Integrating Planning & Experimentation

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ABSTRACT: USJFCOM Joint Innovation and Experimentation Directorate experiments with an effects based approach to operations (EBAO) by integrating the planning process across diverse domains, spanning local to global scopes, and conducting excursions over different time durations and geographical regions. Providing a comprehensive planning framework requires a shift from the traditional approach of single-scope, military experiments that use attrition-based simulations as the main driver. An integrated planning environment is a many-sided approach that allows a user to plan the actions of any entity in the environment and at any scope, such as a national government, military force at a given echelon, key leader, organization, or critical economic infrastructure.

To support such a comprehensive framework requires more than simple syntactic interoperability. Several emerging technologies enable semantics-based integration. Using these emerging technologies, this paper explores how the Synthetic Environment for Analysis and Simulation can be semantically integrated with the Integrated Gaming System, an adaptive planning environment, to create a more complete environment in which EBAO experiments can be conducted in support of USJFCOM.

Further, this paper explores how emergent behavior was applied in an application that supported, but not limited to, a homeland security scenario called Demo America in support of the Modeling and Simulation (M&S) Capabilities Demonstration Fair Homeland Defense and Defense Support to Civil Authorities.

BACKGROUND

The USJFCOM Joint Innovation and Experimentation Directorate (J9) experiments with an effects based approach to operations (EBAO) by integrating the planning process across diverse domains, spanning local to global scopes, and conducting excursions over different time durations and geographical regions. Providing a comprehensive planning framework requires a shift from the traditional approach of single-scope, military experiments that use attrition-based simulations as the main driver. An integrated planning environment is a many-sided approach that allows a user to plan the actions of any entity in the environment and at any scope, such as a national government, military force at a given echelon, key leader, organization, or critical economic infrastructure.

Comprehensive Planning

Strategies encompass planning from multiple scopes and diverse perspectives. A planning environment that integrates planning across the various granularities and that allows plans from multiple sides is necessary in order to capture the challenge of experimenting with planning in a synthetic environment. Specifically, this adaptive planning environment could assist decision makers in making more informed decisions. The proposed applications going far beyond an initial military focus to a larger context of bridging planning across all facets of one's sociality to include issues associated with homeland security and defense (HLS/D).

An integrated planning environment that is to support unbiased wargaming must allow any group or entity to strategize. Effects based planning (EBP) leverages nonmilitary as well as military actions in an effort to achieve desired outcomes, incorporating the influence of populations on military planning and visa versa, the side effects of military operations on populations.

Military planning can span scopes from individual unit tactics to campaign level strategies. Consequently, an integrated planning environment must capture all levels of temporal, spatial, and individual granularity, where individual granularity is the amount of aggregation of human entities, such as an individual first responders, platoon, security force, and battalion.

Once the various sides have designed plans, an experimentation environment that represents society is required to execute the various interacting and interfering plans. Any side can take actions on nonmilitary entities, such as determining potential impacts on key infrastructure or how to sequence the rebuild of critical infrastructure. Actions are simulated within a synthetic environment that includes political, military, economic, social, information, and institution entities (PMESII).

The SEAS-IGS Society provides an integrated planning and experimentation environment required in order to experiment with EBP in an efficient manner. The SEAS-IGS Society consists of the Synthetic Environments for Analysis and Simulation (SEAS) and the Integrated Gaming System (IGS). SEAS facilitates planning from the nonmilitary perspective. Military strategies are designed and rehearsed through IGS. The plans are executed by bridging the runtimes of SEAS and IGS simulations to form a synthetic environment that incorporates population behavior and military operations.

EXTENSIBLE TECHNOLOGY

Facilitating the integration of the SEAS-IGS Society into a single planning and experimentation environment, a technology called the SimBridge is what enables this Society of Systems (SoS) approach. Both the SoS and SimBridge will be discussed in more detail later in this paper.

SEAS Overview

SEAS provides a framework that is unbiased towards any one specific scenario, model, or system and can be used to represent fundamental human behavior theories without restrictions on what can be modeled, uncommon in today's simulation efforts. The enabling technology leverages recent computational advances in agent-based distributed computing to decouple control as well as data flow.

SEAS is built from a basis of millions of agents operating within a synthetic environment. Agents emulate the attributes and interactions of individuals, organizations, institutions, infrastructure, and geographical decompositions. Agents join together to form networks, from which evolve the various cultures of the world's population. Intricate relationships among political, military, economic, social, information and infrastructure (PMESII) factors emerge across diverse granularities. Statistics calculated from the simulation are then used to provide measurable evaluations of strategies in support of EBAO decision making.

