Decision Infrastructure for Counterinsurgency Operational Planning (DICOP)

Elan Freedy, COL Lou Lartigue, Lisa Chung, Raj Ratwani, Gershon Weltman, James Zanol, Brian Pierce, and Marvin Cohen

Abstract—**This paper describes a new Decision Infrastructure for Counterinsurgency Operational Planning (DICOP). DICOP facilitates the cognitive processes of the command team by providing a method for organizing relevant situational data, visualizing and modeling operational factors, assessing uncertainty and risk, and identifying and planning courses of action that are likely to provide the greatest utility. DICOP is organized around three main components: Mission Analysis; Mission Modeling; and Mission Planning. Mission Analysis provides a method for rapidly organizing and analyzing incoming intelligence and situational information. Mission Modeling provides a structure for constructing campaign models (lines of effort, objectives, and end states), using doctrinal templates, assessing the impact of situational factors, and associating intelligence information with the model. Mission Planning supports resource to task allocation, scheduling, and order generation. Initial positive evaluation by US Army command personnel has shown that DICOP is a powerful tool that fits the needs of the counterinsurgency planning team. Users highlighted three key cognitive features: (1) the ability to explicitly represent and manipulate operational factors in a modeling framework, (2) the ability to directly associate intelligence in support for or against those factors, and (3) numerical measures of utility and risk for different courses of action. The paper describes the DICOP cognitive rationale, its functional features, its initial evaluation, and the plans for further empirical evaluation in an operational environment.**

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Index Terms— **Command and control cognitive enhancement, counterinsurgency planning, decision support systems, influence diagram modeling, visualizations**

I. INTRODUCTION

The Decision Infrastructure for Counterinsurgency (COIN) Operations Planning (DICOP) is directed toward bringing new capabilities for organization, assessment and visualization to planning COIN Operations, with a particular focus on Non-Lethal Operations (NLO). COIN and NLO are military activities that are growing in importance as emphasis shifts from conventional warfare to operations in support of regional security and economic and political stability. Specifically, the DICOP system is designed to provide a revolutionary new capability for aiding tactical commanders at brigade level and below to generate optimal courses of action (COAs) within hours using available laptop computers, to assess the ongoing performance of the constituent COA tasks, and to integrate the NLOs with planning and monitoring of lethal operations in an overall COIN campaign.

COIN Operations seek to influence the *behavior* of target decision-makers or audiences in a Host Nation (HN) through the use of a variety of activities, focusing on three main desired end states: Self-Sufficient Security, Stable Governance and Functioning Economy. To manage these activities, commanders participate in the well-understood "OODA" loop, where OODA represents a continuous process of O*bservation* to collect decision relevant information, O*rientation* to achieve situational understanding, *Decision* to select a best course of action to bring the instant state into alignment with the objective state, and A*ction* to execute the selected activity.

However, COIN Operations include a number of features distinct from the commander's more usual OODA situation. These factors contribute to the complexity of creating and leveraging a system for this new environment; they include the following:

- The operational environment is comprised of a broad scope of activities spanning the physical, information, and cognitive domains. The operational environment is acted upon by a number of forces: internal and external, known and unknown, *qualitative* as well as *quantitative.*
- Planning timelines are much longer than those in the purely lethal operational environment
- The operational environment is not as well-defined or as well-understood as "traditional" military lethal

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14. ABSTRACT

This paper describes a new Decision Infrastructure for Counterinsurgency Operational Planning (DICOP). DICOP facilitates the cognitive processes of the command team by providing a method for organizing relevant situational data visualizing and modeling operational factors, assessing uncertainty and risk, and identifying and planning courses of action that are likely to provide the greatest utility. DICOP is organized around three main components: Mission Analysis Mission Modeling; and Mission Planning. Mission Analysis provides a method for rapidly organizing and analyzing incoming intelligence and situational information. Mission Modeling provides a structure for constructing campaign models (lines of effort, objectives, and end states), using doctrinal templates, assessing the impact of situational factors, and associating intelligence information with the model. Mission Planning supports resource to task allocation, scheduling, and order generation. Initial positive evaluation by US Army command personnel has shown that DICOP is a powerful tool that fits the needs of the counterinsurgency planning team. Users highlighted three key cognitive features: (1) the ability to explicitly represent and manipulate operational factors in a modeling framework, (2) the ability to directly associate intelligence in support for or against those factors, and (3) numerical measures of utility and risk for different courses of action. The paper describes the DICOP cognitive rationale, its functional features, its initial evaluation, and the plans for further empirical evaluation in an operational environment.

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environments.

- Forces in the COIN environment interact and inter-depend in complex and non-obvious ways (e.g. short term and long-term goals may be in conflict).

