integrating the army into its new command, the commanders and staff prepared a complete and formal 'estimate of the situation.' The separate corps presented their plans at a combined meeting of all the commanders and principal army and corps staff officers. This allowed each of the corps to understand the plans and rationales of their fellows. These plans were then 'war-gamed' - played out on the map - so that the action could be thoroughly previewed and every possible contingency discussed in detail." [Perla, 1990]


(Image Source: US Army)

After WWII, modeling and simulation capabilities were furthered by advancements in electronic and computer technology. Silicon transistors and integrated circuits made modeling and simulation easier, faster, and more accurate. The Advanced Research Projects Agency network (ARPANET), the genesis of the Internet, was also the basis for distributed wargaming.

In the early 1970s ARPA changed its name to the Defense Advanced Research Projects Agency (DARPA). DARPA's SIMNET project began in 1983 to exploit technologies and concepts developed in DARPA's Tank Gunnery Trainer project. The Army became a co-sponsor in 1985 and started using the technology for training (SIMNET-T) and research and development (SIMNET-D). Through the use of increasingly capable and economical computer and communications equipment, SIMNET's developers expanded their system from an individual tank simulator to a tank battle simulator for company-sized units.

Multiple, interconnected tank trainers maneuvered on the same virtual battlefield and cooperated to engage a common enemy. [Office of Technology Assessment, 1995, p.2]

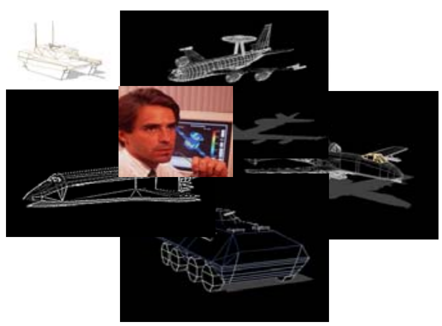
Advancements in satellite communications made global wargaming possible, and during the 1980s, the Warrior Preparation Center, at Einsiedlerhof Germany, distributed wargames throughout Europe and back to the United States. During the 1990s these exercises were extended to include Korea. Now, distributed modeling and simulation exercises routinely take place between simulation centers, field units, aircraft, and naval ships, seamlessly.

1.B Model and Simulation Concepts

1.B.1 Model Concepts

The concept of representing entities, systems, processes, or phenomena with a model is so general that it is difficult to establish an all-encompassing classification scheme. Models may be classified as: static or dynamic; deterministic or stochastic; discrete or continuous; and iconic, analog, or symbolic; among others. [Shannon, 1975] These categories are not exclusive, for example a model may contain a mix of discrete and continuous components. Using this system, a model can belong to one or more of at least 24 different categories. Another approach is to classify models by their physical attributes, for example, physical models, scaled models, analog models, interactive games (management models), automated simulations, and symbolic models. [Shannon, 1975] However, within the Army, models are most often classified simply as physical, mathematical, or process models, [DA Pam 5-11, p.96] although there are overlaps between the classes.

"A model is a physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process." [DA Pam 5-11, p. 96] The more common models that Army personnel are likely to encounter include maps, emulators, prototypes, simulators, stimulators, and field exercises conducted with instrument systems.



(Image Source: DMSO MSSOC)

1. **Physical Models**

A physical model is "A physical representation of the real world object as it relates to symbolic models in the form of simulators." [DA Pam 5-11, p. 96] "The distinguishing characteristic of a physical (also sometimes called iconic) model is that it in some sense 'looks like' the entity being modeled." [Shannon,1975]

"Physical models may be full-scale mockups (such as Close Combat Tactical Trainer [CCTT]), scaled down (such as a model of a battlefield or fortification) or scaled up (such as a classroom mockup of an M-16). They may be used for demonstration (e.g., dummy grenade) or for indirect experimentation. Scaled templates, used to study the placement of artillery, are examples of two-dimensional, scaled down, physical models for experimentation." [Shannon, 1975] Other examples include vehicle mockups, inflatable decoys, aircraft recognition models, and "the crash dummies". In addition to being visual and/or tactile representations of reality (things that you can see or touch), physical models may also be detectable by auditory or olfactory senses.

1:75 scale model of the C9 Class container ship President Lincoln. This model offers full remote control of forward and reverse thrust, rudder control and bow thrusters. It is operated by harbor pilots supporting redesign of the harbor at Barbers Point, Hawaii.
(Image Source: U.S. Army Corps of Engineers.)

Example of a Physical Model

2. Mathematical Models

A mathematical model is "A series of mathematical equations or relationships that can be discretely solved. This includes M&S using techniques of numerical approximation to solve complex mathematical functions for which specific values cannot be derived (e.g., integrals)." [DA Pam 5-11, p. 96] Typical mathematical models used for military combat applications are closed-form equations, or numerical approximations, that calculate measures of combat effectiveness. Probability density functions, equations of motion, various attrition algorithms, fractional damage models, and weapon damage functions are all mathematical models. Most mathematical models are formed from algorithms.

STINGER MISSILE CHARACTERISTICS

Type	Supersonic, surface -to-air
Diameter	2.75 inches
Length	58 inches
Guidance	Passive infrared homing and modified proportional navigation
Range	Excess of 4 kilometers
Speed	Mach 2.2
Warhead	High explosive
Motor	Rocket, solid propellant, two-stage
Acceleration Rate	1 Meter per .5 second

Example of a Mathematical Model

An algorithm is "A prescribed set of well defined unambiguous rules or processes for the solution of a problem in an finite number of steps." [DMSO, 2003] Synonyms for an algorithm include recipe, process, method, technique, procedure, and routine. [Knuth1997] Algorithms are essential elements of mathematical models because they provide a coherent, orderly path from input, through the mathematical equations, to output. Knuth (1997) lists five important features of algorithms:

a. Finiteness. "An algorithm must always terminate after a finite number of steps."
b. Definiteness. "Each step of an algorithm must be precisely defined."

c. Input. “An algorithm has zero or more inputs: quantities that are given to it initially before the algorithm begins, or dynamically as the algorithm runs.”
d. Output. “An algorithm has one or more outputs: quantities that have a specified relation to the input.”
e. Effectiveness. “An algorithm is generally expected to be effective, in the sense that its operations must all be sufficiently basic that they can in principle be done exactly and in a finite length of time by someone using pencil and paper.”

A good model will include not only the algorithms, but also documentation that explicitly states the purpose of the model, assumptions, variables, relationships between variables, and perhaps a solved example and some evidence of how the algorithms were validated.

Because there are a wide variety of mathematical models available, Arney (2002) further categorizes them as being:

- Discrete (difference equations, linear algebra, and discrete random variables) vs. Continuous (ordinary differential equations (ODEs) and continuous random variables)
- Deterministic (applied analysis) vs. Stochastic (probability and statistics)
- Linear (linear algebra and ODEs) vs. Nonlinear (numerical analysis)
- Single Variable (ODEs and numerical analysis) vs. Multivariate (linear algebra).

3. Process Models

A process model is a representation of the processes performed by a system. Sometimes known as procedural or behavioral models, process models allow for “An expression of dynamic relationships of a situation expressed by mathematical and logical processes. These models are commonly referred to as simulations.” [DA Pam 5-11, p.96] A simulation is defined as “A method for implementing a model over time.” [DA Pam 5-11, p. 96]

Process models are categorized as discrete or continuous and are associated with “next event step” or “time step” time advance mechanisms respectively. [Shannon, 1975] A discrete model is one for which the state variables change instantaneously at separated points in time [Law and Kelton, 2000] (i.e., updates are made only at specific time intervals). For example, the model used to describe the firing of a gun at a target, a single shot at a time, is normally considered a discrete model, with state variables (e.g., the point of impact), changing only when another shot is fired. A continuous model is one for which the state variables change continuously with respect to time (Law and Kelton, 2000) (i.e., updates are made at specified time intervals). The model used to describe a missile movement through the air is typically considered continuous. Some systems are clearly described best by one type or the other, but either type might be used. [Law and Kelton, 2000]

Worksheet for Evaluating Models

Source of information (name, organization, position, telephone, location)	
What model/object am I looking at?	
Who (what, when) created the model and for what purpose?	
What simulation is the model in (what version)?	
If known, when was the model created?	
What type of model is it (Physical, Mathematical or Process)?	
What aspects of the real world are being modeled?	
What is the basis of the data?	
What data does it need to run and where do you get it?	
What affects the model (environment)?	
What are the attributes and what are the variables?	
o Algorithm (PK, logistics)	
o Units of measure	
Is the model based upon a work around?	
How does the model run in this simulation?	

o How fast does the model run?	
How accurate is the model?	
Has the model been validated? For what applications is the model accredited?	
What are the assumptions?	
Additional Questions for Evaluating Physical Models	
What is the scale?	
Is the model 2D or 3D?	
What is the original intent of the model?	
What other equipment is needed to use this model?	
What is the underlying mathematical structure for the model?	
Additional Questions for Evaluating Process Models	
What are the steps being modeled?	
o What's the start and what's the end?	
Is the model discrete or continuous?	
What are the triggers for each step of the process?	

1.B.2 Simulation Concepts

1.B.2a Simulation Definition

A simulation is "a method for implementing a model(s) over time." [DA Pam 5-11, p. 96] A simulation application is "A specific, individual project session that requires or uses an M&S to achieve its purpose." [DA Pam 5-11, p. 93] There are three types of simulations used to support Army applications: live, virtual, and constructive. Examples include: instrumented field exercises (live), manned vehicle simulators (virtual), and computer-generated forces (constructive). For a discussion on the ability of live, virtual, and constructive simulations to effectively operate together, see section 1.B.5.

One of the issues that should be addressed early on when discussing a simulation is whether it is real-time or non real-time. "Real-time simulation requires that the simulated model's time base corresponds identically to the actual time on a wall clock. Real-time simulation is desirable in virtual and live simulations, for which participants shouldn't be able to distinguish the responses of real and simulated entities in all aspects including their timing. In many analytical, design or control studies, we want the simulator to grind out model behavior much faster than it occurs in reality." [Cloud, 1998. p. 90]

1. **Live Simulations**

A live simulation is "A representation of military operations using live forces and instrumented weapons systems interacting on training, test, and exercise ranges which simulate experiences during actual operational conditions." [DA Pam 5-11, p. 95] The terms field exercise or live exercises are synonymous with live simulation and involve real people operating real systems in the field.

(Image Source: U.S. Army)
Example of Live Simulation

Live simulation may be thought of as an elaborate role-playing activity that allows for realistic force-on-force operations. Live simulation may be conducted over an extended period of time like the Louisiana Maneuvers were or over shorter periods such as a four-phase exercise designed to test a battalion's ability to deploy from fort to port, establish combat service support operations, conduct force protection and re-deploy to home station. Operation Slayer is an example of how the Army is using live simulation to train soldiers and develop leaders. [Heap, 2003]

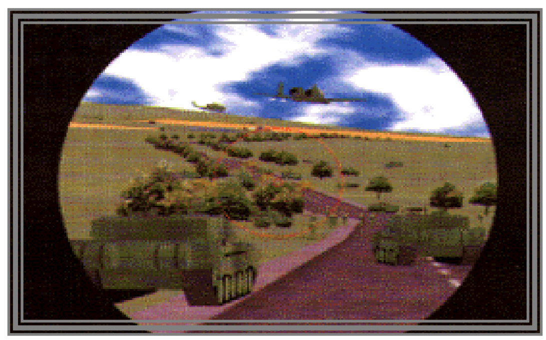
In general, live simulations may:

a. Involve individuals or groups.
b. Use actual equipment.
c. Involve sensors/instrumentation that track location, time of weapon fire, time of weapon impact/casualties, and other important information.
d. Provide an area of operations similar to that used in combat.
e. Not fully replicate actual combat operations.

Examples of live simulations include: (a) the 1941 Louisiana Maneuvers [Louisiana Maneuvers, 2003]; (b) the 1990 Desert Shield exercises conducted in Saudi Arabia prior to, and in preparation for, Operation Desert Storm; (c) exercises conducted in Kuwait for hostilities between the U.S. and Iraq; and (d) recurring unit training events conducted at Army Combat Training Centers (e.g., National Training Center at Ft. Irwin, CA; Joint National Training Center at Ft. Polk, LA; or Combat Maneuver Training Center at Hohenfels, Germany).

2. Virtual Simulations

A virtual simulation is "A synthetic representation of Warfighting environments patterned after the simulated organization, operations, and equipment of actual military units." [DA Pam 5-11, p.99] A simulator, the most common type of virtual simulation, is: "(a) A device, computer program, or system that performs simulation; (b) For training, a device which duplicates the essential features of the task situation and provides for direct human operation." [DMSO, 2003]

Examples of Virtual Simulations

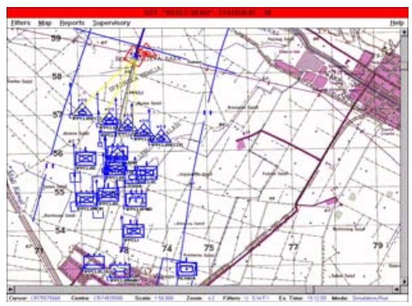
Virtual simulation often involves the use of simulators that include both physical models that look and feel, from an operator's perspective, like the system being emulated and computer-generated visual displays that allow participants to navigate through a virtual environment (VE).

Often, the virtual environment matches the real environment in terms of general terrain features such as placement of rivers, lakes, and mountains. Major manmade elements, such as roads and buildings, radio transmissions, radar sensing and radar jamming, can also be included in the virtual environment. A variety of weather conditions, such as clouds, wind, rain, fog, dust, and smoke, are also used to increase realism.

Virtual simulations inject human-in-the-loop in a central role by requiring the operator or team member to exercise motor control skills (e.g., driving a tank), decision skills (e.g., committing fire control resources to action), or communication skills (e.g., as members of a Command, Control, Communications, Computers and Intelligence team).

3. Constructive Simulations

Constructive simulations are "M&S that involve real people making inputs into a simulation that carries out those inputs by simulated people operating simulated systems." [DA Pam 5-11, p. 94] Constructive simulations may be operated in an automatic (no-human-interaction) or semi-automatic (human-in-the-loop) mode. Some constructive simulations are capable of operating in either mode (e.g., the Tactical Simulation [TACSIM], the Joint Conflict and Tactics Simulation [JCATS], the Enhanced Air Defense Simulation [EADSIM], and Janus).



Screen Capture of a Constructive Simulation

In automatic mode, constructive simulations are initialized to a set of starting conditions, then run, without human intervention, for a specified period of time or until a predefined set of conditions have been satisfied. All orders, directions, etc., are pre-built and loaded prior to run time, or are handled dynamically using built in behavior algorithms. Automatic mode is suited for analysis because (a) it is generally faster than real-time (e.g., more trials mean more data can be collected in a fixed amount of time); (b) trial outcomes are repeatable; and (c) extraneous variables can be more easily controlled. Specific uses include scenario drivers for seminars and strategic level wargames; force structure analysis and POM related issues; strategic and operational level planning; weather forecasting, etc.

In a semi-automatic mode, the simulation is initialized to a set of conditions, as in the automatic mode, but the simulation is run at near real time to support human-in-the-loop interactions. This type of simulation is suited for training and some forms of research where human-in-the-loop is a desirable feature (e.g., utility assessments etc.). In general, the level of human interaction depends on the simulation and level of training audience. For example, units are typically controlled in the Corps Battle Simulation (CBS) at the brigade or battalion level; the Brigade/Battalion Simulation (BBS) is controlled at the company level; and the Joint Conflict and Tactics Simulation (JCATS) is controlled at the individual soldier level.

In a wargame, constructive simulations usually support two or more sides with each side making independent decisions based on its perception of the battlefield. Whenever possible, organic C4I systems are used to support the information flow between the training audience and the role-players. Ideally, the role-players are pulled from subordinate staffs and are familiar with the type of information the training audience expects to see (e.g., content, detail, perishability, etc.).

Constructive simulations are characterized by:

a. The grouping or aggregation of forces. Various levels of aggregation occur at the theater, campaign, and engagement level.
b. The use of Graphic User Interfaces (GUIs) to monitor simulated forces and receive status reports, combat outcomes, etc.
c. Speeds at or near real-time for games, but varying for research and analysis.

In addition to the examples cited above, Army M&S professionals may encounter the following constructive simulations: the Warfighter's Simulation (WARSIM); the Joint Theater Level Simulation (JTLS); the Air Warfare Simulation (AWSIM); the Navy's Research, Evaluation and System Analysis simulation (RESA); and the Marine Air-Ground Task Force Tactical Warfare Simulation (MTWS).

4. Why the Army Uses Models and Simulations

All three Army Modeling and Simulation (M&S) domains (i.e., Advanced Concepts and Requirements [ACR]; Research, Development, and Acquisition [RDA]; and Training, Exercises, and Military Operations [TEMO]) use M&S for essentially some combination of the following five reasons: speed, quality, cost, feasibility, and/or risk reduction.

The benefits derived from being able to quickly resolve time-sensitive, operational and/or programmatic issues are self-evident. In research and development, models have been used to accelerate Operational Test and Evaluation of systems that normally compete for limited resources such as range time.

M&S improves the quality of decisions by allowing us to simplify complex problems down to a level where we can better deal with and understand the salient issues driving system behavior or performance (e.g., the weather, tactics, employment, numbers, decision making, etc.). Validated simulations (faithfully representing a system) improve analysis by significantly increasing the number of possible trials and excursions, thus increasing confidence in the resulting observations, findings, and conclusions. In the training arena, M&S provides the means to create virtual environments that are transparent to the user (i.e., indistinguishable from the real world).

M&S can reduce the cost of: (a) requirements planning, (b) research and development, and (c) training. Simulations offer a relatively cost effective means to experiment with new concepts, test new systems under conditions only found in large-scale operations, and train leaders and staffs. Because models can be built, tested, and modified at a comparatively low cost they can be used to conduct controlled experiments in situations where direct experiments are cost-prohibitive. If the model is properly designed, the results can be used with a high degree of confidence to predict the performance of the modeled system. An example is the use of live fire data to validate fly-out models, which are in-turn used to predict systems performance, thus preserving limited numbers of high-value assets.

M&S provides a means to study and resolve issues, or conduct training that cannot be accomplished directly, because they are either physically impractical or dangerous. Examples include: (a) assessing the performance of hypothetical systems, (b) evaluating configuration changes to existing systems, (c) analyzing the utility of proposed communications networks, or (d) assessing the effects of chemical, nuclear, and biological weapons on target populations. McHugh (1966) states that M&S provides the means for training troops, who, "unlike other professionals, cannot practice their profession -war- except in time of war." M&S provides the means to practice highly dangerous activities, practice activities in environments that aren't easily accessible like a chemical or nuclear contaminated battlefield, and to expand access to systems that are in limited supply like training crews in a new weapons system before the system is fielded.

5. How Army Models and Simulations are Used

The Army has divided its modeling and simulation activities into three domains (ACR, RDA, TEMO) as noted in the accompanying Table below. For a more detailed explanation of these domains, see section 1.B.6.

Domain	Domain Activities	Simulations/Simulators
Advanced Concepts and Requirements (ACR)	Force Planning Requirements Development Warfighting Experiments	Re-configurable Simulators Constructive Models
Research, Development, and Acquisition (RDA)	Basic/Applied Research Weapons System Development Test and Evaluation	System Prototypes Engineering and Physics Models Advanced Collaborative Environments (ACE) Interoperable Model and Simulation Environment (IMSE)
Training, Exercises, and Military Operations (TEMO)	Individual and Collective Training Joint and Combined Exercises Mission Rehearsal Operations Planning	System Simulators Training Simulations

The Army's M&S Domains With Example Activities and Systems

Within these domains, M&S are used to support analysis, experimentation, planning, and training.

All three domains use M&S to support analysis. ACR uses M&S to analyze new concepts and technologies to develop future doctrinal, training, materiel, and organizational requirements. RDA uses M&S to analyze the design and performance characteristics of new systems. TEMO uses M&S to support military readiness including training, pre and post analysis of operations, and validation of operational plans.

All three domains use M&S to perform tests and experiments. One of the classic models in the Test and Evaluation (T&E) community is the scale model or mock-up used in wind tunnel tests. In more advanced applications, M&S are used to emulate the behavior, physical properties, or performance of objects that are not otherwise available (e.g., hypothetical systems, weapons of mass destruction, subsystems or components like radar heads, etc.). Stimulators, which are a subset of emulators, are used to subject systems to the physical aspects of the environment without actually taking them to the field. Stimulators include the physical structures used to test the effects of vibration, wind, water, and temperature extremes on system performance and durability, and the hardware/software suites used to inject electro-optical and electromagnetic signals directly into the sensors of actual or hypothetical systems.

Models play an essential role in strategic, operational and tactical planning. At the high end, M&S is used to develop service-funding requirements and to plan major deployments. At the other extreme, there are other developmental tools used to support operational planning. Logistics models are examples used, across this spectrum of operations, to plan and monitor the movement of supplies and materiel to troops in the field.

Live, virtual, and constructive simulations are used to support all levels of training at all echelons of command. Part task trainers and simulators support individual and team training. Brigade/Battalion Simulation (BBS), Joint Conflict and Tactics Simulation (JCATS), and One Semi-Automated Forces (OneSAF) support leadership and staff training at Battalion/Brigade and below. Corps Battle Simulation (CBS) supports leadership and staff training at Corps and above. Digital Battlefield Sustainment Trainer (DBST) is a federation of models and simulations used to train Brigade staffs in the effective use of digital systems on the modern battlefield.

6. Where Army Models and Simulations Are Used

Constructive simulations are used in the Pentagon, at major headquarters (Training and Doctrine Command; Army Materiel Command; Research, Development and Engineering Command; Army Research Laboratory), Battle Laboratories, Battle Simulation Centers (BSCs), Professional Military Schools, and by Army contractors in the development of new systems, tactics, etc. See Appendices B and C for information on the BSCs and Battle Laboratories.

Virtual simulators are used worldwide, with the majority located at or near operational units and major training centers where they can be used on a daily basis – for example weapons simulators, the Close Combat Tactical Trainer (CCTT) and the Aviation Combined Arms Tactical Trainer - Aviation Reconfigurable Manned Simulator (AVCATT-A).

Live simulations are used to train both "at-home" and or deployed forces. Most live exercises are conducted on dedicated training ranges, or use permanent air, land and sea training areas like the Combat Training Centers located at the National Training Center at Ft. Irwin, CA; the Joint Readiness Training Center at Ft. Polk, LA; and the Combat Maneuver Training Center at Hohenfels, Germany. Live exercises are also conducted, on an ad hoc basis, to prepare for pending operations. Examples of the latter include exercises conducted in Saudi Arabia prior to Operation Desert Storm.

7. Who Performs Modeling and Simulation in the Army

Models are used extensively in the following Army career fields as displayed in the accompanying table below:

Field	Army Career Field
Modeling and Simulation	Simulation Operations Officer (FA 57)
Science	Army Scientist Program, Nuclear Research and Operations Officer (FA 52)
Acquisition Corps	Research and Development Officer (FA 51)
Space	Army Astronaut Program, Space Operations Officer (FA 40)
Management	Contracting and Industrial Management (FA 97), Human Resource Management (FA 43), Comptroller (FA 45)
Computers	Systems Automation Officer (FA 53)
Intelligence	Information Operations (FA 30), Strategic Intelligence (FA 34)
Cryptology	Information Operations (FA 30), Strategic Intelligence (FA 34)
Operations Research	Operations Research/Systems Analyst (FA 49)

Model Users

8. Important Considerations for the Employment of Models and Simulations

Typically, the resources needed to conduct a live exercise are substantial. Cost factors may include any or all of the following: labor costs for contractors, consumable resources (e.g., fuel, ammunition, time, etc.), repairs to damaged equipment, maneuver damage to terrain (if occurring on private land), and injury or fatalities to participants.

Virtual simulations offer many advantages over live simulations. Simulated tanks do not burn fuel, break down, or destroy terrain, thus reducing much of the expense incurred in live simulations. Warfighters are able to practice individual skills, tactical decision-making, intra- and inter-team coordination, and communication skills but at much lower cost and physical risk. Their principal drawback is the lack of “feel” that trainees get when engaged in live simulations. For example, non-motion based tank simulators have a smooth ride, even while traversing rough terrain.

Constructive simulations range in size from very small to very large. Large constructive simulations normally require a significant effort to prepare them for use. An 18-month lead-time is not unusual. However, even small events can be adversely affected by database issues, limited access to equipment, a lack of Verification, Validation and Accreditation (VV&A); and inadequately defined requirements.

9. Evaluating Models and Simulations

In general, models should be evaluated in terms of their ability to perform their intended function. The objective is to increase user confidence that a specific model meets the required needs and is appropriate for its intended use. Within the Army, a formal Verification, Validation and Accreditation (VV&A) process [DA Pam 5-11, p.99] has been established to ensure and document each model's suitability for use for a specific purpose. Verification is "The process of determining that an M&S accurately represents the developer's conceptual description and specifications. Verification evaluates the extent to which the M&S have been developed using sound and established software-engineering techniques." [DA Pam 5-11, p.99] Validation is "The process of determining the extent to which an M&S is an accurate representation of the real-world from the perspective of the intended use of the M&S. Validation methods include expert consensus, comparison with historical results, comparison with test data, peer review, and independent review." [DA Pam 5-11, 1999, p.99] Accreditation is "The official determination that a model, simulation, or federation of M&S is acceptable for use for a specific purpose." [DA Pam 5-11, 1999, p. 92] These procedures are discussed in section 2.C.1.

Live simulations are not subject to the VV&A procedures identified in DA Pam 5-11. Because they are inherently physical (firing missiles, flying helicopters, shooting rifles, etc.), evaluation of such simulations (for the intended purpose) is generally straightforward but frequently difficult to measure. The simulation is considered "good" if the skills of the training audience are advanced.

Worksheet for Evaluating Simulations

What is the source of information (name, organization, position, telephone, location)	
Who is the proponent for this simulation?	
What simulation am I looking at?	
Who (what, when) created the simulations and for what purpose?	
What version?	
If known, when was the simulation created?	
What type of simulation is it (live, virtual, or constructive)?	
The primary purpose of the simulation is for what domain?	
What are the primary hardware requirements?	
What aspects of the real world are being simulated?	
What is the basis of the data?	
What are the various databases?	
o Build time	
o Data requirements	

o Availability of off-the-shelf databases	
What data does it need to run and where do you get it?	
What is the input and what are the outputs?	
What affects the simulation (environment)?	
What are the attributes and what are the variables?	
o Algorithm (PK, logistics)	
o Units of measure	
Is the model based upon a work-around?	
How accurate is the simulator?	
Has the model been verified, validated and accredited (VV&A)? and for what purposes?	
What are the assumptions?	
How does it portray systems, humans, environments?	
o What are the limitations?	
o Are there known work-arounds, and what are they?	
o Are they documented and who maintains them?	

Is the simulation interoperable with other simulated and real world equipment?	
o HLA	
o ALSP	
o DIS	
o COE	
What are the effects on runtime management?	
What are the security levels of the simulation?	
What is the minimum bandwidth needed for distributed operations?	
What are the time considerations?	
o Update rate	
o Latency	
o Speed	
o Lag time	
What are the data input and output, and storage for replay requirements?	
o Real time visualization	
o AAR capability	
o Authentication	

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1.B.3 Modeling and Simulation Process

The modeling and simulation process, or "the modeling process" for short, is a series of steps, followed in a defined order that the Army uses to develop and employ computer-based models and simulations. Key Army participants in this process are the: Sponsor, Proponent, and Developer.

- The Sponsor is "The agency which sponsors the development or use of M&S utilizing either in-house, other government agency, or contract resources." [DA Pam 5-11, p. 98]
- The Proponent is "The organization responsible for initiating the development and directing control of the reference version of the model or simulation." [DA Pam 5-11, p. 96]
- The Developer is "The organization responsible for developing, managing or overseeing M&S developed by a DoD component, contractor, or Federally Funded Research and Development Center. The developer may be the same agency as the proponent agency." [DA Pam 5-11, p. 96]

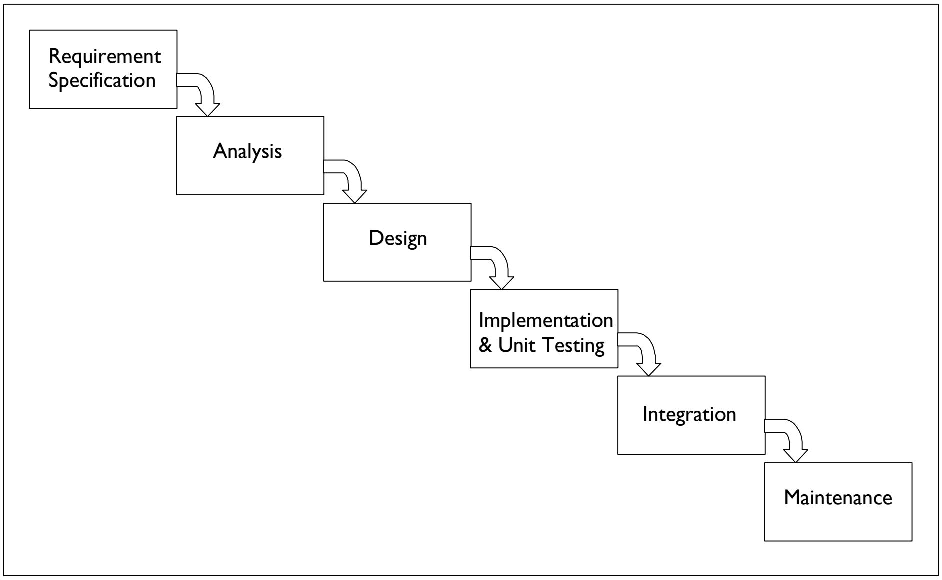
1. Process Description

The Army's approach to developing large software programs may be described in terms of three elements: (a) a development paradigm, (b) a development method, and (c) the technical and administrative procedures that are executed as part of the development process.

2. Development Paradigms

A paradigm is "A particular approach or concept, used especially in software to refer to the way a given task is presented to and handled by the user." [Webster, 1995] A development paradigm is, in effect, a high-level conceptualization of how the modeling process should be executed. Over the last several decades, two paradigms have evolved to handle large, complex software development programs like those associated with Army simulation: (a) the Waterfall Model, and (b) the Spiral Development Model. Differences between the two models include: (a) their conceptual views of M&S development, (b) the degree to which requirements are specified, and (c) the structure, or degree of rigidity, imposed on the development process.

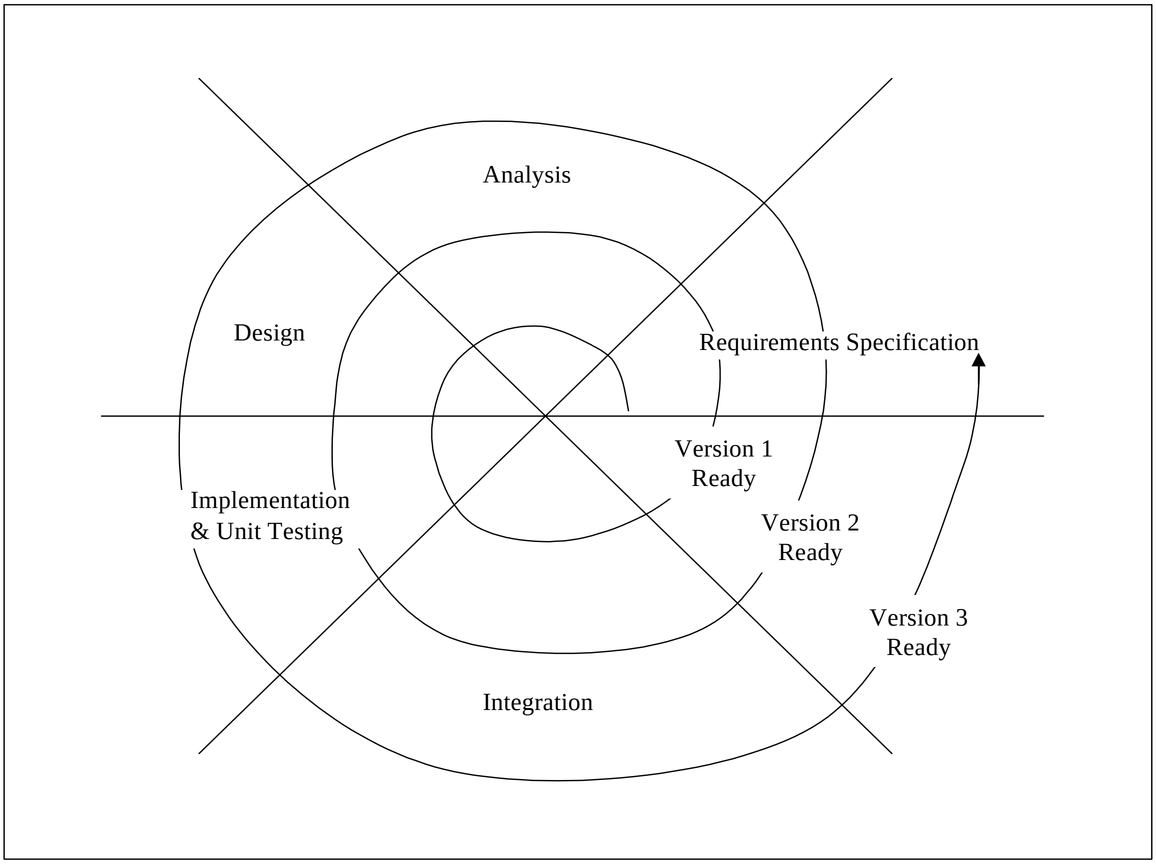
The Waterfall Model has traditionally been used to develop first product versions. [DA Pam 5-11, 1999] and [Jacobson, Christerson, Jonsson & Overgaard, 1996] Its success, as a process, lies in its highly structured approach with a well-defined start (i.e., requirements specification) and finish (i.e., a definable end product). In general, the Waterfall Model is considered relatively inflexible compared to the Spiral Development Model because it is tied to a series of discrete developmental phases, or process steps, each of which must be completed before the next one begins, although strictly speaking, this is not always the case. [Jacobson, 1996] Additionally, user involvement is limited to those activities that are associated with moving from one step to the next, which for complex M&S, can result in out-dated functionality. [DA Pam 5-11, 1999] Despite these misgivings, the Army continues to use this approach when M&S development is outsourced to contractors. [DA Pam 5-11, 1999] A typical Waterfall Model is illustrated in the figure below.



Waterfall Development Model [Jacobson, 1996]

The Spiral Development Model takes a global view of the entire system life cycle in which development is seen as a series of build-a-little and test-a-little advancements. [DA Pam 5-11, 1999] and [Jacobson, 1996] The spiral development cycle does not usually start with full fleshed out or approved requirements, but does provide a continuous series of partial advancements through the use of prototypes and user involvement. [DA Pam 5-11, 1999] Consequently the Spiral Development Model is more responsive to changes in requirements than the Waterfall Model. A typical Spiral Development Model is illustrated in the following figure.

It is worth noting that the steps illustrated in the above figures, i.e., Requirements Specification, Analysis, Design, etc., are essentially the same for both models, and are generally consistent with other sources, even though they may be given different names. [Jacobson, 1996]



Spiral Development Model [Jacobson, 1996]

3. Development Methods

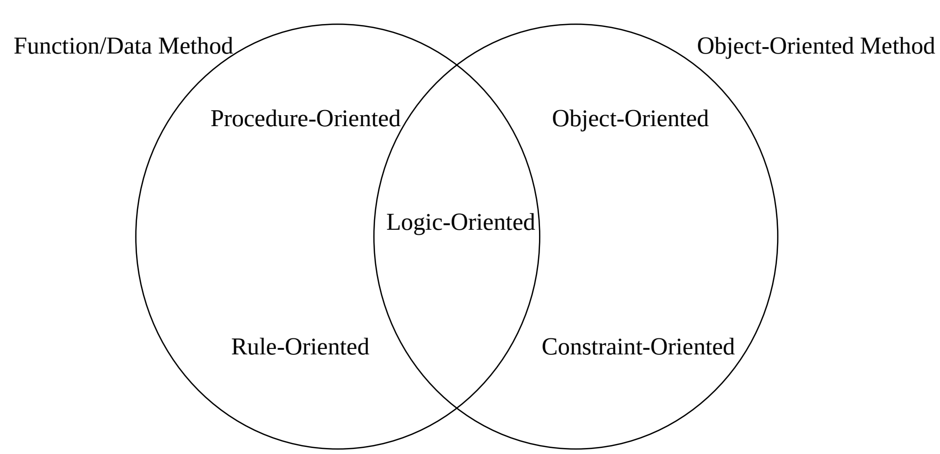
Booch (1994) defines a development method as "a disciplined process for generating a set of models that describe various aspects of a software system under development, using some well-defined notation." Development methods are, in effect, conceptualizations of how best to model the system, entity, phenomenon, or process in question. Jacobson (1996) states that system development methods can be divided into two design categories: (a) functional/data methods, and (b) object-oriented methods. Function/data methods are those methods that more or less treat functions and/or data separately, and include both Top-Down and Data-Driven structure designs. [Booch, 1994] and [Jacobson, 1996] Most older systems, like Corps Battle Simulation (CBS) and Brigade/Battalion Simulation (BBS), have Top-Down structures. Object-oriented methods view software systems as collections of cooperating objects, within which functions and data are highly integrated. In addition to the model structure, the choice of development method affects to some degree the activities conducted during each developmental phase, but most notably, tasks associated with analysis, design, implementation and testing. For example, during the design phase, a top-down approach will focus on algorithm decomposition while an object-oriented approach will focus on finding and organizing objects, defining relationships and describing how they interact.

Likewise, the choice of development method also affects how a model is implemented (i.e., programming style and language). For example, the programming language FORTRAN is well suited for top-down designs, while the programming language C++ is well suited for object-oriented designs. Booch cites Bobrow and Stefik in identifying five main programming styles:

1.	Procedure-oriented	Algorithms
2.	Object-oriented	Classes and objects
3.	Logic-oriented	Goals, often expressed in a predicated calculus
4.	Rule-oriented	If-then rules
5.	Constraint-oriented	Invariant relationships

Main Programming Styles

The relationship between the program design (e.g., functional/data or object-oriented) and the programming style used to implement the design is illustrated in the Figure below.



Compatible Methods and Programming Styles

As shown in the figure, there is no one programming style that is a best fit for all applications. For example, selecting a Procedure-Oriented programming style and language, like FORTRAN, to support an object-oriented design is probably not a good choice. Failure to match a program language with a compatible design can significantly increase program risk and complexity.

4. Technical and Administrative Procedures

Technical and administrative procedures are effectively the step-by-step tasks that the sponsor, proponent, and developer perform in the process of developing a model. As Jacobson (1996) noted, there are a number of ways to decompose the M&S development cycle, but they all share a common thread in terms of the major tasks performed and the order in which they are accomplished. To illustrate this point, the table below provides a high-level overview of the modeling process from various perspectives. The apparent “holes” in the table are due more to the grouping of tasks, based on the methods used, than to substantive difference in the tasks or their sequencing. For example, under Shannon, validation includes model implementation, testing, etc.

Jacobson [Object-Oriented]	**Booch [Object-Oriented]**	**Law and Kelton [Hybrid]**	**Shannon [Top Down]**
Requirements Specification	Establish Core Requirements (Conceptualization)	Identify the Problem	Systems Definition (Requirements)
		Define Requirements	
		Develop Study Plan	
Analysis (Form Logical Description of Model)	Develop a Model of the Desired Behavior (Analysis)	Gather Data	Model Formulation
		Develop a Conceptual Model	
Preliminary Design	Create an Architecture (Design)	Develop Algorithms	Data Preparation
Detailed Design			
Coding	Evolve the Implementation (evolution)	Write and Verify Code	Model Translation (Code)
Unit Testing		Implement the Model	Validation
Integration			
Systems Test		Analyze and Validate the Output	
		Accredit the Model	
Maintenance	Manage post delivery evolution (Maintenance)	Maintain the Model	Fielding
			Documentation

Steps in the Modeling Process

The steps described in the above table are sequential, although not necessarily mutually exclusive (i.e., most steps are generally accomplished in turn, while others like validation, occur throughout the process). Note that: (a) modeling is an iterative process and changes in user objectives, model requirements, or design features may lead back to a previous step for updates; and (b) the steps used to describe the M&S process are common to most development efforts, but the type of supporting tasks used to complete each step can vary significantly based on the methods used. For a more descriptive decomposition of the modeling process and supporting tasks, see DA Pam 5-11, Chapter 2, Figure 2-5. *Spiral Development Cycle.*

5. Why We Use A Modeling Process

The Army uses well established development paradigms, methods, and procedures for model and simulation development to: (a) manage complexity; (b) reduce costs; and (c) work more efficiently. The Waterfall and Spiral Development paradigms evolved to meet the community's need for systematic, efficient, and responsive approaches to managing complex software development projects. Having a repeatable, documented process for the development of models provides a framework for the planning and implementation of studies. It helps project managers, study planners and model developers to organize and resource projects, and to track where they are in the development cycle. With a good process in place, model development is less expensive, more efficient and inherent risks are reduced.

6. Important Considerations

Modeling is an iterative process that requires continuous reassessment to ensure that critical features of the real system are modeled and that the modeled features are needed for the application. Consequently, the M&S process should:

a. Closely involve the ultimate user,
b. Stay focused on user objectives,
c. Provide a usable interpretation of all tests, etc., in a format that the user understands.

Document model development and validation, data sources, and analytic or statistical techniques. M&S developers should begin by simplifying the model as much as possible, without compromising it.

a. Detailed models are expensive to program, debug, and run.
b. It's difficult to obtain data and determine parameters for complex models.
c. The output of complex models is difficult to explain and interpret.

Modularize the model:

a. Create a series of simple models that can be used together to model a complex system.
b. Individual modules may be specified in more detail as required.
c. Develop overall program design prior to coding.

Use validated models whenever possible.

Plan for data collection and management as these are not trivial tasks.

Use established data models:

a. Use accredited sources.
b. Document all sources.

Develop multiple competing models (as necessary):

a. For less understood relationships, it may be necessary to create several plausible models based on observed behavior.
b. Candidate models are tested by designing experiments that can detect inadequacies in the initial designs. [Shannon, 1975]

1.B.4 Representation

1.B.4a Systems Representation

The Department of Defense Joint Publication 1-02 identifies a “system” as “Any organized assembly of resources and procedures united and regulated by interaction or interdependence to accomplish a set of specific functions.” [JP 1-02, 1994]

1. **Background**

For the purpose of this discussion, systems are considered unique and different from the environment they exist in and the humans who interact with them. If we exclude humans and the environment from a system’s description, we create an object (i.e., a collection of items or procedures) that may have some internal organization, but does not have cognitive thought and does not react or generate actions or conditions on its own. It must be stimulated by human interaction or the environment to perform its function. Whenever humans use objects, a system comes into use. Therefore, understanding the salient proprieties of systems is important because we use them to interact with our environment. A clear and unambiguous description of a system’s characteristics is critical to its accurate representation in models and simulations.

2. **Systems Representation Categories**

It is the Undersecretary of Defense for Acquisition and Technology’s position that the best activity to describe a U.S. system is the system’s proponent. Consequently, DoD leaves the formal representation of systems to the individual services, and the formal representation of foreign systems to the Defense Intelligence Agency. [USDA&T, 1996] Within DoD and the Army, systems are prioritized and categorized based on their use, operating environment, and physical ownership, in that order.

The first category, “systems use”, is divided into six areas: units; weapons; platforms; sensors; life support; and Command, Control, Communications, Computers, and Intelligence (C4I). This division is not mutually exclusive, since some systems can be represented in more than one area. For example, a Blackhawk helicopter may be considered a platform if it is used to transport soldiers and materials around the battlespace, or as a C4I system if it is used for command and control of a military action.

The First Categorizing of Systems

The second category, “the system’s operating environment,” is divided into four areas: air, sea, space, and ground. Once again, systems may be represented in more than one area. For example, the Marine Corps’ newest platform, the Advanced Amphibious Assault Vehicle, could be considered a sea or a land system depending on how it is employed.

Individual Ground Sea Air Space

The Second Categorizing of Systems

The third category, "physical ownership," is determined by the sovereign country that physically owns the system. This category is the most ambiguous because a single military system may be produced by numerous countries and sold to numerous others. Examples include the M-1 Abrams tank, an armored vehicle that has versions produced and operated by several different countries, or the M113 armored personnel carrier, originally manufactured by the U.S. but found in the inventories of many other countries.

3. Data Considerations

The following systems-related issues need to be considered before systems models (i.e., representations) are developed and executed in simulations.

a. Duplication and Inconsistency

There are numerous DoD and service-sponsored repositories dedicated to cataloging characteristics and effects data for fielded systems. While there is an on-going effort to coordinate their activities and resources, these repositories remain, for the most part, unconnected, technically and philosophically. A recent informal review by the Modeling and Simulation Information Analysis Center (in Alexandria, VA) identified 150 different models of the U.S. M-60 main battle tank. While there was some agreement between the M-60 characteristics data used in the various models, there were also differences from model to model that were attributed to inconsistencies in authoritative sources.

b. Lack of Data

There are military systems today for which no authoritative characteristics data exists. There is no way to modify existing representation data files to accommodate these systems because they are either unknown to the community in general, there are security classification issues involved, or they exist in very small numbers. Developers must accept that, for this type of system, new data must be developed.

c. Lack of Understanding

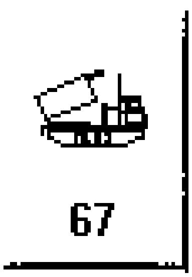
Many programmers and others working to develop systems representations have, at best, a limited understanding of the operational and engineering concepts behind the systems being modeled. It is crucial that developers be given clear and unambiguous system descriptions along with authoritative, comprehensive, and compatible characteristics data.

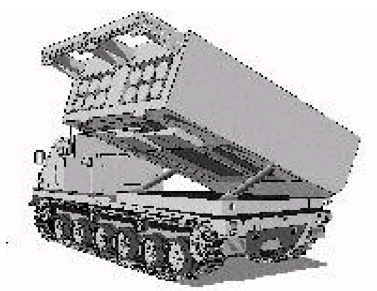
4. Challenges of Aggregation

Aggregated groups of systems present unique modeling challenges because: (1) the group's collective combat effectiveness will generally be greater than the sum of their individual combat ratings, and (2) problems associated with replicating the non-linear nature of force tailoring (i.e., mixing dissimilar units for combat). Care must be taken in simulation database development to ensure that the resulting accumulation of data does not depict an aggregated collection of systems that is no longer relevant to the requirement.

5. Cost Tradeoffs
Before modeling a system, the user should compare the cost of the modeling effort to the impact that the model is expected to have on achieving the objectives (i.e., expected benefit). The user should consider alternative approaches if the cost is unrealistically high or the benefit-cost ratio is unexpectedly low.

6. Graphic Representation
Graphic representation and resolution are not the same issues. A good graphic representation does not necessarily mean that the system is accurately portrayed in the simulation. A tank model may include an accurate picture of a tank, while at the same time, basing the simulated tank's behavior and performance on characteristics data that only remotely resemble the actual tank. Individuals who are not familiar with modeling and simulation are at risk of over or under estimating the credibility of a model based solely on the quality of its graphics. The fact that it looks "exactly" like the item it is depicting does not mean the model acts like it at all.






(Image Source: JCATS documentation and U.S. Army)

7. Challenges of Multi-State Systems
In most simulations, systems are allowed to change their attributes during an execution cycle. For example, a tank may suffer a firepower kill, and lose its ability to shoot, but not its ability to move or communicate. A tracked bridge-laying vehicle can still move after laying its bridge section but it no longer has the capability to accomplish bridging. Unfortunately, these same models, that allow changes in state, need additional work before users can effectively employ the tank and the bridge-laying vehicle in non-traditional roles.

8. Current and Future Systems Representation Challenges
In many respects, systems are easier to represent in models and simulations than human behavior or the natural environment. Systems are considered easy because their characteristics data is readily available and verifiable using standard measuring schemes. On the other hand, small omissions in design or inappropriate data can dramatically alter simulation outcomes. The latter is very significant because systems data is easy to generate,

and easy to modify. Users at the lowest level have the ability, in some simulations, to enter the systems database and change the data, sometimes without regard for accuracy or the applicability of the change to the scenario. Special care must be taken in all phases of development to ensure that:

a. system models are verified, validated, and accredited for their intended use,
b. system models are used only for approved purposes, and
c. appropriate data, from authoritative sources, are used, and that safeguards are in place to prevent unauthorized modification.

Worksheet for Evaluating Systems Representation

Checklist Item	Checklist Response
What model or simulation (version) is being examined?	
What system is being examined?	
What are the requirements/needs for representing this system in the model/simulation?	
Which of these requirements/needs are actually incorporated into this system representation?	
What parts of the system are actually represented within the simulation and what parts are represented outside the simulation based on a workaround?	
What is the source of the information or data for the representation?	
Are these representations validated and/or documented?	
What are the assumptions used in the representations?	
What are the limitations (e.g., accuracy, data, time constraints) of the representations?	
Is there more than one representation of the system within the full (distributed) simulation or exercise? If so, which version of the representation is being evaluated?	

Is a single entity (e.g., one tank, one machine gun) being represented, or is a combination of such entities being represented?	
How realistic/accurate is the visual representation of this system in the simulation displays?	
How does the system representation actually represent the following?	
- Movement? Is movement constrained on the terrain? Does a formation move more slowly than a single vehicle?	
- Firing?	
- Communications?	
- Crew?	
- Maintenance or repair?	
- Loss of mobility and retention of firepower?	
- Loss of firepower and retention of mobility?	
- Loss of crew and retention of firepower and mobility?	
- Detection, engagement, and/or report on friendly, OPFOR, or third-party systems?	
- Dependence on supplies of fuel, ammunition, food, water, or other consumables for continued operation?	

1.B.4b Human Behavior Representation

1. Background

Representing humans is the subject area in modeling and simulation that refers to forms of emulation of the decision-making process and motor activities. Representation can be broken down into three primary categories: those things that happen in our environment that drive us to make decisions, the actual decision-making process, and our physical actions after we make a decision. An important subset of this subject area is organizational modeling, the representation of the unique aspects of groups of humans acting as a single entity.

2. Brain Functions

Humans are considered to be the most complex living organisms on the earth, so it should follow that they are the most difficult to represent.

Sensory input is initially transmitted to our brain through all of our senses: touch, sight, hearing, smell, and taste. Each of the senses reacts to what is around it and inputs generated "raw" information, unique to it, to the cerebrum, the "cognitive" or thinking part of the brain. The cerebrum contains a historical memory of the bulk of all of our past sensory input, resulting decisions, and subsequent experiences.

3. Factors in the Decision Process

a. Memory

In order to generate decisions, the cerebrum compares current sensory input against all past memories. Environmental input is compared to remembered information and situational input is compared to past decisions that have been made. To this complex mix is added a cognitive decision-making process that determines what new decisions will be made, based on all past information that can be retrieved and all present input available.

b. The Environment

When we react to our environment, it is always done in the context of the environment as a whole, rather than as a response to a single aspect. For example, imagine you are sitting in a darkened room. You smell smoke, you see the glow of a flame, you feel heat, and you hear the crackling of a fire. Even though you have all this input it has to be taken in the context of a bigger picture. Depending on your past experiences and a much larger variety of environmental factors confronting you, you will choose to either jump out of the nearest window because the room you are in is burning down, or you will simply continue to smoke your cigarette. The environment we exist in is therefore an additive to the total of what must be considered for representation of the human decision-making process.

c. Moderating Influences

We never make decisions in a perfect world; there are always a wide variety of influences inside and outside our brains, and outside our bodies, that impact on our decision processes. We'll call these external and internal moderators.

External moderators refer to influences on our decision-making processes that originate outside our bodies. Extreme heat or extreme cold will slow down our cognitive processes and decrease our ability to make correct and timely judgments. Extreme noise or excessive vibration will distract us from what we are concentrating on. Requirements to make decisions under risk or uncertainty will change how we evaluate situations and generate decisions.

Internal moderators refer to those influences internal to our bodies that will change our decision-making process. Internal moderators can be in the form of extremes, such as extreme hunger or extreme fatigue. Individual intelligence, unique cognitive styles, or our current general attitude toward a moral or sociological situation can dramatically impact on our decision-making process.

It is the infinitely complex operation of the human cognitive process, coupled with an equally infinite set of variables that come about from internal and external moderators, that make humans one of, if not the hardest, aspects of representation.

d. Physical Movement

Once a decision is made it is passed out as a directive that will, at some point, require physical activity by a human. Since movement is finite, this represents a quantifiable aspect of representation. In addition, activity can be manifested both mathematically and through image generation. When movement is generated through mathematical solutions, or algorithms, it results in output data that depicts the result of the movement. When movement is also depicted in the form of a viewable image it is shown as a human entity performing tasks.

Over the past twenty years, the simulation community has made significant advances in depicting viewable physical movement. Advances in computing capability and processor speed have allowed humans to be shown on a viewing screen, in a form so lifelike as to appear almost as a photograph. However, it is important to remember that this high quality visualization is just that – a visualization. The underlying algorithms are what give a human representation its level of fidelity.

e. Organizations

Conventional wisdom has for some time stated that an organization is the compilation of the effect of the cumulative parts of the individuals in that organization. However, if, theoretically, you have a group of ten soldiers they will contain a certain sum of duties and responsibilities. If you designate ten identical soldiers as a “squad”, they will contain a definable amount more of duties and responsibilities. It is this synergism of capabilities that requires specific representation. [National Research Council, 1996]

Military structure is formed around the concept of organizations, but when we speak of them we are not just talking about the academics of this structure. Organizations refer to, for example, the relationships between similar or dissimilar, superior and subordinate, or organic and non-organic organizations. It also refers to command and control structures and support relationships. This multi-dimensional structure that allows military units to cooperate and perform efficiently in battle is considered an entirely unique aspect of human representation.

4. Representation Methods

a. Computer Generated Forces

The process of emulating humans is generally called “computer generated forces”, or “CGFs”. CGFs are able, to varying degrees, to portray the actions of a human. They may represent an individual, a combatant platform that is controlled by an individual, or a group or aggregated humans or platforms. Some CGFs are "dumb". That is, they have no automated maneuvers at all but are simply manipulated on a screen by a human operator. Other CGFs have varying degrees of automated behavior built into them.

There are several methods currently in use by which the human decision-making process is modeled, but most of them fall into two primary areas: "semi-automated forces", called "SAF" or with SOAR. SAF is generally considered to be the use of rule-based systems with finite supporting databases to emulate the decision-making process. SOAR (originally an acronym meaning "State, Operator and Result") uses an "intelligent agent" concept that responds to an associative mechanism for interacting with the functional environment that results in what is known as an "expert system". [Newell, 1987]

These CGFs either play both sides of a simulation in order to generate speedy and doctrinally consistent answers to analytical questions, or they will provide, to a degree, a "thinking" opponent to a human player in a training environment.

b. Semi-Automated Forces

SAFs are more commonly used in military M&S than is SOAR. SAFs are sometimes organic to specific simulations (i.e., the Close Combat Tactical Trainer simulator) or they are self-contained and can be applied to a variety of different simulations (i.e., the Joint Semi-Automated Forces simulation).

None of the fielded SAFs are fully autonomous and, at some point, they all require human intervention. Additionally, the following important behavioral functionality is lacking or missing:

- The ability to generate doctrinally appropriate organizational command/control or support relationships.
- The ability to support a realistic number of decision alternatives.
- The capability to learn and adapt to changing situations.

c. Modular Semi-Automated Forces (Mod SAF)

One of the most widely used SAFs in the Army is the Modular Semi-Automated Force simulation, or ModSAF. ModSAF is a software application used to construct computer generated forces applications. This application is the natural progression of the original SIMNET SAF developed in 1990. ModSAF is made up of a set of modules that an operator uses to create and control large numbers of separate entities that can be used for realistic training in the virtual battlefield. These entities are maneuvered in some part by computers, rather that solely by humans, giving them the name "semi-automated". Entity types basically cover the full range of combat systems and dynamic structures and can interact with each other and with systems controlled by humans. Currently there are several different versions of ModSAF being used to support the full range of Army M&S Domains. [http://www.aiai.ed.ac.uk/~arpi/SUO/MODULES/modsaf.html, Accessed Feb 2003].

d. OneSAF

One Semi-automated Forces (OneSAF) is currently under development by the Army. By 1995, the Army had numerous CGFs that covered a wide spectrum of capabilities. An Army assessment was conducted in late 1995 that concluded that no single current CGF could accomplish current requirements or were constructed to support future needs. Consequently work was begun to re-engineer ModSAF into a future SAF test bed called OneSAF Operational Test bed, or OTB. At the same time the requirements process was begun to eventually generate a completely new SAF called Objective OneSAF. OTB v1.0 was released in January 2001 and officially replaced ModSAF for Army use.

OTB is a High Level Architecture (HLA)-compliant evolution of ModSAF that is designed to be used by the Army M&S community now and be a test bed for Objective OneSAF.

Objective OneSAF's most significant characteristic will be its flexibility. It will be scalable in that it will permit easy use by a wide variety of types and sizes of units. It will be composable because a user will be able to assemble a custom simulation quickly from a pool of reusable components that fit easily together. It will be manageable because the simulation's system characteristics, databases, algorithms, etc., will be able to be modified "on the fly" without operators having to recompile code before the simulation can again be executed. Objective OneSAF will also be completely interoperable with C4I systems and other virtual and constructive simulations. [http://www-leav.army.mil/nsc/nextgen/onesaf/, accessed Feb 24, 2003].

e. Joint SAF

The Joint Semi-Automated force application (JSAF) is a SAF that operates at about the same levels and fidelity as OneSAF, but with unique characteristics for use in a Joint environment. Sponsored by Joint Forces Command Experimentation Directorate, JSAF is designed to be an HLA-compliant federation of several unique simulations that work together to represent the Joint battle space. While its execution is at entity-level like OneSAF, JSAF uses both SAF technology for ground operations and SOAR technology (see 1.B.5.2.6.1 above) for pilot behaviors. JSAF will be seen primarily when Army activities play in Joint exercises sponsored by Joint, Air Force, Marine, or Navy organizations. [http://www.mstp.quantico.usmc.mil/modssm2/InfoPapers/INFOPAPER%20JSAF.htm, Accessed February 24, 2003]

5. Summary

None of the currently in-use CGFs are fully autonomous. That is, at some point they all require "human-in-the-loop" interface. In addition their ability to generate doctrinally appropriate organizational command/control or support relationships, their depth of available decision alternatives, and their capability to learn and adapt to changing situations varies from lacking to non-existent. Future human and organizational representation must solve these issues before computer generated forces are able to present a comprehensive and flexible component to support military modeling and simulation.

Worksheet for Human Behavior Representation

Checklist Item	Checklist Response
What model or simulation (version) is being examined?	
What human and organization behaviors are required/needed in this simulation?	
Which of these human and organization behavior requirements/needs are actually represented in this simulation?	
Is the human and organizational behavior actually represented within the simulation, or is it represented outside the simulation based on a workaround?	
What is the source of the information or data for the representation?	
Are these representations validated and/or documented?	
What are the assumptions used in the representations?	
What are the limitations (e.g., accuracy, data, time constraints) of the representations?	

What aspects of human and organizational behavior are addressed within the simulation?	
- Psychological state?	
- Fatigue?	
- Training/readiness?	
- Combat proficiency?	
- C4ISR (including the impact of degraded C4ISR on other units)?	
At what level (e.g., individual, unit) are these human and organization behaviors represented?	
How are these human and organization behaviors represented?	

1.B.4c Environment Representation

1. Background

The environment is the exercise field on which models are played out, or simulated, over time. The environment can be the floor of a building, a human body, or an entire battlefield (several hundred square miles). For military operations, the environment will determine the actions and limitations of the systems and humans that are interacting within that environment.

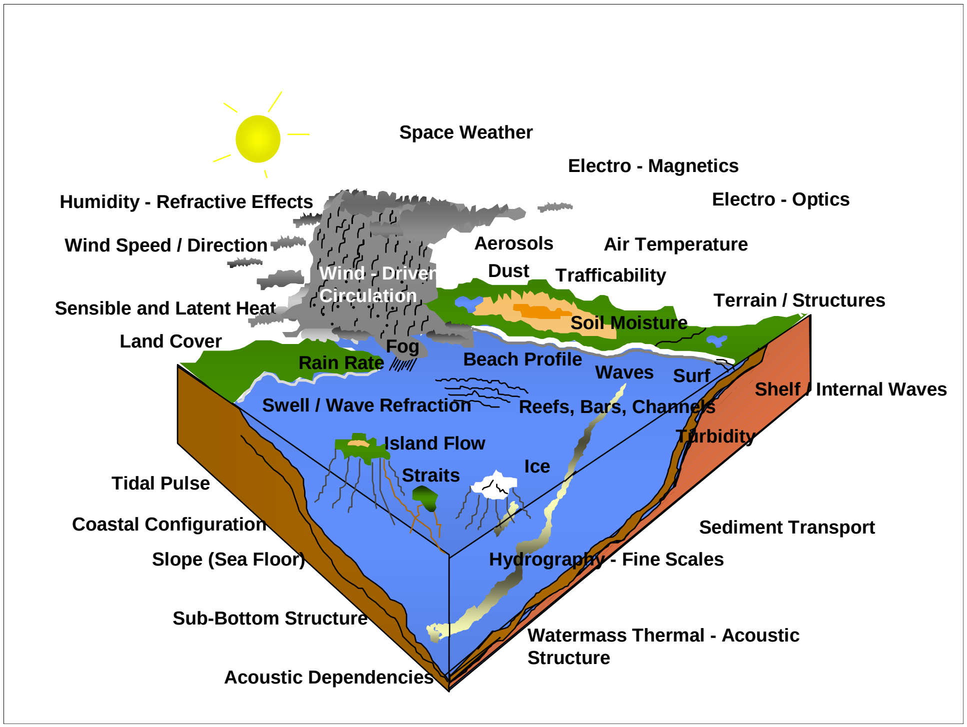
Realistic outcomes of a simulation are dependent on realistic representations of the environment that the simulation is to be portrayed in. That does not necessarily mean that all representations of the environment must be an exact emulation of reality. Rather, a usable environmental representation must accurately reflect the elements that are necessary for that particular simulation at the appropriate level of fidelity. These natural environment elements could include portions of terrain, ocean, or air and space. The appropriate environment is determined by the purpose of the simulation.

2. Environmental Data Generation

Terrain is normally represented as a series of data points (usually within three dimensions) that provide the user with a specific location on the earth (or other environment), usually with a three dimensional component accompanying it. The accuracy of the depicted position is determined by the type of location algorithm used and the degree of its mathematical accuracy.

There are several processes currently used by the Army to ascertain position. For example, a location might be defined by its latitude and longitude or by a unique coordinate system such as the Universal Transverse Mercator. When terrain is presented to a user in a simulation, it will normally be in the form of polygonal representation. Some legacy simulations use a hexagonal representation, while many current representations are through a graduated series of triangles. Weather data comes to a user either as a historical narrative, as specific databases that reflect historical information interpolated to forecast conditions, or as current climatologic information.

There is no all-encompassing database of information supporting the environment. Normally environmental information comes from a host of national-level support agencies, such as the National Imagery and Mapping Agency (NIMA), along with a wide variety of other available national-level and specialized environmental data. This information comes in many forms, from straight narratives, printed and digitized map products, and digitized weather forecasts, or specific digital data in a system-specific data format (such as digital terrain elevation data [DTED] or digital features analysis data [DFAD]). Some M&S, like some engineering models, may require only a flat plane playing field while others may require an extreme level of three-dimensional accuracy. It all depends on what the user of the M&S requires.



Simulation Environment

3. Technical Challenges

a. Data

Traditionally, representing the environment has been difficult, and results have often been ambiguous. While the majority of the earth's land surface has been mapped by satellite or has well documented survey mapping, much of this data has not been translated into knowledge that is appropriately formatted and usable to the modeling and simulation community. Consequently, terrain data that is unique to a specific requirement must often be generated anew at significant time and cost.

b. Terrain Representation

The original method of depicting terrain data in an electronic simulation was through a hexagonal representation system. This system required that unique attributes, such as rivers and roads, must run along the border between two hex cells. General terrain characteristics, such as jungle or rough desert rock, must be homogeneous inside of a hex. Even though the terrain within a hex (whose size can be quite large) might vary widely it could only have one specific type of terrain depicted, with an associated loss of realism. More recently the hex system has been replaced by a polygonal system that allows for a more accurate positioning of locations and accounting for attributes by generating polygons within polygons for extreme accuracy of unique terrain feature coordinates and attributes.

c. Dynamic Features

Representation of many aspects of the environment beyond terrain is difficult to accomplish because they are dynamic. That is, many of these components of the environment change their characteristics either periodically or at random. Dynamic aspects of the environment such as shorelines, built-up area size and shape, landscape, and road count and quality are constantly changing and require continuous maintenance to ensure accuracy. The attributes of foliage change by season or because of nature (e.g., forest fires). Some components of the environment, such as water, may change their attributes frequently and to many different compositions (e.g., ice, rain, ground moisture, clouds, etc). Other features can be introduced by human interaction (e.g., culverts, railroad berms, canals, etc).

d. Feature Complexity

Another aspect of the environment is the complexity of changing it. That is, the terrain and all that is below, on, or above it, can be arbitrarily changed through either an act of nature or by man. Bombs can alter a landscape, obscurants can change the weather complexion of a battlefield, or natural catastrophes can dramatically alter the terrain. All these additional external components must be addressed before an accurate representation of the environment can be accomplished. All the above, and much more, will continue to impact on the ability to consistently generate a quality representation of the environment.

4. Environment Management Structure

In 1996 the Under Secretary of Defense for Acquisition and Technology (USD(AT)), in accordance with the Modeling & Simulation Master Plan, placed additional emphasis on inter-Service M&S environmental representation coordination by designating a Modeling and Simulation Executive Agent (MSEA) for each of the three primary areas of the natural environment. [USDA&T Memo, 1996] Specifically, the MSEA responsibilities for the natural environment were delegated as follows:

a. **Terrain:** Originally the Defense Mapping Agency (DMA), now known as the National Imagery and Mapping Agency (NIMA).
b. **Oceans:** The Department of the Navy; specifically, The Oceanographer of the Navy.
c. **Air and Space:** Department of the Air Force Executive Agent for Air and Space Weather.

The MSEA designation provides these individual organizations with the responsibility to manage and oversee all aspects of DoD modeling and simulation related to the authoritative representation of their respective environments.

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Worksheet for Evaluating Environment Representation

What simulation (version) or model are you looking at?	
How does the model/simulation represent terrain?	
What specifically in the natural environment am I looking at?	
Is the simulation environment the same as that being played by the training audience?	
Is the environment built in the simulation or is it based on a work-around?	
- If work-around, source of work-around and what documentation is available?	
- What is the source of the simulated environment?	
Is the environment dynamic?	

Does the simulation incorporate real work environmental data?	
- If digital terrain elevation data (DTED) is used, to what level?	
Do environmental obstacles automatically affect movement?	
- Do environmental obstacles/effects limit detection ranges (i.e., line-of-sight, IR, acoustics etc.)?	
- What effect does the environment have on simulated communications, satellites, and ground-based sensor (e.g., radar) placement?	
- Is the environment depicted on a flat or curved earth? What is the effect?	
For networked simulations is more than one representation of the earth necessary to support the total network?	
Do the different simulations use the same terrain data base information/format?	
- Which one are you evaluating?	
Do environmental and man-made features shown on C4ISR displays exist in the simulation database?	
- Do they affect movement?	

Additional questions for specific environmental features	
For aviation and air defense assets: - How is altitude represented?	
- How are roads represented?	
- Can unit symbols or equipment icons automatically follow the road trace on a simulation map display?	
- Does the defined road width affect the maneuverability of larger formations? Of single entities?	
How are bodies of water represented?	
- Is water a barrier to movement for land vehicles, and an avenue of movement for boats or amphibious craft?	
How are bridges represented? Do the bridges depicted on tactical maps serve as automatic crossings over water barriers, or is operator input required?	
How is the effect of ambient temperature represented?	
How is the effort of surface trafficability represented?	

Aviation, air defense, UAVs, personnel effects	
- Does the simulation account for periods of daylight, twilight and dark, and their effects on visibility and detection ranges?	
- Are obscurants represented?	
- Smoke	
- Fog	
- Sand	
- How does the environment portray obstacles?	
- How is wind represented?	
- Do wind speed and direction vary during a simulation run?	
- What is the effect of NBC on simulations play?	
- Does wind effect clouds, fog, smoke, and obscurants?	

1.B.5 Interoperability Concepts

The Army's Modeling and Simulation Master Plan and Army Regulation 5-11 define interoperability as the ability of a set of Models and Simulations (M&S) to provide services to and accept services from other M&S and to use these exchanged services to enable them to operate effectively together. An example of interoperability is the Digital Battlestaff Sustainment Trainer (DBST). DBST is a federation of constructive simulations and virtual stimulators that provide a synthetic environment for training forces. For more information on DBST, see Chapter 3.

The role the FA 57 plays in ensuring interoperability is to assist the commander in bringing together the correct M&S, C4I systems and other decision support tools in a seamless architecture. This architecture must support the commander's objectives in each of the three M&S domains.

1. How Interoperability Applies to Models and Simulations

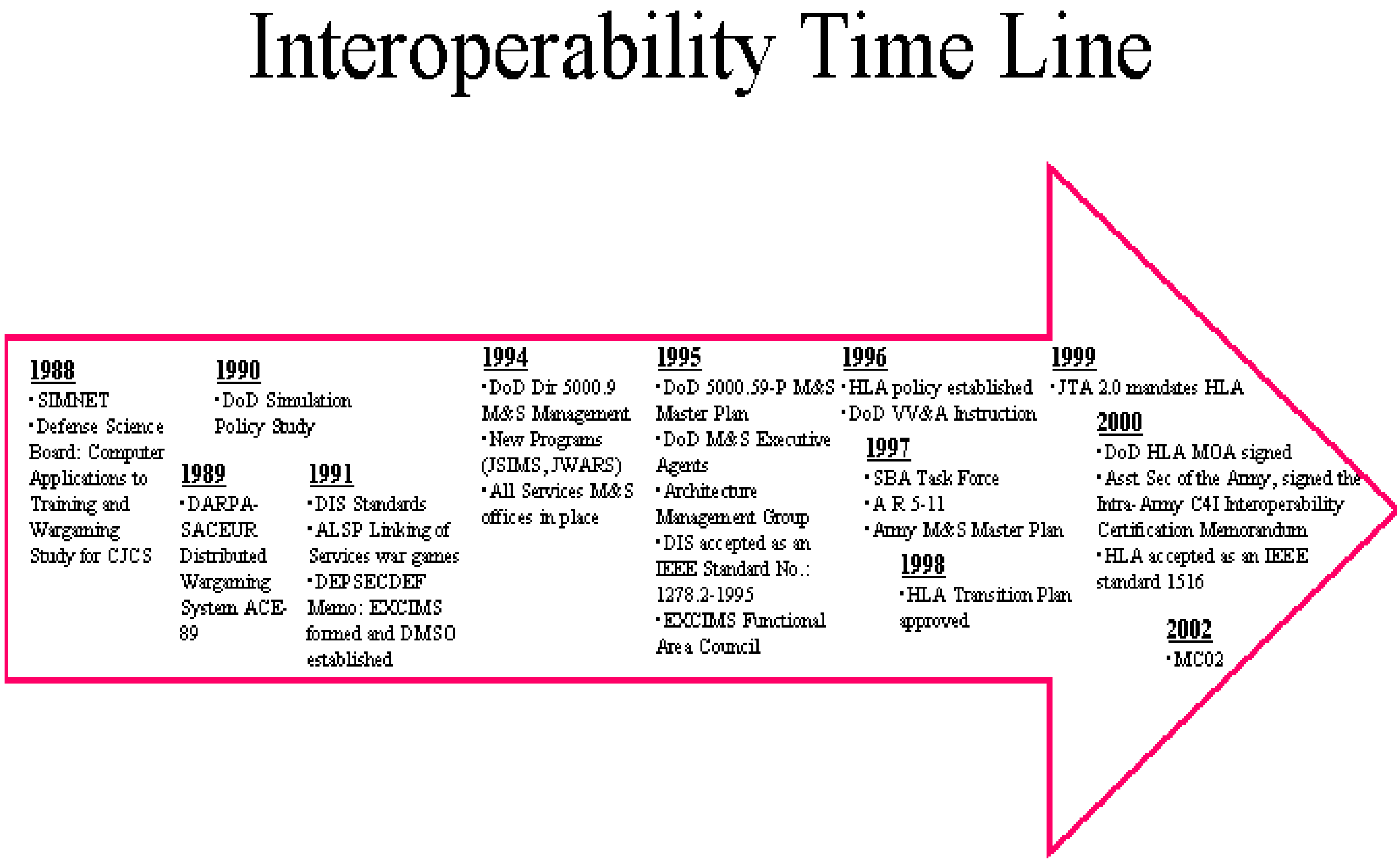
The Army Joint Technical Architecture calls for the DoD common technical framework for M&S to facilitate interoperability and reuse [JTA-A, 2002]. The framework has three components:

a. A common high-level architecture to which all simulations must conform.
b. Functional Description of the Mission Space (FDMS) (formally called Conceptual Model of the Mission Space) to provide a basis for the development of consistent and authoritative simulation representations.
c. Data standards to provide common representations of data across models, simulations, and C4I systems.

It is important to understand that interoperability goes beyond simply accepting and providing services as defined above. Interoperability addresses two attributes of models and simulations: their ability to exchange data, and their ability to use the data. In this context, data can be thought of as the inputs and outputs from the various models and simulations. Interoperability means these various models and simulations must be able to appropriately process the data, for example by converting formats, or by aggregating or disaggregating the data. An example of this is two simulations that use the same Digital Terrain Elevation Data (DTED) source files, but different algorithms for determining the location of an entity on the terrain. One will assign the entity to the closest elevation posting, and the other will take an average between the different posts. This can result in a difference of several meters in the reported location of the same entity in different simulations, and can have unfortunate consequences if linked to the live world.

2. History of Interoperability

The following interoperability time-line summarizes the major advancements in model and simulation interoperability over the last 15 years.



The History of Simulation Interoperability

In the late 1980s, the Army fielded Simulator Network (SIMNET) to support collective training requirements. In the early 1990s, DoD experimented and the Army cosponsored research and development of various technologies that would link simulations, and promote interoperability, to support service and joint training. In the early 1990s two important simulation interoperability protocols appeared. They were the Distributed Interactive Simulation (DIS) and the Aggregate Level Simulation Protocol (ALSP). For more discussion on DIS and ALSP, see Chapter 3.

In 1995, the Defense Modeling and Simulation Office (DMSO), working with teams from industry, government, and laboratories, began work on the High Level Architecture (HLA), a new technical architecture for interoperability to overcome the shortcomings of DIS and ALSP [Kuhl, 2000]. For more discussion on HLA, see Chapter 3.

3. The Advantages of Interoperability in Models and Simulations

Interoperability between simulations, and C4I systems, is growing in importance. Interoperability enables the Army [Army MSMP, 1997] to:

a. Integrate service and DoD M&S tools for the purpose of creating true Joint environments.
b. Reuse simulations by leveraging other Army and non-Army M&S activities for the purpose of creating the most efficient and effective M&S capabilities for the force.

4. How Interoperability is Used

Interoperability is a reality that must be considered by commanders at all levels as they prepare for the next war. Within the M&S community, it is understood that no single simulation supports all missions, and it is only through the ability of simulations to interoperate with other systems that M&S will effectively support the needs of each commander.

5. Important Considerations for the FA 57 Officer

Army M&S, C4I systems, and other tools are required to meet interoperability standards. The Joint Technical Architecture – Army (JTA-A) mandates the use of standards that foster interoperability for any system that transfers information electronically. [JTA-A, 2002] At the Joint level the Joint Technical Architecture (JTA) mandates the same capability. Both documents have a section on Modeling and Simulation that mandate the use of HLA for interoperability purposes.

Army Regulation 5-11, Management of Army Models and Simulations, dated 10 July 1997 addresses DoD interoperability requirements. Chapter 3 directs that models and simulations comply with JTA-A.

In December 2000, the Assistant Secretary of the Army signed the Intra-Army C4I Interoperability Certification Memorandum (Department of the Army Memorandum, 2000). This memorandum requires that all systems being (1) developed or updated, or (2) that have or may have interfaces to other systems, be certified as interoperable. DBST was one of the first Army simulations to undergo the certification testing in the Common Technical Support Facility (CTSF) at Ft. Hood, Texas [Black, 2002].

6. What Is the Utility of Interoperability?

Having simulations that interoperate with other systems helps to reduce cost, reduce risk and encourages reuse. If properly considered, interoperability reduces issues concerning data structures, or use of different algorithms, that surface during training/exercises. This shifts the community's focus away from the "models" and onto "training". Most importantly, interoperability supports the creation of synthetic battlespaces for evaluating advanced concepts, designing and testing new systems, and training forces to operate in the 21st century.

1.B.6 The Army Concept of Model and Simulation Domains

Army models and simulations are organized and managed by the domain in which they are primarily used. The Army has three domains: the Advanced Concepts and Requirements (ACR) Domain; the Research, Development, and Acquisition (RDA) Domain; and the Training, Exercises, and Military Operations (TEMO) Domain. The Table below, “Army M&S Domains,” provides a synopsis of key domain activities and the types of supporting models and simulations used.

Domain	Domain Activities	Supporting Models & Simulations
Advanced Concepts and Requirements (ACR)	Force Planning Developing Requirements Warfighting Experiments	Re-configurable Simulators Constructive Models
Research, Development, and Acquisition (RDA)	Basic/Applied Research Weapons System Development Test and Evaluation	System Prototypes Engineering and Physics Models Constructive Models Distributed M&S IMSE ACE
Training, Exercises, and Military Operations (TEMO)	Individual and Collective Training Joint and Combined Exercises Mission Rehearsal Operations Planning	System Simulators Training Simulations

Army M&S Domains

The ACR, RDA and TEMO domains are covered in section 1.B.6.

1.B.6a The Advanced Concepts and Requirements (ACR) Domain

1. ACR Domain Description

The ACR includes experiments with new concepts and advanced technologies to develop requirements in doctrine, training, leader development, organizations, materiel and soldiers that will better prepare the Army for future operations. ACR evaluates the impact of horizontal technology integration through simulation and experimentation using real soldiers in real units. [AR 5-11, 1997]

2. ACR Domain Focus

As stated in the 9 August 2001 Advanced Concepts and Requirements (ACR) Model & Simulation (M&S) Domain Management Plan, (http://www.amso.army.mil/structure/domains/acr/plan.htm, Accessed 6, Jan 2003) key areas of ACR domain focus are Strategic Direction, Concept Development, Requirements Determination, and Force Planning.

Strategic Direction is the process of developing and assessing Army plans, strategic concepts and major programs for achieving National Military Strategy and Defense Planning and Policy goals and objectives; and developing the Army's investment strategy for obtaining, allocating and optimizing use of resources to meet strategy. Strategic Direction concepts include: Force XXI, Objective Force and Future Combat Systems.

Concept Development is the process of developing strategic, warfighting, operational and functional concepts. These concepts describe how the full range of Army capabilities can be used on future battlefields and in future operations. Representative concepts include: Forward Presence, Dominant Maneuver, Precision Engagement, Division Operations, Information Operations, Battlefield Visualization, Space Support to Land Warfare, Full-Dimensional Protection, Focused Logistics and Velocity Management.

Requirements Determination is the process of identifying changes in strategic, battlefield and institutional military requirements. Representative requirements include: doctrine, training, leader development, organizations, materiel, soldiers, installations, strategic lift, force stationing, consumables, and services. Force (i.e., force level and force mix) and organization requirements (e.g., unit design) are included in the force planning process described in the next paragraph.

Force Planning is the process of determining capabilities, requirements and risks for force levels, force design, force structure and Army units. The products of force planning support strategic direction and requirements determination; ensure that forces are sized, balanced, and stationed to meet strategy; provide the basis for acquiring and distributing materiel and provide the basis for acquiring, training and distributing personnel in the Army.

3. ACR Domain Mission

Developing and preparing land forces for future military operations is a core competency of the institutional Army. It is a principal focus of ACR Domain M&S to provide insights and quantitative and qualitative data to support analyses for planning and evaluating these forces as they will be employed in military operations at all levels and combat intensities, currently and in the future across the spectrum of conflict and peacetime engagement. Other types of analyses supported by ACR Domain M&S include Analysis of Alternatives (AoA) studies; personnel, equipment and ammunition requirement determination; doctrine and concept development; force modernization alternative evaluation; manpower and resource management program design; potential threat estimation; and planning for mobilization and deployment and sustainment of improved mobile and flexible forces to meet those threats.

The ACR M&S Domain is the initial entry point for analysis of "futures" work. The Domain has the responsibility to provide analysis to justify Army requirements and assess the worth of concepts and alternative approaches to satisfy those requirements. This responsibility identifies a vision for the Domain and a role of "futures" work that will validate the follow-on requirements for the Research, Development, and Acquisition (RDA) and the Training, Exercise and Military Operations (TEMO) domains. *The "vision" for the ACR Domain is – "First to Model – Providing accurate and reliable models and simulations to enable definition and justification of Army concepts and requirements."* The combination of principles and enablers, outlined within the ACR management plan, underpins a management process to unsure that the ACR Domain provides reliable and credible analysis to define and defend "future" Army requirements.

As stated in the ACR M&S Domain Management Plan, Doctrine, Organization, Training, Leadership, Material, Personnel, Facilities (DOTLMPF) considerations are important in the development of concepts for the Army and play a major role in determining its future composition. The processes of developing strategic, warfighting, operational and functional concepts flow from ACR Domain-conducted DOTLMPF analyses.

4. ACR Domain Management

Primary Function	Office
Domain Manager	ODCS G-3 Director of Analysis and Chief Information Officer (DAMO-AC)
Domain Agent	TRADOC Assistant Deputy Chief of Staff for Developments (ADCSDEV)
Domain Advisory Group	Representatives from: HQDA (G-3), CAA, HQ TRADOC, TRAC, SMDC, MTMC-TEA, CASCOM, MANSCEN, and others by invitation

Responsibilities of domain managers and agents are described in the Army M&S Master Plan (AMSMP) and Army Regulation (AR) 5-11.

The ACR Domain Manager is responsible for:

a. Prioritizing Domain M&S requirements,
b. Preparing Domain investment strategy,
c. Integrating activities across the Domain,
d. Acting as advocate for the Domain. Justifying and defending resources needed,

e. Developing and maintaining Domain Management Plan and investment strategy, and
f. Justifying requirements to the Requirements Integration Working Group (RIWG).

The ACR Domain Agent is responsible for:

a. Coordinating requirements within the Domain, with other domains and services, and with joint commands and agencies.
b. Approving/disapproving Domain requirements recommended for validation.
c. Providing baseline assessments and recommending ACR priorities for sustainment, development and research.
d. Justifying requirements to the Requirements Integration Working Group (RIWG).
e. Assisting Domain Manager in development and maintenance of the management plan and investment strategy.

The Domain Advisory Group (DAG) is responsible for:

a. Ensuring technical synergy, compatibility, and quality of domain models and simulations.
b. Assisting the ACR Domain Manager/Agent in expressing user requirements with sufficient technical detail to allow estimation of costs.
c. Recommending technical improvements to Domain M&S.
d. Reviewing submitted requirements to the Domain.
e. Recommending approval/disapproval of requirements to the Domain Manager/Agent.

ACR Domain Users are responsible for:

a. Identifying requirements for modifications to existing M&S (or new M&S) to their "sponsor" and submitting to the Domain Agent representative.
b. Providing data to the ACR Domain Agent representative for the requirements database.
c. Assisting the Domain Agent representative in updating of the Domain Investment strategy.

5. ACR Domain Key Players

Several agencies support the Domain mission and provide analytical assistance to define and justify future Army requirements. Examples of organizations that support the Domain are:

a. Center for Army Analysis (CAA) - Assesses strategy, strategic concepts, broad military options, resource allocation alternatives, and analysis of army force level capabilities in context of joint and combined forces.
b. TRADOC Directorates of Combat Developments (DCD) - Develops future operational capabilities, identifies and explores issues and questions using DOTLMPF analysis, promotes promising ideas and discards doubtful ideas, primary consumer of “Screening Tools”, and User representative of materiel solutions.
c. Battle Laboratories - Support DOTLMPF requirements determination via experimentation and analysis, investigate and refine ideas providing insights and findings, and primary consumers of “Insight Tools”.

d. TRADOC Analysis Center (TRAC) - Validates and confirms ideas, defends defined options, conducts AoA studies, conducts studies investigating and refining ideas, and primary consumer of “Conclusion Tools” and secondary user of “Insight Tools”.

6. Major ACR-Related Forums

a. AMSEC - The Army M&S Executive Council.
b. RIWG - The Requirements Integration Working Group.
c. AORS - The U.S. Army Operations Research Symposium. - An annual event sponsored by a different Army organization within the ACR domain each year.
d. MORS - Military Operations Research Society – [http://www.mors.org]

1.B.6b The Research, Development, and Acquisition (RDA) Domain

1. RDA Domain Description

The RDA Domain includes the use of M&S for research and development, and acquisition of materiel solutions.

2. RDA Domain Focus

The principal focus of the RDA Domain is supporting research, development, and acquisition through the efficient and effective use of Modeling and Simulation (M&S) resources. Collaboration and re-usability will enable the RDA Domain to capitalize on Domain M&S capabilities and expertise, and significantly accelerate the Army Transformation.

3. RDA Domain Mission

The RDA Domain management includes oversight of M&S supporting all system acquisition programs, Science and Technology Objectives (STOs), Advanced Concept Technology Demonstrations (ACTDs), and Advanced Technology Demonstrations (ATDs).

The Domain Manager will coordinate M&S activities, and develop and maintain supporting plans for the domain to include the Domain Management Plan and Domain Investment Plans.

4. RDA Domain Management

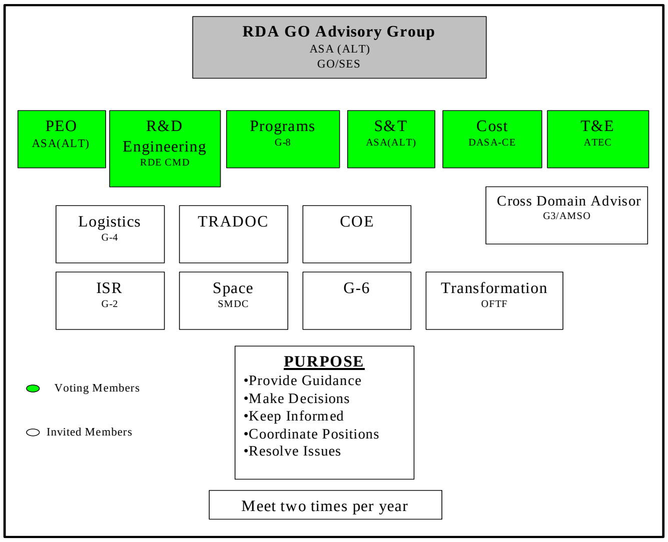
The RDA Domain Manager is the Deputy for Systems Management, Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology, ASA(ALT), SAAL-ZS.

The RDA Domain is a diverse M&S community that requires a different approach to M&S management. There are three levels of management for the RDA Domain depicted in the RDA Domain Management Group Figure below.

The RDA General Officer Advisory Group (RDA GOAG) (a two star body) is the highest level of management that reports to the AMSEC and consists of six voting members organizations and eight additional invited organizations. Additional organizations are invited as needed. The voting members of the RDA GOAG are the Deputy Assistant Secretary for Research and Technology to the ASA(ALT); Director, Force Development, Deputy Chief of Staff G-8; Commanding General, U.S. Army Test and Evaluation Command (ATEC); Commanding General, Research Development and Engineering Command; Deputy Assistant Secretary of the Army, Cost and Economics; and Deputy for Systems Management to the ASA(ALT), who represents all of the Program Executive Officers and chairs the RDA GOAG.

The invited organizations are critical to RDA Domain business processes and are represented directly as members of the AMSEC. The invited organizations include Assistance Deputy Chief of Staff, Army G-4; Deputy Chief of Staff for Simulation and Analysis (DCSSA), HQ TRADOC; Corps of Engineers; Objective Force Task Force (OFTF); Space and Missile Defense Command (SMDC); Office of the Chief Information Officer, Army G-6; and the Army Model and Simulation Office, Army G-3.

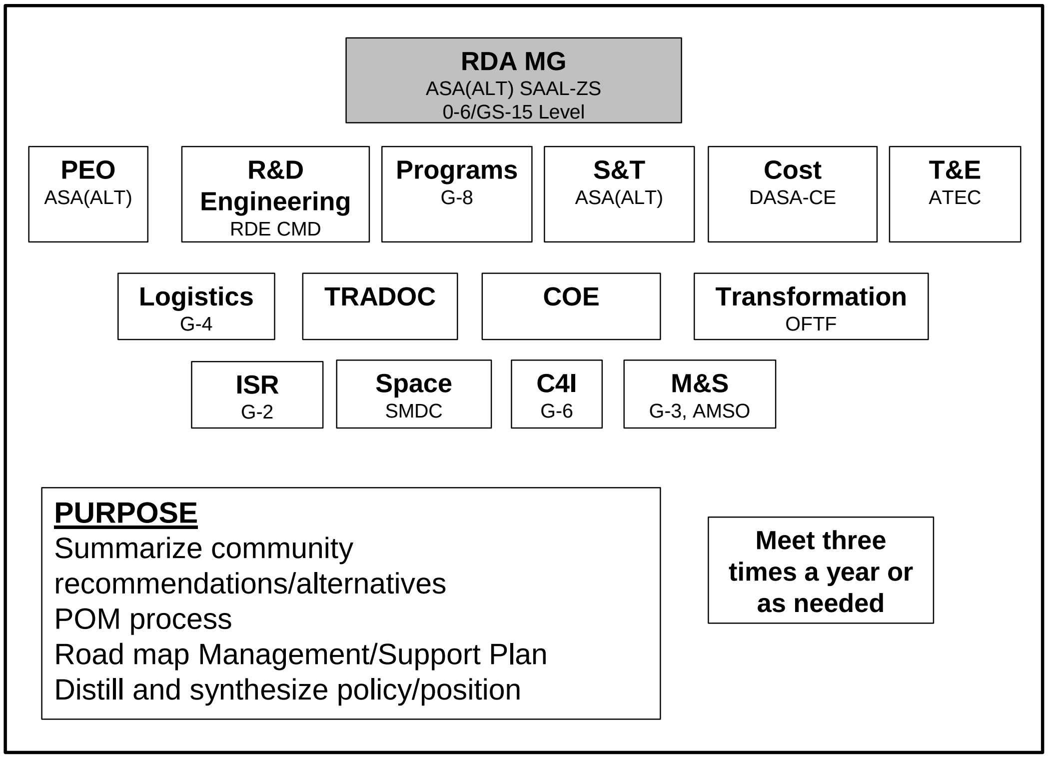
The purpose of the GOAG is to provide guidance, make decisions, keep the domain informed, coordinate, resolve issues, and champion RDA needs. The GOAG signs a Memorandum of Agreement establishing their support, roles, and responsibilities as participants of the domain. This group meets twice a year or as needed. The GOAG is supported by a RDA Domain Management Group (RDA MG).



RDA General Officer Advisory Group (RDA GOAG)

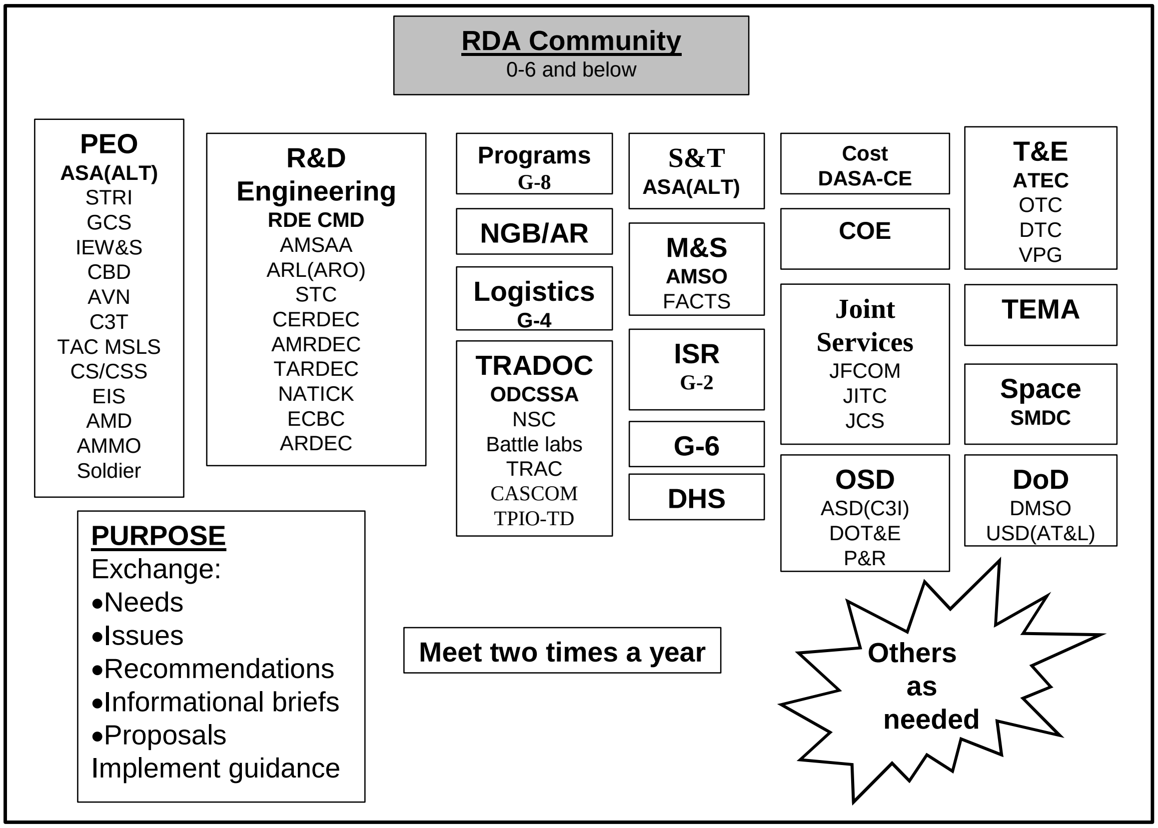
The domain management is conducted at the O6/GS-15 level and organizationally mirrors the General Officer Advisory Group. Representatives in the management group are depicted below. The RDA MG is chaired by the Domain Manager's assigned O-6 level Action Officer, who represents and coordinates with the PEOs before RDA MG meetings.

The purpose for the RDA MG is to summarize and coordinate community recommendations, develop the domain management and investment plans, distill and synthesize policies and positions, and identify RDA M&S requirements through the RIWG process. This group meets three times a year or as needed.



RDA Management Group (RDA MG)

RDA CG is comprised of managers, technical experts, subject matter experts, cross-domain organizations, joint organizations, OSD and others identified by members of the RDA MG. This group has a critical role in influencing RDA Domain management decisions. The RDA CG is identified in the figure below. The community group exchanges issues, provides information, identifies needs, makes recommendations, and implements RDA M&S guidance. The community meets twice a year or as needed at an RDA CG Workshop hosted by the chair of the RDA Domain Management Group. Communication throughout the year utilizes email, Army Knowledge Online (AKO), VTCs, and other on-line forums.



RDA Community Group (RDA CG)

5. RDA Domain Key Players

RDA Domain GOAG Chairs:

a. ASAALT SAAL-ZS
b. RDE Command
c. Army G8
d. ASAALT SAAL-ZT
e. ATEC
f. DASA-CE

6. Major RDA-Related Forums

a. SMART Conferences
b. RDA Domain Community Group meeting
c. Simulation Interoperability Workshop (SIW)
d. Military Operations Research Society (MORS)

1.B.6c The Training, Exercises, and Military Operations (TEMO) Domain

1. TEMO Domain Description

The TEMO Domain's training and exercises include most forms of training at echelons from individual trainee through collective, combined arms, joint, and/or combined exercises. Military operations include mission rehearsals and evaluations of all phases of military operations. [AR 5-11, 1997]

2. TEMO Domain Focus

The principal focus of the TEMO domain is providing M&S capabilities that support the maintenance of a trained and ready force. TEMO supports core processes providing the institutional Army's core capabilities of Develop the Force, Generate and Project the Force, and Sustain the Force. Domain activities include individual, crew, and collective training events and M&S support to military operations at the tactical and operational levels using a variety of networked and stand-alone live, virtual, and constructive M&S capabilities.

3. TEMO Domain Mission

The mission of the TEMO domain is to provide enhanced training support to the Combatant Commanders. The TEMO domain M&S vision is to build a synthetic training environment, integrate it with today's live training, and use automated training management tools to provide trainers a flexible, mission essential task list (METL) driven menu of structured exercises. The Army is aggressively moving from its current disparate family of models and simulations to a hierarchical model and simulation architecture that leverages and keeps pace with advances in modern information technology and "Military Affairs" evolution. The Army is accomplishing this while simultaneously maintaining relevancy, vibrancy and robustness in the current family of models and simulations. TEMO's tasks are:

a. Coordinate and manage domain activities.
b. Develop and maintain the domain management plan, investment plan, and other supporting plans as necessary.
c. Identify, develop, and integrate M&S training requirements that meet interoperability and commonality standards.
d. Maintain a M&S database of integrated and prioritized training requirements that supports TEMO mission strategies.
e. Manage assigned TEMO M&S resources to ensure funding for the requirements absolutely necessary to meet the Army's most critical needs.
f. Serve as the TRADOC proponent for the live, virtual, and constructive training environments.
g. Communicate with Army organizations and agencies as necessary.
h. Coordinate cross-domain issues with the RDA and ACR Domains through the Army M&S management structure.

Primary Function	Office
Domain Manager	Headquarters, Department of the Army, Deputy Chief of Staff G-3, Director of Training (DAMO-TR)
Executive Manager	DAMO-TRS (DA Pentagon)
Domain Agent	TRADOC Deputy Chief of Staff for Operations and Training, Ft. Monroe
Executive Agent	National Simulation Center (NSC) (TRADOC Fort Leavenworth)

TEMO Domain Management

Responsibilities of domain managers and agents are described in the Army M&S Master Plan (AMSMP) and Army Regulation (AR) 5-11.
The TEMO Domain Manager is responsible for:

a. Prioritizing Domain M&S requirements.
b. Preparing Domain investment strategy.
c. Integrating activities across the Domain.
d. Acting as advocate for the Domain and justifying and defending resources needed.
e. Developing and maintaining Domain Management Plan and investment strategy.

The TEMO Domain Agent is responsible for:

a. Coordinating requirements within the Domain, with other domains and services, and with joint commands and agencies.
b. Approving/disapproving Domain requirements for validation.
c. Providing baseline assessment and recommends RDA priorities for sustainment, development and research.
d. Justifying requirements to the Requirements Integration Working Group (RIWG).
e. Assisting Domain Manager in development and maintenance of the management plan and investment strategy.

Primary Function	Office (Examples)
Combat Developer - Command or agency that formulates doctrine, concepts, organization, materiel requirements, and objectives.	NSC (National Simulation Center) (TRADOC)
Materiel Developer - The RDA command, agency, or office assigned responsibility for the system under development or being acquired.	PEO STRI (Program Executive Office Simulation, Training, and Instrumentation)
Requirements Developer	TRADOC Deputy Chief of Staff for Simulation and Analysis (DCSSA)
Training Developer - Command or agency that formulates, develops, and documents or produces training concepts, strategies, requirements (materiel and other), and programs assigned for mission areas and functions.	ATSC (Army Training Support Command)

TEMO Domain Key Players

Major TEMO Domain-Related Forums

a. AMSEC.
b. TLGOSC (Training and Leader General Officer Steering Committee)
c. RIWG
d. LVCTEPR (Live, Virtual, Constructive Training Environment Periodic Review) Council of Colonels.
e. SIW (Simulation Interoperability Workshop).
f. SMART Conference (Simulations and Modeling for Acquisition, Requirements, and Training).
g. I/ITSEC (Interservice/Industry Training, Simulation and Education Conference).

TEMO Domain Key Publications

a. AR 350-38: Training Device Policies And Management.
b. AR 350-41: Training In Units.
c. AR 350-50: Combat Training Center Program.
d. Training with Simulations (CGSC Course).
e. TEMO Domain Management Plan, 15 Mar 00.

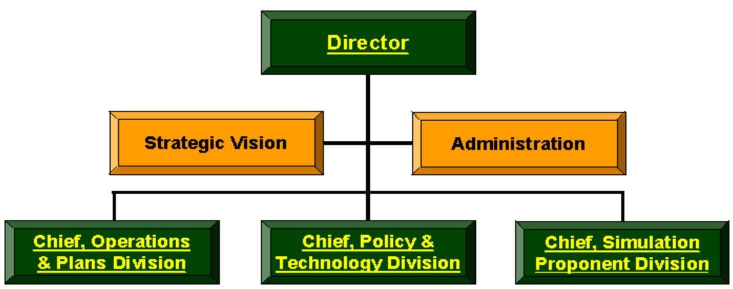
1.C Model and Simulation Organizations

1.C.1 U.S. Army Modeling and Simulation Organizations

1.C.1a Army Model and Simulation Management Office (AMSO)

1. Organization

G-3 Organization Missions, Functions and Responsibilities



Organizational Structure

2. Mission

The Army Model and Simulation Office (DAMO-ZS) provides the Army enterprise level vision, strategy, oversight, integration (horizontal & vertical), training & management of modeling and simulation activities across all M&S domains and environments. It is also responsible for simulation operations proponency life-cycle management. The Office also:

a. Assists senior leaders in properly resourcing Army M&S programs
b. Ensures the integration of M&S across Army M&S domains to foster reuse and development of common M&S components and tools
c. Optimizes delivery of non-core competencies
d. Secures resources; people, dollars, infrastructure, installations and time
e. Implements SMART

f. Establishes and executes Simulation Operations (FA 57 and CP36) Proponency
g. Institutionalizes M&S business practices
h. Fosters reuse and development of common M&S components and tools
i. Acts as focal point for Army M&S matters with the Joint Staff, Combatant Commanders, DARPA, DMSO, other services, DoD agencies, and OSD Staff elements
j. Promotes the Army M&S Research Program
k. Leverages M&S technologies into key Army business processes

3. History

In June 1994, the Chief of Staff of the Army identified a need for strategic-level focus and synchronization of Army model and simulation efforts. The DCSOPS was assigned responsibility for strategic planning of Army M&S. The ADCSOPS-designated executive agent for these tasks was a proposed Army Simulation Strategic Planning Office (SSPO) that did not yet exist. An ad hoc group was formed in DAMO-TR the following year to draft a charter for the SSPO. The charter was approved on 30 Jun 1995, and signed by the Deputy Under Secretary of the Army (DUSA[OR]); the Assistant Secretary of the Army for Research, Development, and Acquisition, (ASA[RDA]); and the Vice Chief of Staff of the Army. The SSPO Charter stated that the General Officer single POC for models and simulations would be the Director of Training and Simulations (DOTS).

The Chief of Staff then directed a review of the issues of strategic-level focus and synchronization of M&S efforts to ensure that the Army was properly organized to leverage the contributions of the SSPO.

The review resulted in an update to the SSPO charter, making the ADCSOPS the HQDA General Officer single POC for coordination of major M&S actions by all external agencies, MACOMs, and the Army Staff. This update took effect on 18 Sep 1995.

Recognizing that M&S made significant contributions outside the Training realm, the SSPO (under DAMO-TR) was merged with the DUSA(OR) Model Improvement Studies Management Agency (MISMA), and renamed the Army Model and Simulation Office (AMSO). AMSO's initial purpose was to reduce M&S redundancies and resources. It was also recognized that AMSO must remain independent of each of the three domains of mission activity across which M&S are applied, so it was placed at the Directorate level, reporting directly to the DCSOPS. An Abbreviated Concept Plan for the AMSO was approved by the DAS on 7 May 1996. October of 1997 saw AMSO specifically designated to serve all Army proponents for corporate management of models and simulations.

In November 2000, AMSO assumed a new mission for management of the Simulation and Modeling for Acquisition, Requirements, and Training program (SMART). In January 2001, the CSA provided guidance to AMSO to develop and execute a Functional Area 57 program. The DCS G3 added to that tasking provision of comparable civilian training under Civilian Program 36. [http://www.hqda.army.mil/amso/history/amso-ltr.pdf, Accessed Jan 27, 2003 and http://www.amso.army.mil/amso/history/concept_plan.htm, Accessed May 2, 2003]

1.C.1b National Simulation Center (NSC)

The Beehive at NSC

1. **Vision**
   a. The vision for the National Simulation Center (NSC) is to develop/field constructive, Command and Control (C2) training simulations for all maneuver, maneuver support, and maneuver sustainment echelons, and a family of virtual simulators for the maneuver battalion and below, with the intent of bringing these simulations together enabling an integrated live, virtual, and constructive training environment, which will support distributed mission training of full spectrum operations with joint, interagency, intergovernmental, and multinational (JIIM) forces within the common operational environment (COE).
   b. To act as Training and Doctrine Command's (TRADOC) executive agent for automated training simulations within the Army and to monitor the development of combat support (CS) and combat service support (CSS) C2 simulations.

2. **Mission**

Provide simulations and simulators to support training exercises and military operations applications, enabling Army operations across the full spectrum of conflict. [NSC, 2002] The NSC also:

   a. Acts as Army proponent for training simulations.
   b. Supports major training exercises worldwide.
   c. Combat/Training Developer and integrator of live environments (ATSC), virtual simulators and simulations, and constructive simulations.
   d. Serve as TRADOC Program Integration Officer (TPIO) for the Live, Virtual, Constructive Training Environment.
   e. Director, TEMO Simulation Laboratory.
   f. TRADOC Project Office (TPO) for C4I Simulation Systems.
   g. TRADOC Project Office (TPO) for Constructive Training Environment.

h. TRADOC Program Integration Office (TPIO) for Virtual Training Environment.
i. TRADOC Project Office (TPO) for WARSIM.

3. **History**

In 1975, the CG, TRADOC directed the Cdr, Combined Arms Center (CAC) at Ft. Leavenworth, to assume proponency for training simulations developed within TRADOC.

In February 1990, CAC's responsibility for simulations was formalized when the NSC was created. The NSC has two primary responsibilities:

a. Develop and field a family of C2 training simulations for all maneuver echelons.
b. Serve as TRADOC's executive agent for automated training simulations; monitor the development of combat support and combat service support C2 simulations.

In 1993, NSC was reorganized under CAC with five missions:

a. Support BCTP, exercise support, battle laboratory for simulation development.
b. Function as the Executive Agent for the Army's family of simulations.
c. Function as the TRADOC functional proponent and live manager for DIS.
d. Develop future virtual and constructive simulations.
e. Provide C2 exercise support to the Army.

4. **Modeling and Simulation Capabilities**

The Table below summarizes NSC modeling and simulations capabilities.

Type of Simulation/Simulator	**Yes**	**No**
Virtual	X	
Constructive	X	
Live		X

NSC M&S Capabilities

As TSM CATT and TPO Virtual, the NSC was the combat developer for the development and fielding of the Close Combat Tactical Trainer (CCTT), a networked system of manned simulators (primarily combat/maneuver weapons systems), and is developing the Aviation Combined Arms Tactical Trainer – Aviation (AVCATT-A) Re-configurable Manned Simulator, which will provide realistic, high intensity, combat training in a virtual environment.

5. **Modeling and Simulation Focus**

M&S Domain	**Yes**	**No**
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)		X
Research, Development, and Acquisition (RDA)		X

NSC M&S Focus

While the NSC has no focus on ACR and RDA issues, several NSC supported simulations and simulators can be used to support analysis and research (e.g., CCTT).

6. Major Programs

The NSC provides M&S support for the following activities: [NSC Home Page]

a. Battle Command Training Program (BCTP) (Primary mission)
b. Exercise Ulchi Focus Lens
c. Exercise Yama Sakura
d. Exercise Roving Sands
e. Reception, Staging, Onward Movement, and Integration (RSOI)
f. Mission Readiness Exercises
g. Joint exercises
h. Testing of new simulations, ABCS systems
i. Various Army Warfighting Experiments (AWE)
j. Joint experiments (e.g., Millennium Challenge 2002)

The NSC uses the following simulations to support its mission:

a. Digital Battlestaff Sustainment Trainer (DBST) (Federation of Simulations)
b. Brigade/Battalion Battle Simulation (BBS)
c. Corps Battle Simulation (CBS)
d. Combat Service Support Training Simulation System (CSSTSS)
e. Janus
f. Spectrum
g. Tactical Simulation (TACSIM)
h. Close Combat Tactical Trainer (CCTT)
i. Army Constructive Training Federation (ACTF)

7. Next Higher Level of Command

Commander, Combined Arms Center

1.C.1c Battle Simulation Centers (BSCs)

The Army has eleven BSCs, eight in CONUS and three OCONUS. Each BSC has the trained staff, facilities, computers, equipment, and network infrastructure to support both at-home and distributed computer-driven exercises. Each center can access simulations suitable for supporting small unit through theater level training. Available simulation capabilities may include, but are not limited by, Janus, Brigade/Battalion Simulation (BBS), the Corps Battle Simulation (CBS) and their associated databases tailored to the host unit's mission and area of operation. Support services include exercise design and planning, control scheme support, professional Opposition Forces (OPFOR) and After Action Reviews (AAR). The OPFOR provide a rational and knowledgeable opposition force for two-sided training events. In addition to these organic capabilities, each center has the potential to operate as a hub or remote site for distributed Army or joint exercises, or Joint and Service concept explorations such as Task Force XXI and Millennium Challenge. [P. G. Castells, personal communication, December 18, 2002]

1. Mission

The mission of the BSCs is to support training of active component (AC) and reserve component (RC) units to sustain readiness and meet worldwide contingency mission requirements using innovative and cost-effective automated battle simulations. [P. G. Castells, personal communication, December 18, 2002]

2. Modeling and Simulation Capabilities

Type of Simulation/Simulator	**Yes**	**No**
Virtual		X
Constructive	X	
Live		X

BSC M&S Capabilities

The BSCs primarily use constructive simulations to meet their hosts' M&S requirements. However, all BSCs have the potential to interoperate with virtual simulators, live exercises and other constructive simulations.

3. Modeling and Simulation Focus

M&S Domain	Yes	No
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)		X
Research, Development, and Acquisition (RDA)		X

BSC M&S Focus

While the BSCs' assets and capabilities are primarily focused on the M&S needs of their host organizations, they do on occasion provide technical support for outside analytical and experimentation efforts such as Task Force XXI and Millennium Challenge. [P. G. Castells, personal communication, December 18, 2002]

4. Major Programs

Each BSC has, as a core function, the requisite capabilities to operate BBS, CBS, and Janus and to develop and maintain scenario specific databases for the host's mission and area of operation. Specific information on BBS, CBS, and Janus is available in section 3.D.

1.C.1d Army Battle Laboratories (BL)

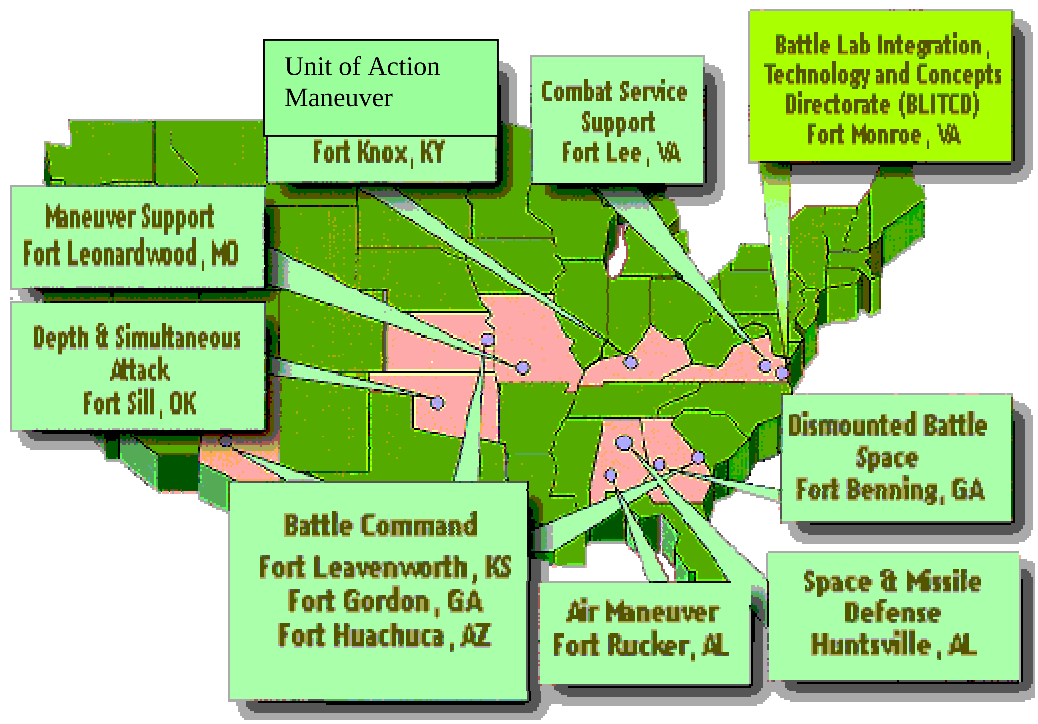
1. History

General Franks, Commander, TRADOC, postulated the battle laboratories concept to Chief of Staff General Gordon Sullivan in late 1991, and promulgated it in the spring of 1992. The battle laboratories began their work in 1992. [Canedy, 1994]

During 1997, the mission of the battle labs evolved with the implementation of TRADOC Regulation 71–9. This regulation defines the roles and missions of the battle labs and directors of combat developments (DCDs) at the TRADOC centers and schools.

In 1997, three new battle labs were established and one was closed. The Early Entry Lethality and Survivability (EELS) Battle Laboratory was disestablished and its functions transferred to the Combat Service Support Battle Laboratory and Dismounted Battlespace Battle Laboratory.

Army Battle Laboratories Locations



2. Mission

Support a specified proponent in accomplishing all futures Objective Force concepts and requirements determination through the use of live, constructive and virtual modeling and simulation.

3. Responsibilities

The responsibilities of the Battle Laboratories are:

a. Execute Joint Capabilities Development System (JCDS) to underpin requirements development and apply the operational environment to the RGS process, with DCSINT oversight.
b. Develop and refine subordinate and supporting concepts and determine required operational capabilities that support the concept. Conduct experimentation, studies and analysis to refine concepts and define requirements.
c. Interact with science and technology community to assess technology potential and prioritize Research and Development activities, feed insights to concept developers, and conduct technology assessments.
d. Develop requirements across all Doctrine, Organization, Training, Materiel, Leader development, Personnel, and Facilities (DOTMLPF) domains, based upon approved priorities. Develop doctrine requirements, road map, and selected doctrine within their specified proponency. In support of Deputy Chief of Staff for Developments (DCSDEV) and Combined Arms Center (CAC), develop and integrate organizational designs within their specified proponency. Develop training strategies and product road maps within their specified proponency. Develop operational architecture and contribute to the development of systems architectures within their specified proponency as directed by the DCSDEV Architecture Integration Management Directorate. Develop materiel requirements documents.
e. Integrate Legacy and Interim capabilities with the Objective Force developmental (DOTMLPF) work within their specified proponency. Transition approved requirements to branch proponent Director of Combat Developments (DCDs), who will be responsible for the cross DOTMLPF developments. Provide oversight and ensure integration between other related branch proponent-based work. Ensure trace ability for all developmental products back to warfighting concepts and The Army vision. [Abbreviated Concept Plan – TRADOC Battle Laboratories, 2002] Refer to Appendix C for more details on Battle Labs.

1.C.1e U.S. Army PEO STRI (Program Executive Office Simulation, Training, and Instrumentation)

1. Vision

The Program Executive Officer's vision for PEO STRI is "Putting the power of simulation into the hands of our Warfighters." [PEO STRI, 2002, p.4]

2. Mission

The missions for PEO STRI are:

- Provide training and test simulation, simulators, target and instrumentation products & services.
- Create a common Synthetic environment to test notional concepts and support R&D designs.
- Leverage live, virtual and constructive to develop a system of systems that train the way we fight.
- Provide materiel life cycle support from concept development through disposal.

3. History

Located in Orlando, PEO STRI is the Army's lead materiel developer for M&S systems. In 1976, the Army established the Program Manager Training Devices (PM TRADE). In 1992, the Department of the Army created the Simulation, Training, and Instrumentation Command (STRICOM) by combining PM TRADE with PM Instrumentation, Targets and Threat Simulators (PM ITTS), and the newly created PMs for Combined Arms Tactical Trainer (PM CATT) and Warfighter Simulation (PM WARSIM). In October 2002, STRICOM was realigned under the Assistant Secretary of the Army (ASA) for Acquisition, Logistics and Technology as PEO STRI. [PEO STRI, 2002, p.5]

4. Modeling and Simulation Capabilities

Type of Simulation/Simulator	Yes	No
Virtual	X	
Constructive	X	
Live	X	

PEO STRI M&S Capabilities

PEO STRI supports the following virtual simulators: Abrams Full Crew Interactive Simulation Trainers; Advanced Gunnery Training System; Conduct of Fire Trainers; Platoon Gunnery Trainers; Tank Driver Trainers; Thru Sight Video; Precision Gunnery Training System for Dragon and TOW; Simulation Networking; and the Close Combat Tactical Trainer (CCTT). [PEO STRI, 2002, p.21]

PEO STRI support for constructive simulations includes operational support to the Battle Simulation Centers, hardware maintenance, Post Production Software Support (PPSS), terrain databases/network technicians, WARSIM, One SAF, Janus, the Brigade/Battalion Simulation (BBS), the Corps Battle Simulation (CBS), and Communications and Intelligence systems. [PEO STRI, 2002, p.20]

PEO STRI provides support for live training and exercises including: the Army's Combat Training Centers (CTC); the Area Weapons Scoring Systems (AWSS); and worldwide Tactical Engagement Simulation (TES) equipment used to support all home station Army force-on-force training. [PEO STRI, 2002, p.20-21]

5. Modeling and Simulation Focus

M&S Domain	Yes	No
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

PEO STRI M&S Focus

PEO STRI uses M&S for TEMO development, acquisition, fielding, and life cycle support of combined arms training systems and Training Aids, Devices, Simulators, and Simulations (TADDS) to support individual, institutional, and collective training.

PEO STRI supports ACR with two board-select Product Manager offices for Ground and Air and Command product lines and two Assistant Project Managers for focused management of the CCTT and support to U.S. Special Operations Command (USSOCOM). [PEO STRI, 2002, p.7]

PEO STRI uses M&S to support the RDA development/evaluation of new Army concepts, to include Future Combat System and transformation to the Objective Force. [PEO STRI, 2002, p.7]

6. Major Programs

The following are PEO-STRI major programs:

a. PM CATT (Project Manager Combined Arms Tactical Trainer) - "CATT" refers to a group of high-fidelity, interactive, manned simulators; command, control, and communications work-stations; exercise control stations; After Action Review systems and the Virtual Combined Arms synthetic environment to support virtual training up to battalion/task force level. [http://www.stricom.army.mil/STRICOM/PM-CATT/homeflash.jsp]

b. PM ITTS (Project Manager Instrumentation Targets and Threat Simulators) - Manages the research, development, design, acquisition, fielding, modification, and capability accounting of major instrumentation, targets, and threat simulators required for developmental and operational test and evaluation (T&E) and training. [http://www.stricom.army.mil/STRICOM/PM- PM ITTS]
c. PM TRADE (Project Manager Training Devices) - Manages development, acquisition, fielding and life cycle support of live training solutions for the Army and other services. PM TRADE also provides products that support digitized training in the live environment. [http://www.stricom.army.mil/STRICOM/PM-TRADE/homeflash.jsp]
d. PM WARSIM (Project Manager Warfighters' Simulation) In partnership with the National Simulation Center (NSC), develops and sustains constructive simulations supporting command and staff training requirements from Company/Battalion through Echelons above Corps, through Joint Task Force levels across the full spectrum operations (through mid/high intensity non-nuclear conflict). [http://www.stricom.army.mil/STRICOM/PM-WARSIM/text.jsp]

7. Next Higher Level of Command

ASA (ASAALT) for Acquisition, Logistics and Technology.

1.C.2 DoD and Joint Modeling and Simulation Organizations

1.C.2a Defense Modeling and Simulation Office (DMSO)

1. Vision

The vision for defense modeling and simulation is to provide readily available, operationally valid environments for use by DoD components:

- To train jointly, develop doctrine and tactics, formulate operational plans, and assess warfighting situations.
- To support technology assessment, system upgrade, prototype and full scale development, and force structuring.

Furthermore, common use of these environments will promote a closer interaction between the operations and acquisition communities in carrying out their respective responsibilities. To allow maximum utility and flexibility, these modeling and simulation environments will be constructed from affordable, reusable components interoperating through an open systems architecture.

2. Mission

The Defense Modeling and Simulation Office provides available and operationally valid environments for use by Department of Defense (DOD) components. To train jointly, formulate operational plans, assess warfighting situations and develop doctrine and tactics. Supporting technology assessment, systems upgrade, both prototype and full scale development and force structuring completes the mission.

3. Modeling and Simulation Focus

The Defense Modeling and Simulation Office is striving to create a close interaction between the operations and acquisition communities in carrying out their respective responsibilities. The office promotes modeling and simulation environments constructed from affordable, reusable components, interoperating through an open systems architecture, to allow maximum utility and flexibility.

4. Technology Thrusts

a. "C4I to Sim" Interoperability - The objective of the Command, Control, Communications, Computers and Intelligence-Simulation Interoperability program is to address deficiencies in the area of reuse, efficiency, architecture standards, and data standards between C41 systems and simulations. The program focuses on improving the exchange of data between command and control (C2) systems and simulations**.**

b. Dynamic Environment - Establish processes and procedures to generate integrated databases containing time-series physical environmental information, computer-aided design files for static and dynamic systems and human and organizational performance information. [Retrieved Jan 29, 2003 via the World Wide Web at: https://www.dmso.mil/public/thrust/de].

c. Human Performance Working Group - DMSO acts as coordinator, organizer and catalyst for human behavior representation. The objectives of this program are to establish partnerships with DoD components to lead collaboration, communication, and information exchange and to leverage a Human Behavior Modeling and Development Environment to promote reuse and interoperability.
d. Knowledge Integration and Data - The Department of Defense Modeling and Simulation Master Plan states in Objective 1 that the Department of Defense should establish standards to support common representations of data across models, simulations and warfighter C4I systems. DMSO has been designated at the Functional Data Administrator for Modeling and Simulation. The key elements are: Authoritative Data Sources; Common Semantics and Syntax; Data Interchange Formats; Data Quality Practices; and Data Standardization.
e. Runtime Infrastructure (RTI) - The RTI software provides a set of services conducted by simulation federates to coordinate their operations and data exchange during a routine execution. The HLA Interface Specification defines access to these services. DMSO does not distribute RTI software. Additional information can be obtained by consulting the following URL: https://sdc.dmso.il/announcement.php
f. Synthetic Environment Data Representation and Interchange Specification (SEDRIS) - The objectives of SEDRIS are the following: to articulate and capture the complete set of data elements and associated relationships needed to fully represent the physical environment; support the full range of simulation applications; provide a standard interchange mechanism to pre-distribute environmental data (from primary source providers and existing resource repositories) and promote data base reuse and interoperability among heterogeneous simulations; provide a set of data elements and associated relationships needed to fully represent the physical environment.

5. DoD Modeling and Simulation Resources

a. The Modeling and Simulation Information Analysis Center (MSIAC) - Is the support activity for the DoD for developers and users of modeling and simulation. It serves to access, acquire, collect, analyze, synthesize and disseminate scientific, technical and operational support information utilizing state-of-the-art tools.
b. Modeling and Simulation Resource Repository (MSRR) - Comprised of seven nodes, the MSRR provides retrieval of modeling and simulation resources. Information providers include DMSO, Army, Navy, Air Force, Missile Defense Agency, DIA, C4ISR Decision Support Center Information System and the OSD MSRR maintained by the MSIAC.
c. M&S University - The M&S University provides modeling and simulation professionals with the latest educational products relating to Department of Defense policies, practices and programs. The course content includes DoD initiatives, non-DoD Government, academia and foreign government issues. The classes are deployable through the use of platform based, as well as web-based and CD-ROM formats, with continuing education credits available to all students.

1.C.2b United States Joint Forces Command (USJFCOM)

1. **Vision**

"Joint Forces Command, with an eye on the future, will allow us to rapidly integrate new ideas and concepts into our forces, into our doctrine and our strategy, and our tactics, and it will help keep the edge we need to quickly adapt to the uncertainties that lie ahead." [Myers, 2002]

2. **Mission**

"The 2001/2002 Unified Command Plan gave USJFCOM a "laser focus" to become the incubator for new transformational concepts to build the military of the 21st century. As a result of the 2002 Unified Command Plan, the USJFCOM missions are": [What is Transformation, Feb 2002]

   a. Joint Force Provider
   b. Joint Force Integrator
   c. Joint Force Trainer
   d. Joint Concept Development and Experimentation

3. **History**

In 1947, the Department of Defense (DoD) created Atlantic Command, as a unified command with responsibility for the Atlantic Ocean Geographical region. In 1993, Atlantic Command became the U.S. based force trainer, integrator and provider, assuming combatant command of the Army's Forces Command (FORSCOM), the Air Force's Air Combat Command (ACC), the Marine Corps Forces Command Atlantic (MARFORLANT) and the Navy's Atlantic Fleet (CINCLANTFLT). In 1999, Atlantic Command's name was changed to United States Joint Forces Command (USJFCOM) to emphasize the command's leading role in transformation of U.S. military forces. [History] In October 2002, the command's focus shifted from geographic responsibilities to transforming U.S. military forces, with the new Northern and European commands picking up its geographic responsibilities. [DoD, 2003]

4. **Modeling and Simulation Capabilities**

Type of Simulation/Simulator	**Yes**	**No**
Virtual	X	
Constructive	X	
Live	X	

USJFCOM M&S Capabilities

USJFCOM uses, or supports the use of, all three types of simulation in on-station and distributed configurations across a wide range of training applications in dozens of exercises each year. For example:

   a. The Joint National Training Capability Exercise combines an NTC Brigade Rotation (live) at Ft. Irwin, an Air Warrior (live/virtual) from Nellis AFB and a USMC CAX (constructive) at 29 Palms with a Surface Launched Air Missile

Exercise (SLAMEX) (live/virtual) from San Diego. [JWFC, 2003]

b. Millennium Challenge 2002 (MC02) also used all three types of simulations. MC02 simulated a high-end, small-scale contingency using a live simulation from locations, such as the NTC, with virtual and constructive simulations from around the country.

5. **Modeling and Simulation Focus**

M&S Domain	**Yes**	**No**
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)		X

USJFCOM M&S Focus

USJFCOM uses M&S to support its joint force trainer and experimentation missions. The use of M&S to support military training is not designed to replace actual experience; rather, it is employed as a more cost-effective means to conduct higher-level exercises more frequently. [JWFC Home Page] Experimentation provides a venue to explore new concepts as well as examine new doctrine, tactics, techniques and procedures for existing and emerging systems.

6. **Major Programs**

USJFCOM manages both programs and simulations of interest to personnel in the FA 57 career field.

a. Programs include:
   1. Joint Center for Lessons Learned (JCLL) - JCLL collects, processes, analyzes, distributes, and archives lessons learned, issues, and key observations from operations, training events, and other sources to enhance the combat effectiveness and interoperability of joint forces.
   2. Joint Integrated Database Preparation System (JIDPS) - JIDPS accesses and retrieves data from various authoritative data sources (ADS), and uses that data to produce simulation-ready force, target, and terrain files in support of training and exercise, analysis, planning, and mission rehearsal.

b. Simulations Include:
   1. Joint Theater Level Simulation (JTLS) - JTLS is an interactive, computer-assisted simulation that models multi-sided air, ground, and naval combat, with logistical, special operation force (SOF), and intelligence support. It was designed as a tool for use in the development and analysis of joint and combined (coalition) operation plans, but is frequently used as a training support model.
   2. Joint Conflict And Tactical Simulation (JCATS) - JCATS is the only self-contained, inherently joint simulation, in use for entity-level training in open, urban, and subterranean environments. JCATS is an interactive, high-resolution, entity-level, conflict simulation that models joint-multi-sided air, ground, sea combat on high/low resolution digitized polygonal terrain.

7. **Next Higher Level of Command**

Secretary of Defense (SECDEF).

1.C.2c United States Special Operations Command (USSOCOM)

1. Vision

USSOCOM's vision for the use of M&S is to support better decisions, enhance warfighting skills, and develop superior systems to maintain the world's most powerful Special Operations Forces (SOF).

2. Mission

"Provide special operations forces to the President, Secretary of Defense, regional Combatant Commanders, and American Ambassadors and their country teams for successful conduct of worldwide special operations, civil affairs, and psychological operations during both peace and war." [USSOCOM, 1997]

3. History

USSOCOM was established, by congressional mandate on April 16, 1987, and assigned many service-like responsibilities, including training, ensuring combat readiness, monitoring personnel promotions and assignments, and developing and acquiring SOF-peculiar equipment. "USSOCOM was also given responsibility for managing a separate Major Force Program (MFP), MFP_11, which ensures the SOF program has visibility at the Department of Defense and congressional levels." [Special Operations Command] The Commander USSOCOM is the only unified commander with responsibility for planning, programming, and budgeting of military forces including the development and acquisition of special operations-peculiar equipment, materials, supplies, and services. "In short, he is the only CINC with a checkbook." [Special Operations Command, 1987]

4. Modeling and Simulation Capabilities

Type of Simulation/Simulator	Yes	No
Virtual	X	
Constructive	X	
Live	X	

USSOCOM M&S Capabilities

USSOCOM, assisted by the US Army Special Operations Command (USSASOC), uses various constructive simulations (e.g., CBS, BBS, and Janus) to train Special Forces soldiers. Other areas of interest include using 3D multi-sensory environments (e.g., virtual, interactive training rooms) to train medics in surgical techniques and to improve parachutists' navigation skills over extended ranges, under near real-mission conditions.

5. Modeling and Simulation Focus

M&S Domain	**Yes**	**No**
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

USSOCOM M&S Focus

USSOCOM characterizes its M&S activities in terms of three functional areas: analysis, training, and acquisition. Evolutionary development of a Synthetic Battlespace with representations of physical and operational environments, standardized models and data, and scenarios linked through communications networks is central to USSOCOM's vision. In addition to training, M&S are used to support SOF operations, including planning and mission rehearsal, as well as Program Objective Memorandum (POM) and acquisition related activities (e.g., special operations Forces Analysis and Modeling System/Special Operations Forces Allocation System).

USSOCOM is also focused on future technologies to support**:**

a. Interactive Training Rooms with polymer or piezoelectric walls that allow 3D panoramic photos to be projected to add realism to a scenario.
b. Simulation Interconnection technology that allows mission planning, rehearsal and execution control management using computer generated forces that provide representation of human (soldier) behaviors.
c. Artificial intelligence technologies that allow for increased and improved decision making, command and control and information flow.
d. Simulation interface technologies that allow for quick exchanges between the human and synthetic environments. [USSOCOM, 2001]

6. Major Programs

The USSOCOM major programs include:

a. Automated Mission Planning System (Analysis, Mission Planning) - Mathematical model with preloaded planning factors.
b. SOF Flight Simulators (Training, Mission Rehearsal) - Six degrees of freedom systems for the MH-47 and MH-60 helicopters (Army).
c. Combat Mission Simulators (Training, Mission Rehearsal) - Six degrees of freedom systems for the AC/MC-130 aircraft, and MH-53 helicopter (Air Force).
d. Advanced SEAL Delivery System (ASDS) Simulator (Analysis, Training, Mission Planning & Rehearsal) - Mobile virtual system for the ASDS.
e. PRISM - Virtual man-in-the-loop system that provides video-driven, interaction with warfighters (a close-combat/quick-reaction small arms training system).
f. Special Warfare Automated Mission Planning System (SWAMPS) - A Windows-driven, tactical level collection of mathematical models and detailed operational data that support analysis, training, mission planning and rehearsal.

g. Live Simulation - Mock-ups and live fire drills.
h. Special Operations Forces Analysis and Modeling System / Special Operations Forces Allocation System (SOFAMS/SOFAS) - Supports assessments associated with POM build and Quadrennial Defense Reviews using heuristic models, operated in the Windows environment.

7. Next Higher Level of Command

Secretary of Defense (SECDEF)

1.C.3 Other Service Modeling and Simulation Organizations

Each service has assigned an organization to serve as its single point of contact for modeling and simulation. As previously noted in section 1.C.1a, the Army Modeling and Simulation Office (AMSO) performs that function for the Army. The Navy Modeling and Simulation Management Office (NAVMSMO), the Marine Corps Modeling and Simulation Management Office (MCMSMO), and the Air Force Agency for Modeling and Simulation (AFAMS) perform similar functions for their respective services. Each is discussed, in turn, in the following three sections.

1.C.3a Navy Modeling and Simulation Management Office (NAVMSMO)

NAVMSMO is the single point of contact for Navy modeling and simulation. For an exhaustive list of current Navy models, simulations, simulators, data sources, development tools, and utilities see section 3.B.2.

1. Vision

"In the 21st century, the United States Navy will use Modeling and Simulation to make better analytical decisions, improve Warfighting skills, and develop superior systems to maintain the world's most powerful maritime forces for the joint force commander. Analysts will construct force structures; warfighters will train and prepare for war; and system designers and engineers will develop new systems and platforms, all through the use of modeling and simulation in a synthetic battlespace credibly replicating the real world." [DoN, 1997]

2. Mission

The role of the Navy Modeling & Simulation Management Office (NAVMSMO) is to provide centralized management of Navy M&S, coordinate M&S efforts across functional areas, and develop policies and procedures necessary for M&S standardization within the Navy. The specific responsibilities of NAVMSMO are delineated in SECNAVINST 5200.38A and OPNAVINST 5200.34.

3. History

Established in 1995, NAVMSMO serves as the Navy single point of contact on all Navy modeling and simulation matters, and for coordination with the other Services, DoD, Joint Staff, and other agencies' M&S organizations. [NAVMSMO Home Page, Accessed Jun 2003]

4. Modeling and Simulation Capabilities

Type of Simulation/Simulator	Yes	No
Virtual	X	
Constructive	X	
Live	X	

Department of Navy M&S Capabilities

The Navy maintains over 1300 M&S related resources. For a complete list of available models, simulations and data sources refer to http://navmsmo.hq.navy.mil for links to *Navy M&S Resources.*

5. Modeling and Simulation Focus

M&S Domain	Yes	No
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

Department of Navy M&S Focus

The Navy uses and relies on M&S for: (a) analysis and assessment, (b) training, (c) acquisition, and (d) support to operations and experimentation. These activities encompass a wide range of functional disciplines including research and development, test and evaluation, education and training, operations, logistics, acquisition, assessment, doctrine development, and experimentation. [OPNAV INSTRUCTION 5200.34]

6. Major Programs

The Navy has (a) 933 models, simulations, and simulators in its current M&S inventory, (b) 233 sources of data to support Navy M&S activities; and (c) 5 tools and utilities for M&S development. To access information on available M&S resources, refer to http://navmsmo.hq.navy.mil for links to *Navy M&S Resources.*

7. Next Higher Level of Command

Deputy Chief of Naval Operations (DCNO N6/N7).

1.C.3b Marine Corps Modeling and Simulation Management Office (MCMSMO)

MCMSMO is the Marine Corps point of contact for Modeling and Simulation (M&S) training technologies. As part of the Technology Division, Marine Corps Training and Education Command, they match opportunities for simulation-based training improvements with the funds and the gear. See section 5 (Major Programs) for a list of computer based training devices.

1. Vision

Develop a coherent plan of attack for systems, finances, people, and support that addresses the Marine Corps' most pressing training needs. The goal is to make training support a single battle so that there is no priority or preference for solutions except for the increased value in the training event supported.

2. Mission

The mission of the Technology Division is to develop, coordinate, resource, execute, support, and evaluate training and education technology for the United States Marine Corps. Their focus is on ground-based systems; aviation-specific training and education technology is handled by Navy Air System Command (NAVAIR). [Training Division: Mission]

3. Modeling and Simulation Capabilities

Type of Simulation/Simulator	**Yes**	**No**
Virtual	X	
Constructive	X	
Live	X	

MCMSMO M&S Capabilities

The types of solutions that Marine Corps Training and Education Command has sponsored include computer-based training devices, distance learning, range instrumentation, ammunition substitutes like paintball, and adaptations of commercial video games, and wargame simulations. See section 5 (Major Programs) for a specific list of live, virtual, and construction training aids.

