Improving Collaboration in Command and Control Environments: Creating and Exchanging Iconic Tags of Key Information

Michael B. Cowen
SPAWAR Systems Center
Code 246205
53560 Hull Street
San Diego, CA 92152
619.553.8004
mike.cowen@navy.mil

Robert A. Fleming
SPAWAR Systems Center
Code 246205
53560 Hull Street
San Diego, CA 92152
813.994.9229
bobfleming@gmail.com

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Michael B. Cowen
Robert A. Fleming
SPAWAR Systems Center, San Diego

Abstract

Collaborative command and control environments for team decision making and situation assessment are becoming increasingly more distributed in time and space. Shared understanding among team members with regard to the impact, importance, and quality of relevant information items (e.g., sensor outputs, text documents, images, message traffic, web pages) is a critical element in the selection of an effective course of action. Here, we focus on the issues of (1) what is the minimum information that needs to be exchanged for shared understanding to occur, (2) how do we capture that information and (3) how should it best be displayed? Distributed teams that communicate asynchronously require a knowledge management plug-in tool that will convert, encapsulate, and tag a group member's subjective understanding of a complex information item into an iconic representation that represent various information parameters. These icons are referred to as Information Objects (IOBs) and are automatically generated from an abstraction template completed by a team member for each decision-relevant information item. These IOBs can then easily be electronically exchanged among the team, improving shared understanding, consensus building, and information fusion among group members and significantly reducing the valuable decision time typically consumed by conflict resolution.

Introduction

As military command and control operations become more global and more network centric, collaborative environments for military group decision making will become increasingly more distributed in both place and time. The traditional face-to-face meeting has been replaced by asynchronous collaboration where the group decision-makers are located in different regions and with differing time-availability considerations. A significant consequence of this is that much of the decision-relevant information is also distributed across the participants. Because of their location, previous experiences, and differing access to information and sources, each participant has uniquely held information items that can significantly impact the decision making process. Uniquely-held information can only impact the group decision if it can be reviewed, evaluated and integrated by other team members.

The work of Stasser and his associates (Stasser & Titus, 1985; Wittenbaum & Stasser, 1996; Wittenbaum, 1998) have clearly shown two significant problems in dealing with uniquely held information. The first is that participants are very poor at sharing their uniquely held information, even though it may have a significant influence on the final decision. They do not intentionally hide the information, group discussions center on the commonly held shared information, and due to time constraints, the uniquely held information is not shared. Second, even if one can devise a way to share this uniquely held information, it is often discounted by the

group and will not impact the final decision. This later phenomenon is discussed by Dennis (1996) in an article aptly entitled "You Can Lead a Group to Information but You Can't Make It Think." A more complete review of this literature has been recently reported by Fleming & Kaiwi (2002).

We hypothesize that uniquely held information is not shared because it increases the cognitive burden of the recipient. In a distributed group decision making environment, each team members must collect, analyze and integrate their own information. Processing information sent by another is an additional cognitive burden. It is likely to be ignored simply because the recipient does not have the time to analyze and integrate other's information. This is unfortunate, because this information has already been analyzed and evaluated by the sender.

Approach

We propose an approach where information (e.g., sensor outputs, text documents, images, message traffic, and web pages) is converted into iconic representations that encapsulate and tag an individual's subjective perception of the information. These icons are referred to as Information Objects (IOBs) and are automatically generated from an abstraction form completed by a team member for a relevant information item. An example of creating an IOB from the abstraction form is shown in Figure 1. The small icon is analogous to a tactical symbol, but represents a document rather than sensor data. We feel that it is far more likely to be used by the recipient than a raw, unprocessed text document.

The use of IOBs will enhance both team and individual decision making. Individual military decision makers, both in an operational and intelligence environment, are required to fuse many information items that differ in quality, timeliness, impact and importance. The decision maker assesses each of these items in the sequence that they arrive, and when a decision is required, attempts to form an overall situation assessment from his or her recollection of those first assessments of the incoming pool of information. This is an error prone process since many of the relevant parameters of individual items are lost due to the cognitive overload placed on the decision maker. The creation and display of IOBs from the initial examination of the information item would leave a permanent, accurate record that is not subject to the limitations of human memory. When a decision is required, this pool of icons becomes available for overall assessments, with each contributing information item still retaining and displaying its distinct information relevance. A decision maker would assess a composite visual display that contains simplified, color-coded icons showing the exact impact and relevance of each retained information item. Just as tactical symbology encapsulates the complex output of remote sensors, IOBs encapsulate the content of complex documents, web pages, images, and reports. A more detailed discussion of the concept of IOBs is presented in Fleming (2003), and Fleming & Cowen (2004).

