

**From Laboratory to Field—Testing A2C2 Concepts
During Global Warfare Exercises**

Stephen M. Hess

Aptima, Inc.
600 West Cummings Park, Suite 3050,
Woburn, MA 01867
781-935-3966; FAX 781-935-4385
hess@aptima.com

William G. Kemple

Naval Postgraduate School
555 Dyer Road, Monterey, CA 93943
831-656-2249; FAX 831 656-3407
kemple@nps.navy.mil

Elliot E. Entin

Aptima, Inc.
600 West Cummings Park, Suite 3050,
Woburn, MA 01867
781-935-3966; FAX 781-935-4385
entin@aptima.com

Kathleen P. Hess

Aptima, Inc.
600 West Cummings Park, Suite 3050,
Woburn, MA 01867
781-935-3966, FAX 781-935-4385
khess@aptima.com

Susan P. Hocevar

Naval Postgraduate School
555 Dyer Road, Monterey, CA 93943
831-656-2249; FAX 831 656-3407
shocevar@nps.navy.mil

Daniel Serfaty

Aptima, Inc.
600 West Cummings Park, Suite 3050,
Woburn, MA 01867
781-935-3966; FAX 781-935-4385
serfaty@aptima.com

*Paper documenting the A2C2 effort Submitted to the
2000 Command and Control Research and Technology Symposium*

For consideration in one of the following core areas:

C2 Experimentation

C2 Decision Making and Cognitive Analysis

C2 Assessment Tools and Metrics

Please direct all communications to the lead author:

Stephen M. Hess

Aptima, Inc.
600 West Cummings Park, Suite 3050
Woburn, MA

hess@aptima.com 781.935.3966 x22

(FAX 781.935.4385)

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 2000	2. REPORT TYPE	3. DATES COVERED 00-00-2000 to 00-00-2000			
4. TITLE AND SUBTITLE From Laboratory to Field - Testing A2C2 Concepts During Global Warfare Exercises		5a. CONTRACT NUMBER			
		5b. GRANT NUMBER			
		5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S)		5d. PROJECT NUMBER			
		5e. TASK NUMBER			
		5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Aptima Inc,600 West Cummings Park Suite 3050,Woburn,MA,01801		8. PERFORMING ORGANIZATION REPORT NUMBER			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)			
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)			
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES 2000 Command and Control Research and Technology Symposium					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES 5	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

From Laboratory to Field—Testing A2C2 Concepts During Global Warfare Exercises

Stephen M. Hess, William G. Kemple, Elliot E. Entin, Kathleen P. Hess,
Susan P. Hocevar, Daniel Serfaty

Global Wargame '99 offered the A2C2 team a unique opportunity to witness a large-scale exploration of Network Centric Warfare (NCW) concepts in the context of an extended operational exercise. The team became involved in Global '99 three months prior to the game, through their interaction with a team of warfighters, under the guidance of CCG1 with whom we conducted a training exercise at the Naval Postgraduate School entitled "Bridge to Global '99." During that training exercise, the A2C2 modeling team introduced a model-based organizational structure designed to optimally support the demands of the Global scenario. CCG1, and a staff of roughly thirty officers, played the organization in a laboratory at NPS, and the A2C2 assessment team observed, collected a range of performance measures, provided detailed feedback about the impacts of Information Technology (IT) tools, assessed the function of the organization relative to model predictions, and captured team processes that evolved and improved as the game progressed. The positive outcome and learning impacts of this experience led CCG1 to recommend a variation on the A2C2 architecture for Global Wargame itself. This presented the A2C2 team with an unprecedented opportunity to follow a model based architecture *from the laboratory to the field*.

This paper will describe Global '99 from the A2C2 perspective, starting with the forces that brought us together with CCG1, briefly describing the outcomes of the bridge to Global experiment, and finally presenting a view of the outcomes of Global itself. We will additionally describe the methods we used to capture data at Global and recommend lessons learned from similar application of A2C2 principles and methods for future wargames.

The Global Wargame Experiment

Although Global'99 was not an experiment in the classical sense, the exercise did manipulate three central components of NCW: Model driven innovations in *organizational design*, new *C2 processes* to match changes in command organization, and availability of advanced *information technologies* and collaboration tools. Changes in *Organization* were introduced at both the CJTF

and Subordinate JTF (SJTF) levels. There were three joint SJTFs with internal structures that mirrored the CJTF above. This hierarchical organization (CJTF and three SJTFs) was an innovation of the A2C2 modeling approach. Inside the CJTF, there were three primary components: A current operations cell, a future operations cell, and an effects coordination board (ECB). This internal organization was driven by the demands of Effects Based Operations (EBO)—an innovation in *process* that was designed to improve *self synchronization*. It was hypothesized that the ECB would provide a means to reexpress the commander's intent/plan in the form of a joint prioritized effects list (JPEL), made available to all SJTFs to interpret and carry out in a coordinated fashion. It was hypothesized that the global availability and flexibility of the JPEL, global information, and flexible communication and collaboration tools—including common information displays, as well as a number of groupware and collaboration technologies including videoconference capabilities, chat, web content, and email—would help the SJTFs to coordinate and develop specific plans and actions to accomplish desired effects in a synchronized way, with the CJTF providing 'rudder correction' only as required.