4. Modeling and Simulation Focus

M&S Domain	Yes	No
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

MCMSMO M&S Focus

Technology Division, and MCMSMO focus on concept development through fielding and employment of computer based training devices of all kind.

The Marine Corps Combat Development Command (MCCDC), Studies and Analysis Division, serves as the cognizant agency for the Marine Corps on all matters pertaining to studies and operations analysis.

5. Major Programs

Training Division: Simulation Section

The Technology Division is the resource sponsor for the following live simulations (i.e. training devices):

a. MILES-2000 - Multiple Integrated Laser Engagement System.
b. NITE Facility.
c. PLI - Position Location Information System.
d. RIS - Range Instrumentation System.
e. SESAM - Special Effects Small Arms Munitions.

The Technology Division is the resource sponsor for the following virtual simulations:

a. CACCTUS - Combined Arms C2 Training Upgrade System.
b. CLASS - Closed Loop Artillery Simulation System.
c. CVTS - Combat Vehicle Training Systems.
d. DVTE - Deployable Virtual Training Environment.
e. ITK - Infantry Tool Kit (i.e. a subset of DVTE).
f. MTD - Minor Training Devices.
g. TDMS - Tactical Decision-Making Simulation.
h. The Technology Division is the resource sponsor for MTWS - MAAGTF Tactical Warfare Simulation.

The Technology Division is the resource sponsor for the following schoolhouse or software-only trainers:

a. PC Game-Based Simulations.
b. SCIP - Simulation Center Infrastructure Program.

6. Next Higher Level of Command

Marine Corps Training and Education Command.

1.C.3c Air Force Agency for Modeling and Simulation (AFAMS)

Located in Orlando, Florida, AFAMS is the Air Force's M&S implementation organization.

1. Vision

To lead the translation of Air Force vision, policy and direction into effective Modeling and Simulation (M&S) capabilities integrated to create a seamless, realistic environment that provides on-demand access in sufficient fidelity to allow Warfighters the opportunity to explore and determine ways to dominate and control the full range of military operations.

2. Mission

To lead, advocate and focus upon the realization of the integrated seamless, realistic environment by implementing Air Force, Joint, and DoD M&S policy and standards; supporting corporate Air Force M&S planning, requirements, and investment; supporting establishment, transition, and integration of major Air Force M&S initiatives and programs; and supporting Air Force decision making and mission execution.

3. History

AFAMS was activated in Orlando Florida, under Headquarter United States Air Force, Air and Space Operations Directorate (AF/XO), as a Field Operating Agency (FOA) in June 1996. In December 1999, the Theater Battle Arena (TBA) became the AFAMS Pentagon Operating Location. AFAMS achieved full strength in calendar year 2000 with 66 government, civilian, and contractor personnel in Orlando, and 16 personnel at the TBA. In April 2002, AFAMS was realigned under Headquarter United States Air Force, Deputy Chief of Staff/Warfighting Integration (AF/XI) when the DCS for Warfighting Integration was established.

4. Modeling and Simulation Capabilities

Type of Simulation/Simulator	Yes	No
Virtual	X	
Constructive	X	
Live	X	

AFAMS M&S Capabilities

AFAMS, in its role as the lead, advocate, and focus for Air Force M&S, has insight into virtual and live simulations and is the oversight agency for Air Force constructive simulations.

AFAMS works closely with the Theater Aerospace Command and Control Simulation Facility, which serves as the USAF's premier virtual simulation facility, Center of Excellence for Distributed Mission Operations (DMO), and center of gravity for major simulation testing and training.

As the oversight agency for Air Force constructive simulations, AFAMS annually supports numerous Service and Joint exercises and experiments (e.g., Prairie Warrior, Roving Sands, Ulchi Focus Lens, Yama Sakura and JEFX) and is the model manager for the Air Warfare Simulation, (AWSIM), which is the Air Force premier constructive simulation.

AFAMS supports Blue Flag Live Fire Exercises conducted by the Command and Control Training and Innovation Group (C2TIG). Blue Flag and other live exercises are conducted to provide component, joint, and combined air operations center training emphasizing real-world plans, procedures and C4I equipment.

5. Modeling and Simulation Focus

M&S Domain	Yes	No
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

AFAMS M&S Focus

Air Force modeling and simulation provides unrestricted opportunities to explore and achieve Full Spectrum Dominance.

6. Major Programs

a. Distributed Mission Operations (DMO) - DMO is an Air Force readiness initiative to achieve a seamless environment for training individual, team, and inter-team skills: http://www.afams.af.mil/programs/projects/dmo.htm.
b. Air Force Modeling and Simulation Resource Repository (AFMSRR) - AFMSRR, part of a DoD wide system, provides a single source for information about and access to AF/Services/Joint/DoD M&S resources in order to facilitate reuse and avoid duplication: http://afmsrr.afams.af.mil
c. AF M&S Professional Development (AFMSPD) - AFMSPD's goal is to increase M&S expertise. To that end, AFAMS is developing an Air Force web-based M&S Advanced Distributed Learning (ADL) Model Program which is expected to be fully functional and available to the field in FY03: http://www.afams.af.mil
d. USAF Distributed Mission Training (AFDMT) - AFDMT is an Air Force readiness initiative for an aircrew training, team training and mission rehearsal system to achieve and maintain individual, team, and composite force skills for its combat and combat support forces: http://www.afams.af.mil
e. Joint Synthetic Battlespace - Air Force (JSB-AF) - JSB-AF is an Air Force initiative for establishing a permanent architecture for simulation centers and users to use for training, experimentation, analysis, exercise, and wargame events: http://www.afams.af.mil
f. Other key programs - Information on other AFAMS programs is available through the AFAMS web site at http://www.afams.af.mil.

7. Next Higher Level of Command

AF/XI.

Chapter 2: Create M&S

2.A Develop Simulation Requirements

2.A.1 Assessing Simulation Requirements

Every organization in the US Army is involved either directly or indirectly with modeling and simulation (M&S). [AMSMP, 1997] As such, the Army's management process, among other activities, prioritizes and integrates M&S requirements and investments. [AR 5-11, 1997] The Army has established the process outlined in the Directorate of Requirements (DAMO-RQ) External Standing Operating Procedures (SOP) for the HQDA Requirements Validation and Approval Process to identify, validate, prioritize, and approve requirements. [DAMO-RQ, 2002]

This SOP directs TRADOC to function as the Army's primary developer of warfighting requirements, including modeling and simulation (M&S) requirements. [DAMO-RQ, 2002] TRADOC Regulation 5-11 defines M&S requirements as "defining the nature of the desired modifications or development of a new tool or capability or significant enhancement to an existing tool or capability used in computer based simulation of military operations, or processes which contribute to military operations." [TRADOC, 1998] Only approved, integrated, and prioritized M&S requirements may be resourced for future development. [AR 5-11, 1997]

Validation and approval begins with an assessment of user M&S requirements. [AMSMP, 1997] The term *Users* is taken to mean 'end-users' of a simulation (e.g., user organizations) or personnel who operate simulations. The remainder of this section examines the Army's process for assessing user M&S requirements.

1. History

In 1992, an Air Force study found that deficiencies in the requirements assessment process accounted for almost half of the problems noted with new simulation releases. [Sim Ops Course, Lesson 2-1, 2003] Historically, end-users have not had the expertise in requirements development or the experience with M&S to formulate complete, adequately structured, and clearly stated M&S requirements. [Might, 1999] As a result, documented requirements for new or improved systems have frequently been incomplete, ambiguous, or poorly written. The following is a list of problems that have complicated M&S requirements development:

a. Many end-users do not understand how models and simulations work.
b. End-users usually know what their needs are, but don't know how to articulate them – their vocabulary is different from that of M&S system developers.
c. Developers mistakenly assume that end-users know how to satisfy their needs and, therefore, accept end-users' solutions to their needs rather than study the requirements and develop proper solutions. [Might, 1999]
d. The lack of prioritization in most historical requirements processes has led to a lack of linkage between the requirements defined and the operational tasks the end-users are performing.

In essence, many past disconnects between fielded M&S capabilities and end-user needs occurred because a complete and thorough requirements assessment had not been conducted.

2. Why Assessments Are Used

Assessments provide the foundation for a solid requirements development process. A well-designed and conducted assessment aids system-users in articulating their requirements and in avoiding historical pitfalls. During the initial stages of the process, end-users identify their organizational requirements and then examine how a model or simulation can accomplish some purpose (e.g., train the staff of an armor-heavy brigade). Their requirements are further amplified and constrained to develop a practical set of Functional Requirements that define what the M&S system must do. Ultimately, developers provide M&S Representation Requirements to define what and how processes and entities and their attributes must be represented in order to meet the Functional Requirements. [Might, 1999] This structure ensures that all detailed requirements are clearly traceable to system-user requirements as well as allowing the developer to systematically control the development process. [Might, 1999]

3. How Assessments Are Used

As in most analytical endeavors, a requirements assessment begins with a problem statement that defines the task(s) to be supported by the M&S system (e.g., training processes or acquisition processes). In this regard, end-users must be selected who can identify the tasks that need to be supported using a model or simulation. Depending on the type of simulation being developed, end-users may be military operators (warfighters) who are the leaders and managers of organizations that use M&S systems, or they may be domain experts (e.g., trainers or analysts), or they may be both. [Might, 1999] Whatever their involvement, end-users define the problem and should be the driving force throughout the development of the system. [Sim Ops Course, Lesson 2-1,2003]

Next, the assessment should describe the problem. This description includes history and data about the problem, the environment (e.g., the turret of a tank or an urban scenario), and boundaries and limits of the system to be developed. [Sim Ops Course, Lesson 2-1, 2003]

Once the problem has been defined and adequately described, the systematic capture of requirements begins. As stated previously, end-users should be the driving force throughout the development. However, subject matter experts (e.g., political scientists, psychologists, cartographers, the intelligence community) may be asked to provide their perspectives. [Sim Ops Course, Lesson 2-1, 2003] In addition, even at this early stage in the assessment, M&S technical experts may be called upon to translate operational requirements into M&S requirements. [AMSMP, 1997] In some situations, an Integrated Concept Team (ICT) may be formed to allow M&S representatives with multiple perspectives to develop or (more likely) to review requirements as they surface from end-users. [TRADOC, 1998] Regardless of who participates in the assessment process, the need for a detailed and systematic approach is paramount. One such process follows; the procedures in this process can be applied equally well to any domain. [Sim Ops Course, Lesson 2-1, 2003]

The Training, Exercises, and Military Operations (TEMO) domain process is as follows:

a. This process begins with an examination of mission requirements. Mission requirements dictate training needs, which in turn lead to training requirements after comparing existing skills and knowledge to those required.
b. End-users then determine the training objectives needed to support key elements contained within the training needs.
c. Alternatives are then established to attain the training objectives, i.e., what is the most cost effective means: virtual simulations, constructive simulations, or live simulations, for end-users to achieve the training needs. Requirements have to define the infrastructure which end-users are capable of supporting and who can answer questions such as whether or not the training system has to accompany the unit into the battlefield.
d. End-users determine the desired outcome of the simulation experience and whether virtual or constructive simulations are needed, while system-users and developers also determine hardware component requirements.
e. System-users and developers validate requirements via audits, interviews and surveys using detailed and structured questionnaires and interviews with warfighters and SMEs either in “focused group discussions” or individually.
f. Requirements are modified based on support available (e.g., equipment, facilities, people, technology, logistics, and other resources), and the intended use(s) of the model or simulation. [Might, 1999]

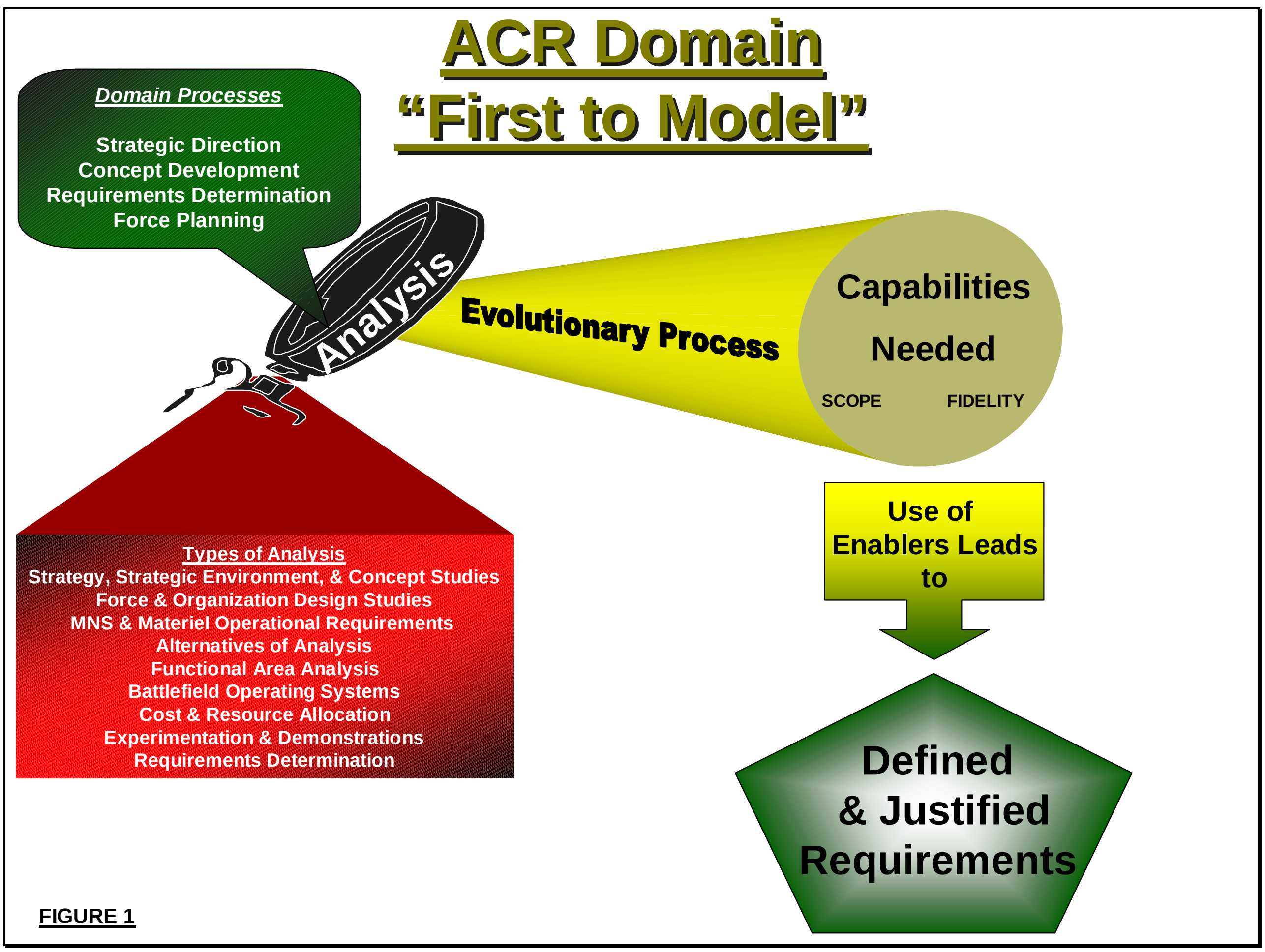
The successful development of simulation requirements, which meet system-users needs and are within budget, demands a team effort from system-users and developers. This team effort should begin with a well-conducted requirements assessment that will ultimately provide a model or simulation that accomplishes the desired purpose(s).

2.A.2 Technical Review of Requirements

Requirement reviews are important to the individual who is serving as a Modeling and Simulation (M&S) Program Manager. These reviews are part of the verification process and must be performed before M&S can be submitted for accreditation. One of the intents of verification is to ensure that the M&S program manager and the M&S accreditation authority use current, consistent, and approved requirements, and that applicable M&S products meet those requirements. [DA, 1999]

1. Description

A technical requirement review is a formal evaluation of documented requirements to ascertain their consistency, traceability, and adequacy. Requirement reviews are conducted at various stages in the M&S development process to monitor progress, identify potential problems, and provide early solutions. Requirement reviews are a formal part of the verification process and must be performed before M&S can be submitted for accreditation.



First to Model

2. History

In 1976, MIL-STD-1521 (USAF) codified the technical review process for military use. This standard, which applied to all services, was revised in 1985 as MIL-STD-1521B (USAF), then later cancelled as part of the 1996 acquisition cost reduction effort. [DoD, 1996] and [DoD, 1985] The concept of technical reviews remains valid, despite this cancellation. Technical reviews are incorporated into civilian system engineering standards such as EIA-632, and continue to be applied in some military development programs. [EIA, 1999] Examples include software verification and validation practices. A less prescriptive system engineering approach is also used. [DSMC, 2000]

3. How Requirement Reviews Are Used

Requirement reviews are used to ensure documented requirements are sufficiently developed to provide: (a) a development direction, (b) a means of monitoring progress, and (c) a convergence of requirements and capabilities in a final product. Specifically, periodic reviews ensure that: (a) changes in user requirements are valid, consistent, and attainable, (b) that user requirements are reflected in the functional and performance requirements of the proposed system, and (c) that the system's functional and physical architectures are traceable to functional and performance requirements and vice versa.

Some of the terms used in this section require some explanation. Definitions are:

a. Functional Architecture – A description of the M&S in terms of what it does logically and the performance required. [DSMC, 2000]
b. Functional Requirement – A description of what the M&S shall accomplish. [DSMC, 2000]
c. Performance Requirement – A description of how well the M&S shall accomplish its objective. [DSMC, 2000]
d. Physical Architecture – The physical and software elements which make up and define the M&S. [DSMC, 2000]
e. User Requirement – A need directly articulated by a potential user of the results of the M&S. [DSMC, 2000]

4. When Requirement Reviews Are Used

A technical requirement review is performed after the requirements have been reviewed with the originating organization for correctness and completeness, and the physical architecture has been defined and before a final commitment is made to develop a model or simulation. A review at this point ensures that the development is both feasible and meets user needs.

5. Important Considerations

It may be necessary to execute this review in parallel with the resource constraint analysis described in Section 2.A.3. Several iterations may be required in the requirements development and review process before development and implementation of the simulation can begin.

6. Utility

The principal benefit of the review process is that it provides a common framework for users, managers, developers, and outside experts to perform and integrate their disparate functions in a complex development process. Requirements are the common thread that brings M&S capabilities and user needs to fruition.

7. Review Process

The table below provides a step-by-step overview of the review process.

Step	Description
1. Review user requirements. a) Verify consistency with mission of M&S program. b) Verify consistency with policy. c) Verify consistency with other user requirements.	The M&S program manager should ensure that the user requirements developed are consistent with the charter of their program and any relevant policies. If there are multiple users of the proposed M&S, the program manager must verify early on that their requirements are consistent with each other. It may prove impossible to satisfy disparate user objectives in a single simulation. Inconsistencies in requirements may not arise until the detailed M&S is developed/implemented. Requirements should be reviewed at every stage from articulation of user requirements to establishment of physical architecture to minimize the impact of inconsistency.
2. Review requirements traceability. a) Trace user requirements to functional and performance requirements. b) Verify that all functional and performance requirements are derived from a user requirement. c) Verify that each user requirement is completely satisfied by functional and performance requirements. d) Trace functional and performance requirements to functional architecture. e) Verify that all elements of the functional architecture are derived from a functional or performance requirement. f) Verify that each functional or performance requirement is completely satisfied by a functional architecture. g) Trace functional architecture to physical architecture. h) Verify that each element of the physical architecture	Traceability review is a key part of the requirements management process. Each user requirement must be examined and broken into different parts when necessary, and requirements for the M&S developed that satisfy all of the different pieces of the user requirement. For example, if a user of a training simulation wants trainees to be able to smell smoke, then the program manager may need to consider a requirement for smoke generation. It must also be clear where the detailed requirements for the M&S originate. This clarity enables the program manager to avoid the development of unnecessary features.

Step	Description
corresponds completely to an element of the functional architecture.	
3. Review functional and performance requirements. a) Verify internal consistency of functional requirements with other functional requirements. b) Verify internal consistency of performance requirements with other performance requirements.	It is also necessary to ensure that requirements are consistent with one another, and that different views among users of the simulation are resolved. A model or simulation that attempts to be all things to all people is enormously complex and costly. Development of such a simulation is risky and requires a major program effort. When such a simulation is completed, it will be difficult to operate and understand.
4. Review functional and physical architecture. a) Verify that architectures are complete. b) Verify that architectures are technically feasible.	M&S program requirements must be reviewed for technical feasibility and required resources. An individual experienced in the development and implementation of M&S and with a broad grasp of current M&S technology should undertake the review for technical feasibility. The individual should verify that the proposed effort is within the realm of current technology, and then ensure that the technical and cost risk assessment is proper and correct. Performance of cost and risk assessment is discussed in Section 3.A of this Handbook.

Step	Description
5. Review resource requirements: a) Personnel b) Time c) Funds - Equipment - Facilities	Review of an estimate of the personnel, facilities, software, and equipment required for the simulation is also necessary. The estimate should cover items such as necessary off-the-shelf software; time commitment of personnel, qualifications, and numbers; land area; buildings; computer resources, including but not limited to type and number of machines; network resources including bandwidth, number of networks and redundancy; simulators; and other types of equipment. The match of software requirements to hardware including such things as storage, processing power, and speed of access to data should also be considered. Security plans and the supply and maintenance system for any necessary equipment also need to be considered, as well as the possible need for relocation of personnel and equipment. These considerations vary from project to project. Some items discussed do not apply to a particular program, and some programs may have additional considerations.
6. Review system engineering practices of developer and program office: a) Is there a system engineering process in place? b) Has a review of the process for compliance with standard guidelines been performed, and if so by whom? c) How are requirements to be tracked? d) How are changes to be incorporated? e) How are risks to be managed?	It is necessary for the program manager and the developers to establish sound system engineering practices, so that the M&S project is completed in accordance with requirements. MIL-STD-1521B discusses the review of the system engineering process in detail. If possible, develop a system engineering process that meets the guidelines set forth in some systems engineering standard. Organizations such as the Electronic Industries Alliance (EIA), Institute for Electrical and Electronics Engineers (IEEE), Software Engineering Institute (SEI), and International Organization for Standardization (ISO) have developed useful standards. This process can then be reviewed either by an internal team or in some cases by an external auditor to evaluate compliance with the chosen standard.

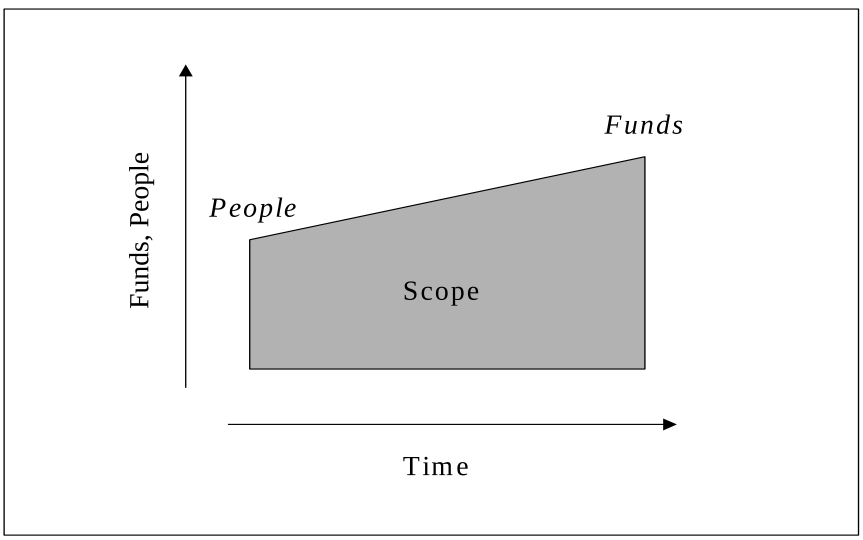
Technical Requirement Review Process

2.A.3 Resource Constraints

There are limits on availability of people, money and time that can constrain M&S development. While deadlines and budget thresholds are obvious constraints, the sequential nature of the M&S development process and access to qualified people may ultimately limit how much can be accomplished within a specified time period. Even when qualified people are available, the time required to train them on project specifics may offset any advantages gained from adding people.

The M&S program manager is responsible for completing the development effort on time and within budget. As previously noted, how much can be feasibly accomplished is a function of time and resources. The figure below illustrates this relationship. The feasible region is shaded in gray. It is the program manager's job to: (a) find a point within this region that maximizes user satisfaction, and (2) to schedule and manage resources in such a way that this objective is achieved. People are usually the primary constraint early on, and funds are usually the constraint near the program development deadline.

One must always manage the effort within constraints. Unconstrained development does not generally equate to maximizing user satisfaction. As early as the 1970s, it was recognized that unconstrained resource allocation is a risky approach for projects, such as M&S programs, where the primary cost driver is labor. [Leffingwell, 2000] The difficulty is that increased communication requirements among the members of a larger team tend to limit the productivity gains from adding personnel. This is not an information technology issue, but rather an issue of interpersonal communication. It is also true that some steps in an M&S program must be performed sequentially. This notion is expressed as Brooks' Law, "Adding resources to a late project makes it later." The inability to efficiently use more people is one reason people and money are not interchangeable constraints. Another problem is that the number of qualified personnel available may be limited.



Relationship Between Time, People and Funding [after Leffingwell, 2000]

1. **Importance of Resource Constraints**

It is common in simulation projects for the final scope of an effort to exceed the time or resources initially allocated. For this reason, a careful analysis should be performed to ensure that the M&S program is delivered on time, within budget, and that it satisfies the users. A table, based on the work of Leffingwell and Widrig, is provided at the end of this section as an aid to analyzing resource requirements.

2. **When Analysis Should Be Used**

Resource constraint analysis should be performed in the initial stage of the development process, before operational requirements are finalized. This initial analysis is performed in two stages, a rough analysis to identify the scope of a project, and a detailed analysis during which costs are estimated with fine granularity using a Work Breakdown Structure (WBS). The program manager uses this WBS later during the program to track expenditures and progress. The program manager may perform further constraint analysis at later stages using the results of the initial analysis, but this would only be done if the program fails to meet plans, resource constraints change, or the original requirements are changed. A thorough initial analysis will minimize the possibility of the program failing to proceed as planned.

3. **Important Considerations**

A key to satisfactory analysis is to have both the users and developers participate in the analysis through an Integrated Product Team approach. The primary and secondary users generally possess a complete understanding of the requirements for M&S to be successful. Narrowly focused subject matter experts frequently do not have this understanding, especially when they have no operational background. On the other hand, the developers are best able to estimate the required scope of effort and technical risk. The program manager must be skilled at understanding the differing viewpoints and perspectives of both groups, and facilitating clear communication between them to help build and sustain consensus.

It may be necessary to execute the constraint analysis in parallel with the technical review described in Section 2.A.2 of this Handbook.

4. **Benefits of an Analysis**

The principal benefit derived from a thorough analysis is that it establishes a basis for the user and developer to formulate realistic expectations. A secondary benefit is that it mollifies, to some extent, the effects of ad-hoc resource allocation on simulation capabilities and development timelines (i.e., deviating from the design specification in an attempt to compensate for shortages in personnel, funding, or time), which will likely lead to failed expectations.

5. Analysis Process

The table below outlines the major steps of conducting a resource analysis.

Step	Description
1. Describe system under consideration, including any available alternatives	Provide a complete description of the system under consideration, including alternatives. Alternatives depend on the situation under consideration. One example might be the use of semi-automated forces to represent some units in an exercise. Another example might be modification of an existing constructive simulation rather than developing a new simulation. Alternatives may be considered for small pieces of the program as well as the entire program.
2. Develop priority for each feature in system and available alternatives. a) Describe requirements satisfied by feature. b) Review requirements with user. c) Obtain user designation of requirements as critical, important, or useful.	Prioritize the desired features of the M&S. This involves linking every feature of the model or simulation to an expressed user need. The user must then identify each feature as critical, important, or useful to mission success. Experience has shown that the more critical features need to be developed, the risk of late delivery and cost overruns increases, so the user should be encouraged to limit the number of critical features. The first stage of program scope reduction is to eliminate features that are merely useful.
3. Estimate level of risk for each feature. (High, medium, low).	Perform an estimate of the risk level conducted by the manager in conjunction with the developers. A scale of high, medium, or low can be used for this purpose. High-risk features have the possibility of significantly impacting resource use and should be considered for elimination if they are not critical. Medium and low risk features may also be eliminated at some point, but this cannot be done solely on the basis of risk in a first cut analysis.
4. Conduct preliminary estimate on level of effort for each feature. (High, medium, low).	The next step is a preliminary estimate of the level of effort required. It is not desirable to perform a complete work breakdown analysis at this point. The intent is to identify difficult features that are not significant. If these features can be eliminated from the simulation without a full analysis, considerable effort in the requirements development can be saved.

5. Review initial estimates with users. Revise project scope, as necessary.	Secure preliminary user agreement on the basic scope of the project.
6. Conduct detailed analysis on level of effort for each feature, including everything necessary to have feature in place. a) Personnel required (numbers and qualifications). b) Hours required. c) Costs. d) Total time required.	Perform a detailed analysis. A frequently used procedure is the Work Breakdown Structure (WBS). A WBS is a product-oriented, family-tree subdivision of the hardware and services required to produce the end product. The WBS is structured in accordance with the way the work will be performed and reflects the way costs will be reported. It is the framework for project management. Once this detailed WBS analysis and the parallel equipment and facilities analysis are complete, the program manager can define a project that will achieve mission success within constraints.
7. Estimate equipment and facilities cost for each feature. a) Identify equipment and facilities required. b) Identify equipment and facilities available. c) Identify purchase and transportation costs.	A detailed analysis of equipment and facilities is performed. Once this is complete, the program manager can define a project that will accomplish mission success, and be achievable within constraints.
8. Review detailed estimates with users. Revise project scope as necessary.	Users of simulation results should be prepared to adjust their requirements based on whether the outcome is feasible, acceptable and within resource constraints.

Simulation Requirements Analysis [after Leffingwell, 2000]

2.B Technical Development of the Simulation

2.B.1 Data Management Planning

Data, the glue that binds operations and business processes, is the key to effective decision-making and forms the “content” at the core of the net-centric environment is the “content.” Content is the data needed to effectively execute missions, whether making strike decisions or developing departmental budgets. For effective content, there must be an approach to make trusted data visible, accessible, and usable. [DoD CIO, Response to Congress, 2003] This sections focus is on the data management aspects of data planning for modeling and simulation.

Authoritative Simulation Objects and Environments

Data Management planning is the mechanism and processes for creating and maintaining visible, accessible, and useable data. Two major focus areas are addressed in data management planning. The first is to “tag” data so that it can be found and understood. The second focus is to organize and maintain the data using communities of interest (COIs), (for example, ACR, TEMO, RDA) to make data easily accessible and promote data interoperability across the Army and beyond. [Data Management, 2003]

A critical step in the development of any model or simulation is the collection of the data required to model the system. In the DoD M&S community, this is commonly called the Knowledge Acquisition/Knowledge Engineering process. This is a non-trivial task. Data can take many forms and come from many places. The types, amount, and formats of the data needed for an M&S development project depend on many factors, including the type of system to be modeled, the degree of fidelity required, the complexity of the system, the type of programming language to be used, and even the development paradigm. The collection of data must be preceded by a data management plan (DMP).

As the Army implements Joint Vision 2020 and the Army Vision to digitize the battlefield, the use of net-centric environments that support the execution of these visions calls for a shift to a “many-to-many” exchange of data among users, rather than just emphasizing point-to-point interfaces. An effective data management plan must support all users and the range of data from real-time command and control data to simulated engineering and campaign-level data. The DMP must accommodate systems and simulations under development as well as legacy systems and simulations through a coordinated transition planning process.

1. Short History of Data Management in DoD

The use of data management planning and DMPs within the DoD was formalized with the 1989 Corporate Information Management (CIM) initiative [DoD Corporate Information Management memo of 10/4/89], and then gained further momentum in 1991 with the establishment of the Defense Information Systems Agency (DISA) Center for Information Management (CIM). [DISA CIM Summary Fact Sheet of March 1992] In November 1993, the then Under Secretary of Defense for Acquisition and Technology USD (A&T) designated the Director, Defense Research and Engineering (DDR&E) as the Functional Data Administrator (FDAd) for Modeling and Simulation (M&S). Subsequently, the DDR&E delegated the M&S FDAd mission and authority to the Defense Modeling and Simulation Office (DMSO). DMSO promulgates the M&S Data Administration Strategic Plan (M&S DASP), which is essentially the DMP for DoD M&S. [https://www.dmso.mil/public/thrust/ki-data/, retrieved March 2003].

The Army uses Simulation Support Plans (SSP) as part of the Simulation and Modeling for Acquisition, Requirements, and Training (SMART) initiative. SSPs include information about data support for individual acquisition programs similar to that found in a formal or organizational DMP. For additional information on SMART, see section 6.C.1a.

2. Army M&S Data Management

Army M&S data management is governed by the DoDD 8320 series. This supports the Army Information Resources Management Program [AR 25-1, 2002] that establishes the necessary framework for identifying, organizing, and managing Army data for development and implementation of information systems that are interoperable within and among the tactical, operational, strategic and sustaining base environments. The data management program addresses the management of manually processed and automated data from data modeling to the data element level. Data and information that are communicated and shared across organizational boundaries should conform to the policies and standards outlined in the Joint Technical Architecture (JTA)-Army. The data management program requires the active involvement of both functional experts and materiel developers. The program assists the Army in understanding what the information requirements are, where official Army data is maintained, and who uses the data. The program includes the activities of strategic data planning, data element standardization, data synchronization, data security, information management control, and database development and maintenance. [DA PAM 5-11, 1999] Note: This DA PAM is currently under revision.

To ensure consistent results from all Army M&S, M&S data management goals must conform to the goals of the Army data standards program. These goals are to:

a. Provide a common set of verified, validated, and accredited data, which can be shared by Army M&S activities.
b. Facilitate internal, joint, and combined interoperability through the standardization and use of common data.
c. Improve data quality and accuracy.

d. Minimize the cost of data production and data maintenance according to the DoDD 8320 series. [DA Pam 5-11, 1999]

3. Data Management Planning

Data management planning is typically described as a process more than a specific document. There may be a number of data management planning documents and software tools used as part of program or project management. Many organizations have some type of overarching data management plan, not necessarily using that title. These plans address many data administration issues, and can be very useful as a starting place for developing a more specific M&S project data management plan within that organization. Within the DoD, the 8000 series of directives addresses data and information management.

DMPs are used by the DoD as enterprise-level planning documents. Most DoD simulation projects are not required to have a formal document called a Data Management Plan. However, most major acquisition programs use M&S support, and will require coordination with M&S developers in the development of the program DMP. Additional data management information related to the M&S will be included in the SSP; Verification, Validation and Accreditation (VV&A) Plans; Configuration Management Plans (CMPs); Technical Management Plans (TMPs); and other technical requirements documentation.

The Data Management Plan (DMP) may be a formal document that contains the information about the data required for the life cycle of a program, system, or project. The DMP begins with a description of the system, its mission and functions. It may also describe in detail the equipment, hardware and software requirements for the system. The focus of the DMP is on the information needed to manage the data to be used or created in the support of the system, such as data sources and providers, data products, data formats, data repositories, logical data model, user interface, data customers, data processing software, and VV&A of data. The detail in a DMP varies depending on the management level and the program it is supporting. DMPs are living documents that need to be updated as required to support system development and changes.

4. Other Important Considerations

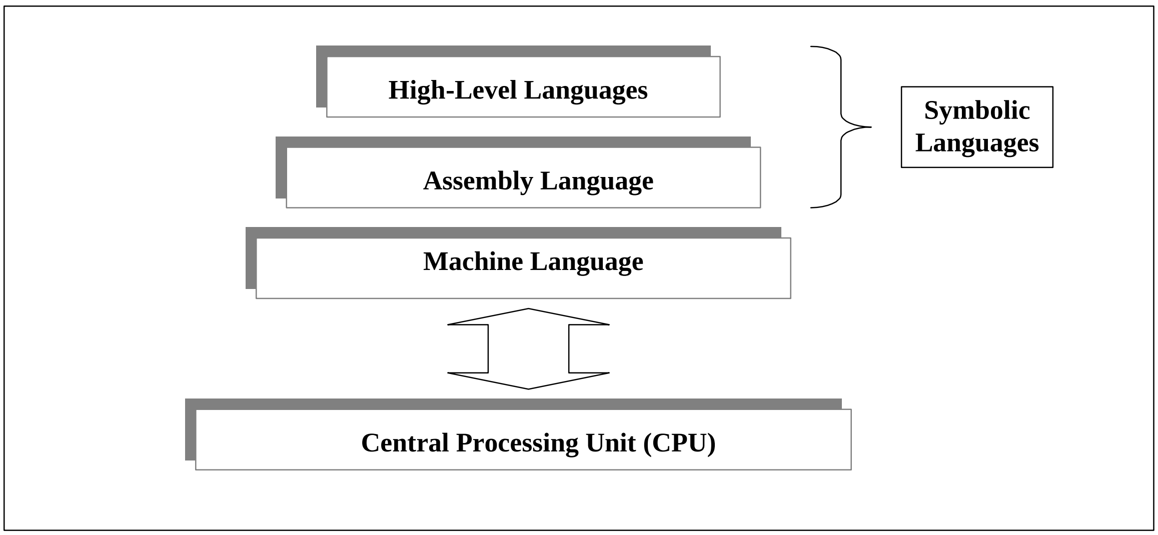
Data and data administration for DoD M&S applications should conform to the policies and procedures for data administration specified in DoD Directive 8320.1. Data, information, and information technologies used in support of M&S are corporate assets and should adhere to the information management policies contained in DoD Directive 8000.1 and DoD Instruction 8120.1 (which replaced DoD Directive 7920.1). [DoDD 5000.59 and DoDI 8120.1]

Defense standardization policies have been undergoing significant changes. Military and DoD standards related to data interchange and software development have been cancelled as a result of adoption of open system standards from international standards organizations such as the Institute of Electrical and Electronics Engineers (IEEE).

2.B.2 Computer Programming Languages

In their most basic form, computer simulations are sets of instructions that can be interpreted and executed by a computer. Programming is the process of using a programming language such as Ada, C++, Basic, or FORTRAN to define these instructions. Such languages are made up of rules, vocabularies, and syntax, or language statements that permit programmers to express computer instructions in a form that is meaningful to both humans and machines. While there are a variety of programming languages, each having unique features, strengths and weaknesses, they all exist to aid programs in defining the instructions that the computer will execute.

The three basic types of programming languages are grouped hierarchically, as shown in the figure below.



Program Language Hierarchy

1. Machine Languages

Machine language instructions, which are written in binary code (e.g., 01101101), correspond directly to individual functions performed in the computer's Central Processing Unit (CPU). This one-to-one correspondence is unique to machine language and is significant for three reasons: (a) this level of specificity requires that each type of CPU has its own machine language; (b) machine language instructions are the only instructions that the CPU can recognize; and (c) instructions, written in any other language, must be translated into machine language before they can be executed.

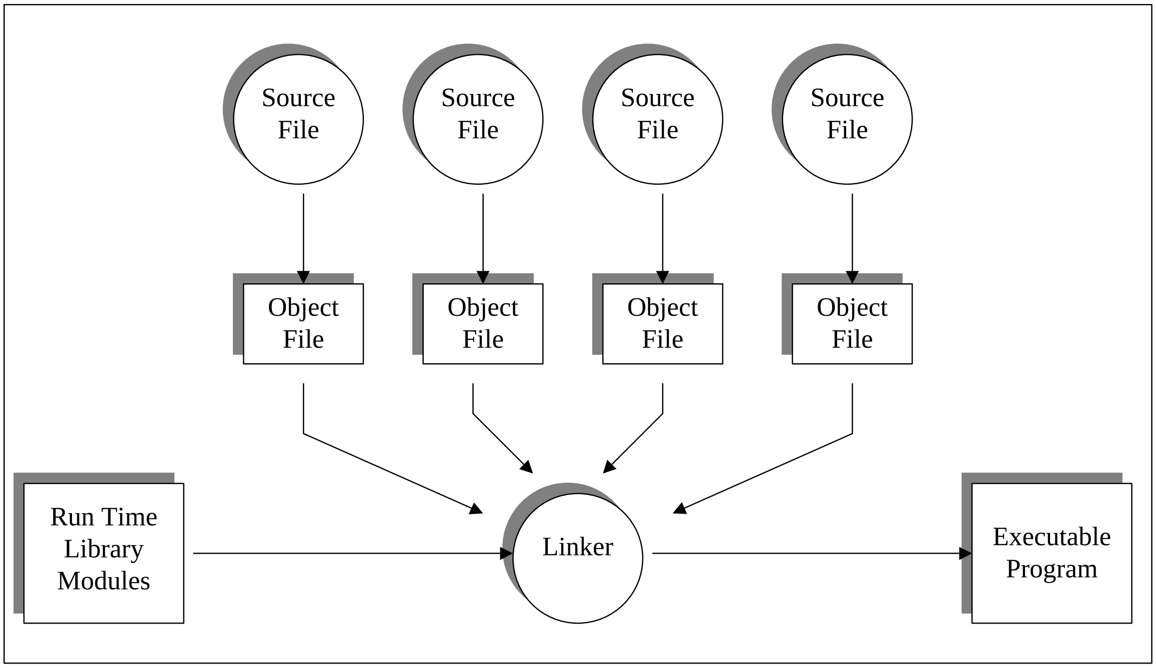
2. Assembly Languages

An assembly language is a programming language that is one step removed from a computer's machine language. [Assembly, 2001] It is also the most basic type of symbolic language. Symbolic languages provide a means of writing program instructions using more familiar symbols and names rather than the zeros and ones used to write binary instructions (e.g., If X=Y then….). Assembly languages are closely related to machine languages in several important respects: (a) they share a common structure; (b) they use the same command sets; and (c) they are CPU specific, that is, each type of CPU has its own assembly language. Because assembly languages use familiar symbols and names, they must be translated into machine language before the CPU can execute them. An assembler is a software program that translates assembly instructions into machine language.

3. High-Level Languages

High-level languages are more evolved than either machine or assembly languages and are preferred for simulation development. High-level languages, as a group, share four important characteristics that distinguish them from machine and assembly languages:

a. High-level languages are procedure or problem-oriented. High-level languages are "languages" in a more general sense because they have structures, vocabularies, and syntaxes that aid in problem formulation and concept articulation. Programmers who use these languages are concerned with solving problems, they are not necessarily concerned with "how" the machine performs required operations. [Shannon, 1975]
b. High-level languages are more abstract in the sense that a language statement, when translated into machine language, creates a number of machine language instructions. This characteristic is important because: (a) it reduces the time and effort required to program a complex problem; (b) it reduces the chance of programming errors; but (c) it also reduces programming flexibility and possibly execution speed. [Petroutsos, 1998] and [Shannon, 1975]
c. High-level languages have what many publications refer to as a "worldview." A language's worldview is a conceptual description of how problems are formulated in that language. For example: SIMSCRIPT sees the world as a series of timed events, C++ sees the world in terms of "classes" and "objects", and FORTRAN sees the world as a calculus. Shannon (1975) points out that each high-level language has an implicit view of the world and that that view must be invoked when it is used. Conversely, machine and assembly languages do not have well defined worldviews.
d. High-level languages use a two-step process to translate high-level secure code languages into executable programs. In the first step, a software program called a compiler is used to translate source code, which is written in a high-level language, into "object files" which are written in machine language. In the second step, another program called a linker, linker-editor, or binder, combines the object files with library modules to form an executable program. This process is illustrated in the figure below.



Compiling and Linking Process [Compiler, 2002]

High-level languages have evolved to handle some of the more difficult aspects of designing, managing, and constructing very large, complex computer programs that must be frequently changed to keep pace with evolving requirements. In general, high-level languages (a) support problem formulation and articulation; (b) are easier to read, understand, and validate; and (c) are more efficient to use, thus accelerating the development process while reducing programming errors. High-level languages, specifically designed for simulations, are used because they:

a. Are generally easier to change,
b. Require less programming time,
c. Provide superior error checking,
d. Provide organic timekeeping mechanisms,
e. Provide a brief, direct vehicle for expressing the concepts arising in a simulation study,
f. Possess the ability to construct and furnish the user subroutines required as a part of any simulation routine,
g. Automatically generate data needed in simulation runs,
h. Facilitate collection and display of data produced, and
i. Control management and allocation of computer storage during the simulation run.

High-level languages take two forms: source code and compiled code or executable code. Source code is used during development to facilitate verification, validation, and accreditation. Compiled code is generally reserved for the final release version. Compiled code provides a means of maintaining configuration control since it cannot be modified by design or accident.

There are literally hundreds of high-level languages in common use. Lawlis (1997) has identified over 40 attributes that can be used to assess the advantages and disadvantages of each language compared against other languages. When comparing languages, it may be desirable to make point-by-point comparisons, but an intuitive approach may make more sense. For example, does a language facilitate testing and validation? Is it amenable to modification? Does it have a broad user base? With this in mind, the following questions are offered as points of departure for comparing languages. [Lawlis, 1997], [Jacobson, 1992], and [Shannon, 1975]

a. Is the source code easy to read and understand?
b. Are intelligibly written user's manuals available?
c. Is there an available pool of programmers experienced in the language?
d. Is there a broad user base; has the language been used to support similar programs or projects?
e. Is the language portable; is it available on other computer systems where the program might be run?
f. Do the compiler and linker include documentation and extensive error diagnostics?
g. Does the language support modern engineering methods?
h. Does the language comply with established standards?
i. Are development tools available?
j. Are appropriate and suitable libraries available?
k. Are appropriate and suitable data models available?
l. How easy is the language to maintain?
m. Is technical support available?
n. What is the cost of installing, maintaining, and updating the language software?

4. Summary

Programming languages are made up of rules, vocabularies, and syntax, or language statements that permit programmers to express computer instructions in a form that is meaningful to both human and machine. While there are a variety of programming languages each with unique features, strengths and weaknesses, they all exist to aid programmers in defining the instruction that they want the computer to execute. In the model and simulation development process, the choice of language is important. Selecting an appropriate language can simplify the coding process, reduce programming errors, and facilitate the Verification and Validation process.

2.B.3 Documentation of Configuration Management

Configuration Management (CM) provides the foundation of a process for ensuring that models and simulations (M&S):

1. function correctly,
2. continue to function correctly, and
3. satisfy users' requirements.

The objectives of CM are to:

1. improve consistency and reliability of M&S systems,
2. avoid unnecessary costs, and
3. minimize risk to the M&S user community.

CM is used by the Army M&S community to establish and maintain control of the performance and function of a model or simulation, and to correlate these with requirements. CM is applied throughout the lifecycle of M&S to ensure continuing operational consistency among M&S versions by helping to:

1. identify the configuration of the M&S system at specified points in time,
2. control the change of the related M&S data and documentation,
3. control changes to the M&S system configuration, and
4. maintain the traceability of the M&S system configuration.

The Army uses CM for its M&S to ensure that:

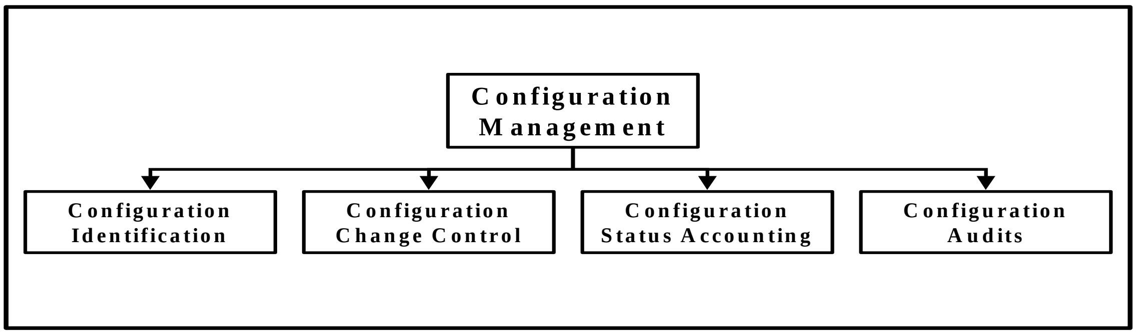
1. shared information (whether it is produced, used by, or released from a software development or support activity) is controlled and maintained,
2. system development is identified, tracked, and controlled from the inception of the concept for the system until it is replaced or retired,
3. information is maintained under sustained control by managing baselines and engineering products as the engineering functions work their way through the development process, and
4. project control change indicators are kept visible.

1. The CM Process and Basic CM Functions

The Interim Defense Acquisition Guide Book states a need for: "a configuration management process to guide the system products, processes, and related documentation, and to facilitate the development of open systems. The configuration management effort includes identifying, documenting, and auditing the functional and physical characteristics of an item; recording the configuration of an item; and controlling changes to an item and its documentation. It shall provide a complete audit trail of decisions and design modifications." [The Interim Defense Acquisition Guide Book, 2002]

Configuration management places under control much more than just the M&S source code or the executable code. Information of interest includes anything concurrently used across project organizations or approved for sharing, such as: the M&S software and its associated documentation; interface requirements and documentation; engineering artifacts resulting from the methods and tools used by the project; trade studies and user requirements, needs, and expectations; management plans; information and reports; project tools and users' manuals; project records and history; test plans, procedures, cases, scenarios, and data; and test tools. [Little Book]

There are four main parts to CM. They are: configuration identification, configuration change control, configuration status accounting, and configuration audits (see the Figure below – Configuration Management Parts).



Configuration Management Parts

A. **Configuration identification** is the ability to identify:
   1. what information has been approved for concurrent use in the project,
   2. who owns the information;
   3. how the information was approved for CM control, and
   4. the latest approved release.

B. **Configuration change control** is the process and procedures that:
   1. designate the level of control through which each work product must pass,
   2. identify the persons or groups with authority to authorize changes and to make changes at each level,
   3. identify the steps to be followed to obtain required authorization for changes, to process change requests, to track changes, to distribute changes, and to maintain past versions, and
   4. provide the change control mechanism to build software systems for tests that have a known configuration and can be exactly reproduced.

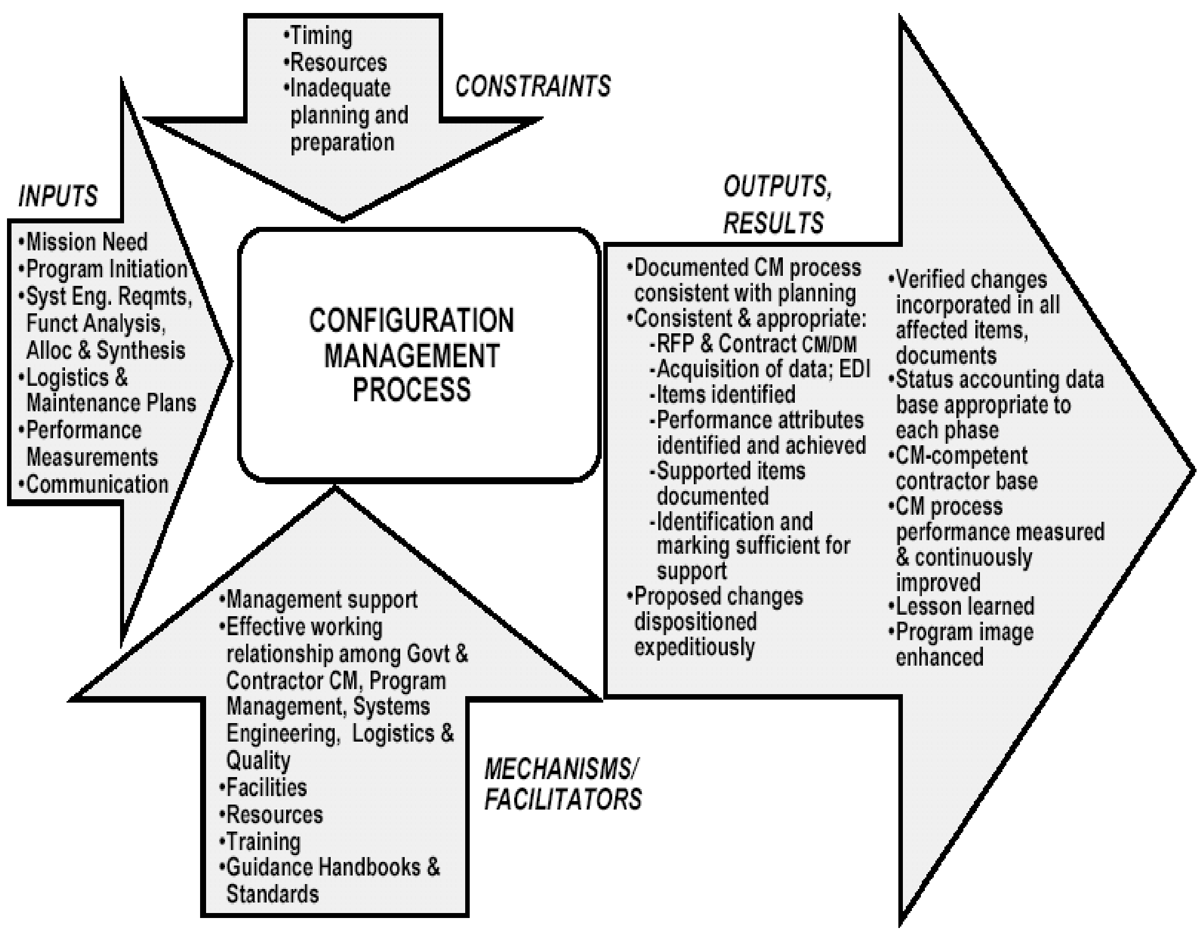
C. **Configuration status accounting** is the formalized recording and reporting of:
   1. the established configuration documents,
   2. the status of proposed changes, and
   3. the status of the implementation of approved changes.

D. **Configuration audits** are the frequent evaluation of the content, baseline integrity, and release integrity of all controlled products to ensure that they conform to their configuration documents. [Little Book]

For example, configuration status accounting provides an accessible and current record of each controlled piece of information that is planned to be used, the content of each release from CM, and who has checked out or is working on a piece of information that the test organization plans on assessing through CM. These functions are usually automated using configuration management computer software systems.

The figure below provides a top-level activity model depicting the CM process. The figure shows:

1. inputs – the information needed to initiate and perform the process,
2. constraints – the factors or information that inhibit or put limitations on the process,
3. mechanisms/facilitators – the information, tools, methods, and technologies which enable or enhance the process, and
4. outputs – the results that derive from the process or information that is provided by the process. [MIL-HDBK-61A(SE), 2001]



DoD Configuration Management Process Model

2. The CM Plan

A CM process is governed by a CM plan. This plan should be developed and implemented early in the system life cycle. The plan provides a basis for review, evaluation, and audit of the overall CM effort. The CM plan includes sections for:

a. responsibilities for CM activities,
b. delineation of CM activities,
c. details of data management,
d. process for configuration identification,
e. details of interface management,
f. process for configuration control,
g. process for configuration status accounting,
h. process for configuration audits, and
i. details of contractor, subcontractor, and vendor control.

3. Practical Considerations in Evaluating CM

The following are some practical considerations for evaluating CM processes, plans, and systems. They apply to the full life cycle of the M&S under consideration.

a. The application of CM should be tailored to the life cycle phase, complexity, size, intended use (including joint and combined interoperability), mission criticality, and logistics support of the M&S.
b. CM data provides the means to correlate any information about the simulation with a particular development version. This becomes particularly important when dealing with iterative development paradigms, such as the spiral and incremental development paradigms. [VV&A RPG, 2001]
c. A robust CM program can be considered to be an indicator of simulation maturity and stability.
d. The credibility of the information provided throughout simulation development and assessment is dependent in part on the reliability of the configuration management program.
e. Problems with configuration management of simulations can occur when simulation source code has been distributed to multiple users, allowing them to make their own changes. Then, the documentation available for any version of the simulation may be incomplete and inconsistent, resulting in a less credible simulation and greater risks involved in using it in an application. [VV&A RPG, 2001]
f. CM helps control changes and coordinates the products of the many different people who work on a common software product. [Humphrey, Chap. 7]
g. CM provides knowledge of the correct current configuration of defense assets and the relationship of those assets to associated documents. The CM process efficiently manages necessary changes, ensuring that all impacts to operation and support are addressed.

4. Summary

"Those who consider the small investment in the CM process a cost-driver may not be considering the compensating benefits of CM and may be ignoring or underestimating the cost, schedule and technical risk of an inadequate or delayed CM process." [MIL-HDBK-61A(SE), 2001]

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CM Documentation Worksheet

General:	
What parts of CM have been implemented for this M&S project?	
Has Configuration Identification been implemented and is it being used?	
Has Configuration Change Control been implemented and is it being used?	
Has Configuration Status Accounting been implemented and is it being used?	
Have Configuration Audits been implemented and are they being used?	
Have baselines been established for use with CM?	
For Configuration Identification:	
What information has been identified (M&S software; M&S software associated documentation; interface requirements and documentation; engineering artifacts; trade studies and user requirements, needs, and expectations; management plans; information and reports; project tools and users' manuals; project records and history; test plans, procedures, cases, scenarios, and data; test tools)?	
What information has been approved for concurrent use in the project?	
Who owns the information?	
How was the information approved for CM control?	
What is the latest approved release?	
For Configuration Change Control:	
What is the level of control through which each product must pass?	
Who are the persons or groups with authority to authorize changes and to make changes at each level?	

What are the steps to obtain required authorization for changes, to process change requests, to track changes, to distribute changes, and to maintain past versions?	
Is there a change control mechanism to build software systems for tests that have a known configuration and can then be exactly reproduced?	
What tools are used to automate configuration change control?	
For Configuration Status Accounting:	
What are the established configuration documents?	
What is the status of proposed changes?	
What is the status of the implementation of approved changes?	
For Configuration Audits:	
When do the audits take place?	
What baselines do they support?	
What are the controlled products for the audits?	
For Configuration Management Plans:	
Is there a CM plan in place?	
What steps does the CM plan cover?	
Is the CM plan being followed?	

2.C Prepare to Use Simulation

2.C.1 Accreditation

1. Description

Accreditation is the official determination that a model, simulation, or federation of models and simulations is acceptable for use for a specific purpose. [DA Pam 5-11, 1999]

In the case of simulation-supported exercises, the task of performing an accreditation assessment and formulating an accreditation recommendation will more than likely fall to an accreditation team. The sponsor for each M&S application will designate an accreditation agent/team to perform the assessment. [DA Pam 5-11, 1999]

The accreditation decision is essentially a formal statement of the sponsor's belief in the credibility of a specific simulation based on how the sponsor intends to use that simulation. The accreditation process is the procedure that the agent/team follows to support the sponsor's determination. This procedure consists of four key elements: (1) developing an accreditation plan; (2) collecting and evaluating accreditation information; (3) conducting an accreditation assessment; and (4) making an accreditation decision. The accreditation agent works closely with the Verification and Validation (V&V) Agent to accomplish the first three elements. The application sponsor makes the final accreditation decision. [DA Pam 5-11, 1999]

2. History

As early as the 1960s, V&V procedures were well established and successfully used to test the credibility of "user developed", "single purpose" models. Verification answers the question "does the M&S work as intended?" Validation answers the question "is the model's output realistic?" [DA Pam 5-11, 1999] Early models were generally developed by the organizations that used them. These models tended to be narrow in scope with limited flexibility. During the following three decades, it became evident that existing V&V procedures, while adequate for their time, were not sufficient to address the growing use of models and simulations for purposes other than that for which they were originally built. In the mid 1980s to the early 1990s, the Department of Defense (DoD) recognized that common V&V practices needed to be established among all users and that existing procedures needed to be expanded and refined to reflect changing trends in M&S uses. The net result was a core set of documents that assigned V&V, as well as Accreditation responsibilities, and established policies, guidelines, procedures, and methodologies. These documents are:

a. DoDD 5000.59 Modeling and Simulation (M&S) Management, Jan 94. This establishes DoD policy, assigns responsibilities, and prescribes procedures for the management of M&S. [DoDD 5000.59, 1994]
b. DoDI 5000.61 DoD Modeling and Simulation (M&S) Verification, Validation and Accreditation (VV&A), Apr 96. This implements policy, assigns responsibilities, and prescribes procedures under DoDD 5000.59 for the VV&A of DoD M&S. [DoDI 5000.61, 1996]

c. DMSO "VV&A Recommended Practices Guide", Updated May 00. This facilitates the application of DoD VV&A directives and guidelines, and promotes the effective application of VV&A. [VV&A RPG, 2001]
d. AR 5-11 "Management of Army Models and Simulations", Aug 97. This provides guidance for the Army M&S Management Program, Configuration Management, Data Management, M&S Release and VV&A. It also establishes roles of the Army Model and Simulation Office (AMSO), Army Model and Simulation General Officer Steering Committee (AMS GOSC), and the Army Model and Simulation Executive Council (AMSEC) in these processes. [AR 5-11, 1997]
e. DA Pam 5-11 "Verification, Validation, and Accreditation of Army Models and Simulations", Sep 99. This provides guidance for the development, execution, and reporting of all VV&A activities. [DA Pam 5-11, 1999]

3. Importance of Accreditation

Within the Army, models and simulations play a prominent role in defining advanced concepts and requirements (ACR); in managing and directing research, development and the acquisition (RDA) of new or improved systems; and in conducting training, exercises, and military operations (TEMO). Given the degree to which M&S are integrated into these activities, the M&S community must ensure that users have the utmost confidence that: (1) their models provide creditable representations of the systems, entities, phenomenon, and processes they emulate; (2) M&S capabilities and limitations are understood and clearly documented; and (3) their simulations are being used appropriately. [AMSO Home Page, Retrieved Feb 2003] Accreditation is a formal declaration that these conditions are satisfied.

4. Use of Accreditation

The accreditation process is applied when: (1) a new model is under development; (2) an existing model is being modified; or (3) a fielded model is used for a new application. Regardless of the context in which the accreditation assessment is made, the general procedures outlined in the Accreditation Worksheet below apply.

Frequently used models can be accredited for a generic class of applications, such as battalion level battle focused training, analysis of alternatives and so on. The Army official with general oversight responsibility for each class of application performs the accreditation. [DA Pam 5-11, 1999] The impact of this "class accreditation" is two-fold. First, it focuses subsequent VV&A efforts on the unique aspects of specific M&S application. As a result, it is only necessary to perform V&V on subsets of the model that have been modified to address specific application requirements. Second, it allows sponsors to perform abbreviated accreditation assessments based on the unique aspects of their specific application. However, DA Pam 5-11 states that "M&S, which have been accredited for a class of applications, require each specific instance of use for that M&S to be accredited." [DA Pam 5-11, 1999] For example, every time the Corps Battle Simulation (CBS) is used to support a Battle Command Training Program (BCTP) exercise, some level of accreditation assessment should be performed on CBS.

Legacy models, M&S which are still used but not implemented using today's V&V standards, or commercial off-the-shelf (COTS) M&S often do not have documented V&V plans and reports and are therefore more difficult to accredit. The accreditation goals and procedures, however, remain the same, although additional consideration may be given to experience gained through past use.

The preferred method of accreditation involves a determination that the M&S is appropriate, before use [DA Pam 5-11, 1999], (However, any use of the results of an M&S is often considered de facto accreditation). Consequently, accreditation planning should begin as soon as an accreditation agent is designated. Ideally, this occurs early in model development or the planning process, in the case of analysis, exercises, etc., so that all VV&A-related activities might be coordinated and executed in a coherent fashion.

5. Important Considerations

The following additional factors should be considered when scoping an accreditation effort and developing the accreditation strategy:

a. Resourcing and scheduling constraints.
b. Scaling the level of effort to the time and resources available. For example, what are the essential make-or-break requirements that must be satisfied before the model can be considered minimally acceptable?
    1. Can the past work be leveraged?
    2. Has the model already gone through a structured process to establish its credibility?
    3. Has model output been compared with validated output from other sources (e.g., combat, field tests etc.)? If so, what is the degree of correlation?
    4. Who built the model? What is their track record?
    5. What data sources were used? Who validated the data?
    6. What implicit and explicit assumptions were made in development and testing? How do they affect model performance with regard to meeting requirements?
    7. What variables of the operational environment are not represented in the model? How do they affect model performance with regard to meeting requirements?
    8. What are the limitations of the model?

c. Coordinating accreditation activities with the User, Developer, V&V Agent, and supporting Subject Matter Experts (SME).
d. Operating overhead including: hardware configuration requirements, software support environment, personnel and facility requirements, and security.

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Accreditation Work Sheet

Develop an Accreditation Plan:	
Obtain a prioritized list of users' requirements.	
Establish a set of acceptance criteria.	
Identify the accreditation decision-maker.	
Identify accreditation information needs:	
a. Assess the operational risks associated with using the simulation.	
b. Refine information requirements using prioritized requirements, acceptance criteria, and assessed risk.	
c. If data collection is not sufficient to meet accreditation, then coordinate necessary adjustments to the V&V plans.	
Plan accreditation assessment activities:	
a. Determine the adequacy of existing or planned documentation in light of expected operational risk levels.	
b. Determine the ability of planned and/or executed V&V activities to provide the necessary information in light of expected operational risk levels.	
c. Determine the ability of the simulation to meet M&S requirements in light of the defined acceptability criteria.	
Establish an assessment process:	
a. Establish the methods of collection (e.g., face-to-face interviews, video teleconferencing, etc.).	
b. Identify types of participants to be included (e.g., operators, subject matter experts, etc.).	

c. Identify required materials (e.g., orientation packages, read ahead, training, etc.).	
d. Identify accreditation team positions/roles (e.g., facilitator, recorder, etc.).	
e. Identify mechanisms for capturing the results of the deliberations and methods for expeditiously resolving conflicts and gaining consensus.	
f. Provide and coordinate accreditation data requirements and priorities to the V&V agent.	
Collect and Evaluate Accreditation Information:	
Review preliminary work.	
Monitor development activities:	
a. Ensure that the impact of all changes to the simulation is understood and addressed.	
b. Monitor changes in risk indicators and, if necessary, reassess priorities and accreditation data requirements.	
c. Ensure that data generation/collection priorities are adjusted and V&V plans modified to reflect the current needs of the accreditation assessment.	
Monitor V&V activities:	
a. Participate in V&V meetings with the M&S PM, Developer, and/or User.	
b. Review all V&V products to ensure that they provide information needed for the accreditation assessment (i.e., they satisfy accreditation data collection requirements).	

Collect supplemental information:	
a. Model documentation.	
b. Simulation descriptive documents (e.g., specifications).	
c. Configuration management plans and implementation evidence.	
d. Instance data or metadata.	
e. Development schedule; execution deadline.	
f. Operational resource requirements.	
Conduct Accreditation Assessment:	
a. Select assessment team members and SMEs.	
b. Notify and brief assessment team.	
c. Ensure team members' availability for all meetings and associated activities.	
d. Provide orientation packages, read-ahead information, or training as required.	
Conduct and record assessment team meetings:	
a. Document all deficiencies (i.e., in both the simulation and in the accreditation information), their impact, and associated risks if they remain uncorrected.	
b. Identify potential work-arounds for each deficiency.	
c. Prepare a draft assessment report for review and concurrence by all assessment team members.	
d. Prepare final assessment report.	
e. Prepare accreditation report with accreditation recommendation.	
Make Accreditation Decision:	
a. Provide user with a copy of the accreditation report.	
b. Brief user on findings, observations, and recommendations.	
c. Respond to questions as required.	

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Chapter 3: M&S Applications

3.A Assessment Process

The process of assessing simulations in support of an Army project is a vital part of the project's overall analysis plan. The assessor should have a thorough understanding of project factors, such as the decisions to be supported by the use of a simulation, the timetable for delivering the results of the simulation, and the resources required and available to develop and manage the simulation.

In line with the development of any large-scale engineering or software project, the fundamental measures governing the assessment and choice of simulations fall into four categories:

1. Performance,
2. Cost,
3. Risk, and
4. Schedule.

Each of these categories of factors can be divided into two subcategories: "hard" and "soft," or objective and subjective factors (see the Table below). Hard (objective) factors are things that can be measured or determined objectively. Soft (subjective) factors are things that are not directly measured, but can be part of a "feeling" towards a system, and often can involve many of the "political" issues for a project. The importance of these categories and subcategories varies depending on the particular Army project's analysis plan.

Type ***Hard/Soft***	**Performance**	**Cost**	**Risk**	**Schedule**
Objective	X	X	X	X
Subjective	X	X	X	X

Assessment Factors for a Simulation

This section presents lists of the assessment criteria (by subcategory) that the Army simulation professional can use to characterize the simulations discussed in the remainder of this chapter. Of course, several specific individual assessment criteria belong to multiple categories or subcategories.

The bottom line in assessing and choosing a simulation is the following: the user and developer must work together by applying their experience and common sense within a careful framework of assessment factors to reach decisions on the suitability of simulations for the project at hand.

3.A.1 Performance Factors

1. Objective Performance Factors

The objective (hard) performance factors for assessing a simulation include:

a. Military functionality
b. Level (campaign, engagement, engineering)
c. Measures of effectiveness produced (modifiable?)
d. Representation of environment
    1. Terrain
    2. Weather
e. Representation of human behavior
f. Resolution
g. Fidelity
h. Clock speed
i. Update rates
j. Interoperability (HLA compliance/certification, DIS, ALSP)
k. Input/output format(s)
l. Security classification
m. Technical specifications

2. Subjective Performance Factors

The subjective (soft) performance factors for assessing a simulation include:

a. Simulation purpose
b. Simulation domain (RDA, TEMO, ACR)
c. Simulation use history
d. Sponsor
e. Personal experience/knowledge
f. Graphical user interface

3.A.2 Cost Factors

1. Objective Cost Factors

The objective (hard) cost factors for assessing a simulation include:

a. Number of runs required (one-time, ongoing, number of excursions)
b. Facilities
    1. Space (rental)
    2. Utilities
    3. Ranges
c. Test articles
d. Personnel
    1. Setup personnel
    2. Support personnel
    3. Operators/Players
    4. Analysis personnel

d. Hardware
    1. Simulators
    2. Computers
    3. Interface equipment
    4. Data capture and collection equipment
    5. Electrical requirements
    6. Space requirements – physical dimensions/portability
    7. Transportation costs
e. Software
    1. Operating system
    2. Source code (high level) languages
    3. Software tools / graphics packages
    4. Software licenses
    5. Documentation
f. Data (databases)
    1. Development (cost, personnel)
    2. Modification (cost, personnel)
    3. Maintenance (cost, personnel)
    4. Availability
    5. Reusability
g. Operating environment

2. Subjective Cost Factors

The subjective (soft) cost factors for assessing a simulation include:

a. Standards
    1. Data
    2. Protocols
    3. Network
b. Cycle time
c. Availability
d. Sponsor
e. Data availability
f. Training availability
g. Simulation support
    1. Who can run the simulation?
    2. Who can modify the simulation?
    3. Who can analyze the simulation result?
    4. What do these folk bring in “baggage”?
h. Personal experience/knowledge
i. Input/output formats

3.A.3 Risk Factors

1. Objective Risk Factors

The objective (hard) risk factors for assessing a simulation include:

a. Security classification
b. Built-in databases

c. Standards (data, protocols, network)
d. VV&A status
e. Accreditation information (including accreditor and for what accredited)
f. Expected retirement date
g. Availability
h. Data availability
i. Training availability

2. Subjective Risk Factors

The subjective (soft) risk factors for assessing a simulation include:

a. Use history
b. User experience/evaluations
c. Personal recommendations
d. Personal experience/knowledge
e. Sponsor
f. Proprietary issues
g. Strengths/limitations
h. Operating environment
i. Hardware
j. Software
k. Electrical Requirements
l. Physical dimensions/portability
m. Accreditation information (including accreditor and for what accredited)
n. Simulation support
    1. Who can run the simulation?
    2. Who can modify the simulation?
    3. Who can analyze the simulation result?

3.A.4 Schedule Factors

1. Objective Schedule Factors

The objective (hard) schedule factors for assessing a simulation include:

a. Number of runs required (one-time, ongoing, number of excursions)
b. Data (including built-in databases)
    1. Development (time, personnel)
    2. Modification (time, personnel)
    3. Maintenance (time, personnel)
    4. Availability
    5. Reusability
c. Cycle Time
d. Availability
e. Training availability
f. Classification/security

2. Schedule Factors

The subjective (soft) schedule factors for assessing a simulation include:

a. Simulation support
    1. Who can run the simulation?
    2. Who can modify the simulation?
    3. Who can analyze the simulation result?

b. How finely do the results need to be analyzed/displayed?

c. Political considerations

3.B Model and Simulation Resource Repositories

3.B.1 Army Model and Simulation Resource Repository (Army MSRR)

1. Introduction

The Army MSRR can be a valuable tool for users of M&S information. It should be one of the first places to go to look for information about M&S. The Army MSRR provides up to date information on Army M&S tools and resources, as well as a portal to the other nodes on the DoD MSRR. Information on Army M&S tools and resources is as close as a mouse and keyboard, and is easy to access.

2. History

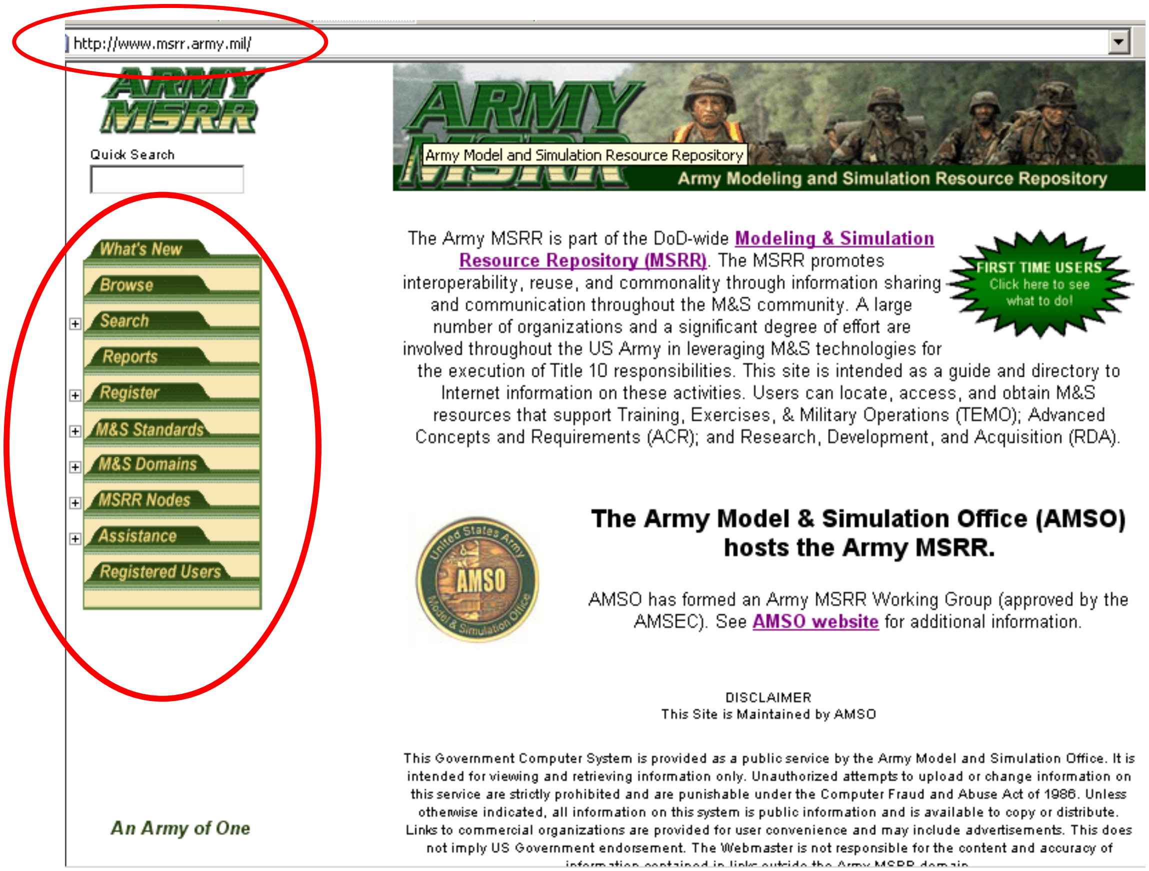
The Army Model and Simulation Resource Repository (MSRR) was originally developed as a result of guidance from the 1995 Army Model and Simulation Master Plan. The Army Model and Simulation Office (AMSO) is the proponent of the Army MSRR.

3. Background

The Army MSRR is the Army node on the Department of Defense-wide MSRR. The Army MSRR provides M&S meta-data to develop and maintain M&S activities in support of Training, Exercises, and Military Operations (TEMO); Advanced Concepts and Requirements (ACR); and, Research, Development, and Acquisition (RDA). According to the Army M&S Master Plan, information concerning all Army M&S should be included in this repository (Army M&S Master Plan, 1995). Exceptions to this policy are those models and simulations that are developed at the engineering level for one-time application. To eliminate any unnecessary duplicative activity by M&S proponents, AMSO serves as the Army single point of contact for provisions to DoD repositories and bulletin board systems. The Army MSRR does not contain the actual models and simulations, but rather references on various M&S information sources, such as Subject Matter Experts; libraries and other repositories; documents; models, simulation, and simulators metadata (information about these M&S tools); related websites; tools and utilities of use in M&S.

4. Navigation

Navigation is conducted through a set of hot buttons located vertically along the left side of the homepage (See circled section in the picture below). All functions involving access, searches, links, and registration of M&S metadata can be conducted through this set. First time users should click there for information on how to use the Army MSRR.

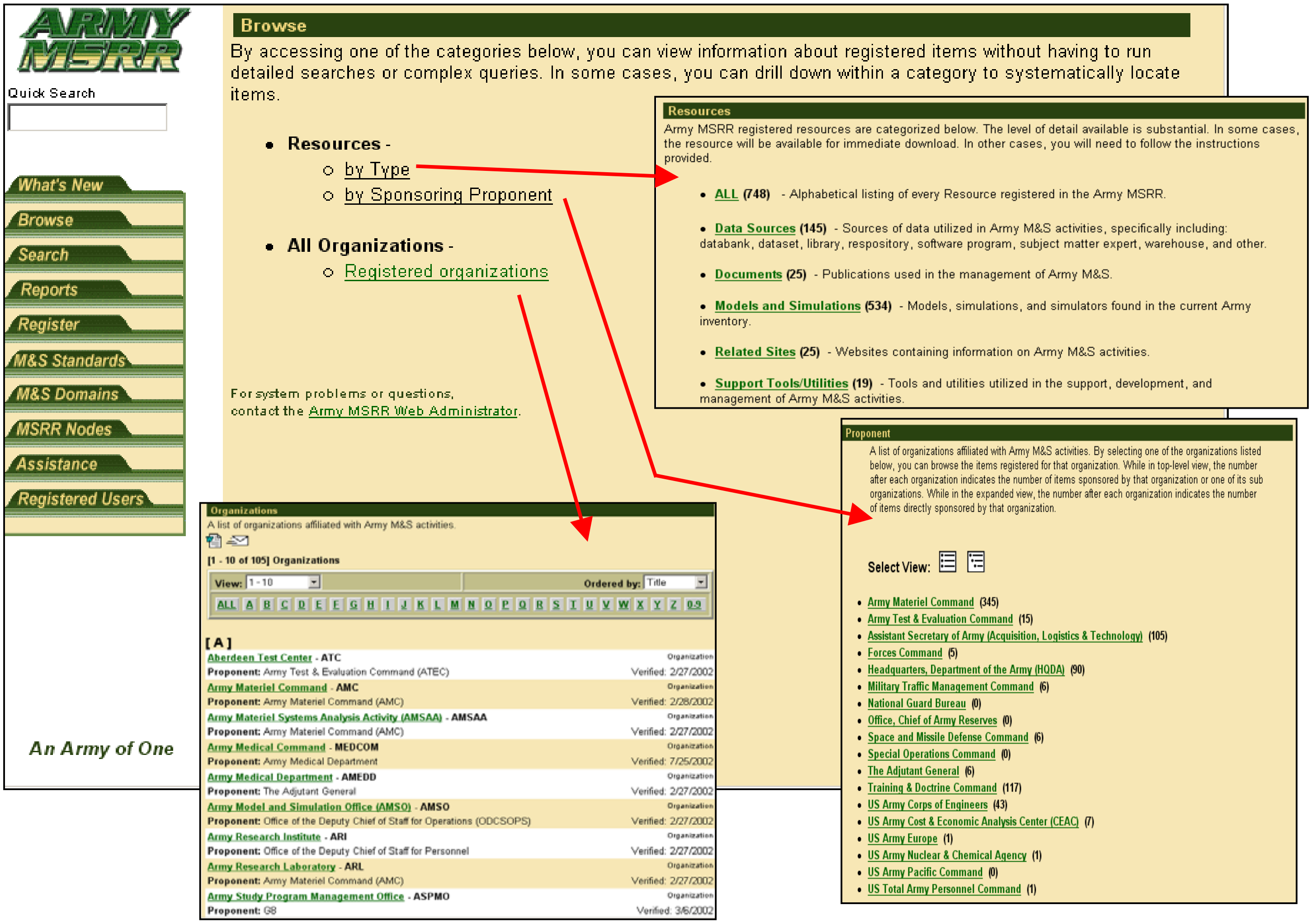


5. Users

Users of the Army MSRR don't have to be registered to view the repository's resources. Registering on the MSRR allows the user to input data—to contribute to the MSRR's resources for others to see and use. Basic queries can be typed in the search window above the index tabs at the top left of the MSRR home page. This is the quickest way to enter a broad "Quick search" for a text string. Viewing can be accomplished through either the **BROWSE** or **SEARCH** hot buttons. **BROWSE** allows the MSRR user to view information about resources without having to run detailed searches or complex queries.

The **BROWSE** index tab opens a page that presents the contents of the MSRR as a table of the various types of resources. If you are trying to see "what's out there?" rather than focusing on a particular system or resource, the **BROWSE** option will prove useful.

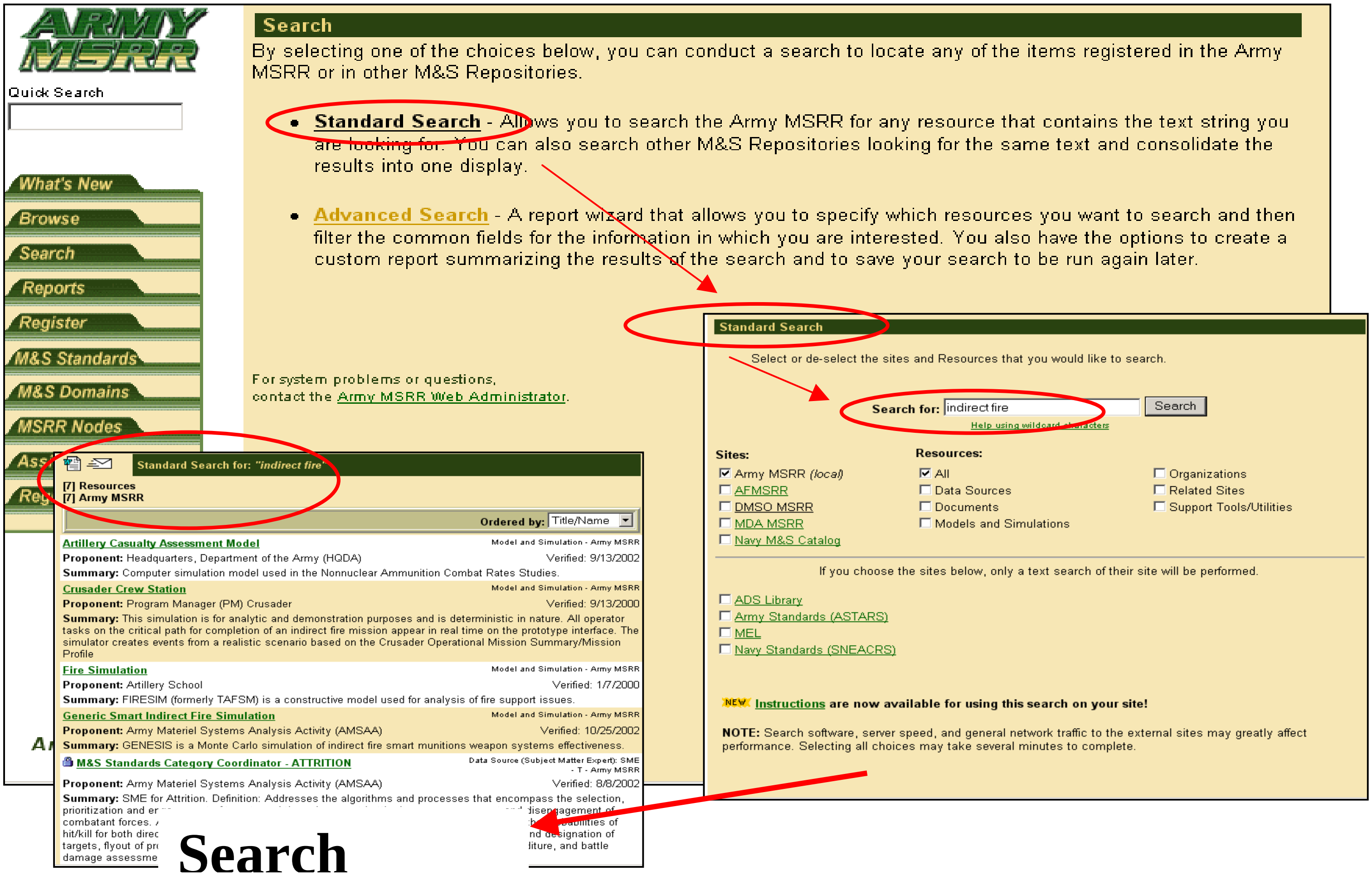
Click on the **BROWSE** button and you will get the screen below. You can **BROWSE** resources by TYPE, SPONSORING PROPONENT, or by REGISTERED ORGANIZATIONS. Examples of what happens when you click on those options are shown below.



6. Search

Allows you to locate resources by either a "Standard" or an "Advanced" search. A standard search is a text string search of the Army MSRR only or the Army MSRR plus other M&S repositories with a single consolidated display. Links are also available on this page to the Army Standards Repository System (ASTARS); the Navy Standards Nomination, Evaluation, Advocacy and Central Repository System (SNEACRS); the Authoritative Data Sources (ADS) Files provided by DMSO; and the Master Environmental Library (MEL). For an advanced search you must specify filters that result in a custom report which can be saved and run again later. The option to run an “Advanced Search” includes the same options for search as the Standard query, but includes an array of Boolean options to define precise criteria based on the contents of specific fields in the record. HELP features prompt the user automatically to assist in properly formatting the search terms. Advanced searches, once defined, can be saved and rerun at will to provide recurring updates on the topic of interest.

Here is an example of a Standard search for resources that pertain to “indirect fire.” You can see that the result is seven resources found. (Army MSRR)



Search

7. **Registration.**

a. **Personal Registration.**

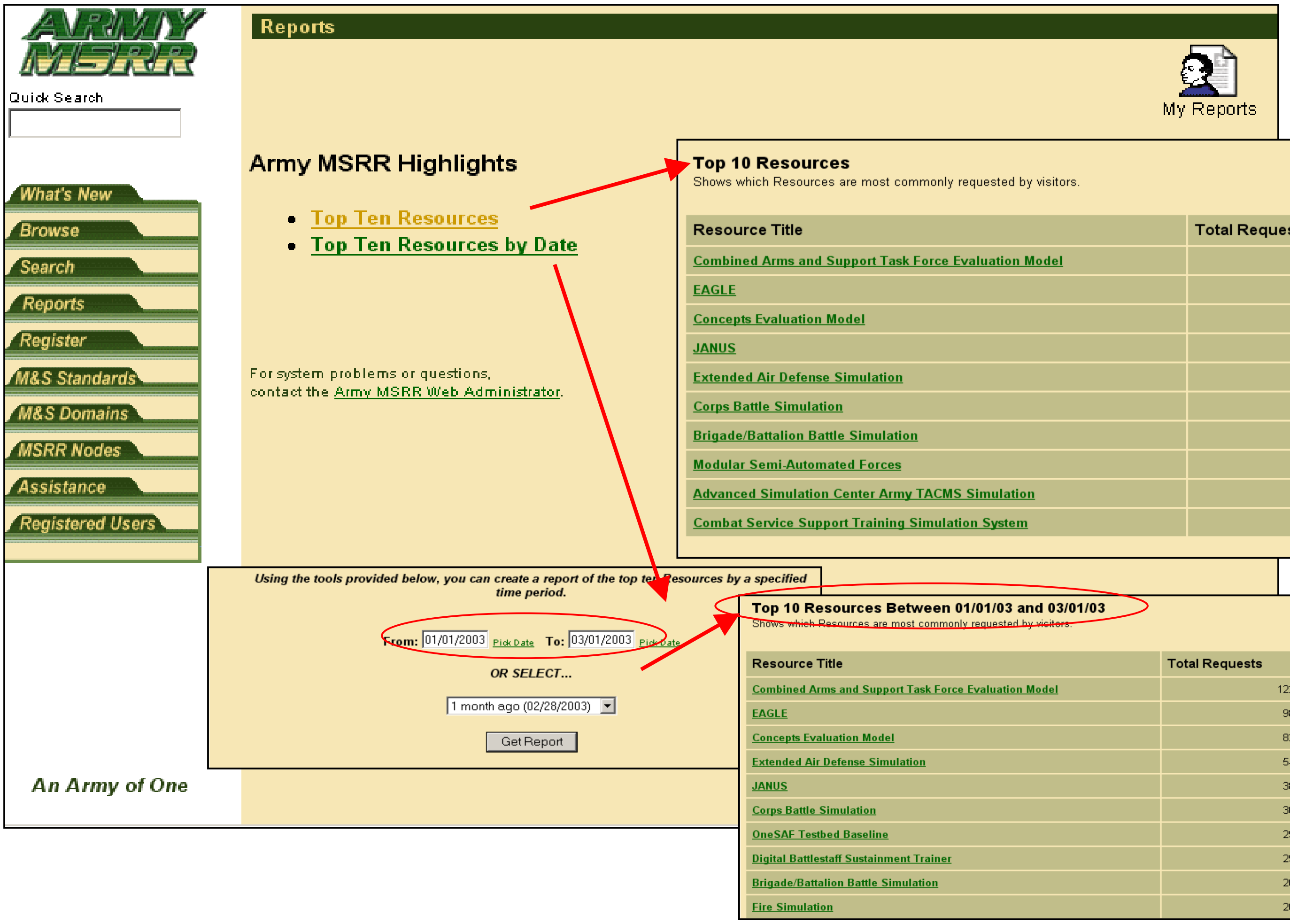
Personal registration is required to post a resource in the repository system. The process for registration begins by clicking on the green “First Time User” banner at the upper right of the Army MSRR Homepage. Registered users can post new resources, and modify, or propose modifications or updates to existing resource entries.

b. **Registering a New Resource**

Among the resources that qualify to be registered are Data Sources (including Subject Matter Experts, libraries, and other repositories), documents, models and simulations (including simulators), related websites, and tools and utilities of use in M&S. A search of the site by type of resource should be sufficient to resolve most questions about the suitability of a resource to be registered. Remaining questions can be directed to the Army MSRR manager.

8. **Reports**

You can query the MSRR to produce reports that show which resources have been accessed most frequently, by total “hits” or within a specific time period. The figure below shows both kinds of reports.



9. Summary

The Army MSRR is a quick and easy on-line resource to find out what M&S resources are out there available to use. Like any repository, it is only as good as the information that is in it. Use it, maintain it, help to ensure that it remains a key source of M&S information. Questions on using the Army MSRR node should be referred to AMSO.

3.B.2 DoD M&S Resource Repositories

1. **History**. The Department of Defense (DoD) Modeling and Simulation Master Plan was developed in 1995 as a result of guidance put forth in DoD Directive 5000.59 (DoD M&S Master Plan). DoD 5000.59 set the initial direction and organization of a variety of programs aimed at solving M&S community challenges (DoD M&S Master Plan). Sub-objective 5-3c of the DoD M&S Master Plan instructed DoD to develop a DoD-level repository system that would provide credible and efficient developer and end-user access to all available M&S community resources (DoD M&S MP, 1995). The result of this requirement is the DoD Modeling and Simulation Resource Repository (DoD MSRR).

2. **General**. The DoD MSRR consists of several, linked, independent classified/unclassified servers accessible through the Internet or the Defense Information Services Network. Each of these nodes, representing several related technology activities in the DoD M&S community, is designed to provide a repository where M&S resources (anything that can be described in writing, i.e., documents, databases, models, simulations, data transformation tools and has potential for reuse can be registered by their owners and discovered by other potential users. The nodes on the DoD MSRR include:
   a. Defense M&S Office (DMSO)
   b. Army MSRR
   c. Navy M&S Information System (NMSIS)
   d. Air Force MSRR
   e. BMDS Integration Data Center
   f. Joint C4ISR Decision Support Center
   g. Defense Intelligence MSRR
   h. Object Model Resource Center (OMRC)
   i. Master Environmental Library (MEL)

   As an FA 57, it is important to be aware of these online M&S information resources and understand how to access and gather information from them. You can access information from most of these sites without registering on them. As a registered user, you can contribute resources so that other M&S users can use them.

   Section 3.B.3 describes all of the MSRR nodes except for the DoD and Army nodes, which are described separately.

3.B.3 Other M&S Resource Repositories

1. **Navy M&S Information System (NMSIS).** The NMSIS is accessed through the Navy M&S Management Office (NAVMSMO) website, http://navmsmo.hq.navy.mil. To gain access to information on Navy M&S resources, click on "M&S Resources" on the left side of the NAVMSMO Homepage. (See picture below). To contact the NMSIS registrar, click on "HELP."

Clicking on "M&S Resources" will take you to the following page. To retrieve the list of Navy models and simulations in the NMSIS, click on "Models and Simulations."

This takes you to the listing of Navy models and simulations as shown in the picture below, listed alphabetically, by title. If you know the name of the model or simulation you need, simply click on the first letter of the title and scroll down the list until you find it.


NAVMSMO

Search Options

Keyword Search START SEARCH

Home | Help

navy modeling & simulation management office

[1 - 50 of 931] Models and Simulations

View: 1 - 50 Ordered by: Title

ALL A B C D E F G H I J K L M N O P Q R S T U V W X Y Z 0-9

[3]

3-Face Simulator — Model/Simulation

Sponsor: NAVSEASYSCOM — Verified: 8/30/2001

Summary: Represents SPY-1 Radar Array Faces

[4]

40MM MK 19 Mod 3 Operation and Maintenance Course — Model/Simulation

Sponsor: Commandant of the Marine Corps — Verified: 1/22/2001

Summary: To familiarize students with the operational characteristics of the 40MM MK 19 MOD 3 Gun.

[A]

A/B-1 shock test vehicle finite element model — Model/Simulation

Sponsor: NAVSEASYSCOM — Verified: 9/23/2002

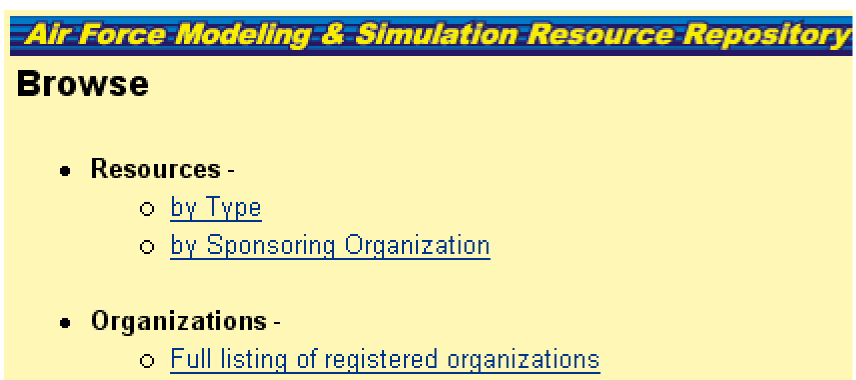
Summary: A tool for shock test planning purposes, to predict the response of the A/B-1 test vehicle from underwater explosive shockwaves.

Acoustic Model Application Project - AMAP — Model/Simulation

Sponsor: Office of Naval Intelligence — Verified: 8/30/2001

Summary: Sonar Performance Prediction

The Air Force and Army MSRRs are organized almost identically. You can peruse AF M&S tools without logging on by clicking on the BROWSE button, which takes you to this page.



Like the Army MSRR node, you can browse by type, sponsoring organization, or registered organization. See the section 3.B.1 (Army MSRR) for examples on what these pages look like and how to use them.

You can also conduct a search, either standard or advanced, as shown in the figure below. Again, see the paper at 3.B.1 (Army MSRR) for more details and a sample search.

Air Force Modeling & Simulation Resource Repository

Search

By selecting one of the choices below, you can conduct a search to locate any of the items registered in the Air Force MSRR or in other M&S Repositories.

- **Standard Search** - Allows you to search the Air Force MSRR for any resource that contains the text string you are looking for. You can also search other M&S Repositories looking for the same text and consolidate the results into one display.
- **Advanced Search** - A report wizard that allows you to specify which resources you want to search and then filter the common fields for the information in which you are interested. You also have the options to create a custom report summarizing the results of the search and to save your search to be run again later.

Looking at the AF MSRR Homepage, you will note the "Top Ten Resources" button. Click on that and you get the option of seeing the ten most often searched-for resources, or the option of inputting a time period to see which were the most often searched for resources in that period. See the pictures below.

Air Force Modeling & Simulation Resource Repository

Top 10 Resources

Shows which Resources are most commonly requested by visitors.

Resource Title	Total Requests
Air Warfare Simulation	7,928
Air Force Standard Analysis Toolkit	4,038
Thunder	2,153
Combat Forces Assessment Model	1,664
Air Force Modeling and Simulation (M&S) Master Plan	1,483
Extended Air Defense Simulation	1,376
Suppressor	1,358
Graphical Input Aggregate Control	1,284
Joint Integrated Mission Model	1,223
PRIME WARRIOR	1,108

Most commonly accessed resources --cumulative

Air Force Modeling & Simulation Resource Repository

Top 10 Resources Between 01/01/03 and 03/01/03

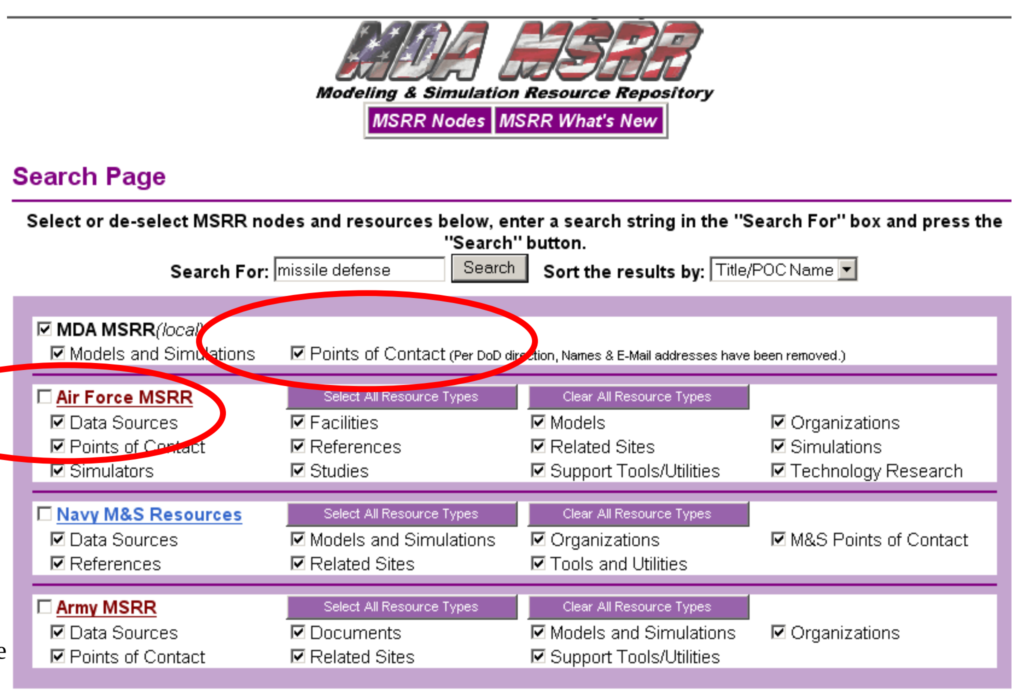
Shows which Resources are most commonly requested by visitors.

Resource Title	Total Requests
Air Warfare Simulation	430
Air Force Standard Analysis Toolkit	174
AFI 16-1001, Verification, Validation, and Accreditation (VV&A)	153
Thunder	75
Air Force C4ISR Modeling Study	72
Air Force Synthetic Environment for Reconnaissance and Surveillance	63
Air Force Modeling and Simulation (M&S) Master Plan	61
Combat Forces Assessment Model	58
Suppressor	55
Joint Integrated Mission Model	51

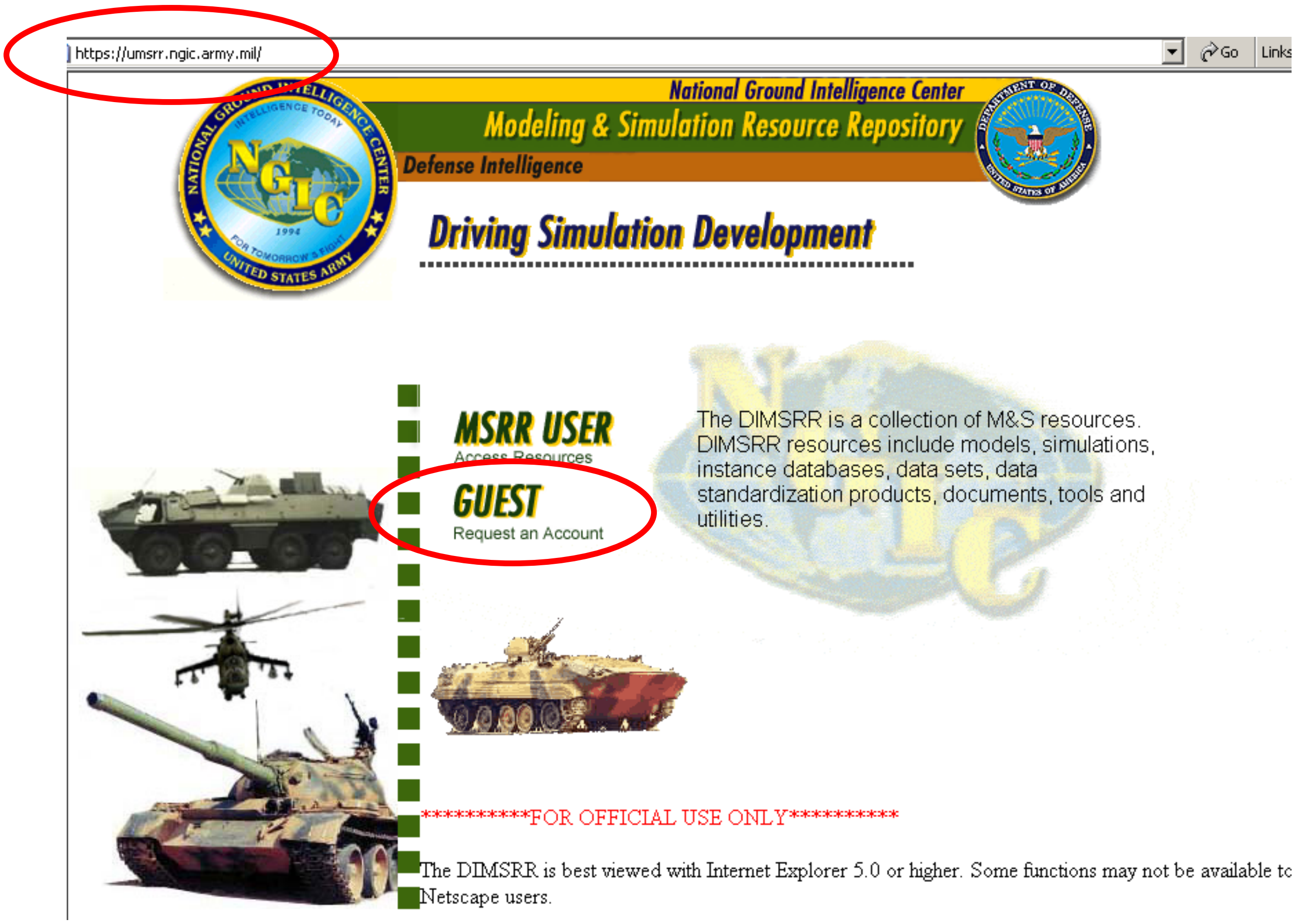
Most commonly accessed resources in a specific period

3. **Missile Defense Agency MSRR Node.** Search the MDA MSRR node for information concerning ballistic missile defense models and simulations. Here is what the MDA MSRR Homepage looks like. The URL is http://bmdssc.jntf.osd.mil/msrr/default.shtm.

Like the other MSRR nodes, you can perform a search by topic or key word. You can also designate which MSRR nodes you want searched. See the example below. The general topic of "missile defense" was entered. The MDA MSRR node is the only node to be searched. Any or all of the others could have been selected merely by clicking in the box next to that node.

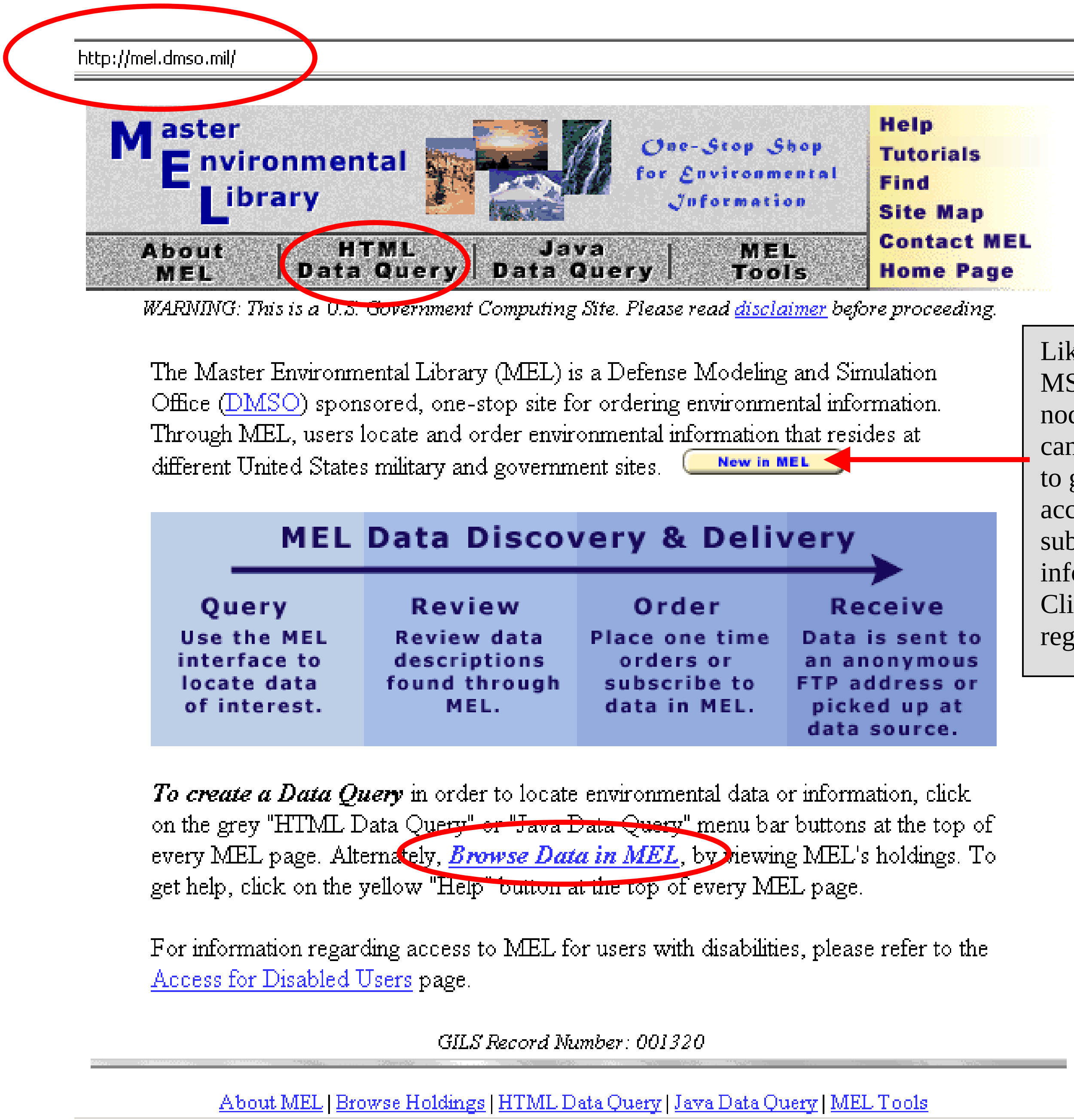


4. **Defense Intelligence Agency (DIA) MSRR Node.** The DIA is responsible for M&S data that represents all non-U.S. systems (equipment). “Non-U.S.” means not only threat, but also allied and coalition countries’ system representation. Go to this site when you need non-U.S. databases for your simulation-supported exercises. Unlike the other MSRR nodes, you have to be a registered user to gain access to any of the information. Here is the DIA MSRR website. The URL is https://umsrr.ngic.army.mil. To request an account, click on “GUEST.”



After Clicking on “GUEST,” you will get the page shown below. Click on Request a DIMSRR Account,” and follow the instructions.

5. **Master Environmental Library (MEL).** The MEL is a special node, differing from the others in that it provides one kind of information only—information about the natural environment. If you need data to build environmental databases, the MEL is the place to look. The MEL will guide you to environment data stored throughout the U.S. at a variety of sites and organizations. Here is the MEL Homepage. The URL is http://mel.dmso.mil.


http://mel.dmso.mil/

Master Environmental Library

One-Stop Shop for Environmental Information

Help | Tutorials | Find | Site Map | Contact MEL | Home Page

About MEL | HTML Data Query | Java Data Query | MEL Tools

WARNING: This is a U.S. Government Computing Site. Please read disclaimer before proceeding.

The Master Environmental Library (MEL) is a Defense Modeling and Simulation Office (DMSO) sponsored, one-stop site for ordering environmental information. Through MEL, users locate and order environmental information that resides at different United States military and government sites. New in MEL

MEL Data Discovery & Delivery

Query	Review	Order	Receive
Use the MEL interface to locate data of interest.	Review data descriptions found through MEL.	Place one time orders or subscribe to data in MEL.	Data is sent to an anonymous FTP address or picked up at data source.

To create a Data Query in order to locate environmental data or information, click on the grey "HTML Data Query" or "Java Data Query" menu bar buttons at the top of every MEL page. Alternately, ***Browse Data in MEL***, by viewing MEL's holdings. To get help, click on the yellow "Help" button at the top of every MEL page.

For information regarding access to MEL for users with disabilities, please refer to the Access for Disabled Users page.

GILS Record Number: 001320

About MEL | Browse Holdings | HTML Data Query | Java Data Query | MEL Tools

Like other MSRR nodes, you can register to gain access or to submit information. Click here to register

To see the kinds of information available through the MEL, click on "Browse Data in MEL." The figure below shows what you will see. Note the wide variety of environment information that is available.

Master Environmental Library — Browse Holdings

Help | Tutorials | Find | Site Map | Contact MEL | Home Page

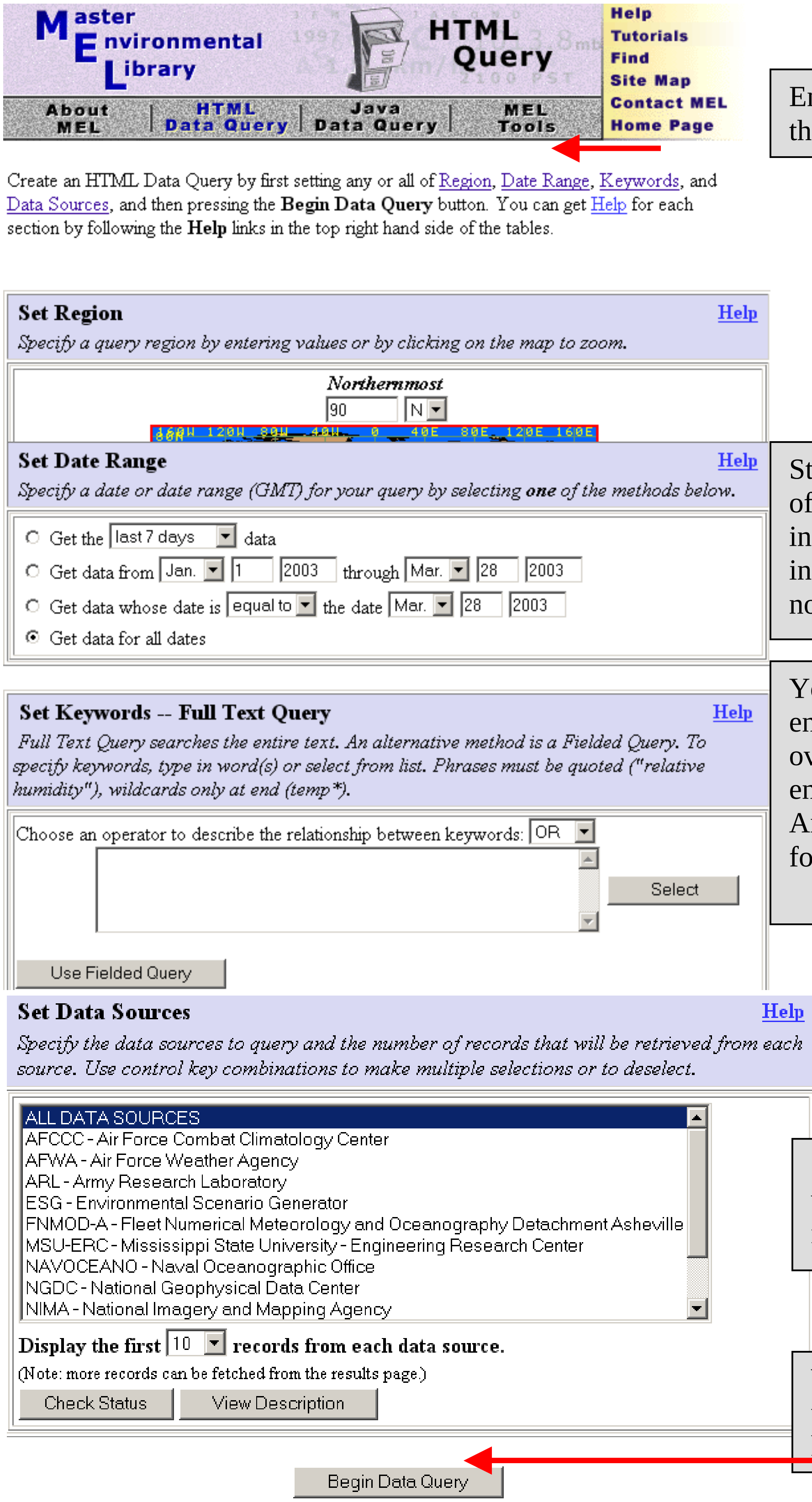
About MEL | HTML Data Query | Java Data Query | MEL Tools

Click on a hyperlink in the table below to browse through MEL's holdings.

MEL Holdings

- Areal Coverage
  Areal coverage descriptions, e.g. Local, Mesoscale, Regional
- Countries
  Country names, e.g. Cyprus, Greece, Turkey
- DoD Locations
  Department of Defense locations, e.g. 29 Palms, Fort Irwin, Ft. Drum
- Environmental Domain
  Environmental domain names, e.g. Air, Ocean, Space
- Exercise and Simulation
  Exercise or simulation names, e.g. AR - Atlantic Resolve, STOW - Synthetic Theater of War
- Originators
- Products
  Product names, e.g. ADCIRC, NOGAPS, DTED0
- Regions
  Region names, e.g. Asia, Middle East, Mediterranean Sea
- Resource Types
  The type of this resource, e.g. Digital database, Image, Model
- Scientific and Engineering Fields
  Scientific and engineering field or discipline, e.g. Atmosphere, Bathymetry, Meteorology
- Temporal Coverage
  Temporal coverage description, e.g. Nowcast data, Historical data, Forecast data
- US States

You can request information on a specific part of the world by using MEL's "HTML Data Query" function at the top of the MEL Website. Click on that button and here is what you will see. Enter information on your desired search area in any or all of the search functions.



Enter information in any or all of these search functions.

Start with the location of the part of the world you want information on. Enter lat/long, information if you know it. If not, click in the area.

You may desire to look at environmental data as it appeared over a specific time period. If so, enter that period here.
Any key words that will help to focus the search should be here.

Specify which data sources you want checked and how many records from each that you want.

When you have completed all of the requested search areas, click here to start the search.

is

3.C Interoperability of Simulations

3.C.1 Distributed Interactive Simulation (DIS)

1. Background

"Distributive Interactive Simulation is a government/industry initiative to define an infrastructure for linking simulations of various types at multiple locations to create realistic, complex, virtual worlds for the simulation of highly interactive activities" [IEEE Std 1278.1-1995]. DIS integrates traditional simulator technologies with computer communication technologies to create a system that provides a common battlefield on which the various simulators can interact in active, real-time situations. [Little, 2002] Data are transmitted across the local area networks or wide area networks using a standard User Datagram Protocol/Internet Protocol (UDP/IP) approach. [Cloud, 1998] The current IEEE standards for DIS are: [IEEE Home Page]

a. IEEE Standard for Distributed Interactive Simulation Application Protocols, IEEE Standard 1278.1-1998
b. IEEE Standard for Distributed Interactive Simulation Communication Services and Profiles, IEEE Standard 1278.2-1995
c. IEEE Recommended Practice for Distributed Interactive Simulation - Exercise Management and Feedback, IEEE Standard 1278.3-1996
d. IEEE Recommended Practice for Distributed Interactive Simulation - Verification, Validation and Accreditation, IEEE Standard 1278.4-1998.

In DIS, individual "systems" like tanks and airplanes are referred to as "entities." Each entity acts as an autonomous simulation, interacting over the computer network with "broadcast" to the other entities simultaneously. These communications are carried out through standardized information formats called Protocol Data Units (PDUs). IEEE 1278.1-1998 establishes the following DIS architecture concepts: [Little, 2002]

a. No central computer controls the entire simulation.
b. Autonomous simulation applications are responsible for maintaining the state of one or more simulation entities.
c. A standard protocol is used for communicating ground truth data.
d. Changes in the state of an entity are communicated by its controlling simulation application.
e. Perception of events or entity is determined by the receiving application.
f. Dead reckoning algorithms are used to reduce communications processing.

2. History

DIS is based on Defense Advanced Research Project Agency (DARPA) SimuLAtor Network (SIMNET) concepts developed in the 1980s. The early goals of the SIMNET program were to guarantee consistency among simulation types and to allow heterogeneous simulators (e.g., helicopters, vehicles) to be connected. In 1990, DARPA combined SIMNET networking technology with simulators from the Navy's Battle Force In-port Training (BFIT) system to successfully demonstrate interactive, distributed, component interoperability. BFIT has since evolved to the current Battle Force Tactical Trainer (BFTT).

In 1992, more than 30 simulators, computer generated force devices, and monitoring systems from more than 20 organizations were linked, for the Interservice/Industry Training Systems and Education Conference (I/ITSEC), to demonstrate basic DIS functions. This demonstration showed the viability of DIS and was largely responsible for gaining industry's acceptance of the standard. [Office of Technology Assessment, 1995]

In 1993, DIS version 1.0 was developed and submitted to the IEEE. [Johnson, 1993] By 1995, DIS had been formally adopted as the IEEE 1278 series of standards. [IEEE Homepage]

The next major milestone in the development of DIS was demonstrated in the 1994 Synthetic Theater of War - Europe (STOW-E) program. The goal was to demonstrate a capability for large-scale battlefield simulation using advanced distributed simulation to combine virtual, constructive, and live simulated combat onto one interactive battlefield. [Office of Technology Assessment, 1995] STOW-E used DIS to link SIMNET simulators with constructive simulations such as Brigade/Battalion Battle Simulation (BBS) and with range instrumentation systems to form one interactive battlefield.

While DIS remains in use, it has been replaced by HLA as the standard technical architecture for Army simulations. [AR 5-11, 1997] The following simulations are DIS compatible:

a. Janus
b. Joint Conflict And Tactics Simulation (JCATS)
c. Digital Battlestaff Sustainment Trainer (DBST) (federation of simulations)
d. Close Combat Tactical Trainer (CCTT)
e. Eagle
f. OneSAF Test Bed (OTB)

3. Importance of DIS

Although the Army does not consider DIS to be a current technology, it continues to be exploited because:

a. It improves simulation quality through entity level resolution of combat and environmental representation.
b. It improves simulation training effectiveness and flexible interfaces with operational command, control, communications, provides computers, and intelligence (C4I) systems.
c. It integrates distributed live, virtual and constructive simulation models.

d. It reduces the overhead costs of knowledge-based, semi-automated forces for simulation.
e. It provides faster databases with improved information transfer.
f. It improves after action and analysis.
g. It provides improved simulation-driven crises rehearsal capabilities. [Office of Technology Assessment, 1995]

In addition to these reasons, which are quoted from the OTA study cited above, the Army has a significant investment in highly effective DIS-based training simulation systems, and a core of expertise for technical support.

4. How is DIS Used

As noted above, the basic link between the various simulations, simulators, and other tools in DIS is a standardized message format called a PDU. A PDU contains information about the status of an object within a simulation (e.g., location, speed, and direction). The prime example of a PDU is the "Entity State PDU" that represents all of the state information about a simulated entity that all of the other simulators need to know. [Hardt, 1998] There are 27 different DIS PDUs that are organized into six protocol families:

a. Entity Information/Interaction
b. Warfare
c. Logistics
d. Simulation Management
e. Distributed Emission Regeneration
f. Radio Communications

The Close Combat Tactical Trainer (CCTT) is an example of how DIS, with its PDUs, can be used to integrate families of simulators and simulations to support research, development, and operational related activities.

IEEE 1278.3 provides guidelines for preparing and conducting DIS supported exercises.

5. When is DIS Used

DIS is used to link live, virtual, and constructive simulations and/or simulators that are physically or logically separate, to create virtual environments.

6. Important Considerations

The use of DIS continues because it has a well-understood, standard set of protocols that have been applied successfully for many years. Also, there has been wide acceptance within the commercial market for DIS as an international standard. The following are some important considerations for the use of DIS:

a. Unit of communication:
   1. Represented by a finite set of Protocol Data Units (PDUs)
   2. PDUs have a well-known and documented static structure
   3. PDUs are pre-defined and are not driven by federation needs

b. Methods of communication:
   1. Stream of regular PDUs broadcast to all participants.
   2. Entity State PDUs are the most common PDUs. One Entity State PDU is intended to fully describe an object's state.
   3. Simulations send an Entity State PDU at least once every time-out period (generally 5 seconds) even if it has not changed
c. Declaration management and DM Services:
   Broadcast – All PDUs are delivered via broadcast, so every federate has access to all of the federation data.
d. Time Management
   1. Simulations try to maintain a 1:1 relationship between simulated time and real world clock time because they normally involve humans in the loop.
   2. There are no time management functions to support faster than real time simulation or event synchronization between different simulations. Event synchronization can only be achieved by synchronizing the machine clocks of the different hosts that the DIS simulations are running on.
e. Extensibility
   1. Desired changes in PDU formats or meanings require formal specification changes.
   2. Because of the length of the approval process, developers use "experimental" DIS PDUs or overload existing PDU components with new meanings.
f. Repeatability

Because of the use of the network and the lack of a way to 'quarantine' ordering of events, DIS is not guaranteed to be repeatable.

3.C.2 Aggregate Level Simulation Protocol (ALSP)

1. Background

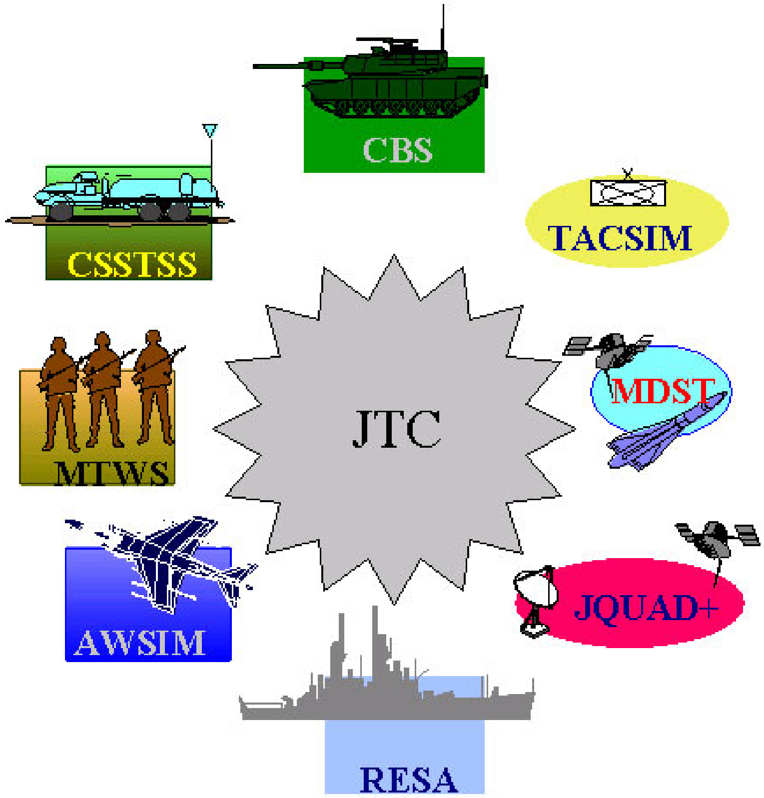
The Aggregate Level Simulation Protocol (ALSP) is a combination of software and protocols that allows disparate simulations to communicate with one another. [Mitre-What is ALSP, 2003] ALSP has been used to interface simulations for a number of different purposes (e.g., Air Traffic Control). However, within DoD, it is used primarily to interface components of the Joint Training Confederation, a family of analytic and training simulations used to support both joint and service sponsored training exercises.

An ALSP interface consists of a set of data exchange message protocols that enable interaction among objects represented in different simulations (e.g., an aircraft in one simulation and an air defense system in another). These interactions are based on four basic principles: (1) distributed computation based on combat entity ownership; (2) avoidance of single critical resources; (3) reliance on broadcast communications; and (4) replication of a limited set of combat entity attributes among all simulations. [Weatherly, 1991] ALSP Version 7.6 can be executed in the following four operating environments:

a. DEC VAX/VMS version 7.1,
b. Sun Solaris version 2.6,
c. SIG IRIX version 2.6,
d. Hewlett-Packard UNIX (HPUX) version 10.10

Each ALSP confederation consists of five basic components: the actors (simulations), the ALSP Common Module (ACM), the ALSP Broadcast Emulator (ABE), the ALSP Control Terminal (ACT), and the ALSP Confederation Management Tool (CMT). The sponsoring agency, for each actor, is responsible for its development and release. The ALSP Executive Agent releases the other four components, which are collectively referred to as ALSP Infrastructure Software (AIS).

a. In ALSP, the "actors" are the individual simulations that have been adapted to interoperate through the AIS. [STRICOM, 1999] In 2002, the JTC consisted of the following "actors": [Mitre-What is JTC, 2003]
    1. Air Warfare Simulation (AWSIM).
    2. Corps Battle Simulation (CBS).
    3. Combat Service Support Training Simulation System (CSSTSS).
    4. JC2WC Joint Simulation Models (JQUAD).
    5. Marine Air-Ground Task Force (MAGTF) Tactical Warfare Simulation (MTWS).
    6. Missile Defense Tool (MDST).
    7. Research, Evaluation and System Analysis Simulation (RESA).
    8. Tactical Simulation (TACSIM).



Joint Training Confederation

b. There is an ACM associated with each actor (or simulation). It provides a common interface between the actor and the rest of the confederation. The ACMs filter messages that are not of interest to their respective actor, regulate time, and facilitate the passing of the privilege to update values. [STRICOM, 1999]
c. The ABE receives messages from an ACM or another ABE and transmits the messages to other ACMs and ABEs in the confederation. [STRICOM, 1999] In operational terms, the ABEs serve as centralized message distribution centers for the confederation.
d. The ACT provides local or remote user access to the ABEs or ACMs. It uses a screen driven display/process to monitor and control confederation and actor activities. [STRICOM, 1999]
e. The CMT allows the user to change quickly from running an ACT as a window on a single component's operations to running the CMT to gain a global perspective on the evolution of confederation time, the health of the communications network, and confederation object definitions. [STRICOM, 1999]

See the Introduction Section to the ALSP Infrastructure Software User Manual [STRICOM, 1999] for additional information on the AIS and its component functions.

2. History

ALSP grew out of a 1990 Defense Advanced Research Projects Agency (DARPA) study that examined the possibility of applying Distributed Interactive Simulation (DIS) principles to the integration of aggregate level constructive training simulations.

In its first attempt, DARPA developed the software and protocols to link the U.S. Army's Corps Battle Simulation (CBS) and the U.S. Air Force's Air Warfare Simulation (AWSIM). By 1993, ALSP was sufficiently developed to support Exercise Ulchi Focus Lens (UFL93) with players and response cells located in Korea and Japan. The simulations, CBS and AWSIM, were executed on computers at the Korea Battle Simulation Center (KBSC) and the Warrior Preparation Center (WPC) in Germany, respectively. [Fischer, 1994] That same year, the Under Secretary of Defense for Acquisition through the Executive Council for Modeling and Simulation (EXCIMS) chartered the Joint Training Confederation (JTC). ALSP then transitioned to a multi-Service program under the JTC [Fischer, 1994]

The current ALSP management structure is described in the ALSP Management Plan. [Mitre-Documents, 2003] Briefly, there are two organizations that participate in ALSP development. The ALSP Executive Agent who is responsible for executing the program, including management of the ALSP System Engineering core support, and the ALSP Interface Working Group (IWG) that implements Program activities. The IWG's subgroups are comprised of users, model developers and government proponents. IWG activities include managing ALSP development, integration, and testing processes to bring new protocols, functions, simulations and system software into ALSP.

The following is a list of JTC/ALSP supported exercises:

a. Ulchi Focus Lens (UFL), KBSC, Seoul, S. Korea
b. YAMA SAKURA 03, KBSC, Seoul, S. Korea
c. Unified Endeavor (UE-03-01), JTASC, Suffolk, VA
d. RS01 03, KBSC, Seoul, S. Korea
e. Prairie Warrior, National Simulation Center (NSC), Ft. Leavenworth, KS
f. Urgent Resolve, WPC

3. Importance of ALSP

ALSP is currently the only interface software used by DoD that is designed to accommodate current systems, and accredited for use with the JTC. As such, it provides the capability to train senior service and joint staffs using service developed and accredited aggregate level constructive simulations in joint and coalition environments.

4. How is ALSP Used

ALSP is primarily used as a part of the Joint Training Confederation to train senior military leaders and their staffs in joint/coalition operations. Since most organizations employing FA 57s will also be JTC users, the FA 57s can expect, on occasion, to participate directly or indirectly in one or more of the ALSP IWG working groups.

5. When is ALSP Used

ALSP is used, or must be considered, during the preparation, execution, and post analysis phases of JTC-supported exercises. The following documents provide additional information related to ALSP operations and functions:

a. The Aggregate Level Simulation Protocol (ALSP) Infrastructure Software (AIS) User Manual, Version 7.6. This manual describes AIS field entries and the implications of various field values; it lists the available operator command and the effects each command has on system operation; and it provides information useful in recognizing and managing confederation-related problems.
b. The Aggregate Level Simulation Technical Specification Manual. This manual describes the message protocol between the AIS and each actor as well as the operational constraints imposed on each actor when it is being operated as a confederate in the JTC.
c. The Joint Training Confederation Operational Specification (2002). This document provides an aggregated overview of the message protocols and the capabilities of the JTC.

6. Important Considerations

The following considerations apply to the use of ALSP in the JTC:

a. ALSP applies only to the discrete-event, logical-time niche of the M&S market.
b. ALSP is designed to accommodate legacy simulations, which must, themselves be adapted to the technical interface requirements of the ALSP.
c. ALSP evolution is driven by JTC needs and requirements.
d. Since ALSP can be run under four different operating systems, it needs to support two different communications protocols. When operating in the Solaris, Irix, or HP Unix environments, ALSP supports only TCP/IP. But when operating in a VMS (VMS) environment, ALSP supports either DECnet or TCP/IP.
e. Actors, linked via the AIS, must conform to the following conventions:
    1. Actors may not be able to control some of the objects in the game-space.
    2. Significant changes to simulation objects must be reported to the rest of the confederation by the actor controlling the object.
    3. Actors must coordinate advances in simulation time with that of the confederation.
f. In ALSP/JTC events in which both the Army Corps Battle Simulation (CBS) and the Marine Corps MAGTF Tactical Warfare Simulation (MTWS) are participating, it is important to consider geographic separation of the synthetic forces operating in the two systems. Separation is recommended because, even with the ALSP interface, CBS and MTWS ground forces do not share a common ground situation, i.e., CBS ground forces located at a given coordinate cannot detect MTWS forces at the same coordinate, and vice versa.

Terminal operators can track units in the other ground combat simulation by "ghosting"; that is, a ground unit in one of these simulations can be displayed on the terminal of the other system, but the ghosted symbol is not functional in the local simulation. To date software changes to enable units of the two simulations to detect and interact appropriately with each other has not been considered cost effective by either service. MTWS aviation assets appear and interact appropriately with CBS units, but Army attack helicopters are not visible in MTWS. Indirect fire functions correctly cross both simulations. Nevertheless, geographic separation between the Army and Marine Corps land forces in a Joint scenario is considered the best method to avoid complicated work-arounds for coordination of forces.

3.C.3 High Level Architecture (HLA)

1. Introduction

The High Level Architecture (HLA) is a software architecture that provides the ability to link different simulations, simulators, models or other tools (including C4I systems) to support training events, experiments, or analyses for the commander.

HLA has a language of its own: acquisition, individual simulations, simulators (such as a tank or a helicopter), models, or other tools are referred to as "federates"; when individual federates are linked together under specified HLA rules, they form a "federation."

HLA was developed based on the following premises:

a. No single, monolithic simulation can satisfy the needs of all users.
b. All uses of simulations and useful ways of combining them cannot be anticipated in advance.
c. Future technological capabilities and a variety of operating configurations must be accommodated.

As a result, a method involving a composable approach to constructing simulation federations was developed. The resulting design principles are that federations of simulations are constructed from modular components with well-defined functionality and interfaces, and that the specific simulation functionality is separated from the general purpose supporting runtime infrastructure. HLA consists of a set of three standards:

a. The HLA Rules.
b. The HLA Interface Specifications (IF).
c. The HLA Object Model Template (OMT).

The HLA Rules define and outline the responsibilities of HLA federates and federations to ensure a consistent implementation. The Interface Specification describes a generic communications interface that allows simulation models to be connected and coordinated, thus, partially addressing interoperability. The Object Model Template forms a documentation standard describing the data used by a particular model, a necessary basis for reuse (IEEE Std 1516-2000).

The HLA calls for a federation of simulations (federates) that are linked together by supporting software called the Runtime Infrastructure (RTI). The IEEE 1516-2000 standard defines a federation as "a named set of federate applications and a common federation object model (FOM) that are used as a whole to achieve some objective." It further defines the RTI as the software that provides common interface services during an HLA federation execution for synchronization and data exchanges. The FOM is defined as a specification defining the information exchanged at runtime to achieve a given set of federation objectives. This includes object classes, object class attributes, interactions classes, interaction parameters and other relevant information. The FOM is like a contract between the individual federates that specifies what kinds of information will be passed between them.

Each federate has a Simulation Object Model (SOM). The SOM, according to the IEEE 1516-2000, is "A specification of the types of information that an individual federate could provide to HLA federations as well as the information that an individual federate can receive from other federates in HLA federations. The standard format in which SOMs are expressed facilitates determination of the suitability of federates for participation in a federation." The SOM is an advertisement where the federate is advertising what its capabilities are. Other federation members can see the SOM and decide what kinds of information they need from that federate. An advantage of HLA over DIS is that federation members can select what information they get from other federation members, thus reducing the amount of data going through the communications link (DIS sends everything about an object to every simulation, whether or not the receiving simulation needs it).

