MILITARY OPERATIONS OTHER THAN WAR (MOOTW): MAKING FLEXIBLE ASYMMETRIC SIMULATION TECHNOLOGIES (FAST) RELEVANT FOR WARFIGHTERS

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ABSTRACT

As in Somalia and Haiti, as well as Bosnia, Kosovo and most recently Afghanistan, MOOTW often encompasses open-ended missions unrelated to traditional military core competencies of fighting and winning wars. Geopolitical factors, transformations in US foreign and security policies, and terrorist attacks, when combined with US political leadership and advances in power projection capabilities, all contribute to the growing importance of MOOTW. Consequently, an emerging challenge for the military is how best to use FAST in training commanders and their staffs to fight and win on the battlefield of MOOTW.

To enhance warfighter readiness, the Defense Modeling and Simulation Office (DMSO) continues to explore FAST in the representation of the natural environment, human and organizational behavioral representation, and repository support. Today, such efforts make it possible to create a prototype MOOTW toolbox that promotes training and readiness as it supports mission planning, analysis and execution. In consonance with documented operational needs for modeling peace support operations and multinational training, as well as non-force-on-force and stability operations, DMSO developed a prototype toolbox to advance end-to-end problem analysis and/or situation rehearsal. Moreover, this prototype supports data and working scenarios, a knowledge base containing lessons-learned in the use of the tools, and assessments done with the tools as well as supporting training materials.

This paper describes the challenges of developing a toolbox environment that allows various tools to operate synergistically through the exchange of data, as well as the employment of reusable scenario definition files, in eXtensible Markup Language. This prototype includes the integration of the United Kingdom's Ministry of Defence stochastic simulation model of Diplomatic and Military Operations in a Non-warfighting Domain (DIAMOND) modified for DoD use, the US Joint Conflict and Tactical Simulation (JCATS) Tool, the Canadian Mine Tool, and the US Unit Order of Battle Data Access Tool (UOB DAT).

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BACKGROUND

For just over 45 years after World War II, nation states developed their national strategic and military strategies that paralleled a world environment polarized by two powers. During this timeframe, U.S. National Military Strategy focused heavily on being ready for major regional contingencies. To meet such force-on-force challenges, we trained and equipped our forces for success across traditionally well-defined military mission areas. Although "operations other than war" (OOTW) was a part of our military strategy, it was not the focal point for combatant commands and the Services. Today, our military is in a period of transformation to meet a different world environment--one that is less polarized and one that presents new challenges for warfighters as they ready to promote our National Security/Military Strategy.

Unequivocally, geopolitical factors, changes in U.S. foreign and security policies, and terrorist attacks, when combined with U.S. political leadership and advances in power projection capabilities, have all contributed to the growing importance of military OOTW (MOOTW). As in Somalia and Haiti, as well as Bosnia, Kosovo and most recently Afghanistan and Iraq, MOOTW often encompasses open-ended missions unrelated to traditional military core competencies of fighting and winning wars. A sample of supporting needs from combatant commands for MOOTW include: 1) a federated simulation to meet today's asymmetrical warfare environment; 2) models for missions involving disaster relief, refugees, peacekeeping, and stability operations; 3) capability to train to non-force-on-force and peacekeeping OOTW, and 4) tools for support operations and multinational training. (Crain, 2002) Consequently, an emerging challenge for the military is how best to use FAST in training commanders and their staffs to "fight and win" on the battlefield of MOOTW.

To enhance warfighter readiness, the Defense Modeling and Simulation Office (DMSO) continues to explore FAST in the representation of the natural environment, human and organizational behavioral representation, and repository support. Today, such efforts now make it possible to create a prototype M&S "toolbox" for the warfighter that promotes training and readiness as it supports mission planning, analysis, and execution, as well as new scenario development processes that target and hone decision-making. In consonance with documented operational needs for modeling peace support operations and multinational training, as well as non-force-on-force and stability operations, DMSO developed a prototype "toolbox" to advance end-to-end problem analysis and/or situation rehearsal. Moreover, this "toolbox" supports data and working scenarios, a knowledge base containing lessons-learned in the use of the tools, and assessments done with the tools as well as supporting training materials.