As a result, we are incorporating some fundamental innovations in military decision support into DICOP so that it will: (1) represent the first application of decision modeling technology to COIN plan formation, assessment and modification; (2) substantially enhance COIN informational representation and integrate it with related lethal geospatial and non-geospatial information tools and systems; and (3) significantly expand the ability of command personnel to plan, analyze, assess, document and brief multi-force campaigns.

Bennett, Posey and Shattuck [1] conducted an extensive cognitive systems engineering (CSE) analysis of the brigade and battalion command and control domain and concluded that "the scope, complexity, and severity of the challenges presented by this domain are staggering (p.350)." Our goal is to alleviate to some extent the challenges faced by the commander and his or her staff in planning and assessing critical COIN activities within this domain.

II. SCIENTIFIC AND TECHNICAL APPROACH

A. *DICOP System Concept*

DICOP's key modeling features are derived from the decision modeling capabilities of Perceptronics' Tactical Group Decision Analysis System (TGDAS) that was developed and tested under a SBIR R&D project jointly sponsored by DARPA and USSOCOM [2][3].

Figure 1 shows the interaction of the modeling, data and visualization layers in the overall DICOP system. DICOP contains three functional layers that interact closely with each other:

- **Model Layer.** The *model* is a user-built representation of a campaign or mission that links military tasks to desired end-states, and includes estimates of how strongly the various modeled elements affect each other. Computations based on the model enable the comparison and analysis of various combinations of possible tasks which can be interpreted as COAs. Templates based on standard campaigns and doctrine help the users build their own model quickly and easily.
- **Data Layer.** This layer contains the real-world situation information that the users apply to build and refine the model. The data take the model from the general case to the specific case reflecting the current campaign status, objectives and end states.
- **Visualization Layer.** This layer presents the COA tasks in terms of their time and space characteristics. It allows the users to format the selected COAs so that DICOP can automatically generate briefing materials that can be used to create operations orders (OPORDs) and fragmentary orders (FRAGOs).

DICOP facilitates campaign planning by providing new methods for visualizing and modeling COIN campaign elements. DICOP allows tactical planners to better prioritize tasks and thereby efficiently assign resources to achieve desired end states. The DICOP concept is fully compatible with the approach to planning (i.e., lines of effort, objectives and end states) defined in the US Army FM 3-24.2 Tactics in Counterinsurgency (TacCOIN) Manual.

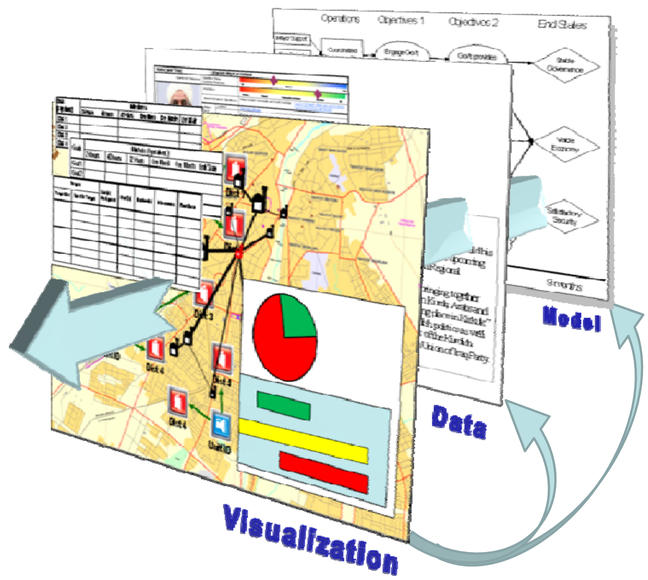

Fig. 1. Modeling, data, and visualization layers of the DICOP system.

B. *Design Objectives*

The primary purpose of the DICOP system is to provide a key set of innovative tactical COIN capabilities, including:

- **Rapid Planning.** Creating COAs within hours to days consistent with the users' normal planning cycle;
- **Multiple Courses of Action.** Generating alternative COAs for consideration and/or presentation to the commander;
- **Feasible, Acceptable, Supportable and Distinguishable COAs.** Ensuring the COAs satisfy criteria that are essential to the tactical unit;
- **Interactive Planning.** Allowing the system to iterate smoothly between presenting the recommended COAs and planning and incorporating of commander's feedback;
- **Measures of COA Effectiveness.** For example, using as a measure of effectiveness whether the indigenous population sustains the processes initiated by the given COA tasks;
- **Single Laptop Support.** Operating with intermittent connectivity to outside data bases and the ability to join the network in a command post and import tactical information through the Publish and Subscribe Server (PASS).

Our focus in this R&D project is on building a prototype DICOP that will usefully support tactical command at brigade and below echelons. At the same time, we are attempting to meet the needs of larger-scale COIN planning by designing a system with strong strategic and operational capabilities. This approach will directly address the top priority military application, and the solution will extend to other important non-military applications such as homeland security, law enforcement, etc.

