2002-05

Knowledge Management and Collaboration in an Effects-Based Operations Environment

Hutchins, Susan G.; Kemple, William G.; Boger, Dan; Adamo, Ron

Hutchins, S. G., Kemple, W. G., and Boger, D. (2002). Knowledge Management and Collaboration in an Effects-Based Operations Environment. In Proceedings of the 7th International Command and Control Research and Technology Symposium, Loews Le Concorde Hotel, Quebec City Canada, September 16-20, 2002.

https://hdl.handle.net/10945/37940

COVER SHEET

Knowledge Management and Collaboration in an Effects-Based Operations Environment

Susan G. Hutchins[1]
William G. Kemple[1]
Ron Adamo[2]
Dan Boger[1]

[1]Graduate School of Operations and Information Sciences
Naval Postgraduate School,
589 Dyer Road
Monterey, CA 93943-5130
(831) 656-3768 Fax: (831) 656-3679
shutchins@nps.navy.mil;
kemple@nps.navy.mil;
boger@nps.navy.mil

[2]Jaycor, Defense Systems Group
(757) 836-3911 (JFCOM) (757) 222-4817 (w) e-mail:
radamo@jaycor.com

May 1, 2002

This paper is submitted for consideration for the 2002 CCRTS track on C2 Experimentation.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2002		**00-00-2002 to 00-00-2002**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Knowledge Management and Collaboration in an Effects-Based Operations Environment	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) **Naval Postgraduate School,589 Dyer Road,Monterey,CA,93943**	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
The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**		**15**	

Knowledge Management and Collaboration in an Effects-Based Operations Environment*

Susan G. Hutchins[1], **William G. Kemple**[1], **Ron Adamo**[2], **Dan Boger**[1]

[1]Graduate School of Operations and Information Sciences
Naval Postgraduate School,
589 Dyer Road, Monterey, CA 93943-5130
(831) 656-3768 Fax: (831) 656-3679
shutchins@nps.navy.mil; kemple@nps.navy.mil; boger@nps.navy.mil

[2]Jaycor, Defense Systems Group
(757) 836-3911 (JFCOM) (757) 222-4817 radamo@jaycor.com

Abstract

New warfighting concepts are currently under development to improve the ability of future Joint Force Commanders to rapidly and decisively conduct particularly challenging and important operational missions as they transition to the fighting force described in Joint Vision 2020. This paper describes one element that is part of these new concepts: knowledge management and collaboration as conducted to support effects-based operations. Collaboration offers great potential to better enable warfighters to plan, monitor, execute, and assess activities across the spectrum of joint functional areas. Collaboration is also essential to develop a shared situational awareness among heterogeneous, distributed team members. Effects-based operations is defined as a "process for obtaining a desired strategic outcome, or 'effect' on the enemy, through the synergistic and cumulative application of the full range of national (military and nonmilitary) capabilities at all levels of conflict." This paper reports on the results of a survey administered during an experiment conducted to help refine the effects-based planning process. Suggestions for improving knowledge management include developing business rules for working in a collaborative information environment and improved display capabilities to help planners track information and documents during different phases of the planning process.

1. Introduction

New warfighting concepts are currently under development at U.S. Joint Forces Command (JFCOM), J9, Joint Experimentation Directorate, to be employed by the U.S. military as it transitions to the fighting force described in Joint Vision 2020. Their primary focus is to develop new joint warfighting concepts and capabilities that will improve the ability of future joint force commanders to rapidly and decisively conduct particularly challenging and important operational missions.[1] A series of experiments and exercises is being conducted to help refine the new concepts and processes under development at JFCOM. Each experiment is designed to support the assessment of these proposed future capabilities and modify current doctrine, organization, training, materiel, leadership, personnel, and facilities. This paper describes one aspect that is part of these new concepts: knowledge management and collaboration as conducted to support the effects-based planning and assessment (EBP&A) process. Collaboration is also essential to develop a common situational awareness among heterogeneous, distributed team members.

* The research reported here was sponsored by the U.S. Joint Forces Command, J9, Joint Experimentation Center, Suffolk, VA.

2. Collaboration

Collaboration offers great potential to better enable warfighters to plan, monitor, execute, and assess activities across the spectrum of joint functional areas. Capabilities included in collaboration tools include the ability to share applications, have a virtual workspace, use voice/audio, whiteboard, video, and chat functions. Many, if not all, of the benefits to be accrued from participating in a face-to-face meeting can be gained using collaborative tools: information flows quickly, outstanding issues are raised, and a certain amount of brainstorming can occur to arrive at a decision. Additionally, "all relevant users or providers of information reach a fuller understanding of the issues because they have seen other viewpoints and received a freer flow of information."[2, p. 2] Collaborative tools offer the added capabilities of providing the ability to share information and resources and coordinate among individuals across geographic and temporal boundaries.

Specific functions needed in collaborative tools include the ability to accommodate a wide variety of group interactions including one-to-one, one-to-many, many-to-many, and many-to-one.[ibid] In addition they need to offer the flexibility to support formal, informal, and ad hoc collaborations. Moreover, these tools should be intuitive to the user regarding where to find collaborators and how to interact with them. Collaborative tools should also accommodate real life situations such as interruptions and still ensure work can be resumed seamlessly.