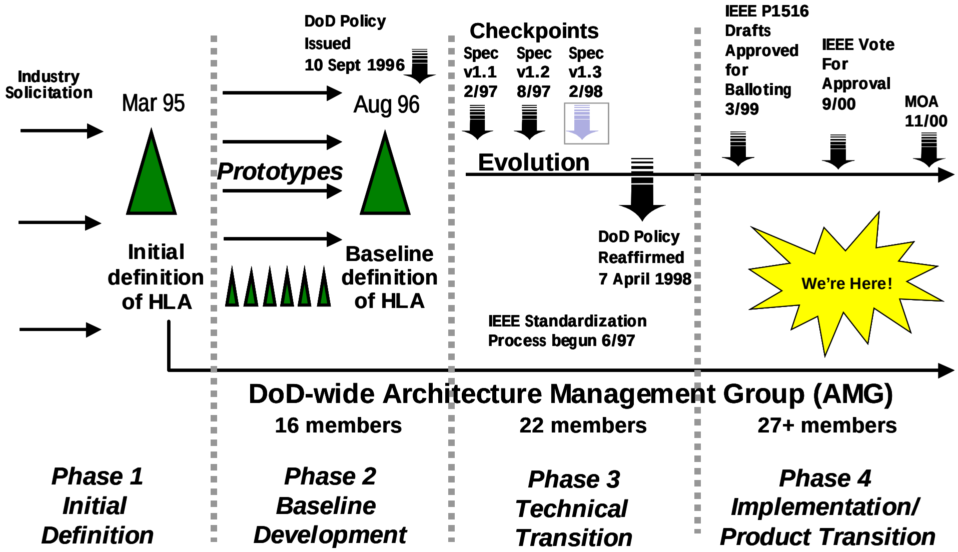
2. Short History of HLA

"The Director of Defense Research and Engineering (DDR&E) assigned the Defense Modeling and Simulation Office (DMSO) the objective of assuring the interoperability and reuse of military simulations" (Kuhl, 2000). This vision was laid out in the DoD M&S Master Plan objective 1-1. In 1995, DMSO set out to define the High Level Architecture. The baseline HLA definition was completed August 1996 as version 1.0 and in September 1996 (DoD 1996), HLA was designated as the standard technical architecture for all DoD simulations.

To prove the HLA concept, the architecture was prototyped in 1996 using four proto-federations (Kuhl, 2000). By March 1998, DoD version 1.3 had been released. The Architecture Management Group (AMG) was established as a sub-group of the DoD Executive Council for Modeling and Simulation (EXCIMS). The mission of the AMG is to advise and assist the EXCIMS in the development and promulgation of the High Level Architecture (HLA) for simulation throughout the Department of Defense. The AMG has the following four functions:

a. Oversees the technical evolution of the High Level Architecture.
b. Oversees the development of supporting tools, implementations, applications, and capabilities by the DoD M&S community.
c. Facilitates and encourages communication between DoD M&S activities about the use of the HLA.
d. Oversees the migration of the HLA technical architecture to national or international standards.

The chart below represents the HLA development timeline up to the year 2000.



Documentation for the DoD 1.3 version of the standard can be found at the DMSO HLA homepage. (https://www.dmso.mil/public/transition/hla/techspecs, Retrieved Feb 2003). Currently this is the DoD accepted version of the standard; however, once a viable RTI has been verified and accepted, the AMG will recommend that DoD adopt the IEEE standard.

By 1997, the Army had called out the HLA standard in AR 5-11 and the Joint Technical Architecture (JTA) – Army. The Technical Architectural Steering Group adopted the HLA Standard in the DoD JTA 2.0 in 1998 (http://www-jta.itsi.disa.mil/, Retrieved Feb 2003). With these mandates, the Army and the rest of DoD began to transition existing simulations to become compliant with the HLA. Some of the earliest Army federates to undergo HLA compliance testing in 1998-99 included: Soldier Station, v. 1.0; ASESS 3.0; Sea Port Military Operation Simulation Model (PORTSIM), v. 3.1; ModSAF, v. 5.0; Enhanced Logistics Intra Theater Support Tool (ELIST), v. 7.3; Integrated Unit Simulation System (IUSS); and Reconfigurable Virtual Fire Unit (RVFU).

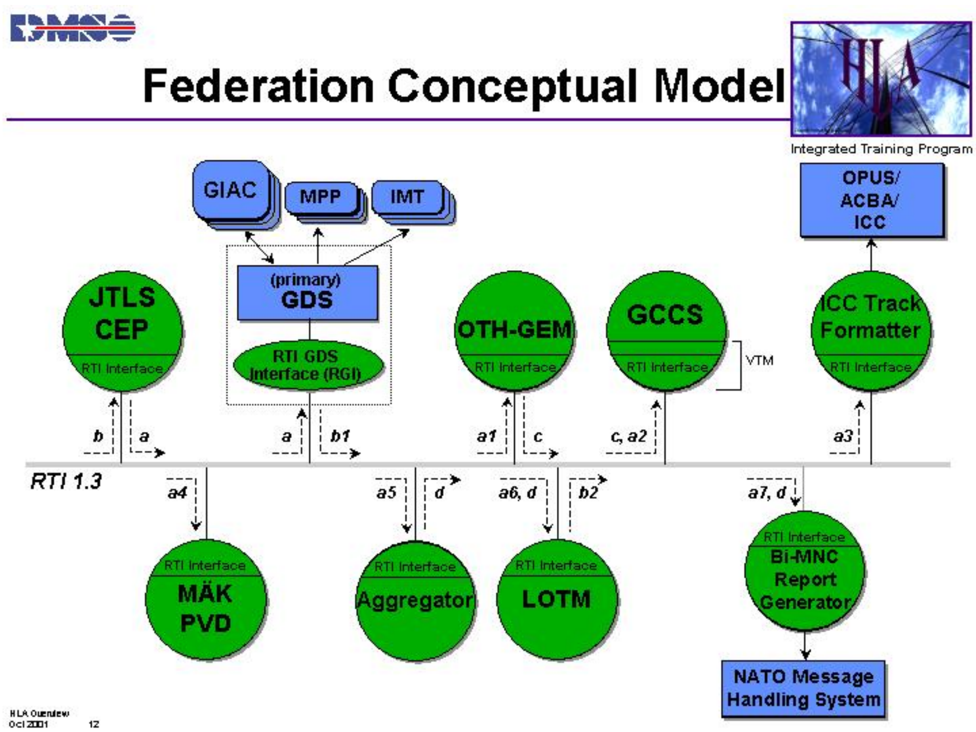
To gain wider acceptance of HLA, DoD submitted the HLA standards to two standards bodies, The Object Management Group (OMG) and the IEEE. The Interface Specification was adopted by the OMG and the current version is Distributed Simulation System (DSS*)* Final Adopted Specification, 2002-05-02 (http://www.omg.org/cgi-bin/doc?dtc/2002-05-02, Retrieved May 2003). The IEEE adopted the HLA Standard in September 2000 as the IEEE 1516 series (http://www.ieee.org, Retrieved Feb 2003).

In November 2000, all of the services signed a Memorandum of Agreement (MoA) that "The High Level Architecture (HLA) shall be the standard technical architecture for interoperability among DoD simulations and where the potential for reuse exists, any other alternative approach must be justified" (Gansler, November 2000). This MoA directed that each DoD component manage and implement its own HLA programs.

In 2002, DMSO began to transition the HLA program. In September, the DMSO-sponsored RTI Next Generation was removed from the software distribution center. This was not an abandonment of the HLA program and technology by the DoD, but rather recognition of the development of a commercial HLA support base. The DoD has retained an interest in and support of those aspects of the HLA program that are not commercially viable or that could impact the DoD's goals of achieving interoperability and reuse among simulation components. RTI Verification, HLA Certification and the Resource Repositories fall into this category.

3. Why We Use HLA

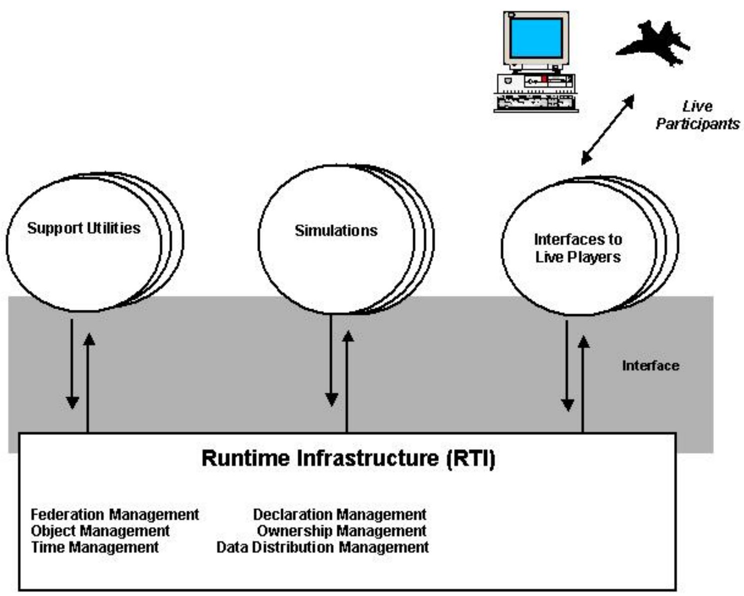
For the simulation designer, HLA is used to bring the best simulations, simulators, models, or other tools together to support the M&S needs of the commander. For example, this might mean a federation consisting of the Joint Theater Level Simulation (JTLS) and the Joint Conflict and Tactical Simulation (JCATS), linking an aggregate level simulation (JTLS) with an entity level simulation (JCATS). This federation would allow the commander to train staffs at a theater level while integrating a special operations unit that operates at the entity level into the overall training event. A second example would be a federation of the Avenger Institutional Conduct of Fire Trainer (ICOFT) with ModSAF to provide ground/air forces that are normally not available. This is how the Avenger ICOFT underwent HLA compliance testing. A third example would be the federation of simulations to real C4I systems. This was demonstrated in the JTLS-GCCS-NATO C2 Federation Experiment where JTLS was federated with various C4I systems. The federation successfully demonstrated that HLA could be used in this manner. The conceptual model looked like the following.



4. How HLA Is Used

As discussed above, the HLA is built around a federation. The chart below provides a sample view of how the federates interact with each other in the federation. In this example each federate passes and receives the various object classes, object class attributes, interactions classes, interaction parameters, and other relevant information as indicated in their SOM. During federation execution the following occurs:

a. Federation Execution Data (FED - an extract of the FOM) is supplied to the RTI when federation execution is created.
b. The RTI must know the names of interaction and object classes, and parameters and attributes, and must know the hierarchy of classes. One federate sends an interaction by invoking one of the many RTI services. The RTI decides which federates will receive the interaction, and invokes a service on each.
c. Each interaction carries named data called parameters.



HLA Federation Interaction

To support the federation developer, DoD has developed an HLA Federation Development and Execution Process (FEDEP) Model. The IEEE-SA Standards Board approved the FEDEP P1516.3 as a recommended practice on 20 March 2003. The purpose of the FEDEP is to describe a high-level process that HLA federations can develop and execute to meet the needs of the federation developer or sponsor (http://www.ieee.org, Retrieved May 27, 2003).

Step 1: Define Federation Objectives. The federation user and federation development team define and agree on a set of objectives that support the users' needs, and then document what must be accomplished to achieve those objectives.

Step 2: Perform Conceptual Analysis. Based on the characteristics of the problem space, an appropriate representation of the real world domain is developed to support the set of objectives defined in step 1.

Step 3: Design Federation. Federation participants (federates) are determined, and required functionalities are allocated to the various federates.

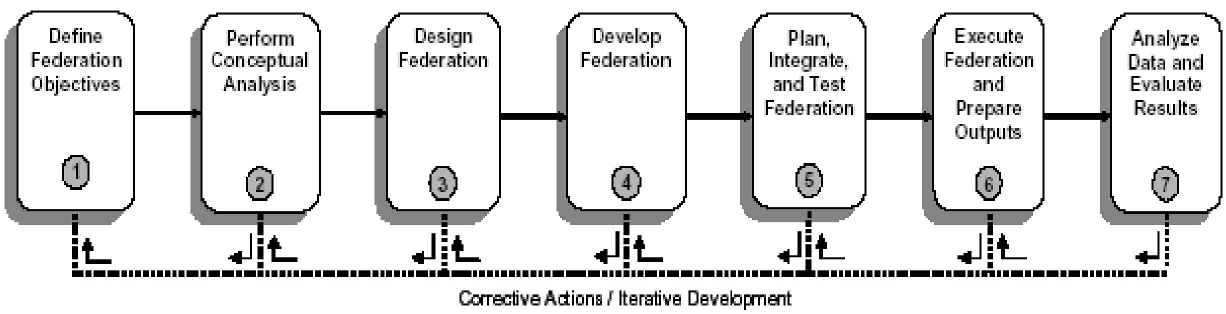
Step 4: Develop Federation. The Federation Object Model (FOM) is developed, federate agreements on consistent databases/algorithms are established, and modifications to each federate are implemented (as required).

Step 5: Plan, Integrate and Test Federation. All necessary federation implementation activities are performed, and testing is conducted to ensure that interoperability requirements are being met.

Step 6: Execute Federation and Prepare Outputs. The federation is executed, outputs are generated, and results are provided back to the user in order to determine if the objectives were met.

Step 7: Analyze Data Evaluate Results. The output data from the federation execution is analyzed and evaluated, and results are reported back to the user/sponsor.

The figure below provides a top-level view of the process.



HLA Federation Development and Execution Process (FEDEP) Model

5. Important Considerations

There are several important considerations in the use of HLA.

a. HLA applies to multiple time management schemes.
b. HLA separates data from the architecture – evolves data as required by applications.
c. HLA selectively passes data among simulations.
d. HLA is built around simulation services that DIS does not contain.
e. HLA was developed with a set of supporting tools; the first set of tools was provided free from DMSO and is still available at the Software Distribution Center (SDC) (http://sdc.dmso.mil/).
f. DMSO encouraged commercial vendors to develop their own sets of tools and their own RTIs. A list of vendors is also available from the DMSO website (https://www.dmso.mil/public/transition/hla/vendorlist).
g. The Army requires in AR 5-11 that simulations are HLA compliant. HLA only applies to simulations.

3.C.4 Interoperability with Real World Weapons Systems

1. Introduction

The rapid advances in computer technology in recent years have opened new possibilities to integrate simulations with real-world weapons systems. The potential suggested by continuing advances in this area is technically quite large, and the trend toward more embedded simulations is clear, but there are questions yet to be definitively addressed. No current systems can be said to "require" simulations for operation, but all combat systems now use simulation technology to improve operator proficiency, team skills, and operational decision-making.

The simulations now in wide use were generally developed to support training in a specific combat system. Although they were developed under a common philosophy, they were developed separately, and were often not designed for networking with other system simulators. Moreover, depending on the maturity of the combat system and the projected arrival date of a replacement, the simulation based training devices that support it may be projected for retirement with the system they represent. On the other hand, the technology of the training devices and systems themselves may prompt replacement of the training systems supporting a mature weapons system. Compounding this issue of technology timing is the corresponding challenge of successfully linking simulations for individual, crew or team, and staff training – that is, live, virtual and constructive simulations into a seamless virtual training environment. Hence, linking simulations to real combat systems or networks of systems poses many challenges.

2. Embedded training

The Army began to meet these challenges with the concept of embedded training, in which sophisticated, system-oriented training devices, incorporating simulation techniques were made available to individual units, or to installations where many such units could share the resources. In 1987, the Commanding General of TRADOC, then General Maxwell Thurman, defined embedded training as a "capability built into or added onto operational equipment and systems. It enables training delivery to soldiers using their own equipment while in the field or at home station." [Roos, 2002]

3. Virtual Simulations

For practical reasons, the embedded training concept has been realized most widely at the unit level, rather than being literally embedded integral to the operational system. Elaborate systems providing realism down to the operator level have been deployed to fixed training sites, or set up with deployed units. But these training systems, while highly realistic, are usually separate from the operational hardware. Thus, there are systems such as the elaborate motion-based driver simulators and flight simulators, based on a specific combat vehicle. For engagement training, Conduct of Fire Trainers (COFT) have developed to help develop and improve the target acquisition and gunnery (or engagement) skills for the crew of a single vehicle, battery, or team of operators of a single system. Some of these trainers have a single instructor workstation to control multiple crews, and may support practice of small unit tactics by multiple crews.

The next echelon of embedded training encompasses small formations. Currently, the Close Combat Tactical Trainer (CCTT) represents the most advanced form of this simulation-based embedded training currently available. CCTT creates a virtual environment to operate and challenge a formation of multiple live crews "operating" realistically detailed modules designed to represent various vehicles including M1 Abrams, M2/M3 Bradley, M113, HMMWV, and others. The aviation equivalent of CCTT is AVCATT – the Aviation Combined Arms Tactical Trainer. AVCATT uses networked cockpit simulators to perform unit collective and combined arms training in a simulated battlefield environment. CCTT, and the other CATT devices, Engineer CATT, Air Defense CATT, and Fire Support CATT can be linked in an expanded network employing the Distributed Interactive Simulation (DIS) networking protocol.

4. Live Simulations

The premier simulation-based live training system is the Multiple Integrated Laser Engagement System (MILES). The latest version of the MILES concept is MILES 2000. MILES equipment, tailored to most individual soldiers and most crew served weaponry, has enabled realistic, but non-lethal, live simulation of combat operations in field conditions. MILES lasers and laser detection equipment enable the individual combatant or crew, trainers, and controllers to know and analyze the detailed outcomes of actual engagements. MILES is used primarily during force-on-force (FOF) exercises from squad through brigade level. MILES enables a high degree of reality in a non-lethal field training engagement simulation, but is difficult to integrate directly into either a virtual or constructive simulation environment. Experimentally, MILES-equipped soldiers have operated inside an instrumented range environment in which the current location, movement, and status of each player can be monitored. An additional process is necessary to convert this location/status/activity data to information that can be integrated with a synthetic environment (currently as DIS Protocol Data Units - PDUs), but that capability has been demonstrated in dedicated efforts. The Mobile Automated Instrumentation Suite (MAIS) is a system used to monitor and display the current location/status/activity of individual combatants and systems in simulated field engagements. MAIS is a portable instrumentation system developed for Army Test and Evaluation Command to support operational testing. It uses UHF radio links from each participating soldier or vehicle (including helicopters and fixed-wing aviation) to a central monitoring post and can monitor up to 1830 participants in real-time. MAIS plans upgrades over the next decade to accommodate interaction with virtual and constructive simulations. MAIS (or something like it), integrated with a MILES-like capability will be required to fully integrate live simulations with virtual and constructive.

5. Constructive Simulations

Of the current constructive simulations in the Army, those that operate at approximately real-time are more appropriate for integration with weapon systems. Janus, a well known constructive simulation generally supporting Brigade and lower echelon training, has been interfaced to a variety of systems using the DIS networking protocol. Increasingly, the Joint Conflict and Tactical Simulation (JCATS), which operates much like Janus but supports a larger terrain box and a higher number of individual entities, is being used in this role. Currently, JCATS is linked via DIS to TACSIM and Multiple UAV Simulation Environment

(MUSE) for intelligence training. TACSIM can take JCATS constructive data and generate USMTF-formatted text reports for input to the real-world intelligence system, All-Source Analysis System (ASAS), while MUSE surveys the synthetic JCATS battlefield to create synthetic “imagery” of friendly and enemy entities on the battlefield. A synthetic JSTARS system is also compatible with this training environment to visually identify moving vehicles from the Janus or JCATS battle space. JCATS can be adapted readily to an HLA interface when legacy DIS-based simulators or simulation systems are replaced or upgraded.

The Digital BattleStaff Training (DBST) system is another Army program that has integrated constructive simulation with live and virtual training environments. DBST serves as a core technical infrastructure around which M&S systems, data collection and After Action Review (AAR) systems, and virtual and live forces can be supported. DBST provides a logical digital interface to Army Battle Command System (ABCS). DBST’s links use the various components of ABCS to display a seamless virtual battle space for echelons up to Brigade. Live and simulated forces can be tracked and coordinated within the simulation/ABCS confederation, and use of the real ABCS systems enables use of tactical communications and realistic communications models to replicate real-world communications with live forces.

6. Embedded Simulation

Embedded simulation capabilities have long been included in certain instances where a benefit could be demonstrated. One example of this approach is in radar. The ability of air traffic control or air defense radars to simulate an aircraft flight path enabled operator training without the expense of actually launching an aircraft. Air defense radars provide an on-board ability to generate multiple simulated radar tracks, jamming effects, electronic countermeasures, and ground clutter. The Firefinder artillery radar uses simulation to train maintenance personnel. The Firefinder Fault Insertion Device (FID) creates technical fault condition "scenarios" on a PC that is physically connected to the AN/TPQ-36 and AN/TPQ-37 radar fault-detection circuitry, so the simulated fault can be diagnosed by maintenance technicians. Continuing dramatic reductions in the physical size and power requirements of computers and communications systems now enable simulation capabilities to be incorporated directly into a much wider variety of operational equipment. As new Army systems are developed and fielded under the concepts of a digitized battlefield and network-centric warfare, more digital technology is being built directly into these systems as part of their basic C4ISR capability. That capability will be enhanced through simulation to enable individual, crew, and team training and networked mission rehearsal, with active links to higher echelons.

7. Future Combat System

The Future Combat System (FCS) Operational Requirements Document (ORD) sets forth a requirement for a network-centric form of operation. Systems such as Stryker and Land Warrior are being developed to accommodate much of the capability anticipated for FCS, but the full capability of the Future Force will not be realized until the full FCS network comes on line. One Key Performance Parameter of FCS for training is “an embedded individual and collective training capability that supports live, virtual, and constructive training environments” [Yakovac, 2003]. FCS systems will possess on-board simulation capabilities comparable to MILES, CCTT or CATT systems, or other high fidelity, high-resolution simulations. FCS is commonly defined as a system of systems, integrated by a robust, persistent network. The FCS network will enable distributed simulation of complex scenarios on virtual terrain, against real or hypothetical opponents, in order to use the collective simulation environment for training, planning for future operations, and the rehearsal of assigned missions. The abilities projected for this simulation-based, networked system of systems hold major implications for continued U.S. dominance on the battlefield, but nobody has ever built such a system before. Experience will be required to discover and fully exploit the capabilities offered by the simulations embedded within FCS.

3.D Army Simulations

3.D.1a Corps Battle Simulation (CBS)

1. **Type: Constructive**
2. **Acronym: CBS**
3. **Purpose for which Developed**

The Corps Battle Simulation (CBS) was developed to provide computer-based, information-rich, coherent battle simulation to support military training exercises at division and higher echelons. Data from the simulation are used to train command and staff officers at the joint task force, corps, division, and brigade levels. CBS was intended specifically to replace manual battle-board methods used in the past, and to be versatile enough to represent the complexity and variation to be found on the modern battlefield.

Development of CBS began in 1983, under the sponsorship of the United States Readiness Command (USREDCOM). CBS was originally named the Joint Exercise Support System (JESS).

A test bed was established at I Corps Headquarters in Ft. Lewis, Washington, for prototype system development and evaluation. The first use of JESS to support an exercise was CASCADE PEAK III in November 1985. In 1990, the U.S. Army became the sponsor of JESS and renamed the simulation CBS. Since that time, CBS has continued to improve through technical improvement and expanded functionality. CBS will remain the simulation-training tool of choice for training commanders and their staffs until the next generation constructive training simulation becomes available.

4. **Dates Developed/Implemented**

The following list shows each CBS version and its release date.

CBS Version 1.0	November 1985
CBS Version 1.1	April 1988
CBS Version 1.2	December 1989
CBS Version 1.3	December 1990
CBS Version 1.4	June 1993
CBS Version 1.5	May 1994
CBS Version 1.6.0	June 2001
CBS Version 1.7.0	June 2002

5. **Domain:** TEMO
6. **Security Classification:** Unclassified

7. Security Caveats

Although the CBS software is unclassified, large portions of the data in CBS exercises are ordinarily classified SECRET. Since a high degree of realism is desired, data in the database must reflect realistic estimations of relative unit strengths, weapon systems characteristics, etc. Planning for secure handling of classified data must be completed before work on the exercise database can proceed. For example, the TACSIM Interface Processor (TIP) provides a unidirectional interface to TACSIM. However, since data in TACSIM (see section 3.D.1d for TACSIM) are ordinarily highly classified, the intelligence reports developed by TACSIM are routed through appropriate organic channels rather than through the CBS communications system. In the multi-site configuration, planning efforts must provide for secure digital communications across the WAN at the SECRET level if classified data are used.

CBS is currently fielded to all active Army Divisions and Corps and to U.S. Joint Forces Command (USJFCOM).

FORSCOM	TRADOC	USAR	MISCELLANEOUS
Fort Lewis, WA I Corps	Fort Irwin, CA NTC	Houston, TX 75th D (E)	Orlando, FL PEO STRI
Schofield Bks, HI 25th ID	Fort Leavenworth, KS BCTP-TMC	Fort Dix, NJ 78th D (E)	Camp Casey, S. Korea 2 ID
Fort Wainwright, AK USARAK	Fort Leavenworth, KS TCDC-CGSC	Fort Sheridan, IL 85th D (E)	Fort Leavenworth, KS ACOTA Team
Fort Hood, TX III Corps	Fort Leavenworth, KS NSC	Birmingham, AL 87th D (E)	Einsiedlerhof, Germany WPC
Fort Carson, CO 7th ID	Fort Polk, LA (BSC)	Camp Parks, CA 91st D (E)	
Fort Riley, KS 24th ID Mech			
Fort Bragg, NC XVIII ABN Corps			
Fort Campbell, KY 101st ABN			
Fort Drum, NY 10th Mtn Div			
Fort Stewart, GA 3rd ID Mech			

CBS Users

8. Applications

CBS is the flagship simulation in the Army Family of training Simulations (FAMSIM). CBS is the standard simulation supporting Division and Corps-level Warfighter exercises for the Battle Command Training Program (BCTP) at Fort Leavenworth. It is used both for active duty units and the National Guard. In a Joint Task Force setting and in other joint exercises, CBS also serves as the Land Warfare component of the Joint Training Confederation (JTC). CBS provides training stimuli for all ground forces staff elements from Brigade to Corps, including combat, combat support, combat service support, and fixed and rotary wing air operations. All Battlefield Operating Systems are represented. In addition to the BOSs shown below, CBS represents fixed and rotary wing air operations, NBC operations including Smoke and Chemical Recon and Decon, Special Operations, Civil Affairs and PSYOP.

9. **Major Functionalities by BOS**
   a. Maneuver: Yes
   b. Fire Support: Yes
   c. Air Defense: Yes
   d. Survivability: Yes
   e. Intelligence: Yes
   f. Logistics: Yes
      1. Transportation:
      2. Supply/Re-supply:
      3. Personnel:
      4. Medical:
      5. Maintenance:
   g. Command and Control (C2): Yes

10. **Other Functionalities**

CBS is primarily a simulation of the process of ground combat. It represents all combat, combat support, and combat service support functions to an appropriate level of resolution for a Division or Corps staff. It represents all organic Army combat systems including helicopters, plus fixed wing aviation. It is designed to exercise the decision cycle supporting fire, maneuver, and planning. In certain cases, CBS reflects activities of the support BOSs as aggregated or summary information appropriate for use at the Division or Corps TOC. This means that Combat Service Support, and Intelligence information, lack the detailed, "granular" level of information necessary to drive lower level functional activities. If personnel, logistics, and intelligence staffs are to be fully employed in a training environment, other specialized simulations are linked to CBS to serve as the combat "driver" that establishes the pace and context for their critical support activities. Thus, a logistics simulation like Combat Service Support Training Simulation System (CSSTSS) and a comparable Intelligence training system, like the Tactical Simulation (TACSIM), can be linked to CBS to expand the training audience as required. CBS can run without these ancillary simulations when appropriate.

CBS is also the environment in which the Opposing Force (OPFOR) is played. At the BCTP, the World Class OPFOR, a team of regional and military experts, studies regional doctrine, tactics, equipment, and practice to portray realistically the enemy forces that land forces might encounter in future operational settings. A comparable OPFOR staff is required to support each CBS exercise. The OPFOR information in the CBS database becomes the basic information about the enemy that can be "collected" using the intelligence collection systems represented in TACSIM.

11. Terrain Management System

Digitized. Terrain boxes for CBS are built from standard geographic data files and products produced by the National Imagery and Mapping Agency (NIMA). The map files are pre-recorded on laser disk for display at each CBS workstation, and the visual map display requires a dedicated laser disk player, managed by a separate processor, either a DEC PC or Commodore Amiga.

12. **Current Terrain Products:** See Table below.

Area	**Name/Location**	**Boundaries/ Spheroid**	**Projection**	**Notes**
Africa	Algeria	27N-38N, 9W-15E (International/Clark 1880)		5 zoom levels
Africa	Nigeria	4N-15N, 3E-19E (International/Clark 1880)		5 zoom levels
Asia	Japan (North)	36N-51N, 131E-151E (Bessel)		
Asia	Japan (South)	24N-37N, 123E-143E (Bessel)		
Asia	Japan (Central)	30N-42N, 130E-142E (Bessel)		5 Zoom Levels; Produced from existing N. and S. Japan Levels
Asia	Korea	33N-44N, 123E-132E (WGS84)		
Asia	Southwest Asia	23N-35N, 42E-58E (International)		9 Zoom Levels
Asia	Caspian Sea	28-45N, 39-51E	N/A	8 Zoom Levels
Caribbean	Cuba, Dom. Rep, Haiti, Jamaica, Puerto Rico, Fla.	17N-32N, 63W-86W (Clark 1866)		
Central America	Central America	7N-18N, 79W-93W (Clarke 1866)	UTM	
Europe (Modified)	"Atlantis"	42N-55N, 14E-7W (International)		Modified Western Europe "Apolitical"
Europe	Bosnia; Yugo. Italy; Albania; Hungary; Austria	40N-48N, 9E-24E (International)		
Europe	Europe Central	47N-55N, 4E-16E (International)	UTM	

Europe	Europe Expanded	43N-55N 2E-24E (International)		9km lowest FOV on TLM maps; 5 Zoom Levels
Europe	Europe Western	42N-55N, 14E-7W (International)		"Atlantis" playbox without mods
Europe (Modified)	"Lantica"	43N-55N, 0-24 E (International)		Western Europe subtracted from west & added to east; Fictitious Countries/boundaries; pasted ocean on outside
Europe	DCX II	40N-48N, 12E-24E		8 Zoom Levels; Fictitious Cities
Pacific	Philippines	4N-20N, 116E-128E (Clarke 1866)		
United States	Southwest United States	28N-40N, 103W-123W (Clark 1866)		

Corps Battle Simulation (CBS) Playboxes

13. Other Environment Representation

Weather: CBS provides for control of the air temperature, wind speed, and wind direction through the WEATHER order, which is reserved for use by senior control staff. These parameters affect the operation of the chemical-contamination mechanism Chemical Weather. There are no localized weather conditions; they are the same everywhere in the simulation Playbox. The Senior Controller can obtain a Weather report that lists the current settings of air temperature, air stability, wind speed, and wind direction.

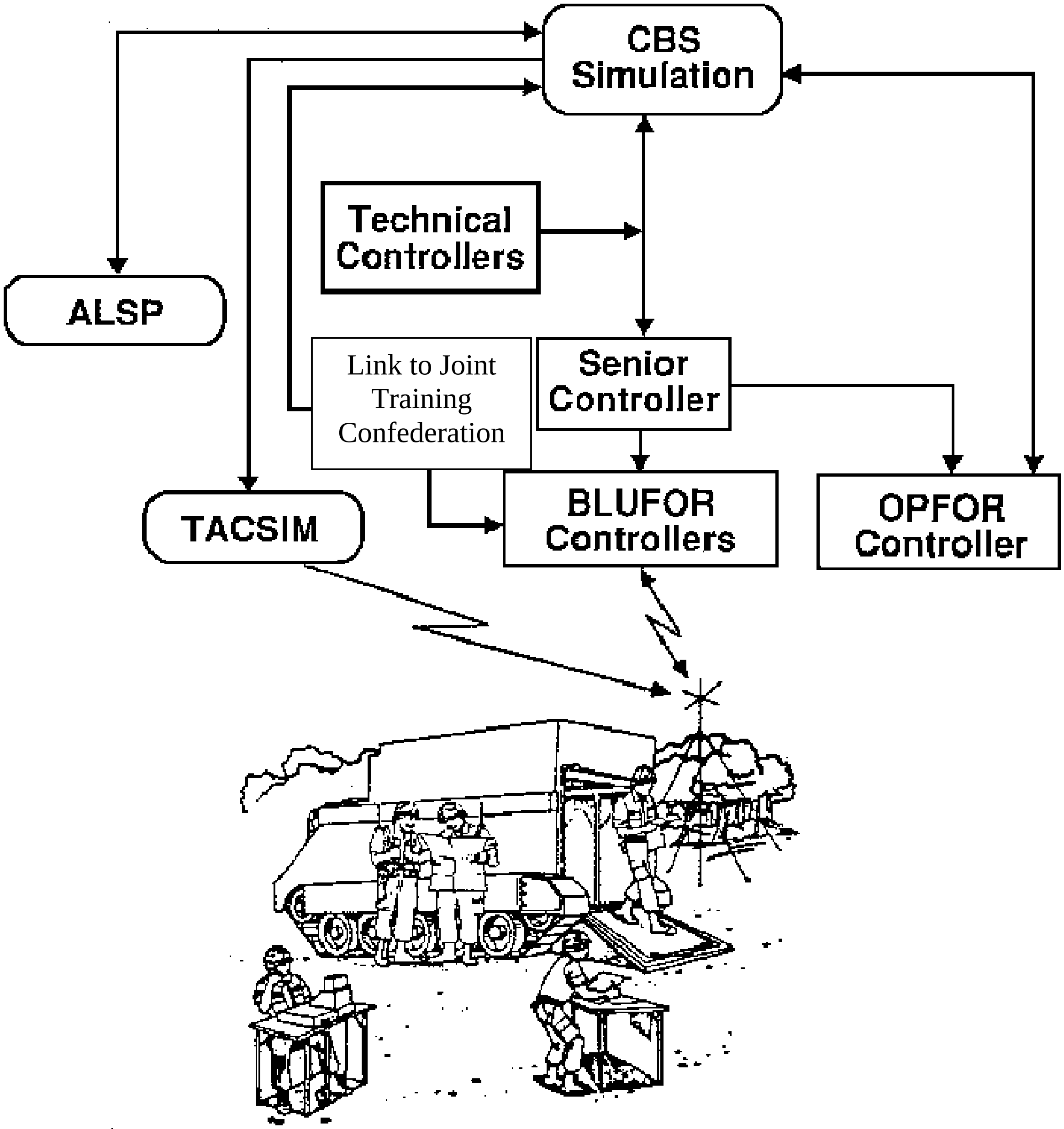
14. Human Behavior

Human behavior is not explicitly modeled in CBS. Human behavior is represented through the decisions, inputs, and responses of human terminal operators, exercise control staff and players.

15. Simulation Strengths

CBS is a mature, well understood, well managed simulation system. Most possible applications of the system have already been explored and effective training procedures are known. While it is normally used to represent doctrinal formations, variations are possible in the organization of both friendly and opposing forces. CBS facilitates real time task organization.

The land battle in most joint training exercises has been, and remains represented in CBS, so the land campaign, the heart of the Joint Training Confederation, resides in CBS.



TOC Player Position

TACSIM portrays detected enemy activity in CBS. Players plan and prepare for operations in a field Tactical Operations Center (TOC) environment, sending “commands” to subordinate units modeled in CBS. The commands are executed in CBS. Attrition and redistribution of forces are calculated in CBS, and reported back to players as operational reports. (See figure above)

16. Simulation Limitations

CBS was designed during the Cold War. It was designed around the reality of the time – that our next major conflict would be essentially two-sided, and that the logical opposing force, the former Soviet Union, would have forces probably nearly at parity with our own in terms of numbers, firepower, and mobility. The OPFOR was characterized by predictable formations, standard equipment, well understood doctrine and tactics, and the presumption that conflict, when it occurred, would be on the well-known terrain of Germany and/or Korea. The disappearance of the Soviet Union led to the emergence of a number of smaller, regional centers of geo-political influence, and of ethnic or religious based opposition movements lacking any conventional forces or identifiable "homeland." While CBS can support scenarios with multiple "sides" and more agile forces, it is not optimized for the types of conflicts we are likely to encounter in the early 21st century.

17. Technical Specifications

a. **Clock Speed** (minimum acceptable CPU speed): Not Applicable due to mixed hardware configuration.
b. **Update Rates** (minimum update interval for time stepped simulations):
c. **Operating Environment:** Mixed. Some VMS, MS Windows, DECNET,
d. **Hardware:** A typical CBS hardware configuration includes one PC Game Events Executive Processor (PC-GEEP) to run the simulation software, multiple MicroVAX (i.e. 3100s (Model 85)) and associated suites of workstation hardware. The majority of the MicroVAXs are used to execute the workstation software and control the workstation hardware suites. Each MicroVAX can control up to six workstations. One MicroVAX is required to run the communications software (in a multi-site exercise, at least one MicroVAX is required at each site for communications), and one (preferably two) MicroVAX is required to run COBRA. The total number of MicroVAXs required is a function of the exercise size and the number of units represented in the simulation. The equipment at each site is connected by a local area network (LAN). Geographically dispersed sites communicate via a wide-area network (WAN). A detailed description of the CBS Hardware Requirements may be found in the CBS Operator's Manual. Additional computers may be required to support specialized CBS functionality (i.e., CBS Master Interface applications). The specific hardware requirements for these capabilities are identified in the appropriate CBS documentation
e. **Hardware Environmental Considerations:**
f. **Software/Operating System:**
g. **Simulation Current Version:** 1.7.0 (released June 2002)
h. **Source Code Languages:** The combat model is written in the SIMSCRIPT II.5 language, selected for the sophisticated process simulation capabilities it provides. The workstation/graphics software is written in the C language, which provides low-level control of input/output processing. The communications software is written in C and handles the DECNET protocol. COBRA is a rule-based expert system implemented in OP5. The database development software is written principally in the C language, with a number of utilities implemented using mixed-language-programming techniques in C and SIMSCRIPT II.5. A graphics control software package, written in MODULA 2 for the Commodore Amiga

2000 computer, is currently being replaced by DEC PCs using Microsoft Windows for Work Groups version 3.11.

i. **Licenses Required:** The CBS software executing on VAX hardware requires the VMS operating system. Microsoft Windows is required for DEC PCs. Amiga DOS is required by Amiga map server hardware.

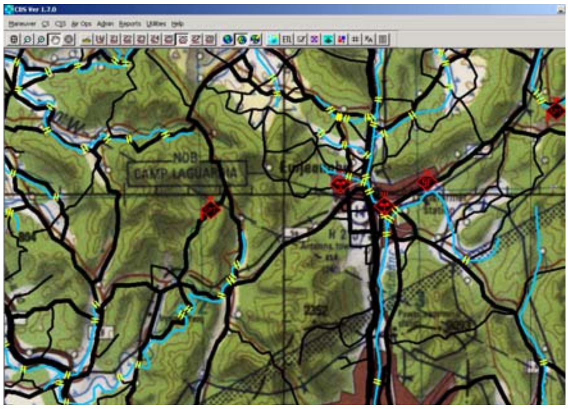
j. **Interoperability:** CBS is interoperable through the Aggregate Level Simulation Protocol with Air Force Air Warfare Simulation (AWSIM), Navy RESA, CSSTSS, TACSIM, J-Quad (C2 Warfare), and certain other special purpose simulations. Outside the ALSP interface, CBS may be linked directly to TACSIM or CSSTSS.
   1. HLA Compliance: No
   2. HLA Certification: No

k. **Standards:**
   1. Internal Network Protocols: TCP/IP
   2. Internal Network Type: Ethernet

18. VV&A

The CBS Version 1.8.0 Functional Verification Test was conducted successfully during February 10-14, 2003, at the National Simulation Center (NSC). Personnel from the NSC, the Battle Command Training Program (BCTP), the Jet Propulsion Laboratory (JPL), and Titan supported the test with personnel from the Program Executive Office - Simulation, Training & Instrumentation (PEO STRI) in attendance. Functional verifications were conducted in the following areas: Air Defense, Aviation, Maneuver, Combat Support, Logistics, and PC Communications. Some of the functionalities tested included:

a. Menu Screen Help and Field Help
b. Model Concept
c. RW Mission and Airlift Mission Changes
d. OAS Mission Functionality
e. FW Air-to-Air Engagements
f. Ground Move Unit to Regeneration Site
g. Create a Task Force with Multiple Layers
h. Display Line of Sight
i. Test for Universal Civilians
j. Establish New Regeneration Site



The CBS Version 1.8.0 Functional Validation Test, April 7-11, 2003, was held at the NSC with organizational representation supporting the testing being similar to the Functional Verification Test. The purpose of this test was to validate the technical and functional Changes made in the CBS 1.8.0 software. This test is the last of the formal Verification, Validation, and Accreditation (VV&A) events that each version of CBS undergoes prior to the annual release of a new version. The Accreditation Event (the final VV&A) for CBS 1.8.0 was the First Use Exercise (FUE), June 2-6, 2003.

19. Future Plans

CBS is in a state of transition between the current VAX/VMS hardware/software, and a more modern and maintainable architecture adapted to the Personal Computer (PC) environment. A PC Intel-based architecture using a Common Hardware Platform (CHP) should be in place at the Battle Simulation Centers with the release of CBS 1.8.0. The CHP will eventually replace the VAX/VMS architecture upon completion of its total fielding. The CHP consists of a Dell Precision Workstation 650 with a 2.4 Ghz CPU, 512 Mb RAM, two removable HDD with 75 Gb storage capacity each, and one CD-RW drive.

PC Workstation

The CBS PC Work Station (PCWS) will have the CHP loaded with Windows 2000 Professional Operating System. CBS Tier 12 sites will have from 30 - 198 CHPs fielded. CBS is slated for retirement and replacement when an appropriate replacement system becomes available.

20. Maintained By

National Simulation Center

21. Next Version/Incorporated into other Applications

CBS Version 1.8.0 is slated for release in mid-2003.

22. Expected Retirement Date

Not later than CY 2008.

23. Modifying Scenario Database

Contact the CBS program office at National Simulation Center.

24. Modifying Simulation Functionality

Refer to Chapter 6

25. Functional Databases

a. **Time to Develop:** Most functional databases within CBS are considered current and reasonably complete. Accordingly, equipment for a new scenario should be available as menu items for selection and inclusion in the new scenario. Time required should be fairly brief. When a particular item of equipment does not exist as a standard menu item, it may be possible to select a similar item, modify the parameters and rename the icon (if necessary). If a future scenario is envisioned, five or ten years in the future for example, major changes to tables of organization and equipment on both BLUFOR and OPFOR sides can be envisioned. In a situation of this sort, request help from the CBS managers at NSC. Expect considerable lead-time to be required for changes of this magnitude.

b. **Where Maintained:** National Simulation Center, Ft. Leavenworth, KS.

c. **Reusable:** Yes.

d. **What Databases are Available:** Refer to current CBS documentation, the CBS Newsletter, or contact the CBS managers at Commercial (913) 684-8155 or DSN 552-8155.

e. **How Can Databases be Modified**

26. Input/Output Formats

a. **Input:** "Commands" to simulated units to move, engage, re-supply, perform reconnaissance, and other military tasks.

b. **Output:** Operational reports to terminal operators/controllers, and as appropriate, direct via C4I systems to players.

27. Representation Issues

a. **Resolution:** Resolution in CBS is generally to units no lower than battalion, but occasionally also to company, platoon or recon team.

b. **Fidelity:** Adequate for the needs of the training audience. Considered high for land-based military operations.

3.D.1b Combat Service Support Training Simulation System

1. **Type: Constructive**
2. **Acronym: CSSTSS**
3. **Purpose for which Developed**

CSSTSS is designed to drive tactical and operational level combat service support (CSS) command post exercises. CSSTSS is a current component of the combined arms training strategy for simulations, and is the U.S. Army's CPX trainer for combat service support battalions through corps support command/theater army area command levels. "CSSTSS imitates selected Standard Army Management Information Systems (STAMIS) reports and provides logistics management data to be used in the military decision making process." (Patrick and Howard, 2000). CSSTSS is typically employed in a standalone mode as an "Exercise Driver" for CSS command and staff, C2, and/or CPX applications. It can also be linked with the Corps Battle Simulation (CBS) and provide high fidelity CSS information during BCTP Warfighter exercises, Combatant Commander-level exercises and other exercises primarily portraying combat operations at division and higher levels.

4. **Dates Developed/Implemented**
5. **Domain**

TEMO

6. **Security Classification**

The security classification of the Main Frame is C2 Minimum trusted class and can process up to SECRET level. The source code is unclassified.

7. **Security Caveats**

Data in the database and provided to the terminals can be up to and include SECRET (to include NATO, RELROK, etc.)

8. **Applications**

CSSTSS is specifically designed to train/exercise combat service support (CSS) commanders and staffs from battalion level up to and including corps support command (COSCOM) and theater army area command (TAACOM), and maneuver/combat support commanders and their CSS staff elements (e.g., S1/S4) on the force multiplier aspects of combat service support. The simulation can fully support "unit specific" or "branch-focused" scenarios, as well as a combined arms scenario. CSSTSS exercises and scenarios can be tailored to meet and support user-specific C2 and staff training objectives for any one or combination of the following unit types:

   a. Quartermaster
   b. Ordnance
   c. Transportation
   d. Medical
   e. Adjutant General
   f. Combined Arms

Combat Service Support functions, when CBS is linked to CSSTSS, are shared between the two simulations. The Corps Battle Simulation executes unit level CSS and CSSTSS, as well as direct support (DS) and general support (GS) level CSS. The exchange of sustainment information between the two models is analogous to the interfaces between unit and DS level of support and is modeled in the sustainment interface. The sustainment interface passes information between the two simulations and disaggregates and aggregates data. For example, CBS deals in Career Management Field (CMF) level of resolution in personnel and CSSTSS deals at the MOS and grade level of resolution. The sustainment interface takes CMF information and de-aggregates it to MOS and grade level of resolution in CSSTSS.

In the database build process, units are designated as being controlled by CBS or CSSTSS. For the most part, combat and combat support units are controlled by CBS, and CSS units are controlled by CSSTSS. CBS controls movement, posture, and positioning of CSS-type units, including those units whose function is controlled by CSSTSS. CSSTSS controls all functional missions of CSS-type units in the network. The exception is the ability of CSSTSS to allocate aviation and ground transportation assets to a non-CSSTSS unit that can be flown/driven in CBS. CSS units, as well as convoys, use the same movement methodology as do maneuver units.

9. Major functionalities by BOS

CSSTSS supplies information to represent the full scope of CSS functions. Detailed process modeling and report generation is provided to create a decision making environment for the following functions:

a. Supply
    1. Consumption and replenishment at unit level
    2. Requisitioning and replenishment for Direct Support (DS) and General Support (GS) echelons
    3. Stock record accounting, Direct Support, and General Support
    4. Property Book management

b. Maintenance
    1. Unit Level
    2. Direct Support
    3. Recovery of equipment
    4. Evacuation of equipment
    5. Combat repair teams

c. Transportation
    1. Transportation Control Numbers
    2. Mode management
    3. Highway Regulating
    4. In transit visibility

d. Field Services
    1. Mortuary Affairs
    2. Mail (as short-tons for daily delivery)

e. Personnel
    1. Personnel Accounting and Strength Reporting
    2. Replacement Operations
    3. Casualty Reporting

f. Medical (CBS generates casualties in linked mode)
    1. Evacuation
    2. Patient Regulating (workload management)
    3. Medical Treatment Facility Management
    4. Forward Surgical Teams

    5. Whole Blood Management
    6. Class VIII (29 supply lines)
    7. Returns to Duty
g. Reception, Staging, Onward Movement/Integration (RSOI)
    1. Port (and aerial port) operations
    2. Force tracking
h. Close and deep / rear operations (Stand-alone mode)

When CSSTSS is used in a stand-alone mode (not linked with CBS), it must have a method to generate losses, damage and destruction of units (personnel and equipment) and stocks. The Close and Deep/Rear Operations module of CSSTSS enables a role player (gamer) to maneuver simulated combat units (both Red and Blue) and engages the opposing force using weapons systems organic to those units. The results of battle engagements are determined by the unit's relative combat power, target posture and MOPP level. Each battle will reduce a unit's combat power depending on the type of engagement and affect the unit's capability to inflict losses on the opposing force. All engagements will generate real time casualty data, equipment attrition data and ammunition consumption. This module consists of nine areas and provides the role player with the capability to:

a. Conduct unit moves
b. Conduct Direct Fire missions
c. Conduct Indirect Fire missions
d. Conduct Attack Helicopter missions
e. Conduct Close Air Support missions
f. Conduct Close Combat missions
g. Conduct minefield encounters
h. Conduct Utility Helicopter Operations
i. Perform other functions such as change MOPP level, etc.

The following table presents the CSSTSS role in both standalone exercises, and when linked to CBS.

	Standalone	CBS-Linked
a. **Maneuver:**	Yes	No
b. **Fire Support:**	Yes	No
c. **Air Defense:**	Yes	No
d. **Survivability:**	Yes	Yes
e. **Intelligence:**	No	No
f. **Logistics:**	Yes	Yes
1. Transportation:	Yes	Yes
2. Supply/Re-supply:	Yes	Yes
3. Personnel:	Yes	Yes
4. Medical:	Yes	Yes
5. Maintenance:	Yes	Yes
g. **Command and Control**:	Yes	No

10. Other Functionalities

In recent years, a substantial interface has been developed between CSSTSS and CBS. With the exception of unit maintenance and unit basic load, CSSTSS, when linked with CBS, provides all the CSS information for the BLUFOR portrayed in the exercise. When confederated (in the Joint Training Confederation), unit maintenance is not portrayed in either simulation, and unit basic load data is contained in CBS. When linked with CBS, CSSTSS does not portray any "Red" forces. When used in a standalone mode, CSSTSS portrays both "Blue and Red" forces. Additionally, CSSTSS can portray Non-Combatants in two fashions; either at the name/SSN level of detail and at the summary level of detail (total numbers only). This could apply to pure non-combatants, enemy prisoners of war, refugees, DA/DoD Civilians, contractors, etc. CSSTSS can also portray allied forces (e.g., ROKA, British, German, etc.) at the name / SSN / MOS level of detail. (MOS includes allied army MOSs with the restriction that they must be alphanumeric, five characters). CSSTSS manages OPFOR logistics in the standalone mode.

11. Terrain Management System: Digitized.

Current Terrain Products: The current fielded version of CSSTSS does not have a GUI capability to portray forces, convoys or map overlays on a graphic representation of the terrain. When linked with CBS, this capability does reside in CBS and any activity reflecting position of CSS units, movement of CSS units and sustainment convoys will be portrayed on a CBS graphic display.

12. Other Environment Representation

CSSTSS does not support environmental representations and effects in its current configuration in a stand-alone mode. When confederated with CBS, all synthetic environment representations and effects are contained in CBS.

13. Human Behavior

Not represented.

14. Simulation Strengths

a. Unit-count unlimited. There is no limit on the number of units that can be portrayed with the exception that the larger the number of entities in the database, the slower the simulation will run.
b. Allied Force representation. Reasonable representation of allied and coalition CSS operations are contingent on appropriate database input (equipment, personnel, units, capabilities, etc.) Some limitations in the simulation to portray CSS units where allied/coalition doctrine is significantly different from U.S. Army doctrine.

15. Simulation Limitations

a. **Geographic Display.** No simulation driven map display.
b. **Document History Files.** For the most part, CSSTSS emulates those portions of existing CSS STAMIS that are essential to perform sustainment operations on a daily basis in a 5-10 day period. Many of the periodic processes and document history files contained in the actual STAMIS systems are not portrayed by CSSTSS; therefore limiting some of the research capabilities normally available to STAMIS operators and managers.

c. **Other-Service representation.** To a limited extent, CSSTSS can also portray internal sister service CSS operations built into the database (e.g; sister service equipment, MOSs, unit functions/capabilities, etc.)

d. CSSTSS is a mainframe system that requires users to establish a robust communications link with the CSSTSS site at LESD, Ft. Lee. LESD uses a mimic setup but it still requires the user unit to rely on LESD to run the simulation. Also, because of the way it's operated, scheduling can be restrictive, i.e., if another unit is using the CSSTSS; LESD is unable to provide CSSTSS anywhere else. In addition, LESD personnel must enter all entities into the exercise database depending on what the unit needs. This can be cumbersome and very time consuming since there can be so many entities and they must be entered using, for example, bumper numbers for vehicles or social security numbers for personnel rosters. These items impact greatly on planning and security.

16. Technical Specifications

a. **Clock Speed** (minimum acceptable CPU speed): See Technical Description Below.

b. **Update Rates** (minimum update interval for time stepped simulations): See Below.

c. **Operating Environment:** QWS 3270

d. **Hardware:** The IBM 9121-440 has 512 MB RAM, 60 GB disk storage, and model 3480 tape drives (Fort Lee, VA Main Frame). Workstation terminal devices can be either IBM 3270 terminals and printers, DEC terminals and printers with QWS 3270 Emulation Software, or Desktop Computers / Notebook computers (486 or better) and printers with QWS 3270 Emulation Software.

e. **Hardware Environmental Considerations**: No unique issues.

f. **Software/Operating System:** CSSTSS is programmed in COBOL, C, JAVA and Command Level CICS. Special system requirements / libraries require MVS/ESA and CICS/ESA.

g. **Simulation Current Version**: 1.8.0

h. **Source Code Languages**: CSSTSS is programmed in COBOL, C, JAVA and Command Level CICS. Special system requirements / libraries require MVS/ESA and CICS/ESA.

i. **Licenses Required**: MS Access and Excel are used to store and prepare for display information for the CSSTSS AAR capability.

j. **Interoperability:** ALSP

1. HLA Compliance: No
2. HLA Certification: No

17. Standards:

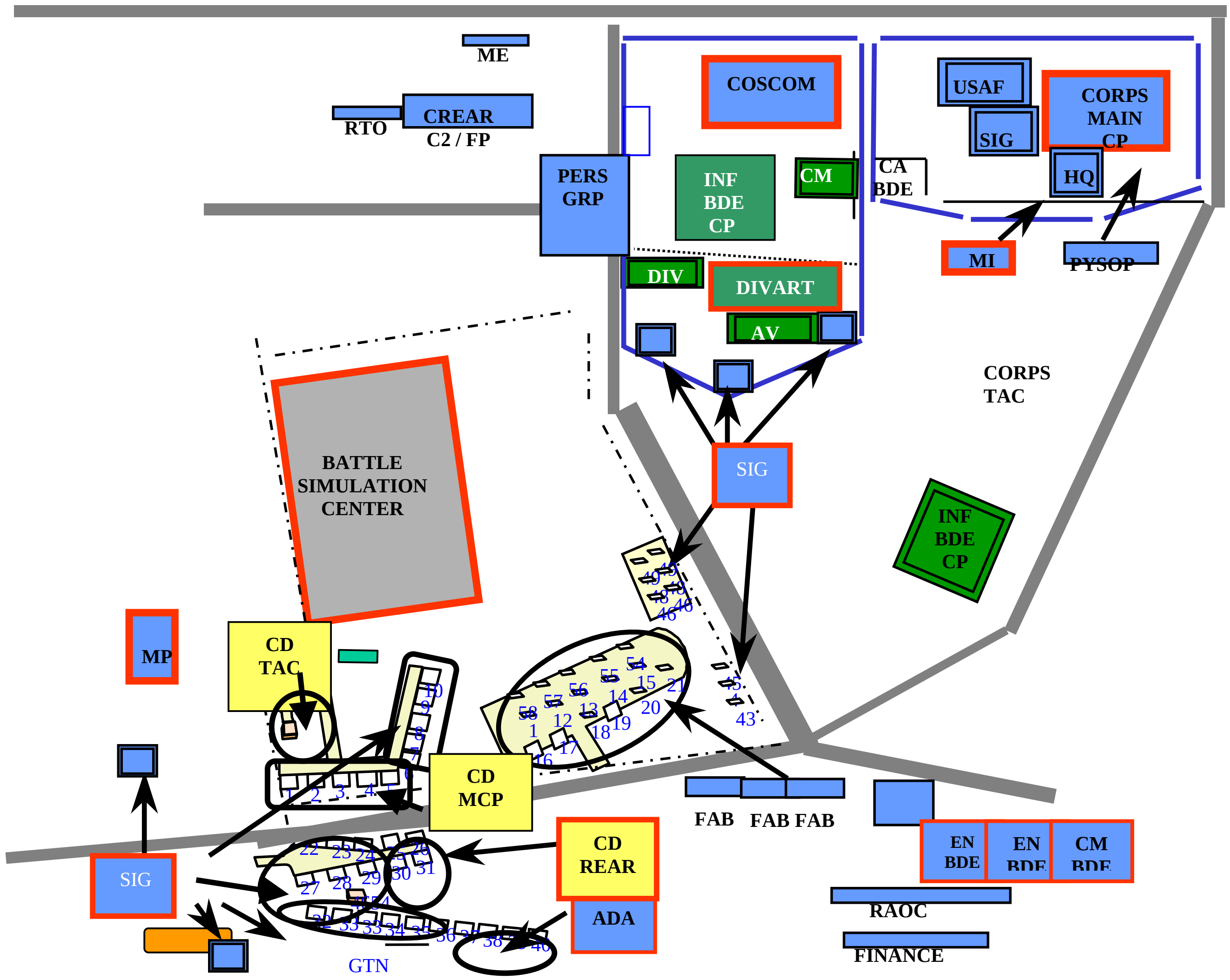
a. Internal Network Protocols

b. Internal Network Type

18. Technical Description

CSSTSS is a mainframe-based legacy simulation. CSSTSS operates on an IBM Main Frame 9121-440 at Ft. Lee, VA. The simulation is distributed to exercise locations either through dedicated communications lines, ISDN lines, or if unclassified exercise, through the worldwide web. Network specific hardware includes an IBM 3745 type communications controller, 3172 TCP/IP controller and DEC channel server. Simulation information / transaction messages are sent through communications lines to several types of terminals; IBM terminals / keyboards / printers, DEC terminals / keyboards / printers, or PCs / printers with QWS 3270 terminal emulation software. CSSTSS will accommodate any mix of this type equipment.

Remoting Exercises and Workstations. Since CSSTSS emulates real world Standard Army Management Information Systems (STAMIS), many of the CSSTSS workstations are located within the training audience TOCs (work cells) as well as in the gamer work cells within a simulation center. Additionally, most CSS units are in the Reserve Component and dispersed in U.S. Army Reserve Centers and National Guard Armories throughout the U.S. To accommodate the training needs of this dispersed training audience, CSSTSS has developed a variety of methods to connect with the mainframe computer located at Fort Lee, VA. Depending on the classification of the exercise (and database), units can assess CSSTSS through four communications methods: (1) Dial up modem, (2) ISDN point-to-point, (3) Dedicated 56kb commercial or military line, and (4) TCP/IP using the Worldwide Web (WWW).



CSSTSS Exercise Configuration -- Corps-level.

Game Control and Reserve Function (HICON) Capabilities. CSSTSS has a wide range of control options, reserve functions and "magic" capabilities available at the HICON work cell. These functions allow the exercise director (exercise control element) to make corrections and adjustments to better control the flow of simulated activities to support and facilitate the exercise training objectives. These functions and capabilities should be used judiciously and only with the approval of the exercise director/designated representative. Refer to the CSSTSS Reserve Functions Manual for more information.

A workstation is defined as either training audience or role player BLUEFOR or UNKNOWN (UNK). Each workstation consists of at least a VT terminal and keyboard. One to four VTs can be assigned to one printer for screen prints and printing of reports. All CSSTSS terminals can access any CSSTSS subsystem (e.g., supply, maintenance, medical, mortuary affairs, etc.) if the terminal operator has the appropriate passwords. Each level and function within CSSTSS is password-protected. The Higher Control (HICON) or Exercise Control Workstation is identical to all other workstations. Access to HICON functions is through appropriate passwords.

CORPS AND MSC TOC	
CSSTSS TERMINALS	
CORPS	2
COSCOM	14
CAV	2
INF DIV	13
CORPS TRPS	12

TOTAL CSSTSS TERMINALS: 132

Battle Simulation Center	
CSSTSS TERMINALS	
SENIOR CTL	3
OIC/PO	1
COMMO	1
AAR	2
CSG	7
CSG	7
CSG	12
MED GP	4
PERS GP	2
ACR SPT SQN	5
DSB	7
DASB	4
FSB	6
FSB	6
FSB	6
SIB FSB	4
CAV DISCOM	7
TSC	6
TOTAL	**89**

Typical CSSTSS Hardware Requirements -- Corps-Level.

19. VV&A

20. Future Plans

CSSTSS is expected to be retired by approximately 2008.

21. Maintained By

National Simulation Center, Logistics Exercise and Simulation Directorate (LESD), Ft Lee, VA. Phone: (804) 765-1789 or DSN 539-1789, Office of the Director.

22. Next Version/Incorporated into Other Applications

23. Expected Retirement Date

CSSTSS retirement is expected in the 2006-2008 timeframe, depending on the readiness of Joint Deployment Logistics Model (JDLM) to replace it.

24. Modifying Scenario Database

A substantial amount of front-end work must be accomplished to use CSSTSS in an exercise. The amount of time required varies depending upon whether CSSTSS will be used in a stand-alone or linked mode (e.g., with CBS). For previous exercises the preparation timeline has reached up to six months for a linked exercise. This period extends from the initial agreement to provide CSSTSS support to an exercise until the point at which the exercise database is ready for use. It includes numerous interfaces with the training audience's POC to ascertain critical information required to construct the database (e.g., task organization, support relationships, unit locations, days of supply, etc.). With this information, the Database Team at LESD constructs the basic Troop list, Equipment Record, Personnel Record, Played Items List, and Class VII to IX Record. These enormous files are built on a desktop computer using Microsoft Access, then passed to subject matter experts (SMEs) at LESD, Ft. Lee, for further annotations and review. The files are then processed through a series of syntax and logic validations before being passed to the Simulation Division for technical file build on the mainframe operating system and additional processing to make them ready for use. The table below shows a typical timeline for the development of a CSSTSS database for a Corps-level Warfighter, operating in CBS-Linked mode.

START DATE	END DATE	TIME REQUIRED	EVENT
28-Aug-00	15-Sep-00	3 Weeks	Project officer data consolidation
15-Sep-00	9-Oct-00	3 Weeks	Database team file build
9-Oct-00	23-Oct-00	2 Weeks	CSSTSS functional file build
23-Oct-00	30-Oct-00	1 Week	CSSTSS Edit and Validation
31-Oct-00	22-Nov-00	3 Weeks	CBS file build
1-Nov-00	3-Nov-00	3 Days	CWFX STARTEX Conference
27-Nov-00	1-Dec-00	1 Week	Initial mirror with CBS
18-Dec-00	5-Jan-01	2 Weeks	CSSTSS Technical File Build
8-Jan-01	10-Jan-01	3 Days	Final mirror with CBS
11-Jan-01	12-Jan-01	2 Days	CSSTSS Database Testing
15-Jan-01	19-Jan-01	1 Week	File Conditioning
28-Jan-01	1-Feb-01	1 Week	FIRST USE OF DATABASE
3-Mar-01	9-Mar-01	1 Week	STARTEX

CSSTSS Planning Timeline -- Corps-Level Exercise.

25. Modifying Simulation Functionality

More detailed information can be found in Chapter 6

26. Functional Databases

a. Time to Develop: Substantial, however most functional databases may already exist.
b. Where Maintained: LESD, Ft. Lee, VA.
c. Reusable: Yes.
d. What Databases are Available: Consult CSSTSS managers at LESD, Ft. Lee.
e. How Can Databases be Modified: Contact LESD Ft. Lee.

27. Input/Output Formats

a. Input: Most input can be provided via standard Army supply and logistical forms.
b. Output: Output is provided on paper and on-line printed reports. No map-based graphical user interface.

28. Representation Issues

a. Resolution: There is no graphical representation. The resolution is “high” in terms of representation of consumption and resource management issues at consumer-level; “low” for force-on-force combat and other BOSs.
b. Fidelity: The fidelity is “high” for representation of Combat Service Support functions; it is “low” for other processes.

3.D.1c One Semi-Automated Force

1. **Type: Constructive**

Virtual when installed in CATT simulators

2. **Acronym: OneSAF**
3. **Purpose for which developed**

OneSAF is the Army's next generation, entity level, and constructive simulation for battalion and below. It will mature to encompass operations from individual to brigade level for BLUFOR, and individual to Division for OPFOR. When fielded, OneSAF is expected to provide the simulation communities of all Services with a common semi-automated force generator capable of supporting constructive and virtual simulation. OneSAF also provides significant enhancements in interoperability by realistically and seamlessly integrating with live play, virtual simulators, and other constructive simulations. (The term Semi-Automated Force (SAF) is being replaced in the Army by the more general term, Computer Generated Forces (CGF), which may include fully-automated simulated entities.) The U.S. Marine Corps, as well as the Army, is expected to use OneSAF.

4. **Dates Developed/Implemented**

Initial Operating Capability (IOC)FY04

5. **Domain**
   a. OneSAF will provide a common, semi-automated force for Training, Exercises, and Military Operations (TEMO), Advanced Concepts and Requirements (ACR), and Research, Development, and Acquisition (RDA).
   b. OneSAF is used to support the following domain-specific activities:
   1. The RDA M&S community is expected to use OneSAF to support weapon system analysis, technology/development evaluations, and test and evaluation activities. When desired, OneSAF can support RDA scenarios by running automatically, with no human-in-the-loop.
   2. The ACR M&S community is expected to use OneSAF to model advanced concept systems operating in future operational environments; assess the operational impact of variations in organization, force level, unit composition, materiel and doctrine; and test courses of actions and operational plans used to support acquisition decisions.
   3. The TEMO M&S community is expected to use OneSAF as the Army's simulation of choice to train leaders and staffs at the battalion level and below, and to support mission planning and rehearsal.

6. Security Classification

OneSAF will operate in either a classified or unclassified mode. Data, software and storage devices will normally be unclassified, however, some scenarios, C4I systems, and system performance data may be classified. When classified data is used, OneSAF will provide Multilevel Security (MLS) functions that support the handling, processing, and dissemination of Confidential, Secret, Top Secret and Special Compartmented Information.

7. Security Caveats

The prospect that OneSAF might be used to support Joint and Coalition training or exercises, presents a potential Operations Security (OPSEC) risk. Autonomous or Semi-Autonomous forces programmed to realistically and automatically execute U.S. tactics, techniques, and procedures could do so in ways that are revealing to foreign participants and observers. Foreign participation in OneSAF exercises should be evaluated beforehand to determine the degree to which U.S. operational capabilities might be revealed by highly realistic SAF/CGF play. Likewise, the computing and simulation technology supporting OneSAF should be evaluated and approved by the Deputy Under Secretary of the Army for Operations Research (DUSA (OR))(IAW AR 5-11) before providing the OneSAF system to foreign governments.

8. Applications

OneSAF will be interoperable with constructive, virtual, and live simulators and simulations. A design goal is to create a simulation environment in OneSAF in which no object gains an advantage or is at a disadvantage due to the simulation in which it resides. OneSAF is specifically expected to interoperate with the Warfighters Simulation (WARSIM), which is also being developed. OneSAF also may be connected to and exchange information with Army tactical C4I systems, including the components of the Army Tactical Command and Control System (ATCCS) and the Force XXI Battle Command Battalion/Brigade and Below (FBCB2) system to emulate real-world information flow to vertical and horizontal echelons. There is no usage history for OneSAF as yet. A considerable body of experience has been gained with a succession of CGF systems, most notably Modular Semi-Automated Forces (MODSAF). MODSAF served as the baseline for development of the OneSAF Test Bed (OTB). MODSAF was also the simulation that supported the Synthetic Theater of War (STOW) and STOW-Europe (STOW-E) experiments.

9. Major functionalities by BOS

a. **Maneuver:** Yes. OneSAF plays light infantry, mechanized infantry, and armored forces. OneSAF also plays a variety of Army aviation operations (Cavalry, Assault, Lift/Heavy Lift, Special Operations, and Aviation Battalion tasks). OneSAF also plays military police operations, nuclear, chemical, and biological operations, and specific Air force, Navy, Marine Corps, and Coast Guard platforms, as well as Close Air Support, Joint Air Attack Team, Suppression of Enemy Air Defense, and Naval Gun Fire. OneSAF plays Opposing Force operations in the form of infantry, mechanized infantry, artillery, air defense, anti-tank, airborne, fixed & rotary wing aviation, combat support, combat service support, and non-combat capabilities.

b. **Fire Support:** Yes. OneSAF plays artillery and associated fire support operations.

c. **Air Defense:** Yes. OneSAF plays both Short Range Air Defense (SHORAD) and High-To-Medium-Altitude Air Defense (HIMAD) air defense operations.

d. **Survivability:** Yes. OneSAF plays a variety of engineer operations.

e. **Intelligence:** Yes. OneSAF plays military intelligence operations.
f. **Logistics:**
   1. **Transportation:** Yes.
   2. **Supply/Re-supply:** Yes.
   3. **Personnel:** No.
   4. **Medical:** Yes.
   5. **Maintenance:** Yes.

g. **Command and Control (C2):** Yes.

10. Other Functionalities

a. At IOC, up to nine “sides” or affiliations can be designated to support play of friendly, allied, neutral, OPFOR, non-combatant, and political roles within a scenario. When OneSAF is fully developed, 25 sides will be available. Alliances and behaviors of each side can change during the scenario.
b. OneSAF simulates the impact of weather, terrain, nuclear/biological/chemical (NBC) contamination, and obscurants on line-of-sight and combatant performance. NBC: OneSAF simulates the initial, residual and environmental effects of NBC cloud growth over time on units, systems, and individuals. Supported NBC events include:
   1. **Nuclear:** surface/air bursts and nuclear disasters.
   2. **Biological:** long-line release and point-generated methods of delivery.
   3. **Chemical:** aerosol and liquid contaminants.

11. **Terrain Management System:** Digitized terrain with variable resolution.

Current Terrain Products:

a. The OneSAF play box varies in area from a minimum of 660x660 km to a maximum of 3000x3000 km. Terrain within the box includes both natural and cultural features. Simulated forces operating within the box are affected by, interact with, and dynamically change terrain features. Within these terrain boxes, multiple map scales can be accommodated. For example, with Topographic Line Map (TLM) 1:50,000 coverage over most of the box, urban areas at scales of 1:12,500 may be accommodated. Digital Terrain Elevation Data (DTED) elevation postings from Level 1 through Level 5 can be accommodated. The National Imagery and Mapping Agency (NIMA) or Army-produced vector-based map products will be preferred, but existing raster-based digital map products can be used when vector products are not available.
b. Natural features will include terrain elevations, rivers, lakes, coastlines, beaches, and vegetation. Littoral features will include subsurface elevations and obstacle data, tides, current, and sea state. Acoustic, thermal, optical and radar line-of-sight calculations will be adjusted to compensate for terrain effects and the earth’s curvature.
c. Cultural features will include buildings, roads, railroads, runways, subways, tunnels, mouse holes, pipelines, sewer systems, power lines, overpasses, bridges, viaducts, obstacles, barriers, minefields, fortifications, and small unit or individual fighting positions. Buildings will be further defined by their height, type of roof, number of floors, stairwells, windows, doors, etc. Roads, bridges and runways will be assigned actual surface trafficability ratings and

can be degraded through use or by adverse weather. Urban areas will represent a special type terrain feature and will be modeled using the cultural features described above.

d. Simulated units and/or individuals will be able to modify both natural and cultural terrain features to improve or inhibit mobility, counter-mobility, survivability, and sustainment. Terrain features can be emplaced, constructed, repaired, marked, traversed, or destroyed.

12. Other Environment Representation

Weather will be characterized by cloud cover, precipitation accumulation, surface wind direction and speed, temperature, relative and absolute humidity, density and pressure by altitude, barometric pressure, solar activity, thermal crossover, and ambient light. Ambient light will include varying light levels for lunar (e.g., no moon, ¼ moon, ½ moon, ¾ moon and full moon), solar (e.g., dawn, dusk, high noon), and man-made (e.g., flares, explosives, weapon flashes, artificial light) illumination.

Obscurants: OneSAF will model the dynamic effects of dust, blowing sand, and smoke on the EO/EM spectrum. Secondary effects on intervisability, target acquisition, and weapon delivery accuracy will also be modeled.

13. Human Behavior

OneSAF will have the capability to edit and/or create behaviors either before or during application execution using on-screen displays to add, delete, or modify the “rule sets” used to define behaviors. Example modifications to human and unit behavior will include:

a. The impact of weather effects on human performance and behavior (e.g., target acquisition, communication, mobility, etc.) when operating in a normal or degraded environment including extreme regions such as jungle, arctic, and desert.
b. The impact of terrain features and battlefield clutter on target acquisition, communications, mobility/trafficability, and firepower.
c. Degradation in performance due to soft factors such as battle fatigue, stress, continuous operations, lack of food and water, the lingering effects of non-lethal weapons, and exposure to psychological operations.

14. Simulation Strengths

OneSAF will reduce the number of support personnel required during an exercise to exploit the simulation. The actions of individual entities within a scenario will be traceable, and rule sets can be modified to maximize the credibility and training value of the automated entities. Linking OneSAF and WARSIM should permit simultaneous play of a single scenario at higher and lower echelons with improved training value for both.

15. Simulation Limitations

Operation of simulations such as OneSAF will seem to the players to be much more like actual operations than some current simulations. More care may be necessary to protect real world operational capabilities, plans, and intentions from those without the need to know.

16. Technical Specifications

a. **Clock Speed (minimum acceptable CPU speed):** OneSAF is capable of running at less than real-time, real-time, or greater than real-time as circumstances dictate. Clock speed can be dynamically changed to accommodate links with command and control systems.

b. **Update Rates (minimum update interval for time stepped simulations):** TBD.
c. **Operating Environment:** Unix.
d. **Hardware:** OneSAF is designed to operate on PC-based platforms and laptops.
e. **Hardware Environmental Considerations:** None.
f. **Software/Operating System:** TBD.
g. **Simulation Current Version:** N/A.
h. **Source Code Languages:**
i. **Licenses Required:**
j. **Interoperability:** OneSAF is expected to significantly increase interoperability between next-generation training simulations and virtual simulators such as the Close Combat Tactical Trainer (CCTT). OneSAF will be HLA compliant and utilize the services of the HLA Run Time Infrastructure (RTI) for dynamic information exchange with other simulations and simulators.
   1. HLA Compliance: Yes.
   2. HLA Certification: Yes.
k. **Standards:**

OneSAF is expected to comply with applicable Institute of Electrical and Electronics Engineers (IEEE), and Department of Defense (DOD) standards for software development and testing, simulation data exchange and Department of Army (DA) directives for models and simulation development and management.

OneSAF uses, when applicable, the layered Joint Technical Architecture – Army (JTA-A) for Information Management. Additionally, OneSAF complies with the DII COE.

All software is developed in compliance with open system software standards
1. Internal Network Protocols: TCP/IP.
2. Internal Network Type: Ethernet.

17. VV&A

The V&V method selected will conform to guidance in DA Pam 5-11. For OneSAF, the V&V of CGF-based simulations poses unique challenges, given the relatively easy portability of CGF objects between different simulations and scenarios. Experience with this process will be necessary to perfect the specific methods to be employed. Accreditation is a part of the overall VV&A process currently underway. Accreditation of OneSAF simulations will be in accordance with the guidance in DA Pam 5-11.

18. Future Plans

OneSAF Objective System (OOS) will be the primary simulation to support operational planning and mission rehearsal for the Future Combat system (FCS).

19. Maintained By

PEO STRI PM OneSAF.

20. Next Version/Incorporated into other Applications

21. Expected Retirement Date

N/A.

22. Modifying Scenario Database

23. Modifying Simulation Functionality

24. Functional Databases

Data is not hard-coded into OneSAF software, but is easily modifiable through a GUI. OneSAF is delivered with a default set of generic unclassified data consisting of a scenario and two terrain databases; these data sets come in an electronic model-ready format.

a. **Time to Develop:** Because of the entity-based structure of CGF simulations, the time for force development for an OneSAF exercise should be reduced through successive iterations, producing refined and credible, and reusable entity models.
b. **Where Maintained:** Responsibilities for this function have not yet been assigned.
c. **Reusable:** Yes.
d. **What Databases are Available:** TBD.
e. **How Can Databases be Modified:** OneSAF databases can be modified before and during application execution using one or more of the following on-screen editors:
    1. Entity Editor--Used to create, configure, review, modify and delete systems.
    2. Unit Editor--Used to modify unit and equipment characteristics.
    3. Organizational Editor--Used to create units from existing units.
    4. Behavioral Editor--Used to create and edit behaviors.
    5. Environmental Editor--Used to add, modify, and remove environmental conditions and features.
    6. Battlefield Graphics Editor--Used to add, modify, and remove battlefield graphics.
    7. User Preference Editor--Used to customize the OneSAF environment.
    8. Overlay Editor--Used to create, display, add, remove, and modify user-defined symbology.
    9. C4I Editor--Used to create, add, modify, and delete information flow networks.

25. Input/Output Formats

Output: OneSAF output can be tailored to meet specific user needs.

26. Representation Issues

a. **Resolution:** OneSAF allows the simulation of individual battlefield components such as soldiers, tanks and helicopters through aggregate units to the brigade level.
b. **Fidelity:** OneSAF represents a full range of operations, systems, and control processes at or below battalion level with variable levels of fidelity that support all M&S Domain requirements

3.D.1d Tactical Simulation

1. **Type: Constructive**
2. **Acronym: TACSIM**
3. **Purpose for which Developed**

The TACSIM system is designed to provide training to intelligence staffs, collection managers, and analysts in a simulated war situation. TACSIM can support training from large-scale joint exercises to specific intelligence section tasks.

4. **Dates Developed/Implemented**

TACSIM originated in 1979 under project Post Oak. The Post Oak Simulation (POSSIM) was an Electronic Intelligence (ELINT) report generator to support development of the All Source Analysis System (ASAS). The TRADOC Combined Arms Test Activity (TCATA) used the system, now known as TACSIM, in support of exercises in the U.S., Europe and Korea in the early-mid 1980s. In the late 1980s, TACSIM was linked to the Corps Battle Simulation (CBS) for combat results, yielding a dynamic, interactive combat scenario in CBS, with responsive high-fidelity intelligence processes in TACSIM. TACSIM, linked to CBS for in-garrison training, began at V Corps, Frankfurt, Germany in the late 1980s, and it has been the Army primary Intelligence training system since 1989. TACSIM support of the Joint Training Confederation (JTC) began in 1994, providing improved realism and training to all JTC members. TACSIM was completely recoded in 2002 as an Object Oriented system, using IBM compatible PCs as the primary hardware platform. A DIS interface was fielded in 2002 to support the Digital Battle Staff Trainer (DBST) and other DIS simulation networks.

5. **Domain:** TEMO
6. **Security Classification**

TACSIM software contains classified information reflecting performance capabilities, sources, and methods of actual US intelligence systems, and detailed information about characteristics of potential OPFOR systems and capabilities.

7. **Security Caveats**

TACSIM is the first and only simulation that is Defense Intelligence Agency (DIA)-accredited as a Multi-Level Security (MLS) System. When a system operates in the multilevel mode, it allows data of two or more security levels to be processed simultaneously when not all users have the clearance, formal authorization, or need to know for all data handled by the system. The system is able to separate and protect the data according to these restrictions. (MLS DoD, 1995) TACSIM is approved for simultaneous connection to networks operating at unclassified, collateral classified, and SCI-security levels.

8. Applications

TACSIM can be used in two ways. For intelligence training only, TACSIM can be operated in the STAND ALONE mode. In stand-alone mode, a “canned” combat scenario drives the TACSIM intelligence functionality. This allows intelligence staffs, sections, and units to train their personnel on specific training objectives. However, the second and most common method for training with TACSIM is in the LINKED mode. In this mode, TACSIM is an intelligence model, or driver, that is linked to another simulation such as CBS.

TACSIM is used at ten sites worldwide: I Corps, FT Lewis, WA; III Corps, FT Hood, TX; 7th Army Training Command, Warrior Preparation Center, Einsedlerhof, Germany (fixed and deployable systems); XVIII ABN Corps, FT Bragg, NC; United States Forces Korea, Seoul, S. Korea; Joint Forces Command, Joint Training Analysis Simulation Center, Suffolk, VA; US Army Intelligence Center, FT Huachuca, AZ; Office of the Deputy Chief of Staff for Intelligence, Falls Church, VA; Battle Command Training Program, and National Simulation Center, (two systems) FT Leavenworth, KS; and the TACSIM Project Office (Developer and field support), Orlando, FL.

9. Major functionalities by BOS

a. **Maneuver:** N/A
b. **Fire Support:** N/A
c. **Air Defense:** N/A
d. **Survivability:** N/A
e. **Intelligence:** Yes - TACSIM supports all BOS areas through provision of timely and relevant intelligence information. It does not duplicate the capabilities of other simulations to which it will be linked.
f. **Logistics:** No
g. **Command and Control:** Yes - TACSIM provides for command and control of Intelligence assets for collection and processing.

10. Other Functionalities

11. Terrain Management System

TACSIM does not represent terrain. The TACSIM area of operations corresponds with the terrain used in the simulations to which it links, such as CBS or the Joint Conflict and Tactical Simulation (JCATS), and the effects of terrain on fire and maneuver are represented in the associated combat simulation. A limited capability to replicate “terrain masking” (i.e., radio line of sight) is available for TACSIM but is not currently implemented.

12. Other Environment Representation

Weather: TACSIM does not replicate weather except for a limited capability to randomly inhibit imagery reports because of cloud cover. Effects of weather on the units portrayed in the corresponding combat simulation will be reflected in their activities, as detected and reported through TACSIM. That is, if the speed of maneuver were reduced due to snow or rain, the rate of movement of the OPFOR would be accurately reported through sensor reporting from TACSIM. It would be the function of an analyst to deduce that weather effects were degrading mobility.

13. Human Behavior

TACSIM simulates human behaviors in two ways. The first is that the TACSIM Analysts’ Model simulates Intelligence Analysts’ behavior. Data like how long the analyst has been collecting, and how skilled the analyst is at fusing information from other sources to create reports are examples of parameters entered into the Analyst Model. The second way that TACSIM simulates human behaviors is the TACSIM HUMINT (Human Source Intelligence) model. TACSIM HUMINT simulates the behaviors of interrogators of enemy prisoners of war (EPW). The number and quality of EPW reports is determined by parameters such as experience and rank of the interrogator. The user assigns these parameters. TACSIM also simulates other human factors. For example, the number of analysts the user makes available in support of a collection mission determines the volume of Communications Intelligence (COMINT) reporting. Additionally, users are required to task the collection systems in TACSIM. These tasks are the cornerstone of Intelligence operations and, although the Human Behavior aspects of such tasking are not simulated, the TACSIM user interface, in a sense, supports live simulation of that major role.

14. Simulation Strengths

The major strength of TACSIM is its high fidelity simulation of intelligence activities. TACSIM is unique in its ability to bring the full G2 staff "into the game" because the output of combat simulations lacks the detail necessary to drive realistic intelligence functions. Another TACSIM strength is its interface to "real world" C4I equipment, through the use of actual message formats. While other simulation systems are beginning to adopt "Sim-to-C4I" linkages, linkage to real-world communications pathways has been a principle TACSIM method since its inception. Other strengths include scalability to support all echelons (including Joint and coalition forces) training requirements, a provision for tasking from distributed geographical locations using web browser technology, an automated database build capability, multi-level security operations/products, and its use of "real world" intelligence database information, and support from National intelligence agencies including the National Security Agency and National Reconnaissance Office.

TACSIM is operationally robust, having been developed and refined over a number of years. TACSIM can process over 2.5 million objects with constant updates while simultaneously simulating 150 Intelligence collection missions (many with multiple platforms/sensors), while also providing the data feed to support 12-16 external Battlefield Visualization models. It has a modular design that greatly enhances stability, coherency of the intelligence scenario, and improves operational reliability. For example, if problems occur with Signals Intelligence, that module can be shut down for troubleshooting/repair, while the simulation continues to generate reporting from imagery, HUMINT, and other systems. Its open distributed architecture enables TACSIM to interface with multiple Simulation protocols (ALSP, DIS, etc.). Thus, TACSIM can support Army and Joint intelligence activity in diverse training environments.

15. Simulation Limitations

Because TACSIM operates at multiple levels of security simultaneously, it must be operated within a controlled environment. This can be either a SCI Facility (SCIF) or a collateral area depending on the requirement. Currently, TACSIM only outputs USMTF messages and has a unique data feed for the Visualization models.

16. Technical Specifications

a. **Clock Speed** (minimum acceptable CPU speed): Varies depending on processor, e.g., PC (dual processors)-1.5 GHz each SUN E250 (dual processor)- 440 MHz each.

b. **Update Rates** (minimum update interval for time stepped simulations): When interfacing with CBS or the JCATS, the game database (objects) is updated every 60 seconds. When in the DIS environment, updates are at a rate (DIS Heartbeat) determined by the users. Updates for the battlefield visualization models are scalable and determined by the users based on their requirements.

c. **Operating Environment**: Solaris based systems-SUN SOLARIS 7 11/99 SPARC Platform Edition and SUN SOLARIS 7 11/99 Intel Platform Edition, CBS Interface-WINDOWS 2000, TAT interface-VMS 7.2.

d. **Hardware:** A typical TACSIM suite consists of:
4 – Dual Processor, 1.5 GHz PCs with 4 GB of RAM each
1 – SUN Enterprise 250 (Communications Support Processor)
1 – SUN ULTRA 60, SMART Communications device
1 – SUN ULTRA 10, NWARS processor
1 – Pentium IV PC, TACSIM Interface Processor (TIP)
1 – Pentium III PC (laptop or desktop), TACIT (Sensor tasking)
Three PCs are provided with the system to support remote locations.

To support a DIS federation, the following additions are required.
1 – Sun ULTRA 10, SMART Communications device (2nd guard)
1 – SUN ULTRA 10, TACSIM DIS Interface (TDI)

17. Hardware Environmental Considerations:

a. **Software/Operating System:** JAVA (platform independent) / Solaris
b. **Simulation Current Version:** 2.5 (2.6 will be fielded in Jun 03)
c. **Source Code Languages:** JAVA – 95%, C (required for CBS interface) – 5%
d. **Licenses Required:** None, Government owned software

18. Interoperability: Joint Training Confederation via ALSP, DIS, CBS, JCATS

a. HLA Compliance: No
b. HLA Certification: No

19. Standards:

a. Data: MS 6040-USMTF
   1. MS 2525B-Graphic Symbols for MapVision
   2. ISO 3166-Country Codes
b. Internal Network Protocols: TCP/IP
c. Internal Network Type: Ethernet -10/100 LAN FAST
d. External Links: T1 required for external models and DIS; Standard Military C4I Communications links for connections between TACSIM and C4I

20. VV&A

VV&A is conducted annually. V&V is typically updated annually during the month of June. In 2003, a joint V&V was performed with PEO STRI (reps) at U.S. Army Intelligence Center and School, Ft. Huachuca, AZ.

21. Future Plans

Planned to be replaced by the WARSIM Intelligence Model (WIM) at date TBD.

22. Maintained By

PEO STRI, TACSIM Project Office; Orlando, Florida

23. Next Version/Incorporated into other Applications

New Software release every year in the June timeframe. Periodic maintenance releases during the year as required. HUMINT functionality not previously included in TACSIM has been added in the version slated for release in 2003.

24. Expected Retirement Date

Pending fielding of WIM.

25. Modifying Scenario Database

TACSIM incorporates extensive parametric databases drawn from authoritative official sources to characterize, in intelligence terms, the activity on the battlefield.   These parametric tables are extensive enough to ‘match up’ with any likely threat order of battle. Nevertheless, subject to security guidelines for access to this information, users can copy the database and make almost unlimited changes to support their training requirements. This changed DB can be saved and reused if required. Note that modifying a TACSIM database may require modifying a CBS or JCATS database as well. New collection systems, which may be needed for support to coalition training exercises, can be created readily if their capabilities are known.

26. Modifying Simulation Functionality

If actual changes are required to TACSIM functionality, refer to Chapter 6. The existing system has evolved to the point where most capabilities needed for Intelligence exercise and training are already incorporated, or are planned for inclusion.

27. Functional Databases

TACSIM supports the Intelligence function.

28. Input/Output Formats

a. **Input:** During operation TACSIM accepts user input via mission tailored command-entry screens, or via USMTF formatted message from remote sites.
b. **Output:** TACSIM outputs USMTF messages that automatically parse in any DoD system capable of handling USMTF. TACSIM outputs a TCP socket data stream or DIS PDUs to the external battlefield visualization systems like JSTARS and UAV.

29. Representation Issues

a. **Resolution:** For intelligence purposes, resolution high.
b. **Fidelity:** For intelligence purposes, fidelity is very high.

3.D.1e Brigade/Battalion Simulation

1. **Type: Constructive**
2. **Acronym: BBS**
3. **Purpose for which developed**
   a. Command Post Exercise (CPX) driver to train Brigade/Battalion commanders and staffs.
   b. Train commanders and staffs in planning, execution, and decision-making skills.
   c. Team building.
   d. Synchronization of Combat, Combat Support, and Combat Service Support tasks. (BBS Information Briefing, 2002)
4. **Date/Developed/Implemented**
   1981 TRADOC developed training model on PC Platform.
   1986 Fielding to Active & Reserve Components.
   1995 Fielding to TRADOC Schools.
   1999 Last MicroVAX version fielded.
   2002 Fielding of PCWS-based V 6.0.
   2003 Fielding of V 6.1 with extended COE capabilities.
5. **Domain:** TEMO.
6. **Classification:** Unclassified.
7. **Applications**

BBS is a PC-based constructive simulation running under the Windows 2000 Professional operating system. The Graphical User Interface (GUI) has a windows-like appearance and was constructed to be intuitive and easy to learn. The system was designed with an Online Help menu system and requires little or no documentation to learn the simulation's functionality. The simulation has some stochastic (roll of the dice) capabilities, but the majority of the functionality is deterministic.

The BBS simulation provides the driver for command post exercises (CPX) for brigade and battalion level commanders and battle staff. Training is achieved by the development of realistic training objectives and goals that are supported by the simulation. Success is measured by how the commander and staff conduct their Military Decision Making Process (MDMP) and relate those decision(s) to the role-players for execution. Success is also determined by the feedback provided by the interaction between role-players and the staff, to determine if objectives and goals have been met.

The simulation operates in a nine-sided, free play, real time training environment, which provides realistic, high-stress conditions for the training audience. BBS has both air and ground warfare capabilities and a high fidelity logistics module including transportation, re-supply, personnel, medical and maintenance required to support a conflict. BBS is a high-resolution training model representing details down to the individual soldier, weapon system and supporting systems. The BBS simulation is designed to provide commanders a tool to train, exercise, and evaluate their battle staff in a realistic, high fidelity and real-time simulation exercise. The commander and battle staffs conduct operations and issue orders and information from their location to the simulation center. Operators/role players in the simulation center implement these instructions as they are received. The operators then provide information generated by the simulation to the staff. This information includes the results of unit movement, contact and conflict with threat forces, BDA, unit(s) status, and unit requests for supplies and support. The information flow between these two groups continues until exercise completion.

"Magic" moves, capabilities and procedures are referenced several times in this description of BBS. Magic is an unofficial term that describes controller-managed administrative adjustments to unit strength, location, supply status, timelines or other attributes to correct oversights or to allow player emphasis in a particular area without being adversely affected by rule-induced consequences in another functional area or BOS. The term probably evolved from operators'/users' comments when they saw unit icons instantly relocate, recover strength, or be re-supplied outside the rules of realism for a given simulation. The BBS design anticipates active controller intervention and management to meet training objectives, and the term is used in that context in the sections that follow.

8. **Major functionalities by BOS**
   a. **Maneuver capabilities include:**
      1. Movement algorithms to support weapon systems and vehicles, fixed and rotary wing aircraft, and ground troops moving over 26 different types of terrain features on digitized terrain
      2. Preplanned movement routes, group movements and group orders
      3. 50 Operational States modeled that affect movement rates, firepower and speed for ground and air units
      4. Major Supply Routes (MSRs) created for convoy movements and transportation routes.
      5. "Magic" movement at any time required
      6. Travel mounted or dismounted (with or without vehicles)
      7. Unit assets can be driven, towed, uploaded for transport and airlifted or paradropped to the desired location

Maneuver units on the ground are influenced by the elevation and feature data that unit(s) or individual(s) are attempting to maneuver through. Units on the move can also set and prioritize targets for fire (priority 1-4) or no fire (priority 5).

   b. **Fire Support:** Fire Support systems include a full inventory of mortars, artillery and MLRS systems with conventional and extended range ammunition, smoke and FASCAM. The fire mission input data includes target location, type fire mission (Adjust fire, Suppression of Enemy Air Defense (SEAD) and Counterfire), unit to fire, mission type (Direct Support, General Support, Reinforcing and General Support Reinforcing), ammunition type (HE, Dual Purpose Improved Conventional Munition (DPICM), Antipersonnel Improved Conventional Munition (APICM), Rocket Assisted Projectile (RAP), Army Tactical Missile System (ATACMS), WP SMOKE, HC SMOKE, ILLUMINATION, COPPERHEAD, ADAM (artillery delivered anti-personnel mine) and RAAMS (artillery delivered anti-armor mine)**?** and ammunition amounts to fire. A status window for each gun tube indicates if the firing unit is waiting for orders, out of range, or firing a current mission. If the tube is firing a current mission, then preplanned missions can be input to fire at a later time.

Units can receive fire missions on the move, but will halt movement to fire the mission and when completed will continue the movement. Preplanned targets (Global & Local) can be input into the system for quick firing. The firing unit can fire a mix of ammunition, and can fire targets sequentially. The Group and Series number must be input along with target number, UTM, firing attitude and target length for the preplanned fire missions. Adjust fire missions, Suppression of Enemy Air Defense (SEAD) missions and Counterfire missions are fired and saved in the unit history reports. The model also includes Call for Fire support of organic mortar systems for units engaged in battle. Target Acquisition Battery (TAB) radars require setup and have displacement times, provide realistic feedback with minimum and maximum detecting ranges for mortars, artillery and missiles, display graphical range fans, and present graphic representation when radars are active. Displays also list queuing schedule, queuing agent assignments for target reporting and a Counter Fire (CF) target information list. They track all CF targets and report how many were fired at. Forward Observer operations include lasing targets, reporting target information and reporting BDA. Range fans for area of coverage are based on ammunition and tube types. Four types of Counterfire zones, Critical Friendly Zone (CFZ), Call for Fire Zone (CFFZ), Artillery Target Intelligence Zone (ATIZ), and Censor Zone (CZ) can be input to provide data to the FSO and firing batteries. Direct fire target acquisition detection, and Line of Sight are also available for display.

c. **Air Defense:** Air Defense systems represented includes manpack/manportable missiles, the Patriot missile system, and intermediate ADA systems as required. Command and control features permit setting weapons status (weapon hold, weapon tight, weapon free). Units can be set up with a target priority list, and systems engagement ranges can be reset and can be set to automatically engage enemy targets. The radar components of ADA systems are assumed to be functional but are not explicitly modeled in BBS, but are implicit within the weapon engagement rules. BBS does not explicitly perform an Identification Friend or Foe (IFF) function to distinguish enemy from friendly air tracks. Friendly air defenses will not shoot down friendly aircraft, but will engage all enemy aircraft, to include UAVs. BBS graphic displays include a missile coverage area that allows the operator to create the umbrella effect to tie in systems for effective area coverage. Systems can be task organized to be OPCON or cross attached to other workstations at any time.

d. **Survivability:** This module in BBS includes a wide variety of engineering and NBC systems. Engineer units must employ their organic assets to dig infantry and vehicle fighting positions or the unit can use pure manpower to dig (but it takes more time to dig positions by hand). Any blue unit can occupy fighting positions whether owned or not and receive credit for decreased exposure once the unit occupies the fighting position. If the assets were not available but come at a later time, their organic assets can then be applied to assist in completing the task. The number of positions can also be increased or decreased if required. Fighting positions can be “magically” emplaced at any time or can be manually emplaced over time based on asset availability. A list of all fighting positions is maintained on the system and can be deleted by the Higher Control workstation.

Engineer units can emplace a wide variety of minefields and obstacles (Volcano (air/Ground deliverable), Gator (air deliverable), Row, Ground Emplaced Mine Scattering System (GEMSS), Hasty Protective, Deliberate Protective, Modular Pack Mine System (MOPMS), Wire, Anti-Tank Ditch, Crater and Bridge Demolition) by either magic or manual. There is a timing mechanism for emplacing mines and obstacles that is based on equipment type, personnel available and size of the minefield or obstacle. The minefield intent and size also determine how many mines or wire is required and whether the unit has the assets to complete the mission(s). Each minefield and obstacle type has specific requirements and the mission will not start before all requirements are met. A unit can be given a preplanned mission to dig, lay a minefield or obstacle but until the unit gets on-site the mission will not execute. The assets must be in the unit with the mission and equipment. Supplies and basic load items can be transferred to enable a unit to complete any mission. Breaching capabilities can be accomplished in many different ways. Depending on the type of breach operations for minefield breaching, obstacle breaching or emplacing a bridge, certain requirements must be met, and rely on assets of personnel, equipment, basic loads and supplies. Breaching can be accomplished using vehicles; plows, Mine Clearing Line Charge (MICLIC), or the unit can conduct a hand breach. Each breach type depending on assets has a time assigned. "Magic" is an administrative function commonly used to set conditions that may have been overlooked, or the operator ran out of time to complete the mission. BBS also represents the process of emplacing and retrieving camouflage.

The NBC module is very involved and represents the real time it took to accomplish the tasks. Although there are magic capabilities to accomplish most tasks, realistic planning is critical to successful training. Unit(s) can set and change their MOPP status at any time, but it does take time to go from MOPP 0 to attain MOPP 4 status. There are nine MOPP levels that can be attained with an Objective Percent/Percent Selected and Current Percent/Percent Attained. When a chemical attack occurs the unit may have early warning or could be surprised. In the surprised scenario there will be casualties of varying degrees assessed against the unit. There are however vehicles that have over-pressurized systems that will provide 100% protection for the passengers, but if the passengers are dismounted casualties may be assessed. Chemical alarms are modeled in the simulation and if emplaced properly will provide advanced warning. The alarms can be emplaced manually by the operator or can be emplaced automatically in the best position giving the unit the best coverage and protection based on weather conditions. NBC chemical and nuclear recon operations can be conducted. The unit is assigned an area to recon and if chemical or nuclear contamination is detected an alert is sent and the area of contamination will be displayed over time. As contaminated areas are discovered NBC reports can be generated and the agent type (GB, GD, AC, VX, HL or Nuclear) reported with strike number, location, agent type and DTG of Attack. Another important aspect is the capability to create NBC Predictions that will display graphically on the screen to show the hazard area and the drift for Chemical, Nuclear and Biological hazards. Units can be assigned a turn back dose (Tdose) for nuclear contamination and can be monitored in the unit status window. Once a unit is contaminated the unit and terrain can be “magically” decontaminated or the unit must go to a decontamination site to conduct vehicle and personnel decontamination operations to include MOPP suit exchange procedures. The decontamination unit must have the required amounts of supplies and assets to conduct the decontamination operations. There must be a supply of water in the area. The unit can have water trucks, water blivets or can use water resources that are coded in the terrain, so the unit can use water from ponds, lakes, streams and rivers to conduct the decontamination. There are other requirements such as STB, DS2, M1Cam and M12A1 Decontamination apparatus. Without the equipment resources the decontamination cannot take place. Sites can be selected and preplanned as Operational or Thorough decontamination sites, but to operate must have the right types and amounts of personnel and equipment. Smoke operations are played heavily in the simulation and model several different types of generators, vehicles and smoke pots. The operator can select from the different equipment types to create the missions that will include density, start and end locations, duration of the mission and activation time. When fog oil is used there is an associated burn time and smoke pots also have a burn time dependent on amounts of smoke pots used. As with most modules there are “magic” capabilities that can be used to create conditions for units to react to or they can be used for administrative purposes (e.g., enemy contaminates an area and it was a mistake-all units and terrain can be magically decontaminated). Magic can be used to administratively set unit Tdose rates, toggle NBC clouds to display or not display on specific workstations, set decontamination time to go slower or faster, and set M8A1 alarms to deploy automatically or manually.

e. **Intelligence:** The Intelligence Module in BBS incorporates, among others, the functionality of Unmanned Aerial Vehicles (UAV) for both Friend and Foe. The UAV can be shot down given the right conditions of Line-Of-Sight and detection. UAVs operate on the battlefield but do not give perfect information. They provide the workstation that owns the UAVs with a picture of detected units and alerts to send as spot reports or over time as a template. UAVs will crash if they run out of fuel, if the command vehicle moves, or if the command vehicle is destroyed. UAVs travel in one of three operational states (Transit, Loiter, Recon) and for each movement information is provided on flight time and fuel usage. Although the UAVs do not provide a 3D picture, information collected by the UAV is relayed to the TOC and provides useful data to drive staff decisions.

   There are three different types of Ground Surveillance Radars (GSR) modeled in the BBS simulation, each with minimum and maximum ranges to detect troop and vehicle movements. GSR also has 3-beam width selections and end scan location/direction of scan. Based on terrain and weather conditions the GSRs may not provide full capability because of weather interference or non-optimum placement on terrain, reducing the potential detection distance. The GSR must be activated and has a setup time associated with each type of radar. Once activated the radars will remain active until the operator turns the GSR off. The GSRs are vulnerable to enemy detection and over time the enemy can locate them.

Remote Battlefield Sensors (REMBASS), unattended ground sensors, are also modeled in the simulation to represent coverage for Infrared, Acoustic/Seismic and Magnetic sensing. Each sensor type has an associated detection range for vehicles and personnel. More than one type of sensor can be emplaced at the same location if required. The sensors can be placed and monitored and provide an alert message once a detection is made. The message will identify the type of detection and indicate if the detected object is moving and its direction of travel. Once the mission is complete the unit can recover the sensor for use at a later time.

Weather is also an intelligence asset as conditions can be changed to replicate the season, light conditions for day/night, sun angle, moon phases, surface conditions such as wet, snow or ice, precipitation to include snow, rain, sleet, and fog, cloud cover, wind speeds, wind direction, temperature, and humidity. Weather has tremendous effects on ground units but little effect on aviation unit operations. There is no radio jamming as the simulation does not monitor or send radio traffic. Communications effects in the simulation are limited to some ELINT capability as some signal units can, over time, identify large units and their high volume of traffic that would be generated.

BBS intelligence includes basic HUMINT capabilities. Each individual soldier in the simulation has aural and visual detection capabilities and can report enemy unit activities in his/her radius of detection, in the form of an alert message to the owning workstation that can be passed to higher headquarters as spot reports. Enemy Prisoners of War (EPW) and civilians are accounted for as objects requiring transport, medical care, and/or sustenance, but intelligence reports from these subjects must be scripted manually.

f. **Logistics:** The embedded capabilities of this module operate realistically so that the information provided by the simulation can drive any type of exercise, to include a pure logistics exercise. Because each of the logistics capabilities is comprehensive, each one is explained below in detail.

1. **Transportation:** Transportation operations are modeled to the individual vehicle and its capacities and basic loads for fuel, fuel consumption rates, maintenance failures, capacities for crew, passengers to include cargo weights and cube capacities. The vehicle cannot be unrealistically overloaded with passengers or cargo, and will run out of fuel. Some vehicles carry water, fuel or cargo and can be dispatched to locations to refuel, rearm, transport other vehicles (e.g., loading slow engineer equipment or loading tanks to deliver to another location). The vehicle can be sent to pick up supplies, ammunition, water, ration or any of the Class I-IX items. The vehicles can be sent alone, in groups for a convoy, can be preloaded with any of the CL I-IX items as long as they do not exceed the vehicles carry

capacities. The vehicles will also follow standard MSR routes that have been input into the simulation.

2. **Supply/Re-supply:** Supply/Re-supply operations are also modeled so that units must order supplies based on the units' Supply Consumption Rate (SCR) or run out of supplies. During initial setup all supply units must be uploaded with supplies. There are options to upload units by single supply item, selected units, Terminal Units or support all units in the simulation. The initial supply levels can be set from 1 to 500 percent based on items in the units' database MTOE. Units conducting routine operations or battle operations consume their basic loads of supplies, to include water, rations, fuel, ammunition and a long list of other items. As the items are consumed, destroyed, or spent the unit has to conduct re-supply operations. Units can be "magically" re-supplied, but the object of training is to make the planners plan and not use the magic capabilities. Units can request, load, unload and pickup supplies as required. As units need supplies they can send request lists to their supplier and the supplier can give then some, none or all of what they have requested. The supplier unit may not have the required item and may have to send out a request to fulfill the customer's list. The re-supply actions are conducted in real time, so if the fuel unit is 20 kilometers away, realistic travel times will be imposed depending on vehicle type, speed, and terrain. Supply points can be setup as Caches, Ammunition Transfer Points (ATP), aviation Forward Area Rearm and Refuel Points (FARRP), or vehicle re-fuel points to provide support to all units that come with in proximity and need supplies. Supplies are tracked as individual items (each) and can be uploaded that way if required. Supplies can also be loaded as bulk, usually the appropriate method. Units can transfer equipment for unit-to-unit or vehicle-to-vehicle, units can cross-level basic load and supplies (redistribute: supplies to Basic load or basic load to basic load, between units or vehicles). Units can split out single vehicles for pickup, load, delivery and unload options or can split any number of vehicles to load a variety of supplies for delivery and distribution to one or more units. When the split unit(s) completes the mission they are then reunited with the parent unit or they can remain split for additional or follow-on missions. The ability to check on supply unit status for their basic load and supply quantities at any time, transfer supply items to other supply units and print reports for all supply classes can be accomplished in a matter of seconds. There are 23 options for supply rollup reports. The "magic" re-supply is an administrative function to "magic" one unit or several units, adjust basic load percentages, source or secondary items and the capability to change source items at any time.
3. **Personnel Module:** Personnel module has the capability to track up to 50,000 personnel by Social Security Account Number (SSAN), Rank, MOS, unit and blood type. Personnel status is maintained for each individual soldier and personnel replacement operations are conducted for pickup and delivery from PERSCOM to the unit level. The module provides a listing for use by the unit S1 to track soldiers in the simulation by name, rank, and MOS, so as to provide a realistic environment for the S1 to participate in the

staff decision-making process. Replacements can be created and placed in the PERSCOM unit in anticipation of unit replacement requests or can be built on-the-fly as required. Once a request is sent for personnel replacements, the requesting unit will receive a confirmation that the request has been received. The replacement center can then decide to send replacements for some, none or all. Personnel rosters can also be changed at any time, and personnel can be redistributed among units if desired. "Magic" is also an option for administrative changes to the personnel function.

4. **Medical Module:** The BBS Medical module has a manual or automatic mode and can be turned on or off at any time. The Medical mission status provides information on all medical units owned by the workstation and provides the capability to split out single medical ambulances, vehicles and air ambulances that can be given the missions to go to a specific location and load wounded personnel by wound priority. (The KIA can also be evacuated but not on the same transportation asset as WIA). There are Graves registration units and morgues to which KIA and Died of Wounds (DOW) personnel can be transported/transferred. For each of the categories the person is identified by SSAN, wound time, and Highest Level of Care (HLC) that the patient needs to be evacuated to before dying of wounds or improper treatment. Unit, patient status, remaining time, if any, rank, MOS, Patient Category 1-349, priority, and blood type also identify the patient. Time is a key factor for evacuations and triage at the medical facility. Medical levels 1-5 are modeled (from the Aidman to L5) and other higher evacuation type units. The medical and associated unit are as follows: CONUS (highest level of care for all 349 wound types) Level 5, Field Hospital (FH) Level 4, General Hospital (GH) Level 4, Combat Support Hospital (CSH) Level 3, Forward Support Medical Company (FSMC) Level 2, Main Support Medical Company (MSMC) Level 2, Forward Surgical Team (FST) Level 2, Area Support Medical Battalion (ASMB) Level 2, Battalion Aid Station (BAS) Level 1, Aidman Level 1, Medical Company Holding (MHC), Mortuary Facility (MORT), Graves Registration Facility (GRF). Each level of care can treat certain wound types and the patient must reach the appropriate level of care in a timely manner or can die of wounds. Patients can die if proper supplies are not available, can die in surgery, and can die even if proper care was received.

There are different report types to get information on any medical issue. Each workstation has a Station's medical queue option that provides information on all owned WIA personnel. Each workstation has a Track Wounded In Action (WIA), Killed In Action (KIA), Died Of Wounds (DOW), Missing In Action (MIA) and Return To Duty (RTD) status option that provides the status of all owned personnel in one of the aforementioned categories. The Transfer Patients KIA or DOW personnel options allow KIA and DOW personnel to be transported or transferred to Graves Registration or the Morgue. The Deliver RTD personnel option allows personnel that have gone through treatment, surgery, recovery and convalescence to be returned to their original unit, or back to the Replacement Center for reassignment to another unit. Patient Management is an automatic or manual option and must be selected to provide patient management. Hospital units allow wards to be built for managing patients throughout the medical process, from receiving the WIA to discharge. Patients awaiting surgery are placed in a queue, in priority order, to include when surgery will be performed and how long the surgery will take. Surgery is also based on Surgeon availability and some patients may require transfer to other hospitals for surgery if the right type and amount of surgeons are not locally available. It is critical that the medical units track patients so that this will not happen and cause a soldier to die because of a lack of planning. Each of the medical facilities has a bed count and can be overloaded; this would also cause soldiers to die, as they would not receive the proper treatment in a timely manner. Wound information for each wounded soldier is available and has wound type, highest level of care required, priority, whether ambulatory or litter patient, and the times required for evacuation and to get to surgery before the patient dies from wounds. The stations can create Ambulance Exchange Points (AXP) and also an option for Collection points for one primary and six secondary points that can receive patients from 100 units in the simulation. Units can be selected to send their wounded to these points for evacuation through the medical care system. Aidman supplies are available and will be consumed as the wounded arrive and triage is started. Patients can be evacuated at any time after they arrive. For each wound type there is an associated amount of CL VIII supplies that will be consumed all the way from the Aidman to surgery. If the medical unit runs out of CL VIII supplies the patients will start to die because they did not receive the proper treatment.

There are a few administrative tools that can be used to create wounds from any of the 349 wound types to drive a pure medical exercise, and personnel can be wounded over time also. The simulation also calculates non-battle casualties along with battle casualties every hour based on a percentage of personnel in the simulation and assuming the wound types are random. The Higher Control workstation (HICON) can speed up treatment times for wounded personnel, and can set the management of patients to auto or manual. Setting the patient management to operate automatically causes the simulation to treat the wounded without any user interaction. When patient control is set to manual, all medical management functions must be performed to evacuate and treat the wounded. The Magic Medical option allows the simulation to treat all WIA personnel and have them in a RTD status at the push of a button, and can have all KIA and DOW personnel automatically transferred to the GRF.

5. **Maintenance Module:** The Maintenance module in BBS provides operations for support from the unit level through GS levels. Maintenance starts at the mission status of the repair units. Vehicles can be damaged either in battle or through six different maintenance failures (Communications, Weapon, Suspension, Electrical, Engine or Chassis). Vehicles must be evacuated for the proper level of repair. Recovery vehicles

must be assigned the mission to pickup and tow the vehicle to maintenance, or if the damaged vehicle is mobile, the vehicle can perform self-evacuation. Maintenance teams can be sent to the unit level to effect repairs if evacuation cannot be performed or if the unit's SOP/FSOP has been planned. The maintenance unit receives the damaged vehicle and the maintenance process begins with an inspection of the vehicle. A time is associated with the inspection. Once the inspection is completed and parts for the repair are identified, if the unit has the required parts, the repair will begin. There is an associated time of repair based on the specific damage or failure. If the unit lacks the required part, then the part must be ordered or picked up. This procedure works the same as re-supply. A vehicle(s) must be assigned to pick up or deliver the part. Distance, terrain, vehicle type, and weather affect the speed at which the vehicle travels to obtain the part. Once the part is delivered to the repair unit, the vehicle is repaired based on time. When the repair is completed, the vehicle is ready for return to the original unit or can be sent to any unit, and can be returned with or without a crew assigned. Once the vehicle is selected for return, BBS calculates travel distance and assumes a 20km per hour speed to determine when the repaired vehicle will reach the unit and be displayed in its unit status report. If the parent unit is moving around the battlefield, the time and distance for return will change. Each damaged vehicle is tracked in a Damaged Equipment list available at all times. Maintenance collection points can also be assigned for evacuation purposes and repair functionality. Other administrative tools can be used to enhance maintenance play. These include the ability to damage systems and vehicles "magically" at any time to support maintenance training objectives, and the repair of all vehicles in maintenance at the push of a button. Other Magic options include the ability to put maintenance on automatic, so that no user interaction is required; a manual mode that forces the units to conduct maintenance; and an option to speed up maintenance inspection, repair and return.

g. **Command and Control (C2):** Command and Control in BBS is represented as a function of reporting, communications, coordination and execution of orders. Orders are received from the Tactical Operations Center (TOC) located outside the simulations center. The orders received by the role-players/terminal operators in the simulation center are input to the computer. The resulting reports from the computer drive the staff decisions. One other aspect of C2 represented in BBS is to task organize forces to support the missions and orders from the commander and staff.

10. Other Functionality

a. Other functionality includes the "magic" capabilities, building new units to add equipment to the running simulation, over 60 types of informational reports, and the capability to distribute the simulation to multiple sites. Enemy Prisoners Of War (EPW) and Civilian Refugees (CIV) are modeled in the simulation and must be dealt with through planning. EPW and CIV will slow units down and affect the firepower of both friendly and enemy units. If EPW/CIV are captured or a unit gains control of either, there will be transportation, feeding and medical requirements that affect the units. EPW/CIV will consume water, rations and medical supplies of the controlling unit.

b. Organic weapons and Individual weapons systems are modeled in the simulation and are tied to the Probability of Hit (PH) and Probability of Kill (PK) tables that are hard coded in BBS and cannot be changed. BBS keeps the PH/PK tables hard coded because BBS is not an analytical model and every time the simulation is played, the user can expect the same results and outcomes. This provides the units with a very stable and constant environment. The weapon systems come with a basic load of ammunition and ranges (min/max).
c. The BBS training suite is deployable, and deployed elements can participate in training with other training sites on a wide area network. This capability adds flexibility and value to the inherent capabilities of BBS for end users. Airmobile and airborne operations are executed in the simulation and are very realistic to the operator. The units can load and carry equipment and personnel on a wide variety of military aircraft and can air drop, air land and drop paratroopers on the Drop Zone. BBS can build sticks (the element of soldiers to exit the aircraft through a single exit on a pass over the drop zone), chalks (the aggregate of the sticks aboard an aircraft), and realistically portray and execute the air operations necessary to support the ground war.
d. The representation of fixed wing aviation in BBS provides air-to-air engagements, Close Air Support (CAS), and Battlefield Air Interdiction (BAI). On Target coverage, low-level flight, loiter capability; Gator emplacement, airdrop and air land capability, and bomb drop capability are also provided.
e. The representation of rotary wing aviation includes air-to air conflicts, low-level flight, contour flight, Nap-of-the-Earth (NOE) flight, recon, Hellfire & Remote lasing capability, attack, pop-up-hover, Volcano emplacement, airdrop and air land. The aircraft can be flown as individual aircraft or as aggregates. All AC (FW/RW) possess Chaff and Flare capabilities to decrease vulnerability. Aircraft also have radar technology, sensors, sights and a wide variety of bombs, missiles and rockets to engage the enemy when required.
f. After action review (AAR) software is embedded in the BBS software. The BBS AAR is a dedicated PC-based workstation that collects near-real-time data by monitoring the network. The AAR system accommodates up to 10 AAR workstations collecting data on a single network. The AAR GUI is designed for ease of use and has a windows flavor that is easy to learn. The AAR system includes a wide range of pre-built tools for the analyst, and is extremely flexible. Toolbars and buttons make it easy to access data. The AAR module can capture data in "snapshots" taken every 1 to 10 minutes of simulation time. The snapshot interval is user defined. A status report giving time remaining to the next snapshot can be selected. Given the 1-minute data capture rate, the AAR module can collect all activity on the entire battlefield for a total of 96 hours. To create more save time on the system, AAR files can be deleted while the AAR is collecting data; however, these cannot be recovered after deletion. The AAR has two main modes. One is the Replay Mode, which allows the AAR to continue capturing game data, select specific snap shots, animate selected snap shots, and print or save a video capture. The second mode is the Live Mode, which shows

the simulation in real time. Data capture continues in Live Mode, and live data can be collected in the form of reports. The current situation can be captured for individual unit(s) and Task Forces for enemy, unknown and friendly units. One strength of the AAR system is that interim AARs can be prepared and conducted at any time during game play, and do not interrupt data captures. The AAR build begins the moment the AAR is started. Options include building task forces for reporting; filtering graphics for unit type, vehicle losses, task forces, control measures; and viewing planned and emplaced mines and obstacles. The slides and reports data can create bubble charts, canned slides, freehand drawings, map slides, test slides and can even import other JPG, BMP, and PowerPoint slides into the AAR briefing. AAR files can also be exported to other media presentations if desired. The AAR operator prepares the slide show, to include animations of the sequence of snapshots to be played on the BBS AAR system. The AAR data can be stored on a CD-R for replay at the unit. This can be a great help in determining future training objectives for the next exercise.

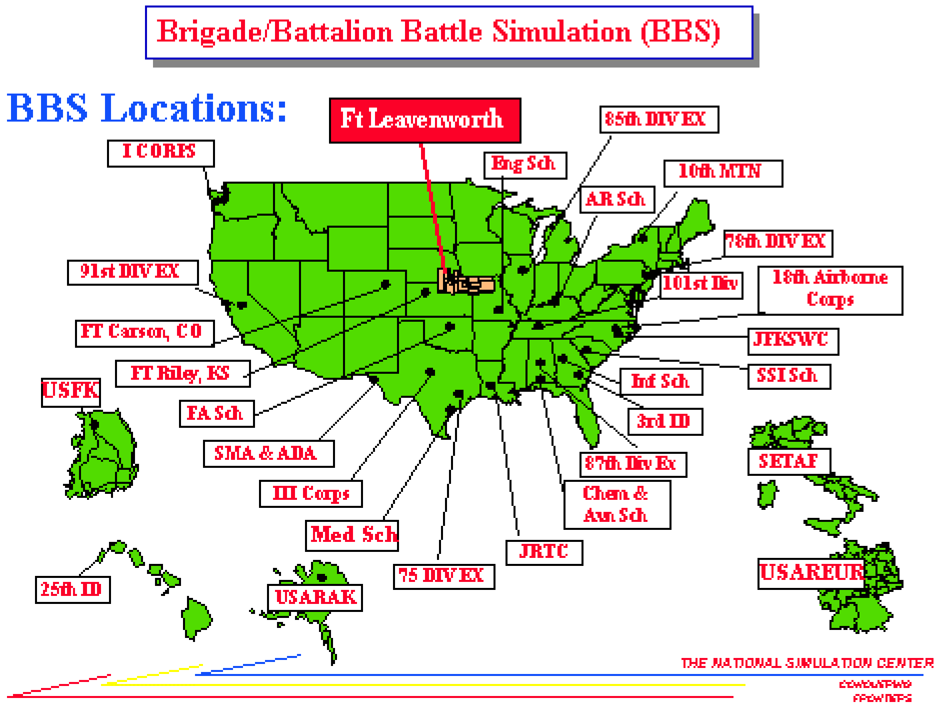
11. Terrain Management System

Current Terrain Imagery System: Digitized Terrain

a. **Terrain Products.** BBS uses three standard products from the National Imagery and Mapping Agency (NIMA) to build the BBS terrain. Arc Digitized Raster Graphics (ADRG) provides the digital map view (1:1,000,000; 1:100,000; and 1:25,000). Digitized Feature Analysis Data (DFAD) provides the 26 different terrain types as thematic layers (i.e., Roads, Tunnels, Desert, Bare etc.). Digitized Terrain Elevation Data (DTED) provides elevation points on the terrain. BBS currently uses 1:100,000 USGS maps to fill in for missing data that NIMA does not have available.
b. **Expense.** There is no cost involved to requesting units to develop new BBS terrain. Terrain is produced by the National Simulation Center. Requestors need only complete and submit a terrain request form. The form can be downloaded from the BBS Web page at the following URL: http://www-leav.army.mil/nsc/famsim/bbs/newsltr/sep02nl.doc. Terrain is built on a first-come, first-serve basis and should be ordered at least 3-4 months in advance.
c. **Time.** The minimum terrain box size is 60km X 60km. Maximum terrain area is 600km X 600km. To build the maximum size box would take 5-10 days to include testing. If editing is required, a 110km X 110km area can be edited in 3-4 weeks. The editing time depends on the number of features to be edited. Desert (e.g., NTC) terrain is much faster to build, and a 110km X 110km box can be edited in two weeks, based on one person editing. BBS allows up to 420 workstations, and all workstations could be used for editing at the same time.
d. **Clarity.** The ability to display the map at different resolutions allows the operator to choose a level appropriate to the task.

12. **Human Behavior:** Not represented in BBS.

13. **Who is using it?**



BBS Suites currently exist at 16 Active duty Corps and division sites (I Corps, III Corps, V Corps, XVIII Abn Corps, 1st AD, 1st ID, 2nd ID, 3rd ID, 4th ID, 6th ID, 10th Mtn Div, 24th ID, 25th ID, 101st Abn Div, CMTC-Hohenfels, GE, JFKSWC and Fort Polk), Five USAR Battle Projection Groups (BPG) (75th Div, 78th Div, 85th Div, 87th Div, 91st Div), 12 TRADOC Schools or sites (Ft. Leavenworth, Army Management Staff College, Chemical School, Engineer School, Infantry School, Artillery School, Air Defense Artillery School, Armor School, Aviation School, Academy of Health Sciences, Battle Staff NCO Course at Ft. Bliss, TX and Ft. McCoy, WI), and Team C Battle Command Training Program (BCTP-TM C). BBS has also been fielded through Foreign Military Sales (FMS) to Australia, Bosnia, Canada, France, Korea, and Turkey.

14. Strengths

a. Easy to use and adaptable to all situations.
b. Standalone system easy to setup and train.
c. Distributed system with no single point of failure.
d. Robust Combat Support and Logistics capability.
e. Large playbox (600km X 600km).
f. Embedded AAR Module.
g. Rapid Terrain Generation worldwide data.
h. Large Icon and personnel count.
i. Complete Combined Arms Trainer for commander and staff.

15. Limitations

a. No C4I stimulation.
b. Not DIS or HLA compliant.
c. No human behavior represented.

16. **Technical Specifications**
    a. **Resolution Issues:** None.
    b. **Fidelity Issues:** None.
    c. **Clock Speed:** 1.5mhz or higher.
    d. **Update Rates:** 60/70hz.
    e. **Operating Environment:**
    f. **Hardware:** BBS is hosted on standard PC. Recommendation for the Common Hardware Platform is provided in Army MSRR.
    g. **Environmental Considerations:**
    h. **Electrical Requirements:** 110/220, 20amp circuit for every two PC workstations.
    i. **Physical Dimensions:** May require a 15X15 foot area.
    j. **Software/Operating System:** MS Windows 2000 Professional & Office 2000 Current Version: **6.0**
    k. **Source Code Languages:** C++
    l. **Licenses Required:** NONE
    m. **Interoperability:**

The current Command and Control Simulation Equipment (C2SE) hardware can host all current models and simulations (M&S) to include BBS, CBS, JANUS and SPECTRUM. However, each M&S has different software requirements and terrain products are not interchangeable. C2SE equipment may not be technically advanced enough to support ONESAF and WARSIM workstations.

1. HLA Compliance: No
2. HLA Certification: No

17. **Standards:**
    a. Protocols: TCP/IP
    b. Network: Ethernet
18. **VV&A**

Each year the simulation is accredited during testing.

19. **Future Plans**
    a. Digital stimulation of C4ISR systems.
    b. Joint Capabilities (add Naval operations).
    c. DIS compliance.
20. **Maintained by**

National Simulation Center (NSC)

21. **Next Version/Incorporated into other Applications**

Version 6.1, which was scheduled to be released in April 2003, will include improvements on the Engineer and AAR modules and add Military Operations in Urban Terrain (MOUT) capabilities. Other features enhancing training in the Contemporary Operating Environment (COE) will be added. [Army MSRR, 2003]

22. Expected Retirement Date

CY 2007, unless ONESAF fielding schedule is changed.

23. Modifying Scenario Database

For extensive information pertaining to database modification, contact the BBS program office at NSC.

24. Modifying Functional Databases

a. **Time to Develop:** Approx. 3-4 days to create, test, and cut a CD-R for a 600km X 600km new terrain database. Equipment tables and engagement rules are fixed data in BBS, and are not normally subject to field updates. Unit databases can be created locally.

b. **Where Maintained:** The master terrain database is maintained at the NSC and each simulation site maintains their own library of simulation terrain sets.

c. **Reusable?** Yes (terrain, unit database and scenarios).

d. **What Databases are Available:** Twenty-one terrain databases are available for use and are listed in the BBS newsletter. Scenarios and unit databases are unit dependent.

e. **How are/Can Databases be Modified?** Use the BBS embedded database and terrain editor.

25. Input/Output Format

a. **Input:** Movement/conflict orders, unit names/locations, re-supply.

b. **Output:** Conflict resolution, tabular reports of battle damage, personnel and logistics status and losses, alerts, graphic battle depiction. Graphics: LVD with digital DTED overlaid with DFAD.

c. **Cycle Time:** 15-second updates.

3.D.1f Spectrum

1. **Type: Constructive**
2. **Acronym**
3. **Purpose for which developed**

The Spectrum simulation was developed to support command and control training for military operations other than war (MOOTW). Spectrum was developed by the TRADOC National Simulation Center (NSC). Spectrum was created using a rapid prototyping methodology during 1994 and 1995, by using the Variable Intensity Computerized Training System (VICTORS) as the basis from which to start. VICTORS, developed in 1993, was used by the Army for low to high intensity conflict training. Spectrum improved on VICTORS by adding a multivariate sociological model and a graphical geographical interface. Spectrum was designed to run on a personal computer (PC). Since the PCs available at the time did not have the power to perform all of the adjudication and communication processes required for a continuously running simulation, the “game turn” methodology used in battle board games was adapted. Spectrum developers selected the approach of using PCs operating in the Windows environment, buying "off the shelf mapping products", and employing flexible database shells to create a versatile, but relatively inexpensive simulation. MOOTW is now encompassed within the doctrinal term Stability And Support Operations (SASO), which will be used in the remainder of this description.

Spectrum has been employed at the Command and General Staff College, various Simulation Centers, among selected operating elements of the Army, and selected allies as an effective, flexible simulation that adds another dimension to training with simulations.

4. **Dates Developed/Implemented**
   a. First fielded in early 1996 with version 1.1.
   b. Version 1.1 used Windows 3.1 and operated on a Novell network.
   c. Version 1.5 added the transportation and engineer modules but remained with Windows 3.1 and Novell.
   d. Version 1.6 operated on a Windows NT operating system and network.
   e. Versions 1.6.1 and 1.6.2 contained code fixes based on requests and reports from field users.
   f. Version 1.6.3, the most current version, includes code fixes and now operates on a Windows 2000 operating system and network. Spectrum is still a 16-bit application running on a 32-bit system and, as such, has some electronic limitations.
5. **Domain:** TEMO
6. **Security Classification**

Code is unclassified. Exercise classification depends on the classification of scenarios and/or databases.

7. **Security Caveats**
8. **Applications**

Spectrum can exercise policy formulators and decision makers (Joint Staff, National Security Council, State Department), Operational Staffs - Non Military Deployment (Combant Command Staff, Embassy Staff), Operational Staffs - Post Military Deployment (Corps and Division Staffs), and Tactical Staffs (Brigade and Below).

Spectrum's relational database is easily tailored to portray any combination of U.S. Joint, and combined forces, non-governmental agencies, tribes, factions, and social groups, with any combination of equipment, ammunition and personnel, including non-traditional elements in military games, like narcotic-traffickers, mob leaders, and civil police.

9. **Major functionalities by BOS**
    a. Maneuver: Yes
    b. Fire Support: Yes
    c. Air Defense: Yes
    d. Survivability: Yes
    e. Intelligence: Yes
    f. Logistics: Yes
        1. Transportation:
        2. Supply/Re-supply:
        3. Personnel:
        4. Medical:
        5. Maintenance:
    g. Command and Control (C2): Yes
10. **Other Functionalities**

    a. **Strategic/Operational:** The Spectrum Regional Analysis Model (RAM) enables players to observe the reactions of selected population groups to various U.S. activities. Such activities might take the form of road building or targeted economic development projects, the method of awarding contracts for construction of facilities, or the impact of U.S. presence on the local population, as a way of considering policy options. Spectrum can simulate a political, economic, and sociological environment where strategic and operational policies, projects, and campaign plans can be implemented and analyzed. Time is then accelerated to show the impact of those decisions over time. The Spectrum RAM is deterministic and can be used for forecasting trends and providing insight to the outcome of strategic and operational policies, projects, and campaign plans.

    b. **Operational/Tactical:** Spectrum combines conflict modeling with a multivariate sociological model to replicate the unpredictable and chaotic environment associated with military missions and SASO. At the operational/tactical level, soldier behavior at local control point, in off-duty locations, or engaged in local construction, medical assistance, or security activities can be trained in an environment in which the local population includes a realistic array of personality types and attitudes toward the U.S. presence. By portraying a thinking, reacting civilian population, U.S., coalition, and combined forces, non-governmental agencies and other groups can prepare for SASO. The problems produced by Spectrum stimulate decision-making procedures exercising staff coordination and inter-agency coordination and communication. At the operational and tactical levels, emphasis can be placed on military options other than force-on-force engagement. Units can be trained in the practical consequences of rules of engagement, personal and unit behavior, and observance of local customs and practices.

11. Terrain Management System

Digitized. Spectrum uses a commercial, off-the-shelf program called MapInfo to generate maps on the workstation screen. MapInfo provides great flexibility to the user when dealing with map products. It allows two and three dimensional terrain views, construction of overlays and other graphical command and control products, and creation of custom icons and objects. MapInfo uses many National Imagery and Mapping Agency (NIMA) products such as Digital Feature Analysis Data (DFAD), Digital Terrain Elevation Data (DTED), and Arc Digitized Raster Graphics (ADRG), bitmaps, or digital pictures of real military maps. ADRG can be superimposed over the features and elevation data to make the workstation display look exactly like the military map of the area. ADRG, and Compressed ADRG (CADRG) are CD-ROM products in standard military tactical scales. Spectrum can also accept other NIMA or commercial bitmap or raster images to support training requirements. Finally, it is possible to optically scan and then manually digitize any graphic picture, map, diagram, or symbol.

The Spectrum playbox is limited by computer hard drive space. On average each 1 x 1 degree box takes 12MB for the terrain file and another 12Mb for the corresponding map files. Areas that have little features, like the desert, would take considerably less Mbytes for the terrain file. Areas that have lots of features, like major metropolitan areas, take considerably bigger.

Current Terrain Products: Training support plans (TSPs) are equivalent to scenarios and databases that are available for reuse or modification. Selected TSPs are listed below:

a. ***Haiti***--The TSP provides for the conduct of peacekeeping on the island of Haiti with a brigade level task force from the 101st Airborne Division (AASLT) with primary focus on one battalion. All of the pre-STARTEX data is real world and based on events that transpired in Haiti before U.S. entry. Embedded in the exercise is the requirement to transition from a peacekeeping mission to a humanitarian relief operation caused by a tropical storm. This scenario can easily be adapted to train a civil affairs battalion, a PSYOP company, a Special Forces advanced operational base (AOB), humanitarian relief organizations, embassy staffs, and other agencies. This exercise can be conducted in three ten-hour days.

b. ***Bosnia***--The TSP is based on the real world events that transpired after the US 1st Armored Division deployed to Bosnia. The focus is the command and control and staff interaction of a brigade task force. This scenario was used to support a SAMS exercise. It was modified to support the training of two multinational division level staffs under the command of the Allied Rapid Reaction Corps (ARRC). The TSP contains terrain playboxes, databases, and situational events. The Bosnia exercise can be conducted in three ten hour days.

c. ***Govinia***--The TSP is exactly the same as the brigade level exercise mentioned above. All of the names of the countries have been changed to make it a totally fictitious scenario.

d. ***Pineland***--The exercise is specifically designed for a Special Forces operational detachment conducting unconventional warfare operations (UW) in the fictitious country of Pineland. The scenario also includes a foreign internal defense mission and a linkup with conventional forces. This scenario was modified by the I Corps Simulation Center to train a military intelligence unit. This scenario could easily be modified to train an SF AOB or forward operating base (FOB). This exercise is conducted in five ten-hour days.

e. ***Eastland***--The TSP was designed exclusively for SOF students during the conduct of Prairie Warrior using terrain in the Czech Republic and Hungary on the fictitious island of Lantica. The training audience is the commander and staff of a Special Forces battalion that has been augmented with mobile training teams from special operations aviation, Air Force special operations groups, military intelligence, military police, engineers, PSYOP, and civil affairs. The mission is to conduct foreign internal defense for Eastlander conventional forces and conduct counterinsurgency operations against an active, well equipped, and well-organized insurgent. Embedded in the exercise are requirements to respond to a natural disaster, control and care of refugees, identify insurgent infrastructure, and employ conventional tactics, techniques and procedures. The scenario could easily be modified to support the training of a Special Forces company, group, or joint special operations task force. The exercise design requires five and one half ten hour days.

f. ***Lantica***--The scenario is a situational event driven exercise for special staff officers without icons or mapping (although mapping is available). These situational events are designed to drive the staff actions and coordination required of the Staff Judge Advocate (SJA) , surgeons, chaplains, contracting officers, PSYOP, civil affairs, finance/comptroller, host nation support, PAO, and others at CJTF, Army Service Component, Theater Support Command, Corps or Division levels. The scenario was developed for use by the Command and General Staff College, and used during the Prairie Warrior 97. The fictitious island of Lantica is used as the base scenario and involves the host nation countries of Baltonia and Vistulia against an aggressor called the BIDSON Axis. Detailed country studies with host nation support annexes, Status of Forces Agreement (SOFA), bilateral support agreements, media descriptions, and PSYOP themes are only a small part of the documentation provided. The exercise is conducted in five and one half ten hour days.

g. ***Macedonia***--The TSP was designed for the School for Advanced Military Studies (SAMS) and involves a joint task force composed of the 82nd Airborne division, a Marine Expeditionary Force (MEF) with air wing, and coalition units defending an airfield from attack by Serbian forces. The scenario is a force-on-force, combat operation having many branches and sequels for and including an embedded Non-Combatant Evacuation Operation (NEO).

Additional exercise materials (mapping, situational events, and unit databases) are available from Peace Shield 97 and Prairie Warrior (98 and 99). All training support packages (TSPs) produced by the Spectrum team are easily modified and users are encouraged to do so. The primary purpose of the TSP is to give users a start point from which to design and develop exercises that support their own particular unit's training objectives. The National Simulation Center's Spectrum team has established a home page on the Internet to exchange information. As the field Simulation Centers and units develop TSPs, the NSC requests they be shared with all Spectrum users.

a. **Expense:** The license fee for MapInfo is approximately $700 dollars per installation. MapInfo must be installed on all Spectrum computers.
b. **Time:** Spectrum is an event-stepped simulation. The flow of time in the virtual environment can be set approximately to real time, or to faster or slower than real time. Spectrum exercises typically include pauses in which the current situation can be discussed, and pre-planned events, moves, and communications can be input for execution at the appropriate game time.
c. **Clarity:** MapInfo offers the user a great deal of control of the map graphic display. The view of the map can be zoomed into focus on a highly localized view, zoomed out for a wide area view, and offset in a 3-D mode so that the effects of vertical terrain height can clearly be seen.

12. Other Environment Representation

Weather and the effects of weather can be represented during a Spectrum exercise. Rain, wind, snow, fog and the effects of mud, flooding, and other weather results are accounted for. Spectrum also accounts for the effects on visibility and detection of daylight and darkness.

13. Human Behavior

Spectrum's unique capabilities allow it to model the political, economic, and sociological conditions in a country or region. The simulation can portray specific societal groups and institutions within the region, and any outside actors affecting the region. Spectrum uses the RAM to model the effects of political, economic, and sociological issues on each defined segment of population. The purpose of RAM is to portray a thinking, reacting, and seemingly unpredictable civilian population with their own opinions and characteristics. Depending on the level of the exercise, the training audience can simulate the effects of plans, policies, and projects on the civilian population or simulate their forces' interaction with the population during operations. A total of 24 groups may be defined in the RAM. A societal group can be both clustered (located in a geographical area) and stratified (a horizontal layer or "spread out"). Additionally, a societal group can be an individual person who has a significant degree of influence, such as the head of a country. The RAM database represents these groups as a series of subjective weighted values derived by a subject matter expert. It is relatively easy to enter the values in the database; however, conducting the necessary research and analysis to initially establish the values should be done by an expert such as an Army Foreign Area Officer (FAO) who is familiar with the political, economic, and military affairs of the region or country being modeled.