Consequently, this paper will describe a prototype OOTW M&S "Toolbox" for the warfighter to access the existing capabilities required for successful execution of selective mission areas across shifting civil-military operations. Moreover, the challenges of developing a software environment that allows various M&S applications and utilities to operate synergistically and share data will be addressed, as well as the employment of reusable scenario definition files in eXtensible Markup Language (XML). Significant tools include the integration of the data from the United Kingdom's Ministry of Defence simulation model of Diplomatic and Military Operations in a Non-warfighting Domain (DIAMOND), the U.S. Joint Conflict & Tactical Simulation (JCATS), the Canadian Forces Landmine Database (CFLD), and the U.S. Unit Order of Battle Data Access Tool (UOB DAT) for use by U.S. Forces in MOOTW.

CONCEPT OF OPERATION

Figure 1 is a graphical representation of the components, operational environment, operational modes and the initial working scenario that compose the concept of operations (CONOPS) for the OOTW Toolbox. The CONOPS is a dynamic rather than static document whose focus primarily is on satisfying documented warfighter requirements. These requirements are initially derived from the DMSO Warfighter M&S Needs Database (WARMOND),

shortfalls identified in the Warfighter's Simulation (WARSIM) Operational Requirements Document (ORD), the Joint Warfare System (JWARS) ORD and the Pacific Command OOTW Requirements Analysis conducted by Dr. Dean S. Hartley III. Additional requirements have been documented during visits to Central Command and the Special Operations Command. Future visits are planned for other combatant commands as well as those National Guard headquarters directly involved in forward deployments.

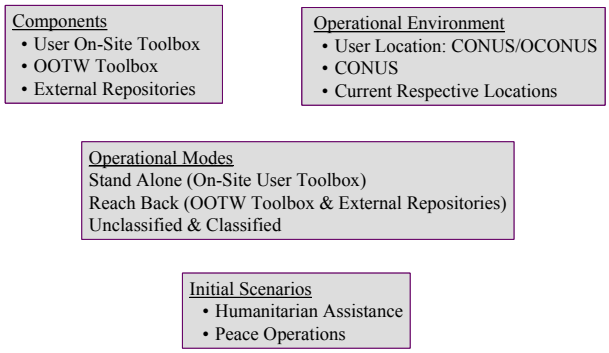

Figure 1. OOTW Toolbox Concept of Operations

The components of the "toolbox" are threefold:
User On-site Toolbox. The user station is an on-site toolbox housed in a laptop or desktop computer. The user station interacts with the OOTW Toolbox proper via Internet (SIPRNET in a classified mode). This user station becomes an on-site toolbox when it has transferred or downloaded user selected information items, tools and or data from the OOTW Toolbox or repositories external to the OOTW Toolbox. The on-site toolbox serves to provide the user immediately available resources to support mission planning, decision-making, and rehearsal and also has the capability to reach-back to the OOTW Toolbox to access additional resources as necessary.

OOTW Toolbox. The toolbox consists of a toolbox catalog (a "card catalog" of resources contained in a relational database), an information library (documents, briefings, reports, studies, etc.), tools (models, simulations, decision aids, enablers), a data repository (data on the environment, demography, military forces and systems, civil organizations) and links to external repositories. The OOTW Toolbox interacts with the user on-site toolbox and the external repositories via Internet (SIPRNET in a classified mode).

External Repositories. External repositories are a collection of web sites that provide OOTW related information, tools and or data. These repositories are linked to the OOTW Toolbox via Internet (SIPERNET in the classified mode) and are accessed by the user from the on-site toolbox via hyper links provided in the OOTW Toolbox. User activation of these hyper links will enable the user to go directly to the external repository, thus bypassing the OOTW Toolbox once connection is made.

The operational environment varies based upon the component of the toolbox in play. The user site toolbox is the respective headquarters location of the user when not deployed forward or when deployed, the operations center of the user. The operational environment of the toolbox proper is the continental United States to ensure the proper support environment and level of security. The operational environment of the external repositories varies with the resource.