The Global team was able to achieve some of the benefits described above, but struggled through a number of process and organizational permutations along the way. In the following sections we discuss the impacts of changes in organization, process, and information technology that the A2C2 assessment team observed in Global'99. In the final version of this paper, data will be presented to support our conclusions and observations.

Impacts of Organizational Change

A ubiquitous observation of the A2C2 assessment team in Global'99 was an organization in constant flux. The ECB reorganized and redefined its business rules several times, and there was considerable shifting of roles and responsibilities among the CJTF components—future ops, current ops, and the ECB. Given this, it was no surprise that there were early difficulties maintaining synchronization among the cells—both vertical and horizontal synchronization. Previous A2C2 research has suggested that effective organizational performance requires that team members have accurate organizational knowledge of the team in which they work because this knowledge helps them anticipate the needs of others and know where to seek desired information. Because of the otherwise-healthy exploration of alternative organizations and processes, however, the organization as a whole was not able to achieve stable, consistent

organizational knowledge. Because of these organizational issues, officers had trouble understanding where to get the information they needed to satisfy their requirements. There was considerable confusion about “who knew what when,” and this impacted information flow in the organization. Data will be presented to show this at both the CJTF and SJTF levels.

Impacts of Changes in Process

The A2C2 assessment team’s basic observation was that the organization experienced difficulty coupling the effects desired at the CJTF level with the actions at the SJTF level: The essence of EBO. Toward the end of the first week of the exercise, the A2C2 assessment team had characterized this difficulty as an “Effects Gulf” between the CJTF and SJTFs. We believe the drivers of this effect included lack of a coherent definition of the term “effect,” divergent temporal requirements at the CJTF and SJTF levels, the need for vertical coordination and synchronizing strategies, and differences in organizational principles that were used to design the CJTF and SJTF levels of the organization. These will be discussed, with supporting data.

Based on our results, the A2C2 assessment team recommended that processes and feedback mechanisms need to be in place to facilitate the coupling of decision cycles at the CJTF and SJTF levels in ways that allow them to run synchronously yet still allow command decisions (expressed as effects) to steer the trajectory of actions taken in the SJTFs. This connection proved difficult in Global ’99: The organization tried a time-locked schedule of products (e.g., JPEL issued at 1030) and an effects-nomination process, but never fully explored a more collaborative generation of effects (vertical collaboration) with preplanned feedback/feedforward mechanisms to aid vertical synchronization. This approach shows some promise, but relies on new processes such as feedback and synchronization mechanisms that require additional thought. This will be discussed with supporting data.

Impacts of Information Technology

As mentioned above, Global ’99 provided warfighters with a range of IT tools including common information displays, groupware and collaboration technologies, and more common tools such as videoconference capabilities, chat, and email. While many of the players were unfamiliar with some of these tools, they very quickly adapted processes to take advantage of them in the management of information. As the game progressed usage shifted from one-to-one communication tools like voice and Email to the more dynamic group orientation of chat and

shared web data. Over the course of the game participants also became more skilled at combining tools such as chat and electronic whiteboard technologies to achieve improved transfer of knowledge. An important finding was the powerful synchronizing effect of chat-based “communities of interest” that were erected to serve conversation and situation awareness around a topic. This phenomena will be discussed, because it represents an important convergence of technology and process that enabled synchronization. We will present data and recommendations for future games.

Summary

Global '99 was the first time that the A2C2 team participated in an exercise of this magnitude, and the first time we have been afforded the opportunity to witness a talented group of warfighters grappling with the organizational impacts of the network-centric future. We learned several valuable lessons about the difficulties of achieving the vision of NCW, EBO and self-synchronization. From the data collected and our theories of team performance, we are prepared to explore potential solutions and share them to improve performance in future exercises. We additionally learned that the pre-experiment approach implemented as the Bridge to Global can provide a valuable source of insight, ideas, methods and learning for both the warfighters and the assessment team, and that this preparation allows us to create a focused approach to assessment at a game the size of Global '99. A2C2 plans to continue exploring the organizational and process concepts investigated in Global '99 by participating in both small and large scale exercises with warfighters in preparation for Global '2000.