The simulation treats institutions like a social group. An institution is a significant practice or organization in a society or culture, and may be composed of individuals from several different societal groups. Examples of institutions are: a religion, a labor union, a political party, an organization such as the United Nations, or an economic bloc like OPEC. Outside actors are constructed in the same manner as a societal group. Outside actors exist outside the country or region, but have influence or interest in the country or region. Examples of outside actors are nations, financial institutions, and other entities that have interests in the region being simulated.

The RAM calculates a factor known as “protest level,” a rating of the degree of satisfaction or dissatisfaction currently held by each defined grouping. Specific human behaviors are input by player commands, and the exchange of information between players, through the structure of the simulation. Preplanned events can be entered in Spectrum, and keyed to happen if specific conditions are met. If those conditions are not met, the preplanned event may not occur in the game. The conditions under which these events can be triggered are time (i.e., this event will occur at two o’clock); proximity/location (i.e., if a friendly unit and an OPFOR unit detect each other in the simulation, the planned event will occur if a friendly unit enters a specific area); and protest level (i.e., if the labor union fails to get a new contract and level of dissatisfaction crosses a threshold).

14. Simulation Strengths

Spectrum can drive exercises at all levels for different training audiences. The simulation's inherent flexibility allows it to model any environment that the exercise designer can imagine. Spectrum has built-in representation of human behavior. It also contains built-in report and AAR capabilities to assist in providing feedback to the training audience. (Mitchell, 2003) Spectrum possesses unique functionality, and is the only Army model able to portray the dynamics of human interaction in a military setting while meeting specific unit-level training needs.

The quality that makes Spectrum different from most Army force-on-force simulations is its ability to simulate societal interactions and represent a multi-sided scenario including external influences on military operations. The concerns and interactions of host nation governments, diverse populations, and other outside actors impact on the decision making of the military. This presents the trainer with a challenging exercise environment that simulates the low end of the spectrum of conflict, and the conduct of SASO for commanders and their staffs.

Spectrum is unique among Army simulations in three distinct respects. First, the game-turn methodology means that an exercise supported by Spectrum does not have a constant timeline driven by the simulation clock. Second, unlike a “combat” simulation, firepower combat results and enemy attrition are not, normally, measures of effectiveness for SASO. Thus, Spectrum rewards non-lethal and non-combat measures, while recognizing the necessity for force protection. Moreover, Spectrum is designed to reveal potential consequences, either positive or negative, of a range of interactions between the simulated Army force and the local population, and between defined segments or factions of the population. Third, role-playing is facilitated between personnel at the various workstations to a greater degree than most military simulations. While Spectrum terminals will normally be assigned by Battlefield Operating System (BOS), they can also be assigned to non-military elements such as the U.S. State Department, NATO or other coalitions, other government agencies, or to non-governmental organizations (NGOs), with whom Army forces might interact in an SASO setting. Also, reflecting the importance of medical support, supply, and mobility/transportation in many SASO settings, Spectrum emphasizes the representation of medicine, supply and transportation assets available for use in SASO scenarios, if required. These features are explained in greater detail below.

a. **Game-Turn Methodology:** At the start, and at intervals during a Spectrum exercise, simulation time is suspended. Players are advised of the current situation and presented with factors requiring action. During those intervals, players consider their next moves and enter appropriate commands. When the simulation is restarted, the timeline advances at a rate determined by the exercise controller or director, and all commands pending for that segment of time are acted upon by the simulation, which executes at a variable rate, normally real time or faster. Results of those actions are reported to players in various ways, depending on exercise objectives. The nature of reports varies with the functional role assigned to the specific simulation terminal. New commands to Spectrum can be entered while the simulation is running if desired, rather than waiting for the next game pause.
b. **Not Attrition Driven:** Spectrum recognizes that in any situation, the use of force may be required, and combat effects are reflected in the game. However, Spectrum is designed to reflect other social consequences of military operations in addition to combat effects. The Regional Affects Model within Spectrum (discussed in greater detail below) contains weighted values for a large number of factors, events, and relationships that can be foreseen in a given scenario. These values can be assigned to economic, medical, political and sociological conditions that may be influenced by player actions. The result of interaction with these factors is a change in the level of satisfaction or protest expressed by each group represented. Achieving a low protest level, rather than a high degree of combat attrition, is one measure of effectiveness in Spectrum.
c. **Role Playing:** Spectrum can transmit and receive scenario-appropriate free text email between the individual workstations. This feature permits routine situational or operational reporting to flow between staff elements if that level of game is the objective. The same feature can be used in an academic setting to form coalitions between factions, to conduct targeted propaganda or intelligence operations, or to distribute "news" about scenario events introduced by the control staff.

15. Simulation Limitations

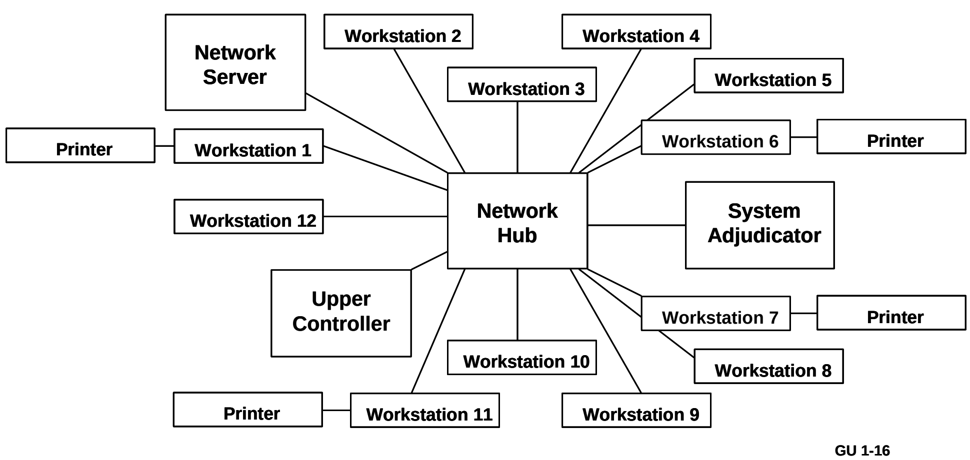
Engagements do not occur automatically in Spectrum as they do in some traditional force-on-force simulations. The user must decide if an engagement is to take place. The effects of combat are not modeled to the same degree of fidelity as in a combat simulation, but wounds or other operating injuries can be included if medical play is a training objective.

16. Technical Specifications

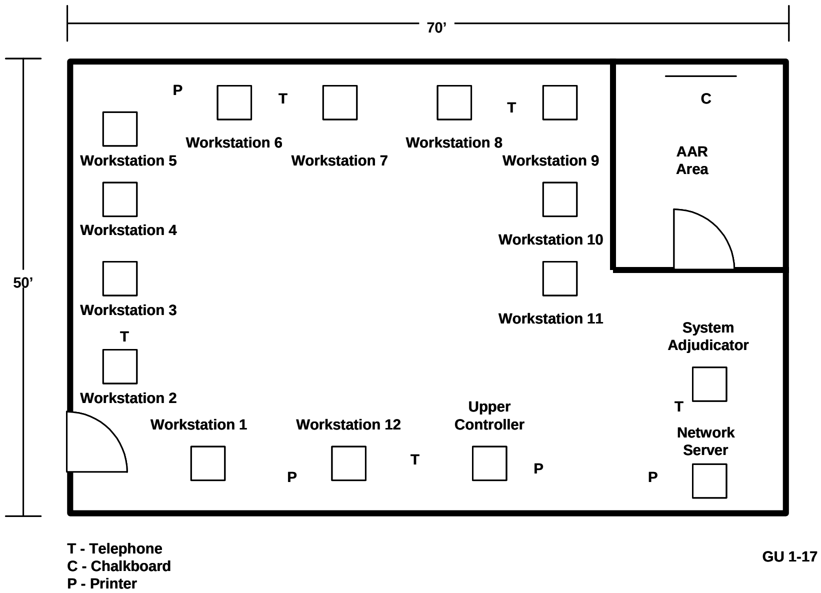
a. **Clock Speed** (minimum acceptable CPU speed): 300MHz. 500 MHz recommended.
b. **Update Rates** (minimum update interval for time stepped simulations): Variable. Game speed can be accelerated to 2-4 times real clock speeds if desired.
c. **Operating Environment:** Windows 2000 version 4.0 or higher
d. **Hardware:** IBM Compatible PC

e. **Hardware Environmental Considerations:** Network router hub required. Network card required in each machine.
f. **Software/Operating System:** MS Windows 2000 Professional & Office 2000
g. **Simulation Current Version:** 1.6.3
h. **Source Code Languages:** Spectrum is written in Turbo Pascal For Windows and MapInfo Basic, both commercial, off-the-shelf programs. The workstation operating systems were written in MapInfo Basic. Spectrum uses Microsoft Windows as its operating platform. The adjudicator software was written in Turbo Pascal For Windows. W2K serves as the communications medium of the simulation.
i. **Licenses Required:** MapInfo Runtime Version 4.0, one license per workstation required.
j. **Interoperability:**
   1. HLA Compliance: No
   2. HLA Certification: No
k. **Standards:**
   1. Simulation makes use of IPX/SPS protocols. Does not use TCP/IP.
   2. Internal Network Type: See network diagram and sample facility diagram below.

SPECTRUM HARDWARE CONFIGURATION



SPECTRUM TRAINING FACILITY



The simulation center's layout and other hardware locations will determine the precise location of the Spectrum hardware. Notice on the diagram the close proximity of the system adjudicator to the upper controller and the network server. Also notice that the player workstations are positioned so that adjacent players cannot view each other's screens. Partitions can be used to separate the workstations if available.

In a strategic or operational level exercise, the training audience directly interfaces with the computer system. Depending on the size of the exercise, anywhere from five to 25 PCs and printers could be required. Typical hardware configuration for this type of exercise would consist of one computer for the Spectrum system adjudicator, one designated as the Spectrum network server, three for belligerent forces, and approximately eight for the training staff.

In an operational or tactical exercise, a corps or division level training staff would require 16 to 30 or more networked PCs and printers. Typical hardware configuration for a corps or division exercise would consist of one computer for the Spectrum system adjudicator, one for the network server, six for belligerent forces, and approximately eighteen to twenty for the training staff and subordinate units.

A battalion level staff training exercise would require a minimum of six networked IBM compatible PCs with printers. Configuration for a battalion exercise would consist of one computer for the Spectrum system adjudicator, one for the network server, one for belligerent forces, and one for each participating company level element.

17. VV&A

Spectrums first verification, validation, and accreditation (VV&A) occurred in August 1995. The Spectrum team conducted version 1.5 V&V testing in January 1997. Several Army school representatives attended and provided subject matter expertise (SME) in support of the V&V. The SME input resulted in some of the functionalities being changed.

Version 1.5 was accredited for training in January 1997 by TRADOC. All versions of 1.6 have been accredited.

18. Future Plans

The following modifications to Spectrum are under consideration for the FY03 work plan:

a. Develop a Universal Exercise Database capability.
b. Change the medical and maintenance modules to incorporate tracking personnel casualties by SSN and repair parts / end-items by identification numbers.
c. Develop an automated capability to create map display resolutions down to urban block and street level.
d. Convert workstation display software from MapInfo to another mapping/display software or newer version of MapInfo.
e. Add AAR collection capability for all player workstations to a single "collect all" workstation.
f. Convert Spectrum software code from 16 to 32-bit format. 7) Add the capability to build terrain from CADRG data to RTGS.

Further development of Spectrum is expected to cease at the end of FY 2003. Spectrum will be maintained and supported at its present level until replaced.

19. Maintained By

National Simulation Center.

20. Next Version/Incorporated into other Applications

21. Expected Retirement Date

Unknown. SASO functionality is being designed into WARSIM and OneSAF. One or both of these systems is expected to replace Spectrum in the future.

22. Modifying Scenario Database

The Rapid Terrain Generation System (RTGS) is windows based and can be used to build the terrain of choice. The software comes on a single CD that contains all the required executables and a users' guide with step-by-step procedures for obtaining the digital data from NIMA, building terrain, and applying it to an exercise scenario. Used in conjunction with the Symbol Editor and Terrain Editor, users can build and customize terrain to meet their training needs.

Time to Develop: The Haiti RAM took the subject matter expert (SME) 140 hours to complete from his initial research to the completion of the stubby pencil matrices and tables and entry of the data in the RAM. Some of the RAM configuration data is very generic for political, economic, and social systems. As an example, a democracy in Western Europe is politically similar to democracies elsewhere. Therefore existing political, economic, or social configuration data can be re-used. Using data from existing political, economic, and social configuration matrices and not completing a country study will decrease the RAM preparation time to 80 hours. Completing the RAM country study will take between 60 and 80 hours. Conversion of an existing RAM to another similar region will mirror the times for completing the country study alone or completing only the host nation specific portions of the RAM

23. Modifying Simulation Functionality

Refer to Chapter 6

24. Functional Databases

a. **Time to Develop:** The Haiti RAM took the subject matter expert (SME) 140 hours to complete from his initial research to the manual completion of the matrices and tables that contain reference data for the RAM. Some of the RAM configuration data is very generic for political, economic, and social systems. Using data from existing political, economic, and social configuration matrices and not completing a country study will decrease the RAM preparation time to 80 hours. Completing the RAM country study will take between 60 and 80 hours. Conversion of an existing RAM to another similar region will mirror the times for completing the country study alone or completing only the host nation specific portions of the RAM.

b. **Where Maintained:** Field-produced databases may be maintained locally. NSC is the repository of expertise and technical assistance for Spectrum.

c. **Reusable:** Yes.

d. **What Databases are Available:** Training support plans (TSPs) are equivalent to scenarios and databases that are available for reuse or modification. Refer to sub-section 11 (Terrain Management System) of this paper for more detailed information on the databases that supports the various TSPs, selected TSPs are listed below:

   1. ***Haiti***--The database provides for the conduct of peacekeeping on the island of Haiti with a brigade level task force from the 101st Airborne Division (AASLT) with primary focus on one battalion.
   2. ***Bosnia***--The database is based on the real world events that transpired after the US 1st Armored Division deployed to Bosnia.
   3. ***Govinia***-- Exactly the same as the brigade level exercise mentioned above. Names of the countries have been changed to make it a totally fictitious scenario.
   4. ***Pineland***--The database is specifically designed for a Special Forces operational detachment conducting unconventional warfare.
   5. ***Eastland***--The database is designed exclusively for SOF students during the conduct of Prairie Warrior using terrain in the Czech Republic and Hungary on the fictitious island of Lantica.
   6. ***Lantica***-- This database is designed to drive the staff actions and coordination required of SJA, surgeons, chaplains, contracting officers, PSYOP, civil affairs, finance/comptroller, host nation support, PAO, and others.
   7. ***Macedonia***—This database is designed to support SAMS and involves a joint task force. The scenario is a force on force, combat operation having many branches and sequels for and includes an embedded NEO.

25. Representation Issues

a. **Resolution:** Resolution of operations in Spectrum appears comparable to BBS or other constructive tactical level simulations.

b. **Fidelity:** Fidelity of combat effects is adequate but not as high as simulations designed to represent combat. Representation of non-combat operational consequences exceeds other Army training simulations.

3.D.1g Eagle

1. **Type: Constructive**
2. **Acronym: None**
3. **Purpose for which Developed**
   Eagle was developed in the late 1980s as a vehicle to investigate the application of artificial intelligence to explicitly modeling command and control in a combat simulation. The model's typical combat functionality (such as attrition adjudication) relies on the extensive combat modeling experience at the TRADOC Analysis Center (TRAC) and is rooted in standard, validated algorithms. Eagle's current applications are course-of-action assessment, combat development, decision support, exercise driver, force development, scenario generation, and staff training.
4. **Dates Developed/Implemented**
5. **Domain:** RDA/TEMO
6. **Security Classification:** Unclassified
7. Security Caveats: None
8. **Applications**
   a. Concepts Analysis Agency Value Added Analysis (95, 96, 97)
   b. Joint Precision Strike Demonstrations (JPSD) (95, 96)
   c. Roving Sands Exercises (96, 97)
   d. U.S. Army Experiment Projects (96, 97, 98, 99)
   e. DMSO HLA C2 Experiment (97)
   f. DMSO Eagle Early Analysis Experiment (96)
   g. DMSO HLA RTI Test and Validation (96, 97)
   h. Joint Training Protofederation (JTFp) (96)
   i. WARSIM Prototype Development (94)
   j. DARPA Dynamic Multi-user Information Fusion ATD (97, 98)
   k. STRIKE Force Command Post Experiment (00)
   l. Future Force Staff Training (Senior Leaders Development) (01)
   m. Discover (2) - Satellite Detection Study (SMDC) (02)
   n. FCS Analysis of Alternatives (AoA) and C4ISR Experiment (02)

9. **Major functionalities by BOS**
   a. **Maneuver:** Yes. Eagle simulates a comprehensive range of Army ground and air combat maneuver.
   b. **Fire Support:** Yes. Eagle simulates the full range of Army artillery maneuver, including target processing and delivery of fires.
   c. **Air Defense**: Yes. Eagle simulates the full range of air defense artillery maneuver, including target processing and delivery of fires.

d. **Survivability:** Yes. Eagle simulates engineer units conducting mobility, counter-mobility, and survivability operations.
e. **Intelligence:** Yes. Eagle simulates air and ground intelligence units, their maneuver, and the acquisition of intelligence (sensor models).
f. **Logistics:** Yes.
   1. **Transportation**: Forward logistics units have implicit delivery of the supplies to the subordinate units. Time is calculated for the loading, movement, and unloading of the supplies to the unit and supplies will be automatically added to the supported unit when that time has elapsed. Specified logistical organizations at brigade level and above have explicit delivery of supplies. A logistical unit has a motor pool of all its available transportation assets. It determines the types and amounts of vehicles required to move the requested logistics. If the assets are available, it forms a convoy. The convoy loads the supplies and then moves long supply routes to deliver them. Once the convoy reaches the forward re-supply unit, it unloads the supplies and returns. While the convoy is on the road it is vulnerable to attack (with the associated loss of supplies and vehicles). Once the convoy returns to the logistics unit the vehicles are placed back in the motor pool and are available for further requests. Eagle also plays Air Force fixed wing flights that provide support to ground units.
   2. **Supply/Re-supply:** Units consume fuel and ammunition (by bullet type). Each unit, based on a task that it is doing, has percentages that indicate when the unit has a "Normal", "Amber" (<40%), or "Red" (<20%) of its on-hand supplies. All units assess this status at the same time (20 minutes) based on the simulation's Logistics Assessment Standard Operating Procedures. If a unit determines that it needs supplies it will request to its higher headquarters for them. The amount ordered is only enough to bring it back up to its basic load. There is no anticipation of needs computed in Eagle. The unit orders the request based on priority of logistics support designated by the commander. The unit's higher headquarters will forward the supply request up the chain of command until it reaches a headquarters that has a supporting logistics unit. The logistics unit receives the supply request and attempts to fill it. If sufficient supplies are on hand to fill (or partially fill) the request it is filled. If supplies are not on hand then they are placed on back order. The logistics unit (which has its own re-supply request process) will determine if supplies are on order to meet this requirement (i.e., wait until they are delivered) or if it needs to order more.

10. Other Functionalities

Eagle plays Air Force assets used in support of ground operations.

11. Terrain Management System. Digitized.

Current Terrain Products: The concept of terrain management in Eagle is that a unit's operations are based on explicit decisions of how to move over the terrain. Terrain data is acted on by a system of mobility corridors, terrain aggregates, and detection evaluation routines with moving entities maneuvering over the corridors. These corridors are produced by the terrain preprocessor through a detailed analysis of digitized data and provide a representation that conforms closely to the way in which military personnel think about terrain. A mobility corridor represents an aggregation of the underlying terrain, and is characterized by width, average cover and concealment data, average trafficability, and other information. Military units plan their routes during model execution by using a search algorithm, using time required, distance to travel, cover, concealment, or a linear weighting of any these as the optimization criterion. This representation philosophy supports the movement of units over the battlefield, as well as engineer work, which may modify mobility, counter-mobility, or survivability, with respect to the terrain. An underlying set of four kilometer by four-kilometer terrain aggregates is also maintained in the interest of efficiency, and to allow units to move off of mobility corridors if necessary.

12. Other Environment Representation: None

13. Human Behavior

Eagle uses a rule-based decision methodology, operating within an inference mechanism, to determine which rule or decision to activate. The behavior of specific units in a scenario is a function of the type of unit, the operations orders it is executing, and the information that is passed among the units involved, interactions with the enemy, and interactions with the environment.

14. Simulation Strengths

The Eagle architecture has proven to be flexible and adaptable to the changing requirements in the simulation community. Though DIS and ALSP protocols and the HLA did not exist when Eagle was originally designed, it has been easily modified to work in each environment. In each case, new objects have been added as application services. The Eagle framework, which normally coordinates interactions between combat units, can now divert interactions to other simulations through these two new protocols. The basic architecture combined with a true object-oriented programming language has proven to be a powerful combination that has allowed Eagle to maintain its relevance in the very dynamic, changing world of combat simulations.

15. Simulation Limitations

Eagle is a constructive simulation, and, as such, cannot supply a realistic visual representation of entity-level activities. It is also limited to brigade-level operations because of its entity-count limitations.

16. Technical Specifications

a. **Clock Speed (minimum acceptable CPU speed)**

b. **Update Rates (minimum update interval for time stepped simulations):** The Eagle minimum time-step interval is one minute, but most time steps are between two and five minutes depending on the actions in an event queue and some interactions that are event-driven within a time step.

c. **Operating Environment:**

   1. **Hardware:** Eagle is designed to operate on high level PC and laptop platforms.
   2. **Hardware Environmental Considerations:** There are no unique environmental considerations for use of the Eagle simulation.
   3. **Software/Operating System:** The Eagle operating system is UNIX/LINUX.
   4. **Simulation Current Version:**
   5. **Source Code Languages:** Eagle contains LISP, C, and FORTRAN software language routines.

6. **Licenses Required:** None

d. **Interoperability:**

1. **HLA Compliance:** Yes
2. **HLA Certification:** Yes

e. **Standards:**

1. **Internal Network Protocols:** TCP/IP
2. **Internal Network Type:** Ethernet

17. VV&A

The major Eagle attrition processes (direct-fire, artillery, on-station helicopter, system-on-system acquisition) were verified and validated against the Vector-In-Commander (VIC) simulation in May 1999 using Army Pam 5-11 accepted V&V methods.

18. Maintained By

TRADOC Analysis Center, Fort Leavenworth, KS.

19. Modifying Simulation Functionality

See Chapter 6.

20. Functional Databases

Eagle contains a scenario generation tool called "Preprocessor", or "PP" which is used to define the starting conditions of the scenario, and the operations or plans that specific units are to execute. It provides user access to planning software objects through an extensive graphical interface, including menus, maps, and display windows.

a. **Time to Develop:**
b. **Where Maintained:** Functional database information is contained within the simulation architecture.
c. **Reusable:** Yes
d. **What Databases are Available:**
e. **How Can Databases be Modified**: See Chapter 6.

21. Input/Output Formats

a. **Input:** Input is through standard peripheral devices such as keyboard and data transfer programs.
b. **Output:** Output is in the form of monitor displays and data in various report formats.

22. Representation Issues

a. **Resolution:** Eagle has identifiable entities at platform level, but normal resolution is from company to brigade levels.
b. **Fidelity:** The fidelity of Eagle entities is considered high enough for it to be used as an entity-level training simulation.

3.D.1h Army Constructive Training Federation

Previously Warfighters Simulation (WARSIM)

1. **Type: Constructive**
2. **Acronym: ACTF**
3. **Purpose for which Developed**

To train Brigade, Division and Corps level staffs. WARSIM was under development to serve as the land warfare component of the Joint Simulation System (JSIMS) joint training federation. Termination of the JSIMS program and associated support of JSIMS after delivery of Version 1.0 in late December 2002, forced the Army to reconsider alternatives to WARSIM for continuing simulation-based Army training under Title 10 responsibilities. Further extending the life of CBS was determined to be not feasible in light of the ongoing transformation of Army capabilities, and the inability of CBS to represent some aspects of the Future Force. It was possible however, to recoup most of the investment in WARSIM, and extend its functionality through federation with existing and future simulations (e.g., CBS, OneSAF).

4. **Dates Developed/Implemented**

ACTF is still in development. No version has yet been released.

5. **Domain:** TEMO, ACR
6. **Security Classification**

The ACTF basic software is expected to be unclassified.

7. **Security Caveats**

ACTF is designed to interface to real-world C4ISR systems operating at classified levels, and must be protected at levels appropriate to the network.

8. **Applications**
9. **Major functionalities by BOS**
   a. **Maneuver:** Yes
   b. **Fire Support:** Yes
   c. **Air Defense:** Yes
   d. **Survivability:** Yes
   e. **Intelligence:** Yes
   f. **Logistics:** Yes
      1. **Transportation:** Yes
      2. **Supply/Re-supply:** Yes
      3. **Personnel:** Yes
      4. **Medical:** Yes
      5. **Maintenance:** Yes
   g. **Command and Control (C2):** Yes
10. **Other Functionalities**

ACTF is designed to support the Future Force. It will be multi-sided and can represent at least 10 sides or factions in a single scenario. It will be compatible with the G2 presentation of the Contemporary Operating Environment (COE), a near-real-time display of all relevant elements of the current battlefield. ACTF will represent non-lethal weapons effects, Special Operations, Military Operations in Urban Terrain, and possess a versatile and robust AAR capability. It will represent elements of the combat power of other services without requiring full participation of other service simulations.

11. Terrain Management System

Digitized.

a. **Current Terrain Products:** ACTF terrain will be built around existing and future standard NIMA terrain products when available. ACTF terrain may also be built from commercial mapping or imagery products if required. The central terrain functional capability is a technical core called the WARSIM Environmental Data Model (EDM). This terrain will be compatible and exchangeable with OneSAF terrain.
b. **Expense:** TBD, but designed to be less than current systems.
c. **Time:** An objective of ACTF is to enable local creation of new terrain files from "scratch" surface of the earth in 36 hours. Need for new terrain may be reduced by enhanced reusability of terrain among systems.
d. **Clarity**: Consistent with Army C4ISR systems.

12. Human Behavior

Minimal. Most human behavior will be the result of terminal operator interactions with simulated entities.

13. Simulation Strengths

ACTF will overcome shortcomings inherent in the design of current constructive simulations and improve overall reusability and utility. It will operate on a common hardware platform. It will provide for direct interoperability between constructive simulations and real-world C4ISR equipment. It will recover much of the investment in WARSIM, but will not require the JSIMS core to function. It will be HLA compliant.

14. Simulation Limitations

Initially, the interface to other Service and future joint simulation capabilities may not be as seamless as desired under the JSIMS program.

15. Technical Specifications

a. **Clock Speed** (minimum acceptable CPU speed): ACTF will operate on the Common Hardware Platform, Command and Control Simulation Equipment (C2SE)
b. **Update Rates** (minimum update interval for time stepped simulations): TBD.
c. **Operating Environment:** Joint Technical Architecture/Army Technical Architecture compliant.
d. **Hardware:** Common Hardware Platform
e. **Hardware Environmental Considerations:** No special requirements.
f. **Software/Operating System:** Windows, LINUX/UNIX
g. **Simulation Current Version:** N/A
h. **Source Code Languages:** C++, Java, Smalltalk
i. **Licenses Required:** Included in software deliveries.
j. **Interoperability:**
    1. **HLA Compliance**: Yes. Still support DIS and ALSP as required.
    2. **HLA Certification**: Planned.
k. **Standards:**
    1. **Internal Network Protocols**: IP, Unicast/Multicast
    2. **Internal Network Type**: Ethernet

16. Future Plans

ACTF will evolve from FY04 through FY08 to assume greater internal functionality, and reduce reliance on current simulations. HLA architecture and an Environmental Data Model shared in common with OneSAF will improve interoperability and reuse while reducing support overhead requirements. The illustration below depicts the year-by-year evolution of ACTF from FY 2004 through FY 2008 as currently envisioned.

17. Maintained By

Materiel Developer - PEO STRI

Combat Developer - National Simulation Center.

18. Next Version/Incorporated into other Application: TBD.

19. Expected Retirement Date: N/A

20. Modifying Scenario Database

A tool set will be part of the ACTF functionality to enable scenarios to be created and modified locally.

21. Modifying Simulation Functionality

22. Functional Databases

a. **Time to Develop:** Objective to be rapid by current standards.
b. **Where Maintained:** TBD
c. **Reusable:** Yes
d. **What Databases are Available:** N/A
e. **How Can Databases be Modified:**

23. Input/Output Formats

a. **Input**: Via graphical user interface, keyboard entry, or incoming messages as appropriate.
b. **Output:** To map, U.S. Message Text Format (USMTF) reports, and multifunction displays with data manipulation capability as required.

24. Representation Issues

a. **Resolution:** Consistent with prevailing C4ISR systems.
b. **Fidelity:** Sufficient to exchange information with C4ISR systems.

3.D.1i Close Combat Tactical Trainer

1. **Type: Virtual**
2. **Acronym: CCTT**
3. **Purpose for which Developed**

CCTT is the first of the Combined Arms Tactical Trainer (CATT) programs. CCTT supports ground maneuver force training and is currently being fielded worldwide. CCTT forms the baseline for current and future efforts to expand development of CATT systems.

CCTT uses various simulators, emulators, and semi-automated forces replicating combat vehicles, weapons systems, dismounted forces, combat support, combat service support, command and control, and opposing forces. It is networked to provide fully interactive unit task training (collective training) on computer-generated terrain. It is being fielded in mobile configurations (platoon level) for the Army National Guard and at fixed sites (company/team level) to support armor and mechanized infantry training for the Active Component. CCTT supports the collective training of Armor, Mechanized Infantry, and Cavalry units from platoon through battalion/squadron level.

4. **Dates Developed/Implemented**

CCTT was developed based on a Training Device Requirement (TDR), which was approved in 1991. The CCTT was then approved by the Milestone I/II Army Systems Acquisition Review Council (ASARC). In 1998, the Milestone III ASARC approved CCTT for Full Rate Production. Currently, CCTT is in Full Rate Production with worldwide fielding.

5. **Domain:** TEMO with RDA and ACR support application.
6. **Security Classification:** Unclassified.
7. **Security Caveats**

Interoperability requirements will most likely result in a classified version of CCTT.

8. **Applications**

CCTT is used Army-wide. CCTT is fielded to FORSCOM, USAREUR, EUSA sites and Mobile Configuration to the National Guard.

9. **Major functionalities by BOS**

CCTT simulates a complete Combined Arms Battlefield environment with emphasis on Armor and Mechanized Infantry Training units. It provides manned modules for Armor and Mechanized Infantry units (Abrams, Bradley, HMMWV, etc.).

   a. **Maneuver:** Yes.
   b. **Fire Support:** Yes.
   c. **Air Defense:** Yes.
   d. **Survivability:** Yes.
   e. **Intelligence:** Yes (via tactical battlefield operations).
   f. **Logistics:** Yes.
      1. Transportation
      2. Supply/Re-supply
      3. Personnel
      4. Medical
      5. Maintenance
   g. **Command and Control (C2):** Yes.

10. **Other Functionalities:** None.

11. **Terrain Management System:** Digitized.
    Current Terrain Products: CCTT provides visual representation of terrain and the natural environment through Image Generation hardware. It also provides correlated terrain database(s) to support modeling of communications and Semi-Automated Force Behaviors.

12. Other Environment Representation

CCTT can simulate basic weather conditions, such as fog and rain.

13. Human Behavior

CCTT includes a validated Semi-Automated Force (SAF) representation of both friendly and opposing forces.

14. Simulation Strengths

Robust, validated simulated Combined Arms environment including SAF and manned modules for Armor and Mechanized Infantry units.

15. Simulation Limitations

Manned Modules only included for Armor and Mechanized Infantry units, other battlefield functionality simulated through workstation input to support the primary training audience.

16. Technical Specifications

a. **Clock Speed (minimum acceptable CPU speed):** Training exercise time will vary for each mission and for each unit that trains on the simulation. These times are representative; they will vary by as much as the commander deems necessary to meet the training needs of the unit being trained.
b. **Update Rates (minimum update interval for time stepped simulations):** 15 Hertz for Visual scene.
c. **Operating Environment:** AIX (Unix) and transitioning to LINUX.
d. **Hardware:** Various computer, networking, and manned modules; reference PIDS and Hardware Specifications.
e. **Hardware Environmental Considerations:**
f. **Software Operating System:** AIX (UNIX) and transitioning to LINUX, plus operating systems unique to specialty hardware (e.g., image generation)**.**
g. **Simulation Current Version:** 7.1.
h. **Source Code Langages:** ADA 95, C++, Fortran.
i. **Licenses Required:** Yes - For a variety of hardware and software configurations.
j. **Interoperability:**
    1. HLA Compliance: Yes.
    2. HLA Certification**:** Yes.
k. **Standards:**
    1. Internal Network Protocols: TCP/IP.
    2. Internal Network Type: Ethernet.

17. VV&A: AMSAA, June 1998.

18. Future Plans: None.

19. Maintained By

Contractor Logistics Support through Program Executive Office Simulation, Training & Instrumentation (PEO STRI).

20. Next Version/Incorporated into other Applications

21. Expected Retirement Date

Not specified.

22. Modifying Scenario Database

Databases are complex and centrally developed and maintained.

23. Modifying Simulation Functionality

Any proposed modifications to the functionality of CCTT by on-site users or operators require a Department of the Army Form 2404 (Maintenance form) to be filled out and processed through PEO STRI PM CATT. See chapter 6 for specific information on this process.

24. Functional Databases

Visual system, SAF, and correlated databases

a. **Time to Develop:** 6 - 12 months, depending on data availability and size.
b. **Where maintained:** Program Executive Office Simulation, Training and Instrumentation/Project Manager Combined Arms Tactical Trainers (PM CATT).
c. **Reusable:** Yes.
d. **What Databases are Available:** Primary 1 (European Terrain), Primary 2 (NTC terrain), Ft Hood, Kosovo, Korea, and Grafenwoehr.
e. **How can Databases be Modified:** Through user requirement to TRADOC Systems Manager CATT and execution by Project Manager CATT.

25. Input/Output Formats

a. **Input:** Compatible with Synthetic Environment Data Representation and Interchange Specification (SEDRIS)
b. **Output:** Compatible with SEDRIS.

26. Representation Issues

a. **Resolution:** Resolution in CCTT is at a high degree of accuracy and at platform level.
b. **Fidelity:** The trainer replicates cues and responses of the operational system, with fidelity sufficient to provide for realistic performance of individual tasks within the context of crew operations. This requires the capability to simulate, in real time, the conduct of combat operations in a realistic environment with an appropriate and challenging opposing force that will require realistic individual, crew, and staff actions, and place the stresses of deficiencies revealed in the Mission Area Analysis (MAA) for the close Combat force and detailed in the Mission Area Development Plan (MADP) and Battlefield Development Plan.

3.D.1j Janus

1. **Type: Constructive**
2. **Acronym: None**
3. **Purpose for which Developed**

Lawrence Livermore National Laboratory (LLNL) initially developed Janus during the 1970s as a way to study the battlefield utility of recently developed tactical nuclear weapons. Janus was one of the first simulations that used a graphical user interface (GUI). Janus was originally written to run on Digital Equipment Corp. (DEC) computers in FORTRAN, using Tektronix graphics terminals for display and command input. It was later ported over to the HP platform running UNIX. In 1983, an early version of Janus was provided to the U.S. Army. This provided the Army with a tool that could simulate combat from the squad to brigade level. By 1991, the U.S. Army had taken over full responsibility for Janus (Sackett, November, 1996). By 1994, the U.S. Army was fielding Janus 4.0 to various Army Battle Simulation Centers. One version, developed initially as a nuclear effects modeling simulation by LLNL, but also used for tactical training, is called Janus (L). Another version, developed for Army combat development needs by the Training and Doctrine Command (TRADOC), and Training Analysis Command (TRAC) activity at White Sands Missile Range (WSMR), is called Janus (T). A third version represents a refinement of Janus (T) intended to satisfy both the combat development and training communities. That version is known as Janus Army, or simply Janus (Version 7.2, November 2001). Janus was fielded throughout the U.S. Army in the 1990s to support training at Battalion level and below. The simulation has also been used to support mission analysis in such areas as Haiti.

In 1992, Congress established the SIMulation In Training for Advanced Readiness (SIMITAR) program as an Advanced Research Projects Agency (ARPA—now Defense Advanced Research Projects Agency, i.e., DARPA) effort. Part of this effort involved modifying Janus by porting the simulation to a personal computer to train staffs and units at their hometown armories (Ridgeway, 1999). Fielding of this version occurred in the mid 1990s.

In 2000, TRAC – Monterey, CA, re-engineered Janus as a technology demonstration. The completed simulation, HLA Warrior, was re-written in C++, ported to a PC running Windows NT, and included an object-oriented design and state-of-the-art user interfaces and built-in High Level Architecture (HLA) tools. HLA Warrior can produce results similar to Janus (Dykman, June 2000).

4. **Dates Developed/Implemented**

Normally, even numbered releases are for TRAC, while odd numbered releases are for NSC and the training community.

a. 1993/December 1994/Janus 5.0.
b. 1994/October 1995/Janus 6.0.
c. 1996/August 1997/Janus 7.0.
d. 1998/February 1999/Janus 7.1.
e. 2000/October 2001/Janus 7.2.
f. 2001/December 2002/Janus 7.3.
g. 2002/December 2002/ Janus 8.01 (TRAC).
h. 2003-2004/ Janus 7.4 (under development).

5. **Domain:** TEMO, ACR
6. **Security Classification:** Unclassified
7. **Security Caveats**

TRAC-WSMR has conducted classified studies using Janus. Scenarios involving real-world plans or classified operational capabilities may require classification of the exercise environment.

8. **Applications**

Janus is used in two primary roles. The first role is as a training tool to train Army Battalion and Brigade Staffs. The second role is by analysts to conduct studies of tactics, techniques and procedures (TTP) as well as to evaluate new weapon systems in various environments, weather conditions, and mission profiles.

Janus is an interactive, closed, six-sided, stochastic ground combat computer simulation. It allows the user to deploy up to six different forces, fight a battle, and analyze the results (Version 7.2, 2001). Janus allows the trainer to specifically focus on the application of tactical doctrine and combat techniques. Commanders must consider all aspects of employing their forces just as they would in combat. Janus models both friendly and enemy weapons systems with resolution down to the individual platform (such as T-80, M2, or individual soldier weapons). The simulation stochastically adjudicates all detections and engagements at the entity level.

Janus has been applied to conduct exercises from platoon up to brigade. In addition, various organizations have conducted numerous non-tactical exercises of varying types as listed below (Various personal communications, January 2003).

a. Earthquake response (Brigade level)
b. Wildfire containment response (Brigade level)
c. Hazardous spill response (Installation/State/County)
d. Installation force protection (Brigade level)
e. Terrorist incident response (Brigade level)
f. Garrison law enforcement operations (Provost Marshal's Office /Battalion level)
g. Prisoner escape and apprehension operations (Battalion level/Confinement Facility)
h. Historical battle vignettes (OPD support to staff ride program) (Brigade/Battalion level)
i. Mission rehearsals (MFO Sinai; live fire exercises; etc.)

j. Peacekeeping operations (State Dept.)
k. Emergency Preparedness Incident Command Simulation (EPiCS) (Department of Justice and the Defense Threat Reduction Agency)

Janus is used within the various Army schools for the following courses:
Officer Basic and Advanced Courses, and Advance and Basic Non-Commissioned Officer Courses. The simulation is also used as part of the train up for the Brigade staffs in BCTP.

Within TRAC, Janus has been used in the Advanced Concepts Requirements (ACR) community for concept development, scenario generation, development of TTPs, and for the Analysis of Alternatives (AoA). In particular, Janus has been used extensively to support Army transformation studies and concept development. Janus has provided most of the force level analytical insights and results for the Future Combat System (FCS) concept development (Phase I) and for the FCS AoA. TRAC's work for ACR has been primarily at the battalion and brigade level, using approximately 40 workstations.

Janus has been incorporated into the following federations: Simulation, Testing, Operations, & Rehearsal Model (STORM) and Digital Battle Staff Trainer (DBST).

The following table reflects Janus users within the U.S. Army as of December 2002.
A current list of organizations and points of contact is available through the National Simulation Center. Janus has also been exported to several friendly foreign countries.

FORSCOM	**TRADOC**	**USAR**	**MISCELLANEOUS**
Fort Lewis, WA I Corps	Fort Benning, GA USAIS	Houston, TX 75th D (E)	Fort Bragg, NC USAJFKSWC
Schofield Bks, HI 25th ID	Fort Bliss, TX USADASCH	Fort Dix, NJ 78th D (E)	Camp Casey, Korea 2 ID
Ft Wainwright, AK USARAK	Fort Irwin, CA NTC	Fort Sheridan, IL 85th D (E)	PEO STRI FMS Team
Fort Hood, TX III Corps	Fort Knox, KY USAARMS	Birmingham, AL 87th D (E)	PEO STRI ARNG Team
Fort Carson, CO 7th ID	Ft Leavenworth, KS BCTP-TMC	Camp Parks, CA 91st D (E)	Orlando, FL PEO STRI PM
Fort Riley, KS 24th ID Mech	Ft Leavenworth, KS TCDC-CGSC		White Sands, NM TRAC WSMR
Fort Bragg, NC XVIII ABN Corps	Ft Leavenworth, KS NSC		Ft Leavenworth, KS ACOTA Team
Fort Campbell, KY 101st ABN	Ft Leonard Wood, MO-USAES		
Fort Drum, NY 10th Mtn Div	Fort Sill, OK USAFAS		
Fort Stewart, GA 3rd ID Mech	Fort Polk, LA JRTC (TF3/LTP)		
	Fort Rucker, AL USAAVNC		

Janus Users

9. **Major functionalities by BOS**

Janus is used for battle-focused training from platoon to brigade level and for command and battle staff training at battalion and brigade level throughout the U.S Army.

a. Maneuver: Yes
b. Fire Support: Yes
c. Air Defense: Yes
d. Survivability: Yes
e. Intelligence: Limited
f. Logistics: Yes
a. Transportation: Yes
b. Supply/Re-supply: Yes
c. Personnel: Limited
d. Medical: Casualties
e. Maintenance: No
g. Command and Control (C2): Yes

10. **Other Functionalities**

Janus serves as a lower-echelon training and mission rehearsal simulation. It allows planning in some detail for a specific target installation and accommodates display of key lines of communication, terrain features, buildings, obstacles, or other selected features. It displays to a greater degree than some other simulations the execution of commands and rules set up in the simulation, and the visual feedback is a strong point in Janus.

11. **Terrain Management System**

Unlike some other simulations, Janus does not display a picture of a standard military map – it draws a terrain map from the elevation data contained in NIMA Digital Terrain Elevation Data (DTED). Trafficability is derived from Digital Feature Analysis Data (DFAD).

a. **Current Terrain Products:** Several hundred worldwide Janus terrain files have been cataloged and are available. The current list is maintained at the Ft. Leavenworth Web site. Existing files can generally be mailed to requestors within one workday. New terrain files are developed at the NSC using the Janus Rapid Terrain Generator. Terrain files can be modified using the Terrain Editor (TED). TED supports eight general categories of terrain features: buildings, fences, rivers, roads, trees, urban/city areas, generic areas (general purpose), and generic strings (general purpose). New files can be produced and dispatched to requestors usually within one week.
b. **Time:** The time to prepare a new terrain box from basic DTED and DFAD data is in the order of a few hours. Additional time may be required to manually draw in desired features.
c. **Clarity:** Good. Janus terrain is displayed as a black-and-white contour map drawn on-screen from the basic DTED elevation data. It is possible to zoom in to specific points on the map display to view enlarged details. Icons can be the same scale as the map background.

12. **Other Environment Representation**

Janus represents wind direction and speed, which is constant across the entire terrain box, and unchanged during the scenario unless purposely changed by human intervention. Janus provides 16 different weather types (Version 7.2, 2001). Each type is made up of the following weather characteristics:

a. Visibility (meters)
b. Wind Direction (Degrees from East, measured CCW)
c. Wind Velocity (kilometers/hour)
d. Electro-Optical Systems Atmospheric Effects Library (EOSAEL) Xscale Atmospheric Model (1 through 4)
e. Air Mass Type
f. Ceiling (above ground level, meters)
g. Relative Humidity
h. Temperature (Fahrenheit)
i. Inversion Factor
j. Log of Ambient Light Level
k. Extinction Coefficient (optical spectral band & thermal sensors)
l. Sun Angle (degrees) not used at this time.
m. Sky-to-Ground Brightness Ratios (Only the 0-degree data is used at this time.)

13. Human Behavior

Currently all human behavior inputs are done through operator-in-the-loop.

14. Simulation Strengths

When introduced, Janus was unique for its ability to aggregate and disaggregate formations, down to the individual soldier, if desired, and its graphical user interface. Most commands are entered in Janus through mouse or “puck”-driven selection of commands from a display window, rather than through the keyboard. Mounting and dismounting of troops from vehicles, including helicopters, allows Janus users to allocate transportation assets in a highly realistic manner. Janus display of fields of view/fields of fire encourages care in placement of assets, and improves this aspect of tactical play over other contemporary simulations. With Janus, unit leaders can explore the battle under different conditions and with different force structures and make multiple runs, both for practice, and for the exploration of alternative tactics.

The Janus standard model of a system is fairly logical and straightforward. It consists of the platform, which defines mobility, and up to three weapons systems. Thus, creating new systems for a scenario is relatively easy, and consists of entering the size, weight, carrying capacity, speeds ranges, weapons characteristics, and tactical qualities in a series of “fill-in-the-blanks” screens.

Janus also has built in features to support analysis, if required, and an excellent capability for After Action Review (AAR). Battle results are available for review and analysis in two ways. The Janus Analyst Workstation (JAWS) provides the capability to replay the battle exactly as it ran during the simulation, to stop at critical points, and to analyze the synchronization of the Battlefield Operating Systems (BOS). JAWS also offers the selective retrieval and graphic display of simulation results such as time and location of direct fire kills. The Post Processor displays reports showing results of the fight, either on the screen or in printed form. (Version 7.2, 2001).

15. Simulation Limitations

Management of large formations in Janus is difficult. There are limitations on the number of objects a single terminal or operator can manage, because of the sequence of "puck"-based command entries necessary. As a ground combat model, aircraft in Janus are inadequately represented. For example, just as if it were a ground vehicle, the turn points of an aircraft must be entered manually. The maneuvers of aircraft (either rotary or fixed wing) performing Close Air Support may take almost as long to enter as they take to execute. Moreover, the Janus icons are fixed – that is, they do not change their apparent heading regardless of the direction of travel. Thus, an Apache or A-10 may appear to be flying backwards while conducting an attack. Also, aircraft can drop bombs "off axis". Bombs are treated as artillery rounds, and a helicopter or jet may engage a target well to the side of the flight path, or even behind it. Janus does not simulate naval forces. While Janus can represent the urban environment, it is limited in its ability to adequately represent building floor plans. The size of terrain box is limited to 300km X 300km. All new terrain files are developed at the NSC using the Janus Rapid Terrain Generator. Most of these shortcomings have been addressed in the Joint Conflict and Tactical Simulation (JCATS). See section 3.H.1d on JCATS.

Janus also has limitations on the numbers of entities of various types that can be used in a given scenario. The following maximum values apply to scenarios (Version 7.2, November 2001):

Data	Value
Workstations	50
Units	3000
System types	400
Indirect fire system types	100
Indirect fire units	1000
Preplanned fire missions per indirect fire unit	12
Direct fire system types	300
Direct fire weapon types	400
Weapons per system	15
Weather type	1
Mine types	10
POL types	3
Fuel supply units	100
Minefields	300
Mines	240,000
Non-mine obstacles	2000
Maximum ammo supply units	800
PREPOS per side	1500
Movement nodes per route	150
Special radars	30
Special flyers	30
Large area smoke clouds	100
Clouds	1000

CAC symbols	42
Intel report maximum detections last 10 minutes	50
Engagement areas per workstation	10
PH and PK data sets per scenario	4000
PSK data sets per scenario	400

Janus limits on number of assets by type.

16. Technical Specifications

a. **Clock Speed** (minimum acceptable CPU speed): Consistent with Common Hardware Platform
b. **Update Rates** (minimum update interval for time stepped simulations):
c. **Operating Environment:**
d. **Hardware:** PC Common Hardware Platform
e. **Hardware Environmental Considerations**:
f. **Software/Operating System:** LINUX/UNIX
g. **Simulation Current Version:** 7.2
h. **Source Code Languages**: Janus is written in FORTRAN and C
i. **Interoperability**:
   1. HLA Compliance: No. Although Janus has been adapted in special circumstances to work in either an HLA or DIS environment, Army training sites currently use neither version.
   2. HLA Certification: No
   3. DIS: Janus 7.1. However, due to hardware limitations with the currently fielded equipment, it was decided by the NSC and PEO STRI to create a separate baseline for the DIS release which will be called Janus 7.2D. This DIS version is currently in development and will be released approximately six months following the release of Janus 7.2 (Release Notes for Janus, Version 7.2 Linux/Unix, 16 November 2001).

j. Standards:
   1. Internal Network Protocols: TCP/IP
   2. Internal Network Type: Computers are networked by thin-wire coaxial cable (IEEE 802.3/Ethernet/10BASE2). Simulations Centers have upgraded to Cat5 cabling. (System Manager Manual, Version 7.2 Linux/Unix, 16 November 2001).

17. VV&A

Janus does not have a specific VV&A document. Based on discussions with TRAC-WSMR, Janus has been continually reviewed, updated, and re-scrutinized with every study using it. The algorithms are always taken from the standards of the U.S. Army analytical community. As the results of each study are briefed up the chain of command, the algorithms, data, and output are challenged and debated. The continual use and review over 20 years of development and enhancement have resulted in widespread acceptance and accreditation by each study director and reviewer. The best validation comes from the comparisons with the Battle of 73 Easting from Desert Storm, documented in 1992. Janus (TRAC-WSMR) completed a type accreditation for DoD Information Technology Security Certification and Accreditation Process DITSCAP in 2002 (M. Crooks, personal communication, January 16, 2003)

18. Future Plans

This section will be updated as the concept matures.

19. Maintained By

The National Simulation Center ATZL-NSC-F, Ft Leavenworth, KS and U.S. Army TRAC-WSMR ATTN maintain Janus: ATRC-WJ, White Sands Missile Range, NM.

20. Next Version/Incorporated into other Applications

The next major release will be 7.4 in 2004.

21. Expected Retirement Date

The retirement date of Janus is subject to the fielding of OneSAF.

22. Modifying Scenario Database

Janus permits ready adaptation of existing scenario data to new scenarios. New equipment, or modifications reflecting new capabilities can readily be entered through the scenario modification menu.

23. Modifying Simulation Functionality

Refer to Chapter Six

24. Functional Databases

a. **Time to Develop:** Each Janus suite is fielded with a baseline database. The time required to generate a new database is subject to the experience level of the database administrator, and the number of existing objects that can be reused. Information on how to build a scenario for use in Janus is found in the current Janus Database Manager Manual.
b. **Where Maintained:** Each Janus suite is fielded with a baseline database that can be modified for local use. Each Janus user site can then maintain its own set of scenarios based on its local customers.
c. **Reusable:** Yes
d. **What Databases are Available:** For terrain, there are over 400 pieces of terrain currently available through the National Simulation Center.
e. **How Can Databases be Modified:** In order to run an exercise, a scenario needs to be developed. There are two ways to build a scenario, either from scratch or through the merging of two other scenarios. The Scenario Forces Editor allows the database manager to develop scenario that meets the users requirements. Below is the Entry Screen for the Scenario Forces Editor [Ibid, pg. 18].

25. Input/Output Formats

a. **Input:** Data entry for scenario creation or modification is via keyboard entry or selections from on-line menus. Command entry during Janus simulations is via "puck" selection from an on-screen menu.
b. **Output:** Various printed reports are available for scenario analysis and after action review. Player-level output is through visual feedback from screen icons, and/or short messages displayed on-screen.

26. Representation Issues

a. **Resolution:** Map scale and icons do not "zoom" at same rate. Otherwise, good.
b. **Fidelity:** Adequate for operational training.

3.D.1k Digital Battlestaff Sustainment Trainer

1. **Type: Virtual and Constructive Federation**
2. **Acronym: DBST**
3. **Purpose for which Developed**

The Digital Battlestaff Sustainment Trainer (DBST) is a federation of constructive simulations and simulators that uses Distributed Interactive Simulations (DIS) and other state-of-the-art-technologies to collectively simulate military operations. It uses information produced by the simulations to stimulate C4ISR systems in a unit's tactical operations center. DBST satisfies digital unit staff training requirements now, until the Objective One Semi-Automated Force (OneSAF) simulation is fully capable and fielded. DBST provides a seamless synthetic environment linking constructive and virtual training simulations with live training forces. DBST’s uniquely designed digital interfaces allow Army units to train using the Army Battle Command Systems (ABCS) found in digitally-equipped Army units. DBST was designed to assist commanders to train collective battle staff tasks at echelons from battalion through division. At the U.S. Army’s Combat Training Centers (CTCs), the DIS bridge, or translator, not only links simulations to the unit Army Battle Command System (ABCS), but also provides the link between constructive and live-instrumented forces. This instrumented linkage allows live vehicles to appear in the various simulations, and constructive entities to show-up on the live vehicles’ ABCS.

DBST simulates military operations using constructive simulations and then, using the interfaces to turn simulation data and information into military message formats, passes (injects) them to the various command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems in a unit. DBST allows commanders to achieve their training objectives by conducting battle staff collective training. Staffs must react to the incoming digital messages while executing the commander’s tactical plan that was designed into DBST’s subsystem databases. Primarily, the targeted training audience (TA) is the brigade and below battlestaff. Training can be oriented toward functional command post (CP) training or full CP training. Battlestaffs of higher echelons may employ DBST to achieve limited training objectives. DBST provides training alternatives for partially-and fully automated brigades during their rotation at the CTCs. It allows them to train and gain experience using their go-to-war systems. DBST creates the right environment for automated rotational units and the realism necessary for using those command and control (C2) systems. DBST is an environment that includes an architecture of several constructive simulations and interfaces to stimulate real-world digital C4I systems for battlestaff training (brigade and below).

4. **Dates Developed/Implemented:** Version 1.0 on March 2002.
5. **Domain:** TEMO
6. **Security Classification:** Unclassified
7. **Security Caveats:** May run classified databases.
8. **Applications**
9. **Major Functionalities by BOS**
   a. **Maneuver:** Yes.
      Through JCATS, which is a high-resolution, multisided, multi-service, entity-level simulation with integrated capabilities used for training, analysis, planning, and mission rehearsal. JCATS evolved from a merger of the Joint Tactical Simulation (JTS) and the Joint Conflict Model (JCM) and is capable of supporting training and exercises from the lowest military echelons through the Joint Task Force (JTF) level. Its high-resolution object oriented systems and aggregated units are capable of stimulating tactical level exercises and a limited number of operational levels of exercise. JCATS also supports force-on-force combat training, at and above battalion level, and supports Joint and coalition warfare stimulating up to 10 sides. JCATS is DIS and HLA compatible, and provides C4I interaction with DoD and U.S. Army systems to include the Army Battle Command System (ABCS).
   b. **Fire Support:** Yes
      1. **Advanced Field Artillery Tactical Data Systems (AFATDS).** AFATDS is a command, control, communications, computers, and intelligence (C4I) system used by field artillery commanders and fire support agencies to provide optimum fire support to maneuver forces. AFATDS provides control of indirect surface-to-surface, attack helicopter, offensive air support, and naval gunfire assets. It stores and displays unit locations and situational graphics and uses fire support control graphics for fire-mission processing and fire-support coordination.
      2. **FireSIM XXI.** FireSIM XXI is an event-sequenced simulation of friendly and enemy artillery forces. It simulates the target acquisition, C3I, weapon/target allocation, logistics, firing platforms, and munitions to a high level of detail. It is large scale (up to corps level for many applications) and high resolution (individual sensors, weapons, fire direction centers, munitions, messages, etc.).
   c. **Air Defense:** Yes
      1. **Air and Missile Defense Workstation (AMDWS).** AMDWS is a C4I system that provides situation awareness of the battlespace for air defense artillery commanders and staffs, and automated support for tactical planning and assessment of air defense-related logistical and personnel resources. AMDWS serves as a center for control, display, and dissemination of air and ballistic missile tracks and air defense target data. AMDWS displays graphical control measures and radar and weapon coverage diagrams to permit mission-planning analysis.

      2. **EADSIM.** EADSIM's utility to DBST is in its runtime models. The runtime models execute a scenario. The runtime models form a single executable process, with the data transfers between the models forming the basis for the timing and

sequencing of the models. The models can be run in varying configurations, with the full-analytical configuration consisting of all four models. The four models consist of:

a. Command, Control, Communications, and Intelligence (C3I)
b. Flight Processing (FP)
c. Detection
d. Propagation (Prop)

Multiple configurations of the models are available, both analytic and utility. The full-analytic configuration consists of the four models as previously discussed. It is the baseline configuration of the model, used for cases where all the modeled aspects of the full-combat scenario are of interest.

3. **FIRE** is the EADSIM command console application that allows a user to dynamically interact with and retask platforms in an EASDIM scenario while it is running in real time. Several different commands allow dynamic retasking of air-to-ground operations, surface-to-surface operations, and search operations. For example, an attack command from FIRE can cause a ground-attack commander (GAC) platform in EADSIM to either select an aircraft or surface-to-surface fire unit (SS FU) to attack a designated ground target. The FIRE user-interface allows the user to select various maps and to tailor display options to show selected icons, areas of interest, and platform mission waypoints.

d. **Survivability:** Yes - Within the JCATS simulation.

e. **Intelligence:** Yes

1. **All Source Analysis System (ASAS).** ASAS is a C4I system of systems used by intelligence staffs to provide management of intelligence assets, missions, and requirements. ASAS supports the production and dissemination of intelligence information via messages, maps, and overlays.

2. **Digital Collection Analysis and Review System (DCARS)** while not a formal component of the DBST suite, DCARS has been used with the DBST confederation in experimentation, such as the Joint Contingency Force (JCF) Army Warfighting Experiment (AWE) and Division Capstone Exercise Phase I (DCX Ph I). DCARS is an AAR system that can record the entire spectrum of information from the tactical internet during an exercise, including location reports, spot reports, and messages from the ABCs. DCARS records the USMTF and VMF traffic from the Army Tactical Command and Control System (ATCCS) systems. The playback does not stimulate the ATCCS, but produces a database of the mission and allows the system analyst and observer/controllers (OCs) to create a presentation showing the mission parameters determined to be significant.

f. **Logistics:** Yes

Combat Service Support Control System (CSSCS). CSSCS is a C4I system that provides automated support to commanders and staffs to control logistics operations and perform logistics planning. CSSCS includes collection storage and analysis of logistical resource data (Classes I, II, III, V, VII, and IX) and personnel information for both units and supply activities. It is also the repository and source for the Baseline Resource Items List (BRIL) and Commander's Tracked Items List (CTIL) for all battlefield function area control systems.

g. **Command and Control (C2):** Yes

1. **Maneuver Control System (MCS).** MCS is the C4I system used by commanders and operational staffs to plan, coordinate, and control tactical operations. MCS provides situation and control overlays, unit and installation locations, and friendly resource status information.

2. **Army Battle Command System (ABCS).** ABCS consists of the commander, staff, doctrine, procedures, and tools used to provide C2 of forces on the tactical battlefield. The system supports both the exercise of command and imposition of control of the combined arms team through the use of several digital systems that allow the entire organization to rapidly share information. ABCS provides automation support to commanders and their staff at each cell based on the mission and phase of operations. ABCS provides seamless connectivity from the tactical level to the national command authority. ABCS are tactical C4ISR systems and as such are not part of the DBST federation. The ABCS systems belong to the training audience and are the target systems that DBST stimulates.

10. Other Functionalities

a. **Tactical Air Support** - Tactical Airspace Integration System (TAIS). TAIS is a mobile, airspace management system providing combined air-ground battlespace management based on service and information system inputs. It is a self-contained system that receives the recognized air picture through various data communication links, providing the operator with 3-D, near real-time situational awareness. The TAIS system receives its air picture via the Air Defense System Integration (ADSI), tactical data link (TADL)-B, and TADL-A links. Full integration of the ABCS foundation products and battlefield functional area (BFA) products give the TAIS complete interoperability with the ABCS community.

b. **Force XXI Battle Command Battalion/Brigade and Below (FBCB2)**. While not integral to ABCS, FBCB2 provides the communications connectivity that constitutes the lower echelon (brigade and below) Tactical Internet (TI). FBCB2 uses the Army Technical Architecture (ATA)-compliant TI for distribution of information. A majority of data distribution is by wireless links that are capable of operating on the move. The TI consists of a system of Army data and voice radios networked together using routers and both commercial and military protocols. Radio systems used include current versions of the Enhanced Position Location Reporting System (EPLRS), Single-Channel Ground and Airborne Radio System (SINCGARS), and when available, near-term digital radio (NTDR).

11. Terrain Management System --Digitized.

Current Terrain Products: Terrain available for DBST is the same terrain available for the basic component systems, i.e., Janus, JCATS, EADSIM, FireSIM, etc. The real complexity in matching up terrain within the confederation comes with the limits on high-resolution terrain databases for Meta/VR and the UAV 3-D visualization models**.** Training objectives and the training audience will define what simulations are used and any limitations imposed due to terrain availability. DBST provides environmental representations and effects in terms of:

a. Operational Map (visuals)
b. Operational Graphics and Symbols
c. Terrain Types
d. Elevation/Line-of-Sight (LOS)
e. Air/Space
f. Natural Features
g. Manmade Features
h. Weather & Light Conditions

12. Other Environment Representation: None

13. Human Behavior

a. Human Movement and Activity - DBST provides extremely minimal to no representations of human movement and activities aside from those required to maneuver and fight. DBST provides options to move soldiers, and or entire units in a dismounted/walking mode.
b. Human Feelings and Effects - DBST Provides extremely minimal to no representations of human feelings and effects, other than simplistic effects of accumulated fatigue. BLUFOR and noncombatant personnel automatically consume water based on activity and weather, and will consume one ration every 8 hours.
c. Human Thinking and Decisions (Cognitive Task Analysis [CTA]) - DBST provides extremely minimal to no representations of human thinking and decisions. Groups of noncombatants can be cooperative or uncooperative based on the quality and level of treatment they are given by BLUFOR units. Uncooperative noncombatants present more of an impediment to movement and maneuver on both BLUFOR and OPFOR units than do cooperative noncombatants. Similarly, it requires more guards to control and or move uncooperative noncombatants. The effects of weather, unit MOPP levels, and unit activity over time can degrade unit effectiveness and unit performance, and create related heat casualties. Wounded BLUFOR and noncombatants personnel will degrade over time (even to death) if the proper level of medical treatment is not provided.
    1. All units apply an optional array of automatic reactions to the changes and effects of battle conditions. Units will stop their movement and or activities to return fire, withdrawal, increase MOPP levels, take defensive protective measures from direct fires, and artillery and air attack, etc.
    2. Both unit effectiveness and unit task performance are degraded, and impeded by the effects of combat/fire suppression.
d. Group Behaviors and Characteristics - DBST provides extremely minimal to no representations of group behaviors and characteristics. DBST does <u>NOT</u> model (portray or support) human psychological behavior factors that impact unit effectiveness or unit task performance in terms or levels of:

1. Individual/Unit Training or Experience
2. Individual/Unit Leadership
3. Individual/Unit Moral and Discipline
4. Individual/Fear or Courage
5. Individual/Unit Fatigue or Misery
6. Individual/Unit Beliefs and Dedication
7. PSYOP Exposure and Susceptibility

14. Simulation Strengths

Expanded Battlespace. DBST offers commanders and staffs a wrap-around environment that gives them a seamless battlespace of constructive–virtual–live simulation. DBST allows commanders and staffs to visualize where friendly units are, where the enemy is, and where their own forces are. This expanded battlespace offers previously unrealized stimulation of the total ABCS system, dramatically increasing training realism and allowing commanders and staffs to “train as they fight” using their go-to-war kit. This increased training realism includes enabling sensor-to-shooter training, air-to-ground training, and tactics, techniques and procedures (TTP) training to deal with digital-analog unit interface issues. Information is clearly presented as an element of combat power in DBST-supported exercises. DBST enables commanders and their staffs to gain and sustain “situational understanding” through the stimulation of ABCS SA, including FBCB2 bottom-up feeds, ABCS top-down feeds, and the simulation of intelligence collection asset feeds such as UAV, JSTARS, etc. Commanders are required to fight the entire battlefield instead of just the close fight.

15. Simulation Limitations

Integration/synchronization of the individual simulation scenario databases is key to a successful exercise. It is not overly complex, but it is time consuming. The quality of an exercise is directly related to the quality and timeliness of the information provided to the DBST-scenario development personnel.

Since DBST is a DIS federation, compliance with standard DIS enumerations and protocols is a must. DBST is also very sensitive to compliance (or noncompliance) with standard unit naming conventions. Naming conventions are used in mapping unit hierarchies and building the tactical messaging files in EADSIM. Noncompliance with naming conventions prevents proper digital stimulation of ABCS systems for the training audience. When constructing a DBST exercise, Exercise Configuration Control must be implemented. This includes a cut-off date after which no more software changes, either to simulation federates or ABCS systems, will be allowed. During the exercise period, any “on-the-fly” ABCS subscriber table changes must be coordinated through exercise control (EXCON) to ensure the federation properly reflects the changes in the ABCS structures. An uncoordinated “better idea” in the CP can cause small through catastrophic effects. Such changes can be made but must be fully coordinated through EXCON.

Although DBST provides extensive coverage for a seamless battlefield environment, one significant challenge with respect to the linkage of constructive to live environments, that no one has solved, remains. That is, a constructive (or virtual) entity may kill an instrumented live entity; however, live entities cannot see and kill a constructive or virtual vehicle. Exercise design and EXCON over-watch must provide “firewalls” to prevent constructive entities killing live instrumented entities.

16. Technical Specifications

a. **Clock Speed** (minimum acceptable CPU speed): Various clock speeds are available through the suite of simulation products.
b. **Update Rates** (minimum update interval for time stepped simulations): Various update rates are used through the suite of simulation products.
c. **Operating Environment:** The DBST base architecture is shown in the figure above, but no two fielded sites are exactly alike. Some sites have fiber while others use 10/100BaseT Ethernet for the DIS simulation LAN. Commonality lies in the fact that the eTSIU provides the link between the DBST simulation LAN and the ABCS tactical systems for MCS, ASAS, AMDWS, and CSSCS. The enhanced Protocol Interface Unit (ePIU) provides a similar linkage between the DIS LAN and the AFATDS. In addition to the constructive simulations and AAR tools mentioned earlier, the DBST architecture includes the eTSIU, ePIU, and other important applications/interfaces. The following are operating environments for the various DBST components:
    1. Simulation-C4I Interchange Module for Plans, Logistics, and Exercises (SIMPLE)
    2. Enhanced Tactical Simulation Interface Unit (eTSIU)
    3. Enhanced Protocol Interface Unit (ePIU)
    4. Simulation Training Operational Research Model (STORM) Federation
    5. Digitized Army USMTF /VMF Message Stimulator (DAUVS)
    6. Meta-VR Virtual Reality Scene Generator (VRSG)
    7. Multiple Unified Simulation Environment (MUSE)
    8. UAV Ground Control Station Driver
    9. TUAV Control Station Surrogate
    10. Joint Service Workstation
    11. ITM/DIS Bridge

d. **Hardware:** See #3 (Operating Environment) above.
e. **Hardware Environmental Considerations:** There are no unique hardware considerations.
f. **Software/Operating System**
g. **Simulation Current Version:** Version 1.0, fielded March 2002.
h. **Source Code Languages:** Refer to individual simulation products.
i. **Licenses Required:**
j. **Interoperability:**
    1. HLA Compliance: No
    2. HLA Certification: No
k. **Standards:**
    1. Internal Network Protocols: TC/IP
    2. Internal Network Type: Ether Net

17. VV&A

VV&A was completed by JFCOM as a part of Millennium Challenge 02. It was only applicable to the portion of DBST that participated in the JTC federation.

18. Future Plans

19. Maintained By

The National Simulation Center and PEO STRI are the federation combat developer/materiel developer. However, individual components, like JCATS, EADSIM, FIRESIM, etc., are still the responsibility of their respective original sponsors. DBST, in that respect, is a customer.

Commander, USACACATTN ATZL-NSC-F
410 Kearny Avenue
Ft. Leavenworth, KS 66027

Materiel Developer:
PEO STRI
Project manager DBST
12350 Research Parkway
Orlando, FL 32826-3276

20. Next Version/Incorporated into other Applications

21. Expected Retirement Date

There is currently no planned retirement date.

22. Modifying Scenario Database

Database development and modification time ranges from 1 day for simple exercises to 1 month for complex exercises (like MC02, with a 35K entity database)

23. Modifying Simulation Functionality

Refer to individual simulation products.

24. Functional Databases

Database considerations vary from component to component. DBST is very sensitive to compliance (or noncompliance) with standard unit naming conventions between the various components. Naming conventions are used in mapping unit hierarchies and building the tactical messaging files. Integration/synchronization of the individual simulation scenario databases is key to a successful exercise. It is not overly complex, but it is time consuming.

Time to Develop: The database development time is specific to the simulations involved, i.e., they come with a standard database and can absorb other databases from other users. Right now there are no specific DBST databases maintained by the NSC, each site has its own. The federation is moving to centralized database sourcing and the establishment of a “base” database.

a. **Where Maintained:** Databases are maintained within individual simulation products.
b. **Reusable:** Yes
c. **What Databases are Available:** Databases are available within individual simulation products.
d. **How Can Databases be Modified:** Database modification is done within individual simulation products.

25. Input/Output Formats

a. **Input:** Input message threads include all protocol data units in DIS format.

b. **Output:** Output message threads include logistical status pseudo messages, personnel status pseudo messages, and entity data pseudo messages, all in DIS format.

26. Representation Issues

a. **Resolution:** Training objectives drive the level of resolution.

b. **Fidelity:** Training objectives drive the level of fidelity.

3.D.1l Combined Arms Analysis Tool for the 21st Century

1. **Type: Constructive**
2. **Acronym: COMBAT XXI**
3. **Purpose for which Developed**

Combat XXI is being developed as an improvement of the Combined Arms Task Force Engagement Model (CASTFOREM), an Army analytical simulation of ground combat. While still capable of meeting today's analytical needs through continuous improvements, CASTFOREM is over 20 years old, and becoming increasingly difficult to maintain. The Combat XXI development is a partnership effort between the Army and Marine Corps. It will be HLA compliant to ensure that it can be federated with Air Force and Navy models and simulations where appropriate. COMBAT XXI is designed to meet the high-resolution analytical needs requiring a sound statistical basis, as well as operate in an HLA federation. Combat XXI will satisfy the unique requirements to maintain a credibly fair fight with simulators preclude OneSAF from fulfilling the requirements for statistical analysis of a large experimental design in which the M&S must be able to run independent of real-time.

4. **Dates Developed/Implemented**

The first development effort, a proof-of-principle simulation, was finished in January 2000. That was followed by the development of a simulation environment intended to be the new infrastructure for COMBAT XXI. As with many software development efforts, it was discovered that the first attempts were too unwieldy and difficult to understand or to meet design goals. This led to a decision for a six-month delay in the original schedule to revamp the architecture and correct the problems from lessons learned from the version 1.0 build. This revamping resulted in a new and far better infrastructure on which to build the remainder of COMBAT XXI. The first version, Version 2.5, using the new architecture, was finished in June 2002. The first fully releasable version will be Version 4.5 and is scheduled for completion in June 2004. Scheduled interim, limited release versions will be 3.0 in January 2003, 3.5 in June 2003, and 4.0 in January 2004. Each new release will build on the previous releases and expand the capabilities and/or add new capabilities.

5. **Domain: ACR and RDA**

COMBAT XXI will support the analytical needs of the Army's Advanced Concepts and Requirements (ACR) domain, including force design, operational requirements, and warfighting experiments, and also the force-on-force analytical needs of the Research, Development and Acquisition (RDA) Domain, which includes basic applied research, weapons system development, and test and evaluation. It will be a closed-form, entity-level simulation of tactical combat including Marine corps and Army force structures, command and control, weapons and tactics, techniques and procedures (TTP). Because COMBAT XXI will be HLA compliant, it will be possible to employ it in a federation with OneSAF to support statistical analytical requirements, to include those of the Training, Exercises, and Military Operations (TEMO) Domain concerning individual and collective training, Joint and combined exercises, mission rehearsal, and operations planning. COMBAT XXI is a joint model representing high-resolution tactical ground combat, tactical aviation functions, naval amphibious functions, and ship-to-objective maneuver of landing forces.

6. **Security Classification**

COMBAT XXI is intended to always maintain an unclassified version of the model code but this does not preclude later additions resulting in classified versions. As a general rule, the code is unclassified while some data inputs and model outputs may be classified. Security is the responsibility of the user who must determine the application security requirements and provide the proper runtime environment meeting DoD Information Technology Security Certification and Accreditation Process (DITSCAP) requirements for that application and its associated hardware.

7. **Security Caveats**

As with all DoD combat simulations, it is possible to produce classified or sensitive output from unclassified code and data inputs. Users must be aware of this caveat and take the appropriate actions to safeguard any such information. Another caveat, because of the HLA requirement, is the use of COMBAT XXI in a federation. While COMBAT XXI code, input data, and outputs could be unclassified, the federation, which then constitutes the simulation, may be classified.

8. **Applications**

Combat XXI will support the analytical needs of the Army's Advanced Concepts and Requirements (ACR) Domain. It will draw from and aggregate other higher resolution- level closed-form, entity-level, HLA-compliant simulation of ground warfare to include Marine Corps and Army organizations, C2, weapons and tactics, techniques, and procedures (TTP). It will replace CASTFOREM as the Army's premier entity-level combat simulation for comparative analysis.

9. **Major functionalities by BOS**
    a. **Maneuver:** Yes. Will represent high-resolution air, ground and sea tactical maneuver.
    b. **Fire Support:** Yes. Will represent fire support networks and high-resolution indirect fire engagements.
    c. **Air Defense:** Yes. Will represent integrated air defense networks and high resolution surface to air engagements.
    d. **Survivability:** Yes. Will model high-resolution engagements that consider active and passive countermeasures.
    e. **Intelligence:** Yes. Will model the intelligence cycle at the tactical level.
    f. **Logistics**: Plays limited logistical processes.
        1. **Transportation**
        2. **Supply/Re-supply:** Yes. Will play fuel and ammunition re-supply.
        3. **Personnel:** Yes. Will play limited return-to-duty processes.
        4. **Medical**: No.
        5. **Maintenance:** No.
    g. **Command and Control (C2):** Yes. Will have the capability to explicitly represent C2 networks, C2 decision-making, and information management at the operational and tactical level.

10. Other Functionalities

The modular structure and the ability to compose entities, units, and situational responses will also facilitate the use of COMBAT XXI for analysis of such divergent problems as civil emergency response and a variety of natural disasters.

11. Terrain Management System

Variable resolution digitized terrain.

12. Other Environment Representation

COMBAT XXI will play selected weather. Several environmental parameters will be included to represent the effects of weather conditions on equipment performance.

13. Human Behavior

The behavioral model will represent the tactical decision cycle. A library of user modifiable decision rules that represent tactical behavior will be included with the release of the model. Decisions will be based upon tactical observations of the battlespace, including: mission requirements, situational awareness, equipment availability, operational status, and environmental factors. Robustness of human behaviors will be determined by the quality and depth of included behavioral rules.

14. Simulation Strengths

COMBAT XXI will be an extremely flexible tool to accomplish analysis for Joint operations. It will be extendable, modifiable, and user friendly.

15. Simulation Limitations

Limitations are primarily imposed by application as opposed to being "built-in".

16. Technical Specifications

a. **Clock Speed** (minimum acceptable CPU speed): N/A
b. **Update Rates** (minimum update interval for time stepped simulations): Simulation will run as fast as possible; this can be anything from faster than real time, through real time and slower than real time. The speed of simulation will be determined by many factors including fidelity and resolution as well as run time hardware platforms.
c. **Operating Environment:** Unix (Eventual - Windows, Unix, Linux)
d. **Hardware:** Current-High-end PC platforms
e. **Hardware Environmental Considerations:** There are no special environmental considerations.
f. **Software/Operating System:** COMBAT XXI will be written in JAVA, a hardware independent language. It was developed initially on high-end PCs under the Microsoft Windows (NT 2000) operating system. Future versions are planned for Linux and Unix platforms.
g. **Simulation Current Version:** As of February 2003, Version 3.0.
h. **Source Code Languages:** JAVA
i. **Licenses Required:** A JAVA Runtime environment and associated license are necessary for execution of the code. Each organization receiving COMBAT XXI will be required to sign a Memorandum Of Agreement with the COMBAT XXI proponent, TRAC Headquarters, Fort Leavenworth, KS, and comply with established policies. There may be costs involved in obtaining the model and any required support.

j. **Interoperability:**
    a. HLA Compliance: Yes (Version 4.5)
    b. HLA Certification: Yes (Version 4.5)

17. VV&A

V&V is being performed during the course of model development by the developers, TRAC-WSMR at White Sands Missile Range, and independent V&V is by the COMBAT XXI V&V agent, AMSAA at Aberdeen Proving Ground, MD.

18. Future Plans

COMBAT XXI development is planned through June 2005, at which time it will largely have supplanted CASTFOREM. Experience has shown that simulations like COMBAT XXI have long life spans (approaching 20 years). TRAC, therefore, intends to maintain and update COMBAT XXI as long as there is a need for it or until technology and/or computer science render it obsolete at which time it will be replaced.

19. Maintained By

TRAC is the model proponent and TRAC-WSMR the primary developer/maintainer of COMBAT XXI. Model release and continued development efforts as well as maintenance of reference versions for the lifespan of the simulation will be handled by the respective organizations for both the Army and Marine Corps. Since the Marine Corps are joint developers and owners of the model, they will have input into the processes and serve as joint partners.

20. Next Version/Incorporated into other Applications

The current version release is 3.5, it was released in June 2003. There is no plan to interoperate this release with any other simulation until it becomes HLA compliant, and then it could become part of a federated simulation.

21. Expected Retirement Date: None planned.

22. **Modifying Scenario Database**

Editors are included in the simulation to allow user modifications.

23. Modifying Simulation Functionality

24. Functional Databases

a. **Time to Develop:** Variable, depending upon how the simulation is being applied.
b. **Where Maintained:** Each using organization will maintain local databases. Data sources are variable, but AMSAA has been and remains the clearinghouse for weapons systems characteristics and performance data for the Army.
c. **Reusable:** Yes
d. **What Databases are Available:** N/A
e. **How Can Databases be Modified:** All data inputs will be user-modifiable by included editors.

25. Input/Output Formats

a. **Input:** In the future input formats will be thoroughly documented and documentation released with each model release version beyond Initial Operational Test and Evaluation (IOTE).
b. **Output:** In the future output formats will be thoroughly documented and documentation released with each model release version beyond IOTE.

3.E Navy Simulations

1. Introduction

The Department of the Navy M&S vision is that models and simulations will provide a set of tools for use by operational units, and to support analysis, training, and acquisition activities. The Navy has established these objectives to attain this vision:

a. M&S and associated information technology will be applied consistently across the four pillars of training, acquisition, analysis, and assessment.
b. M&S technology will be readily available to the warfighter.
c. M&S will be consistently applied across the Navy-Marine Corps team afloat or ashore, home or deployed.
d. Investments will be cost effective, have measurable benefits, and build on DoD and commercial capabilities and standards. (SECNAV Instruction 5200.38A).

The Navy M&S Management Office (NAVMSMO) is responsible for coordination and integration of the Navy's M&S efforts. Information on the simulations listed below is largely available at the NAVMSMO web site under "M&S Resources.

3.E.1a Air Strike Campaign Model

1. **Acronym: THOR**
2. **Sponsor:** Pacific Fleet, includes Fleet Marine Forces (3rd Fleet, 7th Fleet, Type Commands)
3. **Applicability**

Campaign level Naval air strike planning.

a. **Application.** A constructive simulation, THOR estimates costs (time, aircraft losses, and ordnance expenditures) of a strike campaign to destroy a specified set of targets. Carrier and land-based aircraft, plus Tactical Land Attack Missile (TLAM) conduct the strikes. THOR is a tool for high-level (campaign) planning. Although it simulates aircraft loading and scheduling, it is not intended for carrier- or squadron-level use. THOR focuses on large "alpha" strikes (a strike group off the carrier—e.g., AWACS, tankers, bombers), rather than, smaller, more frequent strikes. THOR doesn't distinguish between day and night operations. Effects of enemy defenses en route to target are treated in less detail than defenses in the target area.

b. **Technical Specifications.**

4. **Hardware and Software:** DEC with VMS, SUN under UNIX
   - **a. Input:** User approves or modifies default databases for five sets of variables: Command decisions; Blue OOB; selection of targets and aim points; Red defensive OOB; various performance factors.
   - **b. Output:** Tabular CRT displays and output files. Graphical outputs available when running under CASES.
5. **Interoperability**

Although THOR can run alone, it normally is run under the Real-time Event Joiner (REJ), which can integrate events from THOR with ASBAT, a battle force defense model, and CLEAR, a logistics model. THOR can also run under CINCPACFLT's Capabilities Assessment Expert System (CASES).

3.E.1b Battle Force Tactical Training

1. **Acronym: BFTT**
2. **Sponsor: NAVSEASYSCOM**
3. **Applicability**

Tactical training at the mission training level for individuals, teams, and battle force, and functional skill and proficiency training to enhance unit readiness.

Application. BFTT provides the Afloat Training Organization, Commanding Officers, and Battle Force/Battle Group Commanders with the ability to conduct coordinated, realistic, high stress combat system training including Joint/Allied training exercises.

A major thrust of the program is to provide a dynamic, interactive war-fighting environment. BFTT training immerses the battle force combat team, unit combat team, warfare area team, and the individual in a facilitator-controlled, interactive scenario-driven, virtual operational environment. Training scenarios are based on specific training requirements and objectives. Throughout the training, BFTT monitors the scenario, combat system equipment alerts and indications, combat system team actions and interactions, and equipment performance. Through use of shore sites, networks, and distributed interactive simulation, BFTT connects ships stationed in specific homeports and allows them to train in a realist tactical environment, as if they were co-located in the same geographic region.

4. **Interoperability: HLA compliant.**

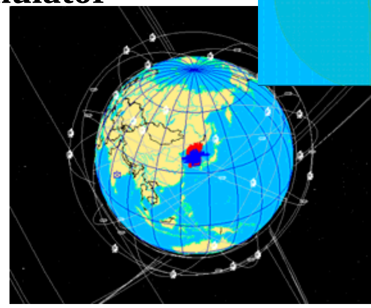
3.E.1c Battle-Force EMI Evaluation System

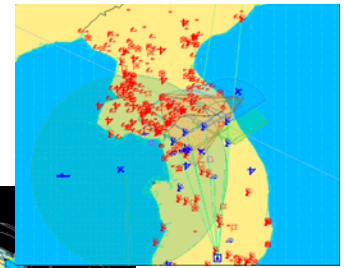
1. **Acronym: BEES**
2. **Version: 5.0**
3. **Version Date: 10/28/1998**
4. **Sponsor: SPAWARSYSCOM**
5. **Applicability**

Campaign level to Engagement level planning for AAW (Anti-Air Warfare), AMW (Anti-Mine Warfare), ASUW (Anti-Surface Warfare), ASW (Anti-SubmarineWarfare), EW (Electronic Warfare), Intelligence, Joint Littoral, Joint SEW, Joint Strike, Joint Surveillance, Mission Training, Reconnaissance, SEW, Special Operations, Surveillance, TBMD (Theater Ballistic Missile Defense) missions.

   a. **Application.** A constructive simulation BEES provides the planner/analyst with an easy to use capability to define forces, platforms and systems of interest in a scenario and simulate a number of warfare areas. Joint, NATO, enemy, and neutral forces can be simulated in AAW, ASW, ASUW, and Amphibious operations. These operations can be occurring simultaneously and may include air, surface, subsurface, and satellite platforms, shore bases, physical and electromagnetic environments weather, sea state, many different types of weapon systems, many different types of sensors, kinematics, logistics, chaff, decoys, battle damage, communications, navigation aids, sensor systems such as SOSUS (for underwater surveillance), HFDF (High Frequency Direction Finding) and SWABS, mining operations, weapon engagements, and many more.
   b. **Technical Specifications.**
      1. **Hardware and Software:** DEC VAX or Alpha System, Open VMS Operating System, Oracle RDBMS
      2. **Source Code Language:** C, Fortran, SQL
      3. **Input:** Concept of what problem is to be studied. Full device characteristics for any “notional” devices.
      4. **Output:** Predicted Signal to Noise ratios. Frequency/Distance Separation charts.

3.E.1d C4ISR Space and Missile Operations Simulator





1. **Acronym: COSMOS**
2. Version: 1.0
3. **Version Date: 12/1/2000**
4. **Sponsor: CNO (N8) Assessment**
5. **Applicability**

Campaign to engagement level simulation of C4ISR systems.

a. Application

COSMOS was developed to support analysis of the performance of C4ISR systems, including the availability, timeliness and quality of information to the warfighter. COSMOS explicitly models collection systems for SIGINT, IMINT, HUMINT as well as surveillance systems using visible, IR, LADAR (for laser mapping), MTI (Moving Target Indicator) and RADAR technologies. Target observables such as IR signatures, radar cross-section, and emitters of various types are represented. The resources and associated timelines required to process, exploit and disseminate the collected information are modeled using a flexible rule-based approach. This approach allows the systems of interest to be modeled at a variety of levels of fidelity.

APPROACH ISR and associated C3 architecture(s), scenarios for conflict, and potential targets are defined by user/analysts for COSMOS using an object-oriented Graphical User Interface. The targets are assigned attributes such as location and movement characteristics, as well as observability (e.g., signatures and radar cross section) characteristics. The types of sensors that the user can define include SIGINT, IMINT, HUMINT, IR, SAR (Synthetic Aperture Radar), and Radars of various levels of fidelity. These sensors can be placed on a broad range of platforms including space-based, airborne, surface, subsurface, and terrestrial systems. COSMOS has engineering level models to simulate sensor performance. COSMOS can also read in sensor information generated by other sources.

COSMOS is currently in use supporting OSD, National Imagery and Mapping Agency (NIMA), Air Force, Army, Navy, Marine, and National Security Space Architect analyses and war games. COSMOS has been interfaced with highly detailed sensor tasking models to support analysis of current and future intelligence system architecture performance.

As example analyses, COSMOS models have been used to support the Navy N87 Directorate of OPNAV to represent maritime mines being loaded onto land transport convoys, transported to port, loaded onto merchant ships, and delivered and deployed at selected locations in the Persian Gulf. Various reconnaissance and surveillance assets, such as Predator, Global Hawk, U-2R/S, JSTARS, F/A-18, P-3C, and NTM, are represented in these analyses. COSMOS has also been applied to assess both Theater Missile Defense and Theater Air Defense system capabilities to meet mission area requirements.

COSMOS has been used in a variety of war games, including the primary Title X games, consisting of the Air Force's Global Engagement, the Army's Army After Next and the Navy's Global War Game. Other war games in which COSMOS has been used include

Navy RMA games, focusing on Network Centric Warfare. COSMOS was used in the Air Force's Aerospace Future Capabilities Games to evaluate C4ISR, space control, and Theater Missile Defense system capabilities.

The Air Force Intelligence Agency accredited the Intelligence and Force Employment Cycle (IFEC) models in COSMOS for use in analysis of Intelligence and Counterforce/Attack Operations systems. COSMOS has an open architecture that is expandable to include other mission areas, higher fidelity models and other models or simulations.

b. **Technical Specifications.**

1. **Hardware and Software:** COSMOS has been compiled to run on: PC Linux, Sun Solaris, SGI Irix
2. **Source Code Language:** C, C++, FORTRAN
   a. **Input:** The toolkit software is input driven. The analyst defines the platforms, locations, equipment, functions, information flow, targets, and threats using a Graphical User Interface (GUI). A specification for the existence and locations of each platform is required. A specification for the capabilities/performance for each modeled piece of equipment/function is required. Specification of the information flow is performed through either a drag-and-drop method, or through rule-based methods. Descriptions of desired environmental constructs, such as DTED data, weather data, feature data, and any desired nuclear events, are needed.
   b. **Output:** Over 250 pre-defined Meaures of Effectiveness (MOEs) and Meaures of Performance (MOPs) are available. These are grouped into functional areas, such as sensors, trackers, weapons, and network flow. The output results are in the form of interactive animation, animation files (MPEG), snapshot views (XWD, PNM, JPEG, etc.), X-Y plots, tables, and text files. The analyst can use the rule-based network flow models to develop new output from the toolkit.

6. Interoperability: HLA compliant. COSMOS has been enhanced to generate and receive Distributed Interactive Simulation (DIS) Protocol Data Units (PDUs). COSMOS has also been interfaced with the Graphical Simulation Builder (GSIMB), which provides an interactive GUI for configuring and controlling the execution of multiple applications distributed across a computer network. The Analytic X-Windows Interface to Simulations (AXIS) tool provides a geographic animation of system performance (including movement of the objects modeled, display of the sensor areas collected/covered, display of the transmission of the information through the architecture, and display of the attack operations assets performing strikes against perceived/selected targets) and summaries of relevant MOEs and MOPs. (NAVMSMO web site, COSMOS page)

3.E.1e Naval Mine Warfare Simulation

1. **Acronym: NMWS**
2. **Version: 2.0**
3. **Version Date: 1/1/2003**
4. **Sponsor: NAVSEASYSCOM**
5. **Applicability**

Theater level mine tactics and systems. Simulates mine warfare, amphibious warfare and ship vulnerability. For use in Joint operations planning.

   a. **Application.** NMWS is a theater level constructive simulation that can be used for the evaluation of mine warfare tactics and systems. It can simulate all aspects of an Mine Counter Measures mission, including mines, ships (MCM, LPD, LHD, etc.), deployable craft (helos, LCAC [Landing craft Air Cushion], MNV, RMS, etc.), and systems (ALMDS, AQS-20, SQQ-32, etc.). It will also keep track of logistical items such as fuel usage, battery life, used mechanical sweep cutters, availability cycles, duty cycles, maintenance cycles, and payloads. Although NMWS is a theater level simulation, it models entity-on-entity interactions. That is to say, if NMWS is executed using 5 Remote Minehunting Systems (RMSs), NMWS will treat each RMS vehicle individually against each individual mine. Each contact identified by the RMS vehicles is passed to a neutralization system such as a diver or a Mine Neutralization Vehicle. This allows the simulation to be used to determine the warfare payoff of a new system concept development. The primary questions answered by the simulation include: How long does the mission take? How many systems, platforms, cutters, etc., were required? How did the systems perform against a specific mine or obstacle? How did the system perform as part of the overall MCM mission?

   b. **Technical Specifications.**
      1. **Hardware and Software:** NMWS executes on PC platforms.
      2. **Source Code Language:** MODSIM III, Visual Basic, C.
      3. **Input:** Systems performance characteristics, environmental data, and operation plans and scenarios.
      4. **Output:** Time to complete mission, assets required, and remaining threat to ships traveling through mined waters.

6. **Interoperability: HLA compliant.**

3.E.1f Research, Evaluation, and Systems Analysis

1. **Acronym: RESA**
2. **Sponsor: SPAWARSYSCOM**
3. **Applicability**

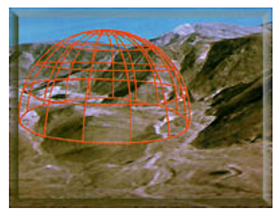
"RESA simulates naval warfare. It models all Navy objects (surface, subsurface, and air) and all of their threats and targets. All naval warfare areas are simulated." (ALSP website) The FA 57 can use RESA for any exercise conducted by the Joint Training Confederation (JTC).

a. **Application.** A simulation of the naval warfare environment used as a tool to support C4I R&D, including examination of alternative C3 architectures, advanced concepts, and interoperability issues. RESA also provides maritime simulation support for command control training of senior allied/Joint commanders. RESA does not directly support acquisition (NAVMSMO web site, RESA page).

b. **Interoperability.** A member of the Joint Training Confederation (JTC), RESA is interoperable with other JTC members using the Aggregate Level Simulation Protocol (ALSP). HLA certification waiver granted.

3.E.1g Tactical Operational Scene

TOPSCENE



1. **Acronym: TOPSCENE**
2. **Sponsor: NAVAIRSYSCOM**
3. **Applicability**

"TOPSCENE is an operational training system consisting of 3D imagery products and infrastructure." Pilots from all services use TOPSCENE for mission rehearsal prior to actual operations. The Army is a major user of TOPSCENE to train and conduct mission rehearsal. For example, "the 160th Aviation Regiment has a Model 4000 unit and two Model 3500 TOPSCENE systems, which were deployed to Bosnia. The 2nd Infantry Division has two units, a Model 3500 and a 4000, located in South Korea." [Lockheed Martin TOPSCENE website].

a. **Application.** "TOPSCENE is a battlefield visualization system that lets aircrews and battle commanders rehearse their missions before going into combat with timely, realistic, real-world images of the contingency area. TOPSCENE provides: rapid, accurate database construction, and real-time 3D fly through. TOPSCENE features include: open architecture, fully scalable, all commercial-off-the-shelf" [NAVAIR TOPSCENE web site].

b. **TOPSCENE Models.**

1. Model 4800 Image Generator (IG). Provides high-resolution imagery and sensor data for combat mission simulation of large area databases. Mission rehearsal and mission training applications are supported with a complete set of mission functions and environments. Supports a variety of weapon systems. Open architecture system of hardware and software, expandable for additional channels, line rates and functionality.
2. Model 4000. Provides photo-based imagery, sensor simulation, and a situational awareness for large terrain databases. Imagery and elevation data are stored on digital disks and transported to the user. Databases can be updated in the field. The operator station is menu-driven and controlled through the keyboard. Mission rehearsal is performed using a throttle and control stick; other weapon-specific controls can easily be added. Other system elements - all COTS - include:
    a. Four Silicon Graphics Infinite Reality processors
    b. Up to 600 Gbytes of removable digital storage
    c. 24-inch high-resolution monitor
    d. Uninterruptible power supplies
    e. Shock-mounted enclosure
    f. 8 mm tape drive
3. Model 400. A compact, low-cost version of TOPSCENE 4000. Provides photo-based imagery and sensor database:
    a. SGI-based platform
    b. OCTANE System
    c. Operator controls (mouse, control box, keyboard)
    d. Removable digital storage (up to 100 Gbytes)
    e. Color monitor

3.E.1h C4ISR Assessment Tool - Navy Simulation System

1. **Acronym: NSS**
2. **Sponsor: Space and Naval Warfare Systems Command (SPAWAR)**
3. **Applicability**

Simulates medium to large theater naval scenarios. Explicitly represents:

a. C4ISR architecture, including communications processes, paths and resultant tactical picture.
b. Chain of command, including Group, WMA and unit/platform commanders.
c. Operational plans, including tactics, doctrine and situation-dependent actions.

1. Application. NSS is an analytical simulation, graphical user interface and database developed by CNO N6 for maritime warfare analysis and operational decision support. NSS models the spectrum of naval warfare including interactions between warfare areas, e.g. C4ISR, strike/undersea/air/surface/ mine warfare, special operations, ground, amphibious, OOTW. A key element of NSS is the explicit modeling of C4ISR. The primary use of NSS is the analysis of alternative Courses of Action (COAs). These analyses are performed to assist the operational decision maker in mission planning and selection by providing user-selectable quantitative measures of effectiveness (MOEs) for each alternative modeled. NSS simulates:

4. **Technical Specifications.a. Hardware:**

   1. **Disk–**
      NSS Server:
      2 GB
      NSS Client: 1 GB
   2. **Memory**
      NSS Server: 512 MB
      NSS Client: 512 MB
   3. **CPU**
      NSS Server: 440MHz Sun Ultra Sparc 10
      NSS Client: 800 MHz Pentium III

5. **Software:**

   1. **Server**: Solaris 2.8, DII COE 4.4 Kernel, ObjectStore 6.0SP5 (OODBMS)
   2. **Client**: NT 4.0 SP6, ObjectStore 6.0SP5, MS Excel, GAMS 2.5
   3. **NSS AE Version:** AE version compatible with either Win2K or NT4.

   Input: Any number of templates (platforms/systems/subsystems) can be associated with numerous variables that can be manipulated according to the study or function under investigation.5. **Output:** A standard set of MOEs that can be modified (or one can create new ones) 6.

Interoperability: HLA certified.

3.F U.S. Marine Corps Simulations

1. Introduction

The US Marine Corps (USMC) uses a variety of simulations, many of which (JCATS, JSAF, Janus, CBS, and others) have already been addressed in separate sections. The Marine Corps, having missions similar to that of the Army, uses many of the same M&S tools. There are a number of projects on which the two Services collaborate and share information. One example is Project Albert, the Marines Corps transformation project, where they collaborate with the Army on urban terrain. This section addresses primarily the USMC-unique simulations.

2. Background

Marines are routinely deployed around the world in deterrent, observer, security, peacekeeping, and combat roles. While on these deployments, Marines are billeted on ships, in embassies, and in base camps, often for extended periods of time. For example, the USMC continuously sources three Marine Expeditionary Units – Special Operations Capable (MEU[SOC]) of roughly 2,200 Marines each. These Marines are embarked aboard U. S. Navy amphibious ships, usually for a period of six months or more. During this deployment, the live training opportunities are rare and often confined to small numbers of ground combatants. Training for Marines while forward-deployed to WESTPAC, Europe, or South Asia is similarly affected.

Combined arms employment is standard procedure for even small Marine units. All Marine units are deployed for combat as Marine Air Ground Task Forces (MAGTFs), so a variety of air and ground weapons are always available. In order to successfully operate this system of fires and maneuver, every Marine needs to know the tactics, techniques, and procedures (TTP) to manipulate all of the assets available. These low-level command and control skills involve both procedural tasks and teamwork, and are highly perishable.

3. USMC Transformation Initiative Using M&S

One of the ways the Marine Corps is meeting the challenge of transformation is through an effort at the MC Warfighting Lab (MCWL) called Project Albert. Project Albert (named after Albert Einstein) parallels the transformation process in that it is a sustained, iterative, and dynamic effort that develops and integrates new concepts, processes, and technologies to gain an understanding of the landscape of possibilities inherent in warfare.

Project Albert's purpose is to support maneuver warriors by giving them an idea of the opportunities and risks in a variety of situations. The decision-makers can ask "what if" questions and not only become aware of the possibilities, but also discover ways they might exploit the opportunities and mitigate the risks.

In Project Albert, high performance computing is being leveraged in innovative ways. For example, fast running, transparent simulation models are used that attempt to capture the key features of the situation without trying to model all of the details. This combination of high performance computing and "small" models allows for the exploration of large portions of the mission space in an attempt to find a good solution to a problem. This uses a process developed within the project called "Data Farming." As the name implies, this process allows for the growth and iterative exploration of large data sets relating to situations where asymmetric enemy action and other fluid circumstances are real possibilities. Over the past few years Project Albert has developed capabilities in several areas to enable Data Farming. These areas include rapid prototyping and scenario building, data access and visualization, and model translation and integration.

Project Albert has begun to pursue application of the still-developing capabilities in several areas at the Warfighting Lab including surf zone/beach zone obstacle reduction and mine countermeasures, defense against enhanced blast weapons, and incorporation of logistics aspects into combat modeling. In addition, a major application effort is to pull Project Albert capabilities into the Sea Viking Experiment wherever appropriate. Work is also taking place with a variety of collaborators including the Army in the area of military operations in urban terrain, the Air Force in the area of uninhabited vehicles, and other nations in areas such as incorporating Project Albert modeling and simulation into command and control. Finally, one area of effort that is promising for applying Project Albert methods and that spans USMC, Joint, and Combined interest, is the war on terrorism.

The ultimate goal of Project Albert is to develop better maneuver warriors. The Marine Corps also aspires to leap forward in the ability to understand the many possibilities inherent in conflict and transform decision-making capabilities to allow these warriors to meet the challenges and exploit the opportunities that they will face in an increasingly uncertain world.

4. Modeling and Simulation Capabilities

USMC uses virtual, constructive and live simulations to train Marines. In the table below, various USMC simulations and tools that support live simulations are listed, as well as those used in the training base alone, virtual and constructive environments. The models in Table 1 are discussed below.

VIRTUAL	**CONSTRUCTIVE**	**LIVE**	**SCHOOLHOUSE**
DVTE Deployable Virtual Training Environment	JSIMS Joint Simulation System	MILES 2000 Multiple Integrated Laser Engagement System	ROC-V Recognition of Combat Vehicles
CACCTUS Combined Arms C2 Training Upgrade Systems	MAGTF Tactical Warfare Simulation	PLI Position Location Information	SCIP Sim Center Improvement Program
CLASS Closed Loop Artillery Simulation System		NITE Facility Night Integrated Training Environment	PC Game-Based Simulation
ISMT-E Indoor Simulated Marksmanship Trainer – Enhanced		SESAM Special Effects Small Arms Munitions	BSC Battle Simulation Center Support Contract
MTD Minor Training		RIS Range	MISTC MAGTF Integrated C4ISR

Devices		Instrumentation System	Systems Centers
TDMS Tactical Decision-Making Simulation			
ITK Infantry Tool Kit (a subset of DVTE)			
CVTS Combat Vehicle Training Systems			

USMC Programs

3.F.1a The Deployable Virtual Training Environment (DVTE)

DVTE, sponsored by the Director, Expeditionary Warfare (N75) in the Office of the CNO, is a collaborative effort between the Program Executive Officer, Expeditionary Warfare (PEO EXW) and Marine Corps Training and Education Command (TECOM). It is adaptable to training tasks involving Joint forces, either in the context of a Joint exercise or for Joint Experimentation. DVTE uses direct interaction with the trainee, and maintains individual tactical and decision-making skills. DVTE is used to train Marines in a variety of occupation specialties as teams in a combined arms environment.

This results in a problem as members of an infantry squad have very different training requirements from those of a vehicle crew. These means that, if put in the same virtual training area at the same time, the levels of activity, the size of the Playbox, and the timelines of operations for these two groups require that one group is always the main focus, while the other is relegated to that of a group of training aids. To overcome this problem, developers divided the training audience and built applications for each: the small unit infantry units would train using the Infantry Toolkit (ITK) and the vehicle operators and infantry commanders would train using the Combined Arms Network (CAN).

Some attributes of the DVTE include:

1. It comes with several CAX scenarios (HAC, MAC, ASCEX). Additional scenarios will be added with FMF and training community input.
2. It uses the Combined Arms Command and Control Tactical Upgrade System (CACCTUS) virtual battlespace, and JSAF, as the ground-truth that the simulators relate to. This means that DVTE provides a reduced portion of CACCTUS to a deployed unit without the overhead of a full CACCTUS setup.
3. The Naval Visualization Program (NVP) will be used as the visualization tool. NVP is a proven software package in use in the Navy today.
4. The simulation includes an After Action Review capability to facilitate critique.
5. DVTE includes support for fixed and rotary-wing aviation, tracked and wheeled vehicles, indirect fire assets, naval assets, and forward observer interaction in the environment.

3.F.1b Infantry Tool Kit (ITK)

The ITK includes four different tools, each created and included to provide specific individual and small-team sustainment training to the deployed Marine.

1. Tactical Decision Games (TDGs) are PC based scenarios that require a Marine leader to evaluate and address a specific tactical problem.
2. The Tactical Decision-Making Simulation (TDMS) places the Marine in a mission critical situation, presents a significant problem, then requires making decisions to solve the problem. The scenario is delivered on PC in the form of video, pictures, and text. TDMS can be run by an individual, but provides the most robust training when accompanied by a facilitator. There is limited branching available to support the most anticipated decisions at each decision point. TDMS is being evaluated at select training locations throughout the Marine Corps.
3. The Forward Observer Trainer teaches Marines how to call for artillery and mortar fire. The tool runs on a laptop PC.
4. The Fire Team Cognitive Skills Trainer (FTCST) is a fully interactive, three-dimensional training tool that allows small units (groups of five to 15 Marines) to solve specific missions. The emphasis is on teamwork and the execution of tactical decision-making skills. FTCST is built using the Virtual Battlefield Simulation (VBS), which is based upon the commercial gaming engine Oxygen II. Individual entities in the training environment are maneuvered and fought by individual Marines sitting in front of networked laptop computers. The physical ground truth is represented in the FTCST; the verbal interaction of the team members and the leadership of the team happen just as in a field environment. As such, a team can think through different problems while in a deployed status.

3.F.1c Combined Arms Network (CAN)

The CAN was developed as a federation of first-person vehicle and weapon simulators, and the Joint Semi-Autonomous Force (JSAF) constructive simulation. Each entity’s location can be exported in near-real time, through a gateway, to USMC command and control systems like Intelligence Operations Station (IOS) v2. This is accomplished by transforming MAGTF FOM PDUs into GCCS-M J-Unit messages. The effect is that DVTE can stimulate command operation centers such as a Landing Force Operations Center (LFOC).

The CAN after action review system is built on top of the Naval Visualization Program (NVP), a GOTS product written and maintained by employees of the Naval Surface Warfare Center – Coastal Systems Station, Panama City, Florida. NVP is visualization software capable of rendering three-dimensional, fly-through viewing of photo-realistic terrain. In addition, NVP displays iconography that shows the location and identity of each entity in the CAN, as well as showing three-dimensional analogs of standard tactical control measures.

3.F.1d Tactical Decision Making Simulation (TDMS)

TDMS is a computer-based decision making simulation. A Marine is provided video clips of a real-world situation, played out by both Marines and actors. The video leads to a series of events; each target event requires a decision to be made by the trainee. TDMS provides a number of decision branches that facilitate the trainee's freedom to choose (most logical) courses of action. TDMS training is best performed under the guidance of a trained facilitator. Facilitator training is incorporated into TDMS deployment/fielding.

TDMS was originally developed by the Marine Corps Warfighting Lab under the name Combat Decision Range (CDR). It is currently in the process of being transitioned from MCWL control and funding to TECOM/TechDiv control and funding.

3.F.1e Indoor Simulated Marksmanship Trainer – Enhanced (ISMT-E)

The ISMT-E is a computer based training system that allows Marines to train to a majority of established Individual Training Standards relating to marksmanship prior to the expenditure of ammunition. Performance measures, feedback, safety and diagnosis of shooting problems improve weapons proficiency skills while maximizing available training resources.

3.F.1f CACCTUS (a.k.a. CAST Upgrade)

CACCTUS is an entity-level simulation that incorporates visualization (out-the-airplane-window), automatic hazardous fires detection, special call-for-fire and 9-line input, interface to C2PC, and an After Action Review module. It is used for mission rehearsal at CAX, general fire support coordination training (whole MAGTF), pre-LOD plan evaluation for IPB, CSS, and logistics in CAX environment. CACCTUS allows virtual augmentation of CAX scenario with any equipment or activity that can be simulated (e.g., NSFS, deep strike, amphibious assault, UAVs, national-level ISR).

3.F.1g Closed Loop Artillery Simulation System (CLASS)

The CLASS supports training for artillery personnel and batteries in all types of artillery missions. CLASS provides the capability for closed loop, integrated training in the conduct of observed and unobserved fire missions. CLASS allows the Forward Observer (FO), Fire Direction Center (FDC) and howitzer section personnel to simultaneously train in a closed loop and stand-alone environment without the use of live ammunition. CLASS enhances the capability of Marine forces to destroy, degrade and delay enemy forces by providing an effective means for enhancing battery proficiency without the risk and expense of live fire training.

CLASS allows artillery batteries to train in garrison and while deployed without live fire costs thus achieving a level of proficiency that will make vital, but rare, live fire training more effective. [USMC TECOM, 2003]

3.F.1h Minor Training Devices (MTD)

Minor Training Devices is an annually funded program that allows for the purchase of those minor training devices that enhance training at Marine bases and stations. MTDs include (but are not limited to) items such as:

1. Rubber weapons for use in training tanks and during hand-to-hand training
2. NBC simulators
3. Artillery simulators
4. Training videos

3.F.1i Simulation Center Infrastructure Program (SCIP)

SCIP is an initiative with the purpose of standardizing the infrastructure within USMC Simulation Centers. This includes:

1. Network routing and data rate
2. Access points into the Simulation Centers
3. Some peripheral hardware standardization
4. VTC standardization/installation

SCIP is needed because USMC Simulation Centers were all created ad hoc and without a definitive standard, other than reliance upon standard commercial products. Given the increasing opportunities for distributed training (both USMC and Joint), SCIP will greatly ease the amount of infrastructure enhancements that currently have to be performed before every distributed training event (at great cost in both time and money). [USMC TECOM, Retrieved Jan 2003]

3.F.1j Range Instrumentation System

The Range Instrumentation System (RIS) will instrument Marines, their vehicles, and their weapons systems with electronic equipment necessary to track and report position and status automatically back to a computerized operations center in near real time. RIS will draw fire engagement data from all elements and integrate this with other instrumentation systems and computer generated forces to expand the size, scope and realism of a given training evolution. It will provide real time adjudication of engagements during both force-on-force and live-fire training.

3.F.1k Night Integrated Training Environment (NITE) Facility

The Night Integrated Training Environment Facility (NITE) provides 24/7, 365 days-a-year night training in individual combat skills and fire team coordination skills. The NITE Lab develops night fighting skills, and therefore increases the individual Marine’s confidence in operating at night in various environments while using night vision devices. Additionally, the lighting technology installed in the NITE Lab accurately replicates ambient light from the moon and stars, thus making the Lab an ideal test and evaluation facility to conduct Limited Technical Assessments of night vision optics and equipment (Panter, Retrieved March 2003).

3.F.1l Multiple Integrated Laser Engagement System (MILES-2000)

MILES 2000 is the current generation of Tactical Engagement Simulation Systems. MILES 2000 was the replacement for the basic MILES, in use since the mid-1980s. MILES 2000 provides the Marine Corps with a family of low-power, eye-safe, lasers that simulate the direct fire characteristics of weapons organic to a reinforced infantry battalion. MILES 2000 enhances the tactical training environment by closely replicating infantry battalion direct fire ranges, capabilities, limitations, and ammunition characteristics.

MILES 2000 provides the capability to conduct realistic reinforced infantry battalion force-on-force engagements. Additional enhancements provide longer battery life, lighter weight, reduced MILES equipment profiles and an after action review (AAR) feedback capability. A MILES Target Interface Device (MTID) makes MILES 2000 interoperable with currently fielded Remoted Engagement Target Systems and Portable Infantry Target Systems (http://www.tecom.usmc.mil/techdiv/miles-2000.htm, Retrieved Jan 2003).

MILES 2000 is an Army program. MILES XXI is the follow-on production procurement of the MILES 2000 training systems. MILES XXI is a force-on-force training system used by both dismounted infantry and mobile weapon crews to increase both combat readiness and fighting effectiveness.

MILES XXI uses laser light in the form of pulses to transmit weapon information to a target. These pulses are transmitted each time a weapon is fired. Information contained in the pulses includes the player ID and the type of weapon used. The target entity processes the information to produce a casualty assessment.

The casualty assessment for a dismounted soldier can produce a state of killed or wounded. The casualty assessment for a mobile weapon system can produce several outcomes, which include catastrophic kill, mobility kill, and communication kill. Both dismounted soldiers and mobile weapon system platforms are equipped with a laser transmitter and laser receiver.

The ability to support an After Action Review is an essential feature of the MILES XXI training system. This is possible because all player activity is recorded during an exercise.

PEO STRI, acting as procurement agent for the Army, awarded a delivery order on 16 May 2001 for the next production phase of MILES XXI. (http://www.stricom.army.mil/PRODUCTS/MILES_XXI/, Retrieved March 2003).

3.F.1m Combat Vehicle Training Systems (CVTS)

The Combat Vehicle Training Systems (CVTS) will be a family of high fidelity, deployable and institutional, precision gunnery, networked training systems that will allow the Marine Corps Ground Forces to satisfy its individual, collective, combined arms, and joint training objectives. The CVTS systems will have two basic configurations that will collectively satisfy the CVTS training requirements. The first configuration will be the deployable Combat Vehicle Appended Trainers (CVAT), which will initially emphasize individual training at each crew position, precision gunnery, and crew communication and coordination at the section and platoon level. The second configuration will be the Combat Vehicle Institutional Trainers (CVIT), which will initially emphasize maneuver and tactical training from the platoon through joint level. Both the CVAT and CVIT systems will include a Distributed Interactive Simulation (DIS) compliant networking capability that will support networked training with each other and other DIS compliant systems such as the Army's Combined Arms Tactical Trainers (CATT). The CVTS system has a pre-planned product improvement to be High Level Architecture (HLA) compliant.

The CVAT systems will be a family of deployable, high fidelity, DIS networked, appended training simulators for the M1A1 Main Battle Tank, the Light Armored Vehicle (LAV-25), and the Amphibious Assault Vehicle (AAVP7A1). The CVAT requirements are expandable to include other Marine Corps ground vehicles as required. The CVAT systems will be fielded throughout the Marine Corps' Formal Schools, Marine Forces Atlantic (MARFORLANT), Marine Forces Pacific (MARFORPAC), and Marine Forces Reserve (MARFORRES). The CVAT systems will emphasize individual, collective, and cross training in gunnery, mission tactics and crew communication and coordination across the skill level spectrum: familiarization, proficiency, and sustainment.

3.G Air Force Simulation

1. Introduction

The Air Force operates closely with the Army on a day-to-day basis. This includes the C-130 used to support Army Airborne training, the airlifter that transports personnel and equipment to a distant contingency, to Close Air Support (CAS) provided in the heat of battle, to the high altitude airborne surveillance platform that provides vital battlefield information in "real-time" to Army units, and a variety of other air missions. Air Force and Army operations influence and complement each other in complex ways to achieve the unique synergy in combat power they provide on the battlefield. Yet, the Air Force perspective on combat is different from the Army perspective, and that difference is reflected in Air Force models and simulations.

When a training exercise or other M&S event is planned that will include Air Force operations or participation, there should be an understanding about the issues considered important to Air Force M&S, and how they complement or conflict with the needs of the Army.

Reflecting the Air Force battlespace and operational concepts, Air Force M&S tend to take an Airpower-centric view, and since the dawn of space operations, an Aerospace-centric view. Reflecting the fact that advanced technology has always been a factor in gaining an advantage in air combat, Air Force M&S also tend to emphasize engineering principles that directly impact on the concepts of advantage in air operations.

2. History

The Air Force built upon its Army heritage, employing conceptual and practical wargames and exercises to explore new concepts and to analyze operations, well before the advent of the computer. Early practitioners at the Air Corps Tactical School at Maxwell Field, Alabama, included Major Claire Chennault, later head of the famous Flying Tigers in China, and Captain George Kenney. As early as 1929, Kenney "developed an air/sea/land wargame that took maintenance, supply, and even airfield construction into account." In WWII, Lt. Gen. Kenney was credited as the architect of General MacArthur's sea/air/land campaign in the Southwest Pacific. [Caffrey, Toward a History-Based Doctrine for Wargaming, 2000]

Air Force innovations brought about the concept of live training on instrumented ranges. The world's first instrumented air weapons range was established at Eglin AFB, FL in 1967. [Caffrey, 2000] Simulating combat in an environment in which every move by every participating aircraft, radar, and weapon was constantly monitored and recorded for later analysis permitted accurate critiques of individual techniques, as well as overall tactics, techniques, and procedures. These critiques also helped to resolve differences in perception. The same philosophy supports today's Army training at the National Training Center, the use of the Multiple Integrated Laser Engagement System (MILES), and comparable instrumented ranges for Navy, Marine, Air Force, and Joint live training.

Air Force use of constructive simulations is thought to have originated within the Operations Research community after WWII. As early as the late 1940s, the RAND Corporation, directly supporting the Air Force, used computers to explore political, economic, and military options in response to various scripted Cold War crises. By 1954-55, RAND was able to conduct computer-supported wargames at Air War College that simulated the course of a nuclear war, and used an air warfare model to perform an airpower-based “net assessment”. [Caffrey, 2000]

In the early 1980s, when the Warrior Preparation Center (WPC) was being established by U.S. Air Forces in Europe (USAFE) near Ramstein, Germany, no constructive simulation could be identified in the Air Force that would be suitable for training U.S. and NATO battlestaffs in concepts of the Air Land Battle in Germany. Yet, the Air Force experience with increasingly sophisticated and effective cockpit and air combat simulators suggested that computer-driven battle simulation should be practical, affordable, and effective. Members of the WPC staff identified a Navy model with potential to be adapted to the needs of Central Europe. The Interim Battle Group Tactical Trainer, (IBGTT, pronounced I-Bigot) represented the air defense of a carrier battle group using surface based air defenses, fighter aircraft, and radar sensors. The battle “map” was displayed as a simulated radar display. IBGTT was modified at WPC to use stationary (and unsinkable) airfields and surface to air missile batteries, and adapted to NATO/German radar display symbol conventions. The modified model was named Air Defense Simulation (ADSIM). ADSIM also constantly accounted for the fuel status and weapons remaining aboard all airborne aircraft, and the loss of a radar would cause a corresponding loss in the ability to display aircraft in its sector of coverage. ADSIM has grown and evolved continuously since the mid-1980s, and was renamed Air Warfare Simulation (AWSIM) in the late 1980s. Representation of the land battle posed similar challenges. The Army teamed with the Air Force at the WPC to create a unique training environment for its day. While IBGTT was being adapted to the Central European theater, an early Army computer-driven force-on-force wargame was being adapted to portray the land battle. The McLintock Theater Model (MTM) was tailored to needs of the WPC. The tailored land combat component of the WPC suite was later renamed Ground Simulation, or GRUSIM. GRUSIM and ADSIM were further adapted to create the impression of a unified air/land battle space, even though the two models ran independently. The joined air/ground combat simulation was renamed JointWars. [Frazier, 2003]

The constant development of new aircraft, and experience gained in live exercises and combat in Korea, Vietnam, and elsewhere, led to more sophisticated combat aircraft and simulators. Observation and study of Soviet air defense command and control methods suggested there was more to the air battle than superior maneuver. By the mid-1970s, highly classified capabilities existed to permit simulation of competing real world aircraft, radars, weapons, and procedures. The Air Force now uses a distributed network of sophisticated fighter, attack, tanker, C2 and supporting simulators to practice specific missions and capabilities in a program known as Distributed Mission Training (DMT), which is conceptually similar to Army CATT.

Simulation is also used by the Air Force for campaign planning, in terms of determining force deployment, and force application options, to plan and schedule airlift, to plan and rehearse specific missions, and to evaluate the costs and benefits of potential new systems.

3. Air Force M&S Capabilities

Following are discussions of the principal Air Force constructive simulations, and a selection of other simulators and simulations intended to reflect unique aspects of the Air Force simulation mission. The source of all these model descriptions, except NASM, is the Air Force Modeling and Simulation Resource Repository (AFMSRR).

3.G.1a Air Warfare Simulation (AWSIM)

AWSIM is designed to train senior commanders and their battlestaffs in the execution of wartime air operations that emphasize joint and combined operations. AWSIM is an interactive, computer-driven, time-stepped simulation of the air warfare environment. It employs latitude/longitude coordinates for geo-location, and simulates day/night operations and limited weather conditions over a smooth earth (no terrain). AWSIM is a two-sided gaming environment in which opposing sides define, structure and control their forces. AWSIM simulates entities including aircraft by type, air bases, ground-based air defenses including Surface-to-Air Missiles (SAM) and SHORAD, surface ships and radars. Aircraft consume fuel and a wide range of specific aerial munitions. Aircraft can acquire and engage targets automatically, or under simulated radar control with humans in the loop. AWSIM monitors and reports individual aircraft missions, fuel state, munitions consumption, and the results of scenario based air-to-air engagement algorithms. Air-to-ground play is accommodated through the ALSP to influence ground forces in the participating ground models and simulations.

a. **Where it is used**: AWSIM supports play of the air warfare environment by executing the directions of the air component commander for battle staff training of Air Force exercises, and the air portion of joint training exercises. In the latter role, AWSIM participates as a member of the Joint Training Confederation (JTC), via the Aggregate Level Simulation Protocol (ALSP). AWSIM can support analysis of air operations and battle management using the AWSIM Analysis Tool Kit.
b. **How it is used:** The simulation is used for team skills development, and as a non-scripted command post exercise driver. AWSIM is the official USAF theater-level constructive theater-level wargaming simulation. AWSIM output consists of a high-resolution display of the air situation, which includes all objects in play, and a series of tabular displays. AWSIM manages the assets and the combat power of the Air Force to execute a simulated air battle, and to drive the decision-making processes that support that battle. AWSIM serves as the focal point for other specialized training simulations to meet particular needs. The AWSIM CTAPS Interface links AWSIM to the Contingency Theater Automated Planning System (CTAPS), the real world system used to compose an Air Tasking Order (ATO). AWSIM can then “execute” the ATO. Logistics Simulation, (LOGSIM) imposes realistic logistics constraints on the forces modeled in AWSIM. It manages the flow of aircraft, fuel and munitions available in AWSIM, and represents equipment, personnel, and airbase consumables. LOGSIM simulates base-level maintenance activities, generates estimated time in commission (ETIC) for specific airframes, tracks aircraft and equipment through the repair process, and consumes and reorders critical spare parts. Aircraft in maintenance are not available for operations until repaired.
c. **AWSIM** is a standard member of the Joint Training Confederation used in most Joint exercises. As such, AWSIM regularly interfaces with and represents air operations for Army Corps Battle Simulation (CBS), CSSTSS, and TACSIM, Navy Research Evaluation, Simulation and Analysis (RESA), Marine Corps MAGTF Tactical Warfare Simulation (MTWS), and Air Force JQUAD (a suite of

four command and control warfare models) and the Missile Defense and Space Tool (MDST). AWSIM also can be configured for integration into a Distributed Interactive Simulation (DIS) network, and to the Theater Battle Management Core System (TBMCS).

d. **Sponsor**: Air Force Agency for Modeling and Simulation (AFAMS). The National Air and Space Model (NASM) will replace AWSIM in the future.

3.G.1b Distributed Mission Training (DMT)

DMT is a recent Air Force readiness initiative for aircrew training, team training, and mission rehearsal system. Its purpose is to achieve and maintain individual, team and composite force skills for its combat and combat support forces. The main "workstation" focus of DMT is the cockpit of a combat aircraft or a crew station simulator such as a ground based radar, an aerial refueling aircraft, AWACS, or an intelligence system. All participating cockpits and workstations can be networked to a common virtual environment and tactical scenario. Such networked virtual training will enable operational units to practice their high-end individual, team, and inter-team combat skills on a daily basis. DMT mission rehearsal will enable Aerospace Expeditionary Forces (AEF) or joint force commanders to prepare and assess their forces for real-world missions. Networking virtual, live and constructive components will form the DMT synthetic battlespace. DMT is designed to link high fidelity combat and combat support simulators with other command, control, intelligence, surveillance, and reconnaissance (C2ISR) systems into an interactive synthetic training environment.

a. **Where is it used?** DMT sites are located at principal operating bases of Air Combat Command. Training can be conducted locally in the individual DMT cockpit environment. However, the DMT network is intended to accommodate simultaneous multiple bases, types of aircraft and combat and combat support missions that can operate realistically in a common virtual environment for general operational proficiency, or to rehearse specific missions.
b. **Sponsor:** HQ USAF/XIW

3.G.1c Joint Integrated Mission Model (JIMM)

JIMM is an advanced Mission (tactical/operational) level analysis model, derived from two earlier air combat analysis models, the Navy's Simulated Warfare Environment Generator (SWEG), and Suppressor. During the 1998-1999 timeframe, the Joint Strike Fighter Joint Program Office (JSF JPO) sponsored work to integrate key functionality from Suppressor into the SWEG model. JIMM, to be used by the Joint fighter community, is the result of that effort. JIMM meets the near-term needs of the Joint Strike Fighter program, and many of the expected requirements of a next generation mission model. JIMM is a distributed (DIS) capable, event stepped, object oriented, general-purpose conflict simulation, and is being readied for High Level Architecture (HLA) Certification. JIMM can participate in a virtual network with other simulations, simulators, hardware, and crew-in-the loop systems, or run in a stand-alone, constructive mode. JIMM supports multi-sided conflicts involving air, ground, naval, and space forces. In addition to the mechanics of flight and combat the system represents the processes of Command and Control, counter air operations, land attack, sea attack, counter-space, intelligence surveillance and reconnaissance, navigation and positioning, strategic attack, and weather services. Players consist of platforms, systems, and expendables, and can move, shoot, communicate, sense, disrupt, and think. The user interface to JIMM is a graphical display of the battle space.

Sponsor: Air Force Material Command, Electronic Systems Center

3.G.1d National Aerospace Warfare Model (NASM)

NASM is the next generation Air Force constructive staff training simulation. The design of NASM will correct many shortcomings of AWSIM, and reflect the changes in the overall threat, and in Air Force technology, capability and doctrine that have evolved since AWSIM was fielded. One NASM enhancements is the accommodation of the play of more than two sides. It will possess better representation of the impact of logistics on air operations. It will represent terrain, weather, and atmospheric conditions, and their effects on air operations. The NASM battlespace will not be confined to a coordinated delimited "play box", but will reflect a global geospatial view. NASM will continue to use latitude, longitude and altitude for primary positioning, but will accommodate automatic conversions to UTM and other coordinate systems, where required, for order entry and visual displays. Representation of objects in the simulation will accommodate radar phenomena, low observable technology, electronic combat, Identification Friend or Foe (IFF), visual, Infra-red, and other sensor capabilities. NASM will have greatly expanded air-to-surface capabilities over AWSIM, including the capability to interface with national or theater specific preplanned target lists, and to represent detection and engagement of fleeting tactical targets. Air-delivered weapons effects in NASM will be specific to the type of ordnance, and consistent with Joint Munitions Effectiveness Manual (JMEM) data. NASM will also improve the simulation of military airlift. It will accommodate special delivery profiles such as airdrop and combat offloads, and will reflect real-world impacts of cargo weight, volume, type, pallet size, passenger seating, etc. NASM will introduce new capabilities to reflect the impact of space operations. Issues such as space lift, GPS availability, national and individual communications capabilities, national and theater ballistic missile warning and defense, airborne and ground moving target detection, and various means of over-the-horizon detection and warning will be accommodated. NASM will also incorporate improved means to set up and alter the basic scenario database, prior to and during runtime execution. NASM will be able to interface to and exchange information with a wide range of real-world C4ISR systems, including the Air Force Mission Support System, the Defense Message System, the Global Command and Control System, Global Decision Support System, the Theater Battle Management Core System (TBMCS), and tactical data links (TADIL A, B and J). NASM will conform to the security requirements and will be capable of operating in Emission Security (EMSEC) controlled environments. After Action Review (AAR) capabilities will be integral to NASM, as will the ability to reconstruct specific past events for detailed review and analysis.

Sponsor: NASM is being developed under a HQ USAF XO Operational Requirements Document (ORD) dated 5 Jan 1999. The development office is Air Force Materiel Command Electronic Systems Center (ESC), at Hanscom AFB MA. The NASM Office of

Primary Responsibility (OPR) is the Air Force Agency for Modeling and Simulation (AFAMS). [SOURCE: NASM ORD 5 Jan 1999].

3.G.1e THUNDER

THUNDER is a two-sided, stochastic, analytical simulation of campaign level military operations. Currently the primary Air Force tool for evaluating the contributions of air and space systems, forces, and capabilities, to large-scale military operations, THUNDER has been in continuous use since its IOC in the mid-1980s. Maintenance and modifications to expand its functionality have been routinely undertaken in accordance with stringent configuration management and version control procedures. Thunder employs explicit air/space, ground, and naval weapons, sensors, platforms and entities to reflect their contributions in terms of combat and combat support capabilities and effects. It automatically plans and executes their actions based on model rules sets, adjudicates the outcomes, and incorporates the results into ongoing operations. THUNDER is the functional equivalent in the Air Force of the TACWAR analytical model in the Army.

THUNDER can run either as a wargame, or as a stand-alone analytical tool. The analytical mode supports issues of force-on-force, employment concepts, and capability tradeoffs. It can employ current and projected force structures. The wargame mode allows the involvement of seminar-style wargame participants who inject player moves, on both sides, during the near real-time execution of the scenario. The new joint analytical simulation, JWARS, will replace THUNDER when JWARS is accepted for use.

SPONSOR: Air Force Studies and Analysis Agency (AFSAA)

3.G.1f A/N FPS-85 Simulated Space Operations Center (SIMSOC)

SIMSOC is a crew-level engagement, mission/submission simulator system, located at Eglin AFB, FL. It is a self-contained Full-Mission training facility that duplicates all the mission functionality of the Operations Center of the A/N FPS-85 Phased Array Radar system. The system consists of a network of Pentium-based PC computers running custom software, and terminals connected directly to an off-line IBM mainframe computer that can support the actual radar. Each computer and mainframe terminal is assigned the task of emulating one real-world hardware component of the radar system. In addition, the facility contains a power line control system (PLCS) controlled from the system’s main console. The PLCS can control any electrical device in the simulator, including lights, alarms, computer monitors, and the phone system. All simulator functions can be written into preplanned exercise scenarios, or executed on demand as an unscripted wargame. This simulator system provides individual and unit level initial and reoccurring training, qualification, certification, and evaluations of radar crews. SIMSOC represents all aspects of the operation of the radar, and the space surveillance mission as live and virtual simulation.

SPONSOR: Air Force Space Command

3.G.1g Man-In-the-Loop Air-to-Air System Performance Evaluation Model (MIL AASPEM II)

MIL-AASPEM is a tactical level, virtual/constructive real-time engagement simulation for one or more players on both sides, using both computer driven and man-in-the-loop simulators. MIL-AASPEM is primarily a Beyond-Visual-Range (BVR) air-to-air model. The rule-based Pilot Decision Logic (PDL) provides a consistent, traceable set of logic for computer-controlled players. The model is deterministic, i.e., rule based and repeatable (the only Monte Carlo routine is the draw against Probability of Kill (Pk) at missile intercept). MIL-AASPEM has been utilized in system and subsystem requirements and effectiveness analyses, in tactics development, as a threat environment for other simulations, as a high fidelity MIL fighter for mission level models (i.e. SWEG), for scripted scenario development and for pure weapon system comparisons. In addition, the model provides the capability to evaluate limited within visual range (WVR), surface-to-air and air-to-ground engagements. This provides the capability to evaluate limited integrated air defense scenarios (IADS).

SPONSOR: AFMC - ASC (Aeronautical Systems Center)

3.H Joint Simulations

3.H.1a The Joint Simulation System (JSIMS)

1. Background

JSIMS is an Acquisition Category (ACAT) 1D DoD developmental effort to create a new simulation system reflecting changes in the distribution and balance of world military power, changes in U.S. military command structures, advances in the technologies of simulation and networked communication, and experience gained with the first generation of computer simulations for exercise and training.

Nine partners, including the Military Services and Department of Defense Agencies, developed JSIMS. The program is managed by the Army-led JSIMS Program Office with technical direction and integration performed by the Alliance Executive Office. JSIMS has been described as the most challenging modeling and simulation program in the history of the Department of Defense, from both a technical and a management perspective.

The JSIMS program employs common components to meet the specified operational requirement. It uses high-level architecture (HLA) standard running with the Defense Modeling and Simulation Office Run-time Infrastructure (RTI). A common simulation engine based upon the Synchronous Parallel Environment for Emulation and Discrete Event Simulation (SPEEDES) architecture supports many of the JSIMS federates, and has paved the way for use of a common simulation engine to support multiple, distinct federate needs. The enhanced HLA Technical Control commercial off-the-shelf system controls federation operations and provides the user with efficient management at initialization and runtime.

A complex security solution implementing auditing, common infrastructure layers guards between enclaves operating at different security levels (multi-level security) and digital signatures, provides security never before implemented in constructive simulation systems. The development of a standard workstation employing common features such as database, scenario generation, after-action review system, and graphical user interface significantly enhances the usability of the system for the warfighter and trainer.

2. History

JSIMS emerged as a concept in the early 1990s, and the development program began in 1995. Its purposes were to:

a. Replace outdated Joint and Service legacy systems.
b. Provide Real-World C4I systems - train as we fight.
c. Provide distributed training - mission planning - mission rehearsal.
d. Achieve CJCS goal to “move more electrons and fewer troops.”

The program was justified when it became clear that there were inherent limitations in the legacy simulations then available (most of which now form the Joint Training Confederation) that could not easily be overcome. The first issue became apparent after reorganizations of DoD that gave increased authority to the Joint Staff and Unified Commands. These reorganizations recognized the decreasing likelihood that a single U.S. military Service would ever again dominate in future conflicts; but so-called “joint” exercises ran on a mix of Service-centric simulations. It was not easy to train a joint staff, as they would fight, because there was no acceptable comprehensive Joint simulation able to represent a flexible mix of service warfighting capabilities in a joint environment. Secondly, the technology of the Joint Training Confederation (JTC) was recognized as a patch, not an optimal solution permitting the various service-built training simulations to exchange information freely. The Aggregate Level Simulation Protocol (ALSP), the bridge that unites the training simulations in the JTC, is purpose-built to link those current simulations that subscribe to it. A modification in one component simulation may still dictate corresponding modifications by other members of the JTC to preserve ALSP functionality, and some technical issues among the JTC members have never been completely resolved. Therefore, a single modern architecture, driven by a Joint view of the battle space, was a logical requirement.

The requirements for JSIMS were quite broad. JSIMS development was in response to Joint, Service, and Defense Agency requirements for:

a. Training
b. Doctrine development
c. Professional Military Education (PME)
d. Course of Action (CoA) analysis, and
e. Mission rehearsal.

These requirements are set forth in the approved JSIMS Operational Requirements Document (ORD), authored by USJFCOM, and all applicable Service and Defense Agency ORDs. The requirements from all Joint, Service and/or Defense Agency ORDs, Technical Requirements Documents (TRD), JSIMS Functional Requirements Documents (FRD) and JSIMS Concept of Operations (CONOPS) are consolidated into JSIMS management documents. JSIMS employs the DoD High Level Architecture (HLA) for Modeling and Simulation (M&S). JSIMS consists of Service, Agency, and Joint models; a Synthetic Natural Environment; and other applications and tools constructed to comply with HLA requirements. Models, representing joint land, maritime, air/space, and intelligence agency domains, interoperate in a Joint Synthetic Battlespace (JSB) creating an operational environment that is coherent across the three levels of war - tactical, operational, and strategic; synchronized between types of events, and realistic in the context of the specific training scenario. JSIMS is also being designed to reduce the number of personnel currently required to operate and control similar simulation based training.

The JSIMS program encountered serious cost overruns and schedule delays, which called into question the viability of the entire program. On December 12, 2002, Deputy Secretary of Defense signed a Program Decision Memorandum. The memorandum terminated JSIMS development beyond Block I, and called for an analysis of alternatives, and a system verification and validation test (SVVT) for Version 1.0.

3. Where is it used?

JSIMS has not yet been used to support an exercise. Delivery of Version 1.0, Block I to JFCOM took place on 20 December 2002. JFCOM Joint Warfighting Center (JWFC) still intends to conduct the SVVT during calendar year 2003. A software support facility is also being established at JWFC to maintain the products and documentation of the program, until a follow-on program can be identified.

4. How was it to be used?

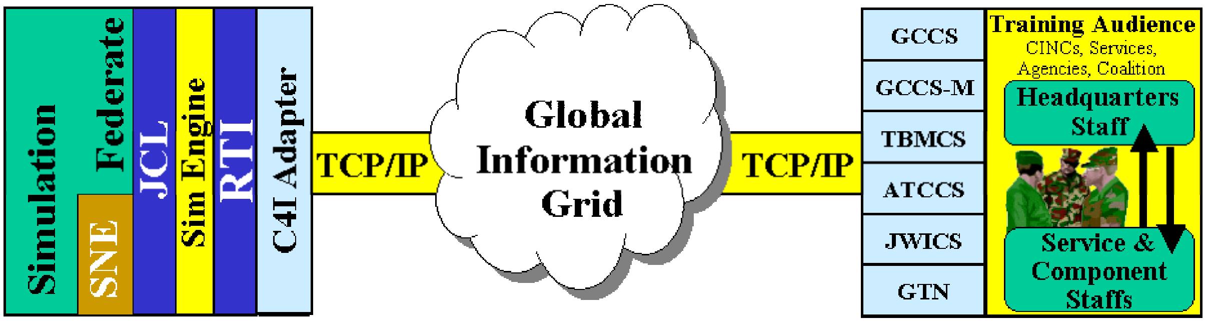
JSIMS was to provide an environment for commanders and their staffs (the training audience) to exercise their warfighting skills in a training environment similar to what they would find in real conflict, with realistic friendly and opposing forces, and real-world command and control systems. JSIMS delivered Block 1 for joint training applications and is preparing for the system verification and validation test to be conducted in Fall 2003.