In terms of operational modes, the "toolbox" must be capable of operating in both a stand-alone mode and a reach-back mode. The stand-alone mode permits the user to conduct training and modeling on-site without having to rely on external resources or Internet connections in order to utilize the OOTW Toolbox capability. Additionally, the reach-back mode permits the user to access resources from the OOTW Toolbox via Internet (SIPRNET in the classified mode), when such resources have not been previously downloaded. The OOTW Toolbox contemplates two classification modes. The OOTW Toolbox must be capable of operating in the unclassified mode and it is desired that it be capable of operating in the classified mode. Additionally, these operational modes should be accessible by the user on a 24-hour, 7 day a week basis. Since the prototype "Toolbox" currently operates in an unclassified, stand-alone mode, the operational modes will be adjusted based upon user demands associated with the ongoing FY03 C^4ISR initiative.

INITIAL WORKING SCENARIO

Notwithstanding the primary focus to support the warfighter tactically at the Division and below echelon of command, the long-term vision of the OOTW "Toolbox" is to support warrior readiness across multiple levels of war (i.e., strategic, operational and tactical) and echelons of command (combatant commanders to/through tactical units) for the many types of MOOTW missions during the planning and execution phases. Achievement of this goal will be accomplished through a block-build developmental approach. Such an approach permits iterative delivery of readily available and early maturing M&S technical capabilities while allowing for refinement and incorporation of emerging M&S technological capabilities to meet user needs. To identify an initial

working scenario, the focus has been on the 16 types of operations involving the military in OOTW as delineated in Joint Publication 3-07 depicted in Figure 2.

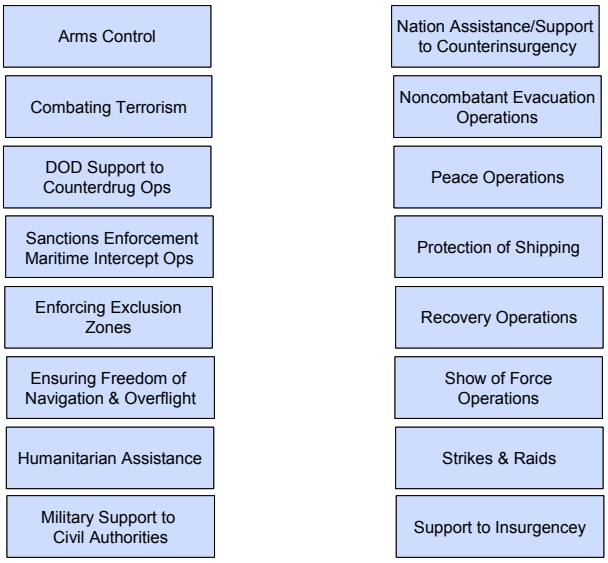

Figure 2. Types of Military OOTW (JP 3-07)

Of the OOTW operations, humanitarian assistance and peace operations were selected as representative of the most frequent activities encountered in OOTW. Within this context, a Kosovo scenario, as well as an Afghanistan excursion, was identified to represent the selective use of candidate tools.

The working scenario shown in Figure 3 depicts the area of operations in the Balkans focusing on Kosovo, which employed a multinational defense force.

Figure 3. Kosovo Area of Operations

The year 2005 was chosen to enable historical MOOTW lessons learned, throughout the Balkan region over the past decade, to be applied within a stability/support setting involving multinational forces. The road to disaster relief describes an 18,000 person stabilization force (SFOR) operating in Kosovo as a result of conflict resolution initiatives by the North Atlantic Treaty Organization (NATO) campaign that had earlier forced the withdrawal of Serbian forces from Kosovo. Notwithstanding relative stability within the region, a major earthquake exacerbated ethnic and political tensions in Kosovo. This disaster produces casualties in the thousands and displaces large numbers of an ethnically diverse population. International, non-governmental, and private volunteer organizations (IO, NGO, and PVO) have entered the area of operations of the NATO-led SFOR that is deployed in three sectors of Kosovo as international peacekeeping forces.

Selective snap shots in time were selected to best accommodate high and low resolution models for simulating the distribution of food and supplies using aviation and ground assets. Moreover, since the rising ethnic tensions were portrayed throughout the working scenario, an ambush of a reconnaissance force during military operations in urban terrain, as well as a show of force, were also simulated using complementary tools.

As depicted in Figure 4, an Afghanistan excursion was pursued that portrayed unit tactics involving peace operations (PO). Inclusive within the multinational

Figure 4. Afghanistan Area of Operations

force structure was the United Nations (UN) International Security Assistance Force (ISAF) as well as the US-led Coalition Task Force (CTF) personnel. Accordingly, the ISAF conducted peacekeeping (PK) operations primarily in the Kabul vicinity while the CTF conducted PK as well as peace enforcement (PE)

operations in the vicinity of Kandahar, Kabul, Bagram, Mazar-e Sharif, and Herat.

