Agent-based Decision Support System for the Third Generation Dynamic Distributed Decision-making (DDD-III) Simulator*

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ABSTRACT

A. Objectives

In this paper, we extend our three-phase organizational design process ([2], [3]), which hypothesizes that congruence between missions and organizations leads to superior organizational performance, to include mission monitoring and dynamic re-planning in order to maintain a desired level of congruence. The dynamic mission monitoring facilitates situation awareness at the team level, which in turn, promotes team collaboration and coordination, and speeds-up the team decision-making processes. The dynamic re-planning allows the organization to maintain (near-) optimal performance in a dynamic, uncertain environment via adjustments to organizational strategies and/or structures.

We propose to utilize the third generation Distributed Dynamic Decision-making (DDD-III) simulator [1], which provides a flexible, controllable paradigm for examining the interactions between the mission structure and the way in which the organization tasked to execute the mission is structured, to operationalize the extension. The approach is to augment the DDD-III simulator with the decision-support capabilities via our optimization-based organizational design process embedded as a decision-making agent [5]. This decision support agent provides the organization with the ability to generate robust plans, as well as, the capability to sense unforeseen variations in the mission, analyze them, adjust the plans, and adapt to the changing needs via strategy and structural adjustments.

B. Method

The addition of optimization-based decision-support to the DDD-III provides the following capabilities: (1) an interactive what-if analysis, i.e., the agent-based tactical decision-support module; and (2) information sharing and collaboration, i.e., the web-based collaborative and information sharing module (an enhanced version of the Knowledge Web (K-Web) [6]). The system architecture, shown in Fig. 1, consists of four components: (1) the DDD-III simulator, (2) the shared online storage module, (3) the agent-based decision support module (DSM), and (4) the enhanced K-Web (termed Intelligent K-Web) module. The architecture places shared storage as the central component, which connects the other system components. The process of maintaining the dynamic database is shared by the other three components. The DDD simulator is responsible for updating the status of all DDD objects. The agent-based DSM maintains the
current performance monitors, analysis, and decision-support information, whereas the Intelligent K-Web module dynamically reads the value-added support information and actively forwards the user inputs to the DSM via the database. The challenge in utilizing the architecture rests in maintaining smooth inter-platform connections, viz., between the DDD simulator running under LINUX® and the other components running under Windows® operating systems. We overcome the inter-platform complexities via database application program interfaces (API).

C. Expected Results

In order to evaluate and verify the usefulness and effectiveness of the proposed decision-support system, a set of scenarios derived from those utilized in the A2C2 experiment 8 [4] are used. In the experimental evaluation, each of the evaluated organizations is represented as a pair; one is provided a team-level decision-support system and the other one without the decision-support. Various individual as well as team-level measures are utilized to compare the performance of the organizational pairs. It is expected that organizations with team-level decision-support systems will outperform those without such support systems on most (if not) all of the team performance measures.

REFERENCES