The following taxonomy of collaborative tools was included in the Joint Staff report on collaborative tools:[2]

- **same time/same place** (i.e., group decision support and meeting facilitation)
- **same time/different place** (i.e., audio/video conferencing, shared whiteboards, chat, video/audio broadcast and shared applications)
- **different time/same place** (i.e., team rooms, shared memory, information sharing, coordination tools, e-mail, newsgroups and recorded video/ audio)
- **different time/different place** (i.e., e-mail, newsgroups, discussion/bulletin boards, group authoring, recorded video/audio and workflow)

Table 1 presents a categorization of collaborative tools as they are used relative to time and place.

Table 1. Collaborative Tool Use Relative to Time and Place. ^

		TIME		
		SAME	**DIFFERENT but PREDICTABLE**	**DIFFERENT and UNPREDICATBLE**
PLACE	**SAME**	**Meeting Facilitation**	**Work Shifts**	**Team Rooms**
	DIFFERENT but PREDICTABLE	**Tele/Video/ Desktop Conferencing**	**E-mail**	**Collaborative Writing**
	DIFFERENT and UNPREDICATBLE	**Interactive Multicast Seminars**	**Computer Bulletin Boards**	**Workflow**

^ From: Joint Collaboration Tools Employment, Joint Staff, Washington, D.C. CJCSM 6xxx.01, 2001.

2.1 Definitions

The following definitions of the functionality afforded by collaborative tools are from the Joint Staff report on joint collaborative tools employment:

Application sharing: gives an organization the capability to use one copy of an application for multiple use, which saves space and ensures application uniformity.

Chat Room: Allows members of a workgroup to "text talk" among themselves, see what each is saying and have a record of the conversations.

Document Management: A tool that facilitates acquiring, classifying, storing, and accessing organizational documents.

Document Sharing: Allows a workgroup to share the same document from one location, giving everyone the most up-to-date version.

E-mail: E-mail allows the user to pick and choose the recipients of the package being sent. The drawback of e-mail is that any information sent is sent individually to each recipient and can use large amounts of bandwidth to carry out each transaction.

Events Log: The events log provides an area where a log for a workgroup is kept as an official record of the chronology and participants in key events that take place during a collaborative event.

Intelligent Agent: An intelligent agent, or simply agent, is a program that gathers information or performs some other service without a user's immediate presence on a regular schedule. It utilizes parameters the user has set up, searches and gathers information that is useful (determined by the parameters of the search criteria), and presents it to the user at a specific time.

Metadata: Metadata, or information about data, provides users with descriptions of the data or informational objects they can access. This metadata is stored with the document and is used to accelerate searches for data.

Push Technology (Netcasting): Software that sends notification of changes to controlled documents, keeping all participants informed of the latest version.

Scheduler/Calendar: Gives a workgroup a central location to post meeting times, project milestones and other information that is time-related. Allows users to schedule meetings by seeing free and busy times for other participants.

Virtual Domain: Gives an organization the flexibility to set up workgroups that are not collocated.

2.2 Benefits of Computer-Assisted Collaboration for New Military Concepts

Additional benefits afforded by collaborative tools that are especially germane to the new military concepts currently under development include: allowing smaller deployed warfighter footprints; improving information exchange among decisionmakers and sources of information; including distributed subject matter experts as participants in the decisionmaking process; capitalizing on the synergy of the total command and control (C2) infrastructure during operations versus relying on isolated efforts; and improving decisionmaking timelines.

3. Effects-Based Operations

Effects-Based Operations (EBO) is defined as a "process for obtaining a desired strategic outcome, or 'effect' on the enemy, through the synergistic and cumulative application of the full range of national (military and nonmilitary) capabilities at all levels of conflict." [3, p. ii] An effect is the physical, functional, or psychological outcome, event, or consequence that results from specific military or non-military actions. The EBO concept is based on the tenant that a better understanding of the adversary,

and the increased involvement of other national agencies, will lead to better-reasoned options to engage potential adversaries.

The EBO process is conceptualized as a continuous and iterative planning and execution cycle. This cycle comprises the following five phases. Developing a comprehensive knowledge, or insight, into the nature of the adversary, the environment, and our own capabilities; this is accomplished by conducting an operational net assessment (this process is described below). The second phase entails articulating the desired effects necessary to break the adversary's cohesion and to cause the adversary to change his behavior—these effects are articulated via an Effects Tasking Order (ETO). The third phase involves determining and applying those elements of national power, i.e., diplomatic, informational, military, and economic, that will be most effective in achieving the desired effects, and assessing the application of capabilities in terms of the desired effects. The forth phase includes conducting an integrated and continuous assessment process to measure and assess the impact of the effects created. The fifth phase involves making decisions regarding ways the commander can adapt and adjust the current course of action to more effectively reach the desired end state.