Virtual International System (SEAS-VIS)

SEAS represents an environment at the fundamental level of individuals, organizations, institutions, infrastructure, and geographies (IOIIG). The population agents of these fundamental types form higher order constructs in a fractal-like manner, meaning sufficient detail exists at multiple levels of focus, from world constructs to individuals. Higher order constructs include political systems (types of government, political parties and factions), militaries (individual soldiers, military institutions, branches of service), economic systems (formal banking networks, black-market structures), social systems (tribes, religious groups, neighborhoods), and information systems (print, broadcast, the internet). The behavior pattern of each of these entities is derived from various theoretical paradigms covering a wide range of disciplines.[1]

Extensible Net Assessment (xNA)

The xNA is the primary data repository used by SEAS Unlike typical data repositories, xNA represents data in its defined ontological format and stores its data in a multi-dimensional space, allowing it to simultaneously store overlapping or conflicting information along different dimensions, but retrieve consistent snapshots of the data when values for the dimensions are constrained.

Typical repositories store only a single snapshot. This means that, as data changes in the repository, old data is overwritten with the new data and lost forever. In xNA, however, all data is tagged with the source from which it came, the point of view that this data is consistent with, and the dates describing the time during which the data is effective. This means that the "old" data is not required to be overwritten, due to the multi-dimensional space in which it is stored; snapshots can still be taken at times prior to the effective dates for the new data or using different subsets of sources or points of view, and the values will show as the "old" values that were effective at the snapshot date.

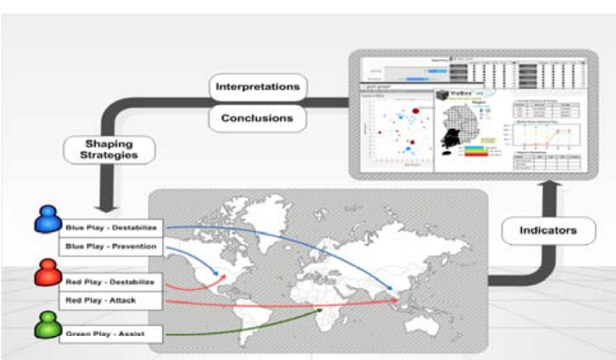

Figure 1. A Conceptual View of SEAS Action Planners in Practice.

Action Planners

SEAS provides a user interface for EBP that enable users to plan a set of actions on PMESII nodes and track how well the simulation results correlate with a set of desired effects. The Action Planner interface allows users to construct a library of plays, build plays into playbooks, and mix and match or reuse plays. Complex, multifaceted strategies can be designed that incorporate actions on individual leaders as well as on localities, cities, nations or organizations.

Experiment Manager (ExMan)

ExMan combines the base system of SEAS-VIS models, xNA information, and Action Planner plays with executable simulations and active systems to provide a dynamic deployment framework. Experiments deployed by ExMan are configured using a description of the simulations to employ, a Simulation Window, and the set of systems that are required in order for the simulations to execute.

The Simulation Window configures the virtual environment by specifying a Simulation Window that includes the amount of fidelity to apply to geographical areas based on a scenario's requirements. The spatial fidelity determines the granularity of population representation and number of nodes (leaders, organizations, institutions, and infrastructure) for the experiment. The temporal fidelity is specified by a Simulation Window in terms of the beginning and ending calendar dates and the size of a time advance.

Society of Systems (SimBridge)

The runtime execution of an experiment occurs using a Society of Systems (SoS).[2,3] A SoS is analogous to a society of people, as both are loosely coupled constructs in which independent individuals contribute toward a single societal identity. A society is an organized group of individuals who associate for common purposes. Simulations, database servers, and other system components make up the Members of a SoS. Members work together to achieve the common goal of modeling the system. Each Member is autonomously managed and cooperates with other Members to reach its personal goals. In the process of meeting its personal goals, a Member contributes to societal goals.

Members in a Society share aspects of their representations of reality with other Members through Shared Reality. All data exchange occurs within Shared Reality. Unlike traditional approaches to integration, Shared Reality is not a centralized management layer. Rather, Shared Reality is only