At Initial Operational Capability (IOC), JSIMS is intended to focus on support for training at the strategic-theater and operational levels of war for unified combatant command staffs, Joint Task Force (JTF) commander and staff, and JTF component commanders and staffs. It will further be used to support Service-training requirements for component commands within the context of a joint force at the operational level. It will also be used to provide situational awareness and operational engagement adjudication for application in the context of joint force academic seminar training events.

As a joint simulation, JSIMS was also intended to replace the Joint Training Confederation with an HLA-based Federation of simulations designed from the outset for interoperability. These simulations and their sponsors included:

a. US Army - WARfighter SIMimulation (WARSIM)
b. US Navy - JSIMS Maritime
c. US Marine Corps - JSIMS Maritime
d. US Air Force - National Air and Space Model (NASM)
e. Joint Information Operations Center (JIOC) Operations, Intelligence, Surveillance and Reconnaissance Simulation (JOISIM)
f. DIA - DIA Object Oriented Model for Intelligence Operations (DOMINO)
g. NRO - NRO National Simulation (NATSIM)
h. NSA - Joint Signals Intelligence (SIGINT) Simulation (J-SIGSIM)
i. WARSIM Intelligence Module (WIM)

As shown in the figure below, JSIMS was intended to be interoperable with the following C4I systems or programmed replacements, regardless of their HLA compliance status: Common Operational Picture (COP) of the Global Command and Control System (GCCS), Global Command and Control System – Maritime (GCCS-M), Theater Battle Management Core Systems (TBMCS), Army Tactical Command and Control System (ATCCS), Joint Worldwide Intelligence Communications System (JWICS) capable system, and Global Transportation Network (GTN)(manual GTN interface at IOC, fully interoperable thereafter). JSIMS threshold capability will be achieved when 100 percent of top-level Information Exchange Requirements (IERs) designated critical for JSIMS Universal Capabilities List (JUCL) Functional Capability J-3 Operations Minimum are satisfied for the listed systems.



JSIMS System Interface Description SV-1

5. **Sponsor : U.S. Joint Forces Command**

3.H.1b Joint Deployment Logistics Model (JDLM)

1. **Type: Constructive**
2. **Acronym: JDLM**
3. **Purpose for which Developed**

Commercially developed for the United States Army Europe (USAREUR). JDLM provides USAREUR and United States Air Force Europe (USAFE) commanders and their staffs tools to conduct the mission planning, rehearsals, and training associated with power projection and military stability operations.

4. **Dates Developed/Implemented**

Initially delivered in 1998. JDLM has continued to evolve, with a typical delivery cycle of 6 months. These deliveries provide enhanced capabilities, in response to user suggestions, on a regular basis.

5. **Domains: TEMO, ACR**
6. **Security Classification**

The model itself is unclassified.

7. **Security Caveats**

Classified databases and scenarios are routinely run using JDLM.

8. **Applications**

JDLM supports training commanders and staffs on all aspects of the Military Decision-Making Process (MDMP) from the tactical through the strategic level. Training audiences

have varied from company level officers practicing those tasks associated with setting up an Emergency Evacuation Center (EEC) in support of non-combatant evacuation operations (NEO), to senior level staffs practicing those theater/national strategic level tasks associated with force projection of a large multi-service formation in support of standing operation plans. JDLM can also be used to support non-military training requirements associated with state, federal and international responses to emergency situations. JDLM supported Pacific Command's (PACOM's) Reception, Staging, Onward Movement, and Integration 02 (RSOI 02) exercise and is scheduled to support Terminal Fury 03.

JDLM provides the tools to gain operational insight and train on the tasks relating to:

a. Mobilization, Deployment, RSOI and Sustainment Operations.
b. In-transit Visibility (ITV) and Velocity Management.
c. The management of the infrastructure and assets associated with: strategic, operational and tactical movements and maneuvers.
d. Maintenance operations – unit through depot.
e. Medical Operations – from point of injury through definitive care.
f. Medical Supply Operations.
g. Personnel replacement operations and strength management.
h. Material management and distribution operations – tactical through industry base.
i. Operations in hazardous environments – chemical and radioactive.

j. Civilian Military Operations – local, national and international.

Its initial capabilities were oriented at providing the echelon above corps (EAC) logistical organizations a simulated environment in which they could plan, rehearse and train on the complex movement management issues associated with power projection operations. As the users became more sophisticated and the operational environment more complex, JDLM capabilities were extended to support a multi-functional, joint, civil and multi-national environment.

JDLM supports both simulation and training, and real-world operations. When fully developed and deployed, JDLM will be a real world logistics planning and management system, with an embedded training capability using the same hardware and user interfaces. JDLM can access the Joint Operational Planning and Execution System (JOPES), download Time Phased Force Deployment Data (TPFDD), and use it to populate a logistical scenario database. That database can then serve as the training database for logistics mission rehearsal.

JDLM in the mission-planning mode can access the TPFDD, project the logistics necessary to meet deployment and operational requirements, and update the database in real time with current information about consumption and flow of supplies and logistics. It thus serves both as a training system, and as an operation support tool to monitor execution. Since April 2001, JDLM has been used to provide In-Transit Visibility (ITV) and Velocity Management information to 21st Theater Support Command. It is an integral component within the 21st Logistical Operations Center.

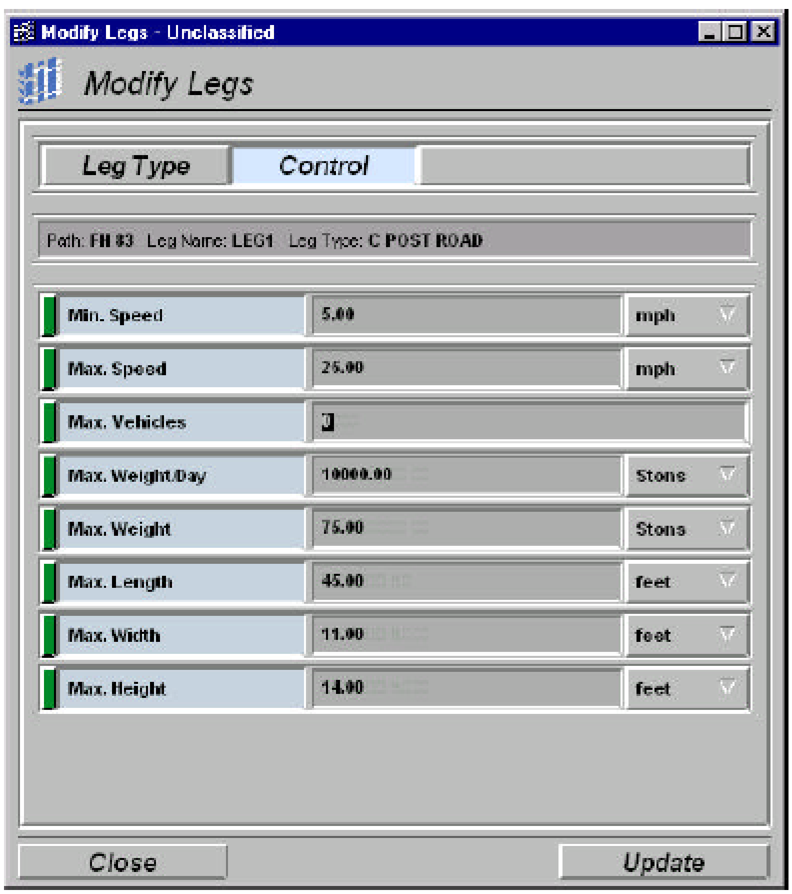
JDLM was used for training and rehearsal of the 21st TSC's Early Entry Module (EEM) on the KFOR 3A/B & 3B/4A deployment/redeployment concept(s) of operations. During execution, JDLM was used to provide EEM and LOC personnel, the ITV necessary to monitor and synchronize all aspects of the operation.

9. **Major functionalities by BOS**

JDLM was designed to provide information to the training audience through their existing command and control systems, without having to go through secondary interfaces (e.g., Runtime Manager). During training and rehearsals, JDLM uses web pages to replicate the real-world GTN, ITV, JTAV and other web based browsers used to track unit and sustainment movements. JDLM provides GCCS or C2PC unit and transporter location data using OTH-T Gold messages. JDLM can receive air mission schedule data in a USMTF format, in accordance with the AMC Interface Design Document for the Command and Control Interface Version 3.1.

JDLM's modeling methodology allows users to simulate a wide range of military and civilian operational environments. For example:

a. Hostile actions — bombs, gas attacks & ambushes.
b. Accidents — crushed hands & auto/air mishaps.
c. Acts of God — diseases, bad weather, natural disasters.
d. Wear & Tear — people & equipment.
e. Vehicle breakdowns — routine/scheduled maintenance.



JDLM Windows-based Displays

The JDLM screen displays use a familiar Windows interface. This display allows the user to specify parametric values of a transportation route segment.

JDLM replicates the transportation processes associated with power projection operations, including:

a. The ability to manage the transportation infrastructure — air, road, rail and sea. Users' decisions can be implemented immediately, and the short- and long-term effects of these decisions can be observed as the scenario unfolds.
b. The ability to provide overall and focused in-transit visibility for all modeled items.
c. The ability to create training-driven constraints during run-time (e.g., by closing a port or disrupting a road route) in order to stimulate the decision-making within the training audience.

JDLM replicates many of the operational aspects associated with power projection operations. These capabilities include:

a. The ability to parse a level 2 TPFDD and automatically execute the unit movements.
b. The ability to model the consumption of material, including tracked items, by any or all units. All classes of supply are modeled either as a class, or as specific items within the class.
c. The ability to model the sustainment process in order to promote decision-making by those tasked to support sustainment and material management. The supply process (i.e., the forward flow of consumable items from depots in the rear, through intermediate supply support activities, to consuming units at any point) can be modeled as an automatic flow (in order to force re-supply of key points) or as a manual flow (in order to force the decisions required to manage the transportation problem).
d. The ability to model the complex interactions that take place during maintenance actions. This capability allows users to decide how best to apply scarce maintenance resources. Maintenance requirements can be defined for any equipment item. These requirements, when they occur, require the users to make decisions on how to deploy available resources in order to provide the best service, how to assign repair teams in order to meet the highest priority work requests, and how to manage the assets (personnel, tools or special equipment, repair parts and consumables, and replacement items) used to support maintenance activities.
e. The ability to model personnel readiness and replacement operations. This capability allows users to practice the critical tasks associated with sustaining personnel readiness within a force. Personnel conditions (e.g., AWOL, emergency leave, etc.) and multi-echelon replacement operations are modeled.
f. The ability to model casualties and their treatment. This capability allows users to practice the critical tasks associated with health service support tasks. Medical treatment is modeled from level 1A (i.e., medic or first responder) through level 5 (i.e., CONUS medical centers). Patient flow is modeled between these echelons, depending on the nature of the casualty. Casualty rates can be based on geographic factors (i.e., different rates of occurrence for different defined areas) or events (e.g., the use of high explosives or the use of persistent or non-persistent

agents). Unit MOPP levels and the consumption and re-supply of medical supplies is modeled.

g. The ability to provide information to JDLM users in the form of scripted scenario events. JDLM allows exercise control personnel to create messages posing conditions that support training objectives, but might not emerge in the course of a free-play exercise. The scripted event messages are delivered to selected JDLM workstations in order to stimulate problem solving and decision-making. These messages can be text, audio, or audio-visual (still or moving images, with or without sound). These messages can be created in advance and automatically delivered at a predefined time, or in response to a predefined event (e.g., when the third unit passes within 5 miles of a defined point), or held until released manually by exercise control personnel.

10. Major BOS

a. **Maneuver:** Yes - JDLM accounts for maneuver support through logistics.
b. **Fire Support:** No
c. **Air Defense:** No
d. **Survivability:** Yes - JDLM supports survivability through logistics.
e. **Intelligence:** No
f. **Logistics:** Yes -
   1. **Transportation:** JDLM can track vehicles, aircraft, ships, pallets, individual and bulk items in transit.
   2. **Supply/Re-supply:** All supply items are tracked at each level of command. Supply items can be anything. JDLM includes a catalogue of all Army supply items (by NSN, nomenclature, and other (depending on class)). Unit inventory is tracked, as is the level of supplies in all supply support activities.
   3. **Medical:** JDLM tracks medical logistics and supply items.

g. **Command and Control (C2):** Yes – JDLM represents command and control of logistics assets.

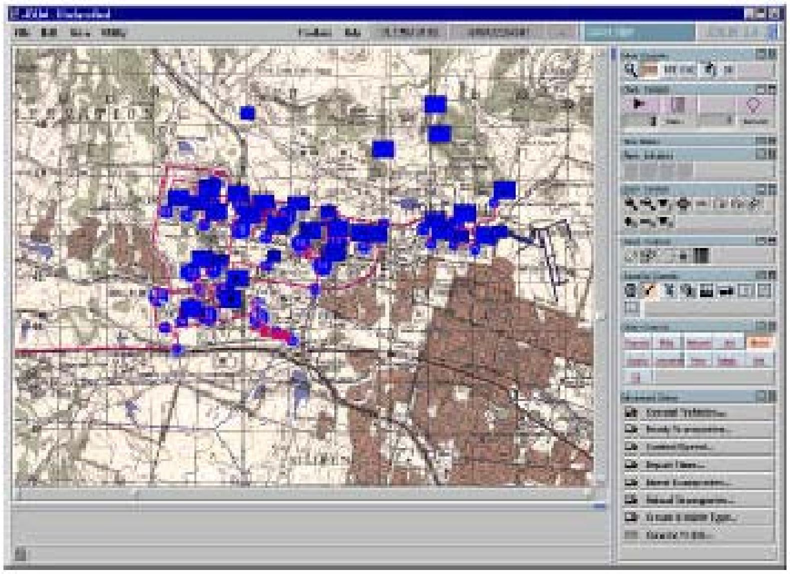
11. Other Functionalities

To meet the requirement to rapidly generate scenarios, JLDM database structures were designed to take advantage of data that is already used by existing real-world systems. For example, JDLM's US Army unit representations were designed to be populated from U.S. Army MTOE TAADS database. Supply data is derived from the electronic catalog that supports the Standard Army Retail Supply System (SARSS); this provides access to over 1.6 million items of supply.

Other sources, such as AMC's Table Management Distribution System (TMDS), provide data required by the JDLM Time Phased Force Deployment Data (TPFDD) and GDSS interface modules. JDLM also uses standard National Imagery and Mapping Agency (NIMA), Vector Product Format (VPF), Compressed Automated Digital Raster Graphics (CADRG) and Controlled Image Base (CIB) formats.
Standard interfaces provide the user the ability to manually import data that is not readily available from a database. Interfaces have been designed to allow the easy semi-automated import of other services', civilian, governmental and multinational organizational structures.

JDLM can model the flow for Time Phased Force Deployment Data (TPFDD). Accordingly, JDLM may be linked to the Joint Operational Planning and Exercise System (JOPES). This is useful for real-world contingency plan development. Analysts can use JDLM to detect issues with flow in the sequencing of planned moves, and discretely model transportation requirements and alternatives.

12. **Terrain Management System**
    a. **Current Terrain Products:** JDLM is provided with Digital Chart of the World, a NIMA-produced base map database with a scale of 1:1,000,000. More detailed regional or local level graphics may be added for specific areas using standard NIMA products including Compressed Automated Digital Raster Graphics (CADRG), Vector Product Format (VPF), and Controlled Image Base (CIB) products. Transportation networks, which are crucial to logistical operations, can be modeled to reflect their characteristics.
    b. **Expense:** Terrain databases are produced locally from in-house resources.
    c. **Time:** Time to produce new terrain varies with the size of the area to be depicted and detail required.
    d. **Clarity:** Using Digital Chart of the World, feature layers may be added or removed from the base maps as required to emphasize key information.



JDLM Screen Capture

JDLM uses standard NIMA digital mapping products to display transportation and other logistical information. Displays are user-defined.

JDLM Screen Capture

JDLM includes Digital Chart of the World for geographic display of sea and air transportation routes, and theater logistic nodes.

13. Other Environment Representation

JDLM does not directly reflect weather, but effects on transportation and logistics can be shown. Display of area contamination effects (drift and dispersal of persistent agents for example) is possible in the scenario, but is rudimentary. Improved simulation of weather in JDLM, or display of weather effects from linked simulations may occur in the future.

14. Human Behavior

Not represented.

15. Simulation Strengths

The object-oriented software code is modern, flexible, and adaptable to evolving requirements for the exchange of information to meet the needs of simulation, training, and interoperability for the foreseeable future.

16. Simulation Limitations

As initially delivered, JDLM was a standalone simulation to support transportation and supply planning and management functions. It could "communicate" with other simulations through a networked message structure, but could not interactively share simulation objects, events, or effects. In other words, if a convoy in CBS were attacked, the JDLM operator would not be aware of the attack until informed of it by the CBS operator. Conversely, if a logistics problem were to affect a unit in CBS (or another simulation), logistics tables in the combat simulation would have to be manually adjusted to reflect the changes reported from JDLM.

17. Technical Specifications

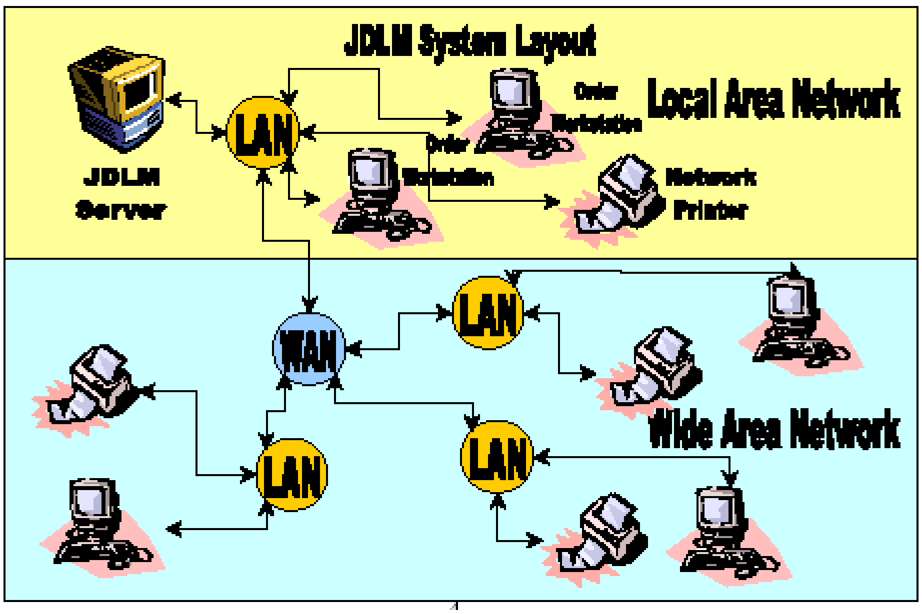
a. **Clock Speed** (minimum acceptable CPU speed)

b. **Update Rates** (minimum update interval for time stepped simulations)

c. **Operating Environment**: MS Windows NT, 2000 or XP.

d. **Hardware**: PC. Although JDLM may run standalone on a single personal computer, a functioning JDLM networked system consists of:

1. A JDLM Server that manages the database build process, event processing, and internal communication management.
2. One or more order workstations are recommended, although JDLM can run on a single server and still provide full functionality.
3. One or more network color printers (required only if hard copy output is required).



Typical JDLM Network Configurations

JDLM can be distributed across a Local Area Network or Wide Area Network, as shown in the notional diagram above. JDLM runs on standard Pentium II (or higher) personal computers. Once the JDLM software is installed, the system can operate in a standalone or networked environment. A division (or below) exercise can typically be conducted using 8 to 10 workstations. A JTF exercise can typically be conducted using 15 to 20 workstations.

e. **Hardware Environmental Considerations**: No special requirements.

f. **Software/Operating System**: MS Windows 2000 Professional & Office 2000

g. **Simulation Current Version:** 2.4.18.03

h. **Source Code Languages**: Java.

i. **Licenses Required**: COTS licenses for Tapestry's Revue and Kernel are required.

j. **Interoperability**:
    1. **HLA Compliance**: Not currently scheduled or funded; anticipated in the future.
    2. **HLA Certification**: As above.

k. **Standards**:
    1. **Internal Network Protocols**: JDLM uses TCP/IP to connect workstations
    2. **Internal Network Type**: JDLM may be networked using routers and/or hubs.

18. VV&A

JDLM has been verified and validated by each using organization.

19. Future Plans

This simulation is to be integrated with Digital Battlestaff Sustainment Trainer, and Corp Battle Simulation. JDLM is expected to replace CSSTSS as the principal high-resolution Army logistics simulation in approximately 2006. (Hamsom, 2003, and NSC briefing, 2002)

20. Maintained By

The JDLM developer/vendor is Tapestry Solutions, 5675 Ruffin Road #305, San Diego, CA 92123. Phone (858) 503-1990; FAX: (858) 503-1999.

21. Next Version/Incorporated into other Applications

Effort is underway to link JDLM with CBS and DBST. Future efforts will link to JCATS and JFAST (Joint Flow and Analysis System for Transportation), a USTRANSCOM transportation model.

22. Expected Retirement Date

JDLM is a new and still developing capability. No plan for retirement exists.

23. Modifying Scenario Database

Databases are created and modified locally. A JDLM database is basically the same as a real world logistics database. Thus, JDLM has been designed to interface with real world systems and to accept real-world data in native formats. JDLM currently receives and correlates data from:

a. JOPES — B8 Formatted TPFDD files
b. TC-ACCIS & TC-AIMSII — Unit deployment Equipment Lists
c. MTMC WPS — Ships Manifest
d. Air Mobility Commands (AMC) GDSS — Workstations & Form 59
e. Ground based Vehicle Transporters — DTRACS, PANATRACS, DYNAFLEET & VIS-STAR
f. AMS & STARS — RF Tag burn records
g. Ground based RF TAG Interrogators — Detect records
h. SARSS — ABF Files & Supply Catalog

24. Modifying Simulation Functionality

7ATC is currently serving as *de facto* configuration manager for simulation functionality. Logistics simulation functional management is overseen by the National Simulation Center logistics element at Ft. Lee, Virginia. Contracting for modifications is also currently coordinated through 7ATC.

25. Functional Databases

a. **Time to Develop**
b. **Where Maintained**
c. **Reusable:** See below.
d. **What Databases are Available:** To minimize the costs associate with configuring or creating scenario-specific data structures, a repository system was developed to maximize data reuse. JDLM's repository infrastructure was designed to provide a way for users to easily store, retrieve and share data between scenarios and sites. For example, if a site in Germany builds a Balkan road network, another site could access that repository, over a wide area network, and download the data into their scenario. Actual procedures for this capability have not been established.
e. JDLM provides the configuration managers the ability to designate and establish data proponents for remote data repositories.

26. Representation Issues

a. **Resolution:** Representation of logistics matters is to the individual entity level (supply item or transport vehicle) if required. Aggregation to represent bulk shipments or formations is possible, consistent with base logistics terms of reference.
b. **Fidelity:** High for logistics.

3.H.1c The Joint Theater Level Simulation (JTLS)

1. Background

The Joint Theater Level Simulation (JTLS) system is an interactive, multi-sided wargaming system that models a joint and coalition force in a total air, land, and naval warfare environment. Focus is on conventional joint and combined operations at the Operational Level of War as defined by the Joint Staff's Universal Joint Task List. JTLS explicitly models air, land, sea, sub-surface, amphibious, and SOF operations. The model supports limited nuclear and chemical effects, low intensity conflict, and pre-conflict operations.

The JTLS system consists of six major programs and numerous smaller support programs that work together to prepare the scenario, run the game, and analyze the results. Designed as a tool for use in the development and analysis of operation plans, the simulation is theater-independent and does not require knowledge of programming. The JTLS system operates on a single computer or on multiple, networked computers, either at a single or at multiple distributed sites.

JTLS employs Lanchester attrition algorithms, detailed logistic modeling, and explicit air, ground, and naval force movement. In addition to the model itself, the JTLS system includes software designed to aid in scenario database preparation and verification; entering game orders; and obtaining scenario situational information from graphical map displays, messages, and status boards.

JTLS is a constructive simulation that represents operational-level air, ground, and naval combat, with logistical, Special Operation Force (SOF), and intelligence support. It is also used as a training support model for exercises that do not require the full Joint Training Confederation. JTLS is theater-independent and does not require a knowledge of programming. It is used and managed by U.S. Joint Forces Command, Joint Warfighting Center (JWFC). JTLS is HLA compliant and is often federated with JCATS. In such a federation, JTLS supports the theater-level view, and supports logistics and similar activities while JCATS is more operational in its perspective and focuses at a much lower level. This pairing addresses a long-standing need in DoD for multiple levels of resolution covering the same scenario.

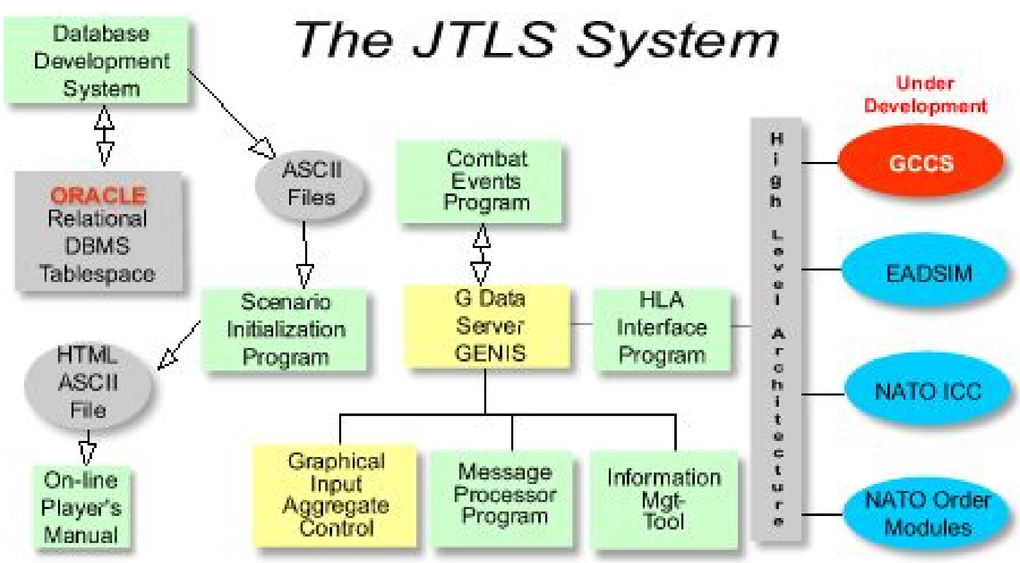
JTLS originated in an era when hex-based terrain was common, and JTLS still employs hex-based terrain. Hex-based terrain aggregates regional terrain and environmental characteristics: trafficability, elevation, and chemical or nuclear contamination. Roads currently map hexagons center-to-center; pipelines and railroads are mapped via independent node-to-node networks; and rivers and shorelines map to hex borders. Point targets modify trafficability by providing targetable enhancements to the baseline terrain conditions. For example, bridges, tunnels, and interdiction points can be explicitly represented and targeted. Destruction of the targets affects the underlying terrain representation. Likewise, pumping stations and rail yards can be explicitly represented and targeted. Their destruction affects the underlying capabilities of the associated pipeline and rail networks.

2. History

JTLS originated in the early 1980s as a project funded by the U.S. Readiness Command, U.S. Army Concepts Analysis Agency (CAA), and the U.S. Army War College. Originally, the Jet Propulsion Laboratory (JPL) was contracted to reengineer and update the Army's McClintock Theater Model (MTM) to meet additional requirements. Testing proved the value of modifications and JTLS was renamed in 1983. Continuous functional and system upgrades have occurred since then. In the late 1980s, JTLS was distributed to the services and unified commands as a component of the JCS-sponsored Modern Aids to Planning Program (MAPP). JTLS was originally hosted on PDP-11 series computers, and has evolved through a succession of hardware environments, including VMS, Sun SPARC, and now is migrating to the PC.

3. Where It Is Used

JTLS is in use at: JFCOM Joint Warfighting Center, USCENTCOM, USEUCOM, USSOCOM, USSOUTHCOM, USPACOM, AUCADRE, Naval Postgraduate School, Combined Forces Command Korea, NATO Consultation Command and Control Agency, and Australian Defense Force Warfare Centre.



Components of the JTLS

4. **How It Is Used**

JTLS is highly aggregated, but has been modified and adapted over its life to broaden its usability and improve its fidelity. It can be used to represent execution of an operations plan against a specific enemy force to establish timing of movements, estimate rates of logistic consumption and re-supply, and to explore a wide range of issues related to employment of forces. JTLS is able to represent deployments, and a typical Time Phased Force Deployment List (TPFDL) can be used as the basic BLUFOR database. The TPFDL force can be deployed from home stations, force packages can be assembled, and movement to the area of conflict can be represented. Firepower and the effects of standoff weapons ranging from artillery to cruise missiles can be employed, along with infantry and armor. Aircraft sorties can be flown individually, or aggregated to show the effects of a concentrated effort. A wide variety of forces and tactics have been added over the life of JTLS in response to user input, and JTLS remains somewhat unique among constructive military simulations for its overall flexibility and versatility.

5. **Sponsor: U.S. Joint Forces Command**

3.H.1d Joint Conflict and Tactical Simulation

1. **Type: Constructive**
2. **Acronym: JCATS**
3. **Purpose for which Developed**

During the late 1980s and early 1990s, Lawrence Livermore National Laboratory (LLNL) developed several simulations that had their historical roots in LLNL's work with Janus. (See section 3.D.1j). The first of these simulations, the Joint Conflict Model (JCM), was developed for the Joint Warfighter Center (JWFC). [Uzalac & Matone, March 1995]. The Joint Warfighting Center and the U.S. Marine Corps used JCM successfully in Operation Just Cause in Panama and Operation Desert Storm in the Persian Gulf. The U.S. Air Force Security Police Agency and the U. S. Army Europe (USAREUR), Berlin Brigade asked for improved capabilities to model the urban environment. This resulted in two simulations: Security Exercise Evaluation System (SEES) and Urban Combat Computer Assisted Training System (UCCATS). SEES and UCCATS were eventually merged in to a single simulation called the Joint Tactical Simulation (JTS).

After the fielding of JTS, the user community recommended that the functionality of JCM and JTS be combined. Under JWFC sponsorship, LLNL began the developed of JCATS based on recommendations from the user community. JCATS was initially fielded in October 1998 on both HP and Sun computers. The simulation version 2.0 was ported over to Linux and with the release of version 3.0 all the database editors were also ported to Linux.

LLNL has continued to upgrade JCATS. Currently the simulation can handle over 30,000 entities and operate on over 50 workstations. The simulation can have up to ten different sides and a terrain box of over 1000 km. LLNL dropped support for HP computers with JCATS version 3.0.

4. **Dates Developed/Implemented**
   a. 1997/Oct 1998/version 1.0
   b. 1998/Nov 1999/version 2.0
   c. 2000/July 2001/version 3.0
   d. 2001/Oct 2002/version 4.0
5. **Domain**

TEMO, RDA, ACR. Primary use of JCATS is for training, analysis, experimentation, and limited course of action analysis and mission rehearsal.

6. **Security Classification**

Normally used in an unclassified environment, however, commands such as USSOCOM have used JCATS in a classified environment.

7. **Security Caveats**

The Theater Aerospace Command and Control Simulation Facility, Kirtland AFB, test bed is at the Secret Level, and they have full intentions to take it above Top Secret, for training [Valverde, personnel communications, 10 January 2003]. USSOUTHCOM Deputy Directorate for Analysis and Simulation has used JCATS to support classified analysis [LTC Hume, personnel communications 13 January 2003].

8. **Applications**

Using Organizations based on a November 2002 JWFC an Executive overview brief of JCATS [https://www-secure.jwfc.jfcom.mil/protected/trainer.html] 90 Major JCATS Users at 135 plus sites as of June 2002.

a. 6 Unified Commands
b. 4 Service Branches
c. 4 Other DoD Organizations
   (OSD, DTRA, DMSO, DARPA)
d. 2 Non-DoD Organizations (USSS, DoE)
e. Major Uses:
   1. School House Training
   2. Training and Exercises
   3. Analyses
   4. Experimentation.

This JCATS image depicts the location of blue forces outside the Oak Knoll Hospital as well as inside one of its nine floors. (K stands for kill or destroyed target.)

f. USSOUTHCOM Deputy Directorate for Analysis and Simulation (SCJ5-DDAS) uses JCATS routinely to support a variety of missions that require lower level (Brigade and below) modeling of forces. Most applications support modeling of Military Operations Other Than War (MOOTW) actions like counter-terrorism, counter-drug, peacekeeping, and humanitarian assistance. The biggest exercises that JCATS supports are the annual Peacekeeping Operations Exercise (PKO North or PKO South) depend on location and countries included, and a bi-annual Humanitarian Assistance Exercise (FA HUM). These exercises bring together 10-12 partner nations with U.S. military, UN and civilian (NGO) organizations [LTC Hume, personnel communications 13 January 2003].

g. U.S. Army Communications Electronics Command (CECOM) has used JCATS in support of training and analysis associated with the Army's Common Ground Station (CGS) system and the Joint Surveillance Target Attack Radar System (Joint STARS) [Final Report: Joint SOF Requirements and Technology Analysis for Implementing the Joint Special Operations Forces Command and Control XXI Vision, p.54].
h. JCATS has been applied to force protection operations and convoys carrying Class III & V supplies at various Battle Simulation Centers (BSC). The Army has also integrated JCATS into the Digital Battle Staff Trainer (DBST) federation for use at the BSC.
i. The Field Artillery School uses JCATS as the ground combat model in its Digital Training Facility. The training facility supports training events for the Warrant Officer Basic and Advanced Courses, the Field Artillery Battalions and Brigades of 3rd Armored Corps Artillery. It is also used to conduct Concept Evaluation and Experimentation under the direction of the Depth & Simultaneous Attack Battle Lab [Waters, personnel communications 10 January 2003]. Other Battles Labs use the simulation for analysis falling in the army transformation realm of Future Force Warrior and Future Combat System [LTC McGuire personnel communications, 9 January 2003]. JCATS has also been used to support NATO's Partnership for Peace exercises by U.S. Army Europe.
j. JCATS has been federated with the Joint Theater Level Simulation (JTLS) through a DMSO funded project. As part of Millennium Challenge 2002 (MC02), JCATS provided the simulation of USMC and SOF Forces. It was also used to support Army and OPFOR ground operations in the DBST federation. The simulation also stimulated the MC02 Joint Common Operational Picture via the JCATS Bridge/GEM-to-GCCS link [Millennium Challenge 2002, Joint Common Operational Picture (COP) Quicklook Report, 20 September 2002, p.7].
k. The Theater Aerospace Command and Control Simulation Facility uses JCATS as the ground environment generator to provide the JSTARS with a ground picture for crew training. They generate a Theater-size war with approximately two-to-four Corps size elements fighting another two-to-four Corps element. Their scenarios are fixed at 6,000 entities; however, they will be stepping up to 12,000 entities when they get a dual 3.1 gigahertz processor system, with 4 gigabytes of RAM and two 36 gigabytes SCSI drives. They disaggregate aggregates down to platoon level to obtain better fidelity for their systems traveling through bends in the road. JCATS is also used in an exercise called Desert Pivot [Valverde, personnel communications, 1/10/2003].
l. The MAGTF Staff Training Program has used JCATS in support of the USMC Urban Warrior advanced warfighting experiment (AWE). The Urban Warrior AWE took place at military installations in Monterey, California and at the abandoned Oak Knoll Naval Hospital in Oakland, CA. These sites were chosen to provide a realistic environment for testing of tactics and technologies in an urban environment [LTGEN Rhoads, 20 October 1999]. In

the Urban Warrior AWE; JCATS was used to augment the experiment by providing the effects of indirect fire. Marines in the Oak Knoll facility equipped with MILES (Multiple Integrated Laser Engagement System) integrated with GPS repeaters communicated with JCATS via a system known as the Multi-C4I System IMMACCS Translator (MCSIT), developed to allow the interaction between live participants and constructive entities in JCATS [MAJ Kelly, 28-30 January 2000].

m. The Human Systems Wing, Air Force Material Command, USAF used JCATS for non-lethal weapon warfighting utility studies. They are studying the airborne capabilities of JCATS to support airborne Non-lethal Warfare (NLW). They have also included beam weapon capability in JCATS to model directed energy NLW. They also added “lasso” capability to increase the number of crowd members one terminal could control manually. They worked to incorporate detailed breakouts of crowd reactions, i.e., allowing a male entity to respond different from a female entity for a non-lethal engagement. [Final Report: Joint SOF Requirements and Technology Analysis for Implementing the Joint Special Operations Forces Command and Control XXI Vision, p.55]

n. Outside of the Department of Defense, JCATS has been used by the Department of Energy to assist in evaluating the security of such facilities as the Savannah River Nuclear Weapons facility and LLNL. The United States Secret Service has used JCATS in their training exercises and evaluation of security at highly sensitive locations.

9. Major functionalities by BOS

a. **Maneuver: Yes**

b. **Fire Support: Yes**

c. **Air Defense: Yes**

d. **Survivability: Yes**

e. **Intelligence: Yes**

f. **Logistics:**

1. Transportation:
2. Supply/Re-supply:
3. Personnel:
4. Medical:
5. Maintenance:

g. **Command and Control (C2)**

10. Other Functionalities

JCATS is fielded with a sample database that allows a database manager to support joint operations. JCATS 4.0 sample database was developed on the database used for Millennium Challenge '02. Note: Databases must be certified to meet user requirements using acceptable data and testing of the data in JCATS.

11. Terrain Management System

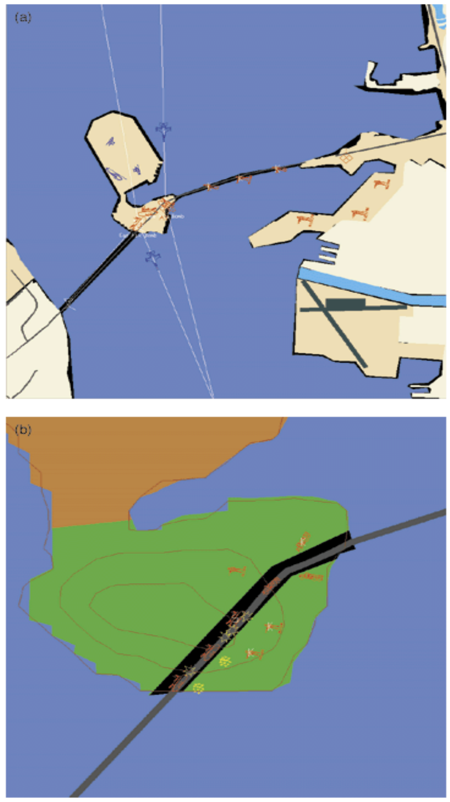
A JCATS terrain file is made up of various layers. The base layer is the map coordinate. The coordinates define the lower left corner of the playbox. Elevation is determined by the use of elevation posting. The following algorithms determine elevation between posts: right or left diagonal for GCS file, or bi-linear curve fit for all others. NIMA

DTED postings are defined as follows. For a one-degree by one-degree cell (60 square nautical miles at the equator):

Digital Terrain Elevation Data (DTED			
DTED	Spacing	Data Points	Megabytes
Level 1	~100m post	1,442,401	5
Level 2	~30m post	12,967,201	54
Level 3	~10m post	144,024,001	583
Level 4	~3m post	1,296,072,001	6,297
Level 5	~1m post	11,660,000,000	68,001

NIMA DTED posting

Terrain with a high number of posts can result in a higher computational time for the computer; this can slow the simulation during a game. JCATS allows for defining sub-regions with different resolutions. These regions are called Maps, and they allow the user to build multi-resolution terrain combining both low resolution (i.e., lower number of posts) for areas of lesser interest and high resolution (i.e., higher number of posts) for areas of higher interest. Overlaid on the elevation data, JCATS places various polygonal and linear shapes. These shapes define features (e.g., buildings, roads, and lakes). The elevation of the terrain affects the feature, causing it to be located on a slope, in a valley or on a mountain. These features create boundaries for the various terrain objects used in a file. Each feature has a specific set of attributes and a priority. This attribute set defines the feature's color, density, and ability to provide cover, trafficability and many other aspects. Attributes determine how an entity interacts with the feature during the simulation run [Terrain Editor User's Guide 4.0.0, 1 October 2002. p. 3-2]. Terrain features are assigned a priority, with background being the lowest and a Portal (entrance to a subterranean feature) having the highest. Those with higher priorities are displayed on top of those with lower priorities.



JCATS also simulated combat on Treasure Island in San Francisco Bay and on the San Francisco–Oakland Bay Bridge. (a) Red forces heading toward Oakland were attacked by blue virtual aircraft and Navy ships. (b) Detail of Treasure Island combat. The yellow sunbursts and star shapes depict the effects from naval gunfire and air strikes, respectively. (K stands for kill or destroyed target; S stands for suppressed.)

Current Terrain Products:

JCATS 4.0 can import the following types of terrain files:

a. NIMA DTED (Levels 0 through 2).
b. JCATS terrain files.
c. AutoCAD DXF files.
d. Grid ASCII files.
e. CTDB (Compact Terrain Database) files.
f. Shape files.

12. Other Environment Representation

JCATS uses a sample weather data set that was derived from the Atmospheric Attenuation data found in AMSAA publication SP 97. Weather conditions are set at the beginning of an exercise and can be modified by darting a new parameter file. JCATS uses the following input data for weather (see the following two tables.) [VISTA (SCENARIO) EDITOR USER'S GUIDE VERSION 4.0.0, 1 October 2002].

Meteorological	
Wind Direction	Compass heading where wind is coming from North = 0 East = 90 South = 180 West = 270
Wind Velocity	Wind speed (km/hr). Wind velocity has an effect on which chemical biological munitions effects files are used during the game. Chemical biological munitions effects must be matched to the wind velocity specified here.
Temperature	Ambient temperature (degrees Celsius). Increasing this parameter tends to increase the chemical cloud mass for a given agent
Temperature Gradient	Temperature variation based on altitude (degrees Celsius per 100 meters).
Relative Humidity	Percentage of actual vapor pressure to saturation vapor pressure. Increasing this parameter tends to increase the effectiveness of HC and WP clouds for a given agent mass.
Cloud Cover Height	Height (meters) of clouds above sea level. This parameter affects guided munitions. If the clearance between a target and the cloud cover is less than the minimum cloud clearance, the munitions will not be chosen.
AMSAA Acquire	
Extinction Coefficients	Effects of the atmosphere under a given weather condition. In this context, extinction, or atmospheric attenuation, means the combined effect of energy absorption and scattering along a shooter's line-of-sight.
Direct View Optics	Atmospheric attenuation value for DVO sensors. JCATS default is based on AMSAA data for a clear summer day with a 16 km visibility range.
1st Gen I2	Atmospheric attenuation value for DVO sensors. JCATS default is based on AMSAA data for a clear summer day (Europe) with a 16 km visibility range.
2nd Gen I2	Atmospheric attenuation value for DVO sensors. JCATS default is based on AMSAA data for a clear summer day (Europe) with a 16 km visibility range.
Thermal	Atmospheric attenuation value for DVO sensors. JCATS default is based on AMSAA data for a clear summer day (Europe) with a 14 km visibility range and a target range of 3km.
Graph	Graphs Contrast vs. Range of extinction coefficient values.

Sky Over Ground Ratio	Defines the brightness ratio of the sky compared to the ground. A sky/ground brightness ratio of 3 corresponds to a bright, cloudless day. The higher the ratio, the more difficult it is to acquire targets.
AMSAA Calculator	Utility to compute a known visibility range to a Sky Over Ground Ratio. The computed value is entered in the **Sky Over Ground Ratio** field.

Weather Conditions Input Data

Weather Degradation - % Normal Speed	A systems percentage of actual speed in various weather conditions and environments. Enter a value of 0% to 100%.

Weather Effects Input Data

13. Human Behavior

The JCATS Behavior Model is capable of representing human behavior contingent on a specific condition, or set of conditions represented in the model. "Commandable" Entity (CE) behavior is "task" dependent as specified by the operator, and is capable of being turned on/off by the operator. Each (selected) JCATS system may have a programmable behavior model that provides for semi-automated responses to events. The behavior task(s) of each system is assignable in the simulation during the planning phase or during the game" (Release Notes, October 2002).

14. Simulation Strengths

JCATS greatest strength is its ability to represent the urban environment accurately at the individual building level, with unique floor plans. JCATS provides the user with the capability of representing all Services, and up to 10 different sides. JCATS has the ability to add additional forces during the simulation run. Global parameters that are set in the parameter file can also be updated during the simulation run. JCATS has two After Action Review capabilities. The first is a standard replay of the simulation. The replay can be shown at one or all clients. The second AAR capability is the Analysis Workstation (AWS). AWS has the capability of reviewing acquisition, shots, movement, and obstacles, at anytime during the simulation run.

15. Simulation Limitations

JCATS has limited capability for analysis as it was originally developed as a training simulation. Nevertheless it has been used by several organizations with external tools in this role. In terms of representing movement, the simulation is limited to three speeds and three different altitudes for aircraft, and three depths for submarines. The simulation does not automatically change from day to night as this is executed by darting in an updated parameter file. Weather conditions are currently a global parameter. This impacts on a scenario that is using a large terrain file, for example 1200 X 1200KM. Weather conditions can be changed also by darting in an updated parameter file.

16. Technical Specifications

a. **Clock Speed** (minimum acceptable CPU speed): The simulation can run from .5:1 to as fast as the CPU can run. The simulation can also be run in a batch mode.

b. **Update Rates** (minimum update interval for time stepped simulations): The type of computer that hosts JCATS impacts the update rate and overall performance. Within the simulation, the size of the terrain and number of postings can also degrade simulation performance. Additionally there are several on/off switches that impact the simulation performance. For example, a database manager can turn on a switch to track missed shots for a ZU23-4 anti-aircraft gun firing several thousand round per minutes – every round's trajectory will be computed.

c. Operating Environment: Unix

d. Hardware: High end PC or laptop

e. Hardware Environmental Considerations: As with any computer network the JCATS should be run in an environment that keeps dust and other objects away from the computers.

f. Software/Operating System: Linux/Sun

g. Simulation Current Version: 4.0 released October 2002

h. Licenses Required: Organizations requesting use of JCATS are required to sign a Memorandum of Agreement with JWFC. Copies can be obtained through the JCATS PM, JWFC.

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Capabilities Support Branch (JW500)
Simulation & C4 Group
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i. Interoperability:

1. HLA Compliance: Yes
2. HLA Certification: Yes

j. Standards: The JCATS data fields use accepted standards such as kilometers per hour for ground speed, knots for naval and aircraft, NIMA's DTED for terrain elevation and Army Materiel Systems Analysis Activity (AMSAA) format for Probability of Hit / Probability of Kill (PH/PK) tables. [VISTA (SCENARIO) EDITOR USER'S GUIDE VERSION 4.0.0, 1 October 2002]

1. Internal Network Protocols: JCATS uses the TCP/IP broadcast protocol to update simulation entities during a simulation run System Administrator Guide, Red Hat Linux 7.3 JCATS version 4.0. Lawrence Livermore National Laboratory, 01 October 2002, p. 9-1]
2. Internal Network Type: The JCATS client workstations use the internal Red Hat Linux operating system feature *Network File System* (NFS). NFS uses a client-server paradigm where the server (JCATS data server workstation) exports a file system to "clients" (display workstations) via Ethernet. The /opt/public and /home partitions are required to be exported via NFS on the JCATS server workstation" [System Administrator's

Guide Red Hat Linux Version 7.3 JCATS Version 4.0.0. 1 October 2002. p. 3-8]

17. VV&A

In 1997, the USAF conducted a study that verified and validated the JTS direct fire algorithm. The U. S. Army's Dismounted Battlespace Battle Laboratory sponsored a study that assessed the ability of JCATS to simulate the capabilities of non-lethal weapons (NLW) and to provide a product that can be incorporated into the full VV&A of JCATS [U.S. Army Dismounted Battlespace Battle Laboratory, 2001, September]. This work investigated the first 32 algorithms on the JNLWD V&V Priority List. It evaluated JCATS algorithms in two ways:

a. Verification of computer code against algorithm documentation,
b. Appropriateness of algorithms within context of U.S. Army current model standards.

18. Future Plans

The next major release for JCATS is planned for November 2003. JCATS continues to evolve to meet user requirements and will be supported by USJFCOM JWFC's prepotency through 2007 and beyond.

19. Maintained By

DoD Proponent:
Chief, M&S Development Branch
USJFOCM – Joint Warfighting Center
116 Laekview Parkway
Suffolk, VA 23423-2697

Model Developer:
Conflict Simulation Laboratory ATTN: JCATS Project Leader
Lawrence Livermore National Laboratory L-184
PO Box 808
Livermore, California 94551

20. Next Version/Incorporated into other Applications

JCATS version 5.0 release date planned for November 2003. Enhancements will include new GCS terrain and other MC02 (ver3.1) features.

21. Expected Retirement Date

JCATS is expected to remain supported by USJCOM currently through 2007. With additional requirements and new uses, JCATS does not have an expected retirement date.

22. Modifying Scenario Database

Database managers can modify existing databases using the editors (simulation, terrain, behavior, and symbol). Each editor has a supporting user manual that provides details on how to modify each field and the types of data required.

23. Modifying Simulation Functionality

24. Functional Databases

a. **Time to Develop:** JCATS comes with a sample database that can be modified to meet user's requirements. The time to develop a database can be as short as a couple of hours, or up to several weeks, based on the requirements. If an existing database is used and modifications are made only to the force structure, then the time required is very short; however, if a new terrain file and force characteristic file are required, then the time needed to adequately develop and test the files can be several weeks.

b. **Where Maintained:** All databases are maintained on-site and on the JCATS server. Files can be saved as a master file or as a working file. A master file is one that in the operating system is owned by the user JDATA. Working files are established and used by JCATS users for a given scenario.

c. **Reusable:** Yes

d. **What Databases are Available:** Scenario files are available from users' list. A current list of POCs can be obtained upon request from the JWFC JCATS Program Manager Office that was listed above. Available databases include those for Corps-size scenarios down to small units (squads and teams).

e. **How Can Databases be Modified:**

25. Input/Output Formats

a. **Input:** All JCATS Input files are stored as either a binary or a flat ASCII file and are read into the server via the SimExec.

b. **Output**: Output files for reports or AWS are saved as ASCII files. An explanation of the event file is available in Appendix E of the simulation manual. The replay (.jdu) file is saved in a binary format.

26. Representation Issues

a. **Resolution:** JCATS displays forces at the entity level and on terrain using NIMA DTED level 2. Terrain data structures can be modified to further improve resolution.

b. **Fidelity:** There are no major fidelity issues.

3.H.1e Joint Warfare Simulation

1. **Type: Constructive**
2. **Acronym: JWARS**

3. **Background**

The Joint Warfare System (JWARS) is a next generation campaign-level model of military operations. Intended for use as a high level analytical tool, JWARS is a state-of-the-art computer simulation of Joint, theater/campaign level warfare. It is designed to represent more battle factors, and to trace their effects at lower (more specific) levels than existing analytical simulations, and to encompass the environments and capabilities of Joint forces rather than those of a single service or operating environment.

JWARS stems from a 1995 Department of Defense (DoD) initiative to build a modern, fully integrated, analytic model of joint warfare. The model is designed to represent uniquely joint functions and processes and component warfare operations. It is based on Joint doctrine and will be capable of representing future warfare. It will aid in force structure analysis, acquisition studies, and combatant commander course of action analysis. It includes functionality to represent the operating conditions and effects of land, sea, air, and electronic forces interacting over extended timeframes.

JWARS' principal significance to Army M&S is that it will soon begin to replace TACWAR, the main Army analytical software, in the Joint environment. The increased versatility and functionality of JWARS will also offer an environment for analysis of problems that are ill suited to the structure and assumptions of the TACWAR system, which has its technical origins in the 1970s.

4. **History**

Over a period of at least two decades, the services have performed operational and resource analysis on the basis of specific simulation systems optimized for their respective operating environments. The Joint Staff and the Office of the Secretary of Defense, in weighing competing programs and recommending strategic options, has had to compare the results of dissimilar models, with different strengths, none of which was optimized for the Joint environment.

Prior to the development of JWARS, a wide variety of analytical simulations were in use to meet a wide range of analytical needs. The chart below shows these, as well as the environment (land, sea, air) that they simulated. The chart shows that none of these simulations was fully capable of performing analysis on all three environments, and none is completely Joint. Additionally, there are shortcomings in functionality among these legacy systems that preclude analysis of the effects on many newer concepts. For example, most of these systems, designed during the Cold War, are two-sided and are of limited utility in the multi-polar world that has emerged since the fall of the Soviet Union. They typically emphasize attrition as a principal measure of effectiveness, rendering them of little use in evaluating non-combat operations. Few of these systems are capable of fully reflecting the effects of the concepts, such as Dominant Maneuver or Information Dominance, which are set forth in current doctrinal guidance such as Joint Vision 2020.

Model Name	Vintage	Users	Sample Applications	Land	Air	Maritime
TACWAR	1960s	CINCs Joint Staff, OSD PA&E	Army Analyses, Base Force*, BUR, MRS BURU, Nimble Dancer (ND), Desert Storm, MRS-05	√	√	
THUNDER	1980s	USAF	USAF Analyses, ND, JAST	√	√	
CEM	1960s	US Army	Army Analyses, TAA	√	√	
GCAM (ITEM)	1990s	US Navy	Navy Analyses, ND, Investment Balance	√	√	√

Note: size of the check denotes emphasis

*The abbreviations used in the table are:

Base Force – JCS Study 1989-92, to determine correct size and makeup of US military forces in the absence of the Red Army, and without inevitability of WWIII.

BUR – Bottom Up Review - A study of major defense program options designed to optimize the future structure of DoD and the services, circa 1993.

JAST – Joint Advanced Strike Technology study, leading to Joint Strike Fighter

MRS BURU – Mobility Requirements Study Bottom Up Review Update, 1995

MRS-05 – Mobility Requirements Study, FY05.

NIMBLE DANCER (ND) – A 1996 simulation-based assessment of US Forces ability to fight and win two simultaneous Major Regional Conflicts (MRC).

TAA – Trade Agreements Act; analyzed effects of acquiring military technology from foreign sources. [Bates, 2003]

The dissimilarities among legacy analytical simulations, and the inability to share databases or to address military operational issues that have emerged since the end of the Cold War, were impetus for high-level studies to resolve these issues. In May of 1995, the DepSecDef approved the Joint Analytic Model Improvement Plan (JAMIP), and directed the Director, Program Analysis and evaluation (DPA&E) in cooperation with the Joint Staff to set up and staff the Joint Warfare System (JWARS) office, and develop a funding plan. In June 1996, DepSecDef designated the Office of the Secretary of Defense (OSD) ODPA&E (Joint Data Support) as primary data support agency for JAMIP.

5. **Date/Developed/Implemented (By Version, if Available):**

JWARS is still in development but has been released in beta versions to selected users. Prototype development began in 1995 and continued through mid-1997. Model development began in mid-1997 and continued through Release 1.4, in May, 2002. Work began on Release 1.5 in May 2002, with beta testing from July through December 2002. Release 1.5 was scheduled for delivery in July 2003.

6. **Domain: ACR**

7. **Security Classification: Unclassified**

8. **Applications:**
   a. Force assessment
   b. Planning and execution
      1. Deliberate planning
      2. Crisis action planning
   c. System effectiveness and trade off analysis
   d. Concept and doctrine development and assessment

9. **Functionality:**

The charts below describe selected JWARS functionality. Chart 1 illustrates the scope of military issues that will be encompassed within JWARS. This represents a large increase in the functionality of a single analytical simulation system over legacy systems. Chart 2 shows that JWARS will be able to analyze not only theater strategic plan, but the logistics that support it. (Source of both: Bates, Logistics Modeling in JWARS)

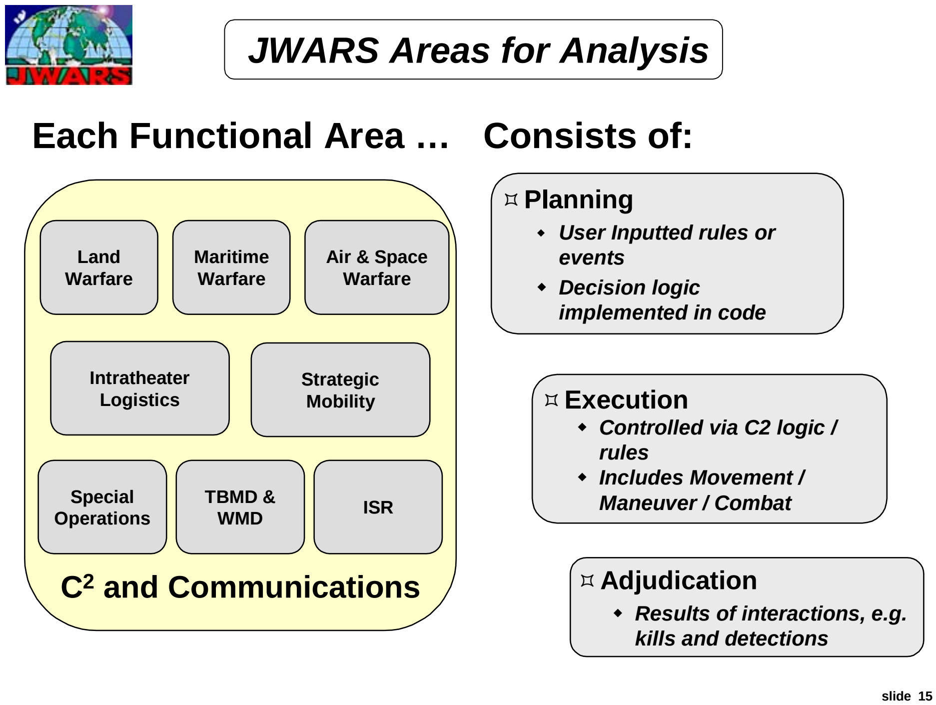

Chart 1

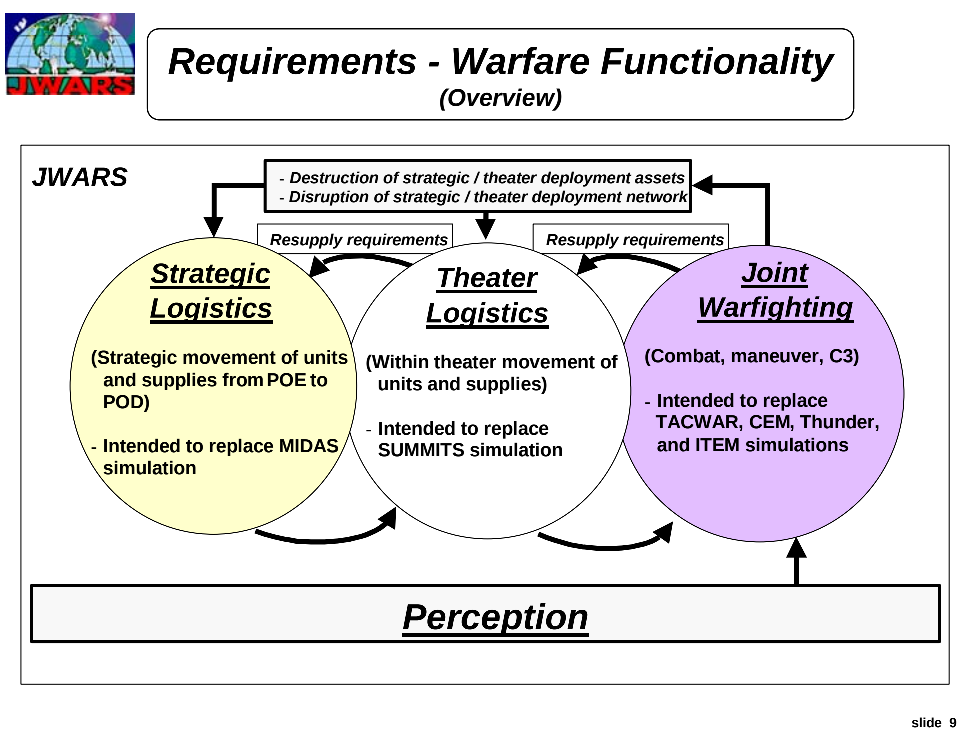

Chart 2

10. Who will use it?

Initially, JWARS users are expected to be principally in the OSD and JCS analytical communities, but Combatant Commanders will also employ the system for integrated planning and the development of alternative strategic concepts and courses of action. Defense agencies such as DISA, MDA, NRO, and others will use JWARS to perform mission analyses and trade-off studies. The increase in functionality of JWARS over the legacy systems suggests that in many applications, JWARS may replace legacy analytical systems in use by the services.

11. Future Plans: Future versions of JWARS will include the following capabilities:

C3	
	Restore Destroyed C2
	Coalition Warfare
	Electronic Attack
ISR	
	Combat Identification
Land	
	Rear Area Security
	Mobility/Countermobility
Maritime	
	Countermine
	Demonstration
Air	
	Time Critical Targeting
	Integrated Air Defense
	Air-to-Subsurface
	Mine Warfare (Air Dep'd Mines)
	Air Refueling

Space	
	Counter Space
	Information Warfare
TBMD	
	Integrated TBMD C2
WMD	
	Nuclear & Biological Warfare
Intertheater Logistics	
	Logistics C2
	Noncombatant Evacuation
Theater Logistics	
	Rail, Air, Pipeline Transportation
	Operational Service Support
	Host Nation Support
Special Operations	
Environmental Effects	
	Space

12. Maintained: JWARS Program Office , (https://www.jointmodels.army.mil/jwars/)

13. Output: **"**JWARS analysis products consist of *reports* addressing *essential elements of analysis (EEAs)*, quantified by *measures* that are calculated from *data elements* captured by *instruments* during the simulation." (Blacksen, Jones, Poumade, Osborne, and Stone, pg 708)

"Another class of outputs consists of information generated and displayed to the user's workstation during a replication." (Blacksen, Jones, Poumade, Osborne, and Stone, pg 708)

These outputs include messages, message categories, message log, reports, measures, and active map.

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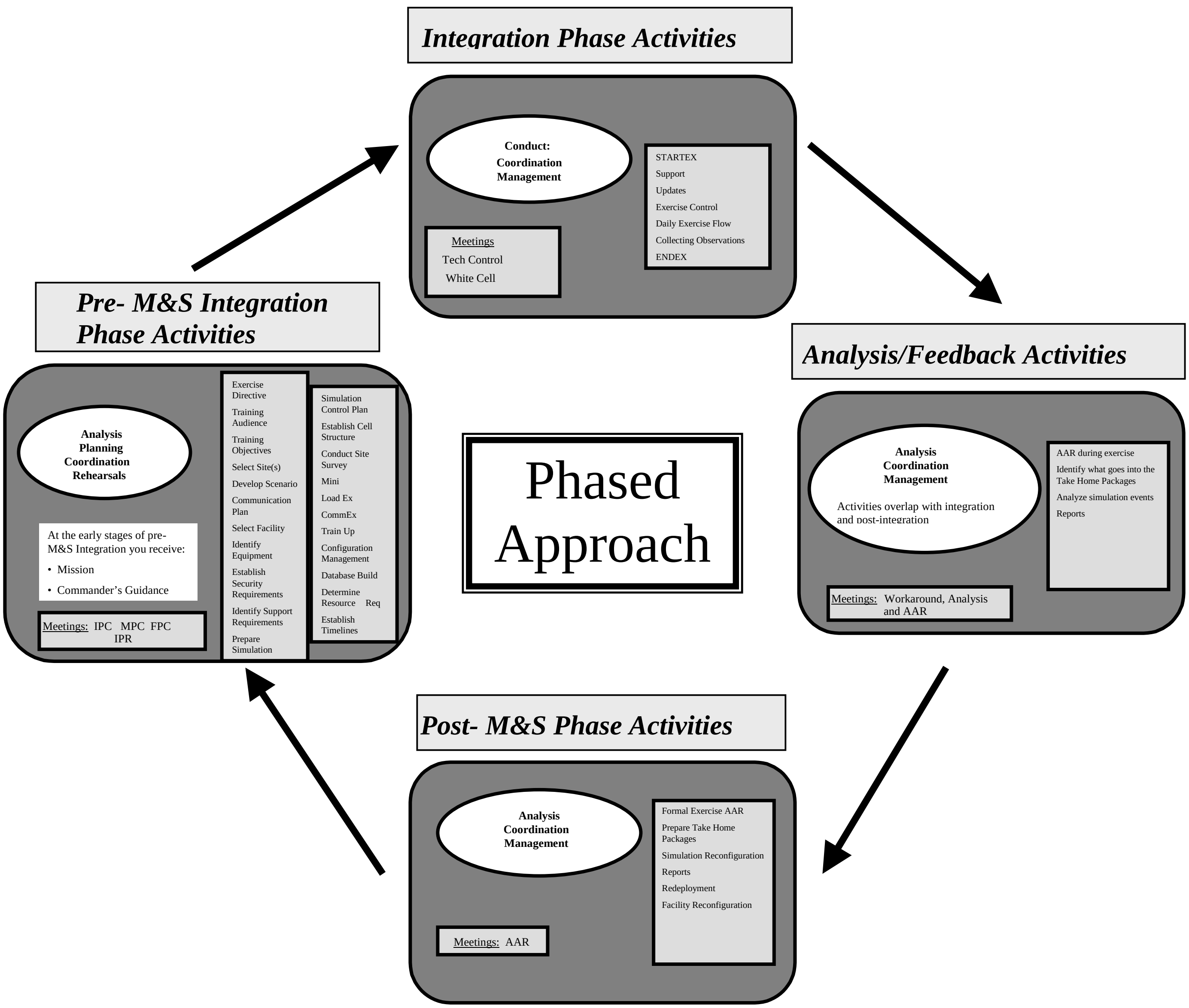
Chapter 4 M&S Integration

4.A.1 Developing the Training Environment

This chapter of the SOH focuses on the process of integrating simulations into exercises. The integration process described is complex and dynamic, requiring the integrator to analyze, plan, coordinate, manage, execute and evaluate many exercise events/activities. These activities can be categorized into four major areas: 1) Pre-M&S Integration activities, 2) Integration within military exercises, 3) Analysis/Feedback activities, and 4) Post-M&S Integration activities. The figure below captures the major functions and activities for each category of the integration process and provides context for how the specific event or activity fits into the overall M&S integration process.



The sections in this chapter address the first three phases of the process and are arranged chronologically in the sequence that the planner would follow when planning a simulation supported exercise. Each contains a worksheet that provides the user with a ready reference for the specific topic.

A brief summary of the topics presented follows:

Pre-M&S Integration Phase

Section 4.A.1a Time Resource Constraints. As a simulation-supported exercise planner, time will be your worst enemy. There will never be enough of it. Critical to your planning sequence is the laying out of all activities that will take place, showing how much time each will take, and resolving shortfalls.

Sections 4.A.2a Identify the Training Audience. A critical step in the planning process is determining who will be trained.

Sections 4.A.2b Identify the Training Objectives. After determining the training audience, a key step is to determine the unit commanders' training objectives—a critical step as all subsequent planning revolves around ensuring that the training objectives for the exercise are met.

Section 4.A.3a Design the Simulation Architecture (Single vs. Multiple Site Exercise). Once the planning is well under way, design of the simulation architecture can commence. This step of the process is made more challenging if more than one site is to be used during the exercise. This section, and its accompanying worksheet, takes the planner through the process of determining the architecture and support requirements for single vs. multiple exercise sites.

Section 4.A.3b Communication. Critical to the success of any simulation exercise is the ability of the communications network to function properly. This section will assist the planner in developing a communications plan that addresses the key elements to ensure success.

Section 4.A.3c Security. Nothing will bring your exercise to a halt faster than security issues. Addressed here are the areas of information systems security, physical security, and internal and external security. The worksheet provided will assist the exercise planner in ensuring security considerations are met.

Section 4.B.1a Design of a Simulation Event. This section provides a brief overview of the first three steps of the process shown in the figure above. It provides information on the planning meetings and activities during the exercise.

Section 4.B.1b Facility Survey. A key event in the planning process is the site facility or site survey. Exercise planners visit the exercise site to determine its capabilities vs. the exercise requirements. Shortfalls are identified and addressed. A detailed checklist is provided to assist the planners as they conduct the facility survey to ensure important topics are addressed.

Section 4.B.2a Exercise Timeline. Additional information on the planning sequence to prepare for the exercise. A detailed worksheet is provided for the planner to follow to ensure that all major topics are addressed in the planning process.

Section 4.B.2b Technical Timeline. Planning for and conducting a simulation-supported exercise requires technical expertise. Addressed here are the topics of database building, exercise distribution, interoperability between participating simulations, stimulation of real world C4I systems, and the physical setup of the equipment.

Section 4.B.2c Support Timeline. Simulation-supported exercises require support from a variety of activities. This section provides information and a detailed checklist to assist the planner in coordinating this support.

Section 4.B.2d Scenario Development. Once the training objectives have been established, the scenario development team goes to work to construct an exercise scenario that meets all of the training objectives.

Section 4.B.2e Documentation—Simulation Control Plan. When all the topics above have been addressed, the exercise planner can write the Simulation Control Plan (SCP). The SCP defines and synchronizes the control and support structures and related activities for the conduct of an exercise.

Section 4.B.2f Resource Constraints. Those areas requiring resources, such as time, personnel, money, communications, and facilities, must be identified early in the planning process. The goal of this part of the process is to identify resources required vs. resources. Identify the shortfalls, if any.

Section 4.B.2g Exercise Support. Additional support planning information is required, to include information on social events, contracting support, arrival and departure times of personnel, parking, equipment transportation, exercise site furniture and fixtures, personnel contact information, billeting, transportation to and from the exercise site, and support teams.

Section 4.B.2h Pre-Exercise Training. In order to achieve maximum benefit from the exercise, training unit, control, and response cell personnel need to undergo pre-exercise training to become familiar with the equipment, the scenario, appropriate responses to system failure, information that can be shared, and other important topics. This paper and worksheet will assist the planner in ensuring key training areas are covered prior to the exercise.

Integration Phase

Section 4.B.3a Cell Functions. The exercise planner must be familiar with the roles and responsibilities of the various control and response cells.

Section 4.B.3b Exercise Flow. The continuity of the exercise depends on creating and delivering a logical and coherent scenario to the training unit. This section addresses the issues related to controlling the flow of the scenario to the training unit to avoid the appearance of artificialities related to the exercise environment.

Analysis/Feedback Phase

Section 4.C.1a Collect Observations. Lessons learned from the exercise assist the training unit in planning future training and also assist the control and response cells in learning how to better conduct future exercises. A collection plan must be developed to ensure that information and data from the exercise is collected in a logical and thorough manner so that it supports the conduct of the After Action Review (AAR).

Section 4.C.1b After Action Review (AAR). The AAR enables the training unit to discover for themselves what happened during the exercise, why it happened, how to sustain strengths, and identifies areas needing improvement. This section discusses both formal and informal AARs and provides a process for planning and conducting an AAR.

4.A.1a Time Resource Constraints

Time is the most important asset and the worst enemy in preparing for a simulation-supported training event. Every moment is needed and there will never be enough of them. The key to successful time resource management is just that—management. A carefully thought out plan of all that is needed to accomplish will pay big dividends.

Consider the key activities involved in planning for an event such as this and divide them into the four phases describe above:

1. **Pre-M&S Integration Phase**

The Pre-M&S Integration Phase is the point at which planning and determining the training event's overall purpose and parameters occurs. Pre-M&S Integration planning is the basis for all future coordination in support of the application, and identifies facility and equipment requirements to support an exercise. Management of the activities for all organizations involved with the M&S integration effort is critical to the success of an exercise.

The end result of Pre-M&S Integration events, such as planning conferences and a site survey, is a written Memorandum of Agreement (MOA) between the training unit and the training facilitator, detailing the objectives, requirements, roles, and responsibilities for each organization involved with the SIMEX. It should include information addressing:

a. The exercise organization
b. Elimination of potential distracters
c. A review of the unit's mission essential task list (METL) and its specific training objectives
d. Milestones, with firm dates and responsible organization(s)
e. Simulation(s) capabilities
f. Personnel augmentation requirements
g. Exercise location(s)
h. Unresolved issues and suspenses for resolution

2. **Initial Meeting**

Early in the process an Initial Meeting must take place between representatives from the training unit and the SIMEX facilitator. At this meeting, participants agree on their responsibilities. Normally, the unit to be trained is responsible for plans, staffing, funding, and equipment. The SIMEX facilitator, in general, is responsible for the scenario, funding, control, facility, and the database. These may change with each situation.

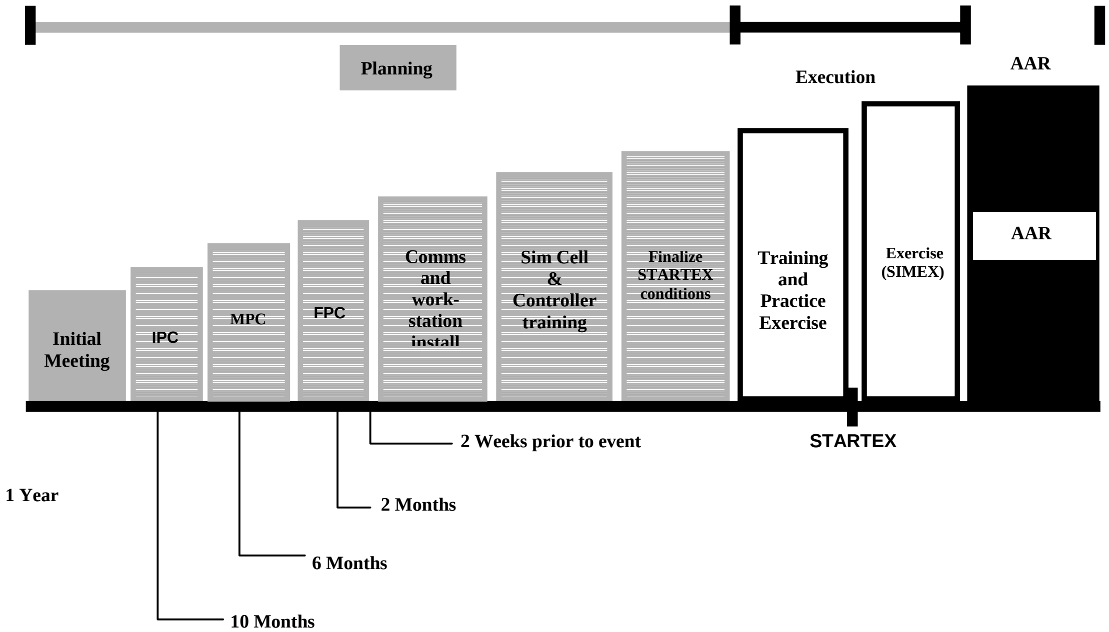
Plan on several other meetings that could occur after the initial meeting, such as other planning meetings, site surveys, and syndicate meetings.

3. **Planning Conferences**

In general, plan on at least three major planning conferences:

a. Initial Planning Conference (IPC)
b. Mid or Main Planning Conference (MPC)
c. Final Planning Conference (FPC)

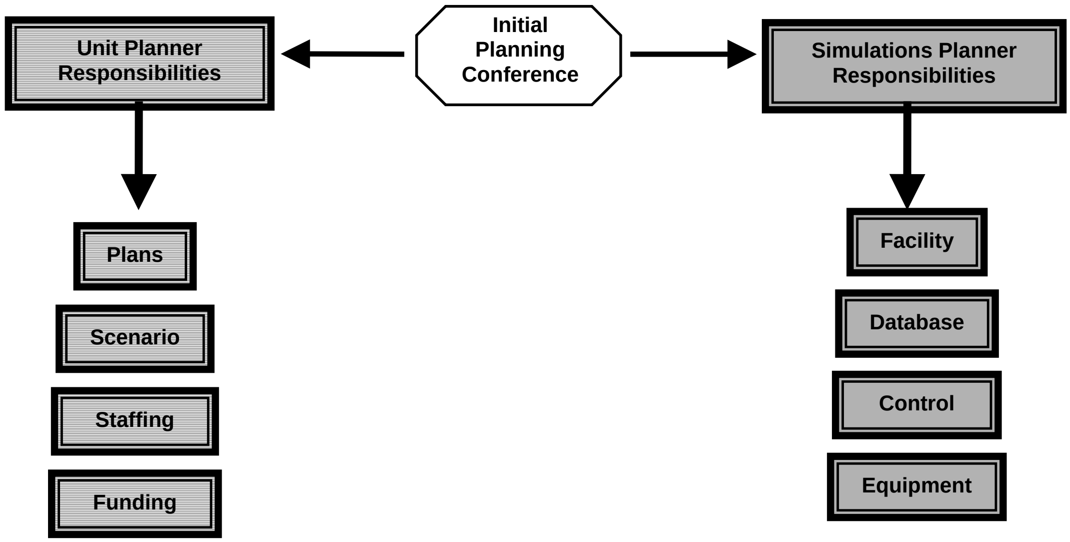
All of these are used to coordinate exercise activities and control plans. The example timeline below depicts a sample planning sequence for a division-size SIMEX.



4. IPC

a. The IPC generally takes place 10-12 months before the training event. This may vary depending on each individual situation. Goals of the IPC may include:
   1. Defining exercise organization
   2. Training objective review
   3. Training audience review
   4. Defining exercise organization
   5. Training objectives review
   6. Training audience review
   7. Agreement on facilities and Simulation(s) review
   8. Establish committees
   9. Set milestones
   10. Open issues
   11. POCs

b. At the IPC, responsibilities discussed in the Initial Meeting are finalized. The IPC should produce the following products:
   1. Committees
   2. Timelines
   3. Responsibilities
   4. Agreements
   5. Open issues



5. MPC

The MPC takes place approximately four months after the IPC. Again, this may change depending on each situation. More than one MPC may be required. Major responsibilities remain the same as shown on the IPC chart above.

Goals and activities of the MPC may include:

a. Managers' updates
b. Committee meetings
c. Committee reports
d. Master Scenario Events List (MSEL) conference
e. Timeline update
f. Review of all issues
g. Identify closed issues
h. Red-flag issues (show-stoppers!)

6. FPC

The FPC is held approximately two months before the training event. The FPC's objective is to address and resolve issues. Final resolution is reached on STARTEX positions, facilities, technical aspects, the exercise schedule, and resource constraints (See "Resource Constraints", section 4). Major responsibilities remain the same as shown on the IPC chart above.

Goals and activities of the FPC may include:

a. Committee updates
b. Last minute changes
c. Training schedule
d. Identify closed issues
e. Equipment setup time
f. Road to STARTEX
g. Exercise schedule
h. Red-flag issues (show-stoppers)

7. **Issues to address between conferences**

The FA 57 has many activities to be addressed and entered into the timeline for exercise execution between these conferences. Here are a few examples; there will be others as the exercise planning matures.

a. **Determine scenario and conduct initial reviews.** Validate exercise objectives and ensure the scenario has sufficient events to satisfy these. Determine the level of participation (scenario and feedback). Save time for the simulation and database review to ensure the simulation(s) adequately exercises the events the training unit wants.

b. **Facility and communication review** (See "Resource Constraints", section 4) Spend some time addressing the following topics:
   1. Physical space
   2. Communications
   3. Electrical
   4. Parking
   5. Environment
   6. Hardware
   7. Furniture
   8. Other equipment

c. **Write the Exercise Control Plan.** This critical document addresses such topics as:
   1. Cell interface process
   2. Objectives and goals
   3. General scenario
   4. Control structure
   5. White cell process
   6. Schedule
   7. Communications lay down
   8. Technical design of the simulation
   9. Hardware lay down
   10. Simulation workarounds
   11. Recovery procedures
   12. Logistics and support (See "Resource Constraints," section 4)

d. **Physical set-up.** When conducting the site survey, be able to answer these questions, at a minimum:
   1. How long does it take to set up?
   2. When are facilities available?
   3. What modifications are required of the facility?
   4. When is the staff available to set-up the facility?
   5. When is equipment available for installation?
   6. How much time is allocated for testing of the equipment?

e. **Training and Practical Exercise (Mini-Ex).** The Mini-Ex is a critical activity. It is the dress rehearsal designed to ensure that everything is ready for the real thing. This is where training unit participants rehearse and practice their roles, where the control staff ensures that the event runs smoothly, where the simulation(s) and databases are tested, and where the support staff ensures that it has what it need to provide support. Mini-ex activities may include:
   1. Training unit personnel train-up on the equipment
   2. Instructions for audience
   3. Final database adjustments
   4. Instruction for controllers
   5. Equipment and communication checksThese are examples of critical tasks that should be accomplished during the Mini-Ex:
   1. Familiarization of cell interactions
   2. Familiarization of communications
   3. Final technical checks
   4. Familiarization of simulation
   5. Practice scenario

8. Integration Phase—SIMEX EVENT

This is what all the planning, conferences, and hard work have been for. However, the FA 57's job is not done yet. As with any training event, issues and crises will arise. To minimize the impact of these, ensure as much as possible that contingency plans are in place to address the most likely occurrences. See "Pre-Exercise Training", section 4, for more information on how to prepare.

As a minimum, consider these exercise activities and make sure that the training unit and control cells are ready for them:

a. **Respond to partial and complete system failure.** Establish procedures to be followed in the event of a system failure. Conduct training in these procedures. Stimulate events in the mini-exercise that will cause the controllers and network administrators to respond to partial and complete system failure.

b. **Role-playing.** Role-playing by controllers may be necessary to keep the exercise going and maintain realism. Determine what roles will need to be played by controllers to conduct the exercise.

c. **Responding to the unexpected.** Attempt to determine what could go wrong and plan for it. Establish procedures to be followed in response to unexpected events, e.g., power failure, press coverage, VIP visits. Conduct training in these procedures.

d. **Respond to requests.** Controllers and cell team members need to know what they can and cannot say to the training audience. Establish procedures to be followed in response to requests for information.

e. **Adjust staff according to the situation.** Situations may arise where members of the control staff may have to be absent. Ensure that there are back-ups ready to step in and keep the exercise going with no loss of efficiency.

f. **Interaction of the cells.** Conduct cell interaction training to practice the passing of required information. Stimulate events in the mini-exercise that will cause the different cells to interact.

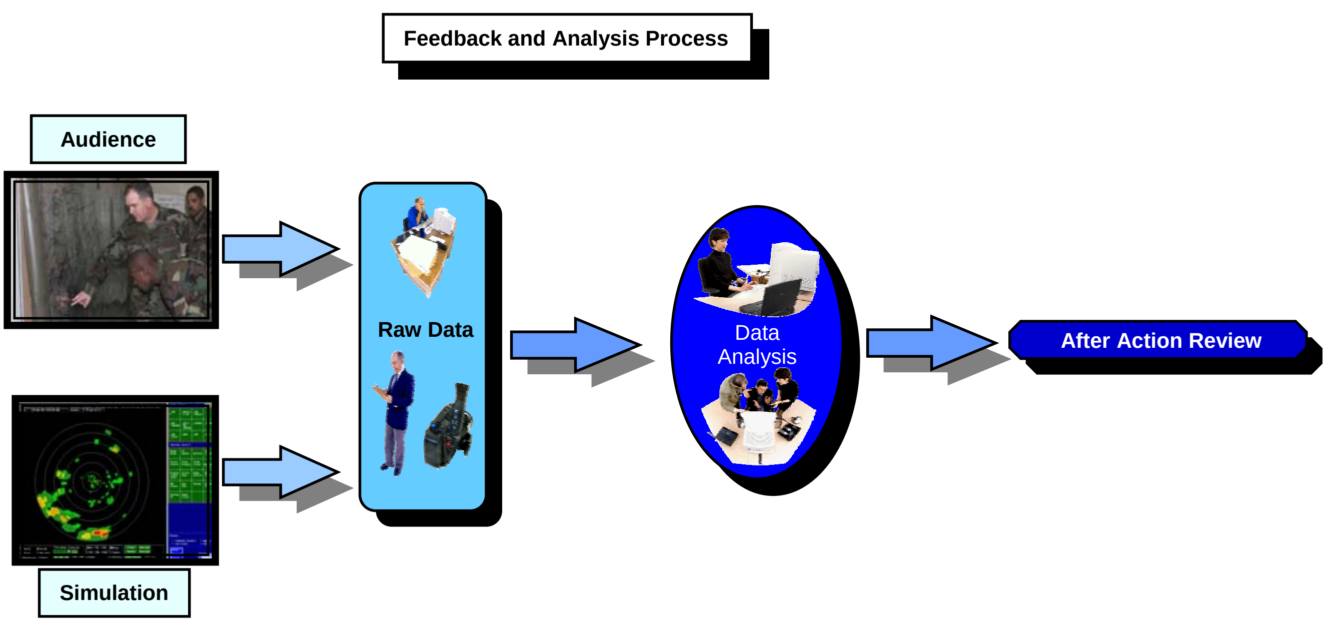
9. Analysis/Feedback Phase

This important phase consists of activities that lead to an analysis of operational and planning data that provide lessons learned, informal and formal exercise reports, and a technical review. It is here that the training unit identifies areas where they are trained and areas where additional training emphasis is needed. It is also where the FA 57, the control team, and the support staff learn what they did right and where they can improve.

Data will be gathered in two ways: from the various participants and from the simulation(s) themselves. Participant feedback is gathered in a variety of ways, to include surveys and interviews. Simulation data is gathered and analyzed by the exercise controllers. The information gathering and results of the analysis are described in detail in section 4 of this Handbook.

The formal products that result from this analysis may include the:

a. Formal SIMEX Review
b. Final SIMEX Report
c. Technical Report
d. Preparation and conduct of the AAR



10. Post-M&S Integration Phase

The final phase to be planned for is the Post-M&S Integration Phase. It is here that the final reports are prepared and information is disseminated to the training community so that others can benefit from the experience. Some examples of activities and products that the FA 57 should plan for include:

a. Store information
b. Develop lessons learned
c. Make technical upgrades and modifications
d. Disseminate information to the community
e. Technical Review
f. Training Review
g. Logistics Review
h. Preparation of documentation
i. Store and share information

11. Summary

Executing a SIMEX requires careful planning and time management. The FA 57 in charge of executing a SIMEX should carefully lay out the steps required to bring the SIMEX to fruition and then energetically execute the plan. The FA 57 should address each of the four phases discussed and understand that each situation will be different. The issues and activities presented here are designed to assist the FA 57 in getting started in the time resource management process and should be adjusted as necessary to meet individual needs.

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Time Resource Constraints Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants: ____

Primary Customer / Exercise Director_____________________________

Phone Number____

Mailing Address____

Email Address____

Facilitator ____

Phone Number____

Mailing Address____

Email Address____

Pre-Exercise Phase

Initial Research Phase
Develop a spreadsheet that lays out all of the major tasks that need to be accomplished. Flesh it out by filling in subtasks under each major heading. Use the chart below to get started.

Task Spreadsheet

Task (Major Events)	Responsible Organization / Person	When Task Will Occur (enter DTG)	Time to Accomplish Task (enter no. of days/weeks)
Concept Development Conference SUBTASKS:			
Memorandum of Agreement (MOA) SUBTASKS:			
Initial Planning Conference (IPC) SUBTASKS:			
Database Build SUBTASKS:			

Site Survey SUBTASKS:			
In-Progress Review(s) SUBTASKS:			
Technical design of the simulation SUBTASKS:			
Write Exercise Control Plan SUBTASKS:			
Final Planning Conference (FPC) SUBTASKS:			

Physical set-up SUBTASKS:			
Training Audience Training SUBTASKS:			
Controller Training SUBTASKS:			
Mini-Exercise SUBTASKS:			

SIMEX event SUBTASKS:			
Analysis / Feedback SUBTASKS:			
Post-M&S Integration Phase SUBTASKS:			

Subtasks to consider for each major task should include, as a minimum:

Initial Meeting - Customer and facilitator agree on responsibilities
Customer: plans, staffing, funding, equipment
Facilitator: scenario, funding, control, facility, database
Initial meeting accomplished Date ________________

Meetings that may occur after initial meeting:
Other planning meetings
Site surveys
Syndicate meetings

MOA Should address:

- The exercise organization
- Elimination of potential distracters
- A review of training objectives
- Milestones, with firm dates and responsible organization(s)
- Simulation(s) capabilities
- Personnel augmentation requirements
- Exercise location(s)
- Unresolved issues and suspenses for resolution
- Funding
- Organization structure
- SOPs
- Extent of exercise area
- Training audience

MOA finalized/signed Date ________________

Exercise Control Plan should address, as a minimum:

- Cell interface process
- Objectives and goals
- General scenario
- Control Structure
- White cell process
- Schedule
- Communications lay down

Exercise Control Plan approved Date ________________

Design Phase

Initial Planning Conference (IPC)

Goals and activities of the IPC should include, as a minimum:

- o Define exercise organization

- Training objectives review
- Training audience review
- Agree on facilities
- Simulation(s) review
- Establish committees
- Set Milestones
- Open issues
- POCs

Develop Agenda for the IPC ______ (X when completed)

Outline for the Conduct of the Exercise ______ (X when completed)

Conduct a Detailed Review of Technical Areas

Simulation Area ______ (X when completed)

Facility Area ______ (X when completed)

Communication Area ______ (X when completed)

Identify the Training Audience

____

____

____

Training Objectives

Identify Subject Matter Experts

IPC Conducted   Date _________________

Mid or Main Planning Conference (MPC)

Goals and activities of the MPC should include, as a minimum:

- Managers' updates
- Committee meetings
- Committee reports
- MSEL conference
- Timeline update
- Review issues

- Issues closed
- Red-flag issues (Show stoppers)

Lead-in Scenario ______ (X when completed)
Exercise Focus of Control ______ (X when completed)
Communication Laydown ______ (X when completed)
Facility Layouts ______ (X when completed)
MPC Conducted Date ________________

Issues to address between conferences

Technical design of the simulation:

- Hardware lay down
- Simulation workarounds
- Recovery procedures
- Logistics and support

Technical design complete Date ________________

Physical set-up:

- How long does it take to set up?
- When are facilities available?
- What modifications are required of the facility?
- When is the staff available to set-up the facility?
- When is equipment available for installation?
- How much time is allocated for testing of the equipment?

Set-up Plan complete Date ________________

Establish procedures to be followed in the event of a system failure.
Procedures established Date ________________

Establish procedures to be followed in response to unexpected events, e.g., power failure, press coverage, VIP visits.
Procedures established Date ________________

Establish procedures to be followed in response to requests for information (RFI) from the training audience.
Procedures established Date ________________

Final Planning Conference (FPC)
The FPC objective is to resolve issues.

Goals and activities of the FPC should include, as a minimum:

- Committee Updates
- Last Minute Changes
- Training Schedule
- Closed Issues
- Equipment Setup Timeline
- Road to STARTEX
- Exercise Schedule
- Red-flag Issues (Show stoppers)

Complete Layout of the Exercise ______ (X when completed)
Clarification of Unresolved Issues ______ (X when completed)
Review Facility and Technical Lay down ______ (X when completed)

Mini-Exercise

Critical tasks that should be accomplished during the Mini-Exercise:

- Familiarization of cell interactions
- Familiarization of communications
- Final technical checks
- Familiarization of simulation
- Practice scenario

Mini-ex activities should include, as a minimum:

- Training unit personnel train-up on the equipment
- Control and Response cell personnel train-up on the equipment
- Instructions for audience
- Final database adjustments
- Instruction for controllers
- Equipment and communication checks
- Practice event
- Test information flow

Training unit personnel trained Date _________
Cell personnel trained Date _________
Equipment checked Date _________
Communications checked Date _________
Information flow tested Date _________
System failure procedures tested Date _________
Unexpected event procedures tested Date _________
RFI procedures tested Date _________
Mini-ex completed Date _________

Exercise Phase
Startex / Simulation Set ______ (X when completed)
Communication Tested ______ (X when completed)
AAR Capability Ready ______ (X when completed)

Post Exercise Phase
Ensure adequate time is allocated for the following, as a minimum:

- Store information
- Develop lessons learned (LL)
- Make technical upgrades/modifications
- Disseminate information to the community
- Technical Review
- Training Review
- Logistics Review
- Prepare documentation
- Store and share information

LL Developed Date _________
Information disseminated to the community Date _________
Technical Review complete Date _________
Training Review complete Date _________
Logistics Review complete Date _________
Documentation complete Date _________

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4.A.2 Developing the Training Environment

4.A.2a Training Audience

As a training event is analyzed, one of the first steps is to determine "who" is being trained. The "who" can be a unit(s), specific duty positions, staff positions, or line positions. The selection of unit(s) and individual(s) identifies the training audience. A training audience should be described as either primary or secondary.

1. **Primary Training Audience**

The units/elements that are the primary focus of the training exercise are designated as the primary training audience. These personnel can include the commander of the unit being exercised, the commander's staff and staff section members, and all other unit personnel whom the commander directs to participate. Typically the primary training audience also includes the attached units or those under operational control (OPCON) of the task force associated with the training objectives.

2. **Secondary Training Audience**

Depending on the exercise, the secondary training audience can range from subordinate units of the primary training audience to the individuals assisting the exercise control staff in the simulation facility.

During the conduct of a simulation training exercise, the primary training audience remains the focus of the exercise and continues to receive the necessary stimuli and responses to meet and support their particular training objectives. The secondary training audience will often have designated training objectives of their own, but they are always secondary to the primary training audience's training objectives.

A typical simulation training exercise has both a training audience and a simulation supporting staff (e.g., role-players and workstation operators). The supporting staff is typically located in the simulation facility and functions as a major component of the exercise support structure. The mission of the supporting staff is to assist the exercise control staff in creating and maintaining the exercise conditions necessary to meet and support the training audience's training objectives. Normally the supporting staff is segregated from the training audience.

Examples of Training Audiences	**DIVISION WARFIGHTER:** (constructive simulation) Primary Training Audience: Division Commander and staff. Secondary Training Audience: Brigade Commanders/separate Battation commanders and staff. **DBST:** (constructive) Primary Training Audience: Brigade and Battalion battlestaffs. Secondary Training Audience: Soldiers staffing exercise workstations in the simulation center. **CCTT:** (virtual) Primary Training Audience: Abrams/Bradley Company Commander focusing on maneuver battle tasks. Secondary Training Audience: Crews of the Abrams/Bradley vehicles.

Each of the Army's Training, Exercises, and Military Operations (TEMO)-related simulation systems is designed to train and exercise a specific training audience in a related set of military tasks and functions. The process of identifying the training audience includes analysis of the following issues:

a. Determine purpose of the exercise. Obtain the commander's intent and any directives from higher organizations. If already developed by the unit, analyze the mission statement for the exercise. Review previous exercises.
b. Identify who receives benefit from the exercise. List units and individuals who will receive training from the exercise. Determine the effect the exercise will have on their training status.

Identify the primary training audience. Identify the unit(s) being trained and the sections or individuals within that unit. Develop a flow chart for the training audience so clear boundaries can be set for the primary training audience. Be sure to identify organizational limits for the primary training audience. After the primary training audience is identified, evaluate their training expectations. Interview the commander, S3, and senior NCOs to obtain their view of the exercise. The primary training audience may not be familiar with models and simulations and may express their expectations in operational, doctrine, or METL terms with competencies gained through the training.

c. Determine the echelon that the training audience is part of:
   1. Analyze the commander's intent, and mission statement.
   2. Determine if it is an individual training or collective training requirement.
   3. Establish whether there are multiple organizations or if there are echelons to consider within the training audience.
   4. Additionally, determine if a company is training their mission tasks or if the staff is training for C4I. For example: Is the type of training requirement for line company training their mission tasks at company and below or a staff is training event for the brigade and division staff using their organic command and control equipment?

d. Identify equipment required. Review the unit Modified Table of Equipment (MTOE) and extract equipment that you must stimulate or replicate within the models and simulation. Talk with the commander and determine the commander's intent for C4I. For example, if the Army Battle Command System (ABCS) is being used, determine which systems will be in the training audience's location and what version of software will be used. Note: Result of this is three fold: a) Identifies which equipment you physically need for the exercise, b) Identifies what equipment will interoperate or be linked with the simulation and c) Identifies what equipment needs to be replicated within the modeling and simulation process.
e. Identify location of the training audience during the exercise. The training requirement drives the location. Answer the following questions: Are they in a field location separate from the simulation facility? Are they on a pad attached to the simulation facility? Are they replicating a field location?
f. List primary and secondary training audience. Publish a list of the training audience and review the list with the exercise director and senior commander of the unit in the exercise. Establish In-Progress Review (IPR) dates to review the primary and secondary training audience and adjust accordingly.

3. **Summary.** Selection of a training audience is just one step in conducting a realistic exercise, but an important one. Ensure that the most appropriate training audience is selected to fit the exercise. Remember, the goal of a simulation training exercise is to create the necessary conditions to enable the training audience to realistically perform/practice their mission-related tasks, processes, and functions to meet and support specific training objectives.

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Training Audience Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants ____

Primary Customer / Exercise Director______________________________

Phone Number____

Mailing Address____

Email Address____

Major Unit in Exercise POC ________________________________

Phone Number____

Mailing Address____

Email Address____

Pre-Exercise Phase

Initial Research Phase

Determine purpose of exercise

Information to be obtained	From	Summary of information
Commander's Intent	Training unit commander	
Higher HQ directives	Training unit commander/G3/S3	
Exercise Mission statement, if developed	Training unit commander/G3/S3	
Previous exercises	Training unit commander/G3/S3	When: What: Who: Tng Objs: Results:

Identify who receives benefit from the exercise

Unit(s)	Individuals	Why they need training? Effect on training status

Identify Primary Training Audience (PTA)

Unit(s)	Collective and/or Individual Training?	Line unit mission task and/or staff C4I training?	Entire unit or selected elements (e.g., staff sections, maneuver units)?	From MTOE, unit equipment that must be simulated or replicated	Unit's location during exercise	Training Expectations

Interviews to determine training expectations, intent for C4I, and to obtain their view of the exercise:

Commander: Date ________________

G3/S3: Date ________________

Senior NCOs: Date ________________

Others: Who ______________________________ Date ________________

Identify Secondary Training Audience (PTA)

Unit(s)	Collective and/or Individual Training?	Line unit mission task and/or staff C4I training?	Entire unit or selected elements (e.g., staff sections, maneuver units)?	From MTOE, unit equipment that must be simulated or replicated	Unit's location during exercise	Training Expectations

Interviews to determine training expectations, intent for C4I, and to obtain their view of the exercise:

Commander: Date ________________

G3/S3: Date ________________

Senior NCOs: Date ________________

Others: Who __________________ Date ________________

Design Phase

Initial Planning Conference (IPC)

Present information on the Training Audience at the Initial Planning Meeting
Date of meeting ___________________
Make necessary adjustments ______
Include information on the Training Audience in the Initial Concept Paper ______
Distribute matrices developed in the Initial Research Phase ______
Confirm information with PTA and STA audiences
PTA Date ______________
STA Date______________
Publish Training Audience information Date ______________________

Main/Mid Planning Conference (MPC)

Conduct review of Training Audience information with:
PTA Date _____________________ Adjustments ___________________________
STA Date _____________________ Adjustments ___________________________

Final Planning Conference (FPC)

Confirm Training Audience information with:
PTA Date _____________________ Adjustments ___________________________
STA Date _____________________ Adjustments ___________________________

In Progress Reviews (IPR)

PTA Date _____________________ Adjustments ___________________________
STA Date _____________________ Adjustments ___________________________

Exercise Phase

Monitor exercise to record changes, issues, and lessons learned with the Training Audience

Unit	PTA	Change in Training Audience	Issue	Lessons Learned	Training expectations met?

4.A.2b Training Objectives

Establishing Primary and Secondary Training Objectives is a critical path in exercise activities. They drive the model and simulation selection, training audience activities, and establish the foundation for evaluating and observing the exercise. FM 7-0 established the training objective as: A statement that describes the desired outcome of a training activity. A training objective consists of the following three parts:

1. **Task.** A clearly defined and measurable activity accomplished by individuals or organizations.
2. **Condition(s).** Describes the circumstances and environment in which a task is to be performed.
3. **Standard.** The minimum acceptable proficiency required in the performance of a particular training task.

When developing training objectives, the following documents are available for reference:

a. Mission Training Plans,
b. Soldiers Manuals,
c. Soldier Training Publications,
d. DA Pam 350-38,
e. Field Manuals,
f. Deployment or mobilization plans,
g. Army Universal Task List (AUTL),
h. Universal Joint Task list (UJTL),
i. Army, MACOM, and local regulations, and
j. Local standing operating procedures (SOP).

An exercise is collective task training designed to develop proficiency and crew teamwork in performing tasks to established standards. Exercises also provide practice for performing supporting critical individual (leader and soldier) tasks. Exercises may be conducted in units or during resident training.

Exercise objectives are often confused with the target audiences training objectives. The simple difference between these two categories is that exercise objectives tend to be stated in general terms, whereas the training objectives are a more definitive subset of the exercise objectives. Exercise objectives provide the overarching purpose and desired outcomes (intent) for the exercise. Typically, the exercise objectives specify the types of doctrinal applications, operations and missions, unit functions, and/or processes that will be performed and addressed during the exercise.

If the training will include mission tasks, involve emerging doctrine or non-standard tasks, commanders should establish the tasks or conditions and standards using mission orders and guidance, lessons learned from similar operations, and their professional judgment. The next higher commander approves the creation of the standards for these tasks. FM 3-0 provides the doctrinal foundations; supporting doctrinal manuals describe common tactics, techniques and procedures (TTP) that permit commanders and organizations to adjust rapidly to changing situations.

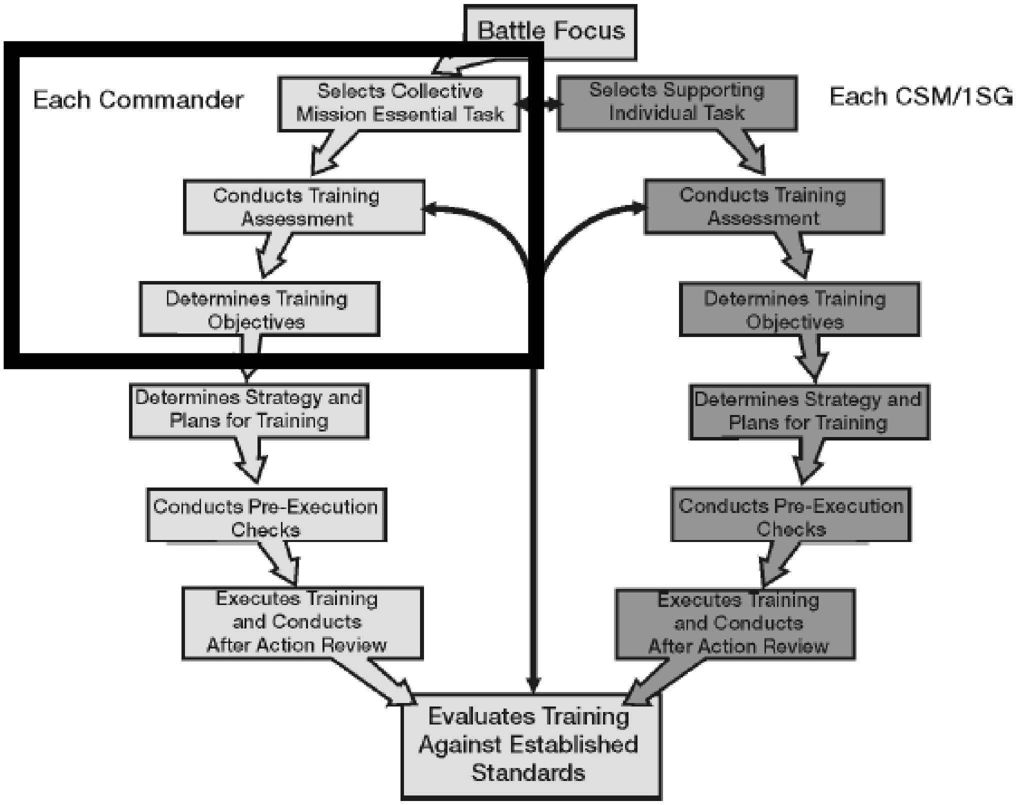
In constructive training events at brigade level and above, it is typical for the training audience, in coordination with the exercise director, to identify specific individual(s) or portion(s) of the training audience that will be performing the specified task(s) (e.g., the brigade commander; the brigade engineer officer; the fire support element (FSE); the S2; or the S3 section).

In Virtual and Constructive training events at battalion level and below, it is typical to accelerate junior leader mastery of tasks directly related to developing tactical competence, confidence, and proficiency that support their unit’s Mission Essential Task List (METL) or supporting critical collective tasks.

In the CCTT, the secondary training audience is composed of those individuals working at the various workstations that emulate command posts. For the most part, the tasks, or the primary training objectives, associated with the secondary training audience are leader or individual staff position tasks contained in the unit Mission Training Plan’s (MTP).

The secondary training objective can be separate and different from the primary training objective, or be a sub-element of the primary. If separate from the primary, ensure that the secondary training audience is identified and why it is not a primary. When viewed as a sub-element of the primary objective, ensure that it supports the activities of the primary. Clearly state why a secondary training objective is necessary for this exercise. Secondary does not mean that the exercise will only accomplish this training objective if there is time. It means that while the primary is being accomplished, secondary training is also occurring. For example: If the primary training objective is to conduct an attack, then the secondary training objective could be to track battle on ABCS.

Effective collective, leader, and individual training are guided by the use of Training and Evaluation Outlines (T&EO). The T&EO provides summary information concerning collective training objectives as well as individual and leader training tasks that support the collective training objectives. They also provide information concerning resource requirements and evaluation standards applicable to a training situation. The principal source documents for T&EOs are MTPs and other soldier training publications. Since the conditions in these publications can vary, trainers adjust and supplement T&EO conditions to conform to the Mission Enemy Terrain Troops –Time and Civil considerations (METT-TC) of the organization's operational plans. This process is identified in the following chart:



The Process of Developing the Primary Training Objectives

a. **Analyze the mission.** Is the mission new or changed? What is the commander's intent? What is the unit's METL? Are there special taskers? What are the technology issues? What are the training problems? What are the current T/P/U for the unit? Has there been a recent policy change?
b. **Determine the training audience**. Who is being trained? Review both the primary and secondary training audience.
c. **Research Doctrine and Publications.** Identify the FMs, MTPs, STPs, and TMs that apply to the mission and training objectives. Review these publications and extract pertinent information.
d. **Identify the "big picture" training requirements to accomplish the mission.** Analyze how soldiers and units can prepare for this exercise. Determine who is being trained. Identify what the training requirement is. Identify where the training is taking place. Answer the question: Why is this training necessary?
e. **Identify primary training objective (s).** Determine if it is collective or individual. Look up the JUTL and AUTL and identify if any tasks in those lists support the mission. Keep the number of primary training objectives in the range of 4-6, since any more could become difficult to train. As the training objectives are clustered, they can be consolidated.
f. **Develop the primary training objective(s).** Writing the primary training objective is the salient step in this process. The written primary training objective is the product that all will observe. The training objective statement must start with an action word,

e.g., to train, exercise, demonstrate, integrate, practice, improve, rehearse, refine, assess, test, evaluate, examine, experiment, confirm, conduct, etc. The primary training objective must be supported and standard. Then identify supporting collective and individual tasks along with the equipment necessary to accomplish the task. The training objective must be measurable and observable.

g. **Focus the training objective to the mission.** Ensure that the training objective which has been developed supports the exercise mission.

h. **Determine if models and simulation can exercise the developed training objectives.** This is a critical path that leads to the selection of a simulation. List the simulations that accomplish the primary training objective, since there may be more than one simulation that can work for this mission set.

i. **Ensure primary training objective(s) support training audience.** This is a quality control check. Read the primary training objectives as the training audience would view them. Determine if the training audience can accomplish the objectives.

j. **Crosswalk primary training objective(s) to primary and secondary training audience.** Develop a matrix listing who in the training audience does what objective. This matrix should drill down below the unit level of detail and look at the category of the training audience.

k. **Review training objective.** Determine who reviews the training objectives and discuss the training objectives with them. Recommended reviewers include but are not limited to: subject matter experts (SME), Commander, Exercise Director.

l. **Publish primary and secondary training objectives.** Publish the primary and the secondary training objectives in the same document.

m. **Identify process for refining the primary training objective(s).** Establish periodic reviews of the primary training objectives.

Training Objectives Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants: ____

Primary Customer / Exercise Director________________________________

Phone Number____

Mailing Address____

Email Address____

Major Unit in Exercise ___________________________________

Phone Number____

Mailing Address____

Email Address____

Pre-Exercise Phase

Initial Research Phase

Analyze the exercise objectives and directive.

- Is the training to be conducted a new mission or change in the unit's current mission?
  YES _____ New or change mission ________________________NO _______
- Do you know the Commander's intent? YES _____ NO ______
  Date received _________________
- Has a METL been developed? YES_____ NO ______ Date received _______________
- Is the training to be conducted a result of a special tasker? YES ______
  Tasker ____ NO _______
- Is the training to be conducted based on a technology issue? (New technology to be tested)
  YES ______ Technology issue _____________________ NO ______
- Are there training problems? YES ______ What are they? _______________________
  NO ______

- Is the training to be conducted a result of a Trained/Partially Trained/Untrained (T/P/U) analysis? YES _____ NO ______
- Is the training to be conducted a result of a policy change?
  YES _______ New policy ______________________________ NO _______

Who is the primary training audience (PTA)?
____.

Who is the secondary training audience (STA)?
____.

Identify the STA

Unit or Separate Org	Training Objective(s)	Function(s)	Point(s) of Contact

Identify training objective(s)

Primary Training Objective(s) (List 4-6)	Secondary Training Objective	METL Task	Individual Supporting Task(s)	Collective Supporting Tasks

Develop training objective(s)

Training Objective(s) (List 4-6)	Condition	Standard	Supporting Collective Tasks	Supporting Individual Tasks	Measurable and Observable? Accomplishable by the Training Audience? (Y/N)	Supports Exercise Mission? (Y/N)

Determine if the simulation(s) selected for this exercise support the training objectives.

Training Objective(s)	Simulation(s) that Support the Training Objective	Simulation(s) Selected to Support the Training Objective

Crosswalk the training objectives with the PTA and STA.

Training Objective(s)	PTA Unit(s) Accomplishing Training Objective	STA Unit(s) Accomplishing Training Objective

Review/approve training objectives

PTA commander review/approval ______ Date ___________________
STA commander(s) review/approval _______ Date __________________
SME review/approval ______ Date __________________
Exercise Director review/approval _______ Date __________________

Design Phase

Initial Planning Conference (IPC)
Present Training Objectives at IPC _____ Date of meeting __________________

Develop/distribute an Initial Concept Paper listing PTA, STA, and primary training objectives ____
Distribute matrices developed in the Initial Research Phase _____
Confirm information with PTA and STA audiences
PTA ____ Date and with whom ___________________________
STA ____ Date and with whom ___________________________
Publish training objectives ________

Mid or Main Planning Conference (MPC)
Conduct review of training objective information with:

PTA _____ Date and with whom ________________________________

STA _____ Date and with whom ________________________________

Final Planning Conference (FPC)
Confirm training objective information with:

PTA _____ Date and with whom ________________________________

STA _____ Date and with whom ________________________________

Exercise Phase

Monitor exercise to ensure training objective(s) are met

Record Lessons Learned concerning whether training was sufficient to meet the training objectives

Training Objective(s)	Training Met Objective (Y/N)	If NO, Why Not?	Corrective Action Required

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4.A.3 Design an Architecture Based on Objectives

4.A.3a Single vs. Multi-Site Exercise

1. Introduction

Although much of the guidance in this handbook is oriented to a single training site, there are often good reasons the training event might extend beyond the immediate site, to other training sites or installations, involve other services, and even involve participation across international borders. There is no authoritative Army or DoD definition of terms like local or remote; even terms like "installation" have been questioned in circumstances when participating military elements having administrative elements inside a single active duty Post are actually dispersed among different training sites. For the purposes of this discussion, a single site exercise is considered to be one in which all simulations supporting the exercise are housed in one facility. Distances between the simulation facility and training audience location are short and may be traveled in minutes, possibly by walking. Multi-site exercises typically (but not always) involve multiple simulations supported in different facilities, networked by temporary dedicated communications circuits, and a dispersed training audience, which may, but need not be located near any of the simulation sites.

The decision to conduct a distributed (multi-site) training event hinges on training objectives and economic factors. Training objectives are, or will be documented in an Exercise Directive that should identify the training audience, and describe the circumstances under which the training should occur to meet the objectives. If there are several options that could meet the training objectives, deciding on single versus multiple sites may be driven by the comparative costs of moving the training audience to a single training location, versus the costs of providing the communications network augmentation necessary to distribute the simulations and provide for management and multi-site coordination. This section necessarily addresses some planning factors discussed in other sections of this handbook. Some overlap of topics is unavoidable in presenting the unique aspects of multi-site exercises.

2. Review the Exercise Requirements

a. Training objectives

Although the exercise requirements may be explicitly stated, they are derived from the exercise or training objectives. It is appropriate to review the basic missions or tasks of the individual units of the training audience, as defined by the Army Universal Task List (AUTL) to ensure that the feedback from the selected simulations will adequately support their training.

Separately, consider the training audience from the perspective of the highest echelon of the training audience, to ensure that the simulation(s) to be used are adequate for their needs, and that there are means to distribute simulation-based exercise reporting to all echelons of the training audience with appropriate timeliness.

It is important to consider that the training objectives do not align automatically with simulation capability. An objective that calls for a combined arms advance along a single axis to achieve an objective may be satisfied completely within the capabilities of a simulation such as Janus or CBS. If the objective calls for demonstration of the ability to conduct the same operation as a Joint Task Force, or with support from naval gunfire or fixed-wing air support, there may be a need to involve Navy or Air Force elements in the exercise. The involvement of other Services or external elements for scenario support or participation may also have an impact on the decision to conduct a multi-site exercise.

b. Live, Virtual, and Constructive Requirements

Historically, the simulations supporting most staff training exercises have been of the constructive type. (Constructive simulations are defined as simulated forces operating simulated systems, in response to human instructions. The output of constructive simulations can stimulate the decision cycle of the training audience.) The introduction of systems that enable integration of live (real people operating real systems) and/or virtual simulations (live people operating or interacting with simulated systems) is fairly recent. The advantages and technical challenges of mixing live, virtual and constructive simulation-based training in coordinated events are still being explored. The integration of one or more members of the Combined Arms Tactical Trainer (CATT) family of virtual simulators (for example) into a constructive simulation may impact the single-multi site equation, depending on whether the specific virtual system is fixed or mobile, its interfacing requirements, and the necessity of a scenario that meets training needs both of the virtual and constructive training audiences. Integration of live participation in constructive simulation environments will become more common as situation reporting generated by simulations begins to flow directly to C4I systems. In that setting, the operator of an ASAS or AFATDS, responding to simulated information via a real C4I system, can be said to be engaged in live simulation. Equally, an infantry company might perform operations on an instrumented training range (a remote site) digitally linked to a simulation environment, and "embedded" as a live actor in a constructive scenario. Such real time, interactive links between live and constructive training environments have been demonstrated, but the process is not yet routine. Advances in simulation technology and improved links between simulation systems and Army C4I systems will improve the ability to coordinate these forms of training in the future.

c. Review the architecture for each model and simulation

Logically, any simulation-supported exercise can be classed as one of four possible combinations of sites and simulations. They are, (1) one simulation operating at one site; (2) one simulation distributed to two or more sites; (3) two or more simulations operating at one site; and (4) two or more simulations operating at two or more sites.

These four possible cases may both reflect and influence the consideration of simulation architecture, based on the simulations to be used. To choose a unique example, an exercise in which the training objectives concern primarily logistics, personnel, and other Combat Service Support issues might logically choose CSSTSS as the most logical simulation to support the exercise. By its nature, CSSTSS is not locally hosted, except for exercises at Ft. Lee where the CSSTSS mainframe processor resides. Thus, if the training audience is concentrated at Ft. Knox, for example, the choices are to (a) move the training audience to Ft. Lee (a single site exercise), or (b) to run CSSTSS at Ft. Lee and distribute the simulation input/output terminals and reporting to the training audience at Ft. Knox (a multi-site exercise). Among major Army simulations, CSSTSS is now unique in being centrally operated from a single site, but it makes the point that the architecture or structure of each simulation needs to be considered in terms of where it will be run or controlled, where training audience inputs will be entered, and where results will be delivered.

If the same exercise employs CBS to generate combat loss and attrition factors to drive the CSSTSS scenario, a decision may be required on where best to host the CBS network – at Ft. Knox (near the training audience) or at Ft. Lee (near the CSSTSS for convenience and a reliable link between the two systems). Note also that decisions on the location of control elements for multiple simulations in an exercise (based both on their architecture and exercise control factors) will influence the need for and distribution of technical support manpower.

A review of the architecture of each of the simulations under consideration to support training objectives may reveal other factors impacting the site distribution of the overall training event, and influence the final selection of simulations to be used. More complex training needs may demand the added capabilities. The complications and support requirements to operate multiple simulations and/or multiple sites are certainly higher than for a single simulation/single site, but fortunately, there is a core of both government and contractor experience available to draw upon in order to make the best decision for the circumstances.

3. Identify training audience physical location in the exercise

The location of the training audience during the exercise impacts the issue of single versus multiple sites. The selection of their location may depend on weather, space or facilities available, or collateral training needs. As background, Army experience and policy dictate that no unrealistic contact should occur between the training audience and the simulation environment. The scenario should be perceived as real events. Thus, some separation between the audience and the exercise environment is required. For that reason Training Support Cells exist to represent the simulated forces in tactical communications to the training audience, particularly on tactical voice nets, but also on digital terminals where appropriate. The Training Support Cells include computer terminal operators who enter the commands necessary to implement the instructions of the training audience to their (simulated) subordinate units, and to report the results of the simulation processes back up the chain of command to the training audience. The physical distance between the Training Support Cells and the training audience can have incidental effects on site decisions, even though tactical communications links are used (for realism) between Training Support Cells and the training audience.

The training audience, if too distant, may affect the requirement for communications support for observer-controllers, or other exercise-unique communications nets. Excessive distance between training audience and Training Support Cells also impacts the cost of various exercise overhead functions such as security, emergency notification, local travel costs, etc. Placing the training audience too near to the simulation or exercise control site risks inadvertent “leakage” of exercise control information to the sensitive ears of some soldiers in the training audience ready to exploit every possible advantage during the exercise. There can be a large difference in the training value of a realistic simulation supported exercise, and one in which a few troops among the training audience have learned to
“play the game”, that is, to exploit their unauthorized or accidental exposure to privileged scenario information.

In an exercise involving live and/or virtual as well as constructive elements, the training audience may not be co-located. A weapon crew or team in a CCTT or other virtual environment must have tactical communications links to the main body of the training audience to conduct tactical coordination, but the exercise and simulation staffs must have separate means to monitor both the virtual environment and the coordination taking place between the audience in the virtual environment and the audience in the constructive environment. This separate non-tactical communications pathway is necessary both for exercise control purposes, and to gather AAR data. The physical configuration of the virtual training facility (a dedicated building or vans, for example) may dictate that it function as a separate training audience site, regardless of its actual proximity to the constructive training audience.

4. Design the architecture of the simulation network

The design of any network of linked simulations serving multiple sites must consider both local and remote information needs, and the provision of information both to the training audience and the control staff. These diverse needs mean that design of the simulation network for a distributed exercise can be very complex. Exercises such as Ulchi/Focus Lens in Korea, or the recent series in CONUS known as Prairie Warrior involved multiple simulations supporting multiple sites. For the past decade, the typical exercise constructive simulation network architecture has been ALSP. However, as legacy systems are replaced, and as coordination of virtual and constructive simulations increases, DIS and HLA protocols are becoming more common. Some events involve multiple networks, each based on a different protocol but sharing the same scenario and event timeline. Events of this complexity require care in planning and reliable means of coordination between sites, both for exercise management and technical coordination.

Getting the appropriate information to the training audience at the right time, in a realistic form remains the objective of the simulation. Simulation managers should attempt to optimize the local configuration with that purpose in mind. Be mindful that simulations conducted locally as part of a larger exercise need to be consistent with scenarios and events executed elsewhere. Likewise, local events of seemingly little overall significance may have widespread consequences. For example, a brief local interruption in electric power could have widespread consequences if it disrupts time-critical exercise data flowing to multiple sites. Dispersed sites and multiple simulations also pose the challenge of sustaining a common exercise timeline, especially in the face of local technical disruptions. A separate, always-available communications pathway should be available between technical control cells at all sites to coordinate troubleshooting and response, data backups, time adjustments between simulations, and other such matters.

5. Identify the interfaces between simulations and C4I Systems

The technical design of interfaces between simulations and C4I systems is a matter for engineers and technicians. Our concern here is for the availability of appropriate information at the interface, and the timely flow of appropriate data through each interface. There are three particular issues to address with regard to the interface between simulations and C4I systems. The first pertains to the perception of the scenario in the training audience. When simulations feed C4I systems directly, current scenario-based information is delivered directly to the training audience, without being “filtered” through the Training Support cells. The flow of that data can be substantially controlled through software commands. However, those elements receiving simulated data in near-real-time via C4I systems may in fact receive their information faster than other staff elements still relying on oral or manually generated reports from Training Support

Cells. Differing perceptions of the current battlefield situation among the training audience could result. This condition could actually reflect situations that would occur in the real world as operational elements convert to digital information systems from older manual and voice procedures, but in the simulation environment, it is important to be sensitive to potentially unrealistic results or reactions, due to incomplete transitions to digital simulation data flows to C4I systems.

The second issue related to simulation interfaces with real world systems concerns access to the interface. Some of the real world systems under consideration process classified information. Simulations interfacing to such systems need to be protected to the same level of security as the C4I systems. Some real-world systems, including certain intelligence systems, accommodate simultaneous connection to simulated and real world data sources, using compartmented memory management techniques. There should be a deliberate effort to ensure that real-world and exercise data are not confused with each other. In some past exercises, simulated information was inadvertently released into real-world data streams, resulting in false alerts among non-exercise participants in the real world.

A third concern with simulation linkages to real world systems is that a technical change in either system may disable the linkage. The fact that a sim-C4I link worked in a previous event may not be proof that it will work the same way in the next event, particularly as new systems undergo evolutionary upgrades. Insure that such connections function properly through testing, and verify that the versions of each system tested are the versions that will be available for use in the exercise.

6. Determine the communications required

If one or more simulations are connected to real-world C4I systems, much of the necessary communication connectivity to the training audience may be accounted for. However, until all tactical communications become digital, tactical voice and data circuits will be required between the Training Support Cells and training audience. Also consider the need for additional linkages to connect controllers at widely separated sites. Various means of communications may be required.

a. Determine communications required within the simulation center

Inside the simulation center, work cells should be designed to facilitate internal communication by voice. Significant amounts of information, including coordination of complex actions can be coordinated in this way. Other means are often used to share information between cells, and between exercise control, technical control, and various functional cells in the facility. These means could include public address or intercom announcements, internal phones, emails, and even human messengers carrying critical information between cells.

Various methods can be used for coordination between dispersed sites. Costs, users preferences, and availability all affect the selection process. The methods include dedicated or dial-up telephones, voice over the internet, internal message protocols built into some simulation systems, internet-based collaborative software environments (such as Lotus Notes or InfoWorkSpace), emails, and voice or video teleconference. Many exercises use a combination of these techniques. It is important to recognize that the communications circuits between simulation controller cells, technical control cells, and the links between a simulation central

processor and remote nodes, are all functionally separate networks. Although the separate circuits may be merged in broadband carriers between sites, the separate functional communications links must remain distinctly dedicated to their individual purposes.
Other communications methods may be employed to meet specific local needs. The use of cellular telephones and non-tactical voice radios for communications between key personnel at a large single site has become fairly common for this purpose.

Direct simulation-to-C4I linkages cannot be depicted by this simple diagram. Removing humans from the communication process between the scenario (the simulation environment) and the data delivery and display process, changes the traditional way exercises have been managed. For the sake of simplicity it might be useful to think of the simulation as an input port (the source of battlefield information) to the ABCCS, or other C4I distribution system.

7. Additional considerations in the multi-site exercise environment

Multi-site exercise configurations involve special concerns that are less likely to occur in a single training site. Among these are:

Personnel deployments.

a. The limited pool of expert manpower to support complex distributed simulations often requires that selected personnel deploy to remote sites to support the exercise setup, the exercise itself, and the take-down and return of deployed resources to their home stations.
b. An important step in planning for such deployments is to determine in advance if contractors can legally work “exercise hours” without incurring unplanned overtime payments.
c. Accommodations for contractors may become an issue, billeting, meals and transportation. Most of these issues can be dealt with satisfactorily, if considered during the planning process.

International travel.

a. Additional issues may arise in deploying exercise support contractors to sites in other countries. Contractors, depending on their role, traveled either as tourists, or under government auspices.
b. Since the fall of the Soviet Union, changes in the status of forces in Europe sometimes limit the access of retirees and other civilians to Post Exchanges, the Commissary, and other conveniences available to the military population.
c. If a contractor is injured overseas, he or she may not have unrestricted access to military health care facilities, as another example. Conditions vary by location, and change over time, but all of these issues need to be systematically investigated.

Security.

a. Although DoD security regulations apply to all services, they are sometimes interpreted differently by the services, or implemented in different ways at different locations. Recognize the issues that may arise, and rely on the senior exercise control staff to resolve such issues affecting more than one site.

b. Be aware that some “security” personnel deal mainly with personnel security and administrative documentation matters, and may be unfamiliar with technical issues of network and data security.

Exercise Duty Hours.

a. Distributed exercises frequently occur in multiple time zones. A standard duty day for all participants may be designated based on Zulu times, or each site may adhere to local times.
b. Using Zulu times may allow synchronization of all shift changes across the distributed exercise.

Coordination of scripted events.

a. Before reliable computer assisted exercises became common, staff exercises were largely run as a series of scripted, consecutive events. The master script was known as the Master Scenario Event List, or MSEL.
b. The MSEL concept called for the individual events that comprised the MSEL to be provided to the training audience at preplanned times, often indicated by a pre-printed date-time-group on the scripted message.
c. The manual procedures that accompany scripted events can cause unexpected problems when communicated across multiple training sites. If used, these scripted “injects” (events added to the flow of events occurring in the simulation) should be coordinated with controllers at all sites to avoid inadvertent scenario conflicts, and to achieve maximum training value from each inject.

Intentionally Left Blank

Single vs. Multi-Site Exercise Worksheet

Name of the Exercise ____

Exercise Organization(s)____

Exercise Participants: ____

Primary Customer / Exercise Director__________________________________

Phone Number____

Mailing Address____

Email Address____

Facilitator ____

Phone Number____

Mailing Address____

Email Address____

Note: This worksheet should be used in conjunction with the Facility Survey Worksheet for each facility to be occupied during the exercise or event. The Facility Survey will assess the adequacy of an individual site or facility to house one or more components of the exercise. This worksheet assumes the selected sites meet minimum requirements for space, electrical service, parking, and other considerations.

There is no recognized definition for the terms single and multi-site exercises. For the purposes of this worksheet a single site exercise is considered to be one in which all simulations supporting the exercise are housed in one facility. Distances between the simulation facility and training audience location are short and may be traveled in minutes, possibly by walking.

Multi-site exercises typically involve multiple simulations supported in different facilities networked by long-distance communications circuits, and a dispersed training audience, which may, but need not be located near any of the simulation sites.

Identify Exercise Requirements Based on Training Objectives (consider all associated command, staff, combat, combat support, combat service support and ancillary training audiences). List Live, Virtual, and Constructive Simulation Requirements by participating element to receive training. List the preferred or selected virtual or constructive simulation(s) to meet training requirements of all elements to be trained. Note objectives to be met by live training, if used.

Unit, Staff Element, or Command Receiving Training	Unit, Staff Element, or Command Mission Training Objectives	Desired/Recommended Simulation Type (Live/Virtual/Constructive)

Summarize major simulation site requirements.

The following table displays the major exercise elements and site management considerations. This projection is for the simulation

Site Name	Training Objective	Simulations Supporting	Linking C4I Systems	Communication Requirement	Security Level

Define each simulation network.

Every simulation may not be required at every training site. The following optional table duplicates some of the same information contained in the one above, but may be easier to use in showing the distribution of each simulation across multiple sites. Show the number of terminals and other key equipment at each site. The information here can serve as the basis for diagrams of the distributed networks supporting each simulation and the associated exercise support elements.

Location	CBS	TACSIM	CSSTSS	DBST	Spectrum	Other (add columns as reqd.)

Diagram each simulation network.

Use link and node, flow chart, or organizational chart style as preferred, but display principal routers, switches, crypto, nodes and/or terminals, ancillary equipment, and electronic connections/interfaces to any other simulation or real world system. Indicate direction of information flow.

Simulation Name	Date Diagram Completed

Diagram exercise communications networks linking multiple sites.
Pay particular attention to supplementary non-tactical or leased connectivity required to support the simulation network, and/or the exercise control organization. Include added telephone lines and switches, video teleconferencing, SIPRNet links, and any other special purpose circuits required.

Network Description	Date Diagram Completed

Multi-Site Operational Considerations – Common examples

Issue	Resolution	N/A√
Coordination between sites in different time-zones		
Deployed contractor clearances incoming/outgoing		
Deployed government clearances incoming/outgoing		
Multi-national security clearance/access considerations		
Local response to remote network outage		
Deployed contractor duty hour limitations		
Contractor/civilian access to military billeting, messing, facilities		

4.A.3b Communication

1. **Overview**

Communication is a critical aspect of exercise integration as the players and the component simulations rely on communications to disperse all information between the different units and simulations at the various exercise sites. The communication requirement can be as simple as telephones or as complex as local and wide area networks. The simulation support staff needs to know how to establish the communication requirement and review communication plans in the context of the simulation architecture. The activities of the exercise will determine the requirements of the communication plan. Normally, the simulation staff has access to SME contractors and government technicians that will prepare the communication support plan. However, the staff needs to establish the communication requirements or baseline prior to the SMEs preparing the plan.

2. **The Process of Determining Communication Simulation Requirements**

   a. Review the mission, training objectives, training audience, equipment and systems used during the exercise. Also identify all models and simulations being employed and consider the size of the exercise. The communication requirement is a direct result of the simulation architecture. As requirements are analyzed, look at the simulation architecture from a general perspective. This view will give the interactions between the simulations and the real world equipment. Once the architecture is understood, overlay locations on the architecture as a start to developing the communication plan. The number of sites and their cell structures also affect the communication plan. Upon completion of this review, the initial communication requirements can be identified.
   b. Identify the locations requiring communication during the exercise. Determine who provides communication to and from the Simulation Center, Exercise Cells, and the Training Audience. Units will use doctrinal communication means when communicating with the Battle Simulation Center (BSC).
      1. The BSC will contain representation from all unit headquarters in the exercise. The exercising unit normally uses only doctrinal MTOE authorized communication links between field command posts and BSC workstations. Tactical communications should not be bypassed unless there is a specific reason such as to provide the functionality for a missing piece of architecture. For example: DCX II by design required S507s to provide center of mass (COM) icons to each unit. Normal organic Lower Tactical Internet (TI) communications would normally provide these calculations, but the units were not physically represented in the simulation.
      2. Unit commanders in coordination with exercise directors should be the only ones allowed to direct that a simulation communications feed replace a tactical communications feed. Identify the flow of communication by answer questions like: What does the unit's organic communication accomplish? What responsibilities (if any) does the simulation staff have to the training audience organic equipment? Does the simulation center provide more than just feeds? What are the responsibilities of the training audience and simulation center in the

overall communication architecture? At what point does the simulation center stop servicing the communication at the training audience's location?

c. Identify messages and information that the simulation will process. Consider the types of messages or information needed to be received from the simulated units in the TOCs. Define every type of box and the types of messages it needs to send and receive. For example:

Do you only want FBCB2 platform situational awareness or do you want S507 maneuver unit icons?
Do you want full C2 messages, including orders?
Do you want to receive graphics?
What counter fire message architecture will you have, is there real radar? What is your fire mission message architecture?

1. Identify other messages such as orders, TACLAN info, etc., that are needed. In some cases, the simulations can't make these kinds of messages, and the role players will have to create and send them via the appropriate equipment. This may require having that other equipment, simulations, and communication architecture to accomplish. Analyze the "other message" impact on your communication requirement separately and consolidate into your plan as needed.
2. These decisions will help to decide whether you want the soldiers in the facility act only as a response cell, or operate as a full TOC and subordinate units. It will also help the simulation staff to determine whether they can provide the stimulation needed and can replicate the desired orders.

d. Identify outside events that will impact the exercise communications. Review the installation training calendar and determine what events could compete for resources or have a negative impact on the communication exercise. Are there competing demands for T1 lines? Are there deployments scheduled that would place communication requirements at risk? What activities near the exercise could degrade service?

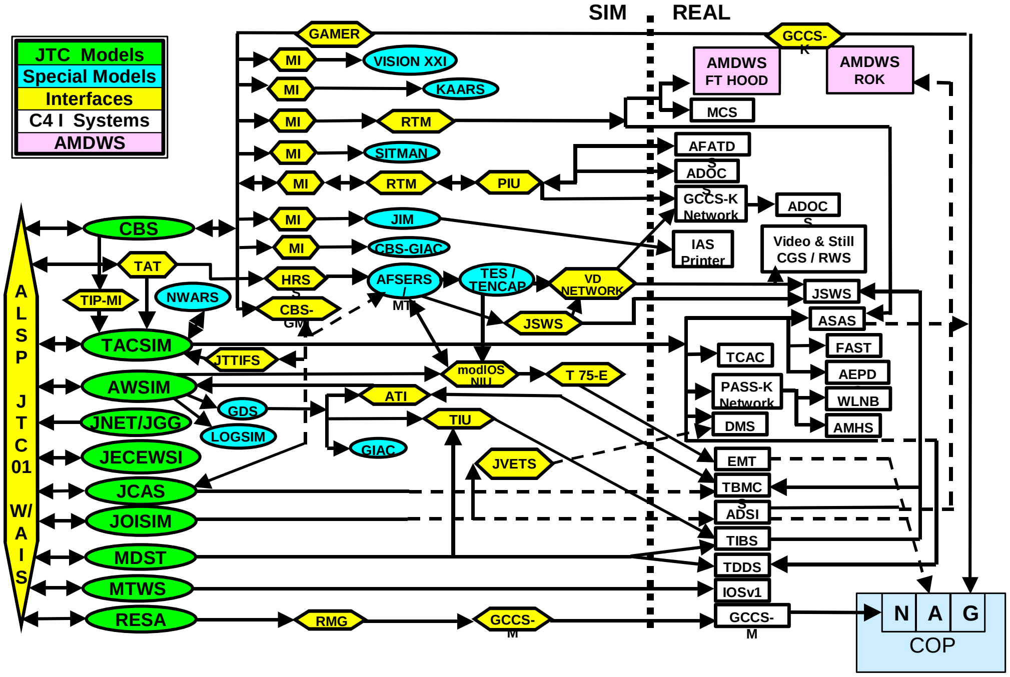
e. Develop a cost estimate for the exercise communication resources. Army Regulation 350-28, Army Exercises contains guidance on exercise funding from a macro level and discusses funding issues that should be addressed during this process. Also work with the installation Resource Management Office (RMO) to identify local funding issues and procedures. Questions to ask about cost of communication include: Are the lines (T1, WAN, Fiber Optics) added just for the exercise? If so, who pays for the installation and use of them? Who pays for the existing lines? Who pays for the use of existing lines? Who pays for the cost of calls? What is the process to determine costs on this installation? Who pays for the remotely distributing the simulation, if required?

f. Review the architecture for the simulations and the interfaces between the simulations and the training audience. To stay ahead in defining operational and systems architecture, staffs must continually identify responsibilities and information needs of each box, network device, and other related systems, and how they must communicate and to which other systems. Understand the systems and know how they all interact, including the type of information passed. Research the interrelationship of the information flow and technical relationships of command and control systems.