Since the overarching goal for military forces was to conduct PO to promote stability and prevent future terrorist havens, the primary focus for the ISAF was "presence" tactics. Correspondingly, the CTF concentrated on three overlapping areas: securing lines of communications for food/medical resupply; protecting friendly forces and the local populace; and assisting the interim government and IO/NGO/PVO in resettling refugees as well as internally displaced personnel.

As with Kosovo, selective representations at the tactical level of warfare were used to portray how diverse tools could be used to enhance the analytical decision-making process involving planning, rehearsals, and execution. Significant within the "toolbox" framework was the synergy derived from the complementary employment of tools in addressing party interactions and corollary tensions that are frequently encountered by warfighters engaged in PO.

CANDIDATE TOOLS

The overarching aim for designing a working scenario in the Balkans as well as an excursion in Afghanistan is to home in on the warfighting requirement that promotes the concept of "how" to think, as opposed to "what" to think. To advance such a purpose, the following tools were initially selected for this prototype to provide commanders and their staffs with an on-site, stand-alone M&S capability that supports MOOTW planning and mission decision-making, end-to-end problem analysis, situation rehearsal and training.

DIAMOND. The Diplomatic and Military Operations in a Non-warfighting Domain (DIAMOND) simulation is a high-level OOTW model that was developed by the United Kingdom's Defence Science & Technology Laboratory (DSTL). It is a fast running, stochastic, object-oriented simulation. It models multiple independent sides, each with its own plans, perceptions and behaviors.

As depicted in Figure 5, movement takes place on a simple node and arc network that may be viewed over a bitmap representation of the geography using its visual displays at slow speed for demonstration purposes. Moreover, DIAMOND may also be run in background mode at high speed to perform the many simulation runs needed during the planning phase to explore possible scenario outcomes in preparation of mission execution.

The features that differentiate DIAMOND from many other similar simulations derive from its purpose of modeling OOTW. In these operations, behaviors of military and civilians (both organized and unorganized) are key drivers to activities and results. Therefore, DIAMOND was designed to incorporate behaviors, such as perception, variable relationships between groups, and negotiations. The command structures and nested missions found elsewhere take on new depth when they interact with human behavior.