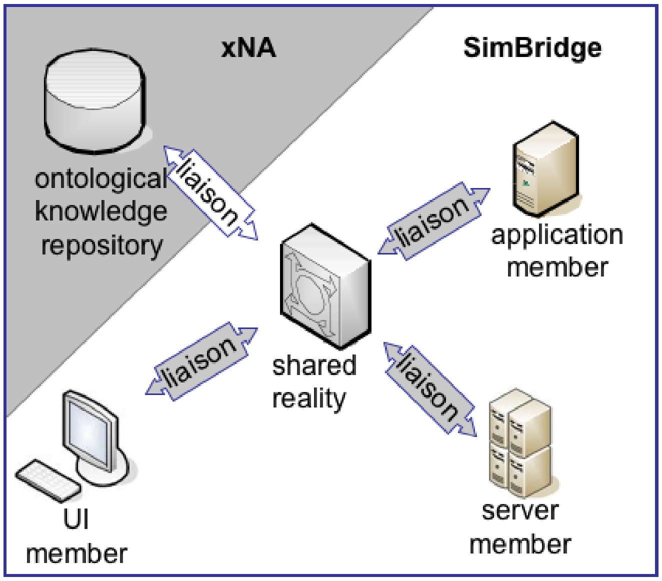

Figure 2. Illustration of the Components of a Society of Systems.

tasked with facilitating distributed and asynchronous access to information.

Each Member in a Society accesses Shared Reality through a Member-specific Liaison. A Liaison consists of the intelligence needed to interact with and control a Member and to interact with the rest of the Society. A Liaison is configured to use Member-specific mechanisms, such as initializations, inputs, outputs, and control mechanisms. In this way, the same Member can be used in different Societies and be continuously developed without being forced to address Society-specific characteristics, enabling reuse and independent development.

Data exchange occurs among Members in a semantics based manner. An ontological structure for all data represented in Shared Reality is housed within xNA. A Liaison uses the ontological specifications to determine which translator to employ to translate from a producer's semantics into a form its Member can consume.

A key aspect that differentiates a Society approach to system integration from other approaches is that the linkages among the Members emerge as opposed to requiring a full specification of an engineered network. In the organizational language of a society, satisfaction of societal goals emerges as all Members progress towards their personal goals.

Integrated Gaming System (IGS) Overview

The Integrated Gaming System (IGS) is a state-of-the-art toolset capable of addressing a wide range of issues (e.g., course of action and concept development and analysis, and capability trades or technology enhancements). At present, the tools offer a unique ability to represent traditional attrition metrics and a host of entropic factors. These tools have been used in wargames, analytic studies, and exercises to assess issues ranging across the kinetic, non-kinetic, informational, and social and cultural domains of complex warfighting environments. IGS provides scenario generation, planning and rehearsal, adjudication, and communication capabilities in a single, integrated architecture, supported by a common database.

As part of the Adaptive Planning initiative for OSD/policy and Joint Staff, J7, IGS will soon be supporting the combatant commands as their primary theater-level wargaming tool. At a recent planner's conference, the COCOM J5 directorates unanimously selected IGS as the preferred wargaming toolset, following an intensive planning evaluation for US Central Command as well as IDA's independent assessment performed for OSD and the Joint Staff.

IGS has the capability to read in various databases (e.g., Intelligence Community's Modernized Integrated Database [MIDB] and USJFCOM's Operational Net Assessment [ONA] database) to assist in order of battle and plan development. IGS also shares information with the following other tools:

- Joint Flow and Analysis System for Transportation (JFAST)
- Joint Semi-Automated Forces (JSAF)
- Satellite Toolkit (STK)

Scenario Tool

The Scenario Tool is the principal interface that analysts and operators use for building and modifying the IGS database, including developing operational order of battle (OOB)s with their supporting, but not limited to, logistics and communications networks. The Scenario Tool consists of four primary interfaces (i.e., windows):

- **Task organization window**—allows the user to develop and adjust force structure
- **Logistics window**—is the interface for creating and linking logistic nodes to units
- **Communications window**—defines and links communications networks with each other

- **Map window**—provides visualization of the force lay-downs, logistics and communications networks, and depiction of key bases and affiliations.

Campaign Planning and Rehearsal System (CPRS) and the Rapid Adjudication Tool

CPRS was developed as a method of automating the military decision-making process for planners. The system is used to view orders, tasks to units, supporting graphics, and text documents. After the OOB has been finalized in the Scenario Tool, CPRS becomes the primary planners' interface for assigning operational and tactical tasks to units and placing them in an interactive multilevel execution matrix. CPRS also presents a display of operational graphics and enables the rehearsal and synchronization of those plans while viewing them on a map display. CPRS gives Red and Blue planning teams a capability to build, view, edit, rehearse, refine and merge plans, and rehearse the timing and sequencing of tasks. For example, in a joint planning environment, individual components can separately develop the land, maritime, and air plans in CPRS. After developing the plans, they can merge the plans into a combined plan for final rehearsal and adjust the timing and location of any tasks not properly sequenced.

