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EXPLORING EFFECTIVE METHODS FOR MODELING A COMPREHENSIVE APPROACH TO POLITICAL, MILITARY, ECONOMIC, SOCIAL, INFORMATION, AND INFRASTRUCTURE (PMESII) / HUMAN, CULTURAL, SOCIAL, AND BEHAVORIAL (HSCB) COMMUNITY OF INTEREST (COI)

Randall B. Garrett
General Dynamics - Advanced Information Systems
Suffolk, VA, U.S.A.

Andreas Tolk
Dept. of Eng. Mgmt. & Sys. Eng.
Old Dominion University
Norfolk, VA, U.S.A.

Timothy J. Bacon
U.S. Joint Forces Command
Capabilities Solutions Group
Suffolk, VA, U.S.A.

ABSTRACT

The crisis response community recognizes the need for a Modeling and Simulation (M&S) approach that is based on a holistic understanding of the complex forces in society that comprise the political, economic, and socio/cultural environment. Comprehension resulting from accurate modeling of this domain could result in improved decision-making and command and control during crisis planning and assessment. The challenge is to build a virtual enterprise of networked area specialists and practitioners that collaborate by tools and technologies to assist organizations with the planning, analysis, preparation, and execution of PMESII activities. Discussed is an approach to establish a virtual Community of Interest (CoI) that both facilitates community interest and networks PMESII people, projects, programs, and tools. Also addressed is how mapping this information to a global visualization tool for shared use by the community can provide available information for both experimentation and real time crisis response.

1 INTRODUCTION

Building a virtual network of Subject Matter Experts (SMEs) and practitioners that can share expertise, tool sets and technologies remains a challenging task. Effective virtual networking should enhance a global Political, Military, Economic, Social, Information, and Infrastructure (PMESII) Community of Interest (CoI) aka "whole of society" comprehensive approach. This network will assist government agencies, international, intergovernmental, Non-Governmental Organization (NGO), private sector and academic organizations and institutions in developing plans for optimal engagement toward crisis response. (Petersen and Binnendijk 2008)

Specific to the US Government (USG), this network would assist in de-confliction of USG Policy and Engagement by enabling improved crisis response multi-dimensional planning. (Joint Operations Publication JP-3, 2007) A goal is that current virtual CoI efforts will become self sustaining, possibly led by a multi-dimensional senior steering committee, and eventually hosted by a neutral third party such as a foundation, NGO or academic institution.

2 INDENTIFYING A COMMUNITY OF INTEREST (COI)

Implementation planning by both government and non-government organizations requires a "whole of society" approach in response to worldwide events; however, the lack of a trusted PMESII SME enterprise inhibits practitioner's ability to create required multi-dimensional plans and analysis to improve information sharing. (Hodermarsky and Garrett 2009) Effective use of expertise for modeling Human Social Cultural and Behavioral (HSCB) or PMESII events requires active participation and involves a broad domain of disciplines, each uniquely contributing to a CoI.

To create an environment for mutual participation among PMESII and HSCB experts, the community must first identify the "who's who" of experts, their body of work and a general categorization of their expertise. Next, this mutual access to SMEs in a virtual environment should allow for a synergy of project awareness among participants of the various disciplines.

A shared interest among this community is the creation of a self sustaining program and virtual enterprise of SMEs, collaboratively networked by tools and technologies that results in trusted relationships that can assist government agencies and non-government organizations. A broad goal is to optimize planning, preparation and execution of crisis response scenarios or PMESII/HSCB mutual experimentation.

Supporting a virtual interaction are lessons learned from private sectors that conclude; a large group of digitally connected individuals will usually be smarter than a small collection of individuals gathered in a single location. (Sanderson, Gordon, and Ben-Ari 2008) Also observed is that mutual online environments, such as wikis, are faster at assembling up-to-date technical information than official web sites. Also, these "virtual" online forums are likely to spot emerging trends before they appear in the mainstream literature.

A loosely formed community of interest of practitioners within this crisis response community already exists. However, its members are geographically dispersed as well as segregated by specialty and expertise, thus rendering them potentially unaware of related efforts. The objective is to recognize and expand interaction among these diverse and multiple relationships.