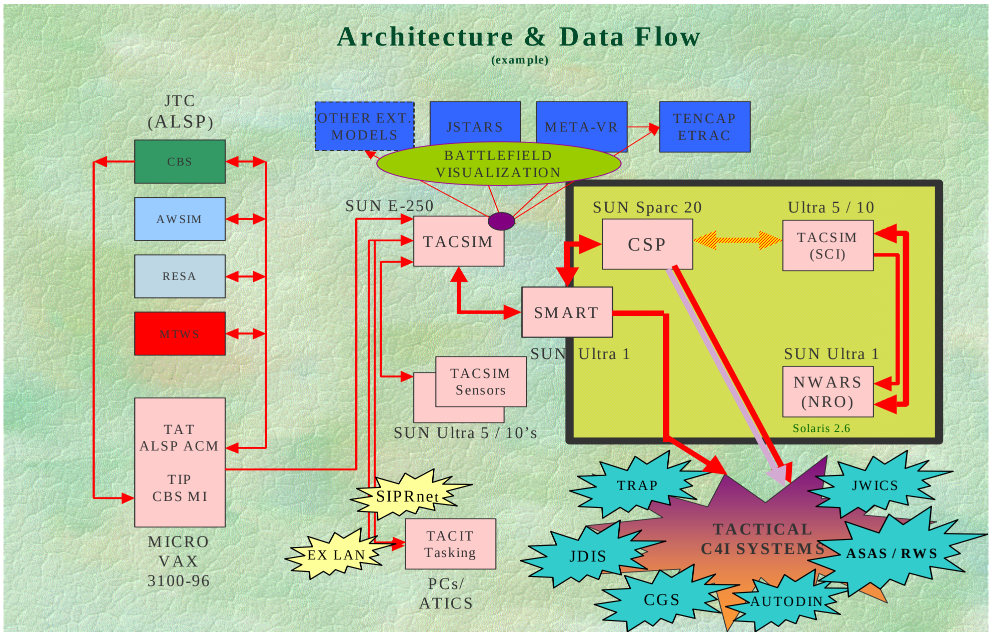
1. It is a technical issue to ensure the Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) system is technically tuned to provide maximum effectiveness – this is analogous to bore sighting a main gun to provide maximum accuracy.
2. It is an operational issue to decide how to use that available capacity effectively - analogous to fire planning for the company or battalion.
3. Commanders must decide "who sends what to whom, when and why", much like they establish reporting requirements in an analog environment. They allocate their C4ISR network/system resources among competing information feeds. They balance "must know now" with "may need to know quickly" and "might want to know sometime".

g. The following three figures provide views of sample simulation architectures. These architectures (if they were for the exercise) would provide the foundation or starting point for exercise communication analysis. The figures depict a complex simulation exercise, a medium simulation exercise, and a small simulation exercise, respectively.

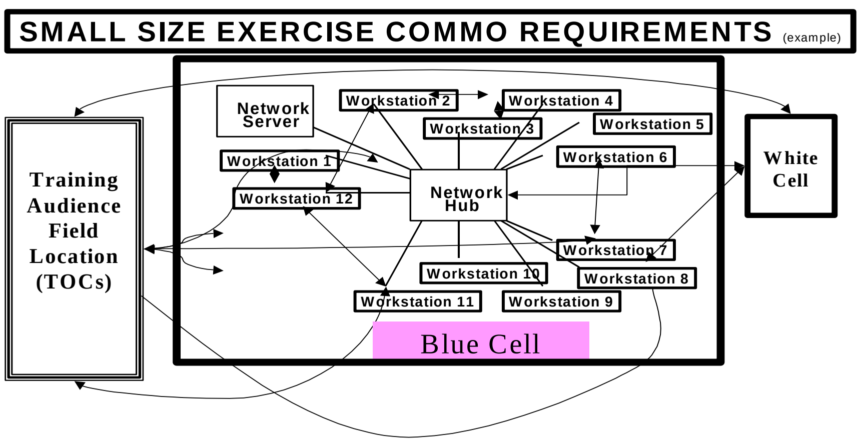
SIM/C4I ARCHITECTURE



COMPLEX EXERCISE USING SIMULATIONS



MEDIUM EXERCISE USING SIMULATIONS

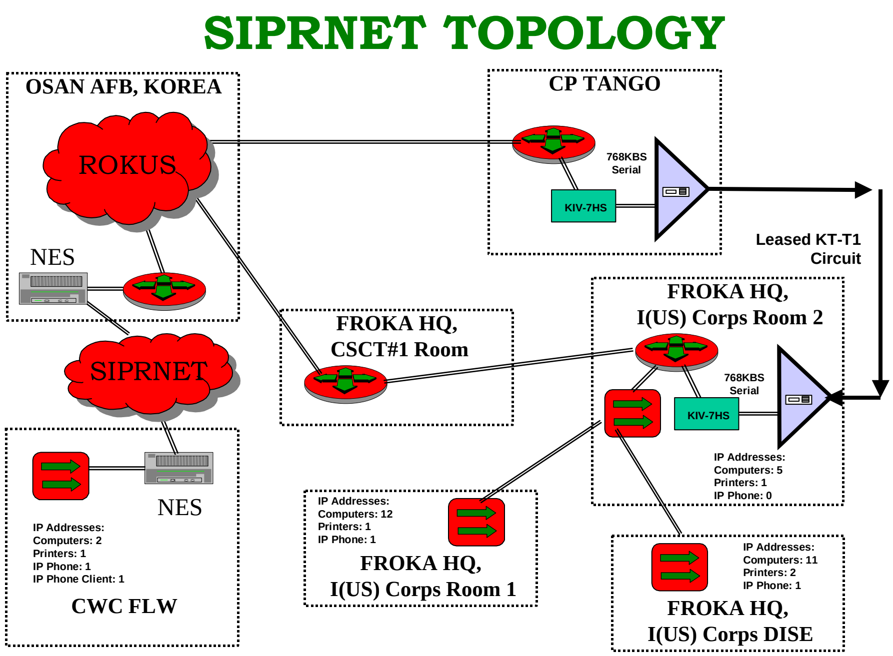


SMALL EXERCISE USING SIMULATIONS

h. Identify the security classification requirements for communications during the exercise. Army Regulation 350-28, chapter 4, and Army Regulation 380-19 contain information on security during an exercise. Section 4.A.3c of this chapter discusses security issues in detail. There must be a determination of the security classification before the total communication plan can be established. Consider the impacts of each of the following on the development, operation, and analysis of the exercise:

- Unclassified
- Classified (Secret, Top Secret)
- Secure Network   (SIPRNET)

The figure below provides an example of an exercise using the SIPRNET.



i. Identify single-channel communication requirements. For example, the workstations and training audience may require single-channel communication. Analyze the cells and determine the single-channel communication need for each cell.

j. Identify Internet technology. There is host of issues related to the Internet. The simulation staff needs to identify what the Internet uses will be. Does the simulation require the Internet to send and receive information? Do the cells require the Internet to communicate? Does the training audience use the Internet? What speed and bandwidth is normal for the unit? Do you have telephones that require Internet connections?
   1. File Transfer Protocol (FTP). This service provides the ability to move files between one computer and another.
   2. Simple Mail Transfer Protocol (SMTP). This service provides the ability to send mail electronically to users of other computers on an Internet.

k. Identify Network requirements. The two figures below provide examples of the types of network that some exercises use. Each exercise must identify its specific network requirements. Ask the following questions to start the identification process:
   - How many networks are required?
   - What will each network do?
   - Determine the acceptable delay of communication (latency) caused by the network. What delays are inherent to the network?   What impact does the

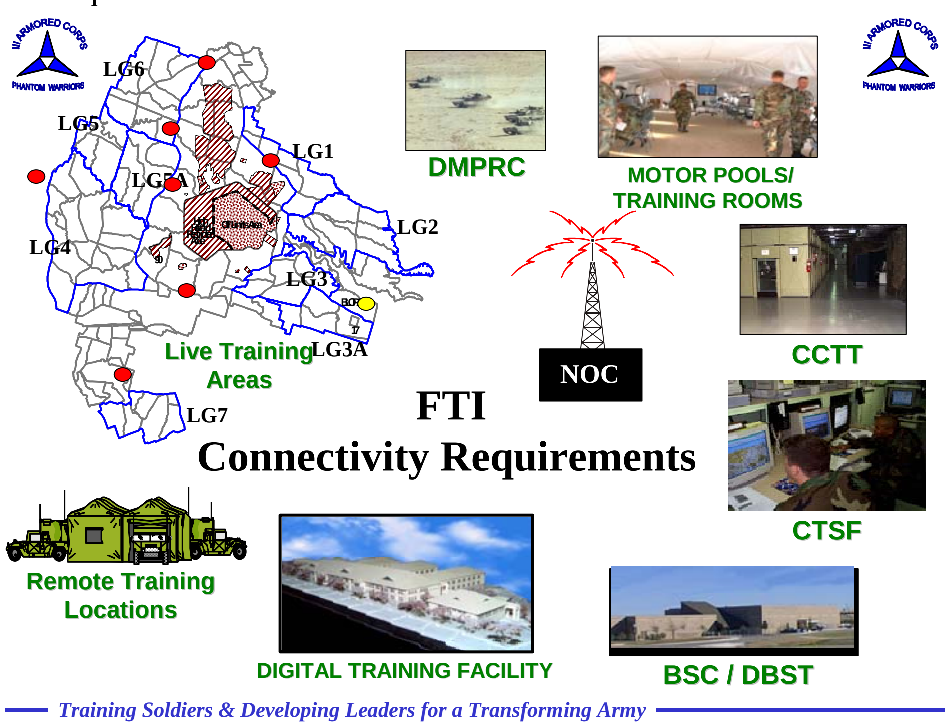
network delay have on the simulation (i.e., game messages update and processing)? Are the delays variable, or unpredictable?

- Determine if negative training occurs because of the network. Does the network do things better or worse than what a normal unit would experience in the field (i.e., faster transfer of information)?

Wide Area Network (WAN) usually refers to a network, which covers a large geographical area, and use communications circuits to connect the intermediate nodes. Transmission rates are typically 2 Mbps, 34 Mbps, 45 Mbps, 155 Mbps, 625 Mbps (or sometimes considerably more)

l. Identify Signal Operating Instructions (SOI) impacts. Who establishes the SOI and manages the SOI? What impact does the SOI have on the training audience and the simulation center? What tactical radios and frequencies will be used?

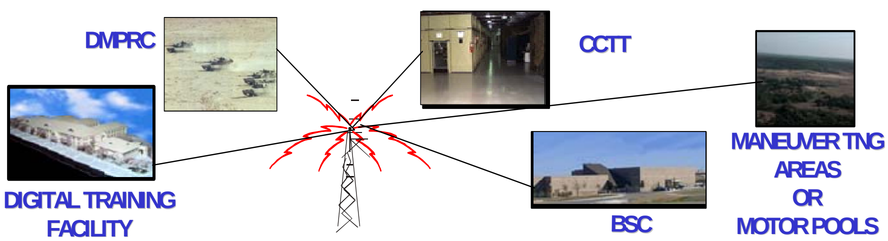
m. Identify Fixed Tactical Internet (FTI) and High or Upper Tactical Internet (UTI) requirements. Most installations describe the Fixed Tactical Internet and High Tactical Internet in different terms and words. The Fixed Tactical Internet is a network of data radios, consisting of Enhanced Position Location Reporting System (EPLRS) on towers controlled by an EPLRS Network Manager (ENM) that support unit digital training via the lower tactical Internet. Some installations define the fixed tactical Internet as a network communications system that replicates the lower tactical Internet. The following two charts represent how Fort Hood is analyzing the FTI and UTI requirement.



Fixed Tactical Internet

Links Tactical, Training, & Garrison Networks into Integrated Packages

- **Supports Unit Set Fielding, unit training and the Digital Multi-Purpose Range Complex (DMPRC).**
- **Lower FTI (L-FTI) provides communications support for the FBCB2 Situational Awareness and other digital platforms / systems at an installation.**
- **Upper FTI (U-FTI) may use MSE or NTDR to support higher level C4I systems such as ATCCS:**
  - **Enables TOC-to-TOC communications.**
  - **Gateway interface from the L-FTI to MSE and NTDR systems**
  - **Interface to Defense Satellite Communications System or to the MILSTAR systems.**
  - **Tie-in with CCTT, Digital Training Facility, BSC, Maneuver Training Areas and DMPRC.**
- **Must involve the G6/S6 and signal units in planning and management decisions**

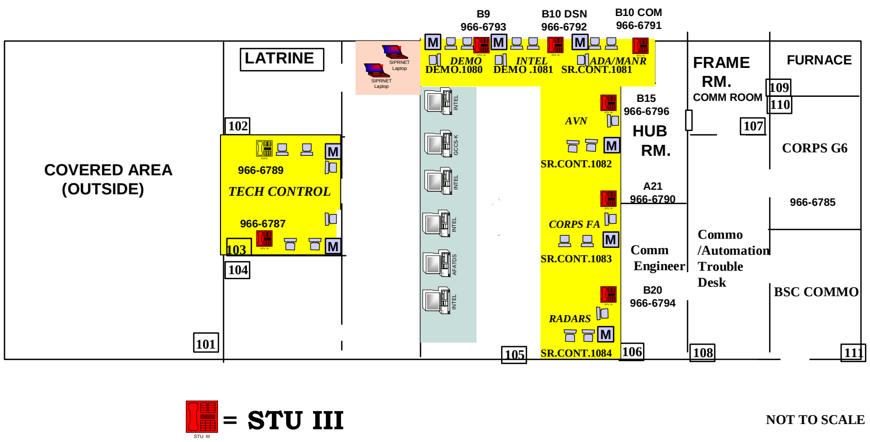


Training Soldiers & Developing Leaders for a Transforming Army

n. Identify analog and digital communication requirements. Identify system(s) and workcell locations that can use analog feeds. Identify system(s) and workcells that require digital feeds. Is commercial voice required anywhere in the exercise? What Defense Switched Network (DSN) lines are required? Are digital phones or analog phones needed? Satellite links required? Mobile telephones required? Modems needed and if so where? Does the security classification impact the analog or digital feeds? What about Fiber Optic needs? First lay out the exercise's analog requirements and then overlay the digital requirements. Below is an example layout of phone requirements in a simulation center together with a sample "cut sheet" to describe the requirements.

PHONES REQUIREMENT

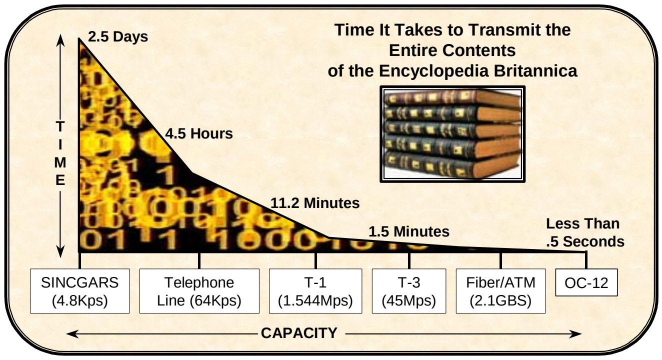
In the Simulation Center



Example Cut Sheet

				ROOM CUTSHEETS				
ROOM:	Room Number Assigned					BLACK BOX	DSN J-Box	
UNIT:	Your Unit							
QUAD	SUBSCRIBER	ODD	EVEN	DEVICE	PHONE #	P / H / Q	JACK	
1	Who this line directly belongs to	What pairs		Type of	Your phone #		>	Where on our
2		this line		Line such				patch panel
3		must hook to		as DCO				your line runs to
4		on J-Box		or FAX				
5								
6								
7								
8								
9								
10								
11								
12								
>	What quad your line must hook to on J-Box							
						RED BOX	Tactical J-Box	
QUAD	SUBSCRIBER	ODD	EVEN	DEVICE	PHONE #	P / H / Q	JACK	
1	Who this lines directly belongs to	What pairs		Type of	Your phone #	Where on our		
2	or which Net this line is	this line		Line such		patch panel		
3	monitoring	must hook to		as DNVT		your line runs		
4		on J-Box		or Gray39		to showing us		
5						the outside		
6						Pad, Hock &		
7						Quad		
8								
9								
10								
11								
12								
>	What quad your line must hook to on J-Box							

o. Identify Bandwidth requirements. What is the transmission requirement for the simulation exercise? Does the bandwidth accomplish the transmission requirement of the exercise? Is the bandwidth better or worse than the normal operations for the training audience? If better, should it be dumbed down to replicate realistic conditions for the training audience? An example of the data transmission times is as follows:



Data Transmissions Timelines

p. Develop the communication architecture for the exercise. This plan has narrative components with diagrams describing the requirement and how the flow of communications occurs during the exercise. The document is a dynamic process, which will change throughout the planning process. Develop a laydown for each exercise rather than relying on previous exercises. An overall architecture should be followed by specific requirements down to the cell level of detail. Have the organization approve the communication architecture in writing. Check to make sure the architecture represents reality and is not just an example. Establish periodic update procedures and ensure each update receives approval after review.

q. Communication Architecture should include at a minimum:

- Simulation feeds
- Long haul feeds and flow
- C4I feeds
- Communication assets
- C2 nodes
- Training Audience feeds
- Interactions between simulation and training audience

r. Conduct a communication exercise (COMEX). A COMEX is an exercise to test communication equipment and to train commander and staff, communications personnel, and small unit leaders in command, control, and communications (C3) procedures stressing communications procedures discipline and traffic flow and the proper selection of message precedence and communications means. (AR 350-28).

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Communications Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants ____

Primary Customer / Exercise Director ____

Phone Number____

Mailing Address____

Email Address____

Major Unit in Exercise POC ____

Phone Number____

Mailing Address____

Email Address____

Pre-Exercise Phase

Initial Research Phase

Exercise Review

Participating Organization(s)	Mission	Primary Training Objectives	Secondary Training Objectives	Simulations to be Employed in the Exercise	Training Audience Systems and Equipment to be Employed	Requirements

Locations requiring communications during the exercise

Organization	Location	Communications Required
PTA		
STA		
Cells		

Communications Structure

Organization	Who does the organization need to communicate with?	What does the unit's organic communications accomplish?	What responsibilities (if any) does the simulation staff have to the training audience organic equipment?	Does the simulation center provide more than just feeds? If Yes, what?	What are the responsibilities of the training audience and the simulation center in the overall communication architecture?	At what point does the simulation center stop servicing the communications at the training audience's location?
Sim Center			NA		NA	
Control Cell			NA		NA	NA
Response Cells - White - Blue - Red - Green - -			NA		NA	NA
Primary Tng Audience (PTA)						
Secondary Tng Audience (STA)						
Security						
Transportation						

Identify outside events that will impact exercise communications (*What activities near the exercise could degrade service?)*

Event	DTG of Event	Organization(s) Effected	Impact	Work-around, If Required

Develop a cost estimate for the exercise communication resources

Requirement	Estimated Cost	Organization Providing Funding / Funding Available	Funding Shortfall
Exercise peculiar equipment			
Repair parts, expendable supplies, and depot level repairs			
Contract support			
Communications lines added for the exercise (T1, WAN, fiber optics)			
Existing communications lines			
Telephone calls			
Fax			
Remote distribution of exercise, if applicable			

Exercise Director briefed on communications funding status and issues Date ______________

System (e.g., box, C4I tool, simulation, network device)	Information it provides / format	Information it needs / format	Interacts with:	Interface Between Simula-tion and Training Audience	Security Classification (Unclassified, Classified (C, SEC, TS,)), Secure Network (SIPRNET)	High Frequency Require-ment	Single Channel Requirement?

Review architecture

Identify Internet Requirements

Organization	Require Internet to send and receive information? If YES, what?	Speed and bandwidth required	Telephones require Internet connection? How many, where?
PTA			
STA			
Control Cell			
Response Cells			
Support Staffs			

Identify Network Requirements

Type of Network	What does each network do?	Inherent network delays	Network delay impact on the exercise	Negative training resulting from network	What does the network do better or worse than the unit experiences in the field (e.g., faster transfer of information)

Identify SOI impacts

Who establishes and manages the SOI? ____

Impact of SOI on the

Training audience ____

Simulation Center ____

Tactical radios and frequencies

Organization	Radio assigned to	Type radio	Frequency

Identify analog and digital communications requirements

System / location	Requires analog or digital feed (Specify)	Requires commercial and / or DSN voice (Specify)	Telephones needed? If YES, digital or analog?	Satellite link required (X)	Mobile telephone required (X)	Modem needed. If YES, where?	Security impact digital or analog feeds? If YES, specify	Fiber optics required? (X)

Identify Bandwidth requirements

Identify transmission requirement for the exercise ____________________Baud rate

Identify the bandwidth available __________________________ Baud rate
Does the available bandwidth accomplish the transmission requirement of the exercise?
YES ____ NO ____

Is the bandwidth better or worse than the normal operations for the training audience?
BETTER ____ WORSE ____

If BETTER, should the bandwidth be reduced to more closely replicate realistic conditions for the training audience?
YES ____ NO ____

Develop the communication architecture

Develop a diagram showing each exercise site (down to cell level), its communication requirement, and how the information flow will occur.

The communication architecture diagram should include, as a minimum:

- Simulation feeds
- Long haul feeds and flow
- C4I feeds
- Communication assets
- C2 nodes

- Training audience feeds
- Interactions between the simulation and the training audience

Communication architecture diagram developed and approved by the:
Exercise Director Date ____________________
Training Audience Date ___________________

Design Phase

Initial Planning Conference (IPC)

Develop a Initial Communication Architecture Concept Paper ____
Identify the Training Audience

____

____

Training Objectives

Identify Communications Subject Matter Experts

Review communications architecture with the:
Training audience ___ Reviewed with ___________________________
Date ________________
Chief Controller Date _______________________
Resolve issues ______

Mid or Main Planning Conference (MPC)

Brief the Communication Laydown ___

Review communications architecture with the:
Training audience ____
Reviewed with __________________________ Date ______________

Chief Controller Date _______________________
Resolve issues ____

Final Planning Conference (FPC)

Complete layout of the communications architecture ____
Clarification/resolution of unresolved issues ____
Review Facility and Technical Lay down ____

Exercise Phase

Conduct a COMEX

Organization	Connecting to: (Organization)	Communication Means	Communications established (X)	Issues	Resolution of Issues
PTA					
STA					
Control Cell					
Response Cells - White - Blue - Red - Green - Other					

Support staff					
Simulation ( )					
Simulation ( )					
Simulation ( )					
Simulation ( )					
Simulation ( )					

Communication Architecture Tested   Date ______________________
Results briefed to Chief Controller   Date ______________________
Results briefed to Training Audience   Date ______________________

During the conduct of the exercise, monitor the communication flow. Resolve issues. Record Lessons Learned.

Organization	Connecting to: (Organization)	Communication Means	Issues	Resolution of Issues	Lessons Learned
PTA					
STA					
Control Cell					
Response Cells - White - Blue - Red - Green - Other					

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4.A.3c Security

1. Information Systems Security

AR 380-19 *Information Systems Security (27 Feb 1998)* establishes Department of the Army Information Systems Security policy. It addresses the areas of communications security (COMSEC), computer security (COMPUSEC), and electronic security (ELSEC). Control of compromising emanations referred to as TEMPEST is covered in the confidential supplement AR 380-19-1.

This regulation prescribes security policy for the protection of classified and unclassified-sensitive information contained in or derived from telecommunications or automated information systems (TAIS) and non-communications emitters in the specific areas of:

a. Hardware security
b. Software security
c. Procedures security
d. Communications security
e. Personnel security
f. Physical security
g. Networks security
h. Electronics security
i. Control of compromising emanations (AR 380-19-1 (Conf.))

NOTE: Even though an M&S event may follow an unclassified scenario, integration of real world C4ISR systems may elevate the level of classification. A thorough understanding and compliance with policy spelled out in AR 380-19 is essential.

2. Physical Security

FM 3-19.30 *Physical Security (8 Jan 2001)* provides additional measures applicable to M&S events. These measures include key control, access control, structural standards, lighting, inventory control, and accountability.

An exercise Site Survey Checklist should contain the following security items:

a. Classified storage and disposal requirements.
b. Mailing address for classified documents.
c. Registered mail account.
d. Issue/Use/Control of access badges.
e. Unit responsibilities for physical security.

3. Internal Security

Exercise participants who are either careless or not aware of proper security procedures commit most security violations unknowingly. Very few are actually committed intentionally. Following the attached checklist will minimize chances for violations.

4. External Security

External security involves protecting the exercise from attacks by threat forces. These attacks could be direct attacks on our systems or could involve the introduction of a computer virus. When addressing external security, consider the following:

- **Threats -** Understand potential attack sources and methods
- **Vulnerability** - Reduce system weaknesses that open the exercise up to attack
- **Impact** - Given an attack, reduce its impact on the mission or damage to the system
- **Recovery** - Reconstitute, reconfigure or reroute after attack
- **Response -** Answer an attack with defensive or offensive countermeasures that reduce future threats and vulnerabilities.

Management Control Evaluation Checklist

The following checklist from AR 380-19 is intended to assist unit managers in the administration of the Army Information System Security Program, and highlights control measures applicable to the M&S community as well:

1. Are appropriate security personnel e.g., Information Systems Security Program Manager (ISSPM), Information Systems Security Manager (ISSM), or Information Systems Security Officer (ISSO) appointed?
2. Are risk analysis/vulnerability assessments performed on any systems that process Army information at the appropriate levels?
3. Are appropriate leadership/management personnel aware of the results of risk analysis/vulnerability assessments?
4. Are countermeasures identified based on the results of risk analysis/vulnerability assessments?
5. Are countermeasures in place that are commensurate with risk/vulnerability?
6. Is there a written security plan to document implementation of countermeasures?
7. Has leadership/management formally accepted the risk to process the information involved? Are the systems accredited?
8. Are countermeasures routinely tested (e.g., user IDs, passwords, audit trails)?
9. Is information System Security training performed at appropriate levels?
10. Are security incidents/violations (e.g., viruses, unauthorized entries or attempts) reported and investigated?
11. Have plans been developed to ensure continued operation in the event of major disruption (e.g., fire, natural disaster, bomb threat, civil disorder)?
12. Has a Configuration Control Board approved each network? Is there an appropriate security official serving as a member of each board?

Security Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants ____

Primary Customer / Exercise Director________________________________

Phone Number____

Mailing Address____

Email Address____

Unit Security Officers/Points of Contact

Unit	Name, Rank, Position	Contact Information

Design Phase

Initial Planning Meeting

Identify:

- Training audience
- Training objectives
- Training dates
- Exercise classification

Identify the Training Audience (X when completed) _____

____

____

____

Identify Training Objectives (X when completed) _____

Identify Training Dates (X when completed) _____

____

____

Develop Exercise Specific Security Guidelines IAW AR 380-19.

Address:
- Unit Security Standing Operating Procedures
- Hardware security
- Software security
- Procedures security
- Communications security
- Personnel security
- Physical security
- Network security
- Electronic security

Exercise Training location:

____

____

____

Classified exercise? Yes _____ No _____

Can facility be secured for a classified exercise? Yes _____ No _____

Do all individuals have appropriate security clearances? (X when completed) _____

Are key control procedures developed and disseminated? (X when completed) _____

Are access control procedures developed and disseminated? (X when completed) _____

Are structural standards acceptable for level of security? (X when completed) _____

Are classified document inventory control procedures developed and disseminated?
(X when completed) _____

Are appropriate arrangements made for classified storage? (X when completed) _____

Are classified waste disposal requirements developed and disseminated?
(X when completed) _____

Is mailing address for classified documents disseminated? (X when completed) _____

Is an account established for registered mail? (X when completed) _____

Are procedures established for the issue/use/control of access badges?
(X when completed) _____

Information Systems Security Personnel Appointments

Title	Name, Rank, Unit	Contact Information
Information Systems Security Program Manager		
Information Systems Security Manager		
Information Systems Security Officer		
Other positions:		

Has a risk/vulnerability analysis been performed on the information processing systems? (X when completed) _____

Date performed ____________________

Performed by ____________________

Have the results of the risk/vulnerability assessment been briefed to key leaders?
(X when completed) _____

Leadership Position	Name, Rank	Contact Information

Have countermeasures been identified based on results of the risk analysis?
(X when completed) _____

Is there a written security plan to document implementation of countermeasures?
(X when completed) _____

Are countermeasures routinely tested (e.g., user IDs, passwords, audit trails)?
(X when completed) _____

Has accreditation been completed on the information processing systems?
(X when completed) _____

Date completed ____________________

Performed by ____________________

Are procedures established to report security incidents/violations (e.g. viruses, unauthorized entries)? (X when completed) _____

Are power sources available to ensure uninterrupted operation of the information systems? (X when completed) _____

Have plans been developed to ensure continued operation in the event of major disruption (e.g., fire, natural disaster, bomb threat, civil disorder)? (X when completed) _____

Has an assessment been done for the chemical-biological-terrorist threat?
(X when completed) _____

Are countermeasures/procedures in place commensurate with chemical-biological-terrorist threat? (X when completed) _____

Exercise Phase

Unit security personnel can use the above checklist to also ensure compliance with established procedures during the conduct of the exercise.

Post-Integration Phase

Exercise Training location(s):
____

____

____

Have all classified materials been accounted for?   (X when completed) _____

Has all classified waste been destroyed in accordance with established procedures?
(X when completed) _____

Have classified hard drives been removed from computers used to process classified information during the exercise?   (X when completed) _____

Have classified hard drives and other information processing equipment been properly stored/secured?   (X when completed) _____

Have exercise access badges been recovered from all personnel?
(X when completed) _____

Have all keys to exercise facilities been recovered from exercise participants?
(X when completed) _____

4.B.1 Conduct Pre-integration Activities

4.B.1a Design of Simulation Event

1. Introduction

This section provides a methodology for ensuring that the utilization of simulations increases training effectiveness. An outline for the design and conduct of effective training exercises using simulations is included.

A computer-based simulation supports and drives specific portions of a training exercise to enhance the delivery of information to the training audience. The trainee learns from the simulation exercise by performing the activities in a context that is similar to the actual event, with similar equipment and procedures, (Alessi & Trollip, 1991). A well-developed training strategy should be an integral part of the simulation development process, from conceptualization through the maturity of a fielded simulation. Developing a simulation database to drive an exercise without clearly defining the training audience and learning objectives will most often lead to unfulfilled training expectations. Negative reactions can cause setbacks to a potentially worthwhile training program, or in some cases, cancellation.

2. Background

A large percentage of simulation-based exercises are designed to train multi-faceted functions through the use of constructive simulations. Constructive simulations involve software representation of two or more opposing forces, using rules, data, and procedures that are designed to depict an actual event or real-life situation (Tucker, 1993). Prior to the implementation of a constructive simulation exercise, an in-depth needs analysis is conducted, and the key indicators of the success of the participating officers and their staffs are identified.

The U.S. Armed Forces have developed simulations that train staffs to work as integrated teams under realistic wartime conditions. This remainder of this section presents the application of simulation-based technologies utilizing an emergency management-training scenario as an example. A four-phase approach to designing simulation exercises is provided, along with an example based on a military installation disaster preparedness training exercise. Even though the particulars would be different based on various scenarios, the methodology is the same.

3. Exercise Participation

a. **Customer.** Prior to beginning any planning for an exercise it is necessary to identify the customer for the given event. The customers for the military installation disaster preparedness training exercise would include military officials, contractors and local level managers responsible for overseeing emergency management personnel, emergency support agencies, and representatives from field operations such as local fire stations, hospitals, public utilities, and sheriffs' offices.

b. **Facilitator.** The facilitator will be responsible for identifying the target training audience, and will centralize the overall scope of the exercise. In the example, the facilitator will gather information on the organizational structure of the specified counties' emergency management personnel and oversee the design of the training exercise.

4. Training Methodology

During the preparation for and conduct of the simulation exercise, a four-phase approach will be utilized which involves a pre-integration, integration, analysis/feedback, post integration phase.

a. Pre-Exercise Activities

In the example, the pre-integration phase is initiated once the installation commander has identified the need for exercising the emergency management personnel on the installation. Copies of the organizational structure and operating procedures for each participating organization assigned to the installation are provided to the training facilitator. Based on the training objectives specified by the installation commander, an exercise plan is developed. Design emphasis is placed on the ability to create a stressful environment for each trainee within the target audience. The instructional goal is to significantly improve the decision-making skills of the participants by having them practice their responses to stressful situations created by the simulation exercise.

b. Initial Research

After the facilitator has identified the target audience (e.g., installation and local community emergency management agencies) and has established that the training will be based on conducting a computer-based simulation exercise, research must then be conducted in the following areas:

1. Identifying the organizational structure of the organization cell;
2. Identifying the organizational structure of the field operations (e.g., fire and rescue services, local hospitals, and the sheriffs' offices) and their standard operating procedures;
3. Securing diagrams of the facilities to be included in the communication layout;
4. Identifying standard procedures for communicating internally to the installation and with county, state, and federal agencies;
5. Identifying assets and resources available within the management area; and
6. Identifying the area of jurisdiction for each of the emergency management agencies.

This information will then be used to design the simulation exercise. To accomplish this, a concept paper describing the layout of the training simulation is developed. The paper is then presented for review by the facilitator during the initial planning meeting.

c. Design

A functional matrix of the critical responses and tasks that may be required during a state of emergency should be laid out. This matrix serves as a point of reference for designing the simulation exercise. In addition to compiling the matrix, three meetings are conducted during the design phase in which effective training objectives are developed and a suitable instructional strategy is planned.

1. Initial Planning Meeting

During the initial planning meeting, a clear and concise definition of the target training audience is established. Training objectives are developed, based upon input from training facilitators, subject matter experts, and representatives from the target training audience. An outline for the conduct of the exercise is planned based on the capabilities and limitations of the computer model. These elements are key to a successful training program.

An agenda of development objectives for the initial planning meeting is provided to all participants at least a week in advance, with time allotted for proposing revisions. A training facilitator should lead the initial planning meeting to ensure the agenda is covered, guidelines are observed, and that an effective exercise concept is developed.

The training facilitator is responsible for ensuring that each member of the development team participates in the brainstorming session in the initial planning meeting, while maintaining the focus of the agenda. The facilitator also ensures that each part of the agenda results in a product that will serve to support the exercise design. Opening remarks by the installation commander provide the overall purpose and direction for the simulation exercise.

Initial Planning Meeting
May 17, xxxx
Disaster Preparedness Drill
Drill Date: July 10 - 14, xxxx

TIME	TOPIC
0800-0810	Introduction
0810-0820	Opening Remarks
0820-0900	Drill Objectives
0900-1000	Proposed Drill
1000-1100	Technical Aspects
1100-1200	Finalize Concept

Sample Agenda for Initial Planning Meeting

Options proposed at the initial planning meeting will aid in developing an accurate definition of the target training audience and centralizing the overall scope of the exercise. Once the target audience and scope of the exercise are adequately defined, the subject matter experts provide a capability review for simulation, communication, and facility support. A detailed review of all three technical areas is planned for a later time in the process, and will result in detailed specifications for each area.

By reviewing the organizational structure, each agency can verify the structure and responsibilities within its own organization to ensure the exercise plan is both realistic and feasible. The objectives set forth by individual organizations are reviewed during this phase, and those that do not contradict the overall training objectives are incorporated into the exercise.

Finally, a fully developed concept is reviewed, and assigned responsibilities for deliverables are reiterated. Upon completion of the initial planning meeting, a copy of all minutes is published and distributed to all participants.

2. Interim Planning Meeting

The design emphasis during the interim planning meeting focuses on ensuring that the exercise will allow the various installation organizations (e.g., garrison headquarters, individual units, fire, police, medical, etc., and the local community) to rehearse the communications that are necessary prior to, during, and after an actual emergency situation occurs. Providing for accurate communication within and among the different participant organizations is a critical part of the design phase.

Building upon the objectives established during the initial planning meeting, the facilitator designs a system to track important aspects of the exercise. Prominent design issues at this stage are the exercise structure and focus of control. All elements of the response to an emergency situation must be represented to ensure that a sense of realism is provided for the target audience in the simulated environment. Replication of those functions and organizations not participating within the exercise must be well designed to ensure transparency. The interim-planning meeting results in establishing four elements of the exercise: a lead-in scenario; exercise focus of control; technical communication procedures; and facility layouts.

The lead-in scenario will establish the starting position for each of the participating organizations, and ensures that all participants initiate the exercise with the same perspective. This information must be shared with the simulation technologist who builds the database so that the simulation is in accordance with the scenario information.

For certain simulated disasters (e.g., an impending hurricane, fire, or flood), lead time must be provided prior to the simulation event in the form of a starting position for the disaster that is outside of the participating installation or local county. In other exercises, installation commanders might desire a spontaneous event such as an earthquake or tornado. Once again, the characteristics of the simulated disaster would depend upon the training objectives established during the initial meeting.

Activities leading up to the initialization of the simulation must be scripted. The scenario and starting positions must be sent to all participants for review prior to the final coordination meeting. Feedback on changes should go through the facilitator to ensure that responsible individuals act upon the revision.

Based on the scenario, the exercise control plan is developed. One lesson learned by the U.S. Armed Forces when using computer simulations is that the agencies participating in the exercise cannot operate as both the simulation controller and the training audience. This is not limited to staff-level participants, but includes all individuals within the decision-making process including those in leadership positions. By including a control cell as a buffer in the design of a simulation exercise, then regardless of the exercise elements the simulation presents, the training audience will be reacting to the situation within the scenario instead of "gaming" the computer.

In the emergency preparedness example, if the emergency management cell is activated with the installation commander in charge, then that individual would participate as part of the target audience and would not have control over the scenario elements nor access to data exclusive to the control of the simulation. This ensures the decision-making processes of participants occur as a result of scenario information presented by the simulation, and not due to anticipation of simulation control cues. Control should consist of all those feeds that are needed to force the cell to operate all functions. This includes, but is not limited to, interaction with federal and state agencies, adjacent counties, private industry (e.g., gas companies, electric companies, etc.), and units in the field. Not only does the control cell provide input for the scenario, but it also deals with requests made by the participants. For instance, requests for assistance or information would be reviewed by the controllers and responded to in a realistic manner and time frame according to the scenario and training objectives.

Once the size of the training audience and the control staff are identified, the technician and the facilitator can conduct site surveys of the facilities that will be used during the exercise. Whenever possible, facilities and equipment that are used during an actual disaster should also be used during the exercise. Additional equipment from the computer simulation and equipment for a control cell should be accounted for in the power and facility layouts. Communication technicians should be a part of site surveys, so that all communication links available in the real world system are replicated in some manner. Attention should be paid to real-world equipment being fed computer generated signals and the feasibility of supporting these equipment. A location should also be identified for the purpose of conducting After Action Reviews (AARs). Diagrams that include furniture, equipment, and communication conductivity should be available for all facilities. Once facilities are agreed upon, a timeline is developed that will allow for equipment installation and system tests prior to the start of the exercise.

During this period of time, contact is made with subject matter experts who will be available to participate in the exercise. These individuals (e.g., FEMA representatives, disaster medical care managers, news personnel, etc.) should represent a variety of fields and are needed to provide expertise on specific topic areas. Prior to the simulation exercise, input from these individuals can ensure that realistic situations are developed to meet the training objectives. Participation by subject matter experts in the design phase contributes to the fidelity and credence of the simulation exercise.

3. Final Planning Meeting

The same participants who attended the initial planning meeting should be present at the final planning meeting to ensure continuity. The purpose of this meeting is to lay out the exercise for all individuals from top to bottom. All aspects of the training event should be reviewed, and any unresolved issues from the previous meeting should be resolved (see Figure below for a sample agenda). To facilitate completion of the design phase, copies of the briefing slides should be made available for review by all principal participants involved with the exercise.

Final Planning Meeting
June 17, 20 xxxx
Disaster Preparedness Drill
Drill Date July 10 - 14, 20 xxxx

TIME	TOPIC
800-0810	Introduction
0810-0820	Opening Remarks
0820-0900	Sub-drill Objectives
0900-1000	Scenario / Control
1000-1030	Technical Aspects
1030-1100	Approve Concept
1100-1200	Facilitator Briefing

Sample Agenda for Final Planning Meeting

Once approved, the database goes to final review and the system is checked to ensure that no software or hardware problems exist. Finally, the central training facility is set up, and all systems are checked and verified to be operational prior to commencement of the training event.

a. Exercise Activities

Prior to the start of the simulation exercise, there is a need for preliminary training for both the controllers and the training audience. Controllers need to be aware of the overall scenario and the specific positions or roles they will play. Also, if the controller is interacting with the computer simulation, he or she will require a certain amount of training on use of the equipment. As a group, the training audience will need a briefing on the objectives, scenario, and exercise architecture. A short period of time should be allotted for the training audience to conduct positional training and communication checks. The simulation exercise should not be implemented until these elements are in place.

The following section describes a simulation exercise based on a hypothetical installation response to a simulated hurricane. This is only one example, as an actual exercise would be designed for a specific training audience based on a determined set of instructional objectives. For a four day training exercise, an installation commander may make a decision to start on a Friday afternoon with a simulated disaster due to strike within 24 hours. The benefit of this training situation is that the emergency response cell can be activated after offices are closed on Friday, and will not interfere with regular business hours.

b. Example Exercise

On a Friday, a simulated state of emergency is declared in response to an approaching hurricane. The installation commander activates the emergency center and, based upon information from the National Weather Center and state agencies (control functions), begins preparing the installation for the anticipated state of emergency. The first segment of the simulation exercise involves the preparation of the participating agencies, individuals within the scenario (residents of the installation), resources, and structures for the impending emergency.

Decisions that are made are logged into the simulation computer, and the simulated responses are enacted. For example, if the decision to evacuate an area is made and logged into the system, then simulated entities representing individuals and vehicles would be moved to designated shelters within the scenario or to locations off the installation. These responses would be affected by factors such as heavy traffic, accidents, or roadblocks limiting travel, and occupancy limits at shelters.

To monitor data related to the actions of a vehicle within the scenario such as a military police car, the simulated vehicle must be located within the scenario where it can make 'observations,' or a command must be made to send the vehicle to that location to obtain information.

As the hurricane approaches, the situation begins to deteriorate and the installation commander may receive reports of injuries, minor property damage, and flooding. The preparation segment continues until the leading edge of the hurricane is an hour away from entering the county. As this segment ends, the elapsed time would be noted so that an After Action Review can be conducted on activities related to this segment.

The second segment of the training exercise continues as the hurricane directly impacts the installation, and lasts until approximately 12 hours after the hurricane has passed. During this segment, information to the emergency response cell would slow, or possibly cease until the simulated hurricane has passed over the operational areas.

Meanwhile, the most severe damage has occurred throughout the installation and local county, and a course of action is needed for execution once the storm has passed. After the hurricane has passed through the installation, information on the condition of residents and property, and the status of emergency agencies begins to flow in. The installation commander's plan of action must be adjusted to deal with the incoming events.

The third segment involves restoration of essential services, additional gathering of information on the status of individuals and property, and assessment of how well emergency agencies are dealing with the situations at hand. The installation commander and participating agencies continue to analyze the situation, and decisions are made to provide support as the need arises. As each segment of the exercise ends, the elapsed time is again noted for reference during the After Action Review.

Throughout the simulation exercise, additional emergency response scenarios are inserted (e.g., looting, secondary fires, water shortage, etc.) to enhance the exercise. The control cell must ensure that the tempo of the exercise maintains an adequate state of stress for the participants without totally overwhelming them. Otherwise, the effectiveness of the training is jeopardized.

Other distractors must also be programmed into the exercise to ensure that the situation is realistic to the participants. Involvement with local press in mock interviews, TV-fed weather updates, and unforeseen emergencies (e.g., damage to a shelter) should be inserted so that all critical functions that the installation commander and his staff must be prepared to perform are exercised.

5. Analysis/Feedback Phase

To ensure that the exercise participants have the ability to review their performances, an after-action review (AAR) is conducted for each segment of the simulation exercise. The purpose of the AAR is to allow the installation commander and other participants to examine the decisions that were made during the simulation, and to discuss the effectiveness of actions taken.

The training facilitator who leads the AAR encourages participants to discuss issues and possible solutions. Also, it is helpful to have subject matter experts on hand for the AARs, so that they may offer advice in their respective areas. For instance if the installation commander struggled with a mock TV interview, a representative from the local news station might present some insight on interview techniques during the AAR. A sample agenda for an AAR is presented in Figure below.

10 minutes	Review the events, decisions, and responses that took place during the training segment. This might include re-playing the log tape of the simulation segment, recapping the major decisions made during the course of the segment, and reviewing a timeline of key responses by the emergency action cell.
10 minutes	The installation commander and key participants provide a brief commentary on the exercise from their points of view.
60 minutes	Based on observations and an analysis of the computer simulation, the facilitator will identify key issues for the participants to discuss. These issues should be cleared with the installation commander before the AAR begins.
10 minutes	The installation commander and each key participant will brief the remaining participants on the key issues discussed, and any suggestions for improvement or revised actions will be discussed at this time.

Example of an After Action Review (AAR) Agenda

The process of following each exercise segment with an AAR allows each participant in the simulation exercise an opportunity to discuss his or her perspective, and to work toward an understanding of the functions and responsibilities of other participating agencies and emergency response personnel.

At the end of the simulation exercise, there should be a wrap-up session for all participants to discuss lessons learned, and to develop plans for modifications to current procedures or policies where necessary, this is the beginning of the post integration phase. The facilitator should request that each participant and controller in the training audience provide a written evaluation of the simulation exercise. This information should be compiled into an after-action document along with an outline of the exercise design and any lessons learned during the implementation of the simulation.

6. Conclusion

The key to the success of a simulation exercise, whether for emergency management or some other training need, is ensuring that the training design methodology maximizes the effectiveness of the learning experience.

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Design of Simulation Event Worksheet

Name of the Exercise ____

Exercise Organization____

Exercise Participants: ____

Primary Customer / Exercise Director______________________________________

Phone Number____

Mailing Address____

Email Address____

Facilitator ____

Phone Number____

Mailing Address____

Email Address____

Pre-Exercise Activities

Initial Research Phase

Identify the Structure of Each Participating Organization

Name of Participating Organization	Date Organizational Structure is to be Provided	Date Structure is Received

Secure Diagrams Of The Facilities To Be Utilized, including Communication Layout

Facilities to be Utilized	Date Facility Diagram to be Provided	Date Facility Diagram is Received

Communication Structure

Name of Participating Organization	Date Communication Structure is to be Provided	Date Communication Structure is Received

Exercise Design Activities

Initial Planning Meeting

Develop an Initial Concept Paper ______ (X when completed)
Develop Function Matrix ______ (X when completed)

Identify the Training Audience

____

____

____

Training Objectives

Identify Subject Matter Experts

Outline for the Conduct of the Exercise _______ (X when completed)

Based on of the Computer Model:
Identify Capabilities that Support the Exercise _____
Identify Limitations that Support the Exercise _____
Develop Agenda for the Initial Planning Meeting _____

Conduct a Detailed Review of Technical Areas
Simulation Area _____

Facility Area _____

Communication Area _____

Obtain a Memorandum of Agreement ______ Date signed _____________

Interim Planning Conference / Meeting
Lead-in Scenario ____
Exercise Focus of Control ____
Communication Laydown ____
Facility Layouts ____
Obtain a Memorandum of Agreement _____

Final Planning Conference / Meeting

Complete Layout of the Exercise _______ (X when completed)
Clarification of Unresolved Issues _______ (X when completed)
Review Facility and Technical Laydown _______ (X when completed)

Exercise Activities
Startex / Simulation Set _______ (X when completed)
Communication Tested _______ (X when completed)
AAR Capability Ready _______ (X when completed)

4.B.1b Facility Survey

The individual responsible for the physical plant of the simulation and control cells conducts the Facility Survey during a visit to the exercise site. This visit and survey is to ensure that the location and facilities will meet the requirements for space, power, climate control, communications and TOC locations. Whenever possible, the Facility Survey is conducted just prior to, or in conjunction with the Initial Planning Conference. Even if the site has been utilized for a past exercise this visit and survey should still be conducted to account for any changes brought on as a result of the Facility Survey.

During the facility survey, all rooms within the designated simulation center and associated facilities should be available for measure. Power and communication requirements for each should also be determined. Any workspace or facility not meeting the standards are noted as unresolved issues and addressed at the Initial Planning Conference.

If there is more than one location, then a separate facility survey should be conducted for each site.

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Facility Survey Worksheet

(If more than one location a separate survey should be conducted for each site)

The facility survey(s) should be conducted prior to or concurrently (if possible) with the Initial Planning Conference to determine the exercise unit's/installation's ability and secure its agreement to provide support for the exercise. The following survey should be conducted for each site and facility to be utilized during the exercise.

Name of Exercise ____

Facility Name ____

Location ____

Unit training at this facility ____

Obtain Blue prints of the overall site if available - Obtained on ______________
If possible obtain photos or take digital measurements of the physical plant.

Is the exercise classified? Yes_________ No_________

Classified storage and disposal requirements______________________

____

____

Mailing address for classified documents__________________________

____

____

Registered mail account____

Access badges as exercise passes________________________________

Responsibility for physical security______________________________

What are the security deficiencies of the physical plant? _________________________

1. Primary Building to be Utilized:

Building Address or number ____

Are blue prints available of the building? Yes_________ No___________

Obtain copy if available - Obtained on ________________________________

2. Is more than one building to be utilized at this site? Yes_________ No_________
If yes obtain the following information on each additional building that will support the exercise.

Building Address or number ____
Are blue prints available of the building? Yes_________ No___________
Obtain copy if available - Obtained on ________________________________

Building Address or number ____
Are blue prints available of the building? Yes_________ No___________
Obtain copy if available - Obtained on ________________________________

Building Address or number ____
Are blue prints available of the building? Yes_________ No___________
Obtain copy if available - Obtained on _________________________________

Building Address or number ____
Are blue prints available of the building? Yes_________ No___________
Obtain copy if available - Obtained on _________________________________

3. Complete the accompanying information sheet to collect the following information on each building (one information sheet per building):

Building Address or Number____

Usable Square Footage of the Building__________________________________

Total Power Available to the Building__________________________________

Number of Restrooms in the Building__________________________________

Climate control in Building (AC)______________________________________

Communication Assets____

Fire regulation for Max Occupation of the Building _____________________

Room Number	Size of Room	Number of Wall Sockets	Number of Electrical Circuits for the Room

4. Obtain the following information to ensure facilities are adequate to support the exercise event.

Name of Cell, Workstation, or Functional Area_________________________

Personnel requirements

Workstation operators____

Operations center augmentation________________________________

Communication augmentation__________________________________

Exercise control augmentation_________________________________

Administration section augmentation____________________________

Audiovisual section augmentation_______________________________

Escort officers for senior observers and DCG-T, CAC_____________

Setup and tear down manpower________________________________

Equipment requirements:

Simulation Workstations______________________________________

Personal Computers____

Shredders____

Copiers____

Audiovisual Equipment____

Maps and map boards_______________________________________

Desks____

Tables____

Chairs____

Communications Requirements**:**

Commercial Voice____

T-1 Lines____

DSN lines____

Tactical Radios / Frequencies__________________________________

Tactical Digital Systems_______________________________________

Approval for use of "brick" radios, and frequencies_________________

MSE lines dedicated for O/C use______________________________

Satellite links, if required____________________________________

Mobile telephones____

Maneuver Control System terminals, if used by the unit____________

LAN____

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4.B.2 Develop Timeline Structure for Integration

4.B.2a Exercise Timeline

The initial task of the FA 57 in generating an exercise timeline is to determine exactly what time is available to plan and execute the simulated training event.

To facilitate this process, the FA 57 should utilize a backward planning approach to ensure the accomplishment of critical milestones and to assess the impact of slippage in achieving these milestones. In this proven and productive approach to timeline generation, one starts where one wants to end up, and then works backwards. That is, first, consider the desired end state of what is to be achieved. Then, determine what events must take place to accomplish this end state. It is critical to consider relevant research requirements as the FA 57 may be required to support units they are unfamiliar with or new equipment that may have been introduced to a participating unit. These research requirements will assist in developing training requirements and should be considered at this stage. The amount of research required is based on the experience of the FA57 and availability of subject matter experts to assist in the more technical areas such as simulation architecture or unit mission sets. Next, consider what organizational support is needed to facilitate the simulation. Then, decide what knowledge and skills the participating units will need to utilize the prescribed simulations. Finally, consider how the participants are given the opportunities to acquire that knowledge and those skills.

What makes this process so critical is that the decisions made at each level profoundly affect those to be made at the next level, and possibly those already made at previous levels. For instance, the knowledge and skills to be influenced will determine the kinds of organizational support required, and may change the scope of training or influence the facilities required to support your event. Whenever decisions or products are revised, trainers/exercise planners must trace back through earlier development and correct all related products/components, whether they are interim products, or final components of the Simulation Control Plan or the related training support package. The importance of keeping all products/components current and in agreement with each other cannot be emphasized too strongly. This is also one of the most difficult challenges in exercise planning and preparation.

This exercise timeline is produced to aid the director of the simulated event in meeting critical milestones. Each exercise is considered an independent event and should be viewed as such. What works one time may or may not work a second time. This could be due to software changes, hardware changes, etc., that may generate changes “down line” requiring increased time requirements for execution. The planning cycle for exercises such as these takes place over approximately an eighteen-month period. Changes to the original timeline will occur and should be handled with minimal disruption to the simulation event timeline to maintain focus on the event itself and not the problems.

It is imperative that the FA 57 be actively involved with each and every step of the process to ensure that objectives and capabilities stay within the framework of the simulation. Failure to be proactive and involved may result in expectations outside the intended design capabilities of the simulation, and require either modifications to the simulation itself or development of multiple workarounds to meet training requirements. The timeline is for a major Army or Corps exercise planning sequence. The timeline information in this paper is an example for reference only. Internal Standard Operating Procedures (SOPs) and simulation event requirements may dictate compression of this timeline to meet mission requirements. The smaller the unit, the more compressed the timeline can become because fewer products must be generated at various levels. However, the FA57's requirements are essentially the same for any exercise regardless of size due to the technical nature of the communication requirements, simulation requirements, exercise configuration, and contractor support.

1. **Phases of the Exercise Execution Timeline**

The timeline is composed of a variety of conferences and reviews that are conducted in conjunction with the planning and execution of the simulated event. These include, but are not limited to, the Concept Development Conference, Initial Planning Conference, In-Progress Reviews (IPRs), and a Final Planning Conference.

The following descriptions provide guidance as to what should be accomplished at each of these conferences, and the products associated with each. Each simulation unit will have a variety of unique conferences and products based on unit SOPs. This list provides the milestones required to establish the foundation for a successful simulation event.

2. **Concept Development Conference (CDC)**

The purpose of the CDC is to prepare for the Initial Planning Conference (IPC). It is an internal, exercise-planning meeting used to determine what topics need to be addressed at the IPC. During the face-to-face session with the unit, exercise representatives will request unit SOPs, training objectives, MTOEs and Battle tasks to establish viable and measurable training. During this task selection process with the unit commander, the exercise representative will encourage developing challenging, measurable, and doctrinally sound training objectives. The exercise representative should conduct an orientation briefing outlining how the capabilities of the simulation facilities match the unit's mission and commander's intent. Key products that are finalized prior to IPC are: exercise task organization (to include non-observed units); scenario (theater of operations, concept of operations, and phase of execution); higher command; exercise location; draft exercise timeline; and confirmed date of the Seminar Weekend which is a series of workshops tailored to assist the commander and their staff in determining focused mission sets necessary for the exercise. The CDC is normally scheduled as far out as possible dependent upon mission receipt.

3. **Site Survey**

The purpose of the site survey is to evaluate the capability of an exercise site to facilitate an exercise. Each facility is evaluated for space (square footage), availability, telecommunications, and temperature controls in the buildings. To conduct an effective site survey, the total number and configurations of workstation cells, as well as telecommunications requirements, need to be assessed for availability. Any improvements that need to be made to the building must be identified. In addition, the survey team will locate an area for the unit to establish their Tactical Operation Centers (TOCs) in a field environment. Ideally, the area should be sufficiently off the hard stand to emplace the TOC tactically. A final product from the site survey should include the initial support plan and the initial communications plan. This information will be included as part of the Memorandum

Of Agreement (MOA) to ensure the exercising units know what their responsibilities are, and what the responsibilities are regarding site preparations.

4. **Initial Planning Conference (IPC)**

The purpose of the IPC is to obtain critical information, and the exercised unit commanders' signatures on the Memorandum of Agreement (MOA). The simulation facility will schedule an IPC with the exercised unit in accordance with the exercise planning timeline. The IPC should ideally occur as early as the tasking process allows. Contact with the exercise unit and a formal notification memorandum should be sent no later than 30 days after being tasked with the exercise, using an approved format defined by SOP. The simulation facility will request essential documents for exercise development prior to the IPC. During the IPC, the exercised unit and the simulation facility should confirm which Mission Training Plan (MTP) battle tasks will be used to support the training objectives for evaluation during the exercise. The MOA is negotiated at the IPC, coordinated by their respective staffs, and signed by the Commanders or designated representatives of the respective units. Their higher headquarters should sign it if appropriate. It becomes a binding contract that stipulates what each unit is responsible for accomplishing. It is essential that all parties understand that changes will not be readily approved due to the ripple effect these changes may have throughout the exercise timeline.

5. **Personnel to attend the IPC should include:**
    a. Scenario Development Team
    b. Exercise Director
    c. Exercised unit personnel
    d. Chief of Group Operations – Observer Controllers/Trainers support
    e. Project Officer
    f. Project Officer Advisor
    g. Simulation facility personnel
    h. OPFOR Commander
    i. Applicable Contractor support personnel
    j. Administrative Logistics representative

The exercised unit should provide the following at the IPC:
    a. Copy of the unit TACTICAL STANDARD OPERATING PROCEDURES.
    b. Copy of the unit MODIFIED TABLE of ORGANIZATIONAL EQUIPMENT.
    c. Copy of the unit MISSION ESSENTIAL TASK LIST.
    d. Selected MISSION TRAINING PLAN Battle Tasks (supporting Training Objectives)

6. **Memorandum of Agreement (MOA)**

A MOA is a formal agreement between the simulation facility and the exercised unit to conduct a simulation exercise. It addresses topics such as timeline of training, STARTEX, ENDEX, and logistical support requirements. The exercised unit commander and the Exercise Director sign the MOA. Once all exercised unit commanders and the exercise director sign the MOA it becomes a temporary-binding document until approved by appropriate command authorities.

7. **In-Progress Reviews (IPRs)**

IPRs are conducted to ensure that all agencies are meeting agreed-upon milestones toward exercise execution and that any changes to the exercise plan are fully coordinated. IPRs dates should be presented on the exercise planning schedules and coordinated with all attending parties. This is the time when key issues should be discussed and possible solutions recommended and forwarded for decision or action. The topics addressed at the IPR should always be kept on the agenda to ensure follow-up of critical issues. This process will allow for constant updating and alignment to ensure all concerned parties are meeting requirement milestones. IPRs should address the following topics:

a. The OC/T support plan, to include qualification status, and the status of internal training in preparation for the exercise
b. Personnel Status. This will include a breakdown of personnel by departure dates, organization assigned to and staff days required if Reservists are involved
c. Billets/dining plan
d. Transportation requirements
e. Communication requirements
f. Administrative and additional logistical requirements
g. Training facilities
h. Training status
i. Database status
j. OPFOR plan
k. OPLAN/OPORD status
l. Simulation support plan
m. Exercise organization
n. End state focus and development of the collection plan

8. **Final Planning Conference (FPC)**

The final planning conference is essentially an external IPR to finalize exercise planning, confirm resources, and “validate” the exercise with the exercised unit. The FPC is conducted with the exercised unit to ensure the scenario and OPORD supports the training objectives, the BDE/BN OPORD process is on track, and resources are coordinated.

Exercise Timeline Worksheet

The exercise timeline is developed through a series of conferences and meetings. As each of these meetings is held it will start a process where continual follow-up on negotiated tasks will establish a timeline building up to the execution of the simulated event and the conduct of the After Action Review (AAR). This worksheet is fairly comprehensive and should assist in setting initial dates for support products and starting the exercise timeline developmental process. This checklist is not all-inclusive as some products may be prescribed by local standard operating procedures. Utilization of simulation experience and subject matter experts will assist greatly in the execution of a workable exercise timeline.

Exercise Name____

Site Location ____

Exercise Organization ____

Exercise Participants ____

Primary Customer / Exercise Director__________________________________

Phone Number____

Mailing Address____

Email Address____

Facilitator____

Phone Number____

Mailing Address____

Email Address____

Exercise Dates_________________________________

Event	Coordinated Activity	Day – Msn Receipt	Date Completed	Responsible POC
1.	Concept Development Conference			
	Task Organization, include Non-observed units			
	Scenario			
	Higher Response Cell			
	Exercise Location			
	Draft Exercise timeline			
2.	Initial Planning Conference			
	Training Objectives			
	Master Scenario Event List (MSEL)			
	Training Audience			
	Simulation			
	Database			
	Familiarize with communications network and security requirements.			
	Procedures and training in response to requests for information (RFI)			
	Establish role player requirements			
	Procedures and training in response to unexpected events			
	Specify what information cells need from each other			
	Specify interaction between the control and support cells			
	Identify Subject Matter Expert requirements			
	Training location(s)			
	Instructors-who will conduct the training			
	Address Life Support			
	Other Support Requirements			
3.	Site Survey			
	Space (square footage)			
	Availability of facility			
	Telecommunication capable			
	Environmental controls			
	Workstation configuration			
	Facility improvements			
	Field Site Set-up location			
4.	MOA Signed			
	Authored by respective staff officers			
	Startex data			

	Endex data			
	Logistical support			
5.	In-Progress Review			
	Follow-up on established milestones			
6.	Training for Training audience			
	Training dates confirmed			
	Audience identified			
	Training conducted			
	Computer literacy established			
7.	Ramp-up Exercise			
	Identify MSEL tasks to be addressed during Ramp-up			
	Validate Database for accuracy			
	Rehearse established workarounds			
	Capture pre-exercise training lessons learned during the exercise			
8.	Final Planning Conference			
	Confirm Exercise planning is on schedule			
	Confirm resources			
	Validate the scenario with the exercised unit			
	Validate that the OPORD supports the training objectives			
	BDE/BN OPORD process is on track			
	Resources are confirmed with approved timelines and on schedule			
9.	Set-up of simulation center and tactical operation centers			
	Set-up Dates			
	Exercise Registration and Orientation			
	Exercise Orientation Briefings			
	Topics for Briefings/ Agenda Items			
	Sign in Procedure			
	Security Verification			
	Badge Issue Procedures			
	Travel Closure Procedure			
	Procedure to Issue necessary information and (O) ration cards			
	Room Assignments Procedures			
	Rental car descriptions			
10.	AAR			
	Facilities			
	Audio/ Visual Equipment			
11.	Breakdown and shipment of equipment			

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4.B.2b Technical Timeline

The technical aspects of any simulated event hinge on the size of the exercise, exercise training requirements, connectivity to real world systems, and integration of Live-Virtual-Constructive simulations. Execution of the technical aspects will not necessarily fall to the FA 57 or Simulation facility representative. However, it is paramount that the appropriate questions be asked to ensure success in the training event. The migration to digital systems and the linkage between real world systems and the constructive and virtual environments will inherently increase the complexity of exercise architecture. Therefore, it is imperative that inquiries be made regarding the bridge between these real world systems, the systems that stimulate them, the constructive simulations being used, the virtual environment, and the tactical operations centers of the event.

The attached timeline Figure 3 serves as an example of the coordination requirements to facilitate a manageable event. It will be the responsibility of the FA 57 or the Simulation facility representative to stay abreast of these technical requirements and ensure adherence to a schedule that may or may not be flexible. Throughout this process the FA 57 will continually cross boundaries between contractors, users, and support personnel. Therefore, the process must be looked at as one working simultaneously throughout and not as individual stovepiped events.

Prior to the Initial Planning Conference (IPC), thought should be given to the pre-planning of the simulated exercise event with regards to the current capabilities of the simulation facility. The lack of required capabilities should not delay the event, however, it may require additional time, money, or personnel to devise a feasible solution or workaround. These are the issues that need to be brought to the attention of the Exercise Director as possible distracters to the event and need to be addressed in subsequent In-Progress Reviews (IPRs).

1. **Database build**

One of the initial technical tasks will be coordination of the build of the databases associated with the exercised units, opposing forces, and higher/adjacent/lower/subordinate units (HALS). This will require determination by the exercised unit of their simulation-based organizational structure, and whether it is desirable to execute an event using the organization’s current structure or future structure. Supporting documentation should be provided to the personnel building the database as soon as possible to facilitate the initial database build and allow maximum time for changes, as required. Throughout the timeline, continual feedback as to structure and systems capabilities should be ongoing.

2. **Distributed exercise**

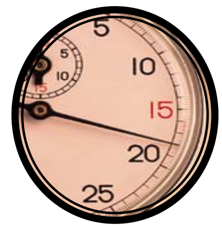
Distributed exercises have many benefits, to include broadening the training audience, conserving resources (TDY dollars), data sharing, and sharing of technical resources. They also come with some inherent disadvantages, including potential delay in communications, downtime, less face-to-face activity, and a potential increase in required resources (enhanced communications and network). A distributed exercise will require additional technical support, whether distributing across the globe or across the room. If the exercise is to be distributed between multiple sites, the technical support requirements will increase rapidly. There is anticipated increase in communications and networking requirements, potential downtime due to equipment failure, and communications delay to offsite locations.

Communication lines must accommodate the flow of information between these multiple sites at a rate at which the simulation can process it and not be hampered. Bandwidth is the ability of communication lines to handle information and flow it to systems associated with the exercise event. If the communications "pipe" is too small, information will move more slowly, and may hinder peak performance from the simulation itself. In contrast, information could be flowing so rapidly that the ability to receive and process the information bogs down the system. The simulations bring with them a certain amount of latency due to computer lag from input to execution of orders in the system. This built in latency will only be increased with long-range communications requirements to multiple offsite locations. Additional sites also require additional coordination with regards to facilities. This would involve physical space, power distribution, and other life support requirements.

Resources – Save TDY, increased communications and networking

Distributed Processing

Potential downtime (more equipment involved, more to break)



Potential delay in communications

3. Interoperability requirement

One of the ways to determine Interoperability requirements is to use engineering processes such as the Federation Development and Execution Process (FEDEP) Model. The purpose of the FEDEP is to describe a generalized process for building federations and assisting them in meeting Interoperability requirements. It is not intended to replace the existing management and engineering processes of HLA user organizations, but rather to provide a high-level framework for HLA federation construction into which lower-level development practices native to each individual application area can be easily integrated. In addition, the HLA FEDEP is not intended to be prescriptive, in that it does not specify a "one size fits all" federation development process for all HLA users. Rather, the FEDEP defines a generic, common sense systems engineering methodology for HLA federations that can and should be tailored to meet the needs of individual applications and assist in ensuring that interoperability requirements are met. The FEDEP as described in *High Level Architecture Federation Development and Execution Process (FEDEP) Model Version 1.5,* December 8, 1999 (https://www.dmso.mil/public/library/projects/hla/guidelines/fedepv15.pdf) contains six steps:

> **Step 1: Define Federation Objectives**. The federation user and federation development team define and agree on a set of objectives and document what must be accomplished to achieve those objectives.

Step 2: Develop Federation Conceptual Model. Based on the characteristics of the problem space, an appropriate representation of the real world domain is developed.
Step 3: Design Federation. Federation participants (federates) are determined, and required functionalities are allocated to the federates.
Step 4: Develop Federation. The Federation Object Model (FOM) is developed, federate agreements on consistent databases/algorithms are established, and modifications to federates are implemented (as required).
Step 5: Integrate and Test Federation. All necessary federation implementation activities are performed, and testing is conducted to ensure that interoperability requirements are being met.
Step 6: Execute Federation and Prepare Results. The federation is executed, outputs are generated, and results are provided.

These steps have been updated and are now available in the IEEE STD 1516.3 ™-2003 IEEE Recommended Practice for High Level Architecture (HLA) Federation Development and Execution Process (FEDEP) (http://www.ieee.org).

4. Stimulation of real world systems

This stimulation requires connectivity among constructive, live, and virtual simulations and real world systems through a software and hardware interface dependent upon which systems are being utilized. As fielding of digital equipment becomes more prevalent and the need to train personnel on their real world systems increases, the requirement to bridge this gap between them and the simulations being utilized will only increase. Care should be taken in possible cross-boundary contractor support requirements, software version release issues in both the interface and the real world equipment, and integration of the live-virtual-constructive systems.

5. Set-up

Physical receipt of the system's hardware components and associated placement in the simulation center require not only additional assistance for movement of equipment, but proper off loading to determine how best to accomplish the mission. This requires coordination of contractor personnel to arrive at prescribed times to accommodate limited workspace and advance the building process that leads into the networking process. Items of consideration for the set-up include movement and offloading of equipment, establishing workplace location, testing of workstation systems, and development of the support structure to accommodate the exercise.

Movement and offloading

Establishing workplaces

Support structure

Setting up and testing workstations

6. **Hook-up**

Networking of the systems must work in conjunction with the physical set-up requirements stated above. As each piece is applied, care needs to be taken not to disrupt already existing architecture and coordination for the merging of systems. Hook-up and testing of hardware with existing architecture, connection to distributed exercise sites, and connectivity to units with the Simulation Center.

Hook-up and testing of hardware with existing architecture

Connecting distributed simulations via the exercise network

Connecting exercise units--together and with the with the Sim Center

7. **Power-up**

Once networking requirements are met and connectivity is established, it will become necessary to power-up the system. Because initial estimates have been made and changes, if deemed necessary, made to the facilities, load testing those results will be critical. Initial amperage from simulated systems should be tested and estimates made for power drains by additional equipment required to execute the event.

8. **Communications plan**

Communications can be the single most important factor in setting up a simulation application. Effective communications are key to the success of the exercise. Without them, the exercise will fail. Communication between the simulation center and the tactical operation centers will be the responsibility of the exercised unit allowing them to exercise their real world organic assets. Although not responsible for this, simulation facility personnel should be involved to ensure connectivity with the center and how these potential power requirements may impact the distribution plan for the center.

9. **AAR Capabilities**

The After Action Review is a critical piece of the simulation event and should be treated as such. Adequate facilities to physically hold the AAR itself, as well as the Audio/Visual support needed to provide graphic representation of lessons learned during the conduct of the exercise are paramount. The simulation facility representative will not only want to ensure the simulation used has embedded AAR capabilities, but if additional AAR systems are used they must be able to be imported into the AAR medium that will be utilized. See Section 4 for detailed information on the AAR process.

10. **VTC capabilities**

White cell players at remote locations may require the ability to interact among geographically separated staff elements. While not required for every exercise, the ability to communicate visually between remote sites is a capability that will enhance the interactivity of critical elements for better evaluation of the event and coordination of information.

Technical Timeline Worksheet

The technical timeline will develop with the FA 57 interactions and the personnel who will be responsible for the implementation of the technical specifications of the exercise. This will include the database build, communications of a tactical and simulation oriented nature, and the process of set-up, hook-up, and power-up. Each exercise is different and should be viewed as such. What worked one time may not work again. The exercise planner must initiate this process and do constant follow-up to ensure critical milestones are met to keep everything on schedule. Once initiated suspense's should be set and met by all practitioners. The following worksheet should be conducted for each site to be utilized during the exercise.

Exercise Name____

Site Location ____

Exercise Organization ____

Exercise Participants____

Primary Customer / Exercise Director_______________________________

Phone Number____

Mailing Address____

Email Address____

Facilitator _______________________________________

Phone Number____

Mailing Address____

Email Address____

Exercise Dates____

Event	Coordinated Activity	Day – Msn Receipt	Date Completed	Responsible POC
1.	Initial Planning Conference			
	Training Objectives			
	Master Scenario Event List (MSEL)			
	Training Audience			
	Simulation to be utilized			
	Familiarize with communications network and security requirements.			
	Procedures and training in response to requests for information (RFI)			
	Establish role player requirements			
	Identify Subject Matter Expert requirements			
	Training location(s)			
	Instructors			
2.	Database build requirements			
	Receive documentation on organization structure from unit			
	Perform initial Database build			
	Verify initial Database			
	Submit changes to Database to Database POC			
	Verify changes to Database			
	Final Database verification prior to Ramp-up exercise			
	Submission of any final changes to Database			
	Final Database verification			
3.	Site Survey			
	Space (square footage)			
	Availability of facility			
	Telecommunication capable			
	Environmental controls			
	Workstation configuration			
	Facility improvements			
	Field Site Set-up location			

4.	Establish Initial communications plan			
	Tactical Communication requirements			
	AAR facilities/capabilities and requirements			
	VTC requirements			
	Distributed Exercise requirements			
	Interoperability requirements			
	Stimulation of “real world” equipment requirements			
	Determine security requirements of exercise			
	Coordinate communication requirements into simulation facility for tactical communications			
	Determine requirements and coordinate for installation of communication “pipe” for distributed exercise			
	Determine and coordinate RTI and RTM requirements as required for interoperability requirements			
	Determine and coordinate for contracting and receipt of AAR and VTC equipment			
	Coordinate security of communications for exercise			
	Ensure communication capabilities into simulation facility for tactical communications exist			
	Ensure requirements for installation of communication “pipe” for distributed exercise are mapped and underway			
	Ensure RTI and RTM requirements for interoperability architecture are established and initial test date set			

	Execute contract for AAR and VTC equipment			
	Facilitate security of communications for initial communication test			
	Lock down date for tactical communications into simulation facility			
	Lock down date for installation of communication “pipe” for distributed exercise			
	Lock down date for communications test with RTI and RTM to meet interoperability requirements			
	Receive and install AAR and VTC equipment			
	Lock down final security communications for exercise			
5.	In-Progress Review			
	Follow-up on established milestones			
6.	Confirm training dates established in the IPC			
	Dates for Pre-Exercise Training confirmed			
	Training audience terminal operators identified			
	Computer familiarization training conducted			
	Level of computer literacy determined			
7.	Set-up, Hook-up, Power-up			
	Coordinate for pack-up of simulation equipment			
	Set transport/shipment date for equipment			
	Contract/transport equipment			
	Check power distribution in simulation center			
	Receive power capabilities report for simulation center			

	Contract/Coordinate for power upgrades of simulation center as required			
	Set arrival date of equipment			
	Arrange for personnel to meet and unload equipment			
	Confirm arrival of equipment			
	Confirm set up of simulation facility			
	Confirm power capabilities of facility			
	Physical Set-up confirmed			
	Networking of systems per communications plan			
	Power-up of system			
	Confirmation of power requirements			
8.	After Action Review Date			
	Facilities are adequate			
	Multi-media equipment is adequate			
	Contract for audio/ visual as needed			
9.	Breakdown of Simulation Center			
	Arrange for personnel to assist in teardown			
	Transport equipment			
	Receive equipment			
	Inventory and repair as needed			

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4.B.2c Support Timeline

The exercise support staff will not necessarily be required to make all of the arrangements to support simulated exercise events. However, they will be required to ensure that responsibility is taken, coordination is made and oversight and assistance are provided in transporting personnel, equipment, and life support for exercise personnel.

This checklist is not all-inclusive, but will provide a foundation for those support elements that need to be addressed and arranged prior to execution. Each exercise brings with it a series of coordination issues that will require diligence to keep from distracting from the focus of the training event. Delegation (where possible) and oversight of each of these elements should be addressed as early in the exercise timeline as possible, and reviewed at each of the In-Progress Reviews (IPRs) to ensure continued coordination throughout.

1. **Request augmentation Observer/Controllers (O/Cs)**

This requirement is dictated by the need to provide proper staffing for any given event. Consideration needs to be made regarding the utilization of augmentation personnel, and their source and qualifications.

2. **Environmental Conditions**

Within the facility, environmental considerations are paramount to accommodate the computer equipment for the simulated training. If these environmental conditions exceed system capabilities, they may have an impact on the capability of the system to operate at peak potential, or worse yet, lead to a complete shutdown.

3. **Physical Space requirements**

The work areas supporting the exercise should be given careful consideration, as they cover a wide variety of requirements. This is essentially the space required to conduct the event. It should consist of, but not be limited to, the following:

   a. Workstation space requirements- equipment and operators
   b. Office space
   c. VIP offices
   d. O/C Work area
   e. AAR facilities
   f. Protocol Office
   g. Field Site locations for Tactical Operation Centers
   h. Smoking / Non-Smoking Areas

4. **Parking**

Parking requires a delicate arrangement as VIPs will generally be involved with any event, and should be given the special consideration due their rank and stature. However, parking must also accommodate the smooth and timely execution of the event, and therefore should include the following categories:

   a. VIP Parking
   b. Government Vehicles
   c. Rental Vehicles
   d. Contractor Vehicles

5. **Hardware**

This is the heart of the exercise, and will occupy a majority of time in ensuring transportation plans are properly executed, and that equipment is tracked, received, operational on arrival, and clears the proper customs authorities (if necessary). Arrangements for the following should be considered in the planning process:

   a. Shipment
   b. Reception
   c. Setup
   d. Customs forms, as required
   e. Disposal/return after the exercise

6. **Other Equipment**

This category embraces those pieces of equipment outside the realm of the simulation and its components, and focuses on support activities. This issue also deals with quality of life issues throughout the event and allows for controlled access of outside products:

   a. Copy equipment
   b. Fax machines
   c. Computer support for Exercise Senior Controllers, Staff, and VIPs
   d. Coffee pots
   e. Microwave ovens
   f. Vending machines

7. **Office Furniture and Fixtures**

These amenities provide the area where most exercise participants will spend the majority of their time. As well as meeting the physical space requirements, all items needed to facilitate work in the workstation cells should be considered, for example:

   a. Desks / workstation tables
   b. Chairs
   c. Tables for planning
   d. Map boards
   e. Office supplies (e.g., markers, bulletin boards, and easels)

8. **Coordinate life support**

Life support of support personnel is critical as it can turn into a training distracter if not planned for early in the process. Planning for these issues ensures the focus will be on the training event and not worrying about where to eat and sleep, or how to get to work. Special consideration should be given to:

   a. Billeting/accommodations
   b. Messing/break facilities
   c. Transportation to and from the Simulation Center, as required

9. Classified Exercise

AR 380-19 and local policies and procedures mandate the type of classification for the exercise (See section 4.A.2, Security). Some items to consider are:

a. Prepare classified material courier authorizations, and arrange for storage of classified materials
b. Ensure security clearances are on hand and meet local requirements
c. Ensure shredding equipment is available
d. Ensure Classification stickers are posted IAW AR 380-19

10. Meet all personnel, record contact information

This includes augmentation Observer/Controllers, and ensures manning for the event is within the agreed-upon structure. Some exercise participants may require additional space due to increased user numbers, which may require action on the part of simulation facility representatives. This will also allow final coordination with specific units and/or individuals as to any changes to the event itself. It will also insure the safe arrival of, and the ability to contact, personnel, as required. Considerations should be given to:

a. Travel closure to the exercise location
b. Issue necessary information that may have recently changed and (O) ration cards
c. Obtain lodging assignments for location of individuals as needed
d. Telephone numbers
e. Rental car descriptions

11. Contracting Support

Each exercise has the ability to exceed organic capabilities of the simulation facility, and may require consultation with outside sources to procure additional space or materials. This will require coordination with local contracting officials and/or garrison support infrastructure to accommodate such issues. A process by which this can be accomplished is as follows:

a. Identify requirements for contracted materials
b. Contact local contracting officer for procedures at that installation
c. Identify potential contractors
d. Solicit bids
e. Award contract
f. Arrange for pick-up or delivery of required material

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Support Timeline Worksheet

The support worksheet is developed through a series of requirements and delegation of responsibility for those requirements. As each of these areas is addressed it will start a process where continual follow-up on negotiated tasks will establish a timeline building up to the execution of the simulated event and the conduct of the After Action Review (AAR). This worksheet is fairly comprehensive and should assist in setting initial dates for support products and start the timeline developmental process. This worksheet is not all-inclusive as some products may be prescribed by local standard operating procedures. Utilization of simulation experience and subject matter experts will assist greatly in the execution of a workable timeline.

Exercise Name____

Site Location ____

Exercise Organization ____

Exercise Participants ____

Primary Customer / Exercise Director______________________________

Phone Number____

Mailing Address____

Email Address____

Facilitator _______________________________

Phone Number____

Mailing Address____

Email Address____

Exercise Dates__________________________________

Most of these requirements can be addressed during the Site Survey and should be considered when reviewing facilities.

Event	Coordinated Activity	Day – Msn Receipt	Date Completed	Responsible POC
1.	Request Augmentees for Exercise			
2.	Facility Environmental Requirements			
	Power distribution check			
	Submit Workorder			
	Workorder complete			
	Hook-up			
	Power-up			
3.	Exercise Work Area			
	Expand current facilities			
	Contract for additional facilities			
4.	Parking			
	VIP Parking			
	Transport from parking to facility			
5.	Equipment Hardware Shipment/Receipt			
6.	Office Equipment			
	Contract for Office Equipment			
	Copy/FAX machine			
	Computer support			
7.	Office furniture and fixtures			
	Contract for Office fixtures			
8.	Life Support			
	Billeting			
	Dining			
	Transport to and from			
9.	Exercise Classification Requirements			
	Reference AR 380-19			
	Security Clearances			
	Shredding of materials			
10.	Personnel In-processing Procedure			

Date required Date complete

Responsible POC

1. Coordinate and Request augmentation personnel: ____________ ____________

____

a. Requirement dictated for proper manning ____________ ____________

____

b. Utilization of augmentation personnel ____________

____________ ____________

c. Source and qualification

2. Coordinate facility environmental conditions for computer equipment

3. Work areas supporting the exercise.

a. Workstation space requirements

b. Office space

c. VIP office

d. O/C work area

e. AAR facilities

f. Protocol Office

g. Field site locations for Tactical Operation Centers

h. Smoking / non-smoking Areas

Parking: Coordinate for the following Date required Date complete
Responsible POC

VIP parking

Government vehicle

Rental vehicles

Contractor vehicles

5. Hardware: Date required Date complete
Responsible POC

Ensure transportation plans are in place.

Equipment is tracked

Receipt of equipment

Operational on arrival ____________ ____________

____

Customs authority requirements ____________ ____________

____

Coordinate with contracting for equipment, as required: Date required Date complete Responsible POC

Copy equipment ____________ ____________

____

Fax Machines ____________ ____________

____

Computer Support for Exercise Senior
Controllers, Staff, and VIPs ____________

____________ ___________

Coffee pots ____________ ____________

____

Microwave ovens ____________ ____________

____

Vending machines ____________ ____________

____

6. Coordinate for office Furniture and Fixtures: Date required Date complete Responsible POC

Desks / Workstation table ____________ ____________

____

Chairs ____________ ____________ ___________

Tables for planning ____________ ____________

____

Map boards ____________ ____________ ___________

Office Supplies-markers, bulletin boards, easels, etc ____________ ____________

____

Coordinate for maps for the play box ____________ ____________ ___________

7. Coordinate life support: Date required Date complete Responsible POC

Billeting / accommodations ____________ ____________ ___________

Dining / Break facilities ____________ ____________

____

Transportation to and from Simulation Center. ____________ ____________

____

8. Classified exercise: See AR 380-19 Date required Date complete Responsible POC

Coordinate for classified material courier authorizations ____________ ____________

____

Ensure security clearances meet local requirements ____________ ____________
____
Insure shredding equipment is available ____________ ____________
____
Insure Classification stickers are posted ____________ ____________
____

9. Meet all personnel / record contact information: Date required Date complete
Responsible POC
Travel of personnel to and from exercise ____________ ____________
____
Issue necessary information and ration cards ____________ ____________
____
Obtain room assignment ____________ ____________
____
Telephone numbers ____________ ____________
____
Rental car descriptions ____________ ____________
____

10.Contracting requirements for local support Date required Date complete
Responsible POC
Identify requirements for contracted materials ____________ ____________
____
Contact local contracting officer for procedures ____________ ____________
____
Identify potential contractors ____________ ____________ ___________
Solicit bids ____________ ____________ ___________
Award contract ____________ ____________
____

f. Arrange for pick-up or delivery of required ____________
____________ ___________

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4.B.2d Scenario Development

The exercise scenario defines the environment in which the training audience will be immersed. This scenario will encompass a broad area of factors to include geographical area, demographics, problem types, participants (causal and restorative), size and scale, secondary effects and complexity. Conditions set by the scenario are tailored to drive decisions and actions of the training audience in the attainment of exercise training objectives. The scenario is built around the training objectives, not the other way around.

1. Purpose of the Scenario

The scenario provides both a structure and methodology to assess training objectives, procedures, and encourages objective assessments leading to improved training for the participants. A realistic scenario enhances the value of the exercise to the training participants and allows training to be directed, safe, and thorough. Creative scenarios allow them to expand beyond their own personal experiences – a process that may be key to their success in future operations.

Scenarios facilitate planning for both current and future operations. An effective scenario allows for the tasks, conditions, and standards dictated by the exercise training objectives and can be specifically designed to address known areas of weakness or contingency operational requirements.

2. Limitations

All scenario development involves tradeoffs. Competing and/or conflicting requirements involving the number of people to be trained, resources (money, personnel, facilities), time, and special considerations such as language or computer skills are inherent in the scenario design process. Maintaining focus on the exercise training objectives that are measurable and linked to training activity will aid this design process.

3. Scenario Development Processes

Scenarios supporting training objectives can be developed in one of two ways. The first way involves selecting the conditions in which the unit will train. This is a discovery process with known situation types but unknown skill sets to be applied. This method is appropriate for experienced, well-trained units looking to apply a variety of skills in an uncertain setting. The second way involves the selection of specific skill sets to be exercised in a more traditional train-to-standard process under preset conditions. All training and scenario development are based on a task-condition-standard methodology. The questions simply becomes one of precedence; selecting either the environment (conditions) or tasks to be trained first.

4. Creating the Scenario: 9 Steps

The following checklist will assist in scenario development.

a. **Categorize - Type of problem and its scale.**
   1. Is this a local, regional, or global situation?
   2. Is this a small or large problem?
   3. Is this a military or non-military problem?

b. **Scale – Number, type & disposition of participants**.
   One, few, or many people involved?

c. **Frame – Conditions at the site/location.**
   Will exercise take place in a field location or in a controlled training facility?

d. **Place training objectives on time line.**

1. Have you established a priority for the training objectives?
2. In what sequence will events appear during the course of the exercise?

(NOTE: Training events may appear in a logical flow rather than from most important to least important sequence.)

3. Can all objectives be accomplished in the allotted time?

e. **Specify observations & measures.**

1. Have you planned to capture computer data – reports, screen shots, etc.?
2. Have you planned to capture electronic data – audio, visual recordings, etc.?
3. Have you planned for specific times, locations, events for observers to make visual observations?

f. **Reassess scenario.**

1. Identify and prioritize objectives.
2. Identify cost-effective strategies.
3. Allocate resources.
4. Execute development.
5. Provide feedback.

g. **After exercise, match objectives to measured results.**

1. Compare exercise results to original exercise objectives.
2. Did you accomplish all of your objectives?

h. **Conduct after exercise briefing.**

Conduct After Action Review after collecting and analyzing both simulation (electronic) and live (observed) data.

i. **Refine scenario before next cycle.**

1. What issues prevented accomplishment of training objectives?
2. Is this a scenario design issue?
3. Modify scenario as required.

Scenario Development Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants: ____

Primary Customer / Exercise Director_______________________________

Phone Number____

Mailing Address____

Email Address____

Scenario Development Points of Contact:

Record unit representatives involved in the scenario development process.

Unit	Name, Rank, Position	Contact Information

Design Activities

Initial Planning Meeting

Identify:
- Training audience
- Training objectives
- Training dates
- Exercise classification

Identify the Training Audience

Identify Training Objectives

Identify Training Dates

Develop exercise specific scenario guidelines.

Address:
- Type of problem and its scale
- Number, type and disposition of participants
- Conditions at the exercise location
- Placement of training objectives on the exercise timeline

Exercise Training location:

____

____

____

Classified exercise? Yes _____ No _____

Describe the type of problem and its scale.

____

____

____

____

____

____

Address such items as:
- Military or non-military situation
- Local, regional, or global issue
- Number of participants involved
- Type of participants involved
- Disposition of participants involved

Describe friendly forces, to include coalition partners.

____

____

____

Describe threat forces.

____

____

____

Are non-combatants involved? Yes _____ Type ______________________
No _____

Describe the exercise terrain box.

____

____

____

Has the priority of training objectives been established? Yes _____ No _____

Can all objectives be accomplished in the allotted time? Yes _____ No _____

Determine sequence of exercise objectives and place on the exercise scenario timeline.

____

____

____

Exercise Phase

Monitor the scenario as the exercise progresses.

Have unforeseen circumstances affected the execution of the exercise scenario?
Yes _____ No _____

Does the scenario need to be modified? Yes _____ No _____

Have procedures been established to modify the scenario? (X when completed) _____

Designate who can modify the exercise scenario.

____

____

____

Can exercise objectives still be met? Yes _____ No _____

Post-Integration Phase

Compare exercise results with original exercise objectives.

Were all objectives met? Yes _____ No _____

Did scenario, as written, allow for the accomplishment of all training objectives?
Yes _____ No _____

Does the After Action Review or exercise Hot Wash indicate the need to modify the scenario? Yes _____ No _____

Recommended scenario changes:

____

____

____

Have specific scenario changes been made/recorded for future exercises?
(X when completed) _____

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4.B.2e Documentation – Simulation Control Plan

A Simulation Control Plan (SCP) defines and synchronizes the control and support structures and related activities for the conduct of an exercise. The SCP is developed and compiled based on the exercise training objectives and requirements specified in the Exercise Directive. Exercise control uses the SCP to manage, control, and support the entire exercise to meet the exercise requirements and objectives. In general, the SCP is:

1. A derivative or component piece of the Exercise Directive
2. Developed and executed in a cooperative/team effort by the exercise planners, EXCON, BSC support staff, and various technical and operational support elements. Specifically, the SCP is the single document that contains, coordinates, integrates, and synchronizes key exercise-related components such as the:

    a. Workstation Organization (BLUFOR, OPFOR, AAR, etc.)
    b. Exercise Control Organization (and specific assignments for OCs, analysts, scripting cell, control cell, and AAR presentations)
    c. EXCON instructions (MEL, preplanned scripted materials, OC and analyst data collection plans, AAR production and presentation schedules, etc.)
    d. Higher HQ and OPFOR OPORDs (and later, the TA OPORD[s])
    e. Exercise Layout and Location Diagrams of supporting participants and TA(s)
    f. Tactical Communications Network
    g. Role-Player/Workstation Operator Manning and Training Schedule(s)
    h. The supporting TSP
    i. Exercise execution schedule covering the dates, times, locations, and participants for the exercise
    j. BSC setup and related technical testing (M&S systems, databases, networks, interfaces, etc.)
    k. TA location setup
    l. Communications exercise (COMEX)
    m. Initialization
    - STARTEX and ENDEX
    - Interim and final AARs

An example of an SCP follows:

Simulation Control Plan Example
Title of the Exercise
Dates of the Exercise
Location of the Exercise

From: ______________________________(Should be Exercise Director)

Subject: (Name of Exercise) Simulation Control Plan

Ref:

- List each pertinent document utilized in this document
- List each pertinent document utilized in this document

1. Situation. Define the event and the key players that will be involved.

Example - The XXX Division will conduct a Community Response Emergency Simulation Training (CREST) exercise facilitated by OOO Corporation. Conduct of the exercise will be at Ft Hood, TX from (start date) to (end date). The exercise will explore roles and missions for the Army in the event of a Weapon of Mass Destruction (WMD) incident within the continental United States. Following the completion of the CREST exercise, the exercise staff and subject matter experts will conduct operational planning in a facilitated discussion by National Interagency Civil-Military Institute (NICI) that will outline and define potential civil support roles and capabilities for the Army in support of Consequence Management (CM).

2. Mission. Cleary define statement of the purpose for the event.

Example - XXX Division staff will form the nucleus of an Army Component headquarters within Joint Task Force-Civil Support in order to develop proficiency in staff planning, conduct service/functional component staff operations, and explore opportunities for Army to contribute within the civil support arena.

a. Commander's Intent. A clearly defined reason for the event

Example - This exercise is an opportunity to provide an exploration of the Army's role and missions within the civil disaster management and weapons of mass destruction (WMD) arena. Through this exercise, we must clearly and specifically describe the general military roles and functions for the Army within Military Support to Civil Authorities (MSCA). This exercise should also provide identifiable exit criteria to facilitate our extrication from operations in support of Consequence Management. The conduct of this exercise must emphasize voice and data communications to operate in this environment.

b. End State. State the desired outcome from exercise event.

Example -

(1) Develop Army staff officers with core capabilities in consequence management at the service/functional component level.

(2) Identify key liaison and coordination links required between the Army component and higher, adjacent, and external agencies.

(3) Establish potential framework for Army component command element involvement with JTF-CS.

(4) Demonstrate expeditionary C4 and support capabilities in response to a WMD civil emergency.

(5) Lay the foundation for further experimentation to refine practices and procedures to facilitate Army involvement in the civil support arena.

3. Execution. Overall conduct of the exercise.

a. Concept of Operations. Brief overview of the exercise

Example - The Community Response Emergency Simulation Training (CREST) exercise will teach the interagency planning and response process required for the effective handling of a domestic terrorist event. This will be a computer-assisted exercise, designed to practice vertical and horizontal interaction in response to a major Hurricane Gary, coupled with a large scale terrorist incident. Active and reserve component military, civilian agency emergency managers from the federal, state and local levels, law enforcement officials and other first responders will be in attendance.

b. Major agencies to participate in exercise. Identify the participants / primary training audience

Example -

(1) Federal Emergency Management Agency (FEMA)

(2) Federal Bureau of Investigations (FBI)

(3) Joint Task Force-Civil Support (JTF-CS)

(4) XXX Division

(5) Florida, Plans, Operations and Military Support Office (POMSO)

(6) Florida State Emergency Operations Center Director (EOC)

(7) State Emergency Management Office (EMO)

(8) Department of Health (DOH)

(9) Department of Transportation (DOT)

(10) Environmental Protection Agency (EPA)

(11) Florida State Police

(12) Conservation/Natural Resources

(13) Florida Army/Air National Guard

(14) Florida State Public Works/Utilities

(15) Florida State Social Services

c. Exercise Development and Executing Agencies._Specific organizations that are involved with the conduct and the execution of the exercise.

Example -

(1) Big Applications Inc. (BAI)

(2) National Interagency Civil-Military Institute (NICI)

(3) XXX Division

(4) Florida POMSO

d. Executing Agencies Responsibilities_Specifically spell out what each agency will do to execute the exercise event

Example -

(1) BAI

(a) BAI will provide an exercise scenario based upon a severe Hurricane Gary that has occurred and affects multiple states. A terrorist will release a weapon of mass destruction, which should be a persistent agent, whether chemical or biological, near the end of the initial response to the hurricane. The details of the event and supporting data for the state of Florida will create a near "real life" simulation that prepare response agencies for the actual event.

(b) BAI will provide a Read Ahead Package that will consist of training objectives with general and special situations. Scenario reference materials will include federal disaster and weapons of mass destruction plans from the participating agencies and organizations.

(c) BAI will use the existing CREST simulation and courseware to set the stage for the following operations involving the XXX Division resources during a disaster and the consequence management phase of a WMD event.

(d) BAI will write a situation that dictates the conditions that set the stage for the XXX Division commitment to this operation. The intelligence summary will help set these conditions.

(e) BAI will write a general and specific situation that demonstrates that all state and federal assets are consumed and precipitate the issuance of orders for select XXX Division assets to deploy to the area and conduct operations as required or directed by JTF-CS. The focus is on military support to civil authority and interagency operations after a presidential declaration of a disaster and the provisions of Presidential Directive 39 for a terrorist event are implemented.

(f) BAI will provide both a written situation and a visual briefing complete with news clippings and sound bites of the events that have occurred up to this point. After the briefing, approximately two hours will elapse for all players in the state EOC, Joint Operations Center and the SPMAGTF TOC to prepare for the start of the exercise.

(g) BAI will change Central Florida names appropriately to address a central Florida regional focus. The entire exercise is fictitious and the mapping, reference materials, state and local government organizations are fictitious. This should not matter to the players as the equipment, mutual aid agreements, and other entities are similar in structure and capability to those found universally across the nation and will be familiar to the players.

(h) BAI will develop an exercise controller book for the entire exercise. This controller book will be very flexible to allow start and stop points if needed to let the players discuss important points or lessons.

(i) BAI will develop an exercise after action report. This will be done in conjunction with XXX Division requirements.

(j) BAI has provided, as an enclosure to this LOI, a list of applicable agencies and positions that will play the state, federal and DoD entities involved in such an operation

(k) BAI is responsible for training workstation operators, upper control cell participants, observer/controllers and role players.

(l) BAI will supervise the conduct of the simulation center, upper control cell, after action facilitation and observer/controllers under the guidance of the XXX Division commander.

(m) BAI will develop a detailed training and exercise schedule for the exercise 19-23 June XXXX or as early as 17 June XXXX, depending on the direction and desires of XXX Division.

(n) BAI will deploy to the exercise as outlined in the deployment and re-deployment schedule.

(o) BAI prepares a written after action report that is to be submitted to the Commanding XXX Division, no later than 15 July XXXX. Included in this report are any recommendations for future exercises.

(p) BAI is responsible for all communications equipment, inter-connectivity between all sites and configures, as well as beta tests, all workstations participating in the exercise.

(2) NICI

(a) NICI is responsible for providing an exercise point of contact (POC) that will participate in an interactive process with Big Applications, Inc. As exercise materials are developed and shipped to the POC, the POC will coordinate them with the staff and approve or make recommendations for changes. POCs are outlined in the coordinating instructions of this LOI.

(b) NICI will provide observers/controllers for the exercise.

(c) NICI will be responsible for the set-up required for the filming of the exercise.

(d) POC will schedule in conjunction with the other POCs site surveys and In-Progress Reviews (IPRs).

(e) From a MIPR provided by the XXX Division, NICI is responsible to handle all payments due to contractors as well as other costs budgeted for and associated with the execution of the exercise and the operational planning conference.

(f) NICI is responsible for contracting billeting for all participants.

(g) NICI is responsible for producing Individual Travel Orders, quarters, and rental vehicle for Big Applications, Inc.

(h) NICI is responsible for providing computer hardware, exercise supplies, and copying capability for the exercise.

(i) NICI is responsible for the audio/visual connectivity between work areas.

(j) NICI is responsible for providing sufficient copies of the exercise binders, observer/controller binders and other exercise materials for attendees, visitors and staff. Big Applications, Inc will supply all original documents for copy.

(k) NICI is responsible for setting up a facility for the CREST exercise and Operational planning conference. The set up should include audio and visual capability for the site. Audio/visual personnel are required to be on hand to assist with technical issues.

(l) NICI will be responsible for providing administrative personnel to assist in consolidating daily discussion material during the CREST exercise and Operational planning conference.

(3) XXX Division, G-3

(a) G-3 is responsible for providing a POC that will participate in an interactive process with Big Applications, Inc. As exercise materials are developed and shipped to the POC, he/she coordinates them with the staff and approves or makes recommendations for changes.

(b) The POC for G-3 is responsible for providing the T/O & T/E of XXX Division organizations needed to be entered into the database.

(c) POC will schedule in conjunction with the other designated POCs all site surveys and IPRs.

(d) The G-3 is responsible for managing any possible invitation of VIPs and visitor logistics, as well as the administrative and protocol arrangements.

(e) The G-3 is responsible for providing a PIO to participate in the exercise as well as provide additional media personnel to role-play the media for the exercise.

(4) XXX Division, Headquarters Battalion

(a) The S-1 will ascertain the Army participation for this exercise and submit a completed reservation form to NICI for action.

(b) The S-1 will produce orders and travel requirements for all soldiers to attend training. The G-1 will forward all travel arrangements for XXX Division to NICI for reconciliation of billeting requirements.

(c) The S-1 will provide at least one enlisted to assist NICI for administration requirements during the conduct of both the CREST exercise and the Operational planning Conference.

(5) Florida POMSO

(a) The FL POMSO will provide a POC that will participate in an interactive process with Big Applications, Inc. As exercise materials are developed and shipped to the POC, he/she coordinates them with the staff and approves or makes recommendations for changes.

(b) The POC will provide the T/O & T/Es of those Florida National Guard organizations to be entered into the database.

(c) The POC is responsible for scheduling all site surveys and IPRs in conjunction with the other designated POCs.

(d) The POMSO is responsible for providing an Information Management individual that has read, write and author capabilities to the existing National Guard Centers information technology databases.

(e) The POMSO is responsible for acquiring for the use of the exercise and the Operational planning conference the following items:

1. One room for NICI to be used by administrative and support personnel.

2. One room for the exercise director and the upper control cell.

3. The Guard Armory floor for the use by the Army operations center.

4. The state Emergency Operations center with personnel outlined in this LOI.

(f) The Florida POMSO is responsible for acquiring subject matter experts outlined in the positions enclosure for both the state EOC and the upper control cell.

e. <u>Critical timelines for executing agencies.</u> Identify the key critical events for the exercise. More detail information should be contained in an annex.

Example -

(1) Curriculum developed for general training session 1 April XXXX.

(2) Key Florida staff positions assigned by 2 March XXXX.

(3) Draft exercise scenario ready for quality control checks due 15 March XXXX.

(4) IPR with specified personnel in Frankfort, Florida 27-29 March XXXX.

(5) T/O & T/Es from Florida National Guard and the XXX Division to Big Applications, Inc by 17 April XXXX.

(6) PIO script from Big Applications, Inc and STARTEX animation due to NICI by 1 May XXXX.

(7) Exercise scenario completed for final proof and quality control by 1 May XXXX.

(8) Final product due from Big Applications, Inc. 17 May XXXX.

(9) Big Applications, Inc completes Exercise, Observer/Controller and Read Ahead materials due 17 May XXXX to NICI for reproduction and distribution.

(10) Read ahead materials mailed by NICI 17 May XXXX.

(11) Conduct final systems training and communications training, observer/controller training, exercise director training and general sessions training 16 June XXXX.

(12) Complete staff internal after action reviews 26 June XXXX.

4. <u>Administration and Logistics</u>. Other key aspects of the exercise should be identified with detail information contained in an annex.

Example -

a. Funding. NICI will receive a MIPR from the XXX Division to facilitate any contracts, travel and In Progress Reviews (IPRs) required for the execution of the exercise and the Operational planning conference.

b. Billeting

(1) NICI will reserve rooms for all participants of the exercise and the conference the following week.

(2) The XXX Division and the POMSO for Florida will provide to NICI names of participants that require billeting for both the exercise and the conference. To expedite this process, a completed reservation form is to be submitted to NICI.

(3) The contract with the hotel will reflect the billeting required of participants only. Any VIPs or visitors invited by the XXX Division or the Florida POMSO will be their responsibility.

c. Transportation. Rental cars have been authorized for selected soldiers. All other agencies are responsible for their own mode of transportation and are not to be funded by the MIPR provided by XXX Division to NICI.

d. Meals. All soldiers will be in a per diem status. All participants are requested to attend a reception at the hotel contracted for billeting on 18 June XXXX. The information regarding this reception is outlined in the additional information enclosure.

e. Uniform. All military personnel will be in camouflage utilities for the entire exercise and follow on operational planning conference.

5. Coordinating Instructions. Any other key pieces of information that everyone would need to know on a regular basis.

Example -

a. Key Points of Contact

(1) Big Applications Inc., John Smith, Contractor COMM (xxx) xxx-xxxx, e-mail john.smith@Big.com.

(2) National Interagency Civil-Military Institute, Major Sue Jones, Training Director U.S. Army, COMM (xxx) xxx-xxxx, DSN xxx-xxxx, e-mail sujones@nici.org.

(3) National Interagency Civil-Military Institute, SGM Paul Jones, Liaison Officer, U.S. Army, COMM (xxx) xxx-xxxx, DSN xxx-xxxx, e-mail jbjones@nici.org.

(4) XXX Division, Colonel George Williams, Chief of Staff, COMM (xxx) xxx-xxxx, DSN xxx-xxxx, e-mail grwilliams@cos.xxxdivision.mil.

(5) XXX Division, Major Terry Summers, G-3 Plans Officer, COMM (xxx) xxx-xxxx, xxx-xxxx, e-mail tsummerss@cos.xxxdivision.mil.

(6) Florida Plans, Operations and Military Support Officer, Major Ron Simmons, COMM (xxx) xxx-xxxx, xxx-xxxx. E-mail rsimmons@bngc.dma.state.fl.us.

a. shihata

Assistant Chief of Staff, G-3

DISTRIBUTION: Special

Annexes: Each annex will provide specific information concerning the various aspects concerning the upcoming exercise event.

(A) Division XXXX Mission, Organization Area of Responsibility, and Exercise Scheduling Procedures

(B) Organization for the Conduct of an Exercise

(C) The Exercise Director's Monthly Status Report

(D) Higher Headquarters Response Cell

(E) Exercise Control Cell

(F) Observer Controller (OCs) Team

(G) Analyst Cell

(H) Exercise Oversight

(I) Exercise Chronology / Milestones

(J) Initial Planning Conference

(K) Commander's Exercise Briefing

(L) In-Progress Reviews

(M) Exercise Rehearsal

(N) Pre Combat Check

(O) STARTEX Briefing

(P) SIMEX BDE and TSB Relationships

(Q) Exercise Hot Wash

(R) Common BCST Terms and Definitions

(S) Logistics Support

(T) Training

Copy to: Exercise Participants

Annex A - Division XXXX Mission, Organization Area of Responsibility, and Exercise Scheduling Procedures

Annex B - Organization for the Conduct of an Exercise

Annex C- The Exercise Director's Monthly Status Report

Annex D - Higher Headquarters Response Cell

Annex E – Exercise Control Cell

Annex F - Observer Controller (OCs) Team

OCs plays a critical role in providing the performance-oriented observations necessary for an effective AAR with constructive criticism that will benefit the training audience. This annex should contain as a minimum the following information:

☐ Should be external to the unit (being exercised), but may come from one or the adjacent units belonging to higher HQ. In this way, the OCs are familiar with the higher SOPs and can utilize this knowledge in the conduct of the exercise. Otherwise, OCs must become familiar with the TA’s SOPs.

☐ Work for EXCON (Senior Control), and perform the role of objective observer/data collector, and as on-site controllers as required by the MEL

☐ Must be proficient in the areas that they are tasked to observe, but also require instructions and training in the performance of their OC duties

☐ Must know and understand the TAs:

- Related OPORDs and missions (this includes the OPORDs and missions of the TA's related higher, lower, adjacent, and supporting units/HQ, and the OPFORs as well)

- Specified training objectives, and the related tasks, standards, and performance measures

☐ Must understand and execute their specified portion(s) of the data collection plan and produce/provide their performance observations and reports in sufficient time to support the AAR presentation schedule

Annex G - Analyst Cell

Annex H – Exercise Oversight

Annex I - Exercise Chronology / Milestones

Annex J - Initial Planning Conference

Annex K - Commander’s Exercise Briefing

Annex L - In-Progress Reviews

Annex M - Exercise Rehearsal

Annex N - Pre Combat Check

Annex O - STARTEX Briefing

Annex P - SIMEX BDE and TSB Relationships

Annex Q - Exercise Hot Wash

Annex R - Common BCST Terms and Definitions

Annex S - Logistics Support

Annex T– Training

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4.B.2f Resource Constraints

Effective training using simulations is resource intensive and involves careful planning, preparation, and tracking. The effectiveness and efficiency of an exercise are based directly on the amount of resource planning that takes place. There is a good chance that the FA 57 on-site will be the one responsible for planning and executing the resourcing plan for the training event. Some major areas to address in planning include people, money, time, facilities, and communications.

1. People

People are the most important resource. There are three primary staffing components: the training unit, the exercise control staff, and the support staff.

a. Training Unit

Ensure that there are adequate personnel from the training unit to:

1. Plan and conduct the exercise planning sequence
2. Develop, enter and test the database (or assist simulation center personnel)
3. Plan and conduct pre-exercise training
4. Plan and conduct the mini-exercise
5. Conduct the training event
6. Conduct the After Action Review (AAR)

b. Exercise control staff

1. Staff control cells (see 4.B.7 for their functions)
2. Site set-up

c. Support Staff

Provide support for:

1. Communications
2. Network maintenance
3. Logistics
4. Maintenance
5. Medical support
6. Security

2. Money

Almost as important as personnel is having adequate funding. The list below provides a start point for funding areas to check:

Adequate funding to accomplish all support functions:

a. Simulation Center contractor support
b. Dining facility
c. Transportation to training site. If parking is limited, transportation may have to be provided
d. Office supplies; copiers with paper
e. Telephone and Internet use
f. Communications / Bandwidth
g. Miscellaneous equipment
h. TDY costs for those people that need to travel to the training event.

3. **Time**

There will never be enough time to plan and execute an exercise; therefore, it is important that the planning is meticulous. The Time Resource Constraints section provides more details, but here are a few major items that should appear on the training event timeline.

Adequate time allocated for:

a. Exercise planning sequence
b. Conferences (IPC, MPC, FPC)
c. Data entry and testing
d. Pre-exercise training
e. Site set-up
f. Mini-exercise
g. Training event
h. AAR
i. Site cleanup
j. Equipment breakdown at conclusion of exercise

If the training unit and/or control personnel are USAR or ARNG, consider whether there are adequate training days to accomplish the planning, pre-training, the actual training event, and post-training AAR. Also determine if the soldiers to be trained will be the same soldiers that attend the pre-exercise training. Available training-days may not allow that. You need to know if your training audience has or has not been to the pre-exercise training. Also, determine if there are adequate training days for both the pre-exercise training and the actual training event.

4. **Facilities**

If the training unit is using a permanent facility for the exercise, rather than conducting it from a field location, consider the following as facility to be used is examined:

a. Facility large enough to accomplish the mission without undue cramping and congestion
b. Adequate numbers of rooms for training unit elements and control elements
c. Briefing and AAR room(s)
d. Work areas for both the training unit and the control teams
e. Separate meal and break areas
f. Adequate billeting for off-shift personnel or support personnel
g. Shower and latrine facilities
h. VIP offices
i. Observer/Controller work area
j. Physical security requirements (Check with your security officer to see about SCIF requirements, barriers, controlled access and other security issues)

Other facility considerations to consider

a. Electrical power source—check to see if there are adequate power and outlets for unit and control cell requirements.

b. Parking

   1. Adequate for training unit, control personnel, and support personnel
   2. VIP parking
   3. If parking is limited, arrange transportation (all shifts, to and from an assembly area)

c. Environment
   1. Air conditioning
   2. Heat
   3. Fans
   4. Trash removal, including classified trash
   5. Cleaning teams (with associated security/escort requirements)

d. Hardware:
   1. Adequate workstations for training unit and control teams' requirements
   2. Additional automation to support email and other administrative functions

e. Furniture

   Adequate desks, tables, chairs, and other necessary furniture

f. Quality of Life. If approved, consider allowing these appliances:

   1. Refrigerators
   2. Microwave ovens
   3. Coffee makers

6. Communications

Along with security, communications is one of the two "long poles in the tent" when it comes to planning and conducting training. It cannot be stressed enough that the communications team needs to spend a lot of time planning and checking. A few items to consider:

a. Bandwidth

   Adequate to handle the data requirements for the simulation(s) to be used, and Internet Email

b. Secure capability

   If classified data will be processed and passed, adequate security procedures and equipment exists.

c. Telephones

   1. Adequate number for training unit, control teams, and support teams
   2. Issue cell phones to those that need them

d. Internet

   Internet access, as needed.

7. Summary

An important factor in the conduct of a successful simulation-supported training event is resource planning. The effectiveness and efficiency of an exercise depends on the amount of planning, checking, and tracking of resources that takes place.

Resource Constraints Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants ____

Primary Customer / Exercise Director__________________________

Phone Number____

Mailing Address____

Email Address____

Facilitator ____

Phone Number____

Mailing Address____

Email Address____

Pre-Exercise Phase

Initial Research Phase

Initiate planning to address the key resources needed to conduct a simulation-supported exercise--people, money, time, facility, and communications.

Example spreadsheets:
People: Determine staffing requirements.

Task	Responsible Organization	Staffing Positions / Names	Shortfalls	Comments
Plan and conduct exercise planning sequence				
Develop, enter, test database				
Plan and conduct pre-exercise training				
Plan and conduct mini-exercise				
Conduct the training event (adequate staffing by training unit)				
Conduct the AAR				
Staff the control cells				

Staff the response cells				
Sight set-up				
Provide support: • Communications • Network • Logistics • Maintenance • Medical support • Security				

Money: Determine funding level for each activity required to support the exercise.

Activity	Funding Requirement	Funding Available	Shortfall	Funding Source
TDY costs for visitors				
TDY costs for staffing augmentation				
Rental transportation				
Office supplies				
Rented equipment				
Communications • Equipment • Telephone and Internet use • Long distance • Long haul lines				

Contractors				
Dining facility				
Support				
Petroleum, oil, and lubricants (POL)				
Repair parts, expendable supplies, and depot level maintenance				
Conferences and meetings				
Moving equipment				

Time: Determine what tasks/activities are required to execute the exercise and the time required for each one.

Event	Time Required to Accomplish	Identify Which can be Worked Simultaneously	Time Issues / Shortfalls
Exercise planning sequence			
CDC			
IPC			
MPC			
FPC			
Data entry and testing			
Site Set-up			
Pre-exercise training			
Mini-exercise			
Training event			
AAR			

Facility: Develop a facilities plan. Organization and Requirements.

Organization	Physical Space	Electric Power Sources (# in each room)	Parking (# of spaces)	Environment	Hardware	Furniture	Quality of Life
Primary Training Audience							
Secondary Training Audience							
Control Cell							
Response Cells							

Consider:

- Physical space
  - Large enough for requirements
  - Enough rooms for training unit elements and control elements
  - Briefing and AAR room(s)
  - Work areas (sufficient number and adequate size)

  - Separate meal and break areas
  - Adequate billeting
  - Shower and latrine facilities
  - VIP offices and billeting
  - O/C work area
  - Secure work and storage areas (for classified work, documents)

- Electrical power source
  - Adequate power and outlets for unit and cell requirements
  - Installation schedule, as required

- Parking
  - Adequate for training unit, control and response cell personnel, and support personnel
  - VIP parking
  - If limited, arranged transportation

- Environment
  - Air conditioning
  - Heat
  - Fans
  - Trash removal, inc. classified trash
  - Cleaning teams

- Hardware
  - Adequate workstations for training unit and control teams' requirements
  - Additional automation to support email and other administrative functions

- Furniture
  - Desks, tables, chairs

- Quality of Life
  - Refrigerators
  - Micro-wave ovens
  - Fans
  - Floor heaters

Communications: Develop a communications plan.

Activity	Bandwidth Requirement/ Current Capabilities	Secure Requirement / Current Capabilities	Telephone Requirement / Current Capabilities	Internet Requirement / Current Capabilities	Shortfalls
Primary Training Audience					
Secondary Training Audience					
Control Cell					
Response Cells					

Design Phase

Initial Planning Meeting

Identify the Training Audience

____

____

____

Training Objectives

Identify Subject Matter Experts

Using the spreadsheets developed during the Pre-exercise phase, develop an Initial Concept Paper for each of the resources (People, Money, Time, Facilities, and Communications)

Papers developed:
People _____ Money _____ Time _____
Facilities _____ Communications _____

Meet with representatives from each participating organization (training audience, cells, support staff). Distribute copies of the concept papers and spreadsheets. Conduct a detailed review of all simulation and technical areas. Review the information, make revisions/upgrades, address potential shortfalls, and examine possible solutions. Determine requirements for additional information, e.g., names for cell staffs. After all meetings have been conducted, meet with the Chief Controller to go over the information gathered, addressing each of the key areas. Provide information on any potential "show stoppers."

Meeting with training audience Date ____________
Meeting with Control Cell Date ____________
Meeting with Response Cells Date ____________
Meetings with support staffs Dates ____________
Meeting with Chief Controller Date ___________

Mid or Main Planning Meeting/MPC

Use the MPC to finalize and formalize, as much as possible, the resource plan. Meet with representatives from each participating organization (training audience, cells, support staff). Distribute copies of the revised/updated concept papers and spreadsheets. Conduct a detailed review of all simulation and technical areas. Review the information, make revisions/upgrades, address potential shortfalls, and examine possible solutions. To the extent possible, fill in the remaining information needed. Identify requirements for additional information. After all meetings have been conducted, meet with the Chief Controller to go over the resources status, addressing each of the key areas. Provide information on any potential "show stoppers."

Meeting with Training audience Date ____________
Meeting with Control Cell Date ____________
Meeting with Response Cells Date ____________
Meetings with support staffs Dates ____________
Meeting with Chief Controller Date ___________

Final Planning Meeting

Finalize and formalize the resource plan. Meet with representatives from each participating organization (training audience, cells, support staff). Distribute copies of the final concept papers and spreadsheets. Conduct a final, detailed review of all simulation and technical areas. Review the information, make final revisions/upgrades, address potential shortfalls, and determine solutions. Fill in the remaining information needed. After all meetings have been conducted, meet with the Chief Controller to brief the resources status, addressing each of the key areas. Provide information on any potential "show stoppers."

Complete layout of the resource support of the exercise _____
Resolution of unresolved issues _____
Review Facility and Technical Lay down _____
Final meeting with training audience Date ___________
Final meeting with Control Cell Date ___________
Final meeting with Response Cells Date ___________
Final meetings with support staffs Dates ___________
Briefing to Chief Controller Date __________

Exercise Phase

Adequate staffing (replacements identified, as needed) _____
Facility inspection _____
Communications tested _____
AAR capability ready _____

4.B.2g Exercise Support Survey

The Exercise Support Survey defines and synchronizes all of the exercise's necessary support structure and its related activities. The Exercise Support survey is conducted and compiled based on the exercise training objectives and requirements specified in the Exercise Directive. The individual responsible for the support operations should conduct the Exercise Support Survey during a visit to the exercise site. This visit and survey are to ensure that the location and support facilities will meet the requirements for logistics, security, life support, and all other aspects of support outside of the actual physical plant. Whenever possible, the Exercise Support Survey should be conducted in conjunction with the facility survey. Even if the site has been utilized for a past exercise, this visit and survey should still be conducted to account for any changes in the area of support.

The individual responsible for the support operations also has the responsibility to ensure that all required coordination is made and to provide oversight and assistance in the execution of all support activities.

The following survey is not all-inclusive, but will provide a foundation for those support elements that need to be addressed and arranged prior to the conduct of the exercise. Each exercise is unique and as a result will have a series of coordination issues that will require diligence to keep from distracting from the focus of the training event. Delegation where possible and oversight of each of these elements should be addressed as early in the exercise cycle as possible and reviewed at each of the In-Progress Reviews to ensure continued coordination.

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Exercise Support Worksheet

(If more than one location a separate survey should be conducted for each site)

The exercise support survey(s) should be conducted concurrently (if possible) with the facility survey to determine the exercise unit's/installation's ability and secure its agreement to provide support for the exercise. The following survey should be conducted for each site to be utilized during the exercise.

Exercise Name____

Site Location ____

Unit at this site ____

1. **Key Dates:**

   Set-up Dates ____

   Exercise Registration and Orientation Dates_________________________

   Exercise Dates____

   After Action Review Date(s)____________________________________

   Break Down Dates______________________________________

2. **Registration and Orientation**

   Registration Location____

   Date / Time for Registration___________________________________

   Sign in Procedure____

Security Verification____

Badge Issue Procedures____

____

Costs (specify amount and purpose) __________________________________

____

Travel Closure Procedure____

Procedure to Issue necessary information and (O) ration cards____________

Room Assignments Procedures_______________________________________

3. Exercise Orientation Briefings

Location____

Date / Time____

Topics for Briefings____

____

____

4. Social ______________ Yes ______________ No

______________ Host ______________ No Host

Location____

Date / Time ____

Costs (specify amount and purpose)__________________________

5. Contracting Support.

Contracting Requirements	Local Contracting POC	Award Contract	Vendor / POC

6. Personnel Numbers and Location

Cell	Number of Personnel	Date of Arrival	Date of Departure

7. Parking

General Parking

Location____

Capacity____

Reserved / VIP Parking Spots

Location____

Capacity____

Parking Slot #	Slot Assigned To

8. Transportation

Shipment

Item Description_________________________________

Date Shipped____

Date for Delivery____

Location Shipped From___________________________________

Shipper____

Reception____

Customs forms (If required)______________________________

Pickup Date____

Shipper____

9. **Office Furniture and Fixtures –** Complete the chart below for the following items: 1) Desks; 2) Workstation tables; 3) Chairs; 4) Tables; 5) Map boards; 6) Trash cans; and any other items that need to be obtained for the cell or area.

Cell or Area	Table Requirement	Chair Requirement	Other Items Required for the Cell

10. **Other Equipment** - Complete the chart below for the following items: 1) Copy equipment; 2) Fax Machines; 3) Personal Computers; 4) Coffee pots; 5) Microwave ovens; 6) Vending machines; and any other support items that need to be acquired and/or require electricity for any given cell or area.

Cell or Area	Items Required for the Cell	Electrical Requirement and Dimensions of the Item

11. Contact numbers for all services being rendered during the exercise.

Support Area	Person's Name	Contact Number Day Time / Emergency Number
Electricity		
Phone / Data Connections		
Copiers		
Water / Plumbing		
Physical Plant		

12. Coordinate Life Support:

Billeting / Accommodations

Billeting Location	Phone Number	Number of Singles	Number Of Doubles	Number of VIP Quarters

Dining / Break Facilities

Dining / Break Facility	Location	Distance from Exercise Site and Hours of Operation

Transportation Plan from Billeting and Dining Facilities to / from Simulation Center

13. Support Manager(s) contact information:

Name Title	Phone	Cell	Email	Fax

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4.B.2h Pre-Exercise Training

Effective training using simulations does not happen by accident; it takes careful planning and preparation. A key element of that preparation is pre-exercise training. The effectiveness and efficiency of an exercise are based directly on the amount of pre-exercise training that takes place. There is a good chance that the FA 57 on site will be the one responsible for planning and conducting pre-exercise training. Here are a few areas to address in planning:

1. **Training Considerations**

Before planning your pre-exercise training, some basic information on the unit to be trained, the training location, and training dates needs to be determined.

First, know who the training audience is. It is important to get the names of the key individuals in the unit so they can be contacted to make things happen. As a minimum, collect the following information:

a. Unit designation
b. Unit home station
c. Next higher HQ
d. Division, Corps, separate command
e. Commander
f. CSM/SGM/Sr NCO on site
g. Operations Officer
h. Logistics Officer
i. Communications Officer
j. Other key individuals (specify)

If the unit to be trained is USAR or ARNG, determine if there are adequate available staff-days for the pre-exercise training. Also, because of staff-day restrictions, it is possible that the pre-exercise trained group will be different from the group that will undergo the exercise. Find out early if that is the case. If so, allocate time at the beginning of the exercise to conduct an abbreviated training session.

Once all the information on the unit has been gathered, determine the personnel that will conduct the actual training event. These could be:

a. Organic personnel from unit to be trained.
b. Personnel from other units detailed for this event.
c. Simulation Center personnel.
d. Other (specify).

Also determine the exercise location and dates. The location could be one of several options, to include:

a. Home station
b. Armory
c. Reserve Center
d. Simulation Center
e. CTC
f. Local training area
g. Other (specify)

Once this information has been collected, planning for the pre-exercise training events can start.

2. Integration Train-up

There are two main groups that need to be trained prior to the exercise: the training audience (unit to undergo the actual training event) and the exercise controllers. Both are key to ensuring an effective and efficient training event.

a. Training Unit Personnel

Training audience instruction begins with the terminal operators. For the simulation to work properly, the unit operators have to know how to input data and commands and to retrieve information. The first step is to identify computer terminal operators. Then, determine the level of computer literacy for each operator as, even in this high-tech era, there are people who have little or no computer skills. If necessary, conduct basic computer familiarization training for those operators that require it. Once everyone is at a basic level of computer literacy, conduct computer terminal training for the unit operators. They will need to learn the specific computer skills for the simulation to be used. Examples of what they need to know include how to: initiate the simulation, input data, move units, send messages, fire weapons, activate sensors, create and send reports. Key unit personnel should be aware of each simulation's quirks or nuances that cause it to function more effectively, but be careful not to teach "gamesmanship."

b. Controllers

Once again, instruction begins with the Controller terminal operators. For the simulation to work properly, the Controller terminal operators have to know how to input data, retrieve information, collate data, and develop feedback for AARs. Again, the first step is to identify computer terminal operators and determine the level of computer literacy for each operator. Conduct basic computer familiarization training for those operators that require it. Once everyone is at a basic level of computer literacy, conduct computer terminal training for the Controller operators. Examples of tasks they will need to know include: inputting data, reviewing status reports on trained unit, downloading reports, passing messages, collating data and feedback, developing AAR reports and presentation materials.

3. Mini-Exercise Activities

An important event in the preparation for any simulation-supported exercise is the mini-exercise, conducted as a "shakedown" for the training unit, the controllers, the network and security personnel, and for the simulation itself. The mini-exercise is designed to ensure, as much as possible, that all is ready for the actual training event. Most of the FA57's attention in the mini-exercise should be focused on ensuring that the various control cells are prepared to execute their jobs efficiently.

Determine early which of the key cell team members have never conducted a simulation-supported exercise before. Have a plan in place to train them to achieve the necessary proficiency. Address their roles and responsibilities, the do's and don'ts, and provide instruction on the simulation(s) to be used in the exercise. As for the more experienced cell team members, conduct refresher training for them, as needed.

It is critical that cell teams be familiar with the scenario. If the training unit has requested specific events for training, then the cell teams must know what these events are and when they are supposed to happen. If time permits, conduct a training session with the cell team members. Review the scenario, point out critical events, and assign responsibility for executing those events. Make sure the cell team responsible understands when and how the event will be initiated.

Equally important to the success of the training event is cell team familiarization with communications and security—always the long poles in any exercise tent. Conduct a session with cell team members, communications and security personnel to familiarize cell team members with the communications network and security requirements.

4. Exercise Activities

Events that occur in any simulation-supported training activity include: simulation system failure, requests for information, role-playing, unexpected events, and interaction between the cells. Training should account for all of these events.

a. Training in Response to System Failure

System failures are going to happen—count on it. It is stressful for everyone because training time and other resources are being wasted. Be prepared to react quickly and efficiently. Establish procedures to be followed in the event of a system failure. Conduct training in these procedures. Stimulate events in the mini-exercise that will cause the controllers and network administrators to respond to partial and complete system failure. Practice, practice, practice. Be ready for this.

b. Training in Response to Requests for Information

Members of the training audience want to know how they are doing. Everyone wants to know if they are winning, if things are going well, if jobs are being done right. Controllers and cell team members need to know what they can and cannot say to the training audience. Establish procedures to be followed in response to requests for information. As needed, conduct training in these procedures. Stimulate events in the mini-exercise that will cause the controllers to respond to requests for information from the trained unit. The bottom line is to know what can be said and not said to the training audience.

c. Training in Role-playing

Role-playing is the portrayal by controllers of units not represented in the simulation. Role-playing by controllers may be necessary to keep the exercise going and realistic. Determine what roles will need to be played by controllers to conduct the exercise. Examples may include representing higher, adjacent, supporting, or supported HQ. Once roles have been established, determine the role player(s) responsibilities and duties.

Rehearse role-playing, as needed. Stimulate events in the mini-exercise that will cause the controllers to have to role-play.

d. Training in Response to Unexpected Events

Despite trying to prepare for every contingency, there will be those unexpected events that have not been considered. Try to minimize the potential for unexpected events by brainstorming, or conducting “what-if” drills with the senior controllers, training unit leaders, and primary support staff. Attempt to determine what could go wrong and plan for it. Establish procedures to be followed in response to unexpected events, e.g., power failure, press coverage, VIP visits. Conduct training in these procedures. Stimulate events in the mini-exercise that will cause the controllers and support staffs to respond to unexpected events.

e. Training in Cell Interaction

The various control cells need to share information. Often, in the heat and excitement of the exercise, this does not happen, resulting in poor communication and coordination. Take the time to specify what information cells need from each other. Conduct cell interaction training to practice the passing of required information. Stimulate events in the mini-exercise that will cause the different cells to interact. Check during the exercise to see if the training paid off.

5. Post Integration Management

Pre-exercise training has been planned and conducted. Now it is time to conduct the actual training event. The FA 57 needs to know if the training that was planned and executed was beneficial, what was covered well, and what improvements are needed before the next event. Stress the importance of note taking on the training by the training audience, controllers, cell team members, communications personnel, security personnel, and support personnel. Make sure they provide a candid assessment of what was covered well in the pre-exercise training and what needed more emphasis. These notes will provide a terrific starting point for the next time around. Collect these Lessons Learned notes and publish them in the final Training Review document.

6. Summary

An important factor in the conduct of a successful simulation-supported training event is the pre-exercise training. The effectiveness and efficiency of the exercise depends directly on the amount of pre-exercise training that takes place. Plan, anticipate, train, and be ready for any contingency.

Pre-Exercise Training Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants: ____

Primary Customer / Exercise Director________________________________

Phone Number____

Mailing Address____

Email Address____

Facilitator ____

Phone Number____

Mailing Address____

Email Address____

Pre-Exercise Phase

Initial Research Phase

Identify the Structure of Each Participating Organization

Name of Participating Organization(s)	Date Organizational Structure is to be Provided	Date Structure is Received

Training Audience(s)

Position	Name, Rank, Organization	Contact Information
Commander(s)		
CSM/SGM/Sr NCO(s) on site		
Operations Officer(s)		
Intelligence Officer(s)		
Logistics Officer(s)		
Communications Officer(s)		
Other key individuals (specify)		

Personnel to Conduct the Training

Personnel	Name, Rank, Organization	Contact Information
Organic personnel from unit to be trained		
Personnel from other units		
Simulation Center personnel Other (specify)		

Design Phase

Initial Planning Meeting

Develop an Initial Pre-Exercise Training Concept Paper. ____ (X when completed)

Address:

- Training objectives
- Training audience
- Training date(s)
- Agenda (training schedule)
- Topics to be covered
- Based on the simulation(s) to be used:
  - Identify capabilities that support Pre-Exercise Training
  - Identify limitations that impede Pre-Exercise Training
- SMEs
- Training location
- Instructors
- Required support
- Post-exercise AAR (Lessons learned from the pre-training, e.g., what was not covered that should have been, what was done right)

Identify the Training Audience

____

____

Identify Training Objectives

Identify Subject Matter Experts

Pre-Exercise Training location/type of training:

Pre-Exercise Training Location(s)	Type of Training	Dates for Pre-Exercise Training	Agenda Developed
Home station			
Armory			
Reserve Center			
Simulation Center			
CTC			
Local training area			
Other (specify)			

Training audience instruction

Identify Computer Terminal Operators (Name, Rank, Org)	Contact Information	Level of Computer Literacy	Scheduled Date for Computer Familiarization Training (if needed)

Training audience terminal operators identified ______ (X when completed)

Level of computer literacy determined _______ (X when completed)

Computer familiarization training scheduled
Date _______________

Computer familiarization training conducted
Date _______________

Conduct computer terminal training for training audience operators, e.g., how to initiate the simulation, input data, move units, send messages, fire weapons, activate sensors, create and send reports.

Training audience terminal operator training scheduled ______ (X when completed)
Date _________
Training audience terminal operator training conducted ______ (X when completed)
Date _________

Controller Instruction

Identify Computer Terminal Operators (Name, Rank, Org)	Contact Information	Level of Computer Literacy	Scheduled Date for Computer Familiarization Training (if needed)

Controller terminal operators identified _____ (X when completed)

Level of computer literacy determined ______ (X when completed)

Computer familiarization training scheduled ______ (X when completed)

Conduct computer terminal training for controller terminal operators, e.g., how to initiate the simulation, input data, move units, send messages, fire weapons, activate sensors, create and send reports.

Controller terminal operator training scheduled ______ (X when completed)
Date _____________

Terminal operator training conducted _______ (X when completed) Date_______________

Pre-Exercise Training Activities

Familiarize cell team members with the scenario to ensure events occur when they are supposed to.

Key MSEL Event	Responsible Cell	Responsible Cell Member	When the Event Occurs

Conduct training with cell team members, communications, and security personnel to familiarize cell team members with the communications network and security requirements.

Session scheduled ______ (X when completed)
Date _______________
Session conducted ______ (X when completed)
Date _______________

Establish procedures to be followed in the event of a system failure. Conduct training in these procedures. Stimulate events in the mini-exercise that will cause the controllers and network administrators to respond to partial and complete system failure.

Event	(DTG or MSEL event) of System Failure Event	Partial System Failure Event (X)	Complete System Failure Event (X)	Cause of Failure	Action Taken	Responsible Support Staff

Training scheduled ________ Date ________________

Training conducted ________ Date ________________

Establish procedures to be followed in response to requests for information (RFI).

RFI procedures established ______ Date ________________

RFI (enter specific request for information)	Who Asked For It? (Training Audience or Support/Control Cell)	Who Received It? (Control or Support Cell/ Person)	Action Taken

Training scheduled ________ Date _______________

Training conducted ________ Date _______________

Determine what roles will need to be played by controllers in order to conduct the exercise.

Role to be Played	Cell and Person Playing the Role	Role Player Responsibility	Role Player Action Taken	Role Player Rehearsal (MSEL event, other event, DTG)
Higher HQ				
Adjacent HQ(s)				
Supporting HQ(s)				
Supported HQ(s)				

Training scheduled ______ Date _____________

Training conducted ______ Date _____________

Establish procedures to be followed by the controllers and support staffs in response to unexpected events, e.g., power failure, press coverage, VIP visits.

Procedures established _______

Event	Cell/Person Responding to Event	Action Taken

Training scheduled _______ Date _____________

Training conducted _______ Date ______________

Specify what information cells need from each other, e.g., terrain data, unit METL, MSEL events, unit MTOE, unit capabilities, unit locations, unit strength, unit activities, control measures.

Information Required	Receiving Cell	Sending Cell	Action Taken

Training Scheduled _______ Date ___________

Training Conducted _______ Date ___________

The control and support cells must interact and share information during the exercise in order for it to flow smoothly.

MSEL Event	Other Event	Information to be Shared	Sending Cell	Receiving Cell	Action Taken

Training scheduled _______ Date ____________

Training conducted _______ Date ____________

Exercise Phase

Capture pre-exercise training lessons learned during the exercise.

Organization	Responsible Person	Lessons Learned Collected (X in the block when received)	Date Received
Primary Training Audience			
Secondary Training Audience			
Control Cell team members			
Support Cell team members			
Communications personnel			
Security personnel			
Support personnel			

Post-Integration Phase

Pre-exercise training Lessons Learned published in the final Training Review document.

Date submitted ______________

Submitted to ________________

4.B.3 Conduct Integration Activities

4.B.3a Cell Functions

1. Introduction

The training of senior officers and their staffs in command and control and staff functions can be expensive and difficult to arrange. This training can be done more often and at reduced costs with the aid of simulation-supported exercises. A simulation exercise serves two major purposes. It provides:

a. Training and practice in decision-making and in operations at the command and staff levels.
b. Basic data for evaluation, planning and study to be used to enhance unit performance.

An important feature of any simulation-supported exercise is the cells that exist to support it. There are two kinds of cells: Control cells and Response cells. Control cells do as the title suggests—control the exercise. Response cells represent units, organizations, and/or agencies that have a role in the exercise, but are not represented by actual players in the exercise. The FA 57 needs to understand the role of both types of cells to effectively plan and execute a simulation-supported exercise.

The training audience is divided into two parts—the Primary Training Audience (PTA), the unit to be trained; and the Secondary Training Audience (STA), which is subordinate to the PTA. The STA may represent higher, lower, adjacent units and non-combatant groups, agencies, and organizations. While the PTA is the principal target for the training, the STA also benefits through participation in the exercise. They can, with reduced staffing, exercise their own command and control functions via their own control cell(s). They may interpret simulated activities and reports to the PTA and may also translate orders from higher level into simulated activities as part of their cell functions. STA cells monitor, interpret, and report the activities of all subordinated echelons in the exercise. The STA cell(s) may be required to role-play when necessary in order to provide information to the PTA. STAs role play, for example, units, ships, or squadrons replicated in the simulation, and based on model output, provide the PTAs and appropriate control elements with all the reports and information they would ordinarily receive in a real-world situation. The STAs also receive tactical orders from their higher headquarters (PTAs) in the exercise, convert these orders into simulation orders, and execute the required operations.

2. Overview of Cell Structure

The cells allow a simulation exercise to be something more than just a computer game. Control cells provide direction and overall control of the exercise. Response cells provide a command and control environment that may consist of one or several decision makers with or without their staffs. They allow for effective management and rapid decision-making to keep the exercise flowing.

A basic principle for simulation training is that the trained staff shall not notice that they are working in a simulated situation. It is the job of the cells to ensure that this happens.

