Decision Support System Engineering for Time Critical Targeting

Dorothy Pedersen
The MITRE Corporation
Burlington Road, Bedford, MA, 10730
pedersen@mitre.org
(781) 271 – 2165

Dr. James R. Van Zandt
The MITRE Corporation
Burlington Road, Bedford, MA, 10730
jrv@mitre.org
(781) 271 – 4517

Dr. Alan L. Vogel
The MITRE Corporation
Burlington Road, Bedford, MA 10730
(781) 271 – 5188
alvogel@mitre.org

Dr. Marlene R. Williamson
The MITRE Corporation
Burlington Road, Bedford, MA, 10730
mw@mitre.org
(781) 271 – 6294

ABSTRACT

Summary

Time-critical decision making in crisis situations stresses the limits of human capabilities. The Joint community recognizes that both decision support and process changes are essential to the successful prosecution of Time Critical Targets (TCT). The Air Force's approach to process change, as identified in the AF Concept of Operations for TCTs, is encapsulated in Dynamic Battle Management (DBM). A key tenet of DBM is providing the decision support and infrastructure services required for TCT prosecution. Several decision aids for time critical targeting, including Time Critical Targeting Aid (TCTA) and weapon to target pairing tools have been developed and evaluated in recent exercises, including DBM simulations and Roving Sands. They and other tools under development, such as Joint Target Execution (JTE) and Attack Operations Decision Aid (AODA), are proposed for inclusion in future experiments such as EFX 99.

We maintain that effective decision support for TCT will require more than the development of decision aid applications. The prosecution of TCTs exists within the larger context of combat operations, and the development of effective decision support

requires a system engineering perspective. This paper provides overviews of selected decision aids for TCT, of results from recent AF exercises, and of proposals for future evaluations. It identifies "holes" that must be filled before decision aids can provide a truly effective decision support capability.

Background

Time Critical Targets (TCTs) are targets of short duration that cannot be prosecuted during the normal targeting process. The specific time and location of a TCT are unknown, and due to its short duration a TCT must be prosecuted when observed. The Air Force's approach for prosecuting TCTs is documented in the "Combat Air Forces Concept of Operations for Command and Control (C2) against Time Critical Targets", published 8 July 1997. The centerpiece of the CONOPS is Dynamic Battle Management (DBM). DBM has an execution phase focus whose main tenets are information superiority, decision support, and placement of execution authority at the node(s) best situated for successful target prosecution.

During the past few years, the Air Force has explored the implementation of DBM. An Integrated Product Team has engaged in two distributed interactive simulations to better assess the implementation requirements and impact of placing components of TCT C2 at forward nodes. These experiments have identified some of the elements that must be considered in a dynamic environment, as well as the impact on communications and decision support system performance. Experimentation with DBM employment will continue with hosting decision support software and prosecuting TCTs from forward nodes, during EFX 99. This experiment will further define communication and other infrastructure requirements.

Decision Support Aids

Zachary [1] has argued that decision support design is a problem in cognitive engineering. He highlights six general decision support needs, which are "weak links" in human decision making that can be improved by computerized aids. These are: 1) projecting into the future, especially in light of uncertainty; 2) making tradeoffs among many competing attributes or goals; 3) managing large amounts of information simultaneously; 4) analyzing complex situations within time/resource limitations; 5) visualizing and manipulating visualizations; and 6) making heuristic judgements, especially if quantitative. An unaided decision maker typically ignores relevant information and/or falls back on simplistic rules of thumb, particularly in time-critical situations which stress the speed of cognitive operations. The "weak links" lead to a useful taxonomy of decision support, which can be used to explore the potential for decision support in a systematic and comprehensive way.

Another useful perspective is the level of automation of the decision aid. For time critical situations a high degree of automation is desirable. However, the maturity and reliability of the decision model determine the degree of automation that is useful. For complex,

high risk applications, the human often cannot be eliminated entirely. We will use both these perspectives to characterize the TCT decision aids.

Decision Support System Engineering

Decision support tools for TCT are designed to organize, sort, and present information so optimal and better decisions can be made. The developers of the tools assume that specific information is available in a form that supports the tools internal processes. The tools in and of themselves are not adequate. They are but one element of the decision support system. The aid must be available to the proper operator/commander, and the information required to support the tool must be available in a format that the tool can use. This last factor especially must be given careful consideration in decision support system design. We will give examples of where decision aids place new demands on information needs in order to be truly useful.

References

[1] Zachary, W. W., "Decision Support Systems: Designing to Extend the Cognitive Limits," in Handbook of Human-Computer Interaction, M Helander [ed], Elsvier Science Publishers B. V., 1988