As a first step in the establishment of a virtual network, a baseline of existing related people, projects, programs, and tools has been developed. The approach uses an on-line mapping and visualization tool to model the information collected from participants and makes it readily accessible via web technology to survey participants. As the virtual network expands, the HSCB experimental community plans to build a test scenario and experiment using input from experts within the CoI. (Law and Kelton 2000)

2.1 Method Introduced for Building a PMESII COI

Initially, a web enabled questionnaire was designed to raise PMESSI/HSCB community awareness and promote voluntary membership to a CoI. Information from the completed questionnaire provided the initial data for mapping to a global visualization tool shared by participating members of the community. This visualization tool became known as the *Catalyst Project*. (The Catalyst Project 2009)

The *Catalyst Project* sponsored by the U.S. Joint Forces Command introduces a method that first, identifies current HSCB/PMESII experts, projects and the related M&S tools used in supporting their programs or projects. Second, it makes an assessment regarding overlaps in project/tool functionality and in observed gaps for M&S capabilities as identified by the CoI experts. Finally, the project provides a virtual workspace for participating SMEs to share program and project information.

This baseline of existing PMESII related projects, programs, and tools provides a "quick look" into existing works and helps identify perceived gaps within community efforts. The idea is that by identifying these gaps and needs of the CoI, efforts may focus on development of both PMESII/HSCB and M&S capabilities resulting in optimal planning and insight into the execution of crisis response or relevant CoI participation in mutual experimentation.

An aspiration for the *Catalyst Project* is to create a virtual catalog of people, organizations, and projects being worked across the PMESII domains. Also, in partnership with the Army Research Laboratory (ARL) and Carnegie Mellon University, the objective is to develop a "Facebook-like" capability linking those doing work in the PMESII/HSCB community with shared or similar work within their organizations. These efforts are viewed as preliminary ground work for observing M&S gaps associated with HSCB. (National Defense University Washington 2008)

2.2 Identifying HSCB Modeling and Simulation (M&S) Tools

An initial problem for the *Catalyst Project* was how to find and establish communication with relevant community experts and associate them with their representative HSCB M&S tools or projects. This exploration also included the identification of PMESII M&S tool sets (Hartley 2006). Early on, a PMESII Baseline Collective Assessment (BCA) provided the framework for the project and presented an initial population of invitees to the web enabled questionnaire by identifying 1600 potential members in 438 organizations.

To motivate the community, the idea of a shared virtual environment was proposed, where experts can share their associated projects or tools contributing to a larger body of knowledge as well as communicate freely as peers. An early discovery in the project was that many experts within the HSCB/PMESII CoI were unaware of the existence of others working on the same or similar M&S projects. Another motive supporting a virtual CoI was the idea of immediate access to experts for decision-makers and first responders in support of immediate crisis response or humanitarian efforts. The basic rationale for this effort is a recognized need for understanding the complex forces in society that comprise the political, economic, and socio/cultural environment. An enhanced level of comprehension can lead to more coherent actions and better focused efforts to achieve HSCB/PMESII objectives.

How does this virtual interaction meet CoI M&S needs? The answer may be that if a problem set is first defined by a CoI member, then a repository of information such as that found in the *Catalyst Project*, may quickly aid with the identification of a correct M&S application. PMESII related tools such as COMPOEX (Hansberger, Spain, and Johnson 2007), PMFserv (Silverman, Gnana, and Nye 2006) and SEAS (Drnevich et al. 2008) are well known throughout the M&S community and serve a specified domain. However, many M&S tools go unnoticed by the HSCB/PMESII CoI and remain ob-

scured. These unnoticed tools may have possible use in a target HSCB objective and as a potential "best fit" for a problem set.

The vision is a functioning virtual enterprise of area specialists and practitioners, collaboratively networked by tools and technologies, establishing a trusted relationship to assist CoI members and organizations in the planning, preparation, and execution of their HSCB/PMESII objectives. This includes the efficient exchange of information in pursuit of shared goals, interests, missions, or processes between members from academia, industry, government, and private entities.