Within CPRS, the Rapid Adjudication Tool provides rapid adjudication of CPRS plans using a correlation of forces model augmented by elements of the EBW Combat, Sensing, and Non-Attrition Algorithms. The Rapid Adjudication Tool was developed to provide planners with the ability to quickly analyze and adjudicate the expected success of potential Courses of Actions (COAs) within CPRS and to select those that warrant further adjudication and analysis in EBW.

Entropy-Based Warfare Model

EBW represents non-attrition factors in military operations and provides detailed campaign and mission-level adjudication of the plans developed by participants. As part of the continued evolution of thinking on warfighting, the EBW model was designed based on the concept that attrition-oriented modeling fails to accurately explain the full construct of warfare. Instead, Mark Herman argued that the correct paradigm for assessing and analyzing warfare addresses the traditional attrition approach but within the context of a larger, non-attritional context, which was a "function of cohesion and physical capabilities… [where] inequalities in cohesion can have as great an impact on combat outcome as does lethality."[4] EBW mirrors this conceptual paradigm by representing the outcome of warfare as a function of traditional lethality in the form of attritional combat and nontraditional impact of entropy on a unit's cohesion and overall combat effectiveness.

In terms of attrition-based combat, EBW represents all forms of kinetic and non-kinetic engagements, including engagements among all the combat mediums of ground, naval, undersea, and air and space and the interactions between each (e.g., air-to-ground, naval-to-undersea, space-to-ground). In terms of non-kinetics, EBW leverages its representation of nontraditional unit attributes such as morale, leadership, and C2 to represent the ability to affect and degrade these attributes. This effort is achieved through several forms of non-kinetic actions, including Information Operations (e.g., psychological operations [PSYOP]) and other non-lethal actions (e.g., electromagnetic pulse [EMP]). The next two sections discuss the traditional kinetic and non-kinetic representations of the EBW adjudication model.

IGS Complex Operations Tools

Despite the initial focus of IGS on the traditional warfight, subsequent development was focused on tools that addressed the political and social aspects of the complex battlespace.

This led to the development of a family of Complex Operations tools within IGS, featuring the Network Exchange Simulation (NEXS), the Political Will Model, and the Stabilization and Reconstruction System (STARS).

Network Exchange Simulation

NEXS was designed in 2005 specifically for US Special Operations Command (USSOCOM) to represent terrorist networks in a global context by discretely modeling asset-based and communication-based traffic over various types of networks (such as financial, weapons, and communications). NEXS identifies and prioritizes key nodes and linkages, either locally or globally, using the Social Network Theory and Mathematical Graph Theory in a dynamic simulation. Like EBW, NEXS helps the analyst develop a perceived view of the network, depending on the level of knowledge of the nodes and their linkages. This view is based on data collected by ISR assets, including human intelligence collection activities. The NEXS tool has customizable metrics to enable analysts to determine the critical interconnections of a nodal organization, determine the key suppliers or middlemen in a region or network of interest, and determine high-value targets for affecting network performance.

Political Will Model

The Political Will Model was originally devised in 2000 in support of a Joint Forces Command effort to develop and explore the rapid decisive operations concept. The Political Will Model represents the relationships among leaders and between constituents and their respective leaders associated with support of a defined policy. This tool measures support for specific policies by linking constituents and assessing the strength of their influence and their reactions to events over time. The output highlights how decision makers can be influenced through non-military and military means to end a conflict faster—and with less combat.

Stability and Reconstruction System

STARS provides an analytical framework for assessing the satisfaction of populations or subsets of a population based on their specific needs and environmental factors that affect their expectations. Subsistence needs of a population (e.g., food, water, shelter) and the capability to partially or fully satisfy them with indigenous infrastructure or external providers can be modeled in STARS. Analysts and planners can estimate the likely capabilities required to satisfy the needs of the factions or cities of a given country or region. This estimate will help the planner identify potential capability gaps, as well as formulate a more effective plan for the implementation of stabilization and reconstruction operations. STARS tracks the status of each of the variables throughout a model run and can provide the user with the final status, trends throughout the time-step, and the implications of the employment of those capabilities. STARS enables analysts and planners to examine the effects of apportioning key capabilities and resources and can help address key issues.

Taken together, these complex operations tools within IGS tools provide a robust capability for the wargamer, analyst, or planner to develop insights into the effects of military and nonmilitary actions on the political, cultural, and infrastructure in a given scenario.

INTEGRATING PLANNING

The core planning system enables a playbook to be composed of plans at the international, national, city, and neighborhood levels, encompassing the detail of tactical unit scheduling as well as the scopes of operational and strategic planning. Plans are stored in an ontology-based repository and retrieved to generate playbooks for specific sides. In both IGS and SEAS, users can merge or mix plans, facilitating the rapid creation of new playbooks.