3. **Simulation Cell Principles**

Several principal concepts govern the activities of the simulation cells.

a. A basic principle for simulation-supported training is that the training unit commander and staff shall not notice that they are working in a simulated situation. The unit staff is not working directly with the simulation, but instead is communicating with a number of Response Cells that are playing subordinate staffs.

c. Response Cells work directly with the simulation. This is done with workstations that are connected to the central server through a network. Response cells give orders to simulated units and receive reports from them.

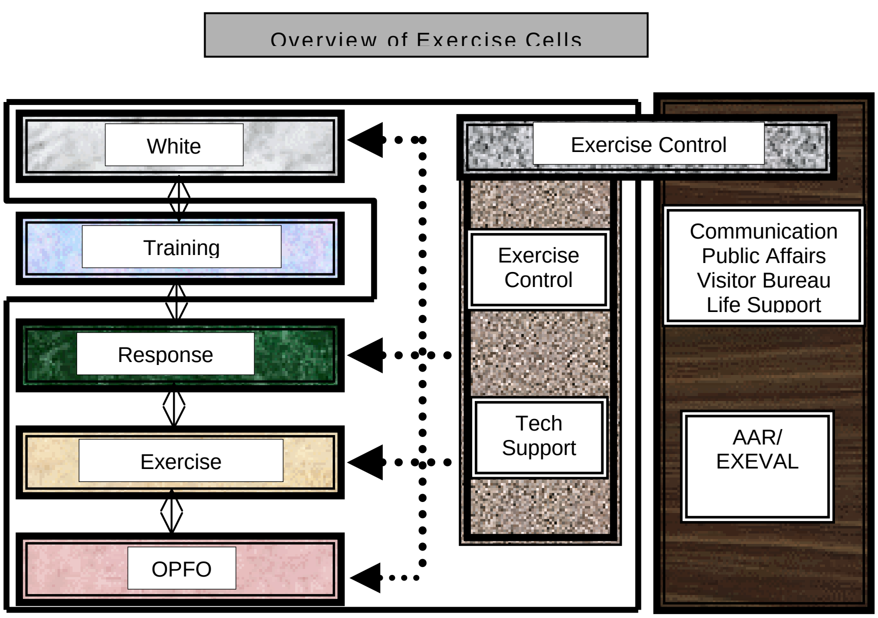
d. The training audience should act and react in a manner similar to that required during the conduct of normal operations.The training audience should interact with Response Cells using normal equipment and means (i.e., radio, phone, fax, email). They must be able to react to partial or total communication failures. By these means, the trained staff sends orders and receives reports from the response cells.

f. Simulations will provide a certain percentage of information, not necessarily everything.

g. Response Cells do not "see" everything, and thus are provided an incomplete view of the total picture in order to mimic normal limits of situational awareness. This forces cells to create and support situation awareness based on reports that come from subordinate units and other sources.

h. The number and type of response cells are determined during the pre-exercise training phase.

The diagram below represents the configuration of a training exercise. Inside the line are the Control and Response Cells. The line indicates that these cells are able to communicate and coordinate with each other. Outside the line are the training audience and the two areas that they are not involved in during the exercise. The Exercise Control Staff crosses both groups as they must interact with both during the exercise.



Information on the various cells and their functions follows. The names and functions of the cells can vary between exercises, simulation centers, and commands. The information provided below is designed to provide the FA 57 officer with general information that can be augmented to suit the exercise at hand.

4. **Exercise Control Staff (ECS)**

The Exercise Control Staff, which is chaired by the Chief Controller:

a. Directs and supervises the exercise Takes responsibility for the exercise and its overall aims and objectives
c. Enforces exercise control guidelines
d. Provides realism to the exercise
e. Ensures that the simulation and the scenario are presenting the same picture
f. Tracks completion of scenario events and training objectives
g. Steers the scenario to make sure training objectives are completed
h. Provides or replicates the following control inputs to the exercise participants:
    1. Initial and follow-on intelligence and scenario/event information
    2. Guidance and orders from higher authorities
i. Provides guidance to other control groups/cells
j. Establishes Commander’s Critical Information Requirements
k. Provides an umpiring function. This can occur in two ways:
    1. Stipulated rules that govern when simulated activities interact with one another
    2. Manually by an umpiring team

5. **Sub-elements of the ECS**

a. Exercise Technical Support Group/Team
    1. Provides the technical support needed for the exercise
    2. Reports to the ECS when critical situations occur that will have a major impact to the exercise proceedings
    3. Is chaired by Chief of Technical Support (CTS)
    4. Provides administration and briefing supportExercise Control Scenario Management
    1. Ensures manual and simulated **injects** follow a coherent story line
    2. Continuously reports to the exercise control staff and suggests major scenario changes, if needed

6. **Response Cells**

Response cells are responsible for executing the training unit’s decisions and playing the opponent and non-combatant roles. They also assist the ECS in supervising the course of events. Response cells see the whole picture as much as possible in order to manipulate the units directly (i.e., change their status and situation), to carry out decisions, provide orders and reports, and to execute the commands of the training unit. The training unit has direct contact and communication with the Response Cells.

Response Cell color designation and duties can vary between simulations. Examples of the various Response Cells include:

a. White Response Cell represents civilian agencies, for example mass media or local authorities.
b. Blue Response Cell represents subordinate units of the exercising unit.
c. Red Response Cell represents the antagonist or the enemy. The Red Response Cell portrays situations in a realistic manner based on rules, procedures, and restrictions similar to those imposed on the exercise unit. It provides for a thinking force in the exercise and subject matter expertise to ensure enemy doctrinal validity.Green Response Cell represents neutral agencies and/or organizations that are not involved in the simulated conflict. Examples might include the Red Cross and refugees.

7. Summary

Understanding the various cells and their functions is key to coordinating the flow of the exercise. Each of the cells plays a crucial role in determining the success of the training. The FA 57 must be intimately familiar with each of the control and response cells to facilitate preparation and execution of the exercise.

Cell Functions Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants ____

Primary Customer / Exercise Director_______________________________________

Phone Number____

Mailing Address____

Email Address____

Facilitator
____

Phone Number____

Mailing Address____

Email Address____

Pre-Exercise Phase

Initial Research Phase
Purpose of a Simulation Staff Exercise: To train the commander and staff of the exercising unit staff. Basic principle for simulation-supported training--training unit commander and staff shall not notice that they are working in a simulated situation.

Identify the Structure of Each Participating Organization

Name of Participating Organization	Date Organizational Structure is to be Provided	Date Structure is Received

Design Phase

Initial Planning Meeting

Develop an Initial Control and Response Cell Concept Paper. ____ (X when completed)

Identify cell requirements, cell functions, cell staffing requirements, cell interaction and information sharing, recording of Lessons Learned, required reports, briefings, and products.

Develop Cell Function Matrix. ____ (X when completed)

Show on the matrix which cells will accomplish what functions. Identify information sharing requirements.

Cell	Function	Information Needed From Other Cells	Info Provided By (List cell providing information required)
Exercise Control			
Exercise Technical Support Group/Team			
Scenario Management			
Response Cell: White			
Response Cell: Blue			
Response Cell: Green			
Response Cell: Red			
Response Cell: Other			
Response Cell: Other			

Identify the Training Audience

PTA ____

STA ____

Identify Training Objectives

Identify Subject Matter Experts

Develop an outline for the conduct of the exercise ______ (X when complete)

Based on of the Computer Model:

Identify Capabilities that Support the Exercise ______ (X when complete)
Identify Limitations that Support the Exercise _______ (X when complete)

Conduct initial Cell Function meeting. Discuss Control and Response Cell Concept Paper and Cell Function Matrix ______ Date of meeting/attendees _______________________

Conduct a detailed review of Cell areas (and areas to be supported)

Simulation Area ________

Facility Area ________

Communication Area _______

Cell areas _________

Interim Planning Meeting

Conduct scenario briefing for Cell members to ensure all understand the scenario, the MSEL, and understand what events happen when Date of briefing _______________

Conduct Control Cell meeting to discuss exercise control and control measures
Date of meeting __________________

Cell communications laydown. Meet with key cell members, communications, and network staff to understand cell communications network. Date of meeting ___________

Determine cell area layout. Prepare diagrams. Diagrams complete _____________

Cell Staffing (Determine staffing for each cell)

Exercise Control Cell

Name	Organization	Contact Information
Chief Controller:		
Deputy:		
Other Key Positions: - - - - -		
Terminal Operators: - - - - - -		

Exercise Technical Support Group/Team

Name	Organization	Contact Information
Chief, Technical Support		
Deputy		

Scenario Management

Name	Organization	Contact Information
Chief, Scenario Management		
Team Members: - - -		

Response Cells

Name	Organization	Contact Information
White Cell		
- Chief - - -		
Red Cell		
- Chief - - -		
Green Cell		
- Chief - - -		
Blue Cell		
- Chief - - -		
Other - Chief - -		
Other - Chief - -		

Final Planning Meeting

Finalize outline for the conduct of the exercise __________
Finalize cell staffing __________
Complete Layout of the Exercise __________
Clarification of Unresolved Issues __________
Review Facility and Technical Lay down __________

Exercise Phase

Ensure cells are staffed, understand functions, and have identified information sharing requirements _________
Communication Tested __________
Briefing and AAR Input developed and submitted ___________

Intentionally Left Blank

4.B.3b Exercise Flow

The continuity of any exercise depends on creating and delivering a logical and coherent scenario to the training audience. This section addresses the issues related to controlling the flow of the scenario to the exercise audience to avoid the appearance of artificialities related to the exercise environment. In support of this process, it is also necessary to make provision for communications between the various control and support elements that cannot (or should not) be seen by the training audience. Since simulation is only an approximation of the real world, it is necessary in exercises to compensate for the technical shortcomings of simulations, as well as to anticipate the unexpected in any planned event. This section describes the way the scenario is delivered to the training audience and the exchange of information that takes place between the exercise control staff, the simulation, supporting role players, and the training audience.

1. **Training Objectives**

A list of desired training objectives should have been documented from the outset of exercise planning to serve as a basis for discussion. That list is refined as the exercise planning process proceeds. The training objectives establish the purpose to be served by an exercise scenario, the roles to be played by training support staffs, control staffs, simulated forces, and the priorities established by the exercise managers. Training objectives should be stated clearly, and in terms that make them relevant for the training audience.

The training objectives should also be realistic for the time available. It may be hard for a commander or training officer to resist trying to pack too many events into the exercise time available, but the projected training audience OPTEMPO should be considered. The exercise should be stressful enough to pose a challenge, but paced to allow for the use of the desired methods and procedures to be followed. The perceived pace of the exercise may be affected by administrative decisions, such as whether or not to conduct the exercise 24-hours per day, but regardless, the training events making up the scenario should focus on a realistic set of training objectives for the time available. With regard to the length of the exercise day, a scenario projected to take five 24-hour days to execute in the real world should take approximately five 24-hour days, or ten 12-hour days to accomplish in an exercise.

The exercise scenario can begin and end at any point in time, at virtually any stage of operations. Depending on the training objectives, a introductory or pre-exercise “lead-in” scenario can be developed to explain to the training audience how they arrive at the situation immediately preceding the start of the exercise. Thus, an exercise could begin with a mobilization at home station, after four days, or ninety days of combat, or at the aerial port of debarkation following a deployment from CONUS to another part of the world, if that supports the training objectives. Remember that the simulation and all scenario support personnel have to be at least as well informed on the lead-in scenario as the training audience, so there is no perceived discontinuity in the scenario.

The process for establishing official training objectives will produce a coordinated document, usually referred to as the Exercise Directive. A myriad of collateral and subordinate training objectives and events may be encompassed by the objectives listed in this document, but the ones listed in the Exercise Directive take precedence.

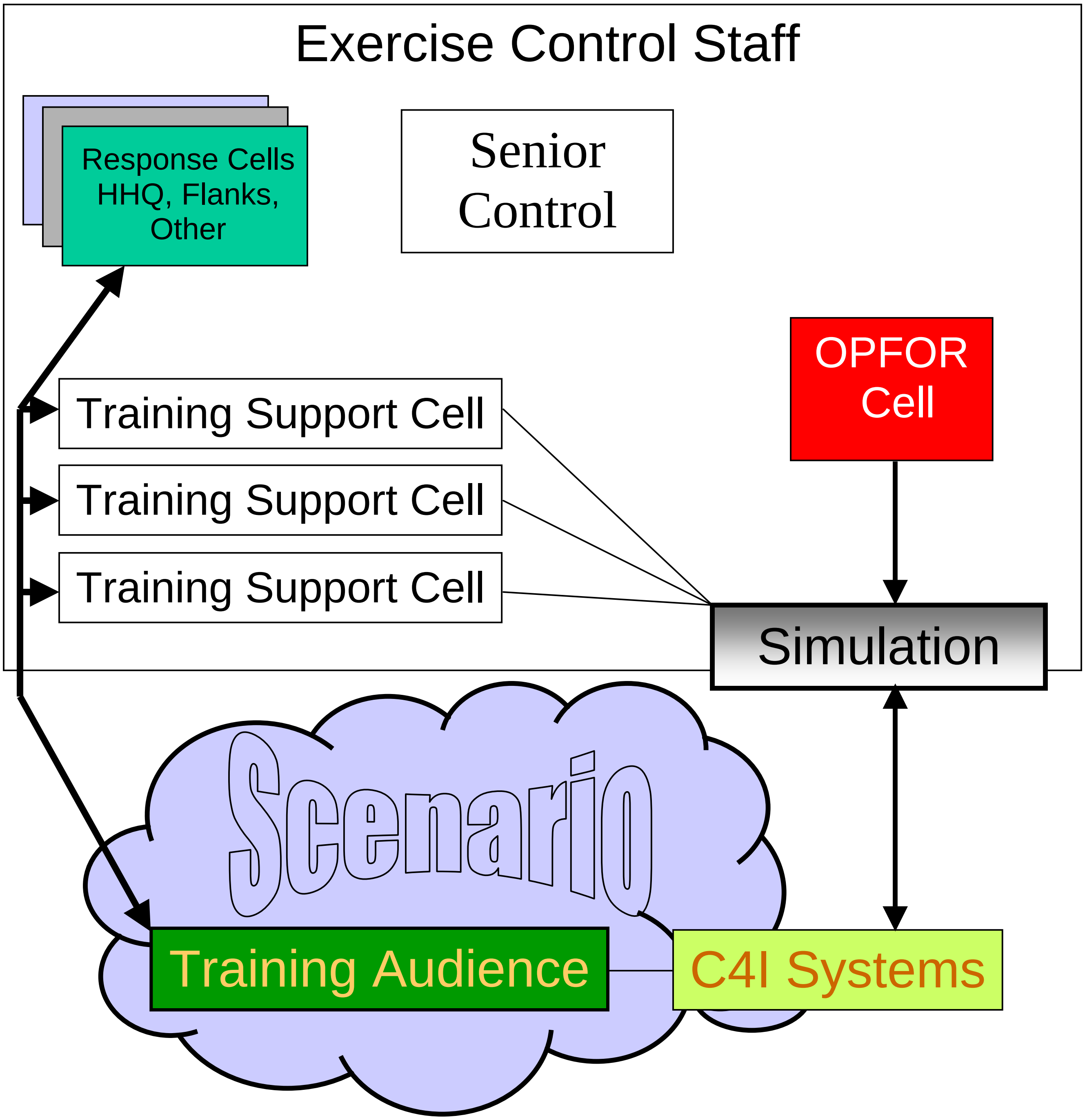
2. The Training Audience

The training audience will be the members of the unit(s) and commands that are tasked to respond to the scenario. Thus, the scenario needs to be developed with their roles, missions, equipment, and skills in mind. At the risk of stating the obvious, if the training audience is a transportation unit, the scenario should be developed to challenge their expertise in transportation, rather than developing a scenario rich in Air Defense or armor employment issues, as an example.

Take the level of command into account. Training a staff led by a general officer calls for a different scenario than one led by a Lieutenant Colonel or a Captain. In the first place, the number of people who must act in response to the scenario is larger under a flag officer than under Field Grade or Company Grades. In the second place, the type of challenge must be adapted to the experience level and span of control of those who will respond to it. Third, the commander of a training audience may view the scenario as a vehicle to facilitate his or her training of the direct support staff, rather than a training event in which the commander himself is the audience. Viewed in this way, the ranking commander heads the training audience, but also uses the exercise as a vehicle to educate his or her immediate staff in responding to the perceptions, needs, and priorities of their commander under those operational conditions. Since commanders have unique personalities and perspectives, this aspect of training can be a valuable return on the exercise investment.

During the exercise, the training audience perceives the scenario and their role in it through standard tactical communications systems. Artificial, or “Exercise Only” communication links should be avoided in the name of sustaining realism in the training experience. Reporting from their subordinate elements, especially those represented in the simulation, should be by tactical voice, data, or other appropriate linkage to live role players in the Training Support Cells. (The Training Support Cells are described below.) Exchange of information with lateral or flanking units not actually present is also via appropriate tactical communications to role players managed by the Exercise Control Staff. Information sent or received from higher headquarters also goes to and from the training audience via tactical C4I systems and is managed by higher echelons in the training audience (if any) or by role players managed by the Exercise Control Staff.

Increasingly, technology is available to permit direct links between the training audience and simulated subordinate units via C4I systems. As more Army units rely on digital data systems rather than tactical voice circuits to receive information about their resources and situation, the links between simulations and C4I systems will become more common. The illustration below reflects the concept that all exercise information conveyed to the Training Audience, regardless of how it is conveyed, is delivered in the context of the scenario. Further discussion of the links from simulations to C4I systems is in the section below discussing the simulation.



3. The Scenario

A scenario is an outline for a hypothetical sequence of events. An exercise scenario involves all the Friendly (BLUE), OPFOR, allied, neutral or other forces listed in planning documents and exercise orders of battle. Most, if not all such units will be represented to some degree in the simulation, and given courses of action appropriate to the exercise training objectives. Planners might also consider separate scenarios for each distinct "side" in the exercise order of battle. Each of those discreet scenarios is played out or executed in the simulation along a common timeline. During the exercise, the planned and decision-based actions of the OPFOR, allied, neutral, non-combatant, or other external forces will be managed by separate cells within the Exercise Control Staff. The effectiveness of these simulated external forces will be affected in the simulation by the decisions of the training audience, as input by the Training Support Cells. All parts of the total scenario timeline must be plausible (under the circumstances of the scenario) and internally consistent to sustain the credibility of the scenario in the eyes of the training audience.

The scenario is not a script. Every event or potential event is not established in advance by reference to a planned narrative. Before computer simulation was common, command post exercises were based on a massive list of pre-scripted events – the Master Scenario Event List (MSEL), tailored in content to stimulate decision processes across the battle staff. The MSEL was quite literally a script, but it was still built around a scenario. The computer-driven simulation now replaces the MSEL with dynamic, realistic, flexible, interactive responses to the decisions of the training audience. However, limitations in the ability of simulations to replicate every possible event needed to meet possible training objectives means that some events directed to some elements of the training audience may still be scripted rather that simulated. One possible example of the need for scripting is to meet training requirements for the Staff Judge Advocate. Current simulations do not represent the operating environment in sufficient detail to address legal questions relating, for example, to U.S. appropriation of private property in a foreign country, or to application of Rules of Engagement in controversial circumstances. In such highly specialized areas, scripted events may still be used to supplement the scenario principally being executed in simulation.

The scenario may be designed to acquaint the commander, staff, and units with operations in an unfamiliar geographic area to which they might be deployed, and the nature of likely opposition in that region. The scenario might also be designed to practice or refine combat staff operations on familiar terrain against a known threat organization. Either scenario is appropriate if it meets the agreed training objectives.

The scenario may also need to accommodate a mix of live, virtual, and constructive simulation events, all supporting the exercise. At the risk of oversimplifying a wide range of possible combinations of information flow, it can be said in general that the results (i.e., the output) of live and virtual simulations will be inputs (or otherwise reflected) in the constructive simulation environment.

4. The Exercise Control Staffs

There is a single overarching control staff for the exercise, but it must fulfill a variety of functions, and it is organized in distinct sections to meet specific needs. The central role of the entire Exercise Control Staff is to create and deliver, in a manner that conveys a sense of realism, the scenario-driven training environment that meets the training objectives. The appearance of realism within a scheduled training event can be difficult to sustain without extensive planning, prior coordination, and creative flexibility by all concerned. Success hinges on insulating, or isolating the training audience from artificialities that exist in the simulation, and the organization that supports the exercise.

5. The Senior Exercise Control Staff

The Senior Exercise Control Staff consists of military and training experts whose mission is to manage all aspects of the exercise scenario to achieve the training objectives set forth in the Exercise Directive. The Senior Controller is normally a full Colonel or higher, and has authority for all aspects of the exercise infrastructure. When the senior commanding officer of the training audience has questions, or desires input to the scenario, he brings his concerns to the Senior Controller. The rest of the Control Staff supports the mission of the Senior Controller in their assigned areas of activity.

The Senior Exercise Control staff can reallocate resources and make spot decisions to adjust the scenario, if necessary to sustain exercise continuity or achieve training objectives. It can invoke backup plans if technical simulation problems threaten to interrupt the flow of the scenario. The Control Staff manages interaction between the training audience and all aspects of the scenario, including notional or “make believe” higher and lower echelon forces, and flanking units not specifically represented otherwise. The Exercise Control staff is responsible to monitor and control the integrity of “game truth” or simulated “ground truth”, and the situation delivered to the training audience through the Training Support Staff, and C4I systems, and to note any apparent differences. As a generality, the senior member of each functional exercise control cell is a member of the Senior Exercise Control Staff, and facilitates scenario coordination across the control staff during the exercise.

The term “White cell” is sometimes applied to the control staff in general, or to the Senior Control staff. Other functional cells within the exercise control staff include the Red or OPFOR cell, which manages the opposing forces in the scenario and in the simulation. It is important to remember that although the OPFOR cell represents the opponent, they are present to support the exercise training objectives, and respond to directions from the Senior Control staff.

Since the end of the Cold War, a need has emerged for other specialized control cells. Some have also been assigned color designators, although as yet there is no official naming convention for these cells. A Green cell representing non-combatant elements, and a Gray cell representing or controlling other organized non-military forces such as police, paramilitary, emergency response, or external country forces not currently engaged in the military scenario are two examples.

So-called “external” response cells representing higher or external headquarters, notional flanking units, allies – virtually any entity not otherwise present or simulated. The external response cell is often tasked to answer any request for information related to the scenario that may be generated by the training audience. “Responses” or replies to the training audience drafted by the response cell are reviewed before release by a member of the Senior Control Staff to ensure consistency within the scenario, and to avoid adverse impact on planned future events in the exercise. Such responses are drafted to appear as if they originate from the unit or command level appropriate for the response. The Simulation Control Staff or cell manages the simulation supporting the scenario, both from the training and the technical standpoint. A separate Technical Control Staff may be present to manage external communications links, electrical power, and other external resources affecting the exercise.

Another function within the Control Staff involves communication with Observer-Controllers or subject matter experts who may be present in a passive role with the training audience, and can provide on-scene feedback about the perceived effectiveness of the scenario from the training audience. Observer-controllers, if used, are typically assigned to make observations and collect information related to procedures used at the point of observation, and to convey exercise instructions or adjudication to specific elements of the training audience in response to challenges or scenario anomalies. They must be discreet, non-intrusive, and fair with the training audience to avoid affecting the perceptions of the scenario. One advantage of the conversion to digital communications systems in the Army is that much information once collected by observer-controllers is now retrievable from the exercise digital database, reducing the need for observer controllers.

Training Support Cells are key members of the Exercise Control Staff, and are discussed separately below.

6. The Training Support Staff/Training Support Cells

The Training Support Staff is part of the Exercise Control Staff. The Training Support Staff has the particular task of being the interface or buffer between the training audience and the simulation. The training audience in an exercise employing constructive simulations controls "synthetic" subordinate units that exist only as database elements in the simulation. Constructive simulation is often described as simulated people operating simulated equipment, but "stimulated" by the actions of live human beings. The Training Support Staff is comprised of the people who interact through computer workstations to "stimulate" those simulated forces. They accept inputs from the training audience in the form of commands and support decisions, acknowledge those inputs on behalf of the simulated forces, and enter the appropriate commands to the simulation. When previous commands have executed, the simulation produces reports indicating new unit locations, supply status, casualties, movements, enemy detections, combat events, etc. Those reports are interpreted by the Training Support Cells to produce reports of a tactical nature, and transmitted by voice or data (as appropriate) back to the training audience. Role-playing is encouraged in the Training Support Cells to convey impressions of the battlefield from the perspective of a soldier operating there, rather than simply relaying database reports to the training audience. The training audience evaluates all reported changes and issues new instructions to their simulated forces via the Training Support Staff.

The Training Support Staff is broken into cells, each aligned with a portion of the training audience in order to manage the simulated assets of the corresponding part of the training audience. For example, the Fire Support Coordination Center might issue firing orders to a simulated battery represented by a Training Support Cell. That cell would input the firing orders, execute the fire missions, and obtain and relay any reported results from the simulated fire mission. The report generated by the simulation might report statistics in the form of a table, or in some cases, a narrative. The contents of some simulation reports are often too detailed to be realistic, because in some simulations they convey perfect knowledge of the simulated action based on an extract of its database. In such cases, the Training Support Cell must report to the training audience a reasonable level of combat results as they could plausibly be observed in a similar live engagement. To report realistically, but without conveying "perfect" knowledge of the simulation database takes experience and operational insight to be faithful to the training objectives. Consequently, Training Support cells are typically manned by highly skilled and experienced NCOs and junior officers who possess the skill, maturity and insight to convey the nature of the current situation, without revealing the unrealistic simulation data on which it is based.

7. The Simulation

The simulation is basically a computer program. It uses mathematical logic and data tables to represent forces, systems, resources, terrain, day/night and other environmental conditions, and other simulated processes. The program applies algorithms to compute and display or report the approximate effect (if any) of each simulated element on all others. The algorithms include provision for logical orders to be input at workstations, and executed by any and every synthetic object. As earlier orders are executed, the "current" situation is adjusted to reflect those changes, and the situation is displayed and/or reported through changes in location, strength, equipment, and readiness among other possible factors.

Some legacy simulations used for training have a history of occasionally generating combat results in the course of the simulation that invite challenge of the results by subject matter experts. Examples have included the ability of radar guided air defense weapons to detect, engage, and kill aircraft that should have been concealed by terrain, or the destruction of a friendly system by an OPFOR weapon that "should" have a very low lethality against it. Any such challenge calls into question the basic credibility of the simulation as a means to enhance training, so such issues have occasionally been studied in depth, but often, to avoid disruption of the ongoing scenario, the data tables of the simulation will be adjusted under controller direction to "erase" the effects of the challenged event.

Several issues come into play in incidents of this sort. The first is the issue of whether the algorithms that controlled the engagement are designed correctly, or whether a "bug" in the simulation software is to blame. Another issue is whether the data supporting the algorithm is correct, and of course there are data resident within the structure of the simulation as well as data specific to the current scenario that should be checked. Another issue relates to the issue of "gaming" the simulation – that is, savvy terminal operators who use controller procedures to override otherwise sound programming in order to gain advantage for a preferred side. Another source of anomalous results has been placement of "invisible" assets on the battle map so controllers can readily assist in replenishment or restoration of forces in the course of the scenario. A fortunate artillery round or bomb falling into a massive but invisible stockpile of "spare" controller assets has created havoc in more than one exercise over the years.

Regardless of the reason such events occur, they risk disruption of valuable training. There are systematic ways to deal with them when they occur, so there is minimal disruption for the training audience. Exact procedures vary, but when an anomalous event is detected, whether by a terminal operator in a Training Support Cell, or by a member of the Training Audience who challenges reported information, it is reported to the Control Staff. Data and event logs, including data from the AAR system may assist in establishing the source of the problem, or the simulation may need to be paused in order to check internal tables. If an obvious data or programming fault cannot be readily corrected, the best course of action is often to restore assets lost in the suspect event and allow the simulation timeline to proceed. If a correction can be made promptly, controllers may agree to set back the simulation clock to a point before the earlier event occurred, and restart prior to the onset of the problem. Each such disruption requires judgment by the control staff to arrive at the best course of action. If the same fault occurs repeatedly, it may suggest a software error that should be referred to the simulation manager for diagnosis and correction after the exercise. Throughout most such disruptions of the simulation, the exercise timeline will continue to run. The Training support cells will employ manual backup procedures to conceal technical problems from the training audience. Prolonged outages, if they occur, must be managed case-by-case.

Fortunately, newer-generation simulations are both more accurate in the representation of specific systems, and more reliable. We can hope they are also somewhat less vulnerable to mischief by individual workstation operators. Errors in data entry, and errors in scenario management (such as the lucky hit on the invisible supply dump) cannot easily be prevented altogether, but experience will reduce their occurrence.

Regardless whether the simulation runs trouble free or with constant disruption, we have already explained that the dry, unrealistically detailed output of some simulations is translated by the Training Support Cells into plausible, tactical and realistically operational-sounding reports before being conveyed to the training audience. Increasingly, newer simulation systems now provide for reporting of simulation-generated information directly to the training audience without first going through the Training Support Cells. This direct delivery occurs by linking simulation outputs directly with C4I systems.

Methods vary for selecting the simulated data output to be transmitted for C4I system inputs. In many instances the simulation output is parsed. To parse means that the pieces of simulation output data are rearranged to match the data format required by the C4I system. Some simulation data may be excluded from reporting, according to rules built into the parsing process. In newer simulations, a standard simulation report format may be designed to match exactly the format required by the C4I system, so that no “middleware” data transformation is necessary. In any case, the link between the simulation and C4I system mimics the data stream that would accompany real world operations in the same scenario. Units that rely heavily on data feeds in the real world (such as the G-2’s All Source Analysis System – ASAS) have used simulated data streams output by the simulation (TACSIM) for many years. The benefits of that process in terms of timely delivery of information, and the ability to sort, selectively display, and retrieve critical data are now becoming more widely available across combat functions via the Army Battle Command and Control System (ABCCS). The next step in technology development will be to use C4I terminal inputs to directly control simulated forces and assets.

Exercise Flow Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants: ____

Primary Customer / Exercise Director______________________________

Phone Number______________________________________

Mailing Address______________________________________

Email Address______________________________________

Facilitator ______________________________________

Phone Number______________________________________

Mailing Address______________________________________

Email Address______________________________________

Training Objectives

For each primary or major training objective, show the corresponding scenario measure or event intended to support that training.

Training Objective	Scenario Event/Condition

TRAINING AUDIENCE

Check the highest level of command in the training audience?

EAC___ Corps___ Division___ Brigade___ Battalion___

In the following table indicate each element of the training audience that will receive simulation data via a C4I system, and/or the Training Support Cell supporting that audience cell.

Training Audience Element	Name the C4I System to Receive Simulation Data Feed	Is Sim-C4I Link One Way (receive only) or Two Way (player orders entered to sim via C4I input)	Training Support Cell Supporting This Training Audience	Tactical Comms Available Between Training Audience & Support Cell? (voice, data)

Scenario

In what country or region does the scenario take place? ___________________________

In what timeframe does the scenario take place? Present _____ Future _______# years

Has a qualified Red cell been identified to perform OPFOR duties? Yes______

Has authoritative data been obtained to build friendly and enemy simulated forces for this scenario?

Yes______

Exercise Control Staff

Is pre-exercise training planned for the control staff? In the following table check the specific elements of training to be provided to each part of the Control staff.

	Training Objectives, Scenario Orientation, Controller Ground Rules	Response Cell Training	Terminal Operator Training	Simulation Overview	C4I System Orientation	Exercise Management Procedures, Senior Level
Sr. Control Staff						
OPFOR/ Red Cell						
Gray Cell						
Green Cell						
Observer-Controllers						
Response cell Flank & lateral						
Response cell Higher echelons						
Simulation Control						
Technical control						
Training Support Cells						

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4.C.1 Analysis/Feedback Phase

4.C.1a Collect Observations

A thorough exercise observation collection plan ensures that valid observations are gathered at the correct time and place. For example, observing METL tasks as they are performed in training is key to accurately assessing unit performance. The observation collection plan is driven by exercise objectives and feeds the AAR process.

The following steps serve as a guide for building an observation collection plan:

a. Review the exercise scenario.
b. Review the exercise training objectives.
c. Identify specific subordinate unit training objectives requiring observation.
d. Select personnel to perform Observer/Controller duties based on rank, knowledge, and experience.
e. Select sufficient personnel for 24/7 data collection coverage in accordance with the exercise scenario.
f. Assign O/Cs to observe designated scenario events based on experience with tasks to be performed. Competence in the specific task to be observed takes precedence over rank.
g. Review applicable Army Training and Evaluation Program (ARTEP) Mission Training Plans (MTPs) to understand task, condition, and standard for each event.
h. Review all doctrinal manuals for current tactics, techniques, and procedures (TTPs).
i. Create data collection forms (if necessary) to ensure all pertinent information such as times, grid locations, call signs, actions and orders observed is collected.
j. Verify that all communications devices are in place and operational to coordinate O/C actions as necessary.
k. Preplan times/locations for O/Cs to observe critical events.
l. Record observations.
m. Gather observations, review with all O/Cs, and verify factual content of observations 2-6 hours prior to AAR based on size of unit observed and preparation time needed.
n. Build/create AAR products to clearly illustrate teaching points based on observations.

Efficient and complete collection of observations can help simulations automate much of the AAR process by tying key observed data to critical events. This data is especially critical in describing “what” happened. With AAR analyst support, simulations can also explain “why” events happened. The observation collection plan supports the experienced AAR facilitator by helping compare exercise results with unit training objectives when discussing “how” to improve.

Screen shots, animation, graphics depicting task force structure, weapons status and coverage, and statistical data unique to each Battlefield Operating System (BOS) are examples of training aids built from data collected. Knowing which training aids may be needed and understanding how they are built help in collecting the right data ahead of time.

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Collect Observations Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants: ____

Primary Customer / Exercise Director______________________________

Phone Number____

Mailing Address____

Email Address____

Design Phase

Initial Planning Meeting

Identify:

- Training audience
- Training objectives
- Training dates
- Exercise classification

Identify Training Audience

____

____

____

Identify Training Objectives

Identify Training Date

____

____

____

Classified exercise? Yes _____ No _____

Exercise Training location(s):

____

____

____

Review the exercise scenario. (X when completed) _____

Review the exercise training objectives. (X when completed) _____

Identify specific unit training objectives requiring observation:

____

____

____

Select personnel to perform Observer/Controller duties based on rank, knowledge, and experience.

Select sufficient personnel for 24/7 data collection coverage as dictated by the scenario.

Observer/Controllers:

Record names of individuals performing O/C duties, by Battlefield Operating System.

BOS	Location	Name, Rank, Unit	Contact Info
Maneuver			
Fire Support			
Air Defense			
Command & Control			
Intelligence			
Mobility/Survivability & NBC			
Combat Service Support			

O/Cs review Mission Training Plans to understand task, condition, and standard for each event. (X when completed) _____
O/Cs review doctrinal manuals for current tactics, techniques, and procedures.
(X when completed) _____

Identify applicable MTPs and manuals by BOS:

____

____

____

Data collection forms available for O/Cs. (X when completed) _____

Identify specific data elements to collect by event by BOS:

____

____

____

Communication devices (radio, cell phone, palm pilot) available for O/Cs.
(X when completed) _____

Email/secure email available for the O/Cs. (X when completed) _____

Plan for capturing work station/analyst computer data – reports, screen shots, etc.
(X when completed) _____

Plan for capturing C4I digital data. (X when completed) _____

O/Cs will identify issues observed during the exercise where doctrine does not exist.

____

____

____

Exercise Phase

Assign O/Cs to observe designated scenario events.

BOS	Event (Date, Time, Location)	O/C (Name)
Maneuver		
Fire Support		
Air Defense		
Command & Control		
Intelligence		
Mobility/Survivability & NBC		
Combat Service Support		

Monitor the scenario as the exercise progresses.

Have unforeseen circumstances affected the execution of the exercise scenario?
Yes _____ No _____

Does the collection plan need to be modified? Yes _____ No _____
O/Cs record observations. (X when completed) _____

Establish Data Cutoff time. Allow 2-6 hours for formal AAR preparation.
(X when completed) _____

Review data with all O/Cs to verify factual content prior to AAR.
(X when completed) _____

Can simple AAR products be built from the data collected to clearly illustrate key lessons learned? (X when completed) _____
Post-Integration Phase

Ensure exercise observations with supporting AAR products are included in Take Home Packages as appropriate. (X when completed) _____

Compare exercise results with original exercise objectives. (X when completed) _____

Does the After Action Review or exercise Hot Wash indicate the need to modify the collection plan? Yes _____ No _____

Recommended collection plan changes:

____

____

____

Have observation collection plan changes been made/recorded for future exercises? (X when completed) _____

4.C.1b After Action Review (AAR)

As stated in TC 25-20, *A Leader's Guide to After-Action Reviews* (HQDA, 1993), the AAR is a professional discussion of an event that enables soldiers to discover for themselves what happened, why it happened, and how to sustain strengths and improve weaknesses. This discussion typically takes place immediately following the conduct of training and is focused on performance standards.

Commanders continually assess their unit's training readiness. The AAR is key to providing feedback for this assessment process. Unlike a simple performance critique, the AAR captures insights from many perspectives – leaders, soldiers, and opposing force players. Because all participants actively take part in the discussion, the AAR is an ideal cooperative, discovery-learning vehicle. Soldiers gain a better understanding of what happened and have a greater probability of remembering lessons learned because of their active role in the AAR.

1. Formal AAR

A formal AAR (conducted at company level (1 hour duration) and above (2 hours duration)) is resource intensive and involves the planning, coordination, and preparation of training aids such as terrain models or map blow-ups, location, and support personnel. The following are key points of the formal AAR:

a. Conducted during or immediately after each event.
b. Focused on intended training objectives.
c. Focused on soldier, leader, and unit performance.
d. Involves all participants in the discussion.
e. Uses open-ended questions.
f. Related to specific standards.
g. Determines strengths and weaknesses.
h. Links performance to subsequent training.

Planning for the formal AAR takes place six to eight weeks prior to the execution of training along with the final preparations for conducting the training event itself.

2. Agenda

The following standard AAR agenda guides discussion and serves to identify items that must be prepared ahead of time:

a. Introduction and rules.
b. Review of objectives and intent.
    1. Training objectives
    2. Commander's mission/intent (what was supposed to happen)
    3. OPFOR commander's mission/intent
    4. Relevant doctrine, tactics, techniques, and procedures
c. Summary of recent events (what happened).
d. Discussion of key issues.
    1. Chronological order of events
    2. Battlefield operating systems (BOS)
    3. Key events/themes/issues
e. Discussion of optional issues.
f. Soldier/leader skills

g. Tasks to sustain/improve
h. Statistics
i. Others
j. Discussion of force protection issues (safety).
k. Closing comments (summary).

3. Informal AAR

Whereas experienced Observer/Controllers usually conduct formal AARs, unit leaders may conduct informal AARs (platoon level and below, 30-45 minutes duration) themselves. The key points and agenda noted above remain the same. There are, however, much less emphasis and need for detailed training aids. Informal AARs allow greater flexibility in scheduling and can be conducted at the time and place where the unit would gain the most benefit. Informal AARs are an excellent tool for on-the-spot coaching.

The following chart shows a comparison of formal and informal AARs:

Formal AAR	Informal AAR
➢ Has external Observer/Controllers	➢ Conducted by unit leaders
➢ Takes more time	➢ Takes less time
➢ Uses complex training aids	➢ Uses simple training aids
➢ Are scheduled in advance	➢ Scheduled as needed
➢ Are conducted where they can be best supported	➢ Held at the training site

4. Four Step Process

The type of AAR (formal vs. informal) dictates the level of effort required by leaders. All AARs follow the same four-step process.

Step 1. Planning

1. Select and train qualified OCs.
2. Review Army Training and Evaluation Program (ARTEP) mission training plans (MTPs) and soldier training publications (STPs).
3. Identify when AARs will occur.
4. Determine who will attend AARs.
5. Select potential AAR sites.
6. Identify AAR support systems (simulation specific).
7. Choose training aids.
8. Review the AAR plan.

Step 2. Preparation

1. Review training objectives, orders, METL, and doctrine.
2. Identify key events OCs will observe.
3. Observe the training and take notes.
4. Collect observations from all OCs.
5. Organize observations.
6. Identify key discussion/teaching points.
7. Produce/refine AAR products illustrating key points.
8. Prepare the AAR site.
9. Rehearse the AAR.

Step 3. Conduct

1. Seek maximum participation.
2. Maintain focus on training objectives.
3. Use AAR products (screen shots, voice recordings, etc.) to illustrate teaching points.
4. Record key points.

Step 4. Follow up

1. Identify tasks requiring additional training.
2. Fix the problem – retrain or revise standing operating procedures (SOPs).
3. Use as input for the commander's training assessment.

These four steps will help leaders plan and execute effective AARs where the candid exchange of ideas and observations will lead to increased unit proficiency. A detailed explanation of these steps can be found in Training Circular 25-20 (HQDA, 1993).

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After Action Review Worksheet

Name of the Exercise ____

Exercise Organization ____

Exercise Participants: ____

Primary Customer / Exercise Director______________________________

Phone Number____

Mailing Address____

Email Address____

Initial Planning Meeting

Identify:

- Training audience
- Training objectives
- Training dates
- Exercise classification

Identify the Training Audience

____

____

____

Identify Training Objectives

Identify Training Dates

____

____

____

Classified exercise? Yes _____ No _____

All After Action Reviews – formal and informal – follow this four step process:

Step 1. Planning

Select and train qualified Observer/Controllers. (X when completed) _____

Have O/Cs been selected on the basis of rank, experience, and knowledge?
(X when completed) _____

Have O/Cs reviewed applicable doctrinal manuals and MTPS?

(X when completed) _____

Review the exercise scenario. (X when completed) _____

Identify logical breakpoints for conducting AARs. This is typically at a change in mission or phase of an operation. (X when completed) _____

Determine who will attend the informal AAR.

Duty Position	Name, Rank	Unit

Determine who will attend the formal AAR.

Duty Position	Name, Rank	Unit

Select potential AAR sites. (X when completed) _____

AAR location:	
Is site large enough to accommodate all participants?	
Can site accommodate necessary audio/visual aids?	
Tables/Chairs	
Flip Charts	
Permanent/Dry Erase Markers	
Maps	
Map Overlays	
Viewgraphs	
Laser Pointer	
Computer Generated Graphics	
Microphone/Sound System	
Is site free of distractions?	

Step 2. Preparation

Review training objectives, orders, unit Mission Essential Task List, and doctrinal manuals. (X when completed) _____

Identify key scenario events for O/Cs to observe. (X when completed) _____

O/C/s record observations. (X when completed) _____

Collect observations from O/Cs. (X when completed) _____

Organize observations from O/Cs. (X when completed) _____

Observations support key teaching points/lessons learned?
(X when completed) _____

Observations supported by factual data? (X when completed) _____

Do any issues need to be reexamined before being presented in the AAR?
(X when completed) _____

Observations support/reflect what “really” happened in the exercise?
(X when completed) _____

Procedures established to relook key issues as necessary? (X when completed) _____

Can AAR products be built from the data collected to illustrate key teaching points?
(X when completed) _____

Prepare the AAR site. Set up the room. (X when completed) _____

Rehearse the AAR. Ensure computer assisted training aids work.
(X when completed) _____

Step 3. Conduct

Are all participants engaged in the discussion? (X when completed) _____

Does the facilitator use open-ended questions? (X when completed) _____

Does the discussion focus on the exercise training objectives? (X when completed) _____

Does the discussion focus on soldier, leader, and unit performance?
(X when completed) _____

Do the AAR products used clearly illustrate the desired points? Yes _____ No _____

Recommended changes to products:

____

____

____

Are key discussion points captured/recorded for future action as necessary?

Key Discussion Points:

____

____

____

Is the following standard AAR agenda used? (X when completed) _____

- Introduction and rules.
- Review of objectives and intent.
    - Training objectives
    - Commander’s mission/intent
    - OPFOR commander’s mission/intent
    - Relevant doctrine, tactics, techniques, and procedures
- Summary of recent events
- Discussion of key issues
    - Chronological order of events
    - Battlefield operating systems (BOS)
    - Key events/themes/issues
- Discussion of optional issues
    - Soldier/leader skills
    - Tasks to sustain/improve
    - Statistics
    - Other issues
- Discussion of force protection issues (safety)
- Closing comments

Step 4. Follow Up

Are there tasks requiring additional training? Yes _____ No _____

Tasks:
____

____

____

Are revisions necessary to unit standard operating procedures? Yes _____ No _____

Recommended SOP Revisions:

____

____

____

Are the AAR results used as input for commanders' training assessments?
(X when completed) _____

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Chapter 5 M&S Evaluation Design

Evaluating a model or simulation is critical to both the user community as well as senior military leaders and members of Congress who make funding decisions related to M&S. This chapter provides information and guidance on the M&S evaluation process, including key methods and procedures related to designing and implementing an M&S evaluation plan. The evaluation planning process should be included during the earliest stages of designing an M&S training activity or event to ensure that there will be adequate resources available and that logistical issues are addressed. It is also important to understand that evaluation methods and procedures can incorporate a range of activities that in some cases require an extensive amount of planning and resources to complete successfully.

By their nature, training evaluation methods and procedures are intended to identify training components that promote positive training outcomes as well as those that are less effective or that may even detract from training effectiveness. In other words, one has to be willing to actively identify weaknesses in order to increase training effectiveness. Over time, and if done in a consistent and systematic fashion, M&S evaluation results will provide an invaluable body of knowledge that can assist users and decision makers concerning how best to apply training resources to achieve the highest level of mission readiness. No training performance measure is perfectly accurate or complete, and all evaluation methods and procedures fall short in some respects. Thus, the best one can do is plan and execute an M&S training evaluation that addresses the training effectiveness questions being asked and supports the overall goals of the Army simulation training community.

5.A.1 Develop Measurement of Training Outcomes

There is general agreement in training evaluation literature that training performance can be separated into two broad areas: training outcomes and associated training activities or processes that support training outcomes (Rossi, Freeman, & Lipsey, 1999). Typically, training outcomes are derived from training objectives, which may be linked to one or more higher-level objectives, such as mission objectives. Mission objectives are regularly incorporated into the planning and execution of large computer-aided simulation training exercises. Thus, the first step toward developing relevant training evaluation measures is to clarify the stated mission objectives and associated supporting training objectives. If done correctly, the training objectives are defined in such a way that they can be observed and ultimately measured. This is not a trivial task, and it is one that can have a significant positive or negative impact on the training evaluation process, as well as the training process itself. Training activities or processes include several components, such as providing opportunities to practice mission essential tasks under realistic conditions, as well as to obtain timely, specific feedback on the performance of the training audience. Within a simulation training exercise, inclusion of what are sometimes referred to as “trigger events” provide the training audience with necessary opportunities to practice appropriate combat tactics. Trigger events can also provide opportunities for conducting timely AAR sessions aimed at discussing performance strengths and weaknesses.

Within the training evaluation literature, there are concepts that are commonly employed to guide the identification of relevant training outcomes and processes. Two such concepts are measures of effectiveness (MOE) and measures of performance (MOP). MOEs may be defined as a measurement of operational success that is closely related to the objective of the mission or the operation being evaluated. For example, an MOE may be the number of enemy tanks destroyed if the objective is narrowly focused on the destruction of this weapon system. However, if a higher-level (mission) objective is to support an infantry battalion, then the best course of action may be to simply suppress the movement of enemy tanks rather than destroy them. To be useful and meaningful, an MOE must be observable and quantifiable, and measure the degree to which critical objectives are achieved. MOPs, on the other hand, are typically more narrowly focused on technical aspects related to readily quantifiable variables such as speed, frequency, or range. Typically, several MOPs are used as component measures for a single MOE. The literature related to these two concepts indicates that they may not always be easily separated and it is not uncommon for the concepts to be used as a single summary concept, as in "MOE/MOP." For training evaluation purposes, MOEs and associated MOPs should be reviewed to ensure they accurately reflect the stated mission objective(s) and incorporate objective criteria for making judgments about training audience performance levels.

Also within the training literature, there is a widely used training evaluation approach outlined by Donald Kirkpatrick (1976) that delineates four hierarchical levels for evaluating training outcomes (see Table 1). As shown in Table 1, the evaluation levels progress from training measures that are relatively simple, non-intrusive, and inexpensive (e.g., obtaining trainee reactions or perceptions) to those requiring substantial resources and planning needed to successfully conduct the evaluation, e.g., a cost-benefit analysis that may extend over an extended period to determine if unit performance improved and if the improvement was worth the resources expended.

In addition, one potentially important evaluation component of a training activity or event involves the composition of the training audience and the accessibility of the training by those who need it. This information (e.g., the number and type of individuals, units, etc.) can assist in demonstrating that force readiness is being maintained or enhanced.

Level	Type	Description
1	Reaction	Trainee reactions to the training experience. Trainee perceptions may be captured as open-ended comments or in the form of ratings, or both. Viewed as an easy, quick and inexpensive way to get positive and negative information about the training experience.
2	Learning	Did the training meet the stated learning objectives? Usually captured using pre- and/or post-tests, quizzes, as well as other performance tests (e.g., ability to deal with a simulated situation or problem).
3	Behavior	Does the trained behavior transfer to, or have a positive impact on, real- world activities and events? May be captured using simulated situations and case studies, post-training surveys/interviews, or on-the-job observations/checklists.
4	Results	Does the training behavior result in a positive impact toward achieving the organization's stated mission and associated performance objectives? This may include conducting a cost-benefit analysis to demonstrate training utility. Training results may only indirectly contribute to bottom-line unit/organization performance, which may take weeks, months or longer to realize.

Table 1 - Kirkpatrick's 4 Levels of Evaluating Training Outcomes

5.A.2 Establish Baseline

The accurate measurement of relevant performance elements accounts for only part of what is needed to successfully evaluate training outcomes. Researcher Mike Scriven (1967) provides a useful description of the core components of evaluation. His definition states that evaluation can be thought of as an observed value that is compared to some standard. Thus, while evaluation can be considered a ratio of what is observed to what is the standard, the numerator (what is observed) may not be a simple value that is readily derived. For example, in the area of program evaluation, the numerator may include several values in the form of program elements that relate to multiple success criteria and associated stakeholder expectations. Thus, for evaluation to take place, judgments regarding the level of performance success must occur. Evaluation necessarily includes identifying performance criteria that define successful performance, as well as performance considered not successful or weak. Defining what is meant by "successful performance" and establishing specific criteria to make this determination requires, in part, that one or more performance standards be established. As an example, suppose an athlete training for the Olympics begins using weight training to strengthen his legs. After working out for several months using a daily weight training regimen, the athlete can jump 42 inches vertically (straight up) from a flat-footed standing position. However, this performance measurement information means little until it is also known that the average athlete in the particular event/sport can do a similar vertical jump of 36 inches, and that the athlete in question could jump only 38 inches vertically prior to starting the training regimen. In any evaluation context, the meaning of performance measures is derived from one or more performance standards. It is also important to place performance results into the bigger picture. In this situation, does leg-strength training translate to an advantage where it really counts - on the field of competition?

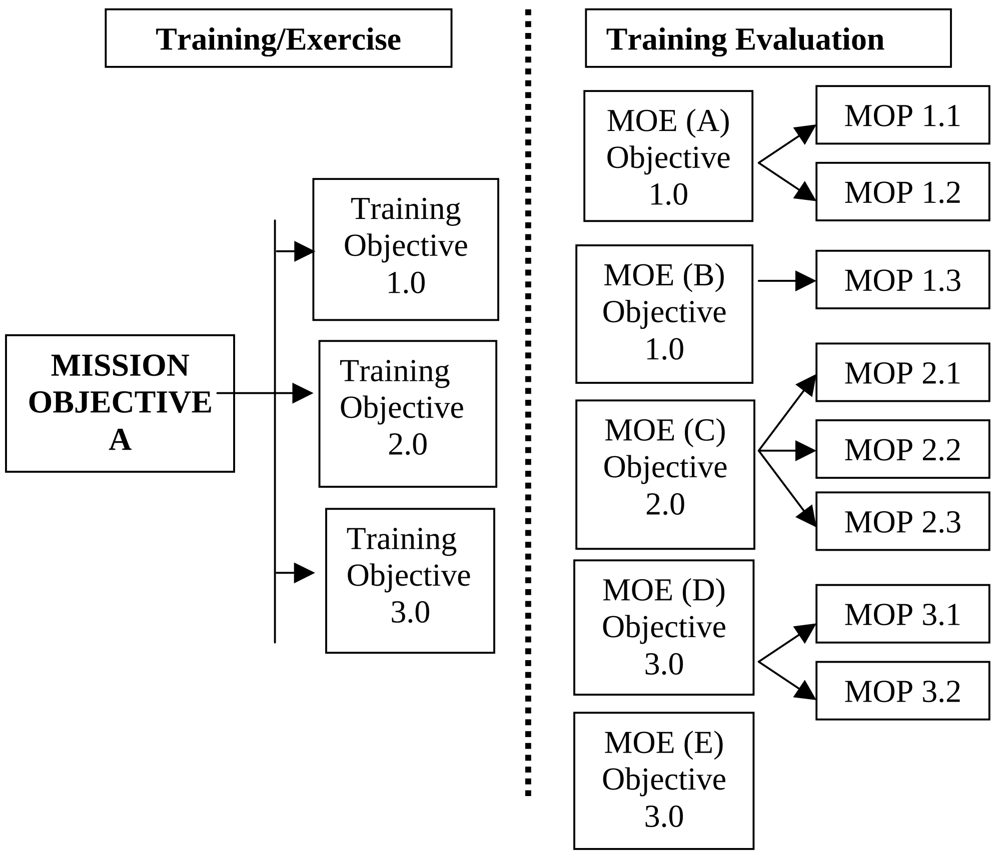
In a similar manner, M&S training evaluation planning must include the identification of relevant baseline performance parameters that can be used to make judgments regarding whether successful training outcomes are achieved. The vertical jump example described previously also demonstrates that having baseline performance data can come from several sources. In some cases, historical information about the average performance of other individuals (or groups) who are doing similar activities may be readily available and can be used as a baseline criterion. It also may be useful to establish the performance level of a particular individual (or group) prior to the start of training in order to establish a baseline. This pre-training (baseline) performance can then be compared to similar post-training performance to provide results that can readily demonstrate performance gains due to training. Of course, it is also important to view performance gains relative to some pre-determined standard, such as an established training requirement. In some instances, the level of performance may be similar, but other factors, such as the length of training to achieve the required performance, become an important measure of comparison.

The use of baseline performance information to demonstrate the level of training success appears simple and straightforward. However, there are numerous factors that can impact the comparison between baseline performance and post-training performance. These factors will be discussed in more detail in Section 5.2 related to training evaluation methods and procedures.

One additional type of performance baseline approach is worth mentioning. In some instances, it is useful to compare the performance of two or more groups in order to evaluate training effectiveness. For example, say that it was important to determine whether the use of a tank simulator provided added value for armor units preparing to conduct a field training exercise (FTX). In this instance, the FTX performance of non-simulator trained units is used as the baseline for comparing similar performance of those units that did receive the tank simulator training prior to their FTX rotation. If the simulator trained units outperformed the non-simulator trained units, then a case can be made for using the tank simulator training prior to a FTX rotation, assuming other variables (e.g., skill levels and experience) are comparable. When the results of a training evaluation are to be used to make key organizational decisions that involve expending significant resources, it is prudent to employ more rigorous evaluation criteria, such as conducting group comparisons. Group comparison approaches fall under what is considered “experimental” or “quasi-experimental” evaluation methods (see Section 5.2). These approaches typically are used less frequently due to their added logistical complexity and, in some cases, increased costs. However, group comparison approaches can provide compelling evidence that can aid decision makers and can be incorporated into comprehensive, quantitative reviews that combine results across training effectiveness research studies.

5.A.3 Align Measures With Training Objectives

As noted in Section 5.A.2, the training evaluation measures are derived from the higher-level mission objectives and the training objectives that support the overall mission objectives. This relationship is described graphically in the figure below. By completing a cross-reference matrix similar to the one shown in the figure, the evaluation planning team can ensure that all critical training objectives have associated evaluation measures for determining whether the training objectives and mission were successfully met. It is also important that the evaluation provides information concerning where performance may not have reached acceptable levels, both in terms of performance outcomes as well as for key process measures. This information allows the training development team to make necessary changes to the training program, for example, schedule additional training if necessary



Example Cross-Reference Matrix for Training Evaluation Planning

5.A.4 Traceability Documentation

Traceability documentation refers to identification of critical current and historical information about a simulation that will help the user to assess its potential for use for a given purpose. It can be thought of as establishing the pedigree of the simulation. For example, the traceability documentation identifies the primary point of contact that controls its use, what requirements documentation is available, and where and under what circumstances the simulation has been used in the past. While it is often the case that the proposed purpose for using a simulation does not exactly match how it was used previously, the traceability documentation is very important to document information in the following areas to help justify why the simulation is being considered for use now, as well as what changes may be required to meet the current needs:

a. What capabilities document (CD, which means either capability development document [CDD], or capability production document [CPD]) exists?
b. What initial capabilities documentation (IPD) exists?
c. Where and under what circumstances has the simulation been used previously (both as a stand-alone, and with other simulators/simulations)?
d. What prior reviews of the simulation are available – when were they conducted, by whom, and what were the results?
e. Who (organization and/or POC) is the primary keeper of the simulation?

5.A.5 Develop Evaluation Methodology and Tools

The types of evaluation methods, procedures and tools selected for use depend on several factors, such as the type and availability of baseline information and the importance of the results for making critical or long-term decisions. Funding and logistical resources must also be considered. Having an elaborate M&S training evaluation plan that cannot feasibly be implemented is less desirable than developing a less complicated plan that can be fully implemented. In addition, if the results of the evaluation will be used to make key decisions involving significant resources, then it is prudent to use evaluation methods and procedures that can withstand outside scrutiny. For example, it may be worthwhile to conduct an experiment involving two or more groups where the training audience is randomly assigned to either an experimental or control (baseline) group. The group comparisons using experimental methods, while resource intensive and logistically complex, can provide robust results that allow decision makers to choose the more desirable path from among selected alternatives. Experimental results can also be incorporated into what is known as meta-analytic studies. Meta-analytic studies incorporate a quantitative review methodology that combines results across multiple experiments to answer key questions within a given field of study, such as the relative benefit of using simulation when training certain tasks or skills. In general, when using what Tannenbaum and Woods (1992) refer to as pre-experimental types of evaluation methods and procedures, the evaluation results will be less robust and thus more open to alternative explanations for how the training results were achieved.

While there are numerous approaches for conducting training evaluation, an approach by Tannenbaum and Woods (1992) focusing on organizational constraints is instructive. These researchers present eight factors to consider when determining what evaluation methods and procedures are appropriate for a given situation:

a. potential for modifying the training program,
b. importance or criticality of results,
c. size or scale of training program,
d. purpose or object of course/program,
e. culture of organization,
d. evaluation expertise,
f. cost of program and evaluation, and
g. time frame for conducting evaluation.

In addition, these researchers describe three primary inter-related components that should be considered when choosing an evaluation methodology:

a. training criteria (similar to the four levels of evaluation described by Kirkpatrick presented in Section 5.A.2);
b. evaluation magnitude (ranging from a pilot study using a small group of individuals to a large scale study that includes many individuals), and
c. research design - three basic types presented below

The three research design types described by these researchers are as follows:

a. Type 1 - Pre-Experimental Approaches
    1. Case studies
    2. Collecting post-test or post-training performance only
    3. Collecting pre- or post-training surveys and questionnaires only
b. Type 2 - Quasi-Experimental Approaches
    1. Comparing pre- to post-training performance for a single group only
    2. Comparing performance of two or more groups where individual trainees are not randomly assigned to groups – for instance, using performance of previously trained groups as baseline or comparing intact groups (e.g., pre-existing squads)
c. Type 3 - Experimental Approaches
    1. Comparing performance of two groups, but assigning trainees randomly to either a control or experimental group
    2. Comparing performance of more than two groups, where at least two groups are considered control groups and randomly assigning individuals to groups.

5.A.6 Functional Versus Technical Evaluation Methodology

There are two important areas that should be included when conducting a simulation training evaluation. One area involves the functional or application-level aspects of the training program and the other involves the technical aspects. Functional aspects relate to the ability of the M&S application to meet the needs of the user. Technical aspects relate to the mechanisms and tools that allow M&S applications to operate effectively.

An Institute for Defense Analyses (IDA) study conducted in 1996 provides information related to identifying useful quantitative and qualitative metrics for functional (application) and technical M&S evaluation activities. These metrics were identified, in part, from an extensive review of 30 DoD M&S case study examples cited by the study team that provided information about the utility of M&S across the various military domains, such as training, test and evaluation, and acquisition. The table below presents a summary of the metrics proposed in the study for use in conducting functional M&S evaluation. Note that the study looked at proposed metrics across a variety of functional domains, thus some of the metrics do not directly target M&S training.

Quantitative Metric Area	**Metric Description**
Analysis	Measures that quantify how the use of M&S applications provide analysts with more accurate "ground truth" information about critical processes
Training	Measures that quantify how the use of M&S applications provide training benefits, reduce/avoid costs and/or various risk factors
Acquisition (Research & Development)	Measures that quantify the ability of an M&S application to increase options and/or avoid costs due to sub-optimal design/development
Acquisition (Test & Evaluation)	Measures that quantify the ability of an M&S application to improve data collection, reduce risk factors, and reduce/avoid costs
Acquisition (Production & Logistics)	Measures that quantify the ability of an M&S application to consider more options and/or save costs related to production and logistics
Qualitative Metric Area	**Metric Description**
Analysis	Measures related to the enhanced data quality that can result from simulation interoperability (i.e., combining live, virtual, constructive)
Training	Measures related to the enhanced training quality due to the M&S application's ability to provide a unique environment (allowing soldiers to engage in realistic combat situations) that improves force readiness
Acquisition (R&D)	Measures related to the enhanced quality of options and scenarios that can be explored via use of M&S applications, especially ones that because of risk or cost may not be feasible under real-world conditions
Acquisition (T&E)	Measures related to the enhanced quality of all T&E tasks (i.e., planning, testing and data collection) that can benefit from use of robust results using M&S applications that pass VV&A scrutiny

Summary of Candidate Functional M&S Evaluation Metrics

In a similar manner, the study provides a list of possible metrics for conducting a technical M&S evaluation. These candidate metrics are presented in the table below.

Quantitative Metric Area	**Metric Description**
Architecture	Percent of legacy programming migration, typically saving time and resources required to write new programming code
Computer Generated Forces (CGF)	Percentage of CGF software re-used, again saving time and resources needed for developing new software code
Environmental Representation	Measures that quantify the ability of an M&S application to represent needed aspects of the environment
Human-System Interface	Measures that quantify user acceptance of the M&S application
Information/Database	Measures related to time/effort saved by re-use of legacy database information
Networking	Measures related to quantitatively describing the use of reliable networks (e.g., that provide increased bandwidth or up time)
VV&A	Measures related to quantitatively describing the use of M&S applications that successfully completed formal VV&A scrutiny
Instrumentation	Measures related to risk reduction, such as when live fire training or testing can be minimized or avoided altogether
Qualitative Metric Area	**Metric Description**
Computer Generated Forces (CGF)	Measures related to enhanced training quality due to more realistic portrayal of enemy, friendly and neutral/civilian forces
Environmental Representation	Measures related to the enhanced training quality due to the training audience becoming “immersed” in the simulation environment
Human-System Interface	Measures related to the enhanced training quality due to the M&S application’s “ease of use,” which typically enhances training transfer
Interoperability	Measures related to the enhanced training quality due to the M&S application’s ability to provide a “level playing field” across all Service branches
Networking	Measures related to the enhanced training quality due to the sense of “immersion” provided by a distributed training environment
VV&A	Measures of enhanced decision making that is produced by using “more valid” M&S applications as defined by VV&A results
Instrumentation	Measures related to the enhanced training quality by the ongoing effort to better integrate C4I capabilities within M&S

Summary of Candidate Technical M&S Evaluation Metrics

5.A.7 Develop Description of Evaluation Methods

As noted previously, learning outcomes typically are in the form of trainee knowledge or performance gains that result from involvement in a specified program of instruction. Training evaluation measures used to capture the extent of knowledge/performance gains can be categorized as being either quantitative or qualitative in nature. Quantitative evaluation includes those measures that can be expressed in numerical form. Test scores are commonly used to quantify learning outcomes, and behavioral rating values are often used to help quantify subjective judgments related to performance. For example, an instructor pilot may use a five-point rating scale, with one being very poor performance and five being exceptional performance, to describe a trainee's level of performance during a post-training check ride. Qualitative evaluation measures are non-numerical in nature, such as observer notes, student and instructor comments, and video/audio tape recordings. This type of measurement information can provide a rich resource that is especially useful for identifying instructional elements that participants find particularly useful or, in some cases, ineffective. It is important to combine both qualitative and quantitative evaluation measures to obtain a robust assessment of key instructional components. It is also important to communicate to the participants the need for frank and unbiased feedback to ensure that less effective instructional material and processes are identified for review and modification by the instructional development team.

5.A.8 Develop Resources to Conduct Training Evaluation

It is not uncommon for training evaluation costs to increase training development and implementation budgets by a substantial amount. The more complex and extensive the evaluation design, the greater the relative cost will be. Training evaluation design and associated cost factors should be identified as early as possible when planning a training activity or program to ensure budget limits aren't exceeded. Cost factors to consider when dealing with training evaluation include: a) number of trainees, b) length of training, c) the nature of the qualitative and quantitative performance measures used, d) need for outside expertise and/or independent evaluator, d) material development (e.g., tests, surveys, questionnaires, rating forms), e) direct and indirect contact hours (e.g., for making observations, evaluator training, scheduling interviews, conducting focus groups), f) software purchases (e.g., use of optical scanning program, statistical package), g) data analysis, h) presentations of results orally and in written reports, and i) purchase or lease of necessary materials and equipment.

In some instances it is worthwhile to obtain outside, independent expertise to conduct the training evaluation to increase the credibility of the results and possibly to deal with the complexities of implementing quasi-experimental or experimental type evaluation approaches. In such cases, assistance may be identified in the form of college/university faculty or from individuals with the appropriate background and academic credentials that have experience conducting military M&S training evaluations.

5.A.9 Execution of the Training Evaluation

When executing a training evaluation, there are several important factors to consider, such as developing a timeline for when evaluation measures are to be collected, identifying a methodology that will support and facilitate the data collection process, and then ensuring the collection process is documented appropriately. Developing a timeline is crucial for developing a training evaluation plan that fits the specific parameters of the training program being considered and has a realistic chance of being implemented. For large M&S training exercises, the evaluation timeline should begin several months prior to the start of the training event and continue after the end of the event until such time as the results from the evaluation are documented and disseminated to the appropriate sources.

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Chapter 6 Determining the Need to Change a Simulation

6.A.1 Modifying Application and Technical Functions of a Simulation

The functions of a simulation fall into two primary areas, technical and application. A technical function refers to the mechanics of a simulation, such as what type of computer language its core programming is written in, its ability to technically interface with another simulation, its graphic capabilities or its screen refresh rate. An application function refers to the attributes of a simulation, such as the fidelity of how it represents various systems, its depiction of bomb craters, its ability to model specific components of weather, or the algorithm it uses to determine a certain probability.

Function changes are done for one or more of three possible reasons:

- The simulation is incorrectly processing a certain aspect (needs a correction, historically known as "debugging").
- The simulation has a function that is designed adequately and processing correctly but it is obsolete or needs to be upgraded (a modification).
- The simulation needs to have an attribute added (an improvement).

Below are descriptions of the process of administering a software change to the 13 simulations that are represented in this handbook, along with an example of any required documentation. Where the process or documentation supporting a simulation is different for technical or application changes, they will be addressed separately.

6.A.1a Joint Deployment Logistics Model (JDLM)

JDLM is currently the Seventh Army Training Command (7ATC) simulation of choice for logistical play. Its Army proponent office is the 7ATC in Grafenwohr, Germany. There is no formal functional or application software change format for JDLM other than a standardized worksheet, shown below, that is used for all modeling and simulation products used within 7ATC. The worksheet below (Figure 1) is a general change request worksheet that is used for all changes on M&S products in the 7ATC.

Recommended software changes to the JDLS simulation are not broken down into separate groups pertaining to technical or application areas but are grouped together as standard proposed changes.

Requests for technical or application modifications to JDLM follow the same administrative procedure, and can originate at either a user or operator location. When the TIR/SCR document shown below is filled out, it goes through the simulation support contractor management structure where it is determined if it is realistically possible to accomplish the change. From there it goes to the Simulations Branch at HQ, 7ATC. The Simulations Branch will review the request and either disapprove it, support it with funding, or support it without funding. If the change is supported with funding the request goes back to the contractor support group for implementation. If it is supported without funding it goes back to the original requestor with cost information to ascertain if they are willing to fund the change. If the originator will fund the change it is returned to the Simulations Branch, formally approved, and then returned to the contractor support group for execution when time and resources become available [22 May 03 telecon with Thomas Lasch, Chief, Simulations Branch 7ATC Directorate of Simulations-Forward, Grafenwohr, Germany].

7ATC DOS-F
Technical Incident Report /
Software Change Request

TIR/SCR#

____
(LOCAL SITE USE)

USER PROVIDED INFORMATION

Originator's Name:	Date:	EXERCISE/TEST NAME:	Workstation:
Organization/Site:		Telephone:	SW Version #

Description of Problem, (Please provide any Simulation Information Necessary to Replicate the Problem) or Desired Changes (Attach Additional sheets as Necessary):

Recommended Action/Solution (Attach additional Sheets as Necessary):

SY Systems Use

TIR/SCR Topic/Title:

Functional Areas Affected:

☐ADA	☐ARTILLERY	☐CONFEDERATION/ALSP	☐ ELECTRONIC WAR.	☐NBC	☐SOF
☐AIR (Fixed)	☐CIVIL AFFAIRS	☐DETECTION	☐ LOGISTICS	☐OPFOR	☐UTILITIES
☐AIR (Rotary)	☐CLOSE COMBAT	☐DOCUMENTATION	☐MEDICAL	☐ PERSONNEL	☐WORKSTATION
☐ AIRLIFT/DROP	☐ COMMUNICATIONS	☐ENGINEER	☐ MOVEMENT	☐PSYOPS	☐OTHER

Analysis/Evaluation/Comments:

Reviewed/Verified By:	Date:
Support Team Recommendation: ☐ WORK ☐ DEFER ☐ CLOSE	

Figure 1, TIR/SCR

6.A.1b Combat Service Support Training Simulation System (CSSTSS)

CSSTSS is a low-resolution training constructive simulation used for logistical play. Resolution is normally from theater to battalion. Its proponent office is the Logistics Exercise and Simulation Directorate, National Simulation Center, Fort Lee, VA.

Recommended software changes to the CSSTSS simulation are not broken down into separate groups pertaining to technical or application areas, but are grouped together as standard proposed changes.

Requested changes come from user and/or operator organizations and go directly to the Exercise Division (there is no formal format for a request) of the Logistics Exercise and Simulation Directorate, NSC, Fort Lee. There they are reviewed by training subject matter experts and forwarded with recommendations for approval/disapproval to the Exercise Division Chief. The Exercise Division Chief is the initial decision point for approval of changes. If approved, the change request will then be formalized as a Software Change Request and go to the Director, Logistics Exercise and Simulation Directorate for final approval. If approved there, the request will be executed when time and funding are available [20 May 03 telecon with LTC Ellsworth, chief, Exercise Division, TRAC, Fort Lee, VA].

6.A.1c Eagle

The Eagle simulation is a constructive simulation used for training and analysis. Resolution is from corps down to company level. The proponent office is TRADOC Analysis Center (TRAC). Eagle is an object-oriented simulation that is normally used only at TRAC headquarters in Fort Leavenworth, KS, with one additional copy at a contractor site in Springfield, VA. Because recommended software changes to the Eagle simulation are usually originated at the same location where they are addressed, they are not broken down into separate groups pertaining to technical or application areas but are grouped together as standard proposed changes.

Proposed software changes by users (study teams) go directly to the TRADOC Analysis Center Operations Directorate (TOD), Ft. Leavenworth, KS, where they are reviewed for accuracy. TOD then passes requests to the Eagle Model Team. The team reviews each request for feasibility and appropriateness and returns the request to TOD for a final decision. If the changes are to be accomplished, the Eagle Model Team will negotiate with the study team to outline each change, prioritize them, and identify how long each change will take to accomplish.

There is no specific format for generating an Eagle Software Change Request (SCR) (27 May telecon with Martha Moody, Senior Operations Research Analyst, Eagle Model Team, TRAC).

6.A.1d One Semi-Automated Force (OneSAF)

OneSAF is a composable, next-generation computer generated force that can represent a full range of operations, systems, and control processes, from individual combatant and platform to battalion-level activities, with a variable level of fidelity that supports all Army modeling and simulation domains with emphasis on both human-in-the-loop and no-human-in-the-loop processes. The Program Executive Office, Simulation, Training, and Instrumentation (PEO-STRI) in Orlando, FL, is the OneSAF proponent office. PEO-STRI does not differentiate between separate software processes pertaining to technical or application areas.

The OneSAF program currently consists of two projects. The OneSAF Objective System (OOS) and the OneSAF Testbed Baseline (OTB). The OOS is currently under development and, as the Army's next-generation Semi-Automated Forces (SAF) solution, will replace a variety of current simulations. As such, the process and documentation by which an OOS user would submit Software Change Requests (SCR) are not yet final. It is envisioned that, when complete, the process will include a web-based solution for submitting and tracking requests. The OTB is a legacy simulation that serves as an interim SAF solution until the OOS is available in the projected FY06 timeframe. Consequently, as a general rule, SCRs are handled informally.

There are three primary ways that OTB software users or operators can make a change to the software:

- **Problem/Trouble Reports (P/TR).** If users encounter a software defect/deficiency, they can submit a P/TR (Figure 2) either through the appropriate webpage into a database or sent directly to a person on the OTB team. Throughout the OTB lifecycle, P/TRs are considered for urgency and severity, which determines how resources are allocated toward their respective resolution.
- **Recommended improvements.** Users or operators may submit suggestions for capability upgrades either directly to the OTB team or encapsulate them within the P/TR format. These are then tracked and considered if resources become available for functional development. However, it should be noted that development of the OTB baseline is largely accomplished through use of customer funds.
- **User Developed Capabilities.** The OTB is distributed to users as source code. As such, OTB community members are afforded the opportunity to develop their own set of unique capabilities. On a regular basis, the OneSAF Program Office sends a request to the OTB community asking for any user-developed functionality to be considered

for integration into the next major version release. If acceptable, these "externally" developed capabilities are integrated and can be leveraged as useful tools throughout the OTB community [30 May email coordination with Mr. Doug Parsons, Chief Engineer, Intelligent Simulation Systems Team, PEO-STRI, Orlando, FL].

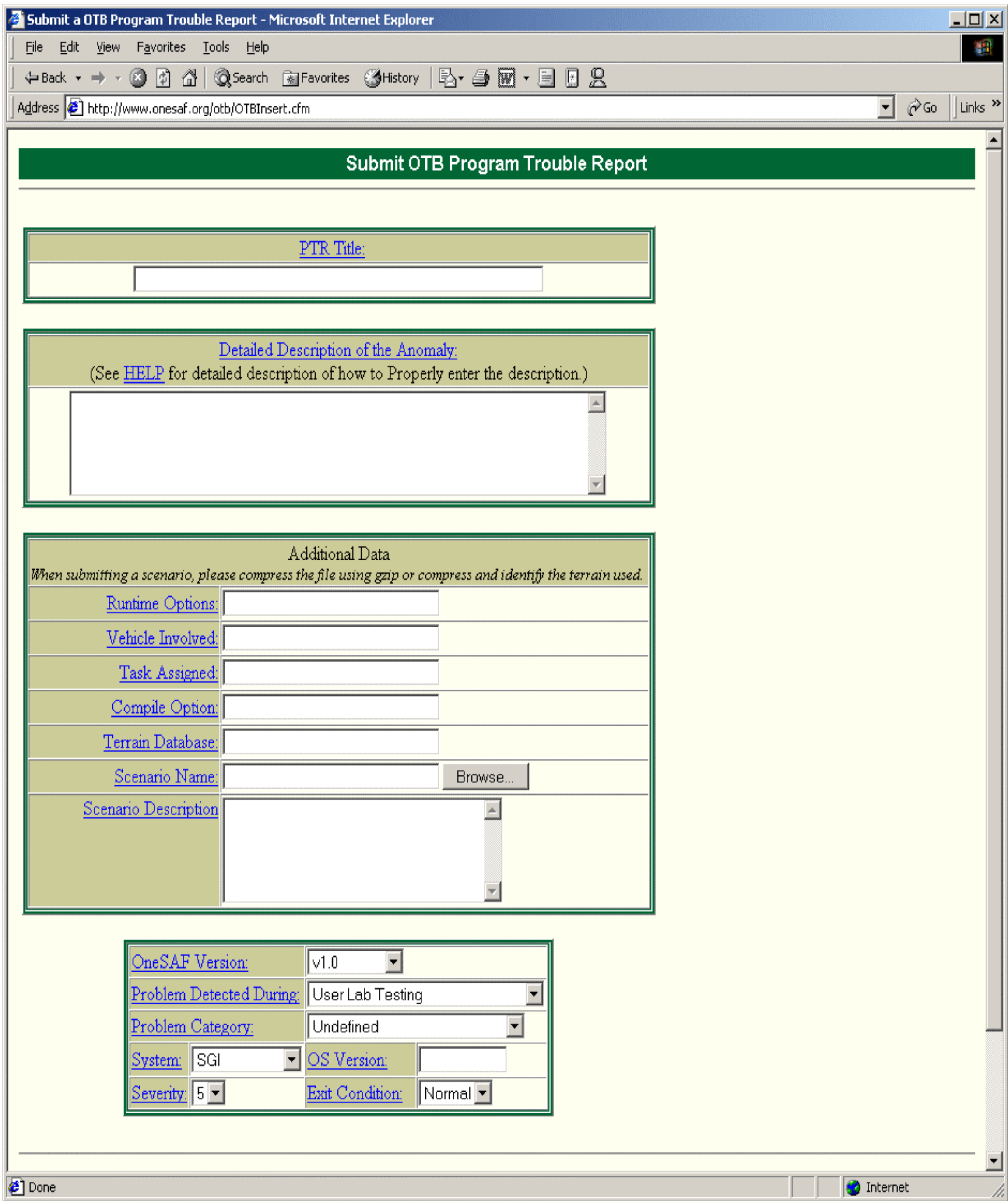

Figure 2 OTB Trouble Report

6.A.1e Corps Battle Simulation (CBS)

CBS is the Army's current low-level constructive training simulation. Its resolution range is between company and corps-level with units normally played at battalion and regiment level. The proponent office for CBS is the National Simulation Center (NSC), Fort Leavenworth, KS. NSC does not differentiate between separate software processes pertaining to technical or application areas.

User and operator-generated requests for all changes to simulation software are initiated by the requester by filling out a Change Request (CR) form (Figure 3) and submitting it directly to the National Simulation Center CBS Configuration Control Board (CCB). The board will decide on the validity of the proposed change and then vote on its priority of development in a future software development period called a "development year" [28 May telecon with Mr. Steve Friend, CBS Contractor Support Team, Fort Leavenworth, KS.

Corps Battle Simulation (CBS) Change Request (CR)

CR#

KS#_________

____
(LOCAL SITE USE)

USER PROVIDED INFORMATION

Originator's Name:	Date:	EXERCISE/TEST NAME:	Workstation:
Organization/Site:		Telephone:	CBS Version/Build #

Description of Problem, (Please provide any Simulation Information Necessary to Replicate the Problem) or Desired Changes (Attach Additional sheets as Necessary):

Recommended Action/Solution (Attach additional Sheets as Necessary):

NATIONAL SIMULATION CENTER

CR Topic/Title:

Functional Areas Affected:

☐ADA	☐ARTILLERY	☐CONFEDERATION/ALSP	☐ELECTRONIC WAR.	☐NBC	☐SOF
☐AIR (Fixed)	☐CIVIL AFFAIRS	☐DETECTION	☐LOGISTICS	☐OPFOR	☐UTILITIES
☐AIR (Rotary)	☐CLOSE COMBAT	☐DOCUMENTATION	☐MEDICAL	☐PERSONNEL	☐WORKSTATION
☐AIRLIFT/DROP	☐COMMUNICATIONS	☐ENGINEER	☐MOVEMENT	☐PSYOPS	☐OTHER

Analysis/Evaluation/Comments:

Reviewed/Verified By:	Date:

Support Team Recommendation: ☐ WORK ☐ DEFER ☐ CLOSE

NSC PRIORITY ☐ **1** ☐ **2** ☐ **3** ☐ **4** ☐ **5** ☐ **CLOSE** | DATE:

Figure 3 CBS CR

6.A.1f Brigade/Battalion Battle Simulation (BBS)

BBS is a medium-to-high resolution constructive training simulation. Resolution is from platoon to brigade level. The BBS proponent office is the TRADOC Analysis Center (TRAC). TRAC does not differentiate between separate software processes pertaining to technical or application areas.

The general philosophy for requesting software changes is to initiate one if the simulation capability or functionality does not fully support the training objectives of the user. An individual will first look at developing an administrative work-around to meet the requirement. If that does not solve the issue, a Software change Request (SCR) will be submitted to add the desired functionality, or a Trouble Incident Report (TIR) will be generated to fix an existing functionality or capability and support the training requirement [23 May email from Mr. Mike Mitchell of the BBS contractor support team, NSC, Fort Leavenworth, KS].

Proposed software changes that are originated by users or operators are normally generated through the SCR (Figure 4) shown below.

NATIONAL SIMULATION CENTER (NSC) ATTN: (BBS TEAM 2 WEST) 410 KEARNY AVE FORT LEAVENWORTH, KS 66027-1306	COMM: (913) 684-8304/8120/8116 DSN: 552-8304/8120/8116 FAX: (913) 684-8372
1. DATE SUBMITTED:	2. UNIT SCR #:
3. USER SITE ADDRESS:	4. TELEPHONE NUMBERS:
	COMM:
	DSN:
	FAX:
5. SCR/TIR ORIGINATOR NAME:	6. SITE POC NAME:
7. BBS SOFTWARE VERSION:	8. PC TYPE:
9a. ERROR CORRECTION:	9b. IMPROVEMENT:
10. Check the appropriate areas below that are most affected by the error or Improvement. More than one area may be selected.	

BBS V6.X Software Change Request (SCR) & Trouble Incident Report (TIR) Form

	A	AAR		S	NBC/SMOKE
	B	ADA		T	NETWORK
	C	AIR/AVN		U	OPFOR/ENEMY
	D	ARCHIVING		V	OPSTATES
	E	ARTILLERY		W	PERSONNEL
	F	C2		X	REMOTING
	G	DATABASE		Y	REPORTS
	H	DIRECT FIRE		Z	SYSTEM MANAGEMENT
	I	DOCUMENTATION		AA	SUPPLY
	J	ENGINEER		AB	TRANSPORTATION
	K	EQUIP/WEAPONS		AC	UNKNOWN UNITS
	L	INTELL/EW/SENSORS		AD	WEATHER
	M	LOS/DETECTION		AE	MOUT
	N	MAINTENANCE		AF	OTHER:___________
	O	MANEUVER/MOVEMENT			
	P	MAP GRAPHIC			
	Q	MEDICAL			
	R	MENUS/SCREENS			

11. Description of the error or improvement. Make all comments to this paragraph in the REMARKS SECTION. Attach supporting documentation (i.e., equipment parameters; Field Manual (FM), Technical Manual (TM) or other source documents).

NOTE: Error descriptions must include all error messages and events (attach printouts) leading to the incident/problem. Line of Site or Movement errors must include UTMs.

12. How does your suggestion improve the BBS model in the following areas? Make all comments to this paragraph in the REMARKS SECTION. Attach supporting documentation i.e. equipment parameters; FM, TM or other source documents.

As a Command Post Exercise (CPX) driver. Please specify the command and staff areas, operations and SOPs that will benefit from this improvement or suggestion.

Operator ease and efficiency.

Realism, game results and reports.

Functionality.

Capability.

Figure 4

6.A.1g Tactical Simulation (TACSIM)

The TACSIM simulation is a low-resolution constructive simulation that is designed to represent a theater-level intelligence gathering effort. While it will depict an individual entity, resolution is normally from theater to company. The proponent office for TACSIM is the Program Executive Office, Simulation, Training, and Instrumentation (PEO STRI) in Orlando, FL.

PEO-STRI does not differentiate between separate software processes pertaining to technical or application areas and uses a consolidated Change Request Form (SCR) for all software change requests [29 May 2003, telecon with Mr. James Shoemate, TACSIM contractor support team, Fort Leavenworth, KS].

Because of the unique characteristics of TACSIM, all user or operator proposed software changes are generated on the Software change Request form (Figure 5) below and sent directly to the TACSIM Division at the National Simulation Center for review and validation. When the TACSIM Division has determined that the proposed software change is valid and appropriate, it is submitted to PEO-STRI where a TACSIM Configuration Control Board (CCB) will determine the development priority for the proposed change during the next software development period (usually a preset 12-month period called a "development year").

TACSIM SOFTWARE CHANGE REQUEST (SCR)

SCR Number:	**Site:**
	POC:
Title:	**Phone:**
	Email:
	Date:
	Site Priority:

Problem Description:

Activity / Function Concerned:

Describe Desired Enhancement:

Miscellaneous comments (Include Possible workaround):

FOR NSC USE ONLY

Date Received:	**Originator Notified:**	**NSC Priority:**
Date Validated:	**NSC POC:**	**SCR Number:**
Rejection Rationale:		**Comments:**

Figure-5

6.A.1h Warfighter Simulation (WARSIM)

Warfighter Simulation (WARSIM), in development since 1993, is a computer-based, low-resolution simulation with associated hardware and is the Army's next generation command and control training environment. It will support the training of unit headquarters and command posts from battalion through theater-level in joint and combined scenarios. Additionally, it will provide command post training events in educational institutions. It will be designed to allow units to train in their command posts using organic C4I equipment, with a minimum of overhead. Originally a replacement for CBS, WARSIM was to be the Army's contribution to the Joint Simulation System (JSIMS) program. When DoD cancelled the JSIMS Service programs in FY 2003 the Army recognized the need to retain WARSIM as an Army Title 10 program. In Jan 2003, the Army directed creation of a simulation federation to capitalize on the WARSIM investment and utilize existing simulations to meet Army training requirements. WARSIM will form the core of the enhancements to the training simulation federation, called the Army Constructive Training Federation (ACTF).

PEO STRI is the proponent office for ACTF. PEO-STRI does not differentiate between separate software processes pertaining to technical or application areas.

During current development of ACTF, there is a baseline change request process (that changes the requirements baseline provided by the Government) between the Government development agent, PEO STRI, and contractors. The contractors also use a configuration management system to maintain the development baseline in which SCRs are written to fix software errors found in software integration and test. There is currently no formal SCR format for this process.

Between the user and the Government development agent there is a User/Developer Configuration Control Board (CCB) to determine what requirements will be met during the next development cycle. Requirement changes from these CCBs are documented and implemented if they are within funding constraints. After fielding, the user/Government development agent CCB will be used to determine any product improvements required [30 Jul 03 email with Ms. Sandy Veauteur, PEO-STRI, Orlando, FL and 31 Jul email with Mr. Robert Miller, also of PEO-STRI, Orlando, FL].

6.A.1i SPECTRUM

SPECTRUM is a high-resolution constructive training simulation developed in the mid-1990s at the Army's National Simulation Center (NSC), Fort Leavenworth, KS. It is designed to represent the command and control process in support of Stability and Support Operations (SASO) and is well suited to support both Weapons of Mass Destruction and Homeland Security activities. Resolution is to entity level, but use is normally oriented on battalion to division staff operations.

The NSC is designated as both the combat and materiel developer for SPECTRUM. The NSC does not differentiate between separate software processes pertaining to technical or application areas when working with the user community.

There are three formal SPECTRUM support report formats produced by the NSC: the Test Incident Report (TIR), the Customer Support Report (CSR), and the Software Change Request (SCR). The TIR is only used during software testing - not normally performed by users. The CSR is only for internal use by the SPECTRUM Support Team at NSC. The SCR is the report normally used (see Figure 6 below) to convey user requests for software corrections or enhancements.

When a user fills out an SCR, it is sent directly to the SPECTRUM Support Team. The SCR is reviewed for validity and priority by SPECTRUM programming specialists and the SPECTRUM Team Chief. After its priority is established according to its' perceived overall value-added to the training community, and the amount of effort and cost to accomplish it, the request is placed in a prioritized list for future execution [31 Jul 03 telecon with Mr. Tony Medici, SPECTRUM Team Chief, NSC, Ft. Leavenworth, KS].

SPECTRUM	1. SCR # SPECT ________________________ (For NSC use only)
Software Change Request (SCR)	

2. Originators Name:	**3. Date:** (mm/dd/yyyy)	**4. Time:**	**5. Workstation:**

6. Individual/Organization/Site Requesting Assistance:	**7. Telephone:**	**8. Spectrum Version #:**
	Fax: **E-mail:**	

9. Description of Problem or Observation (Attach additional sheets as necessary):

10. Recommended Action / Solution (Attach additional sheets as necessary):

11. Functional Areas Affected: (select the category by placing the cursor in the appropriate box)
☐ADA ☐ ARTILLERY ☐ CONFEDERATION\ALSP ☐ ELECTRONIC WAR ☐ PSYOP ☐AIR (Fixed) ☐CIVIL AFFAIRS
☐ CONTENDERS ☐ LOGISTICS ☐ SOF ☐AIR (Rotary) ☐CLOSE COMBAT ☐ DETECTION ☐ MEDICAL
☐ UTILITIES ☐ AIRLIFT/DROP ☐ COMMUNICATIONS ☐ DOCUMENTATION ☐ MOVEMENT ☐ WORKSTATION
☐ NETWORK ☐ ENGINEER ☐ NBC ☐ MAINTENANCE ☐ PERSONNEL ☐OTHER ___________

Figure 6

6.A.1j Digital Battlestaff Sustainment Trainer (DBST)

The Digital Battlestaff Sustainment Trainer (DBST) is a federation of simulations, stimulators and other technologies that collectively simulate a wide variety of military operations by providing a synthetic environment linking constructive and virtual training simulations with live training forces. The digital interfaces used in DBST allow Army units to train using the Army Battle Command Systems (ABCS) found in digitally equipped Army units. DBST was designed to assist commanders in training collective battle staff tasks. At the U.S. Army's Combat Training Centers (CTCs), the DIS bridge or translator not only links simulations to unit ABCS, but also provides the link between constructive and live-instrumented forces. This instrumented linkage allows live vehicles to appear in the various simulations, and constructive entities to show-up on the ABCS in the live vehicles.

The primary federates of DBST are Janus/JCATS, FIRESIM, EADSIM, and the after-action review systems VISION XXI and DCARS. The proponent office for DBST is the National Simulation Center (NSC).

6.A.1k Combat XXI

COMBAT XXI will be the follow-on HLA compliant model for CASTFOREM, an Army analytic model used for analysis of land warfare in support of new requirements, especially in the Analysis of Alternatives (AoA) process. COMBAT XXI is used as a combined arms analysis tool to meet the analysis needs of the ACR & RDA communities as well as those of the Marine Corps.

Combat XXI is currently under development with an IOC of 2004. The proponent office is the TRADOC Analysis Center (TRAC) at Fort Leavenworth, KS, with primary work conducted at the TRAC facility at White Sands Missile Range, New Mexico.

Combat XXI is centrally fielded and centrally maintained by TRAC, White Sands. The Combat XXI program office does not differentiate between separate software processes pertaining to technical or application areas.

A web-supported SCR is planned as part of the formal support process for Combat XXI, but it is not yet defined [28 Jul 03 teleconference with Mr. Dave Durda, TRAC White Sands Deputy Director, M&S Directorate].

6.A.1l Close Combat Tactical Trainer (CCTT)

CCTT is a distributed, interactive, non-motion simulator suite designed to represent the Army's M1 Abrams series main battle tank, the M2/M3 Bradley Fighting Vehicle, and the M113 series armored personnel carrier with resolution at entity level. The proponent office for CCTT is the Program Manager-Combined Arms Tactical Trainers (PM-CATT), National Simulation Center.

CCTT is centrally fielded and centrally maintained. The CCTT program office does not differentiate between separate software processes pertaining to technical or application areas.

User or operator proposals for software changes are processed on a Computer Software Trouble Report (Figure 7) through the TRADOC System Manager PM-CATT for validity, then through the Materiel Development Manager PM-CATT for prioritizing within a preplanned improvements program [15 Jul 2003, telecon with Mr. Pat Spangler, Deputy Program manager, CATT, PEO-STRI, Orlando, FL].

CCTT FIELD SUPPORT
COMPUTER SOFTWARE TROUBLE REPORT, CDRL D004
(DI-E-2178A - Modified)

STR CONTROL NUMBER:		_			**DATE:** _	
CATEGORY:	Software:	☐	Documentation:	☐	(identify) _ _	
SUBMITTING TECHNICIAN:						
LOCATION:	Beauregard	☐	Graf ATC	☐	Leesburg	☐
	Benning	☐	Hood1	☐	Minden	☐
	Carson	☐	Hood2	☐	Riley	☐
	Casey	☐	Knox	☐	Stewart	☐
			Los Alamitos	☐	Tennessee	☐
COMPONENT:	M1A1	☐	M1A2/SEP	☐☐	M2A2	☐
	M2M3	☐	M3A2	☐	M113	☐
	M981	☐	HMMWV	☐	DI PL	☐
	DI SL	☐	SAF	☐	CGF	☐
	AAR	☐	MCC/MC	☐	COMMO	☐
	UMCP	☐	FABTOC	☐	TACP	☐
	FDC	☐	FSE	☐	CES	☐
	CTCP	☐	CBT	☐	LAPTOP	☐
URGENCY:	1. Prevents Training			☐		
	2. Degraded Priority Function			☐		
	3. Degraded Non-Priority Function			☐		
	4. Temporary Anomaly or Other Inconvenience			☐		
	5. Other Anomaly (Describe):			☐		
BASELINE:	Processor:		CCTT SW Version:		ESIG Version:	
	43P	☐			RTS	

Figure 7

6.A.1m Janus

Janus is an interactive, event-driven, ground combat simulation that is used for battle-focused training from platoon to brigade level and for command and battle staff training at battalion and brigade. Janus version 7.3 is currently fielded within the U.S. Army at battle simulation centers with units—active and reserve component— and at schools to support instruction. Janus suites vary in size from a standard suite of 16 workstations to a maximum of 24.

The proponent office for Janus is PEO STRI, Orlando, FL. The Materiel Developer is NSC, Ft. Leavenworth, KS. The NSC does not differentiate between separate software processes pertaining to technical or application areas when working with the user community.

There are three formal Janus support report formats produced by the NSC: the Test Incident Report (TIR), the Customer Support Report (CSR), and the Software Change Request (SCR). The TIR is only used during software testing - not normally performed by users. The CSR is only for internal use by the Janus Support Team at NSC. The SCR is the report normally used (see Figure 8 below) to convey user requests for software corrections or enhancements.

When a user fills out an SCR, it is sent directly to the Janus Support Team. Their Janus programming specialists and the Janus/SPECTRUM Team Chief review it for validity and priority. After its priority is established according to its perceived overall value-added to the training community, and the amount of effort and cost to accomplish it, the request is placed in a prioritized list for future execution [29 Jul 03 telecon with Mr. Larry Harrison and Mr. Robert Varney of Anteon, primary contract support organization for Janus].

Janus	1. SCR # ____________________ (For NSC use only)

Software Change Request (SCR)

2. Originators Name:	3. Date: (mm/dd/yyyy)	4. Telephone:	5. E-Mail:
		(Voice) (Fax)	

6. Organization / Site Requesting Assistance:	7. Janus Version:
	Operating System Version: HP-UNIX LINUX

8. Description of Problem or Observation: (attach additional sheets as necessary)

9. Recommended Action / Solution: (attach additional sheets as necessary)

10. Other Comments:

11. Reviewed / Verified By:	12. Date: (mm/dd/yyyy)

Upon completion of this form, attach it to an E-Mail message and send to nscweb@leavenwworth.army.mil or Fax (913) 684-8352, or call (913) 684-8327 (DSN 552).

Figure 8.

6.A.1n Joint Conflict and Tactical Simulation (JCATS)

JCATS is a multi-sided, interactive, entity-level conflict simulation utilized by government organizations (e.g., military and site security organizations) as a tool for training, analysis, planning and mission rehearsal. The simulation is primarily focused at command and control or unit synchronization issues.

The proponent office for JCATS is the Joint Forces Command in Suffolk, VA. The Materiel Developer and original author of JCATS is Livermore Labs, Livermore, CA.

6.B Assessment of Changes to a Simulation

6.B.1 Alpha Testing

Alpha testing and beta testing are related components of the simulation testing process, which is a key part of simulation verification, validation, and accreditation (VV&A). By the time that a modified simulation is ready for alpha testing, the shortfalls of the original simulation will have already been identified, the new needs/requirements of the modified simulation will have already been defined and validated, the changes will have already been coded, and new data will have been defined, modified, and undergone VV&A. The common purpose of the alpha test and the beta test is to assess the changes to the modified simulation.

From the Defense Modeling and Simulation Office (DMSO) VV&A Recommended Practices Guide (http://www.msiac.dmso.mil/vva/Ref_docs/VVTechniques/vvtechniques.htm, Retrieved, 8/4/2003), the alpha test is defined as the "operational testing of initial, complete version of the model at an in-house site uninvolved with the model development." The beta test is defined as the "developer's operational testing of first release version of a complete model at a beta user site." These two definitions do not coincide completely with those of the software world where the "alpha test" is the unit, module, or component test phase (performed "in house") and the "beta test" is the initial system test (performed at users' locations) (http://www.epri.com/eprisoftware/processguide/index.html Retrieved, 8/4/2003).

The alpha and beta testing procedures are usually spelled out as a part of the developer's overall software development process. Historically, the names alpha and beta originate from earlier tests for measuring hardware development.

Alpha testing occurs during the prototype stage at the point when the simulation is first able to run. The simulation need not have all of its intended functionality, but it should have its core functions, it should be able to accept inputs through mock interfaces to other systems, and it should be able to generate outputs. The alpha test includes unit testing, component testing, and system testing.

The results of the alpha test are used to evaluate the simulation's algorithms, interfaces, data structure, and logic flow. A common strategy in alpha testing is to concentrate the testing effort on those parts of the simulation that are the most complex or are the most used. This "systems view" enhances the knowledge gained during the alpha testing to support resolution of the most pressing design questions. Alpha testing does not usually test for reliability, documentation, or installation procedures.

Before alpha testing commences, the developer should define the test's overall objectives, processes, schedules, tools, and passing criteria. Then the testing begins by performing unit tests on the individual simulation functional modules before they are joined together. During unit testing, the tester enters a wide range of inputs into the module to check that it functions properly on its own. This process sometimes uses "drivers" or special programs/simulations to provide environments and inputs. When unit testing is completed, the simulation modules are interfaced so that testing can occur in ever-larger subsets of the full simulation. This integration testing is completed when the entire simulation has been assembled and tested.

Important issues to resolve before the beginning of the simulation integration testing part of alpha testing include (Reference 2):

- Is the software architecture fully defined in the design document?
- Is the structure of global data identified?
- Is the component-level design complete for all modules within the system?
- Is an integration schedule established?
- Are drivers and stubs defined and developed?
- Are stubs available so that top-level modules can be adequately tested?
- Is regression testing performed as new modules are integrated?
- Are components integrated depth first so that appropriate functionality along one control path can be demonstrated?
- Are error-recording mechanisms in place?
- Are drivers available so that bottom level module clusters can be adequately tested?

Alpha Testing Worksheet

A source for much of the information in this worksheet is Reference 2

Plan for the alpha test	
Who participates?	
How many alpha testers are needed?	
What tasks should each tester perform using the simulation?	
What feedback should be gathered?	
What actions will be taken based on the feedback?	
What is the alpha test timetable?	
Produce the alpha test plan	
Alpha test objectives	
Tasks to be performed	
Platforms and configurations to test	
Key software properties and functions to be evaluated	
Test schedule	
Major milestones	
Individuals and responsibilities	
Alpha test feedback form	
Prepare for the alpha test	
Produce list of individual alpha testers	
Develop procedures for submitting feedback	
Perform the unit tests	
Interface Tests:	
Is the number of input parameters equal to number of arguments?	
Do input parameter and argument attributes match?	
Do input parameter and argument units match?	
Are the numbers/attributes of arguments transmitted to called modules equal to numbers/attributes of parameters?	

Are the units of arguments transmitted to called modules equal to units of parameters?	
Are the number of attributes and the order of arguments to built-in functions correct?	
Have input-only arguments altered?	
Are global variable definitions consistent across modules?	
Are constraints passed as arguments?	
Are file attributes correct?	
Are OPEN/CLOSE statements correct?	
Do format specifications match I/O statement?	
Do buffer sizes match record sizes?	
Are files opened before use?	
Are end-of-file conditions handled?	
Are I/O errors handled?	
Are there any textual errors in output information?	
Data Structure Tests	
Check for improper or inconsistent typing	
Check for erroneous initialization or default values	
Check for incorrect (misspelled or truncated) variable names	
Check for inconsistent data types	
Check for underflow, overflow and addressing exceptions	
Data Flow Tests	
Fully test component interfaces	
Exercise local data structures at their boundaries	
Test all independent basis paths	
Test all loops	
Test all data flow paths	
Test all error handling paths	
Perform the Integration Tests	
Analyze the alpha test results	

6.B.2 Beta Testing

Alpha testing and beta testing are related components of the simulation testing process, which is a key part of simulation verification, validation, and accreditation (VV&A). By the time that a modified simulation is ready for beta testing, the alpha test will be complete and the changes dictated by the results of that test will have been incorporated and re-tested.

From the Defense Modeling and Simulation Office (DMSO) VV&A Recommended Practices Guide, (http://www.msiac.dmso.mil/vva/Ref_docs/VVTechniques/vvtechniques.htm, Retrieved, 8/4/2003) the alpha test is defined as the "operational testing of initial, complete version of the model at an in-house site uninvolved with the model development." The beta test is defined as the "developer's operational testing of first release version of a complete model at a beta user site." This definition is usually expanded to mean testing "under realistic field conditions." These two definitions do not coincide completely with those of the software world where the "alpha test" is the unit, module, or component test phase (performed "in house") and the "beta test" is the initial system test (performed at users' locations) (http://www.epri.com/eprisoftware/processguide/index.html, Retrieved, 8/4/2003).

The alpha and beta testing procedures are usually spelled out as a part of the developer's overall software development process.

The beta test, the second phase of simulation software testing, presents selected simulation users with the opportunity to try out the product in a "real-world test" before general release. Hence, beta testing is sometimes considered to be "pre-release testing." The simulation software is ready for beta testing and user feedback when it is operating with most of its functionality.

By testing in customer environments, beta tests give users the opportunity to exercise the simulation, find errors, and correct them before the simulation is released. The beta testers check the technical accuracy of the simulation, and use it with their own computer setups, data and workflows to ensure that the simulation will perform as desired in their own environments.

Because the beta test simulation is to be installed at customers' sites, the developer should first perform a careful review of the software to ensure that there are no severe programming errors that could cause damage to the beta testers' systems. This review should also check for completeness of the draft user documentation, the test instructions for the beta tester, and the feedback form to acquire the testers' comments.

Beta testing evaluates:

- Functionality
- Algorithms
- Procedures
- Documentation/tutorials
- Installation instructions
- Ease of use

Beta testing also evaluates:

- Technical approach
- Specific calculations
- Order of screens and steps
- Organization of menu items
- Quality of written explanations

After the beta testers provide the feedback, the suggestions should be reviewed and integrated (as possible) into the simulation. All input received should be retained. If some input is not incorporated into the release of the simulation, it needs to be considered for future releases.

Beta Testing Worksheet

Plan for the beta test	
Who participates?	
How many beta testers are needed?	
What tasks should each beta tester perform using the simulation?	
Are usability-oriented tasks included?	
Is input on installation, draft documentation, on-line help, and ease of use requested?	
What feedback should be gathered?	
What actions will be taken based on the feedback?	
What is the beta test timetable?	
Produce the beta test plan	
Beta test objectives	
Evaluate simulation technical content	
Evaluate simulation ease of use	
Evaluate draft user documentation	
Identify errors	
Tasks to be performed	
Platforms and configurations to test	
Key software properties and functions to be evaluated	
Test schedule	
Major milestones	
Individuals and responsibilities	
Beta test feedback form	
Prepare for the beta test	
Produce list of beta testers	
Develop procedures for submitting feedback	
Prepare beta tester instructions	
Prepare list of functions, features, and data to be tested	
Review beta simulation software prior to shipping	
Ship beta simulation software to testers	
Perform the beta test	
Analyze the beta test results	

6.C Create A New M&S

6.C.1 Identifying New Requirement

6.C.1.a Simulation and Modeling for Acquisition, Requirements and Training (SMART)

SMART is a critical philosophical viewpoint to fully assimilate M&S into the Army. Training is absolutely critical to all aspects of the operational army, but the systems for training, the methods of training, and the doctrinal concepts applied are all areas of both interest and influence for the FA 57 officer. The imperative for the training community is that as operators, they are the user community in the sense of major systems procurement, and have a critical responsibility to be a part of the process, not just in receiving and training with new equipment delivered to them, but in the description of the need for new equipment, the operational uses of that new equipment, and the assurance that the equipment is correct before it arrives in the field. Therefore, the idea that as an operator (user), "I'll take this equipment and it better be good," is only as valid as the operator's efforts to make sure it's good before it arrives in the field.

"Simulation Based Acquisition is SMART for the Army," is the title of an article co-authored by then LTG Paul J. Kern (currently GEN Kern is the Commander of the Army Materiel Command) and Ms. Ellen M. Purdy that introduced the concept of SMART to the Army in RD&A magazine in the May-June issue in 1999. Simulation-Based Acquisition (SBA) had been previously identified as a new Department of Defense concept in October of 1996. Concerned that the name SBA didn't capture the full spirit and intent of the Army's planned approach to this concept, the Army adopted Simulation and Modeling for Acquisition, Requirements and Training (SMART). The Army's view was that the concept needed to be more expansive, including not just the acquisition community, but the training and analysis communities as well. The above-mentioned article stated it as follows:

"SBA is an Office of the Secretary of Defense (OSD) initiative to reform the acquisition process so that the acquisition community uses modeling and simulation (M&S) robustly throughout the acquisition life cycle. The goals of SBA are to reduce the time to field systems, reduce total ownership costs, and increase the military utility of fielded systems. These goals are of primary concern to the Army, but we recognize that we cannot achieve them through the efforts of the acquisition community alone. It requires the combined, integrated efforts of the Acquisition Workforce along with the requirements and training communities, hence the name SMART."

The general approach of SBA was first described in October 1996, in a document entitled, "Study on the Effectiveness of Modeling and Simulation in the Weapon System Acquisition Process." The Director, Test, Systems Engineering and Evaluation (DTSE&E), commissioned this study at the time when DTSE&E was a part of the Office of the Under Secretary of Defense for Acquisition and Technology. This study observed that M&S was being widely used, and was a powerful tool for development of new systems. M&S represented a new way of doing business that promised significant benefits in the acquisition process.

In August, 1999, following the announcement of the new SMART concept described in the article above, a SMART Strategic Planning Workshop was conducted to bring together the senior leadership of the respective domains to discuss the future of SMART. The purpose of this effort was to establish a baseline to begin institutionalizing the concept of SMART within the Army. This resulted in the development of a vision statement and a set of strategic goals for SMART. These products were published in an Assistant Secretary of the Army (Acquisition, Logistics, and Technology) (ASAALT) memorandum jointly signed by the DCSOPS representing the TEMO domain; the Military Deputy to the ASAALT, representing the RDA domain; and the Deputy Under Secretary of the Army (Operations Research) representing the ACR domain.

The SMART Vision Statement is to “be a world leader in Modeling and Simulation to continuously improve Army effectiveness through a disciplined collaborative environment in partnership with industry, government, and academia.” To clarify and expand upon the vision statement, four goals were established in this memorandum. The four goals are:

- Promote comprehensive modeling and simulation (M&S) policies, disciplined processes, and a high performance workforce to stimulate innovation and agility in developing enhanced Army capability.
- Establish a means to continuously and quantitatively measure, in a joint environment, life cycle cost and relevant measures of effectiveness.
- Create and maintain disciplined collaborative M&S environments for all stakeholders to exchange and reuse data and information to support "SMART" modernization decisions.
- Establish habitual associations and incentives to leverage the investments and inventions of academia, industry, and other government partners so that the Army benefits from the synergy of mutual investments.

The goals addressed several areas where applying a coordinated M&S effort could provide significant benefits. Two principal ideas derive from this document. First, the idea that many different organizations working together in a collaborative effort can achieve greater success in systems development, both in terms of cost savings and system effectiveness, can be seen throughout. Second, that a broad, comprehensive view of Army M&S efforts affords opportunities for reusing previously developed M&S capabilities and reduces the redundant development due to a lack of coordination or information on available M&S.

Since the time that these goals were published, the concept of SMART has continued to evolve and spread. The Army recognized early that new acquisition efforts would involve more than just the acquisition community. It also recognized that to be truly successful, SMART must be far reaching, capturing not just the interest, but also the full support of each of the domains. That is why the senior leadership of the three domains developed the SMART vision and goals discussed above. Anticipating that the concept would continue to evolve, they laid the groundwork for “the continuing process of institutionalizing SMART in the Army.”

Recently, SMART has been described as "…a change in Army business practices, through the exploitation of emerging M&S and other information age technologies, to ensure early collaboration and synchronization of effort across the total Army systems life cycle." The original focus has shifted from how to better employ M&S, to how to exploit new business practices and relationships, using key technologies such as M&S, across the full lifecycle of those combat systems that embody the transforming army.

As the concept has matured, four tenets of SMART have been developed to encapsulate this new way of doing business. These tenets impress on users the need to:

<u>Create</u> improved quality, timeliness, and economy (Better, Faster, Cheaper).
<u>Collaborate</u> with all stakeholders using a robust, integrated, disciplined Collaborative Environment (CE) and digital representation.
<u>Capitalize</u> on emerging and state of the art Modeling and Simulation and related technologies to optimize readiness through modernization.
<u>Cultivate</u> a total lifecycle perspective from concept exploration to retirement (lifecycle evolution).

The first tenet, <u>Create</u>, focuses on improvement in the quality of the product, the timeliness of development and delivery of the product, and the overall economy of the system throughout its life cycle. To accomplish this, changes must occur in the way we do business. Quality can be improved by applying best business practices to the effort. By using M&S to help assess things like finite element analysis, human factors engineering issues, and to focus on better application of M&S to assist in risk reduction, quality will be enhanced as a result. Timeliness of products means to deliver these high quality products more rapidly than in the past, to create a timelier product by reducing the length of time from concept to fielding. Creating better economy means to produce products that have lower lifecycle costs because the right decisions were made during development to avoid costly mistakes, and to afford better design, better materials, and more efficient systems, resulting in a less expensive product across the total life cycle.

Training is another aspect of creating improved quality. M&S can and will be used to create more effective, cost efficient training at individual, crew, and system level. Integration of live simulation techniques with virtual simulation in simulators and stimulators, as well as system representation in constructive simulations, must be accomplished to cover the full spectrum of training for individuals, crews and commanders.

The second tenet, <u>Collaborate</u>, calls for the cooperation of all stakeholders. That is, all the interested parties from the initial concept development team to the system disposal team, and includes program managers, contract developers, user representatives, the test and evaluation community, trainers, logisticians, and even extends to the academic community. Collaboration is the heart of SMART. By using a robust, integrated, disciplined Collaborative Environment (CE) and digital representation, these stakeholders can take part in critical exchanges of information that support optimum systems development, production, and sustainment.

Collaboration with and between all the stakeholders includes many possible interactions among what in the past may have been considered uncommon relationships—involving contractors, government and DoD organizations, academia, and even the entertainment industry. Not only is collaboration important for all these participants, it should span all functional areas and domains, as well as program milestones and major program decision points.

Collaboration for the trainer means working with the analysts and the acquisition corps personnel who generate the requirements and develop the technologies to meet the ultimate needs of the users/trainers. M&S is used to assess capability shortfalls, but without operational inputs, technicians who don't understand the operational aspects of the systems they are analyzing, may skew their assessments. Engineers that build systems also may not understand the implications of tradeoffs between capability and physical characteristics, e.g., an individual weapon that is highly effective, but weighs too much is unacceptable, even though it is effective. The user/trainer, warfighter-in-the-loop, can address such problems so that the proper capability is delivered to soldiers in the field.

The third tenet, Capitalize, anticipates taking advantage of all the new and emerging technology available to improve the developmental process, the exchange of information, and the systems' components as well. New technology affords the capability to link all players in the distributed collaborative environment described above. By quickly harnessing emerging technologies, the Army can apply these new technologies, techniques and best practices to provide greater efficiency and capability to continually improve the force, and support Army Transformation. This is one of the most expansive aspects of SMART, since it looks not just at M&S applications, but at other technologies as well; new information technologies, computer capabilities and automation techniques are but a few examples.

Capitalizing on new technology is not limited to the acquisition community. Often times, input from the field, based on field experience or new ways of using current equipment, can result in new systems development. That type of input can only come from experienced users/trainers.

The final tenet, Cultivate, seeks to refocus all of the domains into a holistic view of systems, not just in their area of particular interest, but across the entire lifecycle. Taking a broad view of systems makes sense for a number of reasons. The narrow-minded view that new concepts and systems are somebody else's business must be overcome. The "I'm an operator, not a logistician, engineer, acquirer, et.al." attitude must be discarded in favor of a broader vision for the good of the Army. Additionally, by looking at the whole lifecycle instead of a narrow slice of it, more efficient application of M&S can be accomplished. This establishes the framework for the application of progressively developed models and simulations to be used, first in concept exploration, through early design and requirements development, and evolved to mature training and sustainment functions and further, to retirement.

To the trainer, cultivating a new way of looking at systems means to look back at the origination of the system (i.e., how and why a particular system was developed, and for what purpose). It means considering the uses out to the end of the lifecycle and eventual retirement of the system. A broader view of the system and how it is used helps improve the whole process by giving an essential operational outlook to the process.

The ultimate goal of SMART is to focus all the supporting efforts on making soldiers in the field the best equipped, best trained and best prepared force in the world. Transformation and achievement of the objective force, a force that can dominate across the full spectrum of operations from peace support to high intensity combat, can only be achieved through the unity of effort of all the domains. Figure 1 illustrates this focused effort.

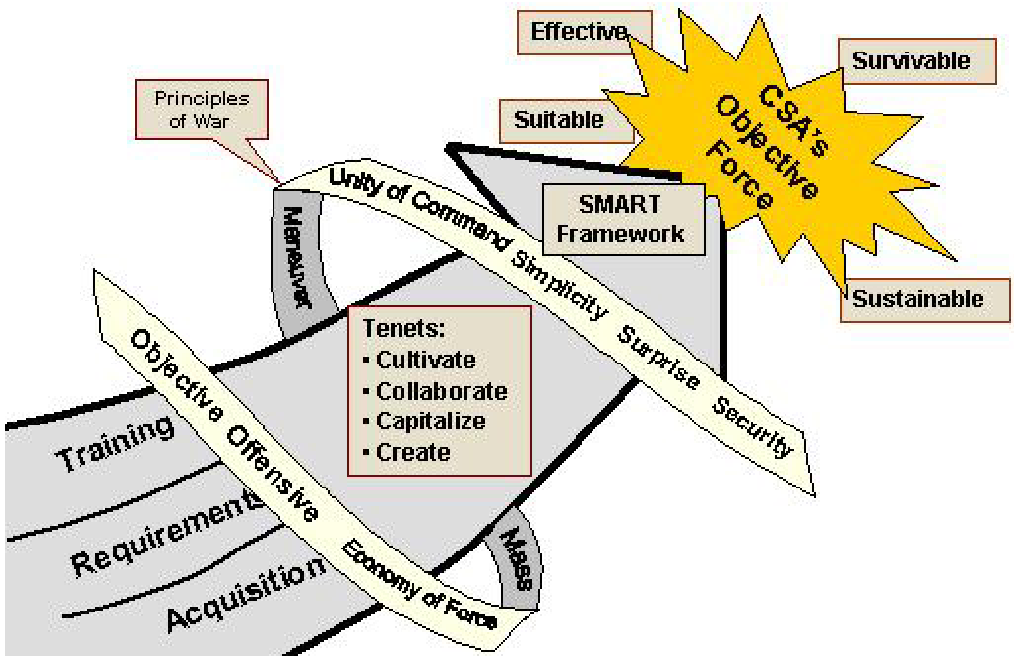

Figure 1. The Full Spectrum focus of SMART

In years past, the process to field new systems was linear, stove-piped and sequential, and looked something like that depicted in figure 2.

Figure 2. Linear Development

There was no organized effort to bring the various stakeholders together to view the system from a holistic, cradle-to-grave, perspective. This led to systems failures, such as the Sergeant York. The process lacked flexibility, and was not reactive to rapidly changing world conditions. The result was systems reaching the field after their technological advances had been eclipsed by newer, competing technologies. The ultimate users did not seriously impact the course of development of the new systems, because each of the domain stakeholders acted sequentially and independently of one another. In order to transform the Army and achieve the objective force, a method of breaching these obstacles had to be devised.

The SMART concept anticipates and seeks to overcome these obstacles by employing the tenets discussed above and applying them to the whole acquisition process discussed in the previous section. First, the analytical and training domains work together, collaborating among themselves, to ensure that the right capabilities are articulated in the initial analyses and the Initial Capabilities Document (ICD). Next, the analysts work with the acquisition personnel to ensure that the capabilities can be translated into materiel solutions and in deriving the Capabilities Development Document (CDD). Trainers serve as the user-in-the-loop to give a field perspective to the systems development, and then to the test plan and the Capability Production Document (CPD). During testing, the training/user community plays a key role providing essential feedback to the acquirers on the effectiveness and suitability of the system. Finally, the fielded system is in the hands of the trainer/user, but both analysts and acquirers play an important role in sustainment and improvement of the system through the evolutionary, iterative acquisition process. This is a circular or spiral process, not the old linear process previously applied. SMART affords multiple entry points for the user in the acquisition process, beyond the end-user role traditionally played. Now, all the Domains are integrated into the process as depicted in figure 3.

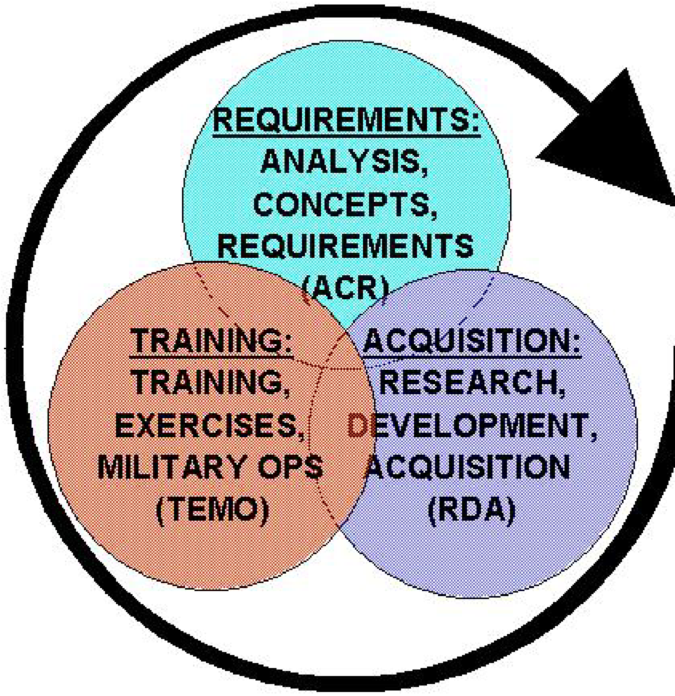

Figure 3. Integration of the Domain in the Acquisition Process

The philosophy of SMART is critical to the Army's goal of achieving the objective force. Training is an integral part of the SMART philosophy. The Training community is essential to all aspects of the operational army, and key elements of the operational army are the systems we train on, the methods of training, and the doctrinal concepts we apply. From the Functional Area Analysis to the sustainment and fielding of follow-on capabilities, trainers are essential players in the process. Without articulate descriptions of needs, and operator oversight as development progresses, the emerging systems will only be marginal successes at best. The training domain has a much greater role to play than to be receivers of equipment, and the SMART philosophy supports the full integration of all the domains throughout the system lifecycle.

6.C.1.b Army Needs and System Acquisition

The process for developing new systems for the Army begins even before the official acquisition cycle starts. It actually includes three distinct processes: "the Joint Capabilities Integration and Development System (JCIDS) Process, the Defense Acquisition System, and the Planning, Programming, Budgeting, and Execution System (PPBES) form DOD's three principal decision support processes for transforming the military forces according to the future DOD vision." The JCIDS identifies the need and then documents the capabilities required for new systems; the acquisition process takes these needs and requirements and translates them into materiel development of the systems; and the PPBES identifies the funding and distribution of these systems across the Army.

The JCIDS is a newly described process for identifying needs, and changes from a requirement- based to a capabilities-based description of new systems for development, in the Acquisition System. This process begins with consideration of national strategic guidance and the Joint Operations Concepts derived from the National Security Strategy. From this guidance, several levels of analysis are conducted to assess shortfalls and needs to fully meet strategic goals. First is the Functional Area Analysis (FAA), which identifies the operational tasks, conditions and standards needed to accomplish the full spectrum of military objectives. Following the FAA, the Functional Needs Analysis (FNA) is conducted. This analysis assesses the current capabilities of the military to meet the tasks identified in the FAA. The FNA generates a list of shortfalls in accomplishing the necessary tasks, which then leads to the Functional Solution Analysis (FSA). The FSA assesses the possible Doctrine, Organization, Training, Materiel, Leadership, Personnel and Facility (DOTMLPF) solutions to the FNA shortfalls. This assessment leads to a decision to take action for DOTMLPF changes developed through one of four efforts: science and technology, PPBS, acquisition or experimentation. This can be displayed graphically as shown in figure 1 below. Three of the four solution paths, with the exception of PPBS, may result in a materiel solution eventually entering into the acquisition system.

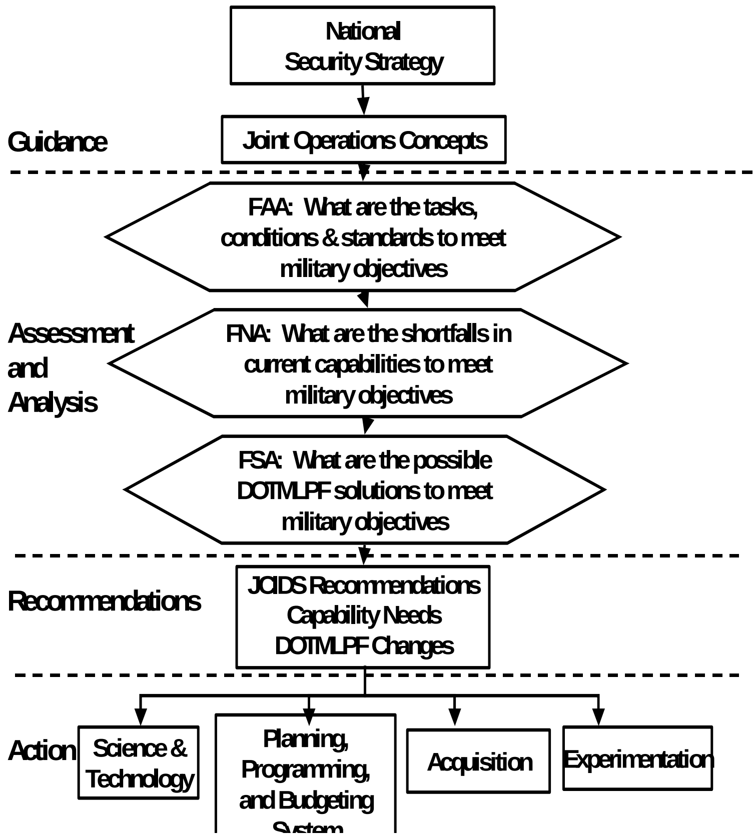

Figure 1. JCIDS Process

The JCIDS lays out the process that leads to entry into the Defense Acquisition System as described above, and establishes guidance on the governing documents for the process. These governing documents are the Initial Capabilities Document (ICD), the Capability Development Document (CDD), and the Capability Production Document (CPD). A detailed description of each is provided in CJCS Manual 3170.01. These documents are briefly described below.

The ICD documents the need for a materiel approach to a specific capability gap derived from an initial analysis of materiel approaches executed by the operational user and, as required, an independent analysis of materiel alternatives. It defines the capability gap in terms of the functional area, the relevant range of military operations, desired effects and time. The ICD summarizes the results of the DOTMLPF analysis and describes why non-materiel changes alone have been judged inadequate to fully provide the capability required. Once approved, an ICD is not normally updated. The ICD becomes a baseline document for all systems considerations associated with producing a product that provides the required capability. The CDD (described below) then serves as the living document to carry contributing systems and subsequent increments through the SDD phase. The ICD replaces the Mission Needs Statement (MNS).

The CDD captures the information necessary to develop a proposed program(s), normally using an evolutionary acquisition strategy. In evolutionary acquisition, the system will be developed in increments, where an increment is a militarily useful and supportable operational capability that can be effectively developed, produced or acquired, deployed and sustained. Each increment of capability will have its own set of attributes and associated performance values. For evolutionary acquisition programs, the CDD outlines the overall strategy to develop the full or complete capability and, details the current increment and future increments of the acquisition program to deliver the full operational capability. The CDD replaces the Operational Requirements Document (ORD).

The CPD addresses the production elements specific to a single increment of an acquisition program. The CPD is finalized after the critical design review when projected capabilities of the increment in development have been clearly specified. The CPD must be validated and approved before the Milestone C decision review. In evolutionary acquisition, a CPD will be prepared for each increment and performance attributes in each CPD will be specific to the designated increment.

The acquisition process has undergone extensive review and change in the past four years. Since May 1999, the guiding documents, the Department of Defense Directive 5000.1 and Department of Defense Instruction 5000.2, have been cancelled and re-issued twice, and revised several times.   The bulk of the changes have been to promote innovation and inspire forward looking techniques to speed the process while at the same time decrease total lifecycle cost and improve the military worth of the resulting systems.

The process is divided into three activities: Pre-Systems Acquisition, Systems Acquisition, and Sustainment. These, then, are divided into five phases: Concept Refinement, Technology Development, System Development and Demonstration, Production and Deployment, and Operations and Support.   To support this framework, several major decision points and Milestones have been established. The Milestones are simply labeled A, B, and C; the decision points are the Concept Decision, the Design Readiness Review and the Full rate Production Decision.   This can be graphically portrayed as depicted in the figure below:

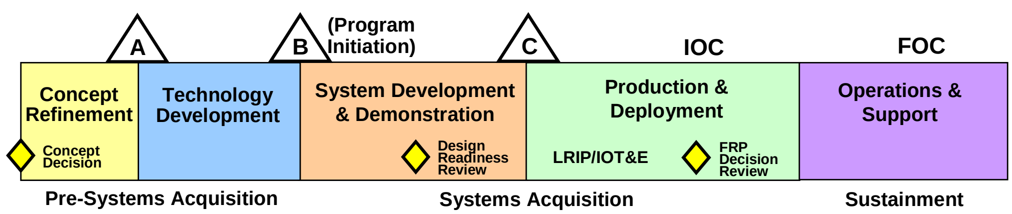

Figure 2. The Defense Acquisition Process

During Pre-Systems Acquisition, activities involve development and refinement of user needs and concept refinement work for the development of a materiel solution to the identified user need. The Pre-Systems Acquisition activity is governed by the Initial Capabilities Document (ICD), discussed above, and consists of the Concept Refinement and Technology Development phases.

Concept Refinement begins with the Concept Decision when the lead agency for development is designated, the Analysis of Alternatives (AoA) plan is approved, the ICD is approved and a date for a Milestone A review is established. These decisions are documented in an Acquisition Decision Memorandum (ADM), however, the decision to begin Concept Refinement DOES NOT mean that a new acquisition program has been initiated. The ICD and the AoA plan guide Concept Refinement; the focus of the AoA is to refine the selected concept documented in the approved ICD. The results of the AoA provide the basis for the Technology Development Strategy (TDS). The TDS documents the rationale for adopting an evolutionary strategy (for most programs) or a single-step-to-full-capability strategy. It includes a preliminary management description; a program strategy; specific cost, schedule, and performance goals; and a test plan to ensure that the goals and exit criteria for the first technology spiral demonstration are met. Concept Refinement ends with the Milestone A decision, when the MDA approves the preferred solution resulting from the AoA and approves the associated TDS.

The purpose of the Technology Development phase is to reduce technology risk and to determine the appropriate set of technologies to be integrated into a full system. The ICD and the TDS guide the activities during this phase. The project exits the Technology Development phase when an affordable increment of militarily-useful capability has been identified, the technology has been demonstrated, and a system can be developed for production within a short timeframe (normally less than five years). During this phase, the CDD is also developed. The Milestone B decision ends the Technology Development phase and approves the CDD and the acquisition strategy. A successful Milestone B decision is dependent upon three things: the technical maturity of the system, approved requirements and requisite funding to go forward.

The Milestone B decision ends Pre-Systems Acquisition activities and signals the beginning of Systems Acquisition This is the initiation point of the formal acquisition program. During Systems Acquisition, the concepts and technologies developed during the previous phases are matured into producible and deployable products that provide improved capabilities for the user. This process is governed by the Capability Development Document (CDD), and the Capability Production Document (CPD) and supported by two phases, System Development and Demonstration (SDD), and Production and Deployment.

The purpose of the System Development and Demonstration phase is to develop a system or an increment of capability that is operationally supportable, producible and affordable; and at the same time has demonstrated system integration, interoperability, safety, and utility. Development and demonstration are guided by the use of SMART and test and evaluation integrated into an efficient continuum as well as by a system acquisition strategy and test and evaluation master plan (TEMP). SDD has two major efforts: System Integration and System Demonstration.

The System Integration effort is intended to integrate subsystems, complete detailed design, and reduce system-level risk. When the program enters System Integration, there is a technical solution for the system, but the subsystems have not yet been integrated into a complete system. The CDD guide this effort, which will typically include the demonstration of prototype articles or engineering development models. The Design Readiness Review ends System Integration and continues the SDD phase into the System Demonstration effort.

The System Demonstration effort is intended to demonstrate the ability of the system to operate in a useful operational way. This effort ends when a system is demonstrated in its intended environment, using the selected prototype and meets approved requirements. Developmental and early operational test and evaluation are critical to determining success and the use of modeling and simulation to demonstrate system integration are critical during this effort. The completion of this phase is dependent on a successful Milestone C decision and allows the project to proceed to Low-Rate Initial Production (LRIP) in anticipation of Initial Operational Test and Evaluation (IOT&E). A CPD is developed during this phase and is approved as part of the Milestone C decision.

The purpose of the Production and Deployment phase is to achieve an operational capability that satisfies mission needs. Operational test and evaluation is used to determine the effectiveness and suitability of the system. The CPD is the governing document for this phase and reflects the operational requirements resulting from SDD and details the performance expected of the production system. Using the LRIP quantities of systems, the IOT&E is executed to determine if the system under test is effective, suitable and survivable. Continuation into full-rate production results from a successful Full-Rate Production Decision Review by the Milestone Decision Authority and is contingent upon successful completion of IOT&E. This decision delivers the fully funded quantity of systems and supporting materiel and services for the program or increment to the users, allowing units to achieve Initial Operational Capability.

Entrance into the last phase, Operations and Support, also signifies the beginning of the final activity, Sustainment. The objective of this phase is the execution of a support program that meets operational support performance requirements and sustains the system in the most cost-effective manner over its total life cycle. This phase includes the supply, maintenance, training, transportation, sustaining engineering, manpower, and other issues involved in the overall sustainment of the system. Sustainment strategies will evolve and be refined throughout the life cycle, particularly during development of subsequent increments of an evolutionary strategy, modifications, and upgrades. At the end of its useful life, a system will be demilitarized and disposed of as required.

The DoDD 5000.1, DoDI 5000.2, CJCSI 3170.01C, and the CJCSM 3170.01 govern the acquisition process. The former describe the timeline and phases, the latter, the guiding documents and the capabilities development process. Figure 3 illustrates how the ICD, CDD and CPD(s) are overlaid on the timeline and phases:

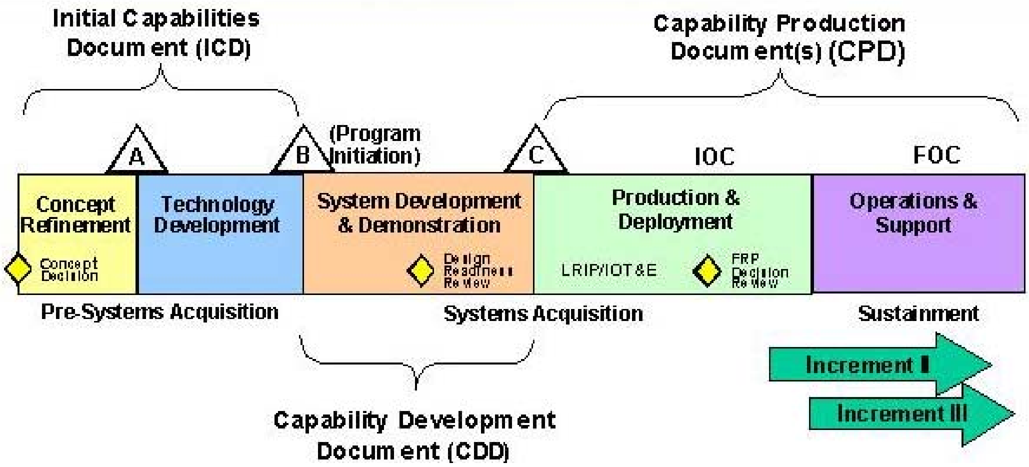

Figure 3. The acquisition timeline with Capability Documents

These combine to form the overall guidance for the development and investigation of new concepts that eventually result in the acquisition of new systems for the warfighter.