2.3 CoI M&S Interoperability

Within this virtual world, the necessity of interoperability among M&S tools with the associated expert theory remains for the CoI participants. (Tolk 2004) A HSCB framework for this interoperability, agreed upon by the CoI members, can help this community bridge gaps associated with M&S architectures and the conceptual semantic overlap associated with psychosocial theory. (Holi and Hyvönen 2004) Some specific examples of target areas of interest are those gaps associated with crisis response/humanitarian operational data as compared with M&S data, and gaps associated with proven social science theory and Irregular Warfare (IW). (NATO 2009)

3 VISUALIZING THE COI

In constructing a visualization tool for the CoI, a system of systems approach was considered that closely aligns with a cognitive mapping approach. (Cañas et al. 2004) The idea is that user thought processes for finding and viewing related systems projects, organizations and locations must be considered when building a data infrastructure to support the visualization software. This approach was applied by using a visualization management tools called "The Brain". (The Brain Visualization Management Tool 2009) Figure 1 is an image of this visualization tool showing a project display and associated meta-data for the PMESII CoI project. Users are able to search for related projects, organizations and individuals. Meta-data is displayed for the selected project or the associated expert.

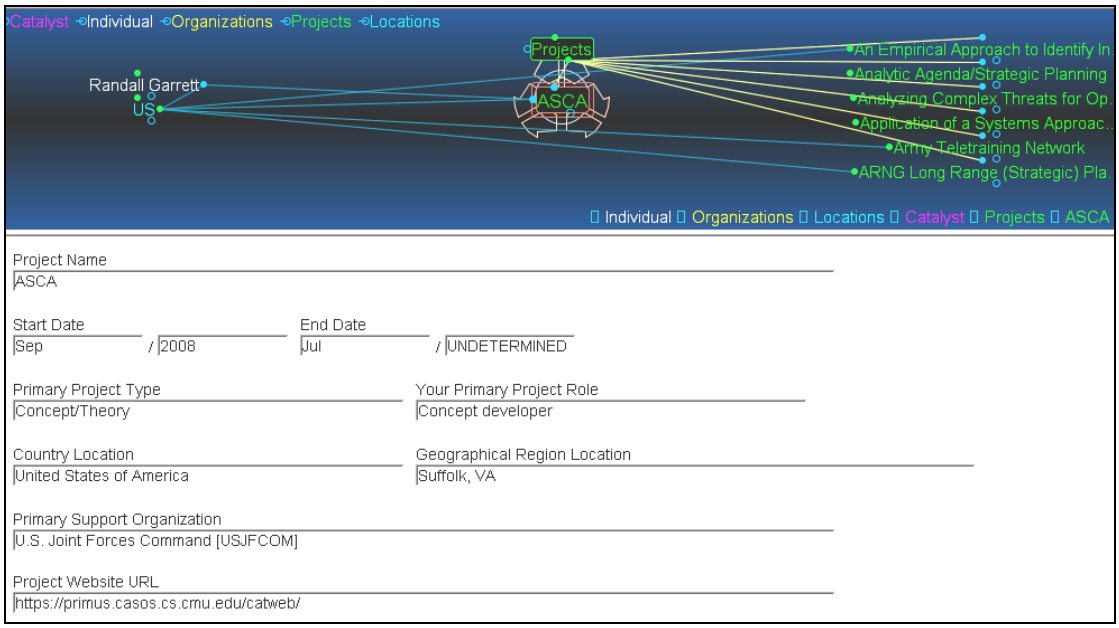

Figure 1: The Catalyst Project Interactive CoI

Currently, the *Catalyst* interactive tool is hosted by Carnegie Mellon University under the support and direction of the Army Research Lab (ARL). Future plans call for the expansion of this project to include decision-management tools that best support the HSCB/PMESII CoI.

4 COI INTERACTIION IN A VIRTUAL ENVIRONMENT

Iterative and focused workshops are logical steps for M&S support in planning for an exercise event using the CoI. Through participation in virtual workshops, the CoI shares an environment with other decision-makers, and interaction among participants may contribute to a carefully selected HSCB/PMESII problem set. In a Virtual World Collaborative Environment (VWCE) an organization or person has the ability to virtually link with colleagues from around the world and address mutual topics, solve specific problems "wiki" style, or introduce themselves and their work to those who they would not normally meet. Potentially, the results of a focused virtual workshop could provide collaboratively developed standards, rules, and guidelines optimizing information sharing & information access for the CoI.

Plans are to have selected HSCB/PMESII CoI members participate in a virtual workshop for the purpose of creating domain related M&S tool assessment among other things. A goal of this assessment process is to debate the merits for this community to adopt an architecture and open standard for human domain PMESII tools, networks & data. The idea is to leverage active communities and assimilate ongoing efforts across the PMESII domain.