SEAS Action Planners and the IGS CPRS tool are integrated together to enable strategies and counter strategies to be designed, characterizing various key players in an n-sided game. SEAS Action Planners provide users with the ability to construct a course of action (COA) playbook consisting of a number of actions to execute at certain times and the amount of available resources to apply to those actions over time. The planning environment in IGS consists of a scenario planning tool for designing an order of battle and CPRS for plan-level rehearsal and tuning. Plans in IGS are composed of time based and condition based tasks.

The semantics of actions and entities differ among the two planning environments. IGS uses entities to represent aggregations of their real world counterparts. For example, an entity may exist in IGS representing the oil infrastructure in a province. On the other hand, SEAS represents the oil infrastructure in a province using a sample of individual physical structures and facilities, such as using one hundred oil-related facilities. Consequently, granularity conversions must be applied to incorporate military actions originating in IGS on infrastructure entities in SEAS.

Another heterogeneity in the integration is in the key metrics used by IGS and SEAS for analysis of results. IGS represents Combat Power and Unit Cohesion for military units, Infrastructure Effectiveness for infrastructure aggregates, and Satisfaction, Agenda, and Stability for population aggregates.

For the population, SEAS provides well being, support for, and emotional arousal against the various sides as key metrics. Infrastructure in SEAS influence a geography's economy. The capability of an economic sector to meet its target sales is provided as a metric that indicates the health of an economy.

Integrating SEAS and IGS provides planning and evaluation from different perspectives in one system. The diverse systems are integrated using an ontological representation of plans and metrics facilitated by xNA.

An Ontology-Based Representation and Repository for Planning

Storing plans in an ontological format allows plans to be easily translated for use by other Members of a Society. Translation of plans is performed automatically by Liaisons as part of the SoS mechanism. This means that other Members of the Society can execute plans using their own data. Plans can be read and used by any Member.

Alternatively, storing plans as a flat input file instead of in an ontological format would force each Member to conform to a common file format and semantics for describing plans. The SoS mechanism, however, alleviates the need for uniformity and enables independently developed planning tools to interact within a common integrated environment. The ontological structure provided by the xNA facilitates the handling of the translation and data synchronization issues by the SoS mechanism.

The use of the ontological structure also facilitates such tasks as reuse of plan components in multiple playbooks, substitution of plans in a playbook, and insertion or removal of plans from a playbook. This is because the ontological structure provided by the xNA breaks down a strategy into smaller, reusable, conceptual components within shared reality that Members of a Society can easily manipulate within the playbooks.

Integrating Experimentation & Planning

Plans, models, simulations, and runtime systems are used to execute plans within a virtual world and provide valuable analysis.

Instantiating Integrated Experiments

To instantiate an experiment, ExMan retrieves a list of configured Simulation Windows from a configuration server. ExMan also loads any checkpoints of simulations executed. This information is then used to instantiate a synthetic environment. IGS is provided with a URL that connects it with the SoS and indirectly with SEAS.

ExMan also provides a centralized user-interface to manage multi-COA experiments, which can include several parallel environments receiving different input scenarios from users. Users are able to instantiate new experiments starting from any calendar date supported by the configuration.

ExMan dynamically discovers all available active Execution Environments (EEs) during startup. EEs are virtualized clusters of systems that synthetic environments can be deployed on. EEs continuously send digital heartbeats to the ExMan, ensuring that ExMan will have the most current deployment information.

Society of Systems Design

The runtime components of IGS and SEAS are developed independently and concurrently. The runtime integration of IGS and SEAS is implemented a SoS.

Given the specific strengths of SEAS and IGS, the following data exchanges are planned to achieve simulation synergy to support PMESII planning.

IGS→SoS

- Current state of military units, a damage level of infrastructure, and actions taken against leaders.

  Military unit status consists of whether a unit is in close combat, whether it is under influence (IO/PSYOP), where it is located, and its combat effectiveness.

- Runtime actions by military units.

  Military actions such as movement, attack, defend, and IO as well as the units involved and the action status.

  Actions on infrastructure, such as repairs to the electricity infrastructure in a region.

  Civilians wounded or killed.

  Collateral damage as a result of combat or other actions.

SoS→IGS

- IGS leverages information on the effectiveness of infrastructure to aid in computing its key metrics of stability, agenda, and satisfaction that are based on the needs and expectations of populations.

SEAS→SoS

- Two principal contributions of SEAS are population behavior and a representation of an emergent economy.

  The size, well being, traits, attitudes, and arousals of a population in a region are shared.