Characteristics that distinguish effects-based planning from traditional objectives-based planning include development of a broader and deeper insight into the adversary through the fusion of information from a broad spectrum of sources, including national and international, government and non-governmental. Insight into the adversary is developed through conducting a complex "system of systems analysis" (SoSA) of the adversary. Planners conduct this systems analysis collaboratively with a networked and distributed team of experts (cultural, behavioral, technical, economic, political, and military) and centers of excellence (think tanks and other institutions where expertise resides relevant to the adversary).[4] EBO planning goes a step further than consideration of which actions will achieve an objective (i.e., the traditional approach) to consider the full range of potential results of our actions (including direct and indirect effects, desired and undesired effects). Key aspects of EBO are the ability of decisionmakers to quickly recognize any unexpected effects and the flexibility and agility to adapt to the implications of those effects. A second key aspect of EBO is an emphasis on the ability to examine the causal linkages and effects through which actions lead to objectives. A third aspect is the Joint Task Force (JTF) Commander's broadened focus. This ability to more precisely select the right set of actions is expected to offer the Joint Force Commander the ability to further minimize undesired collateral effects.

Joint activities involved in EBO would be inefficient without the use of collaborative tools. Planners and decisionmakers in distributed locations need to conduct synchronous dialog sessions with each other and interact based on the use of a shared view of the battlespace concerning the impact of actions included in the ONA and ETO. A common understanding of the impact of proposed actions, the desired effects to be achieved, responsibilities for carrying out the actions, and the current friendly and adversary situation are also accomplished via the coordination and negotiation activities that are conducted in a collaborative information environment.

4. Operational Net Assessment

The challenge inherent in the EBO process is to accurately identify the causal linkages that determine whether or not the action taken will achieve the desired effect.[ibid] This challenge is addressed through the Operational Net Assessment (ONA). The ONA is a product of collaboration among analysts at strategic, operational, and tactical levels. It provides a common knowledge base available to all customers from the national strategic level to the tactical level. Contributions of potential customers

impact each element of the ONA, since the ONA views a potential adversary as an interdependent system of systems, all of which contribute to some degree toward his societal coherence, will, and capability to pursue a course of action inimical to friendly interests. The ONA goes far beyond traditional intelligence assessments. It is an action-oriented process that provides a continuous stream of knowledge from adversary vulnerabilities to effects to tasks. Information contained in the ONA should help planners and operators develop greater situational awareness and understanding of the adversary.

5. Limited Objective Experiment on Effects Tasking Order-to-Actions

An experiment entitled Effects Tasking Order (ETO)-to-Actions Limited Objective Experiment (ETO-to-Actions LOE), was conducted at the U.S. Joint Forces Command (JFCOM), Joint Futures Laboratory, Suffolk, VA, 3-14 December, 2001, to examine elements of EBO, and to specifically assess and refine the effects-based planning and assessment (EBP&A) processes. This experiment was designed and conducted in a partnership with the Naval Postgraduate School, JFCOM, J9, and the Navy Warfare Development Command. Previous experiments and exercises, such as Unified Vision 01, focused primarily on the Joint Task Force Headquarters (JTFHQ) level of command, with the majority of effort directed at refining the process down to producing an ETO. The ETO-to-Actions LOE focused within and below the JTFHQ to examine the required coordination and collaboration processes (both vertically and horizontally) between the JTFHQ and functional components headquarters, which is needed to collaboratively develop the ETO and translate the effects directed in it into tactical actions on the battlefield.

The experimental participants included representatives from all services, organized into a Joint Task Force HQ staff and functional component HQ staffs (Joint Force (JF) Maritime Component Commander (JFMCC), JF Air Component Commander (JFACC), JF Land Component Commander (JFLCC), Joint Special Operations Task Force (JSOTF), and Joint Psychological Operations Task Force (JPOTF) (not depicted in Figure 1)). Thirty-nine percent of the participants were active duty, forty-two percent were retired military personnel, and the remainder were civilian concept developers at JFCOM. Three days of training on the new effects-based planning processes and the collaboration and decision support tools were provided. Five days of game execution consisted of the participants conducting collaborative planning between the Joint Task Force HQ staff and the subordinate functional component staffs, with the JTF Commander issuing new and revised, collaboratively developed, ETOs to the Joint Force. Figure 1 depicts the organizational structure that used was for the LOE and the number of participants in each node of the organization.

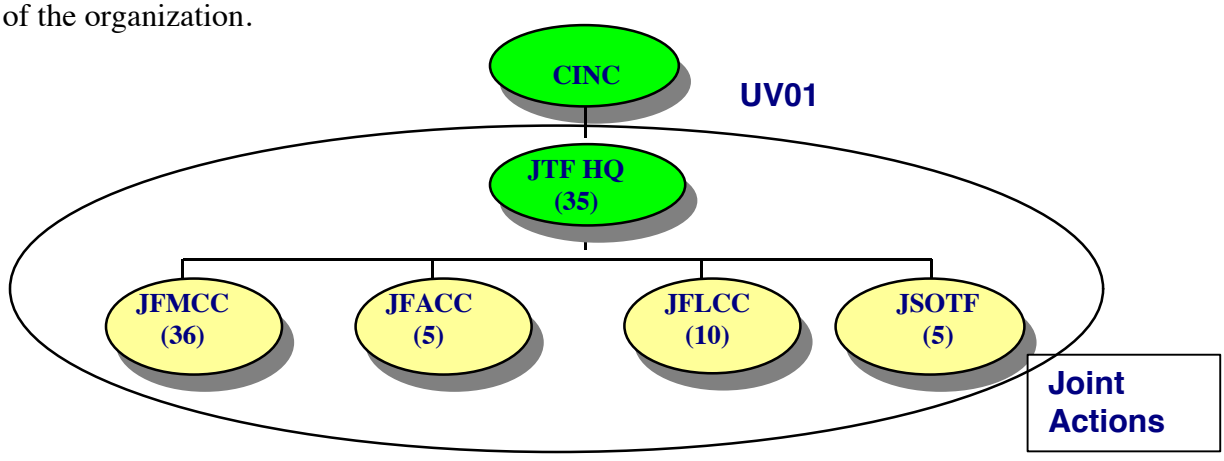

Figure 1. Organizational structure and number of participants for the ETO-A LOE. [3]