Appendix A: Acronyms

AAR	After Action Review
AARES	After Action Review (AAR) and Evaluation System
AAW	Anti-Air Warfare
ABCS	Army Battle Command System
ABE	ALSP Broadcast Emulator
AC	Active Component
ACAT	Acquisition Category
ACM	ALSP Common Module
ACR	Advanced Concepts and Requirements
ACRT	Advanced Concept Research Tool
ACT	ALSP Control Terminal
ACTF	Army Constructive Training Federation
ADM	Acquisition Decision Memorandum
ADRG	Arc Digitized Raster Graphics
ADS	Authoritative Data Sources
ADSI	Air Defense System Integration
ADSIM	Air Defense Simulation
ADTL	Armywide Doctrinal and Training Literature
ADTLP	Armywide Doctrinal and Training Literature Program
AEF	Aerospace Expeditionary Forces
AFAMS	Air Force Agency for Modeling and Simulation
AFATDS	Advanced Field Artillery Tactical Data Systems
AFMSPD	AF M&S Professional Development
AFMSRR	Air Force Modeling and Simulation Resource Repository
AFSAA	Air Force Studies and Analysis Agency
AIS	ALSP Infrastructure Software
ALSP	Aggregate Level Simulation Protocol
AMBL	Air Maneuver, Battle Laboratory
AMC	Air Mobility Commands
AMDWS	Air and Missile Defense Workstation
AMG	Architecture Management Group
AMP	Analysis of Mobility Platform
AMSEC	Army Modeling and Simulation Executive Council
AMSMP	Army M&S Master Plan
AMSO	Army Model and Simulation Office
AMW	Anti-Mine Warfare
AoA	Analysis of Alternatives
AOB	Advanced Operational Base
AORS	Army Operations Research Symposium
APC	Armored Personnel Carrier
APICM	Antipersonnel Improved Conventional Munition
ARPA	Advanced Research Projects Agency
ARRC	Allied Rapid Reaction Corps
ARTEP	Army Training and Evaluation Program

ASAALT	Assistant Secretary of the Army (Acquisition, Logistics, and Technology
ASDS	Advanced SEAL Delivery System
ASMB	Area Support Medical Battalion
ASUW	Anti-Surface Warfare
ASARC	Army Systems Acquisition Review Council
ASAS	All Source Analysis System
ASC	Aeronautical Systems Center
ASTARS	Army Standards Repository System
ASW	Anti-Sub Warfare
ATACMS	Army Tactical Missile System
ATCCS	Army Tactical Command and Control System
ATIZ	Artillery Target Intelligence Zone
ATO	Air Tasking Order
ATP	Ammunition Transfer Points
AUTL	Army Universal Task List
AVCATT-A	Aviation Combined Arms Tactical Trainer -Aviation Reconfigurable Manned Simulator
AwarE	Advanced Warfare Environment
AWE	Army Warfighting Experiment
AWS	Analysis Workstation
AWSIM	Air Warfare Simulation
AWSS	Area Weapons Scoring Systems
BAI	Battlefield Air Interdiction
BAS	Battalion Aid Station
BBS	Brigade/Battalion Simulation
BCBL	Battle Command, Battle Laboratory
BCTP	Battle Command Training Simulation
BDA	Battle Damage Assessment
BEES	Battle-Force EMI Evaluation System
BFA	Battlefield Functional Area
BFTT	Battle Force Tactical Trainer
BFV	Bradley Fighting Vehicle
BPG	Battle Projection Groups
BOS	Battlefield Operating System
BRIL	Baseline Resource Items List
BVR	Beyond-Visual-Range
C2	Command and Control
C2W	Command and Control Warfare
C2SE	Command and Control Simulation Equipment
C3I	Command, Control, Communications, and Intelligence
C4I	Command, Control, Communications, Computers, and Intelligence
C4ISR	Command, Control, Computers, and Intelligence, Surveillance and Reconnaissance
CAA	Concepts Analysis Agency
CACCTUS	Combined Arms C2 Training Upgrade System

CADRG	Compressed Automated Digital Raster Graphics
CAN	Combined Arms Network
CAS	Close Air Support
CASES	Capabilities Assessment Expert System
CASTFOREM	Combined Arms Task Force Engagement Model
CATT	Combined Arms Tactical Trainer
CBS	Corps Battle Simulation
CCB	Configuration Control Board
CCTT	Close Combat Tactical Trainer
CD	Capabilities Document
CDC	Concept Development Conference
CDD	Capability Development Document
CDR	Combat Decision Range
CE	Commandable Entity
CECOM	US Army Communications Electronics Command
CF	Counter Fire
CFFZ	Call for Fire Zone
CFZ	Critical Friendly Zone
CGF	Computer Generated Forces
CGS	Common Ground Station
CHP	Common Hardware Platform
CIB	Controlled Image Base
CLASS	Closed Loop Artillery Simulation System
CM	Configuration Management
CMF	Career Management Field
CMT	ALSP Confederation Management Tool
CMTC	Combat Maneuver Training Center
COA	Course of Action
COE	Contemporary Operating Environment
COFT	Conduct of Fire Trainers
COMBAT XXI	Combined Arms Analysis Tool for the 21st Century
COM	Center Of Mass
COMEX	Conduct a Communication Exercise
COMINT	Communications Intelligence
COMPUSEC	Computer Security
COMSEC	Communications Security
CONOPS	Concept of Operations
COP	Common Operational Picture
COSCOM	Corps Support Command
COSMOS	C4ISR Space and Missile Operations Simulator
CPD	Capability Production Document
CPX	Command Post Exercise
CR	Change Request
CREST	Community Response Emergency Simulation Training
CS	Combat Support
CSH	Combat Support Hospital

CSR	Customer Support Report
CSS	Combat Service Support
CSSBL	Combat Service Support, Battle Laboratory
CSSCS	Combat Service Support Control System
CSSTSS	Combat Service Support Training Simulation System
CTAPS	Contingency Theater Automated Planning System
CTC	Combat Training Centers
CTIL	Commander's Tracked Items List
CTS	Chief of Technical Support
CTSF	Common Technical Support Facility
CVAT	Combat Vehicle Appended Trainers
CVIT	Combat Vehicle Institutional Trainers
CVTS	Combat Vehicle Training Systems
CZ	Censor Zone
DA	Department of Army
DAG	Domain Advisory Group
DARPA	Defense Advanced Research Projects Agency
D&SABL	Depth and Simultaneous Attack Battle Laboratory
DBST	Digital Battlestaff Sustainment Trainer
DCARS	Digital Collection Analysis and Review System
DDR&E	Director of Defense Research and Engineering
DEC	Digital Equipment Corp
DFAD	Digitized Feature Analysis Data
DIA	Defense Intelligence Agency
DIS	Distributed Interactive Simulation
DITSCAP	DoD Information Technology Security Certification and Accreditation Process
DMSO	Defense Modeling and Simulation Office
DMT	Distributed Mission Training
DoD	Department of Defense
DOH	Department of Health
DOT	Department of Transportation
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership, Personnel and Facility
DTSE&E	Director, Test, Systems Engineering and Evaluation
DOW	Died of Wounds
DPICM	Dual Purpose Improved Conventional Munition
DS	Direct Support
DTED	Digital Terrain Elevation Data
DUSA (OR)	Deputy Under Secretary of the Army for Operations Research
DVTE	Deployable Virtual Training Environment
EAC	Echelon of Above Corps
EADSIM	Extended Air Defense Simulation
EDM	Environmental Data Model
EEC	Emergency Evacuation Center
EEM	Early Entry Module

ELINT	Electronic Intelligence
ELIST	Enhanced Logistics Intra Theater Support Tool
ELSEC	Electronic Security
EMO	Emergency Management Office
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
EpiCS	Emergency Preparedness Incident Command Simulation
ePIU	Enhanced Protocol Interface Unit
EPLRS	Enhanced Position Location Reporting System
EPW	Enemy Prisoners of War
eTSIU	Enhanced Tactical Simulation Interface Unit
ESG	Environment Scenario Generator
EW	Electronic Warfare
EXCIMS	Executive Council for Modeling and Simulation
EXCON	Exercise Control
ESG	Environment Scenario Generator
FAA	Functional Area Analysis
FACT	Focus Area Collaborative Team
FAMSIM	Army Family of Training Simulation
FARRP	Forward Area Rearm and Refuel Points
FAO	Foreign Area Officer
FBCB2	Force XXI Battle Command Battalion/Brigade and Below
FBI	Federal Bureau of Investigations
FCS	Future Combat System
FDC	Fire Direction Center
FED	Federation Execution Data
FEDEP	Federation Development and Execution Process
FEMA	Federal Emergency Management Agency
FH	Field Hospital
FIST-V	Fire Support Vehicle
FM	Field Manual
FMS	Foreign Military Sales
FNA	Functional Needs Analysis
FO	Forward Observer
FOA	Field Operating Agency
FOB	Forward Operating Base
FOF	Force-on-Force
FOM	Federation Object Model
FPC	Final Planning Conference
FRD	Functional Requirements Documents
FSA	Functional Solution Analysis
FSE	Fire Support Element
FSMC	Forward Support Medical Company
FSOP	Field Standard Operating Procedures
FST	Forward Surgical Team
FTCST	Fire Team Cognitive Skills Trainer

FTI	Fixed Tactical Internet
FTP	File Transfer Protocol
FTX	Field Training Exercise
FUE	First Unit Equipped
FW	Fixed Wing
GCCS	Global Command and Control System
GCCS-M	Global Command and Control System – Maritime
GEMSS	Ground Emplaced Mine Scattering System
GH	General Hospital
GRF	Graves Registration Facility
GS	General Support
GSR	Ground Surveillance Radars
GTN	Global Transportation Network
GUI	Graphical User Interface
HALS	Higher/Adjacent/Lower/Subordinate Units
HFDF	High Frequency Direction Finding
HICON	Higher Control
HIMAD	High-To-Medium-Altitude Air Defense
HLA	High Level Architecture
HLC	Highest Level of Care
HUMINT	Human Intelligence
IAATS	Intelligence Analyst Advanced Toolset
IADS	Integrated Air Defense Scenarios
ICD	Initial Capabilities Document
ICOFT	Institutional Conduct of Fire Trainer
IDA	Institute for Defense Analyses
IEEE	Institute of Electrical and Electronics Engineers
IERs	Information Exchange Requirements
IF	Interface Specifications
IFEC	Intelligence and Force Employment Cycle
IFF	Identification Friend or Foe
IG	Image Generator
I/ITSEC	Interservice/Industry Training, Simulation and Education Conference
IPD	Initial Capabilities Documentation
INE	Integrated Natural Environment
IOC	Initial Operating Capability
IOS	Intelligence Operations Station
IOTE	Initial Operational Test and Evaluation
IO	Information Operations
IPC	Initial Planning Conference
IPR	In-Progress Review
ISMT-E	Indoor Simulated Marksmanship Trainer – Enhanced
ISSM	Information Systems Security Manager
ISSO	Information Systems Security Officer
ISSPM	Information Systems Security Program Manager
ITK	Infantry Toolkit

ITV	In-Transit Visibility
IUSS	Integrated Unit Simulation System
IV&V	Independent Verification and Validation
IW	Information Warfare
IWG	Interface Working Group
JAWS	Janus Analyst Workstation
JCATS	Joint Conflict and Tactics Simulation
JCEWC	Joint Communication Electronic Warfare Center
JCF	Joint Contingency Force
JCIDS	Joint Capabilities Integration and Development System
JCLL	Joint Center for Lessons Learned
JCM	Joint Conflict Model
JDLM	Joint Deployment Logistics Model
JIDPS	Joint Integrated Database Preparation System
JIMM	Joint Integrated Mission Model
JIOC	Joint Information Operations Center
JMEM	Joint Munitions Effectiveness Manual
JNTC	Joint National Training Capability
JNTF	Joint National Test Facility
JOPES	Joint Operational Planning and Execution System
JPL	Jet Propulsion Laboratory JQUAD JCEWC Joint Simulation Models
JPSD	Joint Precision Strike Demonstrations
JSAF	Joint Semi-Autonomous Force
JSB-AF	Joint Synthetic Battlespace - Air Force
JSIMS	Joint Simulation System
JSTARS	Joint Surveillance Target Attack Radar System
JTA	Joint Technical Architecture
JTA-A	Joint Technical Architecture - Army
JTC	Joint Training Confederation
JTF	Joint Task Force
JTF-CS	Joint Task Force-Civil Support
JTFp	Joint Training Protofederation
JTLS	Joint Theater Level Simulation
JTS	Joint Tactical Simulation
JUCL	JSIMS Universal Capabilities List
JWFC	Joint Warfighter Center
JWICS	Joint Worldwide Intelligence Communications System
KBSC	Korea Battle Simulation Center
KIA	Killed In Action
LEOPARD	Low Earth Orbit Position and Reporting Device
LESD	Logistics Exercise and Simulation Directorate
LFOC	Landing Force Operations Center
LL	Lessons Learned
LLNL	Lawrence Livermore National Laboratory
LOS	Line-of-Sight
LVCEPR	Live, Virtual, Constructive Environment Periodic Review

M&S	Modeling and Simulation
MAA	Mission Area Analysis
MADP	Mission Area Development Plan
MAGTF	Marine Air-Ground Task Force
MAIS	Mobile Automated Instrumentation Suite
MANSCEN	Maneuver Support Center
MARFORLANT	Marine Corps' Formal Schools, Marine Forces Atlantic
MARFORPAC	Marine Forces Pacific
MCWL	Marine Corps Warfighting Lab
MDMP	Military Decision Making Process
MCS	Maneuver Control System
MDST	Missile Defense Tool
MEF	Marine Expeditionary Force
MEL	Master Environmental Library
MESA	Modeling and Simulation Executive Agent
METL	Mission Essential Task List
METT-TC	Mission Enemy Terrain Troops –Time and Civil
MHC	Medical Holding Company
MIA	Missing In Action
MICLIC	Mine Clearing Line Charge
MIL AASPEM	Man-In-the-Loop Air-to-Air System Performance Evaluation Model
MILES	Multiple Integrated Laser Engagement System
MLS	Multi-Level Security
MNS	Mission Needs Statement
MoA	Memorandum of Agreement
MODSAF	Modularized Semi-Automated Forces
MOE	Measures of Effectiveness
MOOTW	Military Operations Other Than War
MOP	Measures of Performance
MOPMS	Modular Pack Mine System
MOPP	Mission Oriented Protection Posture
MORS	Military Operations Research Society
MORT	Mortuary Facility
MOUT	Military Operations in Urban Terrain
M-PADS	Multi-Purpose Aerial Delivery System
MPC	Main/Mid Planning Conference
MSBL	Maneuver Support, Battle Laboratory
MSC	Major Subordinate Commands
MSCA	Military Support to Civil Authorities
MSEL	Master Scenario Events List
MSR	Major Supply Route
MSRR	Model and Simulation Resource Repository
MTD	Minor Training Devices
MTI	Moving Target Indicator
MTID	MILES Target Interface Device
MTM	McLintock Theater Model

MTOE	Modified Table of Equipment
MTP	Mission Training Plan
MTWS	Marine Air-Ground Task Force Tactical Warfare Simulation
MUMIV	Manned-Unmanned Teaming of Aerial Vehicles
MUSE	Multiple Unified Simulation Environment
NASM	National Aerospace Warfare Model
NAVMSMO	Navy M&S Management Office
NBC	Nuclear/Biological/Chemical
NEO	Non-Combatant Evacuation Operation
NGO	Non-Governmental Organization
NICI	National Interagency Civil-Military Institute
NIMA	National Imagery and Mapping Agency
NITE	Night Integrated Training Environment
NLW	Non-lethal Warfare
NMSIS	Navy M&S Information System
NOE	Nap-of-the-Earth
NSC	National Simulation Center
NSS	Navy Simulation System
NTC	National Training Center
NTDR	Near-Term Digital Radio
NVP	Naval Visualization Program
OC	Observer/Controller
ODE	Ordinary Differential Equation
OMG	Object Management Group
OMRC	Object Model Resource Center
OMT	Object Model Template
OneSAF	One Semi-Automated Forces
OOS	OneSAF Objective System
OPCON	Operational Control
OPFOR	Opposition Forces
OPSEC	Operations Security
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
OTB	OneSAF Test Bed
PACOM	Pacific Command
PC	Personal Computer
PC-GEEP	PC Game Events Executive Processor
PCWS	PC Work Station
PDU	Protocol Data Unit
PDL	Pilot Decision Logic
PEO STRI	Program Executive Office Simulation, Training & Instrumentation
PH	Probability of Hit
PK	Probability of Kill
PLCS	Power Line Control System
PLIS	Position Location Information System
PM	Program Manager

PME	Professional Military Education
POL	Petroleum, Oil, and Lubricants
POMSO	Plans, Operations and Military Support Office
PORTSIM	Sea Port Military Operation Simulation Model
POSSIM	The Post Oak Simulation
PPBES	Planning, Programming, Budgeting, and Execution System
PPSS	Post Production Software Support
PSM	Portable Space Model
PTA	Primary Training Audience
P/TR	Problem/Trouble Reports
RAM	Regional Analysis Model
RC	Reserve Component
RDA	Research, Development, and Acquisition
REMBASS	Remote Battlefield Sensors
RESA	Research, Evaluation and System Analysis Simulation
RFI	Requests For Information
RIS	Range Instrumentation System
RIWG	Requirements Integration Working Group
RMO	Research Management Office
RMS	Remote Minehunting Systems
RSOI	Reception, Staging, Onward Movement, and Integration
RTD	Return To Duty
RTGS	Rapid Terrain Generation System
RTI	Run Time Infrastructure
RTM	Run Time Manager
RV	Random Variable
RVFU	Reconfigurable Virtual Fire Unit
RW	Rotary Wing
SAF	Semi-Automated Forces
SAM	Surface-to-Air Missiles
SAMS	School for Advanced Military Studies
SAR	Synthetic Aperture Radar
SARSS	Standard Army Retail Supply System
SBA	Simulation Based Acquisition
SCIF	SCI Facility
SCIP	Simulation Center Infrastructure Program
SCP	Simulation Control Plan
SCR	Software Change Request
SDC	Software Distribution Center
SEAD	Suppression of Enemy Air Defense
SEDRIS	Synthetic Environment Data Representation Interchange Specification
SEES	Security Exercise Evaluation System
SHORAD	Short Range Air Defense
SIMEX	Simulation Exercise
SIMITAR	SIMulation In Training for Advanced Readiness
SIMNET	Simulator Network

SIMSOC	Simulated Space Operations Center
SINCGARS	Single-Channel Ground and Airborne Radio System
SISO	Simulation Interoperability Standards Organization
SIW	Simulations Interoperability Workshop
SJA	Staff Judge Advocate
SMART	Simulation and Modeling for Acquisition, Requirements and Training
SMDBL	Space & Missile Defense, Battle Laboratory
SME	Subject Matter Expert
SMTP	Simple Mail Transfer Protocol
SNEACRS	Standards Nomination, Evaluation, Advocacy and Central Repository System
SOF	Special Operation Force
SOFA	Status of Forces Agreement
SOI	Signal Operating Instruction
SOM	Simulation Object Model
SOP	Standard Operating Procedures
SOS	Space Operations System
SPAWAR	Space and Naval Warfare Systems Command
SPEEDES	Synchronous Parallel Environment for Emulation and Discrete Event Simulation
SSAN	Social Security Account Number
SSP	Simulation Support Plans
STAMIS	Standard Army Management Information Systems
STA	Secondary Training Audience
STORM	Simulation, Testing, Operations, & Rehearsal Model
STOW	Synthetic Theater of War
STP	Soldier Training Publication
SVVT	System Verification and Validation Test
SWAMPS	Special Warfare Automated Mission Planning System
SWEG	Simulated Warfare Environment Generator
TAACOM	Theater Army Area Command
TAB	Target Acquisition Battery
TACSIM	Tactical Simulation
TADDS	Training Aids, Devices, Simulators, and Simulations
TADL	Tactical Data Link
TAIS	Tactical Airspace Integration System
TBMCS	Theater Battle Management Core System
TBMD	Theater Ballistic Missile Defense
TCATA	TRADOC Combined Arms Test Activity
Tdose	Turn Back Dose
TDG	Tactical Decision Game
TDMS	Tactical Decision-Making Simulation
TDR	Training Device Requirement
TDS	Technology Development Strategy
TECOM	Marine Corps Training and Education Command
TED	Terrain Editor

T&E	Test and Evaluation
T&EO	Training and Evaluation Outlines
TEMO	Training, Exercises, and Military Operations
TES	Tactical Engagement Simulation
THP	Take Home Package
TI	Tactical Internet
TIP	TACSIM Interface Processor
TLGOSC	Training and Leader General Officer Steering Committee
TM	Training Manuel
TLM	Topographic Line Map
TMDS	Table Management Distribution System
TOC	Tactical Operations Center
TOD	TRADOC Analysis Center Operations Directorate
TOPSCENE	Tactical Operational Scene
TPFDD	Time Phased Force Deployment Data
T/P/U	Trained/Partially Trained/Untrained
TRAC	Training Analysis Command
TRADOC	Training and Doctrine Command
TRD	Technical Requirements Documents
TSP	Training Support Plan
TTP	Tactics, Techniques and Procedures
UAV	Unmanned Aerial vehicle
UCAV	Unmanned Combat Aerial Vehicle
UCCATS	Urban Combat Computer Assisted Training System
UFL	Ulchi Focus Lens
UJTL	Universal Joint Task list
USAFE	United States Air Force Europe
USAREUR	U. S. Army Europe
USD [AT&L]	Under Secretary of Defense (Acquisition, Technology, and Logistics)
USJFCOM	US Joint Forces Command
USMC	US Marine Corps
USMTF	US Message Text Format
USREDCOM	United States Readiness Command
UTI	Upper Tactical Internet
VBS	Virtual Battlefield Simulation
VIC	Vector-In-Commander
VICTORS	Variable Intensity Computerized Training System
VRSG	Virtual Reality Scene Generator
V&V	Verification and Validation
VV&A	Verification, Validation, and Accreditation
VV&C	Verification, Validation, and Certification
WAN	Wide Area Network
WARSIM	Warfighter’s Simulation
WIA	Wounded In Action
WIM	WARSIM Intelligence Model
WMD	Weapon of Mass Destruction

WPC	Warrior Preparation Center
WSMR	White Sands Missile Range
WVR	Within Visual Range
WWW	Worldwide Web

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Appendix B: BSCs/BPCs Simulation Capabilities

1. **Overview:** This appendix describes the Army's capabilities to support constructive simulations training.

2. **Constructive Training Simulation Support:**

   a. **Organization:** FORSCOM resources 15 constructive simulation support facilities across CONUS. These include nine hosted by AC installations and five hosted by the RCs. Additionally, Third U.S. Army headquarters is resourced with a constructive simulations capability in support of CENTCOM missions.
   b. **AC Facilities:** The nine AC facilities are administered by the AC corps which they support. The facilities are located with each of the corps headquarters, or at the division headquarters located away from the corps and brigade headquarters away from divisions.
   c. **RC Facilities:** The five RC hosted facilities are co-located with the 1st Brigade (Simulation) of each of the five TSD. The TSDs are OPCON to the CONUSA for training support missions. The TSD Simulation Brigade mission is to provide Battle Command Staff Trainer (BCST) to RC/ARNG CA/CS/CSS unit commanders. The TSD simulation brigades focus on the brigade and battalion staff using CBS, BBS, CSSTSS, JANUS, and SPECTRUM, as appropriate.

3. **Prioritization of Battle Simulation Usage:**

   a. The nine AC BSC's first priority is to AC units, and then priority for RC units as listed below.
      1. The Force Support Package (FSP) units, Divisional Round Out/Round Up (RO/RU) units, units with Latest Arrival Date (LAD) < 30 days, and enhanced Separate Brigade (eSB) units.
      2. Army National Guard (ARNG) division and strategic brigade units.
      3. All other units within training capacity.
   b. The five USAR BPCs are prioritized as listed below.
      1. All FSP units (those units with annual BCST requirements).
      2. All other units (triennial BCST requirements).

4. **Simulation Needs in the Near (FY 03-04) and Mid (FY05-09) Term:**
   a. Field the Army Constructive Training Federation (ACTF) to all BSC/BPC with appropriate linkage to ABCS and CS/CSS functions.
   b. Field OneSAF to all BSC/BPC with appropriate linkages to ABCS and with CS/CSS functions.
   c. Reach and maintain operational funding levels for the 15 simulation centers.

d. Field CBS Runtime Manager (RTM), BBS RTM, and Digital Command and Staff Trainer (DCST) to provide a digital training capability until the ACTF is fielded.
e. Modernize the BSC/BPCs.
f. Commence implementation of embedded simulations in weapon and C2 systems.
g. Digitize training ranges.
h. Man simulation center to realistic levels in Department of the Army Civilian (DAC) and Military Personnel.
i. Field fully-funded digital battlestaff sustainment trainer (DBST).
j. Complete PC porting to all fielded and future simulations.

5. Organizations

1. HQ, Third U.S. Army/ARCENT
2. Locations and General Capabilities of Corps BSCs
3. I Corps BSC
4. III Armored Corps BSC
5. XVIII Airborne Corps BSC
6. Location and General Capabilities of Division BSCs
7. 3rd Infantry Division (M) BSC and Ft Stewart’s Sim Division
8. 7th Infantry Division BSC
9. 10th Mountain Division BSC
10. 24th Infantry Division
11. 101st Airborne Division (AA) BSC
12. Locations and General Capabilities of Brigade BSCs
13. Ft. Polk BSC
14. Locations and General Capabilities of TSD BPCs
15. TSD Area of Responsibilities
16. 75th TSD BPC
17. 78th TSD BPC
18. 85th TSD BPC
19. 87th TSD BPC
20. 91st TSD BPC
21. Korea Battle Simulation Center (KBSC)
22. USAREUR and USAFE Battle Command Training Centers

A. HQ, Third U.S. Army/ARCENT

1. **Training Mission:** Third Army has no direct training mission with either AC/RC forces. When deployed, Third Army is allocated forces by FORSCOM, as required. Third Army does not staff or man a BSC for the purposes of training external staffs or commanders; however, it does maintain a small set of equipment for internal staff training, and for the development of external exercises.

   Third Army conducts a number of CENTCOM-directed exercises with US and Coalition forces, some of which are supported in whole or in part with simulations. The available equipment and personnel are used to help develop and support the exercise, along with other agencies tasked to provide the bulk of the simulations support.

2. **Training Audience:** Those forces allocated by FORSCOM or directed by CENTCOM with which Third Army is to exercise. Exercises are held with Reserve units such as the 3rd Medical Command (MEDCOM), 3rd Personnel Command (PERSCOM), 244th Theater Aviation (AV) Brigade, 355th Signal Brigade, 377th TAACOM, 416th Engineer Command (ENCOM) which are War-traced to Third Army, and the 513th Military Intelligence (MI) Brigade.

3. **Manpower:** Current authorizations call for five officers and five enlisted personnel. No department of the Army Civilian (DAC) personnel are authorized. Three contractor personnel are provided by the National Simulation Center (NSC). Currently on hand are four officers, two enlisted, and three contractors.

4. **Simulations Capabilities:** Simulations on hand include BBS, EADSIM, and SPECTRUM. The VISION XXI After Action Review (AAR) system is employed, and the Tactical Warfare Model (TACWAR) Course of Action (COA) system is on hand for analysis.

5. **Hardware Assigned:** BBS = 4 workstations and 2 Micro-Vaxs. EADSIM = workstations SPECTRUM = workstations TACWAR =1 workstation.

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6. Locations and General Capabilities of CORPS BSCs

I Corps
Fort Lewis

Simulations

- JCATS
- BBS
- CBS
- JANUS
- FSST
- TACSIM
- SPECTRUM

Tng Audience (Div/Bde)

AC	RC
1 Per	Corps Arty
1 MP	42 ID
62 MD GP	41 IN
201 MI	66 CAB
555 EN GP	81 IN
593 CSG	311 COSCOM
SOCOM Units	177 MP
1 SFG	35 EN
2/75 In(Rgr)	82 ROC
	364 CA
ARPAC Units	464 CM
3/2 ID	142 SIG
1/25 ID	111 AD
(26 Bn)	(60 Bn)

III Corps
Fort Hood

Simulations

- CBS
- BBS
- Fire Control Series
- JANUS
- TACSIM

Tng Audience (Div/Bde)*

AC	RC
1 CAV DIV	35 ID
4 ID	
6 AR	49 AR DIV
13 COSCOM	33 IN
31 ADA	53 IN
89 MP	66 IN
504 MI	155 AR
513 MI	256 IN
CATB	263 ADA
Corps Arty	420 EN
	460 CM
	AR/MT/IA NG
(172 Bn)	(134 Bn)

* Separately located Bde listed under Bde BSC (Carson/Riley).

XVIII Abn Corps
Fort Bragg

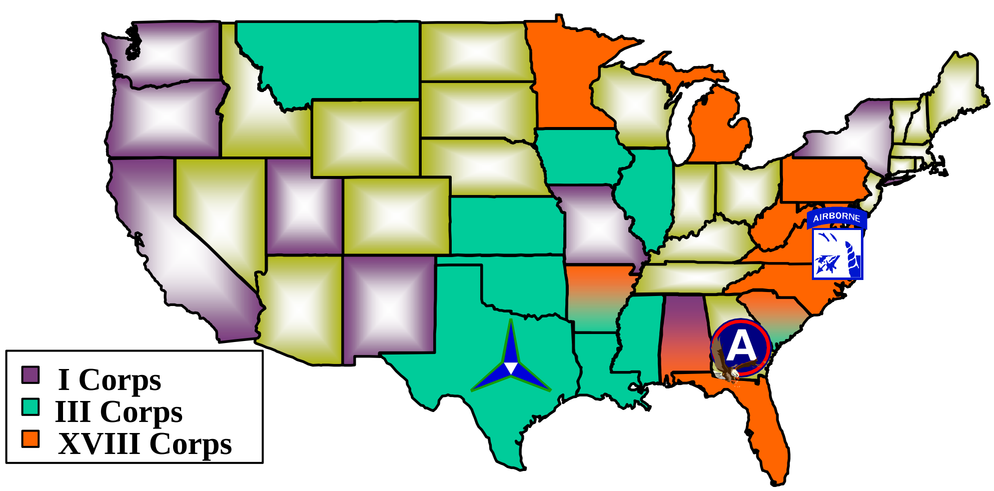
Simulations

- CBS
- BBS
- ARCHER AARS
- TACSIM
- BICM
- JANUS

Tng Audience (Div/Bde) *

AC	RC
82 ABN Div	30 CS GP
1 COSCOM	30 SIB (HVY)
16 MP	415 CM
18 AV	AL/AR/FL/MD/
18 FA	MI/MN/MO/NC
18 PER GP	/PA/SC/VA/WV
18 FI GP	ARNG
20 EN	
35 SC	
44 MED	AC (cont'd)
525 MI GP	189 IN
902 MI GP	229 AV RGMT
(79 Bn)	(67 Bn)

* Separately located Div listed under Div BSC (10/24/101/ Polk).



B. I Corps BSC

1. **Training Mission:** Support the CG I (US) Corps' training program for both AC/RC units in order to meet his worldwide contingency mission requirements using innovative and cost effective automated battle simulations. This simulation support provides several multi-level training tools and capabilities that complement both AC/RC commander's training programs. Maintain active liaison with TRADOC and other defense department agencies to remain in the forefront of simulations technology.

2. **Training Audience:**
   a. **AC** consists of the I Corps HQs, HQs 25th Infantry Division (ID), 1/25th ID, 3/2d ID, 593rd Corps Support Group (CSG), 201st MI Brigade, 555th Engineer (EN) Group, 1st Military Police (MP) Company, 1st Personnel Group, 62d Medical (MD) Group and Special Operations Command (SOCOM) units (1st Special Forces Group (SFG) and 2/75th Ranger Battalion). (26 battalions)
   b. **RC** consists of Corps Artillery, 42d ID, 41st IN Enhanced Brigade (E-Bde), 66th Combat Aviation Brigade (CAB), 81st IN E-Bde, and 311th COSCOM. (60 battalions)

3. **Manpower:** Currently there are four officer, two enlisted, and eight DAC personnel authorized at the BSC.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS, JANUS, JCATS, SPECTRUM, FSST, and TACSIM.

5. **Hardware Assigned:** CBS/BBS = 67 workstations and 29 controller stations. JANUS = 33 workstations and 1 controller station. SPECTRUM = 8 workstations and 2 controller stations. FSST = 1 suite. TACSIM = 1 suite.

C. III Armored Corps BSC

1. **Training Mission:** Provide simulation support to the AC/RC, and NG units that make up III Corps. Develop, as needed, stand-alone exercises to support Army-wide training. Function as the III Corps Mobilization and Deployment Center.

2. **Training Audience:**

   a. **AC** consists of 1st Cavalry (CAV) Division, 4th ID, 6th Armor (AR) Brigade, 13th COSCOM, 31st Air Defense Artillery (ADA) Brigade, 89th MP Brigade, 504th MI Brigade, 513th MI Brigade, CATB, and the Corps artillery. (172 battalions)
   b. **RC** consists of 35th ID, 49th AR Div, 33rd IN Brigade, 53rd IN Brigade, 66th IN Brigade, 155th AR Brigade, 256th IN Brigade, 263rd ADA, 420th EN

Brigade, 460th Chemical (CM) Brigade, and the Arkansas/Montana/Iowa ARNG. (134 battalions)

3. **Manpower:** Currently there are three officer, two enlisted, and three DAC personnel authorized at the BSC.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS, Fire Control Series, JANUS, and TACSIM.

5. **Hardware Assigned:** CBS/BBS = 51 workstations and 17 controller stations. JANUS = 32 workstations and 2 controller stations. TACSIM = 1 suite.

D. XVIII Airborne Corps BSC

1. **Training Mission:** Support tactical battle simulation training exercises for all AC/RC units assigned to or under the operational control of the XVIII Airborne Corps. Corps proponent agency for the development and fielding of C41 systems. In the event of general mobilization, configures facilities and battle simulation systems to serve as a mobilization/demobilization control center. Exercise program at XVIII Airborne Corps is command driven.

2. **Training Audience:**

   a. **AC** consists of 82d Abn Div, 16th MP Brigade, 18th AV Brigade, 18th Field Artillery (FA) Brigade, 18th Finance (FI) Group, 18th Personnel Group, 20th EN Brigade, 35th Signal Corps (SC) Brigade, 44th MD Brigade, 525th MI Brigade, and 902d MI Group. (79 battalions)
   b. **RC** consists of 30th CS Group, 30th Separate Infantry Brigade (SIB), 415th CM Brigade, and South Carolina/North Carolina/Maryland/Pennsylvania/Minnesota/Virginia ARNG. (67 battalions)

3. **Manpower:** Currently there are no officers, no enlisted, and three DAC personnel authorized at the BSC.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS, JANUS, TACSIM, Battlefield Intelligence Collection Model (BICM), and an AAR System dubbed “ARCHER”.

5. **Hardware Assigned:** CBS = 67 workstations and 36 controller stations. JANUS = 16 workstations and 1 controller station. TACSIM = 1 suite. AARs = 5 workstations.

6. Locations and General Capabilities of Division BSCs

3 ID (M)
Fort Stewart

Simulations

- BBS
- JANUS
- CBS (Remote)

Tng Audience (Div/Bde)

AC	RC	
3 ID (M)	30 IN	164 ADA
	48 IN	218 IN
	53 IN	263 ADA
(36 Bn)	(29 Bn)	

7 ID
Fort Carson

Simulations

- BBS
- JANUS
- CBS (Remote)

Tng Audience (Div/Bde)

AC		RC
7 ID	3/4 ID	38 ID
10 SFG	3 ACR	116 AR
43 Spt Gp		169 FA 278 ACR (-)
(18 Bn)		(46 Bn)

10 MTN DIV
Fort Drum

Simulations

- AWSIM
- CBS (Remote)
- BBS
- JANUS

Tng Audience (Div/Bde)

AC	RC	
10 ID	42 ID	101 FA
157 AF Gp	27 IN	192 FA
	86 IN	209 FA
(16 Bn)	(30 Bn)	

24 ID
Fort Riley

Simulations

- BBS
- CBS (Remote)
- JANUS

Tng Audience (Div/Bde)

AC	RC
24 ID	35 ID
1/1 ID	30 ESB
3/1 AD	48 IN
937 EN	218 IN
(16 Bn)	(31 Bn)

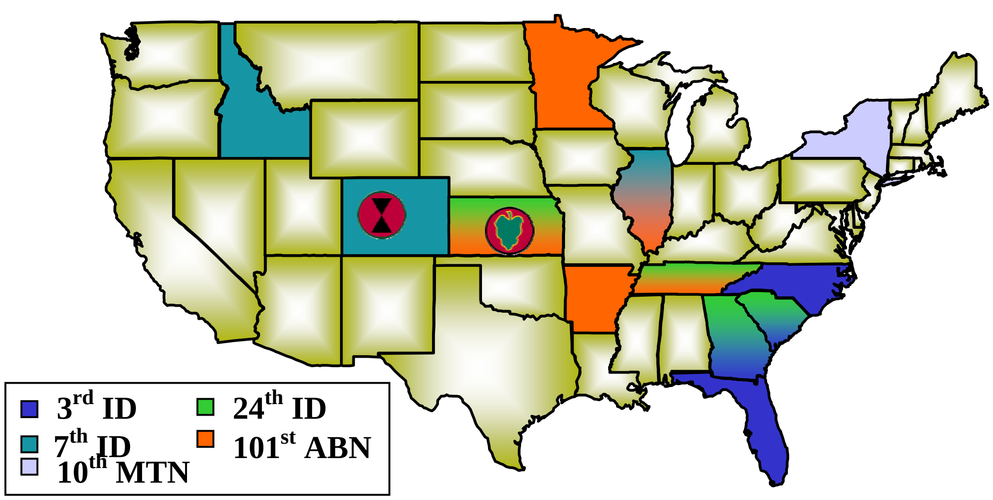
101 ABN DIV
Fort Campbell

Simulations

- BBS
- JANUS
- CBS (Remote)

Tng Audience (Div/Bde)

AC	RC	
101 ABN DIV	34 ID	149 AR
	35 ID	39 SIB
	38 ID	196 FA
		278 ACR
(25 Bn)	(47 Bn)	



E. 3rd Infantry Division (Mechanized) & Fort Stewart's Simulations Division

1. **Training Mission:** Provide unit training assistance in the planning, coordination, scheduling, and execution of simulation (constructive) and simulator (virtual) training events. Proponent for future Live & Constructive development plan. Simulation Goals - Integrate simulations/simulators horizontally and vertically, establish a networked battle command training complex, ensure systems meet training needs, match simulations/ simulators to training goals, and keep abreast of simulation evolution/revolution.

2. **Training Audience:**

   a. **AC** consists of 3rd ID (M). (36 battalions)
   b. **RC** consists of 30th IN Brigade, 48th IN Brigade, 53rd IN Brigade, 164th ADA Brigade, 218th IN Brigade, and 263rd ADA Brigade. (29 battalions)

3. **Manpower:** Currently there are: three officers, three enlisted, ten DAC within Simulations Division; 25 contractor personnel at the BSC; and 26 contractors at the CCTT & Virtual facilities authorized within the Simulations Division.

4. **Simulations Capabilities:** Simulations provided include CBS, BBS, JANUS, DBST and JCATS systems.

5. **Simulator Facilities:** Simulator facilities include Unit Conduct of Fire Trainer (UCOFT), Improved Moving Target Simulator (IMTS), GUARDFIST II Indirect Fire Trainer, and Engagement Skills Trainer (EST).

6. **Hardware Assigned:** **CBS/BBS** = 27 workstations and 10 MicroVAX with upgrade to 54 PC workstations & 10 servers in Aug 03. **JANUS** = 16 workstations and 1 controller/AAR station. **DBST** Suite available to stimulate AFATDS, ASAS, MCS-L, CSSCS, and AMDWS. **JCATS** = 16 PC workstations. **UCOFT** = 5 M1 COFT's and 5 M2 COFT's. IMTS = 40 foot dome, Avenger Table tops, and classroom. **GUARDFIST II** = One 30 seat Indirect Fire trainer, three 1 to 1 indirect fire trainers, and a map reading & orienteering course. **EST** = 1 facility with ten firing positions. **CCTT** = 14 M1, 14 M2, 1 HUMMV, 2 dismount stations, full TOC & TAC, 10 SAF workstations, and 5 AAR stations.

F. 7th Infantry Division BSC

1. **Training Mission:** Plans, coordinates, trains, administers, and conducts exercises and operations in the support of computer driven exercises and acts as the proponent for new equipment related to the support of simulations training such as CBS, BBS, JANUS, SPECTRUM, and DBST. Additional capability provides manual simulation and terrain board exercises.

2. **Training Audience:**
   a. **AC** consists of 7th ID and its 3 NG eBrigades IN (Light), 3/4th ID, 3rd CAV, 10th SFG, and 43rd CS Group. (31 battalions)
   b. **RC** consists of 38th ID, 116th AR Brigade, 169th FA Brigade, and 278th CAV. (46 battalions)

3. **Manpower:** Currently there are no officers, no enlisted, and one DAC authorized at the BSC.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS (remote), JANUS, DBST and SPECTRUM.

5. **Hardware Assigned:** CBS/BBS = 27 workstations and 9 controller stations. JANUS = 26 workstations and 1 controller station. DBST =16 workstations plus UAV, Fire Sim. SPECTRUM = 18 workstations.

G. 10th Mountain Division BSC

1. **Training Mission:** Provide simulations training to both AC and RC units from battalion through division commanders and staffs down to the squad leader level in AR 5-9 area. In addition, provide simulations training to any unit training on Fort Drum.

2. **Training Audience:**

   a. **AC** consists of 10th ID. (16 battalions)
   b. **RC** consists of 42d ID, 27th IN Brigade, 86th IN Brigade, 101st FA Brigade, 192d FA Brigade, and 209th FA Brigade. (30 battalions)

3. **Manpower:** Two DACs authorized at the BSC.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS (remote), JANUS, JCATS and DBST.

5. **Hardware Assigned:** CBS/BBS = 37 workstations JANUS = 16 workstations and 1 controller station JCATS = 14 workstations and 1 DBST Suite (consisting of FIRESIM, EADSIM, UAV, EPIU/TIU and VISION21).

H. 24th Infantry Division BSC

1. **Training Mission:** Provide simulation support to platoon through brigade commanders, staffs, and soldiers in AC and RC units assigned to and supported by Fort Riley.

2. **Training Audience:**

    a. **AC** consists of HQ 24th ID (Mech), 1/1st ID, 3/1st AR Div, and 937th EN Group. (16 battalions)
    b. **RC** consists of 35th ID and 30th Heavy Separate Brigade (M), 48th Heavy Separate Brigade (M), and 218th Separate IN Brigade. (19 battalions)

3. **Manpower:** Currently there are two DAC authorized at the BSC.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS (remote), JANUS.

5. **Hardware Assigned:** 35 Common Hardware Platform systems.

I. 101st Airborne Division (Air Assault) BSC

1. **Training Mission:** Provide the division's platoon through division level commanders with a cost effective means of exercising their headquarters staff in the command and control of combined arms operations. Units are trained using Corps Battle Simulation, Brigade/Battalion Simulation , JCATS and the DBST Simulation.

2. **Training Audience:**
    a. **AC** consists of 101st Airborne Division. (25 battalions)
    b. **RC** consists of 76th SIB, 34th ID, 35th ID, 38th ID, 278th CAV Regiment, 196th FA, 184th Infantry BDE, 201st ENGR BN and 149th AR Brigade.

3. **Manpower:** Currently there are no officers, three enlisted, and one DAC authorized at the BSC.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS (remote), JCATS and DBST.

5. **Hardware Assigned:** CBS/BBS = 27 workstations . JCATS =14 workstations and 2 Servers, DBST consists of EADSIM , FIRESIM , META VR UAV and the VISION XXI AAR SUITE.

6. Location and General Capabilities of Brigade BSC

J. Fort Polk BSC

1. **Training Mission:** To provide Fort Polk AC/RC units in Louisiana with simulation supported battle command and staff training using the BBS and CBS simulations.

2. **Training Audience:**
   a. **AC** consists of 2d CAV. (5 squadrons and 51st Chemical Co)
   b. **RC** consists of 39th IN Brigade and 256th AR Brigade. (12 battalions)
   c. **RC** consists of 256th AR LANG Brigade. (5 battalions)

3. **Manpower:** Currently there are no officers, no enlisted, and no DAC authorized at the BSC. One contractor currently assigned as Computer Operations Supervisor.

4. **Simulations Capabilities:** Simulations provided include BBS and CBS (remote).

5. **Hardware Assigned:** CBS/BBS = 10 workstations and 5 controller stations.
   10 workstations and 1 After Action Review workstations

6. Locations and General Capabilities of TSD BSCs

TRAINING SUPPORT DIVISION

BATTLE PROJECTION CENTERS

75 TSD
Houston, TX

Simulations
- BBS
- CBS (limited)
- CSSTSS (limited)
- JANUS
- SPECTRUM

Tng Audience
31 Bde thru theater
115 Bn

78 TSD
Fort Dix, NJ

Simulations
- BBS
- CBS (limited)
- CSSTSS (limited)
- JANUS
- SPECTRUM

Tng Audience
65 Bde thru theater
214 Bn

85 TSD
Arlington Heights, IL

Simulations
- BBS
- CBS (limited)
- CSSTSS (limited)
- JANUS
- SPECTRUM

Tng Audience
71 Bde thru theater
88 Bn

87 TSD
Birmingham, AL

Simulations
- BBS
- CBS (limited)
- CSSTSS (limited)
- JANUS
- SPECTRUM

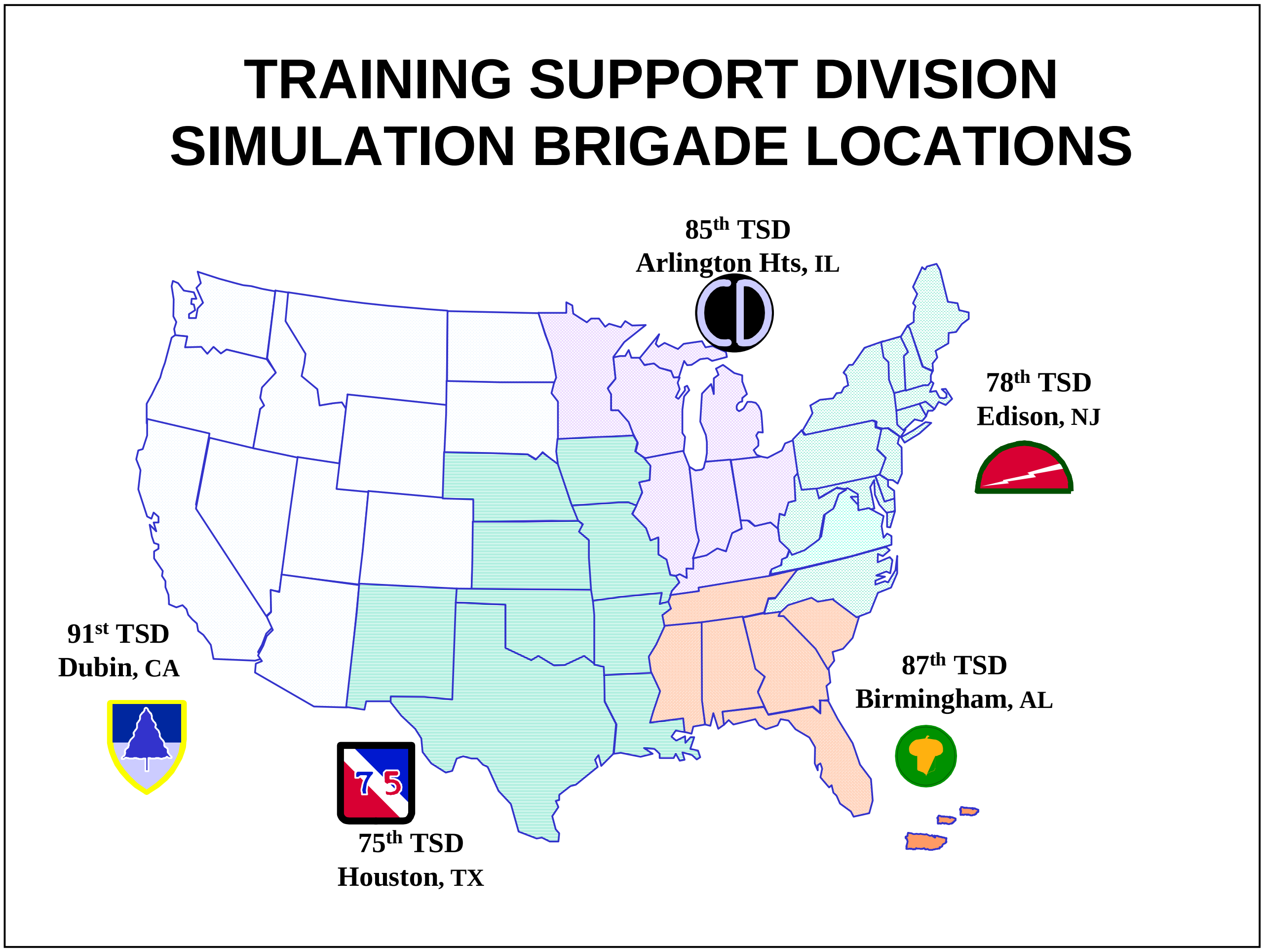
Tng Audience
83 Bde thru theater
211 Bn

91 TSD
Dublin, CA

Simulations
- BBS
- CBS (limited)
- CSSTSS (limited)
- JANUS
- SPECTRUM

Tng Audience
26 Bde thru theater
106 Bn

7. TSD Area of Responsibilities



K. 75th TSD

1. **Training Mission:** Plan, coordinate, and conduct external exercises using computer simulation to provide Battle Staff and Leadership training for RC units, both NG and USAR.

2. **Training Audience:**
   a. **AC** none.
   b. **RC** consists of 27 Brigade/Group headquarters that include 136 Battalions or equivalents.

3. **Manpower:** The TSD is a multi component organization that is composed of AC, USAR, and ARNG personnel. The TSD serves as the higher HQs for the BCST and three Training Support Brigades (TSBs). The BCST Brigade includes a headquarters, Battle Projection Group (BPG), and 1st Simulation Exercise Group (SEG) in Houston, Texas, and 2d SEG in Fort Sill, Oklahoma.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS, and JANUS.

5. **Hardware Assigned:** BBS/CBS = 39 VAX workstations and 45 CHP workstations and two GEEPs. Janus = 24 CHP workstations and two hosts.

L. 78th TSD BPC

1. **Training Mission:** Plan, conduct, and execute computer assisted Brigade/Battalion Battle Staff training exercises for NG and USAR units. On order, assist 1st US Army mobilization and deployment training with Command and Staff Training, utilizing MDMP, TOC operations, CPX's, and MRE's.

2. **Training Audience:**
   a. **AC** none.
   b. **RC (USAR & NG)** consists of 67 brigade through theatre command level units that includes 219 battalions.

3. **Manpower:** The 1st Brigade (BCST) includes a HQs located in Edison, NJ, a BPG located at Fort Dix, NJ, the 1st SEG located at Edison, NJ, and the 2d SEG located at Bristol, RI. Total authorized strength of the brigade is 542 personnel.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS, SPECTRUM, CSSTSS (dial in to Fort Lee, VA), JCATS, and Janus.

5. **Hardware Assigned:** BBS/CBS = 33 workstations and 19 controller stations. Janus = 16 workstations and 2 controller stations. SPECTRUM = 13 workstations and 2

controller stations. (CSSTSS uses components of BBS/CBS equipment). Received the common hardware platform (CHP) on 3 Apr 2003 consisting of 86 PC's and 3 servers.

M. 85th TSD BPC

1. **Training Mission:** Provide technical support to each Simulation Exercise Groups and client units on conducting BCST simulation exercise to RC/ARNG battalion and brigade headquarters. Provide support to the simulation exercise design and AAR planning via the contract team. Participate as technical experts and provide simulation support for the conduct of simulation exercises by each TSBs. Synchronize training support within the TSD AOR enhancing individual and unit readiness to meet directed mobilization and/or wartime requirements. Protect the force.

2. **Training Audience:**
   a. **AC** none.
   b. **RC** consists of 71 brigade through theater command level units that includes 88 battalions.

3. **Manpower:** The 85th TSD is a Multi-Component organization that is composed AC/RC and ARNG and contractor personnel. The TSD serves as the higher headquarters for the BCST (simulations) and the three TSBs. The 1st Brigade (BCST) (simulations) includes a HQs located at Fort Sheridan Reserve Center in Highland Park, IL along with two Simulation Exercise Group and the Battle Projection Center is located at Arlington Heights, Illinois.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS (limited), Janus (on request), SPECTRUM, and CSSTSS.

5. **Hardware Assigned:** BBS = 80 workstations and 3 controller stations. Janus = 16 and 2 controller stations.

N. 87th TSD BPC

1. **Training Mission:** Plan, conduct, and evaluate computer-assisted simulations for units in the 1st U.S. Army area of operations. Assist in 1st U.S. Army mobilization and deployment training.

2. **Training Audience:**
   a. **AC** none.
   b. **RC** consists of 83 brigade through theater command level units that include 211 battalions.

3. **Manpower:** The 87th Division (Training Support) is a multi component organization that is composed of AC/RC personnel. The Division serves as the higher HQs for the 1st Brigade (BCST), (Battle Command and Staff Training), and four Training Support Brigades, (TSB). The 1st Brigade (BCST) includes a HQs, the BPG, as well as the two Simulation Exercise Groups (SEG). All are collocated at the Hanson Reserve Center located in Birmingham, AL.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS, JANUS (on request), Spectrum, and CSSTSS.

5. **Hardware Assigned:** BBS/CBS/Spectrum = 80 common hardware platform workstations. Janus = 2 x 8 workstation suites. Capability to project CSSTSS.

O. 91st TSD BPC

1. **Training Mission:** Plans and conducts simulation exercises for RC units at company level and above in Fifth Army Western Region. On order, assist CONUSA Mobilization Assistance Team, provide personnel augmentation and simulation support, as directed.

2. **Training Audience:**

   a. **AC** none.
   b. **RC** consists of 26 brigade through theater command level units that includes 106 battalions.

3. **Manpower:** The 1st Brigade (BCST), 91st Division (TS) is a multi component unit composed of soldiers from the AC/RC, DA civilians, and contractors operating from the 91st Division BPC. The BPC is the nerve center for all simulation exercises.

Housing a variety of simulations and manned with a force of specialized and extensively trained soldiers and civilians, its mission is to produce and project the simulation. The mission is unique in that the brigade takes the entire exercise to the unit's home location; transmitting all the command and control data over telephone lines.

4. **Simulations Capabilities:** Simulations provided include BBS, CBS (limited), SPECTRUM, CSSTSS, and Janus.

5. **Hardware Assigned:** BBS = 30 workstations and 15 controller stations. Janus = 16 workstations and 2 controller stations.

Korea Battle Simulation Center (KBSC)

Overview: This annex describes simulation capabilities of the Korea Battle Simulation Center in support of U.S. and allied forces in Northeast Asia.

1. **Constructive Training Simulation Support:**

   Organization: KBSC operates three simulation facilities in Korea and provides simulation support to ROK/U.S. Combined Forces Command (CFC) and US Forces Korea, Eighth U.S. Army, the armed forces of the Republic of Korea, U.S. Army Japan (USARJ), and the Japan Self Defense Forces. Services provided by the KBSC are as follows:

   a. Exercise design and control.
   b. Professional opposing forces.
   c. Theater through small unit simulation support.
   d. After action reviews.

In its capacity as the Northeast Asia Regional Simulation Center (NEARS), KBSC also provides a full range of simulation support to other friends and allies in the region.

2. **KBSC Facilities:** KBSC is located at three camps in Korea (See figure below). The Walker Center, responsible for division and higher level exercises, is located on Yongsan Army Garrison in Seoul, Korea. The Warrior Training Center (WTC), in direct support of the U.S. 2nd Infantry Division, is located on Camp Casey. The Counterfire Simulation Center (CSC), whose primary mission is support of the U.S. 2nd Infantry Division Artillery, is located on Camp Stanley.

Figure 1 - KBSC Sites

3. **KBSC Partners.** The Korea Air Simulation Center, located on Osan Airbase, Korea, provides air modeling support during CFC theater level exercises and U.S. Army Japan/Japan Ground Self Defense Force exercise Yama Sakura. The III MEF Tactical Exercise Control Group, located on Camp Courtney, Okinawa, Japan, participates in CFC theater level exercises and cooperates with KBSC in conducting two ROK Marine Corps exercises annually. ROK Army Battle Command Training Program, located in Yusong, Korea, provides primary simulation support to ROK Army corps and division exercises and also participates in CFC theater level exercises. (See Figure below)

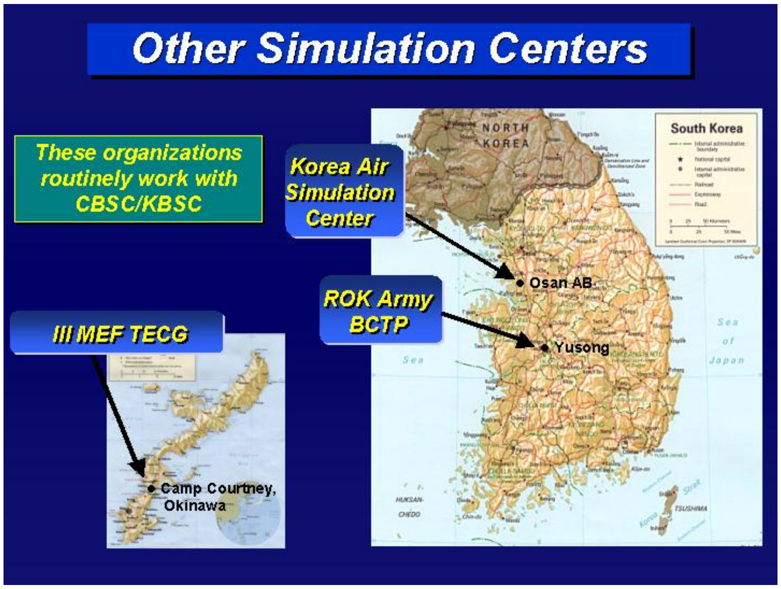


Figure 2 - KBSC Partner Sites

4. **Virtual Training Simulation Support:** The KBSC has a robust virtual downlink capability to portray a full range of UAV and JSTARS support for U.S. and ROK forces. The Warrior Training Center hosts the Close Combat Tactical Trainer (CCTT) consisting of 14 M2 Bradley Fighting Vehicle modules, 14 M1 Abrams Tank modules, and one HMMWV module.

   a. **Priorities:**

      1. CFC theater level exercises (Ulchi Focus Lens and RSOI/Foal Eagle).
      2. Eighth U.S. Army including 2d Infantry Division and non-divisional combat, combat support and combat service support exercises.
      3. ROK armed forces.
      4. U.S. Army Japan/ Japan Ground Self Defense Forces.
      5. Northeast Asia Regional Simulation Center.
      6. Other exercises as capabilities permit.

b. Capabilities:

1. Models. KBSC hosts a wide range of models typically used in either the Joint Training Confederation (JTC) (See Figure3), or the Digital Battlestaff Sustainment Trainer (See Figure 4). We also tailor these confederations to meet training unit needs.

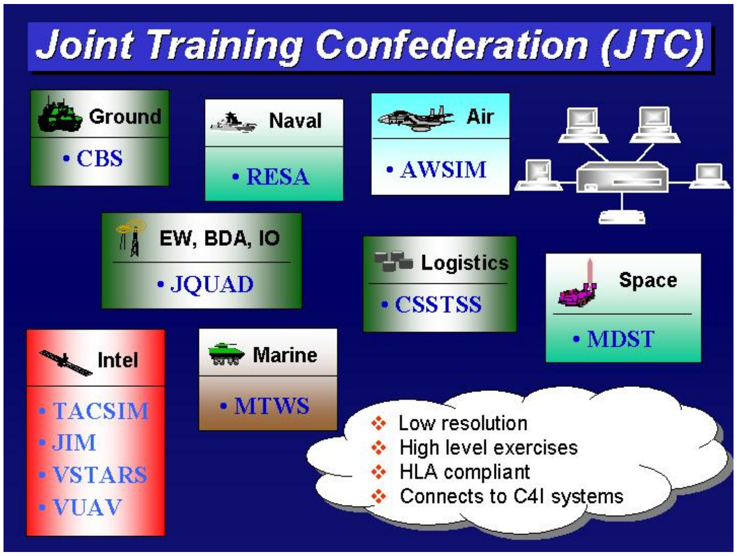


Figure 3 - JTC

The Joint Training Confederation (JTC) consists of a series of models that portray all forms of warfare. All of these models are interfaced via the Aggregate Level Simulation Protocol (ALSP). The JTC is the KBSC's primary driver for high level, joint and combined exercises.

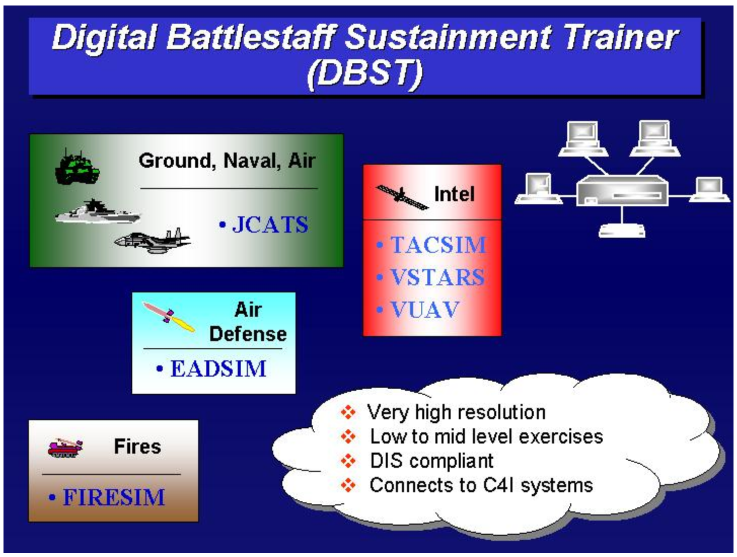


Figure 4 - DBST

The Digital Battlestaff Sustainment Trainer (DBST) consists of a series of object level models capable of linking to various C4I systems. DBST is primarily used to drive brigade and lower level exercises.

5. **Distributed Exercises**. KBSC routinely distributes to multiple sites and operates from bare-based facilities. Figure 5 shows the eleven simulation centers that were linked together during Ulchi Focus Lens 02.

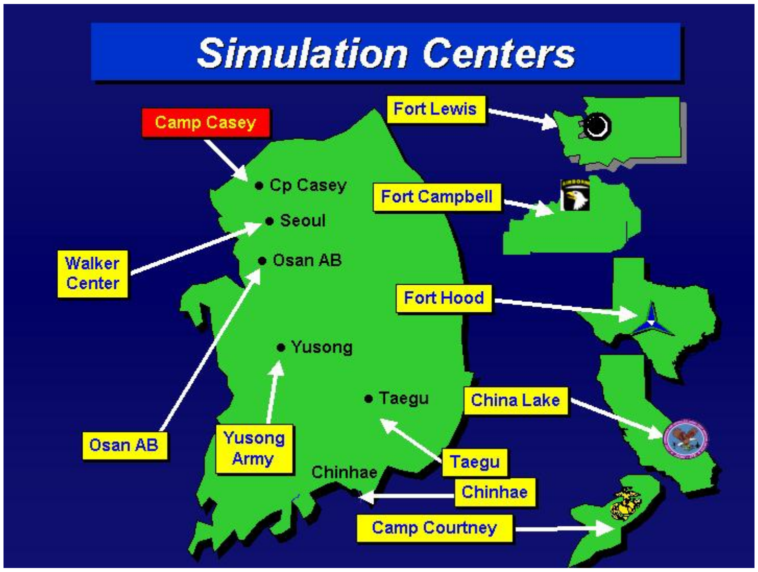


Figure 5 - Ulchi Focus Lens 02 Distributed Sites

6. **Simulation to C4I Connectivity**. A very important feature of modern military exercises is the portrayal of realistic data in Command, Control, Communications, Computers, and Intelligence (C4I) systems. This is achieved through digital linkages of the simulations to the C4I systems located in player command posts. KBSC has extensive experience in stimulating these systems and routinely provides data to the C4I systems of all the services. Figure 6 shows the simulation to C4I architecture for a typical Ulchi Focus Lens exercise.

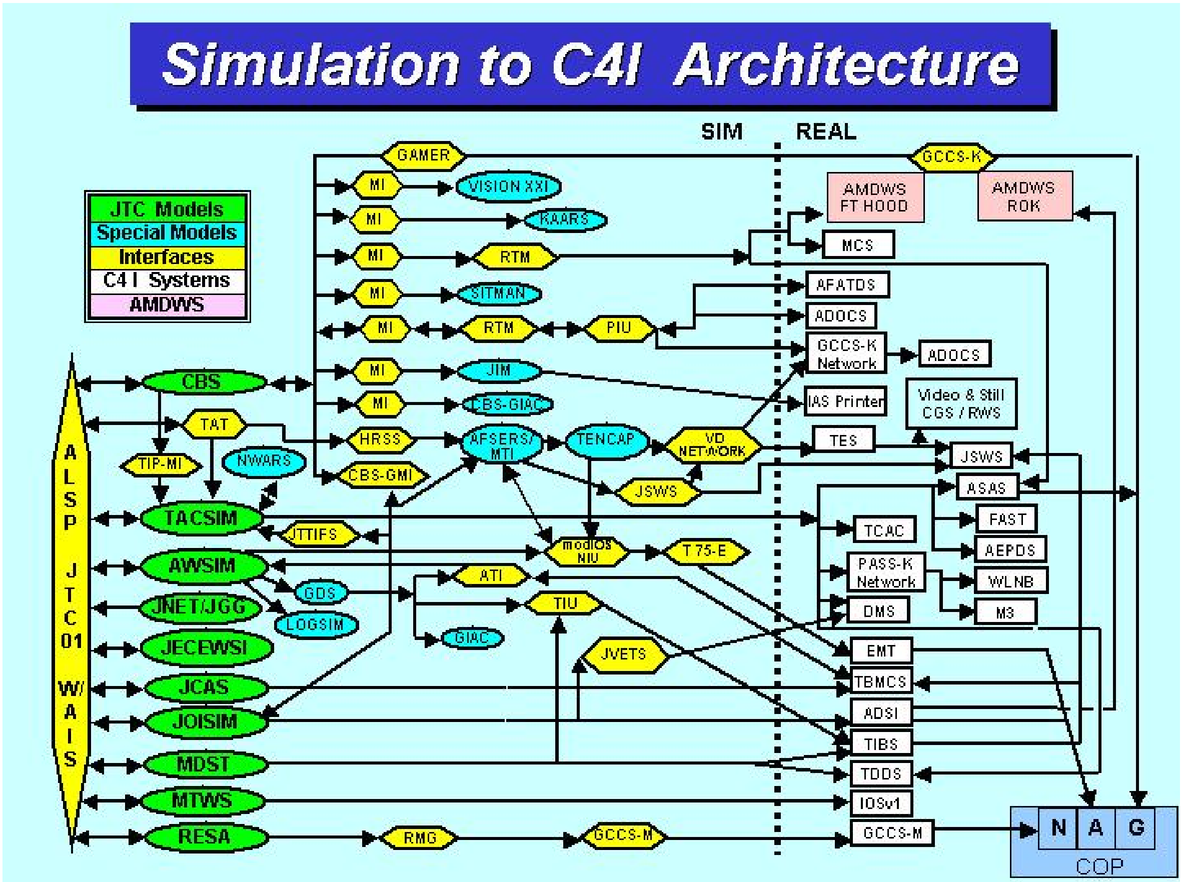


Figure 6 - Sim to C4I

7. **Exercise Command and Control**. The KBSC has developed an exercise command and control system that is optimized for distributed exercises. This system is known as the Combined Exercise Information System (CEIS) and operates on the same networks as the simulations. CEIS consists of video teleconferencing (VTC), a secure telephone system, web browser, FTP client, an e-mail client, and a scenario events management system. Figure 7 shows the components of this system.

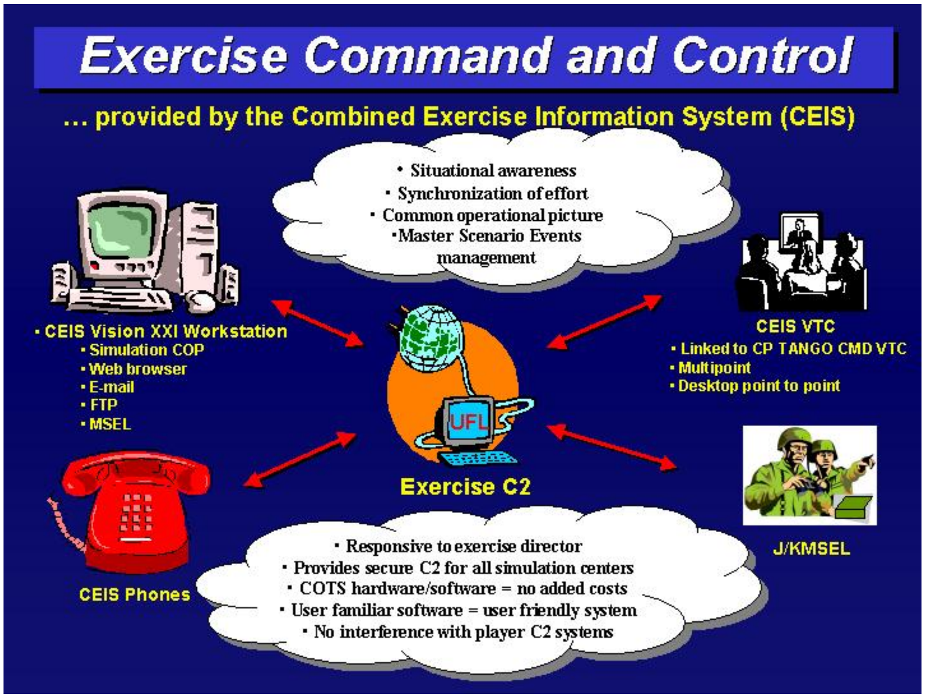


Figure 7 - CEIS

8. **Simulation Initiatives:** In addition to planning and executing many exercises in a year, KBSC works closely with the ROK armed forces to develop their new family of simulations and make them interoperable with current and future U.S. simulations. Figure 8 shows the proposed ROK-U.S. model integration.

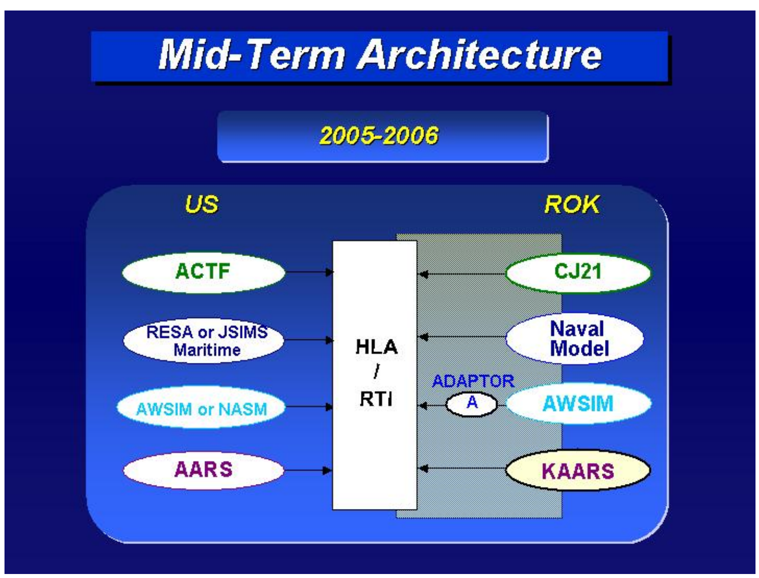


Figure 8 - ROK-U.S. model integration

9. Simulation Needs in the Near and Mid Term:

a. Field High Level Architecture (HLA) compliant version of the Joint Training Confederation.

b. Field interfaces that permit the seamless integration of the live, virtual, and constructive training environments.

c. Continue support of ROK military efforts to develop simulations and ensure they are interoperable with U.S. simulations.

d. Assist the ROK services in developing tactics, techniques, and procedures for the planning and execution of operational and theater strategic level exercises.

e. Field the Army Constructive Training Federation (ACTF) with appropriate linkage to Army Battle Command Systems (ABCS).

f. Further develop the Northeast Asia Regional Simulation Center to provide simulation support to U.S. forces and our allies throughout NE Asia.

g. Construct a digital training facility at the Warrior Training Center.

USAREUR and USAFE Battle Command Training Centers

1. **Training Mission:** The Battle Command Training Centers, Warrior Preparation Center (WPC) and the USAREUR Battle Command Training Center, are the premier training centers for U.S. forces in Europe.

   WPC, co-sponsored by USAREUR and USAFE, provides constructive training environment support for the operational level of war. The Warrior Preparation Center facilitates the training of component, joint, and combined force commanders and their battle staffs at the operational level of war by providing realistic exercises, mission rehearsals, and operational analysis support. It interfaces with the Joint Warfighting Center to support USEUCOM Joint training. Additionally, it provides support for NATO exercises.

   The USAREUR BCTC supports all live-virtual-constructive training in Europe. Directorate of Simulations (DOS), 7th ATC is the USAREUR proponent for constructive simulation training and provides USAREUR with a relevant, robust, and responsive simulations program. The program considers the issues and challenges that result from the strategic and technological environments in which USAREUR must operate. It is capable of enhancing USAREUR's ability to act with agility, speed and power. The USAREUR BCTC is responsible for six subordinate BCTCs at various locations in Europe.

2. **DOS Vision**: Premier simulation training organization that is relevant and responsive today and into the future. The goal is to fully integrate constructive, virtual, and live training into a seamless synthetic environment that is capable of training USAREUR Commanders and Staffs in the full spectrum of military operations, SASO to High Intensity Conflict now and in the future.

3. **DOS METL**:
   a. Plan, design, execute and/or facilitate Component, Joint and Combined Leader Training from platoon to EAC, across operational spectrum.Provide single point management for constructive simulation resources and contracting vehicles.
   c. Create, sustain and enhance USAREUR's suite of models and simulations tools and capabilities. Interface with M&S and other TMA organizations within DoD to influence policy, resources and new technology.
   d. Create and Implement Constructive Simulation Training Strategy, Policy and Procedures. Interface with M&S and other TMA organizations within DoD to influence policy, resources and new technology.

4. **Exercise Strategy.** The USAREUR/USAFE constructive training strategy is descriptive, not prescriptive: This means that 7th ATC and WPC provide commanders with a suite of simulation tools to chose from and commanders utilize these tools based on their requirements, UR 350-1 guidance and USAREUR/USAFE training guidance. In general, 7th ATC resources 2 homestation computer aided exercises (CAXs), which culminate with Brigade and Battalion level Leader Training Program events at CMTC. Additionally, 7th ATC resources two homestation CAXs for Corps/Division separates with the culminating event being their participation in a Warfighter (WFX). Corps/Division headquarters are resourced for one full ramp-up exercise prior to their WFX and two smaller DOCCEX exercises.

5. **Training Audience:** Headquarters trained by the two centers include; USEUCOM, USAREUR, V Corps, 21st Theater Support Command, 3d Corps Support Command, 1st Armored Division, 1st Infantry Division, SETAF, 173d Infantry Brigade, USAFE, 3d Air Force, 16th Air Force, and 32d Air Operations Group, NATO and Partnership for Peace headquarters.

6. **Manpower:** DOS Organization: Senior Army O-6 assigned to the Warrior Preparation Center (WPC) serves as the DOS and rotates as the commander and vice-commander of WPC with the Air Force counterpart. The DOS is organized to leverage the planning, technical and analytical capabilities of WPC. Each maneuver brigade, SETAF and 21st TSC, has Battle Command Training Centers capable of supporting up to Brigade level CAXs with augmentation.

   Current authorizations for WPC are; U.S. Army 67 military and 28 civilian; US Air Force 68 military and 29 civilian; 65 contractors round out the WPC workforce. USAREUR BCTC has a staff of 8 military, 9 civilian, and 160 contractors that support nine different simulation locations.

   Battle Simulation Contract: DOS manages and oversees the USAREUR Battle Simulation contract which supports requirements at USAREUR's eight (8) Battle Simulation Centers (BSCs) in Germany and Italy, technical support to USAREUR exercises at the Warrior Preparation Center (WPC), and Subject Matter Experts/Exercise planning support to USAREUR DCSOPS. Additionally, on an as needed basis, this contract supports Joint/NATO exercises, Partnership for Peace (PfP), Mission Rehearsals, and sustainment training for deployed units at remote locations in the European Command (EUCOM) Area of Operations. Specialized technical support includes generation of digital terrain in support of USAREUR's suite of models and simulations and the development and analysis of topographic and imagery products in support of training and real world missions.

   7. **Simulations Capabilities:** Simulations on hand include the Army's Family of Simulation Models (FAMSIM Extended Air Defense Simulation [EADSIM], Air Warfare Simulation [AWSIM], JQUAD, Marine Tactical Warfare Simulation [MTWS], Joint Theater Logistics Simulation [JTLS], Joint Warfare Simulation [JWARS], SPECTRUM and Vision XXI After Action Review [AAR]). For analysis WPC has on hand: JMP, ARENA, Palisades Decision Tools Suite, LINDO, LINGO,

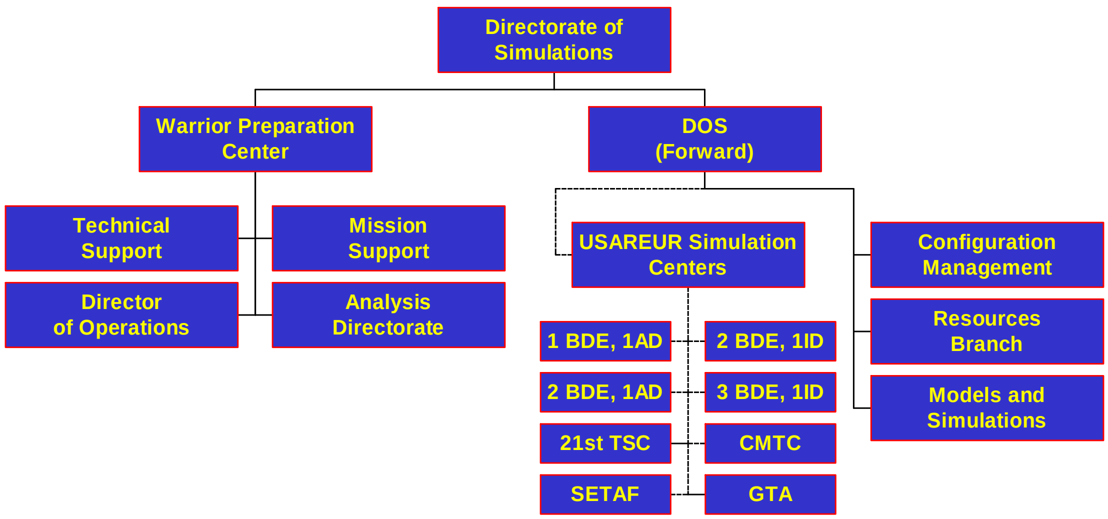
What's Best, JFAST, ELIST. Additionally, USAREUR has some unique capabilities that are generally not found in any other MACOM:

a. **Joint Conflict and Tactical Simulation (JCATS):** USAREUR is the only MACOM that makes wide spread use of JCATS, which provides USAREUR the unique ability to execute Joint and Combined CAXs as well as a robust MOUT capability not found in Janus.
b. **Joint Deployment Logistics Model(JDLM):** JDLM is a USAREUR-developed system that provides state of the art deployment and logistics modeling and is the most advanced logistics training tool available to the Army. JDLM is currently being integrated with the Digital Battlestaff Sustainment Trainer (DBST) and has been selected as the Stryker Brigade's logistics model of choice.
c. **Deployable JCATS/JDLM Suite:** Since JCATS and JDLM are PC based systems, they are readily deployable via laptop computers. USAREUR has a suite of laptop computers that can be deployed in airline-checkable shipping cases.
d. **3D Visualization:** USAREUR has the capability to create digital terrain for a number of 3D-visualization models and link them to JCATS to enhance training and situational awareness.
e. **Terrain Generation**: The USAREUR TerraSIM shop is the only activity in the Army that is dedicated to developing digital terrain and terrain products for M&S.
f. **Network Infrastructure:** DOS has the ability to distribute/link simulations anywhere in the world. They have permanent connectivity to Ft. Leavenworth and dial-up capability between all 9 USAREUR simulation centers.
g. **Facilities:** The USAREUR Battle Simulations Center (UBSC), CMTC Leader Training Center (LTC) and the Warrior Preparation Center are the three most advanced and capable simulation centers available to Army units. The UBCTC is by far the best large-scale exercise facility while the CMTC LTC is by far the best Brigade and below facility in the Army.

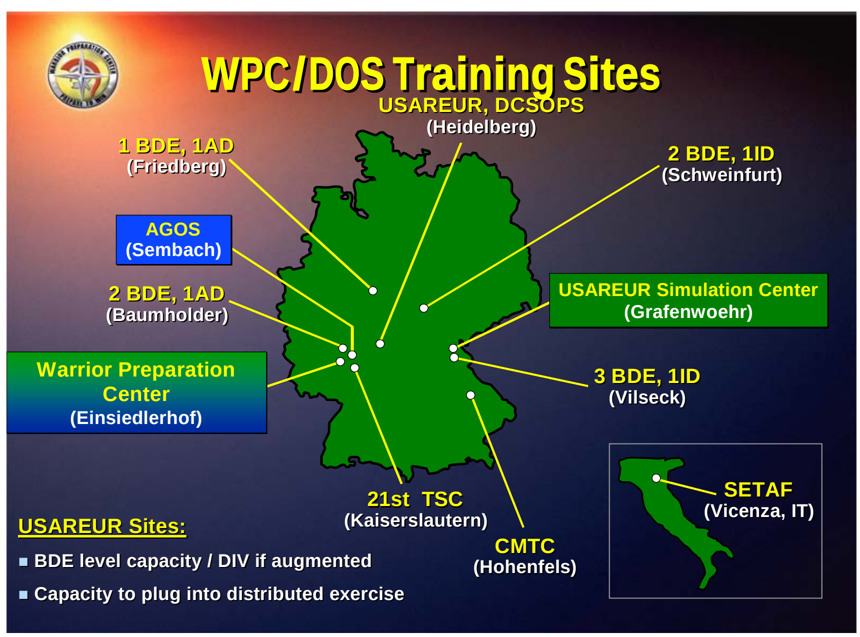
8. Future: USAREUR fielded the Digital Battle Staff Trainer (DBST) in FY01 and culminated its debut by deploying it to Drawsko-Pormorskie, Poland in support of the first ever synthetic wrap-around exercise in a deployed environment during Victory Strike II. This system provides the capability to stimulate and simulate all C4I systems fielded in USAREUR: ASAS, , AFATDS, IFSAS, FDS, ADOCS, AMDWS, GCCS-A/C2PC, CSSCS, CGS/JSWS, UAV, TAIS, BFT, TES and Q36/37 radar. DOS-F currently has the lead to integrate DBST and CMTC-IS to create a synthetic "wrap-around" effect by linking live and constructive domains during Brigade Rotation at CMTC. DOS also has the lead for fully integrating DBST with the Deployable Instrumentation Systems - Europe (DIS-E), CCTT and JDLM. The addition of DIS-E and JDLM to the DBST Toolkit, will provide the Army with a world-class deployable CTC-like capability. Finally, USAREUR is fully prepared to fully implement the Army Constructive Training Federation (ACTF) in FY04 and accept OneSAF in FY05/06. With the fielding of OneSAF in FY06, the USAREUR Battle Simulation program will be well positioned to support USAREUR's 2010 and beyond training strategy.

9. **Hardware Assigned:** WPC and USAREUR BCTC have a wide selection of hardware platforms to support their mission, ranging from Sun to SGI to PC. There are some residual VAX systems.

Organizational Structure



Locations



Appendix C: Army Battle Labs

A. Air Maneuver Battle Laboratory (AMBL), Ft. Rucker, AL

1. Vision

Provide direction, oversight, and horizontal integration for aviation operations. Improve capability of air maneuver forces to shape the battlespace. Enhance precision strike operations capabilities of the combined arms and joint force.

2. Mission

AMBL examines advanced warfighting concepts and technology through experimentation, technology demonstrations, and concept experimentation in order to determine viability and utility for the Warfighters in the 21st Century Battlespace.

3. Modeling and Simulation Capability

Air Maneuver Battle Lab M&S Capabilities

Type of Simulation/Simulator	**YES**	**NO**
Virtual	X	
Constructive	X	
Live	X	

4. Modeling and Simulation Focus

AMBL M&S Focus

M&S Domain	**YES**	**NO**
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

5. Key Programs

Manned-Unmanned Teaming of Aerial Vehicles – MUMIV will look closely at the man-machine interfaces necessary between a team of advanced warfighting platforms, such as the RAH-66 and a UAV. The objectives include determination of the techniques and software applications that will enable the team to achieve the best level of performance for the tactical reconnaissance and tactical surveillance missions.

Multi-Purpose Aerial Delivery System (M-PADS) CEP – M-PADS examines the force multiplication effect on brigade combat teams by providing an uninhabited aerial vehicle (UAV) capable of on-demand delivery of a variety of lethal and non-lethal payloads. This concept is intended to complement the Air Force's Unmanned Combat Aerial Vehicle (UCAV) system. The M-PADS is tailored to meet the more stringent rules of engagement for Peace Keeping (PK) and Small Scale Contingencies (SSC) as opposed to Major Theatre War (MTW), when UCAV would be employed.

Wing Store UAV - Explores enhancements in information dominance, survivability, and targeting by air and ground maneuver elements equipped with a unit level, recoverable UAV. This UAV will contain a limited sensor package, be inexpensive and provide direct feedback to the maneuver unit.

ACRT - The Advanced Concept Research Tool (ACRT), located at the AMBL is a "full-up" helicopter research cockpit, which is reconfigureable to different aircraft types and allows for "man-in-the-loop" aviation involvement in many different levels of experimentation. The ACRT program provides organic assets to the Battle Lab that can be used independently or as part of a simulation confederation to conduct experimentation.

A2C2S Command-on-The-Move - Develops and validates the suitability of linking a replica of the command module of the Army Airborne Command and Control System (A2C2S) UH-60 with a reconfigurable aircraft simulator and to integrate this unit into wargaming software for experimentation on a variety of command-on-the-move problems. Pertinent areas of investigation emanating from the recently completed TFXXI and DIV XXI AWEs include information overload, battle staff size and composition, mission employment, and procedures for command-on-the-move. One of the unique features of this experiment is the use of Non-Developmental Item (NDI) approaches fusing existing systems and software to resolve dependence on the production of full-scale simulators. That level of development does not often occur until after the fielding of the objective system. The capability described provides essential functionality to support early experimentation with a new system and enhances our ability to conduct controlled investigations of command-on-the-move problems.

6. **Next Higher Headquarters.** Training and Doctrine Command (TRADOC)

B. Battle Command Battle Laboratory (BCBL), Fort Huachuca

Vision

Fort Huachuca explores Intelligence, Electronic Warfare (IEW) and Command and Control Warfare (C2W).

Mission

Battle Command Battle Laboratory (Huachuca) provides vertical and horizontal integration for Intelligence, Surveillance, and Reconnaissance support to Information Operations, as it pertains to cross-Battlefield Operating System (BOS) and Service applications, to fully explore and exploit the products of the information revolution.

Modeling and Simulation Capability

BCBL (Huachuca) M&S Capabilities

Type of Simulation/Simulator	YES	NO
Virtual	X	
Constructive	X	
Live	X	

Modeling and Simulation Focus

BCBL (Huachuca) M&S Focus

M&S Domain	YES	NO
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

Key Programs.

a. Projected operating systems and environments. It will be deployed in both Unix and Windows based ABCS systems and will be able to query and display any open data base connectivity (ODBC) compliant data source and create an overlay of this data.

b. Maneuver the Network (MTN) – The MTN experiment will endeavor to develop a common integrated scriber (IS) overlay system that will visualize, for the Commander and Staff, a virtual representation of common operational picture (COP) dissemination effectiveness within the unit as well as the location of key IS shaping actions and details in relation to the overall scheme of maneuver.

c. Intelligence Analyst Advanced Toolset (IAATS) - Three key areas are the focus of the Battle Laboratory's efforts under this project: Predictive Course of Action (COA) tools; Improved Collection Management (ICM); and Soft Order of Battle Analysis (SOBA). In each of these areas the goal is to provide greatly enhanced speed, visualization of data, and ease of use for the intelligence Vizier - A Java based viewing application compatible with all current and analyst.

d. Data Sonification space-based infrared (SBIR) - Develop a Data Sonification (DS) application that increases the Situation Awareness (SA) of a commander, analyst, planner, or battle captain through intelligently audio-encoded information.

e. Stability and support operations (SASO) Wargamer SBIR - Investigate decision-aiding software and/or hardware architectures, and intelligent inferencing technologies, to support Information Operations (IO) / Information Warfare (IW).

6. **Next Higher Headquarters.** Training and Doctrine Command (TRADOC)

C. Battle Command Battle Laboratory (BCBL), Fort Leavenworth

1. Vision

Fort Leavenworth explores the art and science of battle command and information operations.

2. Mission

The BCBL (Fort Leavenworth) consists of four divisions and one laboratory. Their individual missions are:

a. Objective Force Division's mission is to support Objective Force Battle Command by integrating the acquisition of ideas, the development of future concepts and the application of evolving technology across Doctrine, Training, Leader Development, Organizations, and Soldier functions in order to improve the war fighting effectiveness of commanders and staffs ensuring tactical success in the future operational environment.

b. Interim Force Division's mission is to evaluate and assess initiatives that further the development of Battle Command for Interim Force Concepts, and document Battle Command lessons learned for incorporation into the Interim and Objective Forces.

c. Legacy Force Division's mission is to evaluate and assess initiatives that further the development of Battle Command in the Legacy and Digitized Forces, and to document Battle Command lessons learned for incorporation into the Interim and Objective Forces.

d. Assessment & Experimentation (A&E) Division's mission is to provide A&E support to the Futures Development and Integration Center (FDIC) and BCBL Divisions for the analysis of concepts and experiments, and the design and execution of experiments. Additionally, the A&E Division will have oversight of the BCBL Triad Joint Battle Command Test Bed, act as the FDIC/BCBL lead for Battle Command Science and Technology and have operational oversight of the FDIC/BCBL Futures Lab.

e. The Futures Lab's mission is to provide a test bed environment, in terms of structure, organization and facilities, for Battle Command and for Command, Control Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) experimentation in both the army and joint arenas.

3. Modeling and Simulation Capability

BCBL (Fort Leavenworth) M&S Capabilities

Type of Simulation/Simulator	YES	NO
Virtual	X	
Constructive	X	
Live	X	

4. Modeling and Simulation Focus

BCBL (Fort Leavenworth) M&S Focus

M&S Domain	YES	NO
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

5. Key Programs

a. **Agile Commander ATD.** A prototype decision support system, DaVinci, has been delivered to BCBL-L and is currently undergoing initial testing. DaVinci is the replacement system for the Battlefield Planning and Visualization tool (BPV) currently being utilized in Prairie Warrior and by several Corps and Division HQ's. Early demonstrations of the DaVinci software have shown a marked improvement over BPV with regards to interface and intuitiveness of use. Version 1 of this software released for field testing Jan 02. Additionally, DaVinci software will be utilized during C3OTM Demonstration during Jan 03.

b. **Commander's Information Fusion Cell (CIFC) CEP.** This experiment is envisioned as the first experiment in a four-year program. Using a building block approach, BCBL-L in conjunction with TRAC will determine, collect and evaluate Battle Command specific information. BCBL-L will use data collected and lessons learned from the DARPA FCSC2 experiment (focused at the Unit Cell/Unit Team level), the FY02 UACEP conducted at MMBL (focused primarily at UA BN and below) and various other experiments and exercises from across TRADOC to focus on the battle command issues identified above as they relate to the UA Bde and the CIFC development for the Objective Force.

c. **Command Post Of The Future.** A DARPA initiative focused on developing an adaptive, decision-centered, visualization environment for the 21st Century commander and his immediate staff. The operational objective of CPOF is to improve the speed and quality of command decisions while enabling a smaller, more distributed, more survivable C2 environment. The goal is to double the speed and quality of these decisions while reducing the staff by one half. The technical objective is to develop the technology necessary to create this environment. Increase the speed and quality of command decision making. Provide the commander with the ability to interact with staff, subordinates, and peers in a completely distributed fashion.

d. **Future Combat Systems Command and Control.** The first FCS C2 Experiment was conducted at Ft Monmouth from 2-14 December under the operational control of the Program Manager. The experimental objective for this first of 4 experiments was "See and Move". The objectives were focused on the ability of the 4 man command and control cell to manipulate the Unit Cells ISR assets to see the enemy and to maneuver their organic vehicles. The C2 cell operated in a mock-up based on the LAV III vehicle in an OTB driven scenario. The first week was spent training on the C2 Software (a Da Vinci derivative known as Commander's Support Environment or CSE) and the second consisted of multiple scenario runs (2 to 3 a day). ARI representatives were collecting human factors feedback from the users following each run and collected and end of exercise survey. The next experiment is scheduled for May and will increase the workload and functional complexity of the cell by adding the "Shoot" function. It is expected the same players and facilitators will be involved. There are 4 planned experiments in this series.

6. Next Higher Headquarters. Training and Doctrine Command (TRADOC)

D. Maneuver Sustainment Battle Laboratory (MSBL), Ft. Lee, VA

Vision

a. The Army must have versatile logistics at all levels with near total asset visibility and split-based operations capabilities to enable just-in-time distribution-based support. The tree principal elements of this vision are: To represent the CSS community in efforts to seek credible and substantive DTLOMS alternatives which enable our Nation's Army to project and sustain itself more effectively in full spectrum operations, in a joint and multinational environment, from strategic to tactical level, and while pursuing CSS-related efficiencies simultaneously.

b. To be TRADOC's and CASCOM's harbinger of CSS DTLOMS change by envisioning, searching for, and ushering in potentially revolutionary change, especially CSS-related technology, into our Army.

c. To guide the Army's future CSS activities into reality.

Mission

Serve as the key Combined Arms Services Command (CASCOM) organization in the DTLOMS requirements determination process, and provide insights, impacts, and recommendations to the Army based on experimentation across all Combat Service Support (CSS) operational capabilities.

Modeling and Simulation Capability

CSSBL M&S Capabilities

Type of Simulation/Simulator	YES	NO
Virtual	X	
Constructive	X	
Live	X	

3. Modeling and Simulation Focus

CSSBL M&S Focus

M&S Domain	YES	NO
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

4. Next Higher Headquarters. Training and Doctrine Command (TRADOC)

E. Depth and Simultaneous Attack (D&SA), Battle Laboratory, Ft. Sill, OK

Vision

Leveraging emerging technologies to increase the accuracy of an attack system, thereby increasing first round hits. Detecting enemy systems and formations at maximum depth to provide near real-time targeting to commanders and targeting information to attack systems. Linking Intelligence/Electronic Warfare (IEW) and attack systems in near real-time to optimize precision targeting, particularly against moving and short dwell targets.

Mission

The D&SA Battle Lab's mission is to provide overall direction, oversight, and horizontal integration for the total depth and simultaneous attack battle dynamic area to meet the warfighter's needs through horizontal integration, experimentation, rapid acquisition, and high tech insertion across doctrine, training, leader development, organization, materiel, and soldiers.

2. Modeling and Simulation Capability

D&SABL M&S Capabilities

Type of Simulation/Simulator	YES	NO
Virtual	X	
Constructive	X	
Live	X	

3. Modeling and Simulation Focus

D&SABL M&S Focus

M&S Domain	YES	NO
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

4. Next Higher Headquarters. Training and Doctrine Command (TRADOC)

F. Maneuver Support Battle Laboratory (MSBL) Fort Leonard Wood, Missouri

Vision

To be the focal point for effecting revolutionary change in America's Defense Goals:

a. Conduct quality live, virtual and constructive experimentation support for customers
b. Team with Army, Joint, Allied, civilian industry, and academia partners
c. Be self-sustaining
d. Operate efficiently
e. Support MANSCEN in science and technology efforts
f. Integrate MANSCEN Homeland Security and Army Transformation Actions

Mission

The Maneuver Support Battle Lab (MSBL) evaluates Army Objective Force operational and organizational concepts and technologies through live, virtual, and constructive experimentation to improve doctrine, organizations, training, materiel, leader development, personnel, and facility (DOTMLPF) programs.

2. History

The Maneuver Support Battle Lab was established at Fort Leonard Wood, Missouri in October 1998 as an offshoot of the U.S. Army Engineer School Directorate of Combat Developments (DCD) Battle Lab Support Element. BSBL was the first Maneuver Support Center (MANSCEN) directorate created to support mutual experimentation efforts of the U.S. Army Chemical School, U.S. Army Military Police School and US Army Engineer School after the October 1999 formation of MANSCEN.

3. Modeling And Simulation Capability

BSBL Capabilities

Type of Simulation/Simulator	**YES**	**NO**
Virtual	X	
Constructive	X	
Live	X	

4. Modeling And Simulation Focus

BSBL M&S Focus

M&S Domain	YES	NO
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

5. Key Programs

BSBL evaluates Maneuver Support related DOTMLPF impacts of Objective Force concepts and operations that include the following Maneuver Support concept imperatives:

a. Understanding the Environment.
b. Enabling Theater Access.
c. Denying Enemy Freedom of Action.
d. Enabling Force Protection and Security.
e. Engaging and Control Populations.
f. Neutralizing Hazards and Restore the Environment

6. Next Higher Headquarters. Training and Doctrine Command (TRADOC)

G. Space and Missile Defense (SMD), Battle Laboratory, Huntsville, AL

1. Vision

Become the Leading organization for innovations within the space and missile defense communities. Develop warfighting concepts, focus military S&T research, and experiment to provide space and missile defense DOTMLPF capabilities to warfighters. Focus efforts on areas beyond the core capabilities of the other battle laboratories.

2. Mission

Deliver space and missile defense innovations to the warfighter.

3. Modeling And Simulation Capability

SMDBL Capabilities

Type of Simulation/Simulator	YES	NO
Virtual	X	
Constructive	X	
Live	X	

4. Modeling and Simulation Focus

SMDBL M&S Focus

M&S Domain	**YES**	**NO**
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

SMDBL supports TEMO domain activities by coordinating, conducting, and advocating efforts to bring space, missile defense, and computer network operations support capabilities to the warfighter; and by participating in joint and service Combatant Commanders exercises, advanced warfighting experiments, Army and Joint experiments, exercises, and wargames, and unit training activities. Products / innovations generated by SMDBL experimentation include analytical insights, impact determinations, validated requirements, new concepts, leave-behind prototypes, DOTMLPF recommendations, and suggested improvements to Tactics Techniques and Procedures (TTPs).

SMDL supports ACR domain activities including experimentation, conducting analyses for materiel development activities and the requirements determination processes, assessing advanced concepts, and supporting the definition of space, missile defense, and computer network operations support architecture for the future warfighter.

SMDL supports RDA domain activities by operating two large computing centers to conduct supporting operations: the Advanced Research Center and the Simulation Center. Additionally, the Ground-based Midcourse Defense (GMD) User Lab, located in Colorado Springs, provides warfighers an independent environment and capability for the operator to train, exercise, and experiment with GMD systems prior to fielding. Its simulation capabilities also include Extended Air Defense Simulation. SMDBL's Focus Area Collaborative Team (FACT) is the lead for ensuring Army space requirements are captured in current and future modeling and simulations.

5. **Key Programs**

   a. Advanced Warfare Environment (AWarE) Program
   b. Broadcast Request Imagery Technology Experiment (BRITE)
   c. Embedded National Tactical Receiver (ENTR)
   d. Extended Air Defense Simulation (EADSIM)
   e. Future Operational Capability Tactical Operations Center (FOC TOC)
   f. Ground-Based Midcourse Defense User Lab (GMD UL)
   g. Low Earth Orbit Position and Reporting Device (LEOPARD)
   h. Operational Analysis for Army & Joint Warfighters
   i. Space Operating System (SOS)
   j. Spectral Imagery Initiatives
   k. Total Defender (TD) Integrated Missile Defense Experiments

6. **Next Higher Headquarters.** Training and Doctrine Command (TRADOC)

H. DISMOUNTED BATTLESPACE BATTLE LAB (DBBL), Fort Benning, GA

1. Vision

To develop and maintain and organization and facility that is capable and flexible enough to support the experimentation needs and requirements of the Army's Vision, it's Transformation Goals, and more specifically the needs/requirements of the Current, Interim and Objective Soldier.

2. Mission

To support the Army's Vision and Transformation goals. To conduct constructive, virtual and/or live experiments to gain insights, impacts and recommend changes to DTLOMPF, based on inputs from soldiers and their leaders, as well as emerging technologies and materiel initiatives to support the Current interim and Objective Force.

3. Modeling and Simulation Capability

The Simulation Laboratory conducts research, development and analysis in the virtual and constructive computer based force on force simulation environments. As part of its mission the Simulation Laboratory supports developmental initiatives for the Dismounted Battle Space Battle Lab, other Department of Defense Agencies, by operating three government owned hardware and software simulations. We conduct research projects that are executed under classified conditions. We provide technical oversight and administration of all research and development projects in constructive and virtual interactive simulation environments. We oversee the development of experimental design methodologies that optimize data outputs. Interpret and apply simulation outcomes to reduce or eliminate deficiencies across all domains of the Training and Doctrine Command. Approve modeling and simulation plans. Quality control the writing of study reports, control the development of scientific briefings of simulation requirements and outcomes. Provide technical simulation assistance as required to the Director of the Dismounted Battle Space Battle Lab.

DBBL M&S Capabilities

Type of Simulation/Simulator	YES	NO
Virtual	X	
Constructive	X	
Live	X	

4. **M&S Focus (Domains)**

The primary focus of the Simulation Laboratory is Advanced Concepts and Requirements (ACR). Fully 80 percent of their efforts are focused in this domain supporting a host programs and organizations across the suite of simulations available in the Simulation Laboratory. In the past 10 years this battle lab has conducted various simulation events in the Training, Exercise, and Military Operations (TEMO) domain using both constructive and virtual simulation. Finally, and to a lesser degree, the Simulation Laboratory provides a venue for outside agencies to conduct Research, Development, and Acquisition (RDA) Simulation Based Acquisition (SBA) activities.

DBBL M&S Focus

M&S Domain	**YES**	**NO**
Training, Exercise, and Military Operations (TEMO)	X	
Advanced Concepts and Requirements (ACR)	X	
Research, Development, and Acquisition (RDA)	X	

5. **Next Higher Headquarters.** Training and Doctrine Command (TRADOC)

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Appendix D: Characteristics of Computer Programming Languages

Simulation Programming Languages – C++

C++ may be viewed as a superset of the "C" language, i.e., C with enhanced structures and additional syntax to support object-oriented programming. C++ was designed and implemented by Bjarne Stroustrup at AT&T Bell Laboratories to combine the organizational and design strengths of SIMULA (i.e., object-oriented programming) with C's facilities for systems programming.

The initial version of C++, called "C with Classes," was first used in 1980 to support traditional system programming techniques and data abstraction methods. The basic facilities for handling object-oriented programs were added in 1993, and then gradually introduced to the C++ community at large. C++ was first made commercially available in 1985 then expanded, in the 1987-1989 time frame, to support generic programming. [Stroustrup, 1991] and [Ellis, 1990] Finally, International Standards Organization (ISO) standard ISO/IEC:98-14882 for C++ was introduced in 1998. [NSITC, 1998]

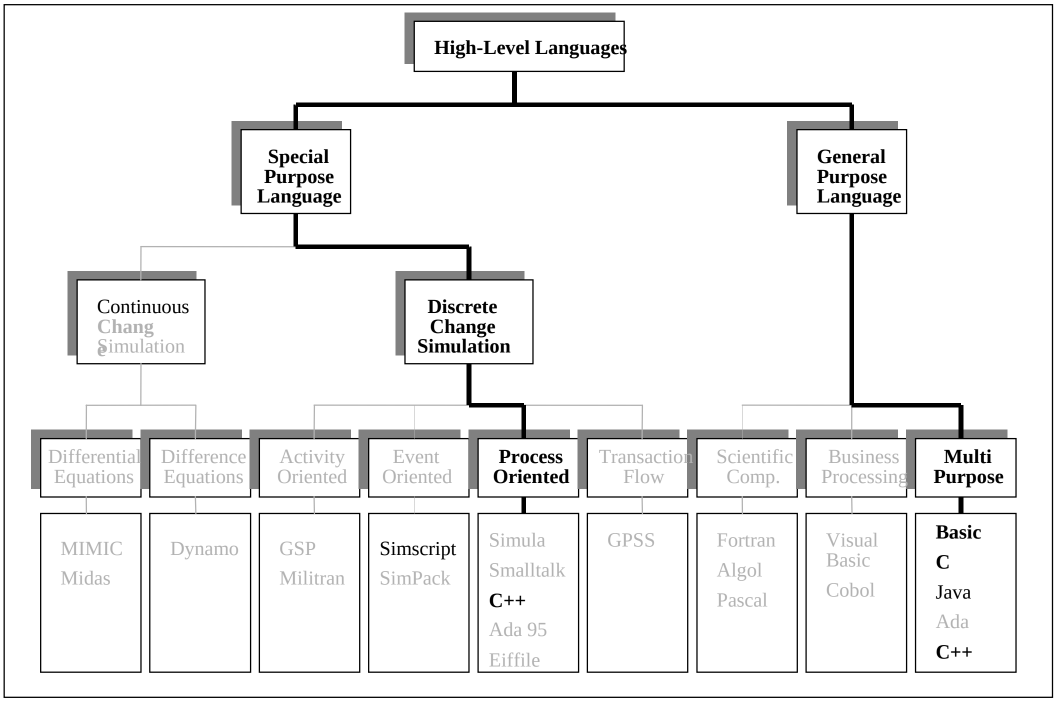
The "++" part of the name C++ is an insider joke; "++" denotes the increment function, so C++ is the follow-on to C, or in Stroustrup's words, "the better C."

1. **Technical Description:**

C++ is unusual in that it may be classified as either a special-purpose, discreet change, process-oriented simulation language that supports data abstraction and object-oriented programming, or a general-purpose language that supports generic programming techniques. (See Figure below.) [Booch, 1994] and [Stroustrup homepage]

C++'s greatest strength lies in its flexibility. It has been used effectively in programs with such diverse functionality as local and wide area networking, numerics, graphics, user interactions and database access. Because C++ is designed to maximize execution speed and minimize memory requirements, it is often used for device drivers and other software that manipulate hardware in real-time [Stroustrup, 1994]. In such programs, reliability and compactness are as important as raw speed. Furthermore, C++ is able to coexist with code fragments and programs written in other languages. C++ is well specified, stable, and supported by standard libraries.

Language features such as ease of maintenance, extensibility, and testing contribute to its widespread use in areas where reliability is crucial and changes are frequent. Many such programs are large, with more than a million lines of code, and long-lived. Other attractive features include classes, inheritance, information hiding, polymorphism, and dynamic binding.



2. Applications:

C++ is heavily used in the development of graphics programs and user interfaces. It is also the most popular object-oriented language today. C++ applications are commonly found in education, research, and industry. Examples of users include financial institutions, telecommunications companies, and the military.

Simulation Programming Languages – Ada

Ada is the first object-oriented programming language to be accepted as an international standard. This language is unique, in that it is the only programming language designed specifically to reduce the cost of writing embedded software systems for the U.S. Department of Defense. [The Ada Programming Language] An embedded system is one where the computer hardware is embedded in the device it controls. For example, the software that is used in fire control systems to generate continuously computed impact points for ballistic weapons is an embedded system.

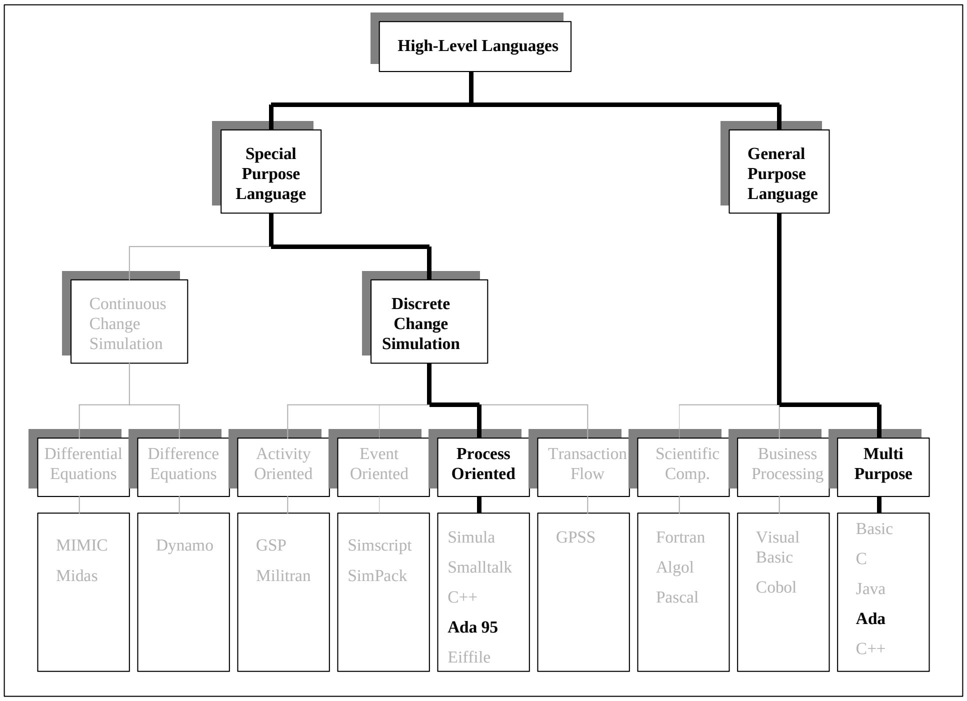
In 1974, a group from each of the services independently proposed the adoption of a common programming language. Up to that point, there were more than 450 programming languages used within DoD, and none of them were standardized. [Ada Programming Language] In response, the director of the Department of Defense for Research and Engineering directed that a joint-service program be implemented. In January 1975, a high-order language-working group (HOLWG) was formed. By 1977, a complete language design specification for Ada was available. In 1980, Ada was published as a MIL-STD and the HOLWG was designated as the Ada Joint Program Office (AJPO). In 1987 Ada was mandated for DoD use [DoDD 3405.1, 1987], but the mandate was rescinded in 1997 when Ada was transitioned to the private sector. [ASD (C3I), 1997]

The term Ada is not an acronym, but rather is the name of an obscure but talented mathematician, Lady Augusta Ada Byron (1815-1852), Countess of Lovelace and daughter of the poet Lord Byron. Known as the first computer programmer, she worked out the theoretical details of Charles Babbage’s "difference engine."

1. Technical Description:

Ada is a high-level language intended primarily for embedded, real-time applications. See Table below for examples of systems with embedded real-time Ada applications. Ada 95, a derivative of the general-purpose language, is a process-oriented simulation language (see Figure C.3). Both versions are commonly used throughout DoD.

Ada’s greatest strength is its reliability and speed as evidenced by its use in embedded mission-essential systems, safety-critical software, and large projects that require portability and maintainability. Significant language features include: (a) Packages – data types, data objects, and procedures specifications can be encapsulated into packages that support the program design of data abstractions, (b) Exception Handling – Ada has a very good exception-handling capabilities which allow the program to handle its own run-time errors, (c) Generic Program Units – it is possible to write a procedure (for example a sorting procedure) which does not require a data type to be specified, and (d) Parallel/Concurrent Processing – Ada supports parallel and concurrent execution of tasks. In addition to these features, Ada 95 provides support for object-oriented programming, flexible libraries, and control mechanisms for shared data.



Classification of Ada and Ada 95

2. Applications:

Ada 95 is the most powerful object-oriented general purpose programming language available. Ada dominates all other languages in supporting computer-based management of air transportation and subway systems. It has also been used to develop everything from video security systems to pollution monitoring devices. Over 99 percent of the aviation software in the Boeing 777 is in Ada. Ada code facilitates such massive software projects as the Space Station and the Paris Metro. [Feldman, 2002] The table below lists a few Army and Joint systems that use Ada:

Ada in Army M&S

Model/Simulations
Advanced Field Artillery Tactical Data System (AFATDS)
Apache Helicopter, Longbow Missile, M299 missile launcher
Grizzly land-mine clearing device
Extended Air Defense Test Bed
Joint Computer-Aided Acquisition and Logistics System (JCALS)
Joint Tactical Radio System (JTRS)
Land Vehicle Electronic Control Technology Test bed
PATRIOT ICC (Command and Control Center)
RAH-66, Comanche Helicopter,
M1A2 Battle Tank
Standard Installation/Division Personnel System (SIDPERS3)
THAAD - Theater High-Altitude Area Defense System

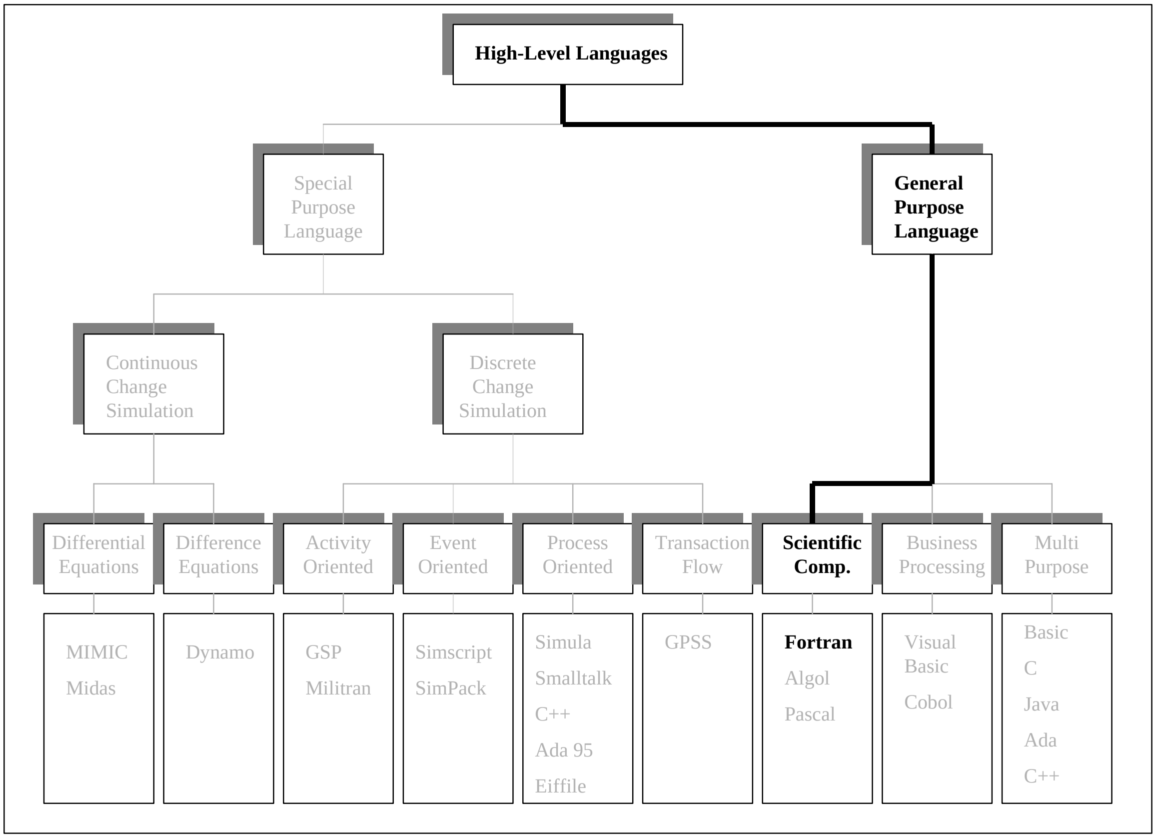
Simulation Programming Languages – FORTRAN

FORTRAN (FORmula TRANslator) is the oldest high-level language in common use today. When the first FORTRAN compiler was released in 1957, it was a milestone in the history of computing. While its developers did not invent the idea of using a compiler to translate source code into object code, they were the first to produce a successful optimizing compiler that produced very efficient code. [FORTRAN, 2003]

Despite its age, FORTRAN remains a popular programming language. For example, there are over 19 commercial FORTRAN compilers that operate under Linux alone, plus dozens of others than run under Windows, MAC OS, UNIX, and even operating systems for massively parallel processing computers. FORTRAN has had many versions over the years. The current standard is FORTRAN 95 (ISO/IEC 1539-1). The newest version, FORTRAN 2000 incorporates many modern structured programming features in a traditional FORTRAN framework.

1. **Technical Description:**

FORTRAN is the most widely used high-level, general-purpose language for scientific computation (see Figure C.2). It has long been the language of choice for complex scientific calculations, engineering models, statistics, and signal processing. Its simple code structure and lack of dynamic data structures lends itself to compiler optimization and tailoring to specific hardware suites (e.g., Vector Supercomputers). The language is characterized by its mathematical orientation and support for floating-point computations. Because it is an older language, it lacks modular-programming structures, however, object, parallel and specialized processing versions have been created.



Classification of FORTRAN

2. Applications:

Government applications of FORTRAN span the range of scientific and engineering fields including structural design, physics, atomic energy, finance and economics, biology and medicine, military operations, logistics, and mathematics. The Table below provides an overview of Army model(s) that use FORTRAN.

FORTRAN in Army M&S

Simulation
Combat Service Support Training Simulation System (CSSTSS)

Simulation Programming Languages – SIMSCRIPT

SIMSCRIPT is one of the oldest special purpose simulation languages in use today. A free-form, English-like general-purpose simulation language produced by Harry Markowitz et al of Rand Corp in 1963. It was implemented as a FORTRAN preprocessor on IBM 7090 and was designed for large discrete simulations. For example, it is the core language used in the Corps Battle Simulation (CBS) and the Brigade/Battalion Simulation (BBS), the Army's Corps/Division, and Brigade/Battalion staff trainers respectively. The current version of SIMSCRIPT is SIMSCRIPT II.5.

1. **Technical Description:**

SIMSCRIPT is a high-level simulation language designed to support portable, high fidelity, large-scale modeling applications with interactive, graphical user interfaces and animated graphics (see Figure C.1).

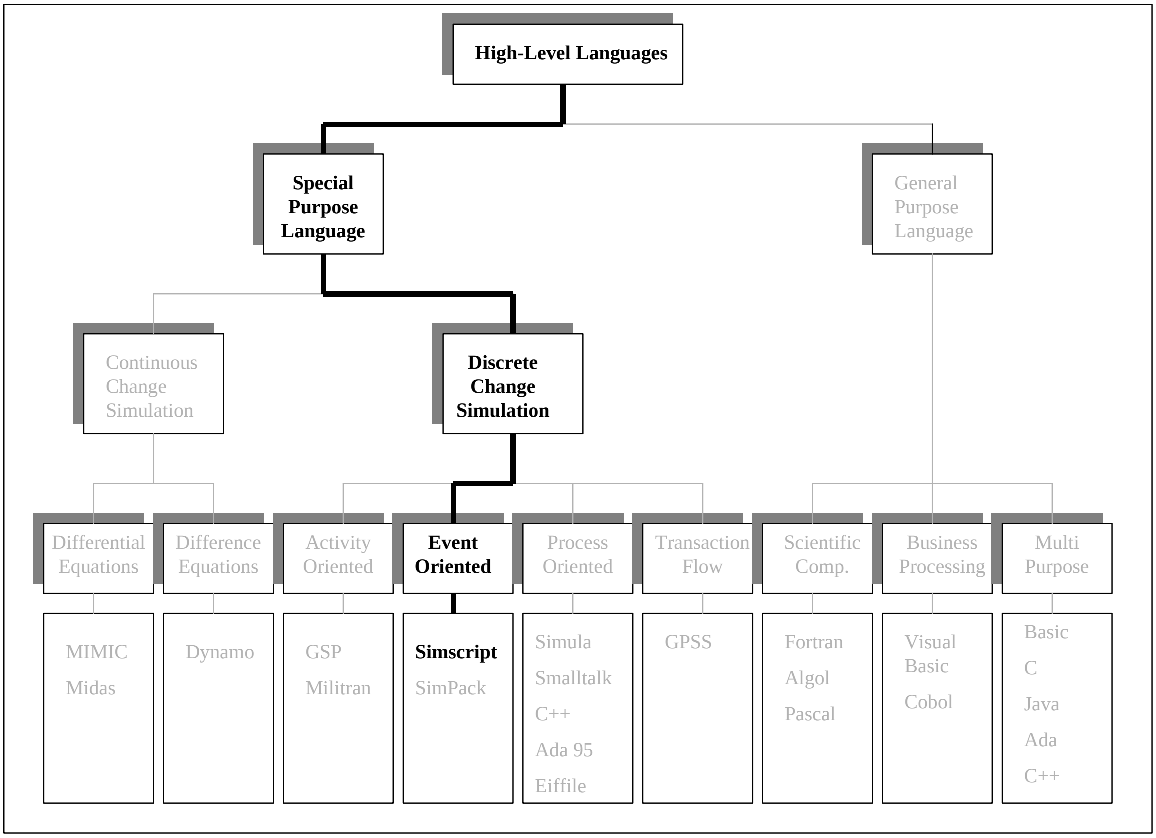
SIMSCRIPT II.5 supports both discrete-event and combined discrete/continuous modeling by coupling a differential equation integrator with the SIMSCRIPT's "next-event" timing mechanism. In discrete-event models, the simulated time progresses in steps form one significant event to the next. The time between significant events is skipped, increasing the computational efficiency. Factories, networks, telecommunications, transportation, inventory control, health care, military operations, wargaming and logistics planning are modeled as discrete-event systems. Chemical reactions, fluid flows or non-linear motion, such as missile fly-outs, require continuously changing variables to be accurately computed as time progresses. These types of systems are modeled as discrete/continuous systems. [CACI Home Page, 2003]

2. **Applications:**

SIMSCRIPT II.5 has been used by thousands of organizations. Current users include: (a) the U.S .Army, (b) the U.S. Air Force, (c) the Federal Aviation Agency (FAA) (d) Rolls Royce, and. The Table below provides an overview of Army simulations that use SIMSCRIPT:

SIMSCRIPT in Army M&S

Model/Simulation	Description	Owning Origination
Corps Battle Simulation (CBS)	Division and above staff trainer	National Simulation Center
Brigade/Battalion Simulation (BBS)	Brigade/Battalion staff trainer	National Simulation Center



Classification of SIMSCRIPT

Glossary

Modeling and Simulation Terms and Definitions

Accreditation (DA Pam 5-11, 1999, p. 92)
The official determination that a model, simulation, or federation of M&S is acceptable for use for a specific purpose.

Accreditation Agent (DA Pam 5-11, 1999, p. 92)
The organization designated by the application sponsor to conduct an accreditation assessment for an M&S application.

Accreditation Criteria (DA Pam 5-11, 1999, p. 92)
A set of standards that a particular model, simulation, or federation of M&S must meet to be accredited for a specific purpose.

Advanced Concepts and Requirements (ACR) Domain (DA Pam 5-11, 1999, p. 92)
One of the three domains for Army M&S applications. ACR includes experiments with new concepts and advanced technologies to develop requirements in doctrine, training, leader development, organizations, materiel and soldiers that will better prepare the Army for future operations. ACR evaluates the impact of horizontal technology integration through simulation and experimentation using real soldiers in real units.

Advanced Distributed Simulation (DA Pam 5-11, 1999, p. 92)
A set of disparate M&S operating in a common synthetic environment within which humans may interact at multiple sites networked using compliant architecture, models, protocols, standards, and databases. The ADS may be composed of three modes of simulation – live, virtual, and constructive, which can be seamlessly integrated.

Aggregation (AMSMP, Appendix C, 1995, p. C-1)
A term applied to M&S in which some or all of the platforms and vehicles are grouped as organized entities of platforms, e.g., flights, convoys, squads.

Algorithm (DMSO, 2003)
A prescribed set of well defined unambiguous rules or processes for the solution of a problem in an finite number of steps.

Analysis of Alternatives (AoA) (DA Pam 5-11, 1999, p. 93)
A study conducted to provide support for acquisition decisions in the acquisition cycle. The AoA illuminates the relative advantages and disadvantages of the alternatives being considered showing the sensitivity of each alternative to possible changes in key assumptions (e.g. threat) or variables (e.g., performance capabilities). These shall be a clear linkage between the AoA, system requirements, and system evaluation measures of effectiveness.

Application (DA Pam 5-11, 1999, p. 93)
A specific, individual project session that requires or uses a model or simulation to achieve its purpose.

Application Sponsor (DA Pam 5-11, 1999, p. 93)
The organization that utilizes the results of products from a specific application of a model or simulation.

Architecture (DA Pam 5-11, 1999, p. 93)
The structure of components is a program/system, their relationships, and the principles and guidelines governing their design and evolution over time.

Data Certification (DMSO, 2003)
The determination that data have been verified and validated. Data user certification is the determination by the application sponsor or designated agent that data have been verified and validated as appropriate for the specific M&S usage. Data producer certification is the determination by the data producer that data have been verified and validated against documented standards or criteria.

Computer Generated Forces (CGF) (DA Pam 5-11, 1999, p. 93)
A capability/technology where computer generated forces are a doctrinally correct representation of both friendly and supposing forces. These forces will support simulations by providing opposing forces, supporting forces, and forces needed to permit a smaller number of personnel to represent a much larger force.

Computer Hardware (DMSO, 2003)
Devices capable of accepting and storing computer data, executing a systematic sequence of operations on computer data, or producing control outputs. Such devices can perform substantial interpretation, computation, communication, control, or other logical functions.

Configuration Management (CM) (DA Pam 5-11, 1999, p. 93)
The application of technical and administrative direction and surveillance to identify and document the functional and physical characteristics of an M&S, control changes, and record and report change processing and implementation status.

Constructive M&S (DA Pam 5-11, 1999, p. 94)
M&S that involving real people making inputs into a simulation that carries out those imputes by simulated people operating simulated systems.

Data (DA Pam 5-11, 1999, p. 94)
A representation of facts, concepts, or instructions in a formalized manner, suitable for communication, interpretation, or processing by human or by automatic means.

Data Accreditation (DA Pam 5-11, 1999, p. 94)
The determination that data have been verified and validated. Data user accreditation is the determination by the application sponsor or designated agent that data have been verified and

validated as appropriate for the specific M&S usage and are included as part of the M&S VV&A process. Data producer accreditation is the determination by the data producer that data have been verified and validated against documented standards of criteria.

Data Exchange Standard (DA Pam 5-11, 1999, p. 94)
Formally defined protocols for the format and content of data messages used for interchanging data between networked simulation and/or simulator nodes used to create and operate a distributed, time and space coherent synthetic environment. Current standards include ALSP and DIS Protocol Data Units.

Data Proponent (DA Pam 5-11, 1999, p. 94)
The agency or organization that has primary responsibility for data collection or database. The proponent develops the requirement for the data.

Data Standards (DA Pam 5-11, 1999, p. 94)
A capability that increases information sharing effectiveness by establishing standardization of data elements, database construction, accessibility, procedures, system communication, data maintenance and control.

Data Validation (DA Pam 5-11, 1999, p. 94)
The documented assessment of data by subject area experts and its comparison to known values. Data user validation is an assessment as appropriate for use in an intended M&S. Data producer validation is an assessment within stated criteria and assumptions.

Data Verification (DA Pam 5-11, 1999, p. 94)
Data producer verification is the use of techniques and procedures to ensure that data meets constraints defined by data standards and business rules derived from process and data modeling. Data user verification is the use of techniques and procedures to ensure that data meets user specified constraints defined by data standards and business rules derived from process and data modeling, and that data are transformed and formatted properly.

Deterministic model (DMSO, 2003)
A model in which the results are determined through known relationships among the states and events, and in which a given input will always produce the same output; for example, a model depicting a known chemical reaction.

Discrete model (DMSO, 2003)
A mathematical or computational model whose output variables take on only discrete values; that is, in changing from one value to another, they do not take on the intermediate values; for example, a model that predicts an organization's inventory levels based on varying shipments and receipts.

Distributed Interactive Simulation (DIS) (DA Pam 5-11, 1999, p. 94)
A subset of advanced distributed simulation, which interfaces through the use of DIS Protocol data Units.

Dynamic Environment (DA Pam 5-11, 1999, p.95)
The constantly changing environment as a result of man-made efforts (battlefield smoke) and natural phenomenon (weather). Incorporating dynamic environment into real time simulations provides a more realistic test bed for weapons, equipment, and personnel.

Dynamic model (DMSO, 2003)
A model of a system in which there is change, such as the occurrence of events over time or the movement of objects through space; for example, a model of bridge that is subjected to a moving load to determine characteristics of the bridge under changing stress.

Emulator (DA Pam 5-11, 1999, p.95)
A physical M&S, which duplicates the behavior, properties, or performance of another system. Emulators are frequently used to generate imputes for other M&S.

Environmental Representation (DMSO, 2003)
An authoritative representation of all or a part of the natural or man-made environment, including permanent or semi-permanent man-made features.

Federation Element (DA Pam 5-11, 1999, p.95)
Term applied to an individual M&S that is part of a federation of models and simulations. Federation elements may be distributed.

Federation of Models and Simulations (DA Pam 5-11, 1999, p.95)
A system of interacting M&S with supporting infrastructure, based on a common understanding of the objects portrayed in the system.

Fidelity (DMSO, 2003)
The accuracy of the representation when compared to the real world.

High Level Architecture (HLA) (DA Pam 5-11, 1999, p.95)
Major functional elements, interfaces, and design rules, pertaining, as feasible, to all DoD simulation applications, and providing a common framework within which specific system architectures can be defined.

Iconic model (DMSO, 2003)
A physical model or graphical display that looks like the system being modeled; for example, a non-functional replica of a computer tape drive used for display purposes.

Independent Verification and Validation (IV&V) (DA Pam 5-11, 1999, p.95)
The conduct of verification and validation of M&S by individuals or agencies that did not develop the M&S. IV&V does not require complete organizational independence, but does imply a reasonable degree of organizational separation to assure unbiased analysis.

Intelligent agent (DMSO, 2003)
A software entity that carries out a set of operations on behalf of a user with some degree of independence or autonomy, and in so doing, employs knowledge or representation of the user's goals or desires.

Interoperability (DA Pam 5-11, 1999, p.95)
The ability of a set of M&S to provide services to and accept services from other M&S and to use the services so exchanged to enable them to operate effectively together.

Live simulation (DA Pam 5-11, 1999, p.95)
A representation of military operations using live forces and instrumented weapons systems interacting on training, test, and exercise ranges which simulate experiences during actual operational conditions.

Model (DA Pam 5-11, 1999, p. 96)
A model is a physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process.

Model types (DA Pam 5-11, 1999, p. 96)
Physical model. A physical representation of the real world object as it relates to symbolic models in the form of simulators.
Mathematical model. A series of mathematical equations or relationships that can be discretely solved. This includes M&S using techniques of numerical approximation to solve complex mathematical functions for which specific values cannot be derived (e.g., integrals.)
Procedural model. An expression of dynamic relationships of a situation expressed by mathematical and logical processes. These models are commonly referred to as simulations.

M&S Developer (DA Pam 5-11, 1999, p. 96)
The organization responsible for developing, managing or overseeing M&S developed by a DoD component, contractor, or Federally Funded Research and Development Center. The developer may be the same agency as the proponent agency.

M&S Proponent (DA Pam 5-11, 1999, p. 96)
The organization responsible for initiating the development and directing control of the reference version of a model or simulation. The proponent will develop and execute a viable strategy for development and maintenance throughout the life cycle of the M&S and for directing the investment of available resources. The M&S proponent serves as the advocate and final authority on their M&S. The proponent will advise the DUSA(OR) on release of the M&S to foreign countries, and will advise the MACOM or Organizational Release Authority for domestic release. Except where responsibilities are specifically designated to an acquisition official by DoD or DA policy e.g. DoD 5000.2 or AR 70-1, the M&S proponent is responsible for, but may delegate execution of: M&S Development; Configuration Management; Preparation and Maintenance of Simulation Object Models (SOMs) as appropriate; all aspects of Verification and Validation; and maintenance of current information in all catalogs and repositories.

Modeling and Simulation (M&S) (DA Pam 5-11, 1999, p. 97)
The development and use of live, virtual, and constructive models including simulators, stimulators, emulators, and prototypes to investigate, understand, or provide experiential stimulus to either (1) conceptual systems that do not exist or (2) real life systems which cannot accept experimentation or observation because of resource, range, security, or safety limitations. This investigation and understanding in a synthetic environment will support decisions in the domains of research, development, and acquisition (RDA) and advanced concepts and requirements (ACR) or transfer necessary experiential effects in the training, exercises, and military operations (TEMMO) domain.

Open Systems Environment (DA Pam 5-11, 1999, p. 97)
The fielding of hardware and software products is interoperable and portable. The objective is to promote competition by allowing systems developed by multiple vendors and nations to interoperate through a common set of computer and communications protocols.

Protocol Data Unit (PDU) Standards (DA Pam 5-11, 1999, p. 97)
In accordance with IEEE Standard 1278,formally defined data exchange standards established for each of the several primary classes of functionality, which is represented, in the DIS synthetic environment (e.g., movement, weapons, firing effects, collisions, etc.)

Prototype (DMSO, 2003)
A preliminary type, form, or instance of a system that serves as a model for later stages or for the final, complete version of the system.

Research, Development, and Acquisition (RDA) Domain (DA Pam 5-11, 1999, p. 97)
One of the three domains for Army M&S applications. Includes all M&S used for design, development, and acquisition of weapons systems and equipment. M&S in the RDA domain are used for scientific inquiry to discover or revise facts and theories of phenomena, followed by transformation of these discoveries into physical representations. RDA also includes test and evaluation (T&E) where M&S are used to augment and possible reduce the scope of real world T&E.

Resolution (DMSO, 2003)
The degree of detail and precision used in the representation of real world aspects in a model or simulation.

Simulation (DA Pam 5-11, 1999, p. 98)
A method for implementing a model(s) over time.

Simulation Clock (DMSO, 2003)
A counter used to accumulate simulated time.

Simulation Entity (DMSO, 2003)
An element of the synthetic environment that is created and controlled by a simulation application through the exchange of Distributed Interactive Simulation Protocol Data Units

(e.g., tanks, submarines, carriers, fighter aircraft, missiles, bridges). It is possible that a simulation application may be controlling more than one simulation entity.

Simulation Management (DMSO, 2003)
A mechanism that provides centralized control of the simulation exercise. Functions of simulation management include: start, restart, maintenance, shutdown of the exercise, and collection and distribution of certain types of data.

Simulation Process (DMSO, 2003)
The imitative representation of the actions of platform(s), munitions(s), and life form(s) by computer program(s) in accordance with a mathematical model and the generation of associated battlefield entities. May be fully automated or partially automated. In the latter case, the human-in-the-loop injects command-level decisions into the process and is not intended to be a "trainee."

Simulation Time (DMSO, 2003)
a. A simulation's internal representation of time. Simulation time may accumulate faster, slower, or at the same pace as sidereal time; b. The reference time (e.g. Universal Coordinated Time) within a simulation exercise, this time is established by the simulation management function before the start of the simulation and is common to all participants in a particular exercise.

Simulator (DMSO, 2003)
a. A device, computer program, or system that performs simulation; b. For training, a device which duplicates the essential features of the task situation and provides for direct human operation.

Sponsoring Agency (DA Pam 5-11, 1999, p. 98)
The agency which sponsors the development or use of M&S utilizing either in-house, other government agency, or contract resources.

Standard (DA Pam 5-11, 1999, p. 98)
A rule, principle, or measurement established by authority, custom, or general consent as a representation of example.

Stimulator (DA Pam 5-11, 1999, p. 98)
A hardware device that injects or radiates signals into the sensor system(s0 of operational equipment to imitate the effects of platforms, munitions, and environment that are not physically present. A battlefield entity consisting of hardware and/or software modules which injects signals directly into the sensor systems of an actual battlefield entity to simulate other battlefield entities in the virtual battlefield.

Stochastic model (DMSO, 2003)
A model in which the results are determined by using one or more random variables to represent uncertainty about a process or in which a given input will produce an output

according to some statistical distribution; for example, a model that estimates the total dollars spent at each of the checkout stations in a supermarket, based on probable number of customers and probable purchase amount of each customer.

Symbolic M&S (DA Pam 5-11, 1999, p. 98)
M&S, which represent a real system using mathematical equations or computer programs. Symbolic M&S are contrasted from other representations such as maps, board games, field exercises, and mockups.

Synthetic Environments (SE) (DA Pam 5-11, 1999, p. 98)
Internetted simulations that represents activities at a high-level of realism from simulations of theaters of war to factories and manufacturing processes. These environments may be created within a single computer or a vast distributed network connected by local and wide area networks and augmented by super-realistic special effects and accurate behavioral models. They allow visualization of and immersion into the environment being simulated.

System (DMSO, 2003)
A collection of components organized to accomplish a specific function or set of functions.

Technical Architecture (DA Pam 5-11, 1999, p.99)
A minimal set of rules governing the arrangement, interaction, and interdependence of the parts or elements that together may be used to form an information system, and whose purpose is to insure that a conformant system satisfies a specified set of requirements.

Test and Evaluation (T& E) (DA Pam 5-11, 1999, p.99)
Test and evaluation includes engineering, developmental, and operational tests.

Training, Exercises, and Military Operations (TEMO) Domain (DA Pam 5-11, 1999, p.99)
One of the three domains for Army M&S applications. TEMO includes most forms of training at echelons from individual simulation trainers through collective, combined arms, joint, and/or combined exercises. TEMO includes mission rehearsals and evaluations of all phases of war plans. Analysis conducted during the rehearsal or evaluation validates the plan as best as the simulation environment will allow.

Validation (DA Pam 5-11, 1999, p.99)
The process of determining the extent to which an M&S is an accurate representation of the real world from the perspective of the intended use of the M&S. Validation methods include expert consensus, comparison with historical results, comparison with test data, peer review, and independent review.

Validation agent (DA Pam 5-11, 1999, p.99)
The organization designated by the M&S sponsor to perform validation of a model, simulation, or federation of M&S.

Verification (DA Pam 5-11, 1999, p.99)
The process of determining that an M&S accurately represents the developer's conceptual description and specifications. Verification evaluates the extent to which the M&S have been developed using sound and established software-engineering techniques.

Verification agent (DA Pam 5-11, 1999, p.99)
The organization designated by the M&S sponsor to perform verification of a model, simulation, or federation of M&S.

Verification & Validation (V&V) proponent (DA Pam 5-11, 1999, p.99)
The government agency responsible for ensuring V&V is performed on a specific M&S.

Virtual M&S (DA Pam 5-11, 1999, p.99)
A synthetic representation of Warfighting environments patterned after the simulate organization, operations, and equipment of actual military units.

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SIMULATION OPERATIONS HANDBOOK

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FUNCTIONAL AREA 57

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