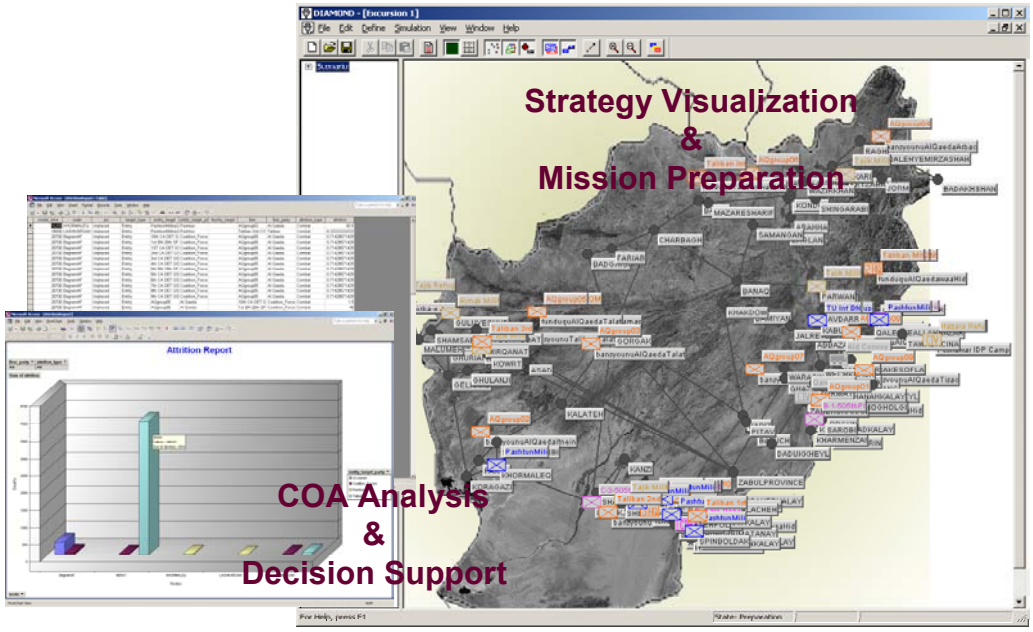

Figure 5. DIAMOND

JCATS. The Joint Conflict & Tactical Simulation (JCATS) is a detailed model of small unit (or individual) activities that was developed by the Lawrence Livermore National Laboratory (LLNL). Its capabilities span the ground, air, and naval domains in support of joint training, analysis, planning and mission rehearsal. Since JCATS provides a range of views as illustrated in Figure 6 (i.e., strategic for campaign observations of large terrain boxes; operational for inspection of city details, roads, rivers, and foliage; and tactical for scrutiny of individual buildings, floor plans, interior walls, doors, and windows), it is especially effective for military operations in urban terrain, both around and within buildings and other closed spaces. An interactive, entity-level simulation, JCATS enables the warfighter to investigate potentially strategically important actions that may be performed at the lowest echelons in OOTW. Applicable to both combat as well as non-combat operations, examples of JCATS' utility in OOTW include such areas as disaster relief, crowd control, raids, noncombatant evacuation operations, and hostage rescue.

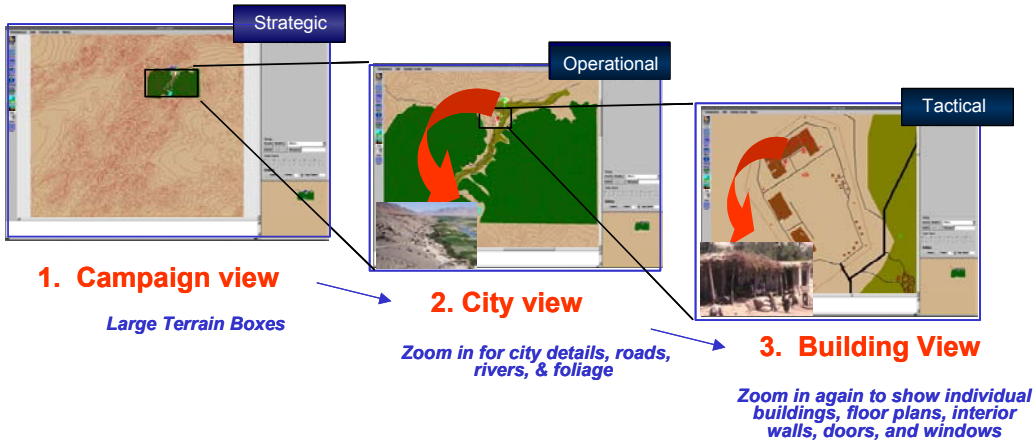

Figure 6. Joint Conflict and Tactical Simulation

UOB. The Unit Order of Battle (UOB) represented in Figure 7 is a data management program that permits the user to select desired units and equipment from a library of classified and unclassified authoritative UOB databases and tailor them for use in other tools. Although originally designed for U.S. military units, foreign military unit and opposing force sources (i.e., Conventional Forces Europe and Modernized Integrated Databases) have also been added and can be exported in XML format. Most recently, selective approximations of IO, NGO, and PVO were constructed and added to the database.