5.1 Effects-Based Planning Process

Figure 2 depicts a high-level view of the steps entailed in the effects-based planning (EBP) process and the planning steps that were the focus of this LOE. [Note, the steps in the EBP process are indicated by the rectangles; the planners, who perform these steps, are indicated by the circles.] The experiment began when the Commander-in-Chief's (CINC) mission statement was issued. The first step in the EBP process involved completing a mission analysis, as a collaborative (vertical and horizontal) process between the Joint Planning Cell (comprised of representatives from the JTFHQ, the components, the CINC staff, and the Inter-agency Coordination Section) and the component's planning cells.

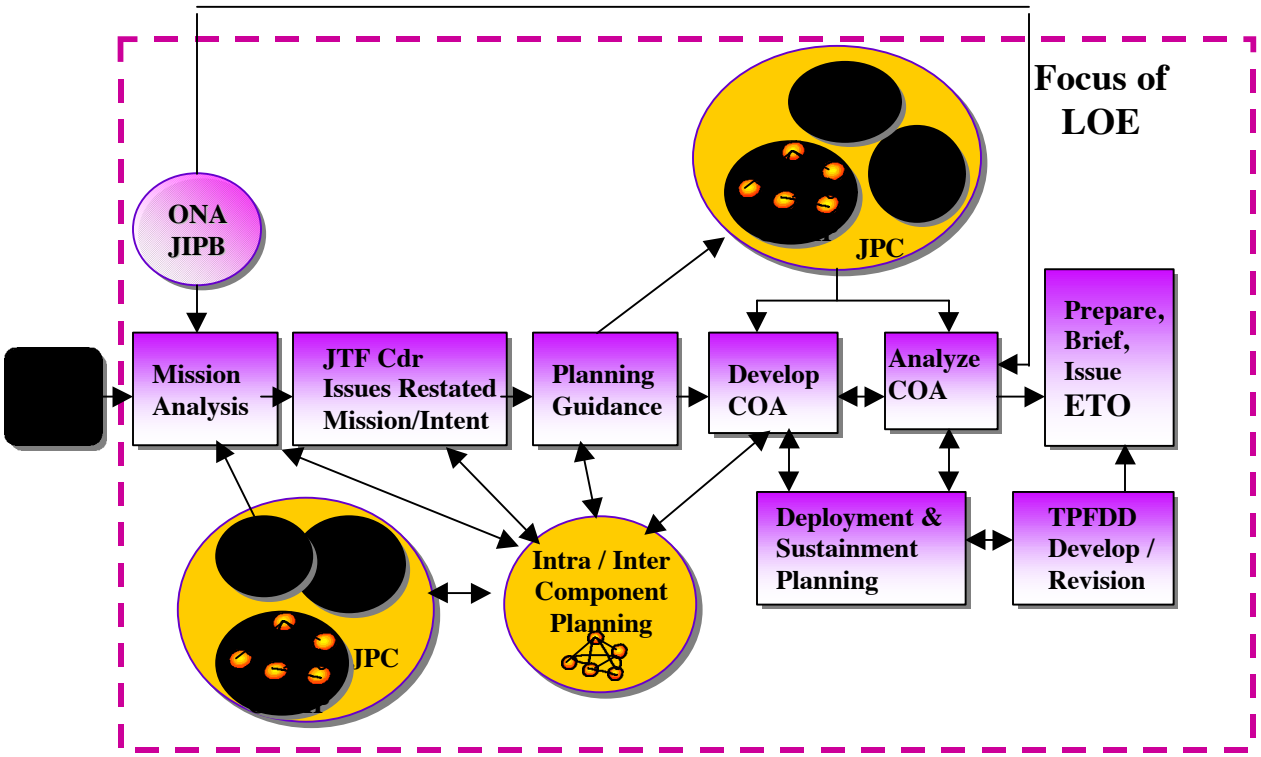

Figure 2. Elements of the JTF Effects-Based Planning process included in the Effects Tasking Order-to-Actions Limited Objective Experiment.[5]

5.2 Information Technology and Collaboration Tools Used in the ETO-to-Actions LOE

The ability to engage in real-time collaboration with other decisionmakers who are geographically distributed, and having rapid access to current, relevant, and accurate information, have become indispensable elements of the joint command and control (C2) planning and decisionmaking process. A collaboration tool suite was introduced to facilitate these information-intensive interactions during the ETO-to-Actions LOE. New information technology (IT) tools, used as part of a networked, web-based collaborative system were also introduced. One goal for the experiment was to develop an understanding of the implications and effects of the distributed planning that provides the foundation for an EBO.