Benefits of this virtual interaction address the impracticalities of meeting in person allowing geographically dispersed members to share a common workspace. Other advantages include cost avoidances associated with travel time and expense, near real time communication within a shared environment and the ability to adjust this environment quickly complementing a shared awareness. However, for virtual interaction to be successful for CoI members, many of the obstacles associated with this virtual interaction must be overcome. Examples of these obstacles are associated with the quality of work performed in the environment. In many cases, software developers are representing a subject matter vice its professional representation by experts in the field. Other examples affecting the quality and content of a virtual meeting include obstacles associated with coordination. In many cases, a virtual working group may settle for reduced quality or performance from the group as the process of making a sustained virtual environment over-rides the importance of the group agenda. Hence, the environment becomes more important than the subject matter at hand.

It is not enough to promote a virtual workspace such as those found in Second Life (SL), the 3D digital world, Olive, OpenSim and other collaborative environments. (http://www. secondlife.com) There needs to be an attraction on the side of the participants, a goal, a perception of meaningful interaction or usefulness, motivation, and a trend surrounding this new environment. Without these, the forum is worthless, no matter how novel or interesting the technology.

The question then becomes how to motivate HSCB/PMESII CoI participants to interact in a virtual environment. An insight into this is provided by a study of the utility of this interaction. (Mudgal and Vassileva 2000) Below are these factors associated with motivating CoI virtual participants:

- Importance of financial gain to the participant or group (greed or generosity)
- Importance of the current goal of the user (receiving help or performing current task)
- Importance of the relationship between the users (friends or foe)
- Risk attitude (how much a user is willing to gamble in negotiation)
- Perceived utility function and factors of the other participants (participants asses each other to optimize their negotiation strategies)

To help nurture a culture for HSCB/PMESII CoI participants, SL is being tested as a possible decision support platform for iterative workshops and as a possible trial experimental medium. SL is an emerging technology that is controversial within DoD, however it is an exciting platform for multi-user visual simulation and decision support.

5 EXPERIMENTATION USING THE COI

Limited Objective Experiments (LOEs) are planned using the CoI to assess a joint task force commander and their staff's ability to effectively use CoI contributions in critical crises response planning. The idea is to develop a "whole of society" answer to a scenario based problem set that evolves as joint task force. This will allow community members to reflect "real world" characteristics in the VWCE allowing enhanced information sharing, collaboration, and lesson learned exchanges.

5.1 Defining the Problem Set

When defining the problem set, a scenario that is important to our partners should be considered. It should also stress the armed forces' ability to work with a community that it does not normally work with. With this in mind, a goal of the experiment is to deter the evolution or creation of a kinetic fight when responding to a crisis response event, thus minimizing the potential for conflict. The CoI may be used to facilitate this discussion and to search for consensus, or frame a realistic problem in the following areas:

- Critical Crisis Response (Rintakoski and Mikko 2008)
- Humanitarian and Stabilization (Robbins, Deckro, and Wiley 2005)
- Homeland Defense
- Public/Private Sector (Sanderson, Gordon, and Ben-Ari 2008)
- Peace Operations (Chandran et al. 2009)

5.2 Presenting the Problem Set to the PMESII CoI

Presenting a defined problem set to the community within a virtual environment entails a trusted interaction among experts and an expectation among collaborative members that their contributed expertise is, in fact, valid for observing a specific experimental event. Stressing the community with a problem set is predicated that community representatives are vetted as experts in their respective fields. This recognition of expertise remains a fundamental premise for the *Catalyst Project* and is an initial step in the direction for a legitimate categorization and sustained confidence regarding a repository of HSCB/PMESII practitioners. However, further work needs to be done in this area and in the area of validating experts for specific PMESII use cases.

The question remains as to the importance of stressing the community with a HSCB/PMESII problem set. A simple answer is that a diverse CoI should provide a non-restrictive view point for crisis response problem-solving and one that is not predicated on individual, cultural or social bias. This broad range of knowledge associated with the CoI should provide new insight for using M&S in support of HSCB/PMESII problem sets. This broad domain of experience associated with multiple experts should serve as a benefit to the experimental community.