Experiment at Colorado State University

Here, we report an experiment that evaluated the use of IOBs in an individual decision making environment. It is logical to first demonstrate that IOBs can improve individual decision making as a prerequisite for improved group decision making. Participants were tasked to rank

companies as investment opportunities given reports about the financial health of each company. We addressed the following question: Do participants who tag information (with IOBs) make better decisions than those who do not tag the same information.

The participants were 36 students from Colorado State University (CSU). They were asked to participate as part of a classroom requirement. All the participants were trained on how to create and use IOBs to tag electronic information such as a web report or graph. The participants were tested individually in CSU's Computer Information Systems Laboratory. Each participant received the same stimuli (i.e., electronic reports). Once the participants logged-on, an instructional page appeared tasking them to rank three generic companies as the best, middle, or worst investment. Participants were provided electronic reports about each company's profits, workforce, leadership, and business markets. Participants had the option of using IOBs to help them deal with the electronic reports and the final rank ordering of the three companies. This rank ordering task is part of a known case study taught at the Colorado State University, College of Business and the companies, given the financial reports provided, were ranked a priori based on a previous factual study.

Unfortunately, most of the participants did not opt to use IOBs: Only 15 of the 36 students chose to use IOBs as part of their decision making process. However, when IOBs were utilized, better decisions were made. Results are shown in Figure 2: Those who used the IOBs were about 20 percent more likely to rank the best company (as determined a priori by experts) as their first choice. It is clear that tagging the reports was helpful. Our results lend support to the belief that IOBs can improve individual decision making performance for a relatively simple ranking task. Improved performance could also be attributed to increased attention on each electronic report afforded by the tagging process, and our future experimental designs will need to account for attention effects. Future studies will also increase the complexity of the scenario and will involve the sharing of the IOBs among distributed participants.

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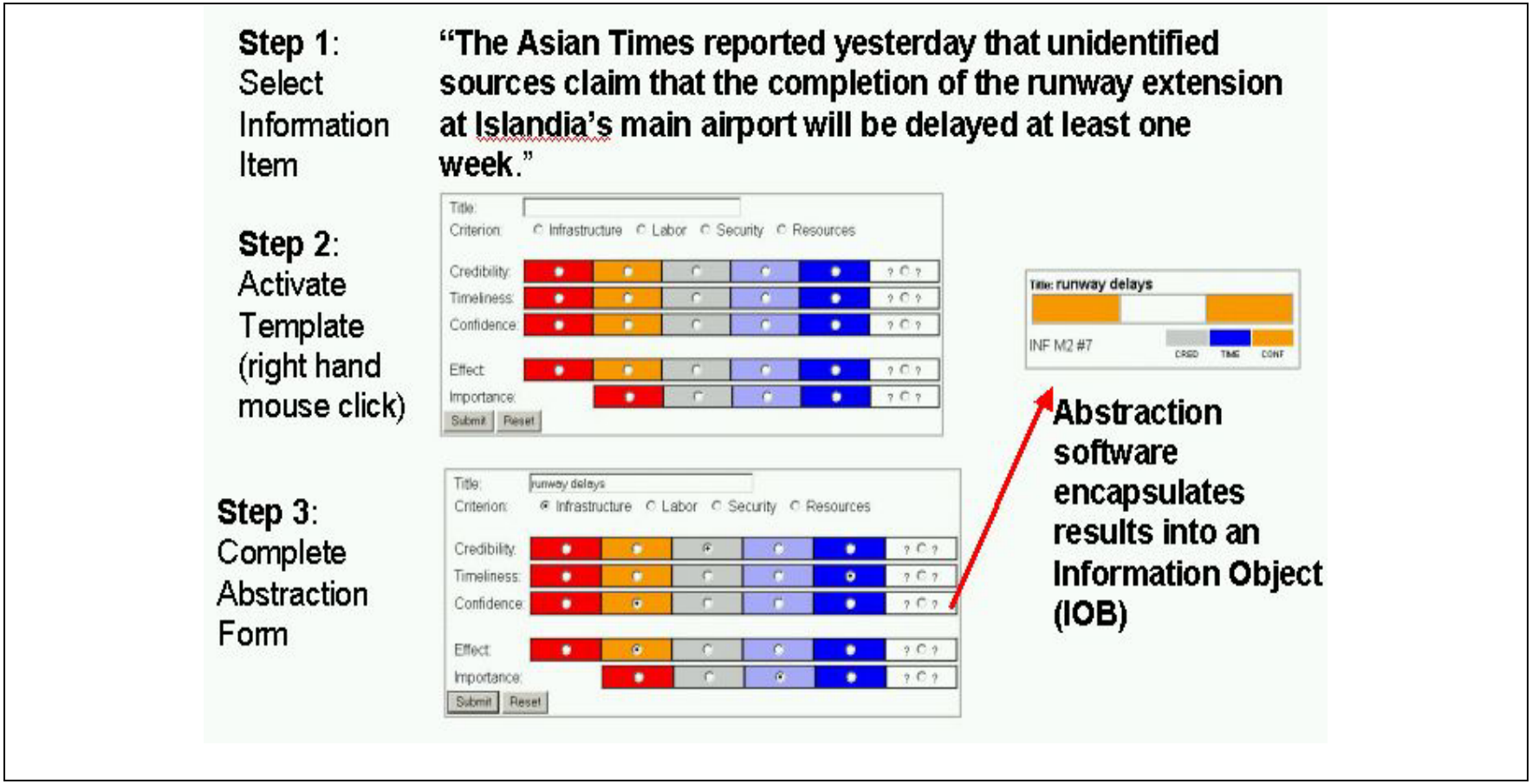