A web-based tool, called the Wargaming Information Grid System (WIGS), and a collaborative planning environment, the Information WorkSpace (IWS), provided the core for the collaboration tool

suite. IWS was used within and among the functional and service components. Functions provided by IWS include real-time text chat and voice, both conducted over the internet. All occupants within a virtual "room" (within the IWS tool) could view and respond interactively to an initiator's message. WIGS was designed to be the central source for shared information during scenario play. The objectives for this website were to: (1) provide a location to post information for all players and to facilitate the exchange of documents, (2) provide access to analytic tools and to an underlying database of reference and briefing materials, as well as (3) provide links to additional websites, in order to provide additional information related to game play.

The following tools were provided to participants, in addition to WIGS and IWS: ADOCS, ONA Tool, and JDIM. The automated deep operations coordination system (ADOCS) is a joint service mission management software application that presented a visual display of the battlespace. ADOCS provides a suite of tools and interfaces for horizontal and vertical integration across battlespace functional areas. The operational net assessment (ONA) tool was accessed through WIGS and provided an initial assessment of the military operation from multiple points of view. These other perspectives on the operation included information and analysis from other branches of the U.S. Government, and many other sources of information, as well as the requirements for information from non-governmental organizations. The Joint Distributed ISR Management Tool (JDIM) enabled the user to find the intelligence, surveillance, and reconnaissance (ISR) information that existed at particular nodes in the organization.

5.3 Survey Administration

Three surveys were administered during the experiment to gather data on the effectiveness of (1) the collaborative tools and the training provided to the participants for this experiment, (2) knowledge management and collaboration as critical aspects of effects-based planning, and (3) the effects-based planning and assessment process. This paper describes the results of the Knowledge Management and Collaboration Survey, and is a companion paper to two other papers that discuss results of the other two surveys.[6, 7]

Twenty-nine survey items were presented as statements about managing information and collaborating to conduct the effects-based planning process. (Due to space limitations, a sub-set of these items are discussed in this paper and are listed in Table 1.) Participants were asked to rate the extent to which they agreed with each statement by using a five-point Lickert scale that ranged from "strongly disagree" to "strongly agree" (where 1 = strongly disagree, 2 = somewhat disagree, 3 = neither disagree nor agree, 4 = somewhat agree, and 5 = strongly agree). Five of the items were open-ended questions and asked participants to indicate ways in which various aspects of the process could be improved. The survey was administered to all 99 experimental participants; 90 completed surveys were returned and analyzed.

6. Results

Table 2 presents the survey items, the mean ratings given by the participants, and the standard deviation for each rating. Overall, the participants' ratings for the majority of the survey items were above the midpoint on the five-point rating scale that was used for these items. This is interpreted to mean the participants found the event to be a productive learning experience and the experiment contributed to their developing an understanding of the effects-based planning and assessment (EBP&A) process. Each of the items will be discussed in the order in which they are listed in the table.

Table 2. Knowledge Management and Collaboration Survey Questions and Results.

Item Number	Survey Question	Mean Rating	Std Dev.
1	My cell/center was able to maintain good situational awareness.	3.8	1.1
2	I was able to maintain good situational awareness across the entire JTF/ Component organization.	3.3	1.1
3	The new JTF structure allowed Components to obtain adequate and timely information.	3.3	.96
4	The Effects-Based Planning Process allowed components to obtain adequate and timely information.	3.2	.99
5	What important pieces of information did you need but where unable to find?	— *	— *
6	When unable to find information you needed, what were the causes?	— ^	— ^
7	How were the interactions required across the JTF to conduct EBP&A different from what would have traditionally be done?	— *	— *
8	Participation in asynchronous collaboration sessions, while engaging in other tasks, was an effective way to conduct planning.	3.0	1.2
9	The new JTF organization structure facilitated the EBP&A process.	3.5	.9
10	The JTF Effects Assessment Cell is a necessary element of the EBP&A process.	3.7	1.1
11	The JTF System of Systems Analysis (SoSA) Cell is a necessary element of the EBP&A process.	3.7	1.1
12	The JTF Collection Management Cell is a necessary element of the EBP&A process.	4.0	.94
13	Collaboration improved my situational awareness.	4.2	1.0
14	The ONA enabled me to develop a better understanding of the adversary as a result of the fusion of information from a spectrum of sources.	3.4	1.1
15	The ONA facilitates component-level planning.	3.5	.86
16	Our cell was able to conduct the parallel collaborative planning that was closely coordinated with subordinate commands.	3.5	.98
17	The presentation aspects of the information available provided an enhanced understanding of the situation, which facilitated rapid development of the ETO.	Yes=59% No=41%	

Notes. * Indicates a text only response.
^ Indicates a different set of choices were presented for this item: these are discussed in section 5.6.

6.1 Maintaining Situational Awareness

The question that asked about their ability to maintain good situational awareness (SA) within their cell received a mean rating of 3.8, indicating that the majority felt they could maintain good SA. One player stated that the tools, e.g., ADOCS, provided very good SA, however, the level of play for the experiment was not that demanding. In contrast, one player thought the time constraints in the LOE impacted their ability to maintain good SA and having only one screen to manage information was a limitation.