  The capability of an economic sector to meet its target is provided, giving a measure of the health of an economy in an area. The capability of an economic sector emerges from the activity of infrastructure in the sector and dependencies on the supplies of other infrastructure as well as the consumer demand of the populations.

SoS→SEAS

- Presence and size of troops—this influences the security of an area and the rapport or conflict between a community and foreign troops.
- Activity, death, and injuries of troops that affect the population's perceptions of the various sides.
- Actions to rebuild or destroy infrastructure will have an indirect influence on a region's economy and a ripple effect on economies that depend on the products of the infrastructure.

Implementation of the SEAS-IGS Society

The SoS design described above will be used to enable activity of military units to impact population behavior and the economy. This Society also enables the analysis of the scenario to be viewed from multiple perspectives.

Plans developed in both SEAS and IGS are available for execution in the runtime environment. SEAS plans enable diplomatic, information, and economic actions to be taken on nodes. IGS plans provide much more detail describing military strategies. Integrating the planning environments together enables fidelity in all aspects of PMESII modeling and planning.

To facilitate the runtime integration, IGS is connected to Shared Reality by an IGS-Liaison. The IGS-Liaison seeks for all data in Shared Reality that indicate the effectiveness of infrastructure. Any infrastructure capability statistics produced by SEAS that are discovered are converted to match the granularity of IGS and transformed in order to be consumed by IGS.

Additionally, the IGS-Liaison queries Shared Reality for population well being, attitude, and arousal statistics and maps these to the decomposition of population represented in IGS. The appropriate mapping is performed by searching for statistics constrained by key distinguishing traits of the population, such as religion and income class. This implementation is useful to investigate potential jurisdiction issues that arise from conflicts along religious and income class lines.

Unit actions to perform activities, such as improve infrastructure, are simulated in IGS and shared in Shared Reality. In turn, the SEAS-Liaison senses any such actions and applies them to infrastructure entities in SEAS. To do so, the actions on aggregated infrastructure must be disaggregated appropriately, depending on the percentage of infrastructure that the IGS aggregates represent. The translation occurs transparent to IGS.

Any small unit activities that can be sensed by a population, are shared among IGS and SEAS. The components in IGS compute the execution of such activities and the IGS-Liaison shared the events with Shared Reality. In turn, the SEAS-Liaison senses these events, which enables the individuals and information networks to propagate their perspectives on the scenario.

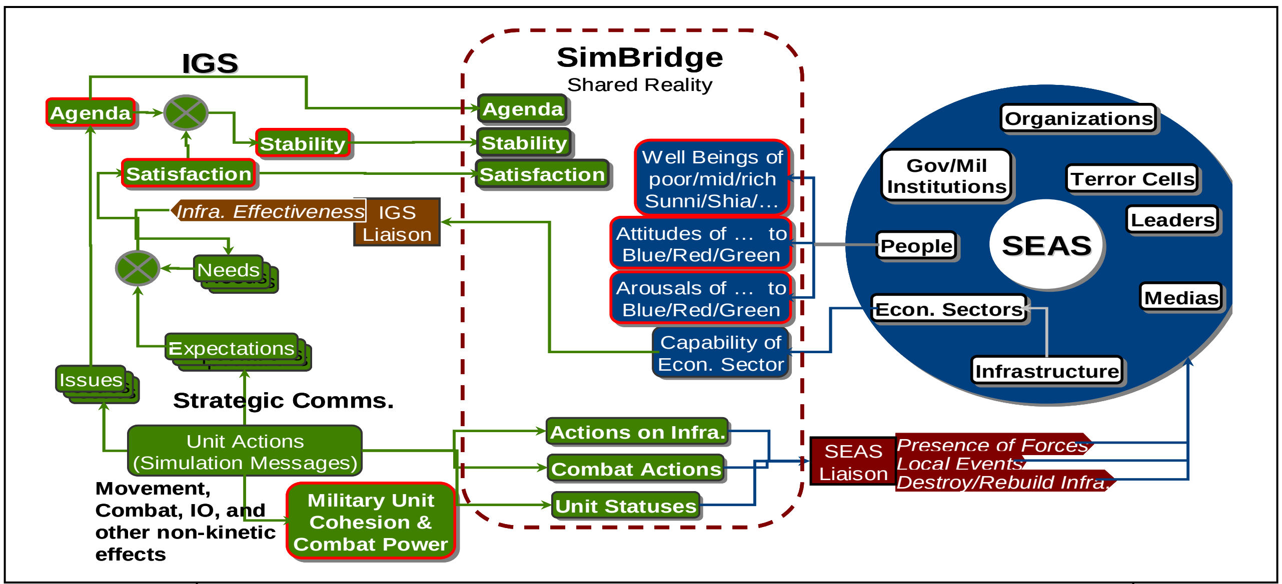

Figure 3. SEAS - IGS Run-Time Integration Approach and Semantic Mapping

In figure three, the keys attributes that are shared across the SimBridge are SEAS measure of the capability of the economy sector, and the IGS notion of unit activities. Overtime additional attributes could be shared across the SimBridge, but this requires the different communities to think what measures of merit (MoM) or indicators could be anticipated as being needed to credibly represent culturally relevant behaviors in an evolving PMESII framework.[5]