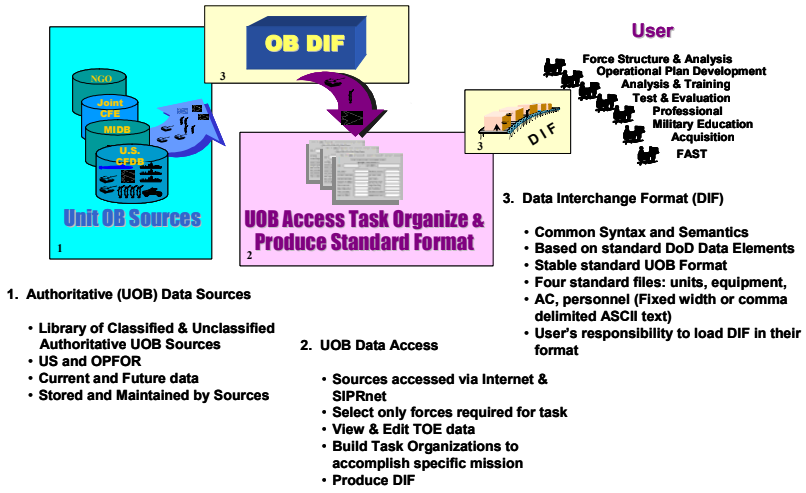

Figure 7. Unit Order of Battle

The UOB consists of three main components: a library of authoritative UOB data sources, a data access tool (DAT), and a data interchange format (DIF). The DAT features a graphical interface that allows users to retrieve/browse UOB data and associated information, as well as select individual units easily and quickly across distributed networks. Moreover, selected units can be task organized to the desired unit level and unit attributes can be edited and used as start-up data in models. Based on DoD standards, the DIF presents UOB information from all library sources in a consistent and standard format that enables users to interface their M&S systems.

CFLD. The Canadian Forces Landmine Database (CFLD) depicted in Figure 8 was produced by the National Defence Mine/countermine Information Centre. An unclassified information tool for the ground soldier, it provides critical information and supporting imagery on approximately 310 mines. The CFLD can be run on a number of platforms and is easily and rapidly updated as new information becomes available. (CFLM User Manual, 2002) This tool resides as a stand-alone data source within the OOTW "Toolbox" and provides a range of options (i.e., key words, shape, material, color, country of origin, mine type/name) to facilitate access by the soldier.

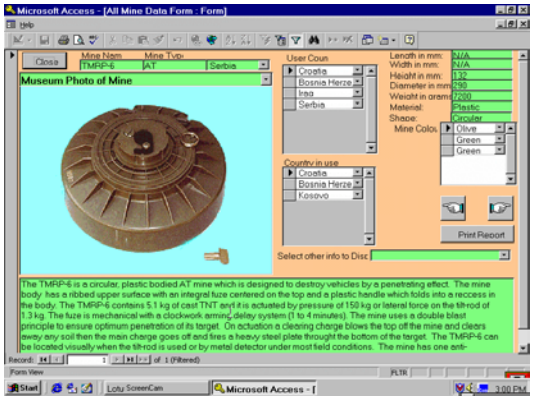

Figure 8. Canadian Forces Landmine Database

PROTOTYPE ENVIRONMENT

Environment. Because the prototype "toolbox" incorporates models (i.e., DIAMOND and JCATS respectively) that execute on different operating systems, the M&S environment needs to be robust enough to support a range of operating systems and software applications. This requirement emerged so that a Microsoft Windows operating system for DIAMOND and a Linux operating system for JCATS could coexist on the same piece of hardware. While boot loaders have existed for several years, allowing the user to select the desired operating system at boot time, the interaction of the applications within the prototype environment created an initial challenge that was met by using VMWare Workstation.

Since VMWare enables multiple operating systems to run on a single physical computer by creating virtual machines, the operating systems and software applications can be isolated within the virtual machines. Moreover, the VMWare Workstation exposes all the hardware devices to each virtual machine, enabling operating systems and applications the access to networking and other system services. With VMWare as an integral part of the "toolbox" environment, the warfighter is able to run applications (simulations and models) that are hosted on different operating systems in a side-by-side environment.

Engineering Approach. Because the prototype environment consisted of several applications, an emergent requirement to organize data and interchange data between applications was created. To meet this challenge, the Controller and a family of DIFs were scoped. As depicted in Figure 9, the Controller serves as the central location for the warfighter to catalog and organize the data being used within the prototype environment. A family of DIFs using XML schema were developed to describe the formats used to share the applications data.

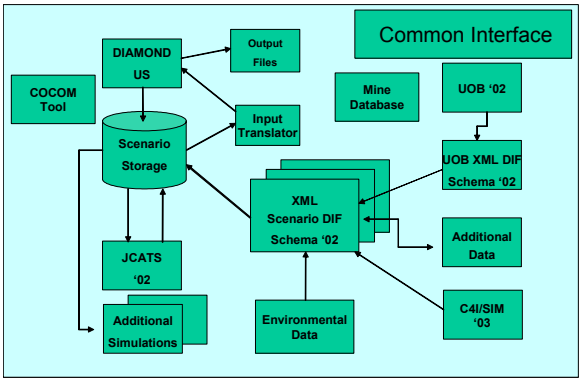

Figure 9. Architecture Structure for Tool Integration

Family of Data Interchange Formats. The basis for sharing data between the applications in the "toolbox" is the definition of common DIFs. Initial work focused around reverse engineering the data required for the simulations within the "toolbox" as well as the scenario data to understand the attributes and semantics. Once this was completed, a common Subject Area Information (SAI) model was forward engineered to capture the definition of the essential

scenario data. From the SAI model, a scenario DIF was generated. This process is portrayed in Figure 10.