5.3 The Virtual Experiment

Conducting a LOE in a VWCE will require active member participation in iterative workshops to plan, organize and "set the stage" for the defined problem set. Recommendations from members attending the these workshops will be used to ultimately define a problem set and to mutually agree on an experimental approach. The workshops will also confront the challenges associated with collaborative experiments in a VWCE. (Wainfan and Paul 2004) What is needed is a collaborative group of proven experts successfully operating in a VWCE dedicated to solving a given HSCB/PMESII problem set.

Currently JFCOM is working with University of Edinburgh in a SL environment testing how PMESII analysis tools, M&S or decision-making systems may present their information in some useful way into this 3D space to be shared by the CoI. Some initial collaborative workshops are using SL avatars for this coordination. If it is shown that systems can be effectively used in this manner and mutually shared within the VWCE, then SL may be considered as a platform for the initial experiment.

6 M&S SUPPORT FOR HSCB

In the process of identifying existing PMESII M&S programs and associated tools in the *Catalyst Project* and comparing system similarities, the issue of interoperability within a collaborative environment became apparent. How can these different tools that address the same social theory both share and display information in a VWCE? How could these disparate systems be used effectively to provide accurate situational analysis for collaborative planning? (Waltz 2008) One answer is to simply display them separately as different views, or feeds, within the same virtual workshop with members addressing given problem sets based on individual displays. However, a better alternative might be to directly address and resolve interoperability and semantic problems associated with an M&S architecture that integrates Psycho-Social models and theory. (NATO 2009) An example use case is to define an M&S structure that could be used to model proven HSCB theory supporting Psycho-Social effects and its mapping to pre-selected elements of Irregular Warfare (IW). (NATO 2009) A road map is needed for HSCB M&S system interoperability and model integration.

7 CONCLUSION

Building a virtual enterprise of networked HSCB/PMESII professionals who are able to collaborate effectively and share program information and who are able to interoperate with related M&S tool sets remains a daunting task. Each discipline may vary widely in methods used to analyze problems associated with HSCB events. Decision-making tool sets are not often compatible between programs. Also, there must be motivation for members to join and contribute toward a collaborative problem set. However, if current efforts prove successful for participation and cooperation among the community, acute observations resulting from shared M&S models in a virtual environment - whose input is contributed by domain experts - could result in a productive scientific approach to planned actions and focused efforts toward crisis prevention.

Initial steps in meeting the challenge of building a virtual enterprise of networked practitioners are complete with implementation of the *Catalyst Project* that provides a PMESII "who's who" of experts, their organizations and projects, as well as the supporting M&S tools. The project is already making significant contributions to the PMESII domain through member awareness, idea exchange and identification of potential colleagues who share similar interest and who are working on related projects. This successful sharing of information among international members found in academia, industry, government, and in the private sector contributes greatly toward building a diverse and broad base of HSCB/PMESII experts for the CoI.

To complete this challenge, mapping this information to a global visualization tool for shared collaboration is currently being addressed by targeted iterative workshops using a VCWE. This environment, when completed, will allow for a shared awareness within a virtual environment for CoI participants. A future goal will be to define a crisis response problem set and use this shared environment for collaboration, experimentation and problem solving.

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AUTHOR BIOGRAPHIES

RANALL GARRETT is the Technical Manager for General Dynamics Advanced Information Systems (GD-AIS) and is the Assistant Program Manager for the United States Joint Forces Command (JFCOM) Modeling and Simulation (M&S) program in Suffolk, Virginia. He received holds a Ph.D. in Modeling and Simulation (2009) from Old Dominion University, Frank Batten College of Engineering and Technology. Randall provides delivery of technology applications and program support for M&S teams in support of the JFCOM (J9) Experimentation Support Group. His e-mail address is <randall.garrett@gd-ais.com>.

ANDREAS TOLK is Associate Professor for Engineering Management and Systems Engineering at Old Dominion University. He is also a Senior Research Scientist at the Virginia Modeling Analysis and Simulation Center (VMASC). He holds a M.S. in Computer Science (1988) and a Ph.D. in Computer Science and Applied Operations Research (1995), both from the University of the Federal Armed Forces of Germany in Munich. He is a member of SCS and SISO. His e-mail address is <atolk@odu.edu>.

TIMOTHY BACON is the Program Manager for the subject projects at the U.S. Joint Forces Command in Suffolk, VA. He holds a M.A. in Human Development from George Washington University and a B.S in Mechanical Engineering from Old Dominion University. His email address is <timothy.bacon@jfcom.mil>.