DEMO AMERICA

In order to assist the user community in thinking about which MoMs would be best to support the modeling needs to depict HLS/D situations of interest, USJFCOM J9 conducted a week long series of demonstrations designed to look at existing modeling and simulation (M&S) capabilities. While the scenario was nicknamed Demo America, the actual week long activity was called the M&S Capabilities Demonstration Fair Homeland Defense and Defense Support to Civil Authorities. For this fair, a sample set of applications were used to stimulate thought on how best to adapt existing capabilities M&S components to HLS/D needs.

Demo America participants were those development teams that responded to an open invitation, and willing to showcase their applications to support a common scenario. The resulting participants came from three basic groups: teams with contracts in support on-going USJFCOM J9 efforts, teams with an active Cooperative Research and Development Agreement CRADA) with USJFCOM, and teams that requested to participate, and provided a white paper on how their application may address the HLS/D concern which was highlighted in the planned scenario. The only other real prerequisites for participation were that the capability had to be displayed in the USJFCOM J9 demonstration area, and a subject matter expert that to be available to answer questions.

Figure 4. Listing of Demo America Teams

Figure four is a listing of those development teams that participated. Of note, some participants have staffs of less than a dozen while others have staffs in the hundreds. However, the key point is that they all represented a different approach to addressing the full spectrum of the HLS/D problem domain.

Event Design

Demo America was not an on-going experiment, but rather a vision to introduce M&S capabilities of J9 and its partners. Given that its main goal was to demonstrate available prototypes and capabilities to stimulate "What If? Thinking", the underlying intent was to solicit feedback to foster a collaborative link among government agencies, military commands, academia, and industry within the HLD/HLS arena. Design was accomplished with four weeks of preparation. The demonstration's construct used a notional terrorist event to provide a common thread to focus the sixteen capabilities. In this way, time did not need to be spent introducing the audience on more than one scenario. Then in regards to this notional threat, the components were divided into three general categories. First, some components were useful at defining the potential of the threat and identifying the threat before a crisis. Next, there were components that were useful at showing how the execution of a threat could threaten a population, and how the local authorities, state and national governments could adapt

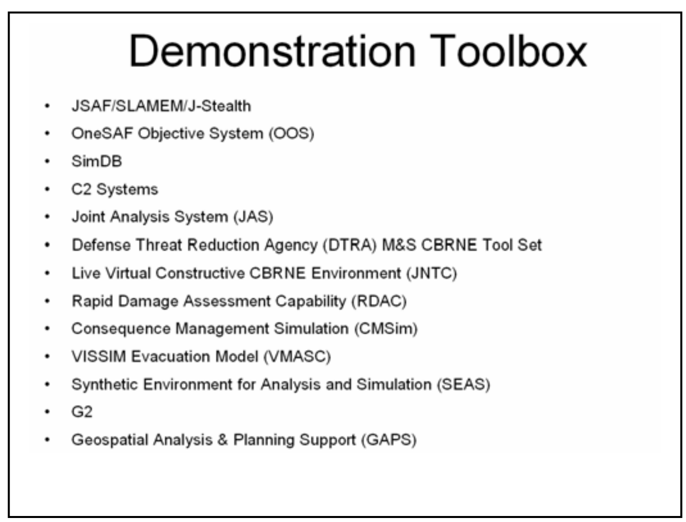

Figure 5. Listing of Demo America Components and their order of presentation.

to best contain the anticipated damage created by Demo America's notional threat. Finally, some components were used to highlight how to bring the entertainment dimension of commercial gaming into the discussion. Figure five provides a listing of the participants and their order of presentation.

FUTURE ADAPTATIONS

As the SoS approach evolves, this effort will address the common M&S gap to improve PMESII Modeling in the 21st century operational environment. This approach of semantic integration could be viewed as the next step beyond the interoperability offered by the High Level Architecture (HLA) protocol. The SoS approach has the potential to improve the methods for United States governmental agencies to better interact among themselves and help bring inputs from non-governmental entities to help forecast societal behaviors of nation-states, trans-national actors, and otherwise unpredictable enemies.