To syntactically describe the DIF, an XML schema was chosen. Since an XML schema provides a tighter definition over syntax of the data, it was chosen for better validation of data. Currently, the prototype environment hosts two DIFs--a scenario DIF and a Force Structure DIF. Because the controller will store data based on the defined DIFs in XML, applications within the "toolbox" will be capable of ingesting XML tagged data and creating XML tagged data for the controller to store based on a family of DIFs developed for the "toolbox."

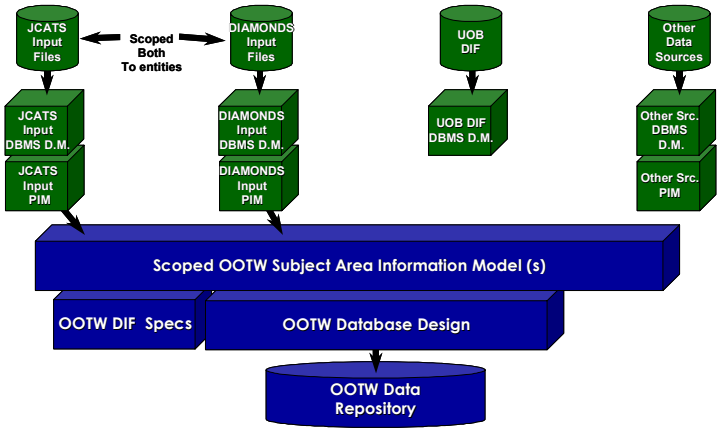

Figure 10. Data Interchange Format Creation Approach

NEXT STEPS

As noted in the discussion of the CONOPS, the OOTW Toolbox effort is dynamic rather than being static. User feedback will dictate the future course of the project. Figure 11 is the test strategy that was employed in part for FY02 and will continue to be developed throughout FY03 to ensure that each evolution of the prototype "toolbox" is consistent and thoroughly reviewed.

The test strategy follows a traditional "alpha, beta final" sequence that includes benchmarking, planning, model testing, integration testing, formal testing, and reporting. Again, paramount importance is placed on satisfying user requirements, which will be integrated into the validation and verification (V&V) process as well as using subject matter experts (SME) in parallel with ongoing use case development.

Future efforts will focus on refining the CONOPS, developing more scenarios, and greatly expanding the types and numbers of tools in the "toolbox." The final architecture and use of XML to share data should greatly facilitate adding existing tools to take advantage of technological advances and the evolution of the missions that the tools will support. In the mid- term, the OOTW Toolbox can serve as a mature, well-developed capability to be incorporated into future M&S development that has focused on conventional combat operations. In the long-term, the OOTW Toolbox provides an opportunity to lend structure to the operational, technical and systems architectures for OOTW M&S capability development.

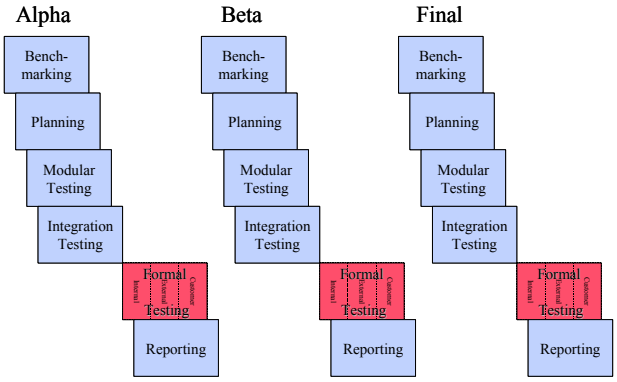

Figure 11. Test Strategy

As the Department of Defense and the Military Services transform and warfighters are faced with more diverse and complex challenges, the OOTW Toolbox becomes a "FAST resource" to meet these challenges.

ACKNOWLEDGEMENTS

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