6.2 Maintaining situational awareness across the entire JTF/Component organization

The mean rating for the question that asked about their ability to maintain good SA across the entire JTF organization was 3.3, slightly lower than their ability to maintain SA within their cell. This is not surprising, as maintaining SA on the entire JTF organization is considerably more demanding. There was a wide range in their ratings depending on where they were located within the organization.

6.3 New JTF structure allowed components to obtain adequate and timely information

The statement that the new JTF structure allowed components to obtain adequate and timely information received a mean rating of 3.3, indicating they neither agreed nor disagreed with this statement. Those who gave this item a low rating indicated it was difficult to know who was responsible for what action, which piece of information posted on WIGS was authoritative, and the limitations of the experiment (e.g., the concepts are still under development) precluded timely information flow. Some players indicated they did not think the structure was very new or that the structure provided the information; instead, it was the tools that were new and provided the information. Comments pertaining to the inability to obtain adequate and timely information indicated the lack of analysis [capability] in the automated tools, the inability to navigate the tools (due to insufficient familiarity with the tools), and not knowing where to mine the information were problems.

6.4 EBP&A process allows components to obtain adequate and timely information

The assertion that the EBP&A process allowed components to obtain adequate and timely information received a mean rating of 3.2, indicating that participants did not particularly agree or disagree with this statement. Several players made the distinction between effects-based planning, which is much more developed, conceptually, and effects-based assessment, which needs further development.

6.5 Important information participants were unable to find

Many things were listed in response to the item that asked what important pieces of information they needed but were unable to find. The most important information was the overall system of systems perspective and the relationship between systems and nodes in time and space. Other information listed as needed included: a workflow status indication for where they were in the overall planning process, knowledge about the actions of other components that were occurring concurrently and that was required prior to another component executing a specified mission, highlighting the enemy's capabilities (the ONA focuses on the enemy's vulnerabilities), weaknesses in friendly courses of action, effects achieved from current operations, a complete nodal analysis with weighting of nodes and effects, and timing considerations to maximize the effect of candidate actions. This information was seen as essential to support the overall objective of developing a stronger plan by using these new effects-based processes. A suggestion for a knowledge management capability was to provide links between the listing of forces/equipment/systems in theatre and the capabilities of those units.

6.6 Reasons for inability to obtain needed information

Problems that caused the inability to obtain all the needed information included the following categories: not knowing where to get the information (21%), not enough time to obtain the information (29%), information needed was not available from any source (22%), inadequate responses to information queries (3%), inadequate communications (4%) and other reasons (18%). Several players indicated the cause was due to databases not being fully populated. As is typical with an event of this size, there was a wide range of opinions expressed. Some players felt that there was not enough time to think, and locate information, while others thought the pace of events was fairly slow. Several players thought the information was not displayed in a way that facilitated its use or linked the information to related information in a way that facilitated its use in a timely manner. A comment, that goes beyond the limitations of this experiment, was the issue of the *quality of information*, i.e., given the tremendous amount of information available, or potentially available, how will information be vetted?

6.7 How interactions to conduct EBP&A were different from what is traditionally done

The item that asked how the interactions required across the JTF to conduct EBP&A were different from the way planning is traditionally done elicited a wide range of replies. The *information* being looked at is different, since the focus is on 'effects' and nodes vice "checking off targets that were hit." Focusing on the desired effect also required a better understanding, by the components, as to exactly what the JTF Commander and staff had in mind. Many players added that the main difference is the emphasis on a collaborative planning environment that allows parallel planning versus serial planning. Use of the ONA, the greater emphasis devoted to developing measures of effectiveness (MOEs)/measures of performance (MOPs), including the standing joint command and control element, and the JFMCC organization, were all different from traditional operations.

6.8 Effectiveness of engaging in asynchronous collaboration sessions to conduct planning

The effectiveness of engaging in asynchronous collaboration sessions, while engaging in other tasks, as an effective way to conduct planning, received a mean rating of 3.0. Asynchronous planning refers to collaboration that occurs at different times, when participants in the collaboration process are involved in other tasks in addition to the task on which they are collaborating. One party places the information they desire to collaborate on in a particular location, then the second party, at a later time, digests the material, and responds. Shared data is the key to collaboration, where two or more people with a common problem use shared data to produce a product. This equivalency, regarding the effectiveness of engaging in asynchronous collaboration sessions to conduct planning, is attributed to several factors: the participants' lack of familiarity with conducting planning this way, their lack of familiarity with the other people in the collaboration sessions, the newness of the tools and processes, and that they were concurrently engaged in other tasks. Several participants thought engaging in asynchronous collaboration sessions was too distracting while trying to concentrate on the task at hand; others became "task-saturated" as they participated in several concurrent chat sessions. Engaging in a discussion in one collaborative session while monitoring the other on-going collaborative sessions, and concurrently fielding questions from a player in another chat session spread their attention across too many tasks. Others thought this the way planning will be done in the future in a collaborative information environment, and that this is a skill that needs to be learned like any other skill. In a real setting, many of the participants would know each other, and would have a history of collaborating. These "habitual relationships" are recognized as critical to being able to engage in effective collaboration, i.e., when people collaborating know each other, there are fewer problems of trust and understanding. Some players wanted to reserve judgment on this question given the artificialities of the experimental environment.