This integration project serves to prototype how relevant, culture-specific human behaviors can be factored into a PMESII representation of the world and how these representations can be visualized whenever, wherever, and by whomever they are needed to better enable the warfighter to win the global modern war. Further, this effort also prototypes a standard for allowing current integrating frameworks to shift to a Service Oriented Architecture (SOA) for consideration and potential adoption by the M&S and C4ISR communities. The value of these prototypes will provide a means for combining the tenants of the EBAO with PMESII modeling to support comprehensive planning. In other words, this project will assist coalition players to better realize the global application of all the elements of Coalition/National power, and how best to apply them to achieve strategic national goals. Thus, the next generation of some of the Demo America components, will be to bring some of their more HLS/D focused capabilities to other USJFCOM and external to USJFCOM M&S community events. This effort would be an expansion and further test of the SEAS-IGS PMESII M&S Society as new Members are joined to the Society.

In summary, during this four-day event, the J9 demonstrated how a disparate collection of M&S components, involving more than fourteen different industry and government organizations, and distributed among several sites around the country in real time, could be focused on a scenario of interest to those involved in HLS/D support to civil authorities applications. Although many of the components have already been used in other USJFCOM events, such as SEAS, the SoS approach makes the rapid addition of other simulations, such as IGS, feasible to quickly become another member of this society. In this way, the IGS adaptive planning capability could be easily added to the Demo America components to further demonstrate a variety of technologies to model, assess, and analyze the scenario as well as offering alternate means to compare varying courses of action to react to the possible dilemmas that may surface in regards to the investigation of various HLS/D situational studies.

Another prospect for future work is to expand support for the Homeland Security Infrastructure Program (HSIP) Geospatial Information. HSIP is the outcome of a joint effort among the National Geospatial-Intelligence Agency (NGA), United States Geological Survey (USGS), and the Federal Geographic Data Committee (FGDC), and is a Geographic Information System (GIS) dataset containing data on critical infrastructure (such as telecommunications, oil, gas, and other industries), first responder locations, road data, etc. Simulations, such as IGS, can currently read and display HSIP information. By publishing this information to SoS, any member of the society would be able to make use of any of the conceptual pieces of the information, without needing to parse the HSIP data or even knowing that the data originated from HSIP. Following the SoS approach, this HSIP aspect becomes a powerful addition to civil authorities, when couple with programs that support analysis, planning, training and experimentation. This approach becomes attractive as semantic-based integration has the potential of being much less costly than tradition interoperability methods as less development work would be required by all parties involved[2].

Another target for expanding this semantic integration of PMESII M&S tools is to support Homeland Defense planning and response initiatives such as with the USJFCOM experiment series Noble Resolve (NR) 2015. NR2015 is an outgrowth of this past year's USJFCOM Urban Resolve 2015 experiment where simulations provided an environment to explore capabilities to identify and isolate activities within an urban environment. As opposed to being warfighter-centric, NR's objective is to incorporate HLS/D scenarios into other USJFCOM events by building on the USJFCOM M&S capabilities developed during events such as Urban Resolve (UR2015). Overall the intent is to find a common M&S thread to integrate HLS/D in future USJFCOM events. Leveraging the semantic integration of the PMESII M&S federation during UR2015 via the SoS approach, as well as the simulations associated with Demo America, will demonstrate the applicability of extending traditionally

DoD-centric simulations and planning processes into the Homeland Defense arena.

References

[1] Chaturvedi, A. R. et. al. "Agent-Based Computational Model of a Virtual International System." In Proceedings of the Conference on Agent 2004: Social Dynamics: Interaction, Reflexivity and Emergence. Chicago, IL, 2004.

[2] Foong, C. M. et al. "Towards Enabling A Distributed And Scalable Society Of Simulations" In Proceedings of the 2005 Agent-Directed Simulation Symposium, San Diego: The Society of Modeling and Simulation International, pp. 11—18, April 3—7, 2005.

[3] Chaturvedi, A. R.; Snyder, D.; Foong, C. M.; Armstrong, B. "Bridging Kinetic and Non-Kinetic Interactions Over Time and Space Continua." Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC) 2005, Paper 2123, pp. 1-11, Orlando, FL, Dec. 2005.

[4] Herman, M. "Entropy-Based Warfare: Modeling the Revolution in Military Affairs," Joint Forces Quarterly, pp. 85-90, Autumn/Winter 1998-1999.

[5] Sokolowski, J. A.; Snyder, D. \"Combining Sensors and Simulations for Real Time Decision Support." Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC) 2006, Paper 2707, pp. 1-9, Orlando, FL, Dec. 2006.