Figure 1. Creating an IOB tag of a newspaper article using our abstraction form.

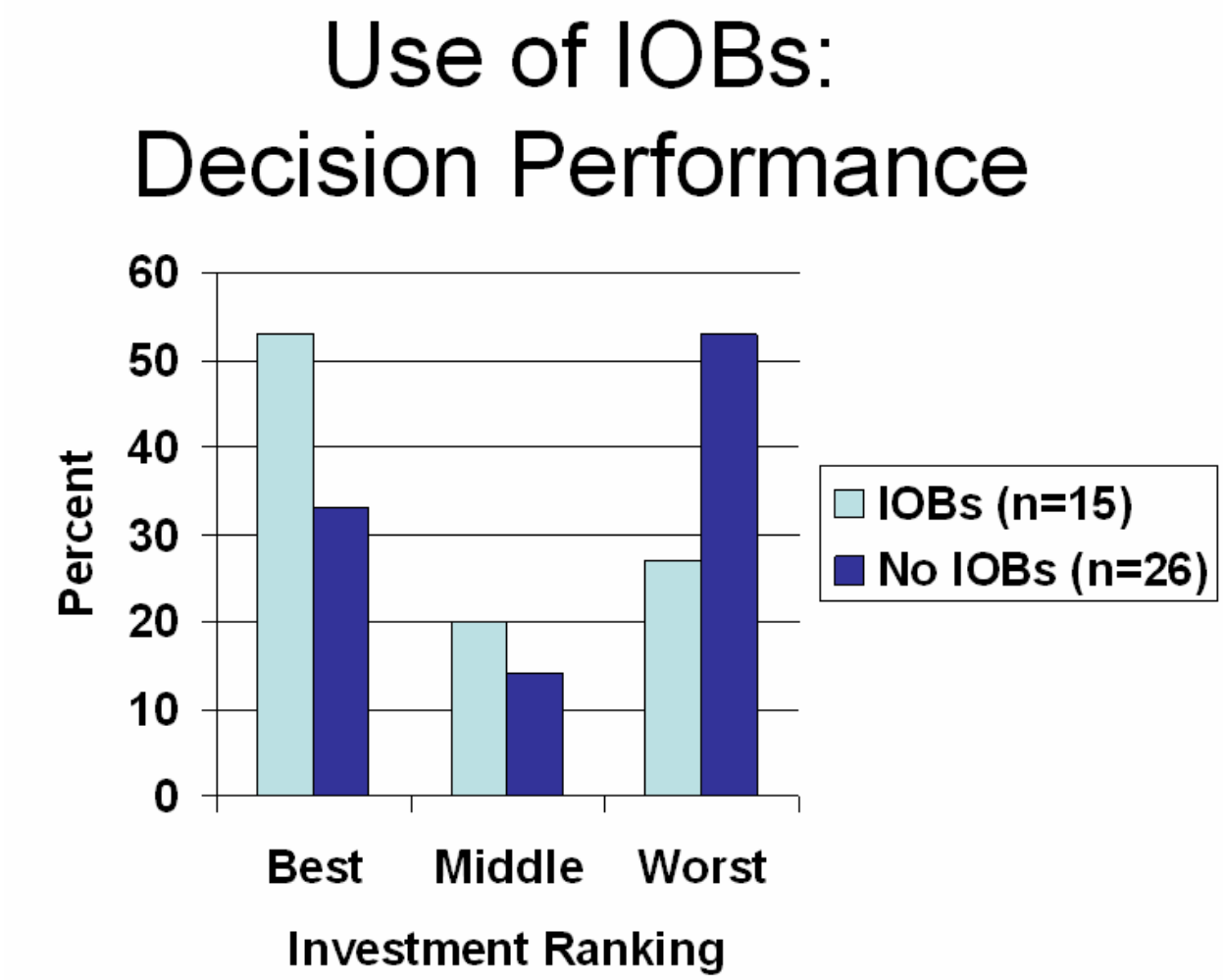

Figure 2. Ranking of companies by IOB group.