6.9 Extent to which new JTF organization facilitated the EBP&A process

The item that asked whether the new JTF organization structure facilitated the EBP&A process received a mean rating of 3.7, indicating that it did for the majority of the experimental audience. While the EBP&A process is maturing, the operations part and the assessment process were not given enough play.

6.10 JTF Effects Assessment Cell is a necessary element of the EBP&A process

The assertion that the JTF effects-assessment cell is a necessary element of the EBP&A process received a mean rating of 3.9, indicating people agreed with this statement. Participants who agreed stated: Feedback is absolutely necessary, assessment is the key to EBO, continuous assessment, and dynamic re-tasking is an integral part of the operation. Assessment drives the application of resources to

accomplish the desired effect. One participant thought that a pure intelligence analyst may not have the operational experience to do this job, and certainly not in an intelligence cell. Someone with an intelligence background would be valuable because this job requires creating and selecting indicators, and intelligence people already do that as part of their job.

6.11 JTF System of Systems Analysis (SoSA) Cell is a necessary element of EBP&A

The item that asked whether the JTF system of systems analysis (SoSA) cell is a necessary element of the EBP&A process received a mean rating of 3.7, indicating people agreed with this statement. One player stated that the SoSA cell provides the fundamental background on how to go about achieving the effects; however, he cautioned it is not an intelligence cell and not a targeting cell. Several players agreed, but had concerns about where this function would be located, e.g., it should be a dedicated capability (possibly federated), removed from the JTF, with routine access to all available information and expertise.

6.12 The JTF collection management cell is a necessary element of the EBP&A process

The item that asked if the JTF collection management cell is a necessary element of the EBP&A process received a mean rating of 4.0, indicating people agreed with this statement. A player who thought the role was conceptually appropriate, thought it focused too much on the usual airborne and overhead imaging assets, particularly those that are historically low density/high demand. He thought this emphasis was tied to the old way of doing things and "does not seem to effectively integrate with other warfighting missions, tasks, and effects."

6.13 Collaboration improves situational awareness

The assertion that collaboration improved situational awareness received a mean rating of 4.2, indicating the majority agreed with this statement. Many players made positive comments in response to this item. A succinct statement was that "information being passed during collaboration always improves your SA." Several felt that collaboration is a *key* element of developing SA and that collaboration is the [way of the] “future.” Players who did not agree with this statement thought collaboration was done in a very narrow band or that the time they spent in collaborative sessions was not very rewarding. Comments related to the tools were that most SA came from collaboration (as opposed to the tools) indicting improved tools are needed.

6.14 ONA contributes to developing a better understanding of the adversary

The assertion that the ONA contributed to developing a better understanding of the adversary received a mean rating of 3.4, indicating people did not particularly agree with this statement. The most important types of information that were missing were the overall system of systems (SoSA) perspective and the relationship between systems and nodes, in time and space. Several players indicated the ONA, as used in the experiment, did not provide a better understanding because there was no single place to go for various types of information and they had to search for information. One player indicated the process of building the intelligence preparation of the battlefield, by all staff sections, created better SA than hunting and individually looking for intelligence "nuggets." The inherent complexity of the ONA was another issue. Some players didn’t think the underlying information and links were developed sufficiently to provide a thorough understanding of the adversary. The ONA has the potential of contributing to planners developing a better understanding of the adversary, but (as the concept of operations indicates) users of this information require knowledge [of the information included in the

ONA] prior to the start of the scenario and they did not have that benefit during the LOE. The ONA needs more cross effects, cross actions, and cross node linkages [added to it]…as it stands now, the ONA is just a database.

6.15 ONA facilitates Component level planning

The item that asked if the ONA facilitates component-level planning received a mean rating of 3.5. One player thought, "we have enacted semi-automatic mechanical linkages from the ONA down to tactical level planning. What is missing is any SoSA input to the links that are in the ONA." In general, comments indicated the ONA could facilitate component-level planning if there were better linkages and collaboration across components. Several players thought the ONA could facilitate component level planning if the ONA was supported by analysis. Those who gave a high rating to this item felt the ONA offered many benefits, including: it reduces a huge volume of information and provides a critical focus for the components; it provides planning guidance for the components to use in translating strategy to operations; tied with a good joint intelligence preparation of the battlefield (JIPB) this would be a great tool; the ONA will facilitate component level planning (if we can get real information during a real world crisis).

6.16 Ability to conduct parallel planning closely coordinated with subordinate commands

The item that asked if their cell was able to conduct the parallel collaborative planning that was closely coordinated with subordinate commands received a rating of 3.5. Several players felt the collaboration tools supported component planning. However, another player felt the collaboration between the headquarters and the components was superficial, i.e., there was little detail.

6.17 Presentation of the information provided an enhanced understanding of situation

This item asked if the presentation aspects of the information available provided an enhanced understanding of the situation, to facilitate rapid development of the ETO. The majority of the players (59%) indicated "yes" and the remaining players (41%) indicated "no." Again, several players indicated the JIPB was essential for developing a campaign plan. One player indicated the ETO web page was useful, although there was no way to ascertain its currency. ADOCS was listed as a great graphical presentation. Player suggestions included: integrating ADOCS with the ONA database, adding the ability to tailor the presentation in ADOCS, and including presentation techniques to show the relationship of effects and key nodes. The goal for this integrated presentation would be to be able to select and effect a node, then graphically see all the nodes in ADOCS that were affected, and vice versa. Several players indicated they need the ability to see other component level information in addition to each cell's and component's view of the desired effects because this information helps others adjust to support the desired effect.

7. Discussion

Collaboration offers great potential to better enable warfighters to plan, monitor, execute, and assess activities across joint functional areas during effects-based operations. Analysts at strategic, operational, and tactical levels need to collaborate to produce the recurring and non-recurring products that support EBO. Both the EBO process and producing the planning products rely on extensive collaboration between planners and decisionmakers at all levels—strategic to tactical. Moreover, the more extensive analysis entailed in the new EBP&A processes, i.e., where a much wider range of information is analyzed, creates a more challenging information management task for planners and operators. This

challenge can be met with the capabilities provided by a collaborative tool environment. The collaboration that occurred between the players during their participation in multiple planning cells facilitated their developing and maintaining a high-level of SA. However, many players expressed concerns about the level of workload encountered. This high workload was produced as a result of several factors. These factors included the players lack of famili-arity with the new EBP&A processes, not enough time allowed to accomplish all the tasks, and the amount of time spent "pulling" data, indicating a greater need for information to be pushed to the user of the information. The complexity of the experimental environment precluded determining if the level and depth of collaboration envisioned for future military operations will produce excessive workload levels.

The ability to collaborate with all involved, for example, to adjust the track of a critical ISR platform was viewed as a tremendous capability. Participation in asynchronous collaboration sessions, while engaging in other tasks, was considered to be an effective way to conduct planning by most players. The planning and deconfliction required the exchange of a great deal of data, which was greatly enhanced by working within a collaborative information environment.

8. Conclusions

The experiment participants provided many valuable suggestions that will contribute to refining the EBP&A process. Concerns were raised about the new procedures creating increased workload. The expectation is that as planners and operators become familiar with the new processes and tools the workload will become more manageable. Many players appreciated the value added by the new EBP&A processes in terms of the *more comprehensive* nature of the analysis of the adversary and the *increased speed* of planning that is possible when planning is done collaboratively, however, the complexity involved caused some concern for some players. A brief summary of several themes that emerged, that cut across many of the survey items is discussed below. These themes included the need for (1) business rules for planning and operating within a collaborative information environment, (2) improved analysis tools and displays, and (3) additional training on using the new information technology and collaboration tools.

8.1 Business rules need to be developed

Business rules are needed to facilitate users gaining quick access to critical data and supporting documentation. For example, information was posted in the IWS file cabinet, on WIGS, in the ONA tool, on SharePoint, on the 'J' drive, and on individual computers. Locating essential information became difficult when there was no established procedure for information storage. Moreover, documents located within any one of these systems were not labeled in a way to make it easy to know which version was the most current, or what the content was. Business rules also need to be developed to provide standards for collaborating among the participants, for example, to add discipline to the process. Clarification is needed regarding who uses which tools, and when, in the planning (and/or execution) process, to produce which products, during the EBP&A process. Business rules are needed regarding when and where to post information and to increase efficiency by reducing the need for decisionmakers to search through tools and data to extract the needed information.

8.2 Provide a Synthesized Picture

A major theme expressed by the participants was the need for synthesized presentations of information, both within the various tools used and across the tools. Many players felt the inability to see a holistic

picture of the adversary, and how striking certain nodes would affect the adversary, was an impediment. Players want dynamic tools that reflect the status of effects as they are achieved. This could be in the form of a visual graphic on a map with a drill down hyperlink.

8.3 Need Additional Training

Players indicated they were not sufficiently familiar with the new processes to sufficiently realize the inherent capabilities of the new EBP&A process. There were also instances where players did not know where to go to get information from the "system." More explicit training on the new processes prior to starting the experiment would facilitate a better assessment of the process.

9. References

1. Shelton, H. (2000). *Joint Vision 2020*. Washington DC.
2. Truver, Scott C. (2001). *Spearheading Joint Transformation—And Supporting Homeland Defense*. Sea Power, December 2001, pp. 46-48.
3. *Framework for Effects-Based Operations*, White Paper Version 1.0, 18 October 2001. US Joint Force Command, J9, Concepts Department, Suffolk, VA.
4. *Operational Net Assessment*, TTP for MC02, Draft Version 1.2, 20 November 2001. US Joint Force Command, J9, Concepts Department, Suffolk, VA.
5. From: ETO-to-Actions Limited Objective Experiment Brief, 29 Nov 01.
6. Hutchins, S. G., Kemple, W G., Adamo, R., Boger, D., Nelson, B. W., & Penta, H. L. 2002. *Comparison of Two Collaboration Tool Suites Developed to Support Joint Command and Control Planning and Decisionmaking*. Proceedings of the Command and Control Research & Technology Symposium, Naval Postgraduate School, June 11-13, 2002, Monterey, CA.
7. Kemple, W. G., Hutchins, S. G., Adamo, R., Boger D. & Crowson, J. J. 2002. *Effects-Based Planning: An Empirical Examination of the Process*. Proceedings of the Command and Control Research & Technology Symposium, Naval Postgraduate School, June 11-13, 2002, Monterey, CA.
8. *Joint Collaboration Tools Employment,* Joint Staff, Washington, D.C. CJCSM 6xxx.01, 2001.