III. COGNITIVE ENHANCEMENTS

The DICOP approach incorporates a number of elements designed specifically to enhance individual and team cognitive performance. These are described briefly below.

A. Combined Naturalistic and Formal Decision Making

While traditional approaches to decision training, support, and consulting have emphasized analysis, *naturalistic* approaches have focused on intuition [4][5]. According to its proponents, the analytical approach helps decision makers avoid systematic violations of consistency constraints, called "biases," by forcing them to break a problem down into components, assess numerical parameters, assemble the pieces into formal models, and derive recommended optimal solutions based on abstract measures [6][7]. Naturalistic aiding and training, by contrast, is rooted in a more concrete and holistic recognition of situational cues, goals, and action affordances [8][9]. The point is not logical consistency or even optimality, but empirically successful performance, to be achieved by approximating the way proficient decision makers actually think and decide [10].

The DICOP framework provides a practical and proven means for merging the principles of naturalistic decision making with those of normative decision modeling and analysis to achieve timely and useful planning and decision making support [2][3]. Users propose courses of action by creating causally-linked sequences of actions, key factors or events in the past, present, or future, and short or long-term mission outcomes. Influence diagram models are built quickly by dragging and dropping elements from a palette based on previous experiences in similar situations and doctrine. Team members interpret the situation and predict its future evolution by linking intelligence information to the scenario elements for which they provide evidence.

This is illustrated in Figure 2, which shows how the DICOP process progresses from Natural Cognition, to more formal Representation and Modeling, to rigorous quantitative Analysis. The feedback loop supports Critical Thinking, another naturalistic process. The most innovative aspect of the TGDAS/DICOP approach is that it captures the decision makers' ideas about the decision problem in the natural form of "scenarios" with connected elements of tasks, objectives and end states.

The support system helps the users transform these scenarios into easily interpretable influence diagram representations using templates mapped to lines of effort and desired end-states. Based on these templates, DICOP suggests related factors to the user selected nodes to allow for greater development of the representation. These representations are then converted into analytical models that are used for easily-understood, quantitative evaluation of the options -- and also to show the sensitivity of the options to changes in their constituent elements.

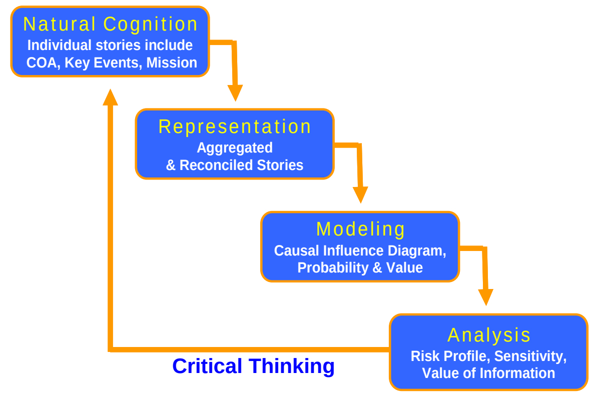

Fig. 2. DICOP Naturalistic and Analytical Decision Processes

B. Influence Diagram Model Representation

Decision analysis is the practical implementation of ideas developed by economists, logicians, and statisticians under the rubric of decision theory. Traditionally, decision analysis has been associated with a set of discrete modeling paradigms: decision trees for choice with uncertain outcomes, event and probability trees for uncertain inference (explanation, prediction, and evidential updating), and goal hierarchies for choice based on multiple criteria [11][12]. Unless extensively pruned, decision trees display every possible combination of variable states as a distinct path and require probability assessments for every branch conditional on the entire path leading up to it. As a result, the exponential growth in model size with number of variables imposes severe burdens on visual intelligibility, assessment, and computation, even with relatively small models.

The most exciting work in decision analysis over the past two decades applies a more powerful modeling technology to these problems, i.e., *Bayesian networks* and *influence diagrams* [13][14].

Influence diagrams are *decision models* that incorporate Bayes nets and in addition support choice under uncertainty and tradeoffs among multiple objectives [15] in a simpler, more easy to follow format. A maximally simple decision problem involves three elements: (1) uncertain conditions (as in Bayes nets), (2) decisions, and (3) consequences.

As illustrated in Figure 3, rectangles are decision nodes, representing variables whose states are actions under the control of the decision maker. Ovals are chance nodes, which represent uncertain conditions with the same parameters as Bayes nets: i.e., conditional probabilities must be assessed for states of chance nodes conditional on all combinations of states of their parents (which may include both decisions and other chance nodes); prior probabilities must be assessed for states of a parentless chance node. For convenience, we sometimes call uncertain conditions *outcomes* when they are influenced by a decision and *situation* factors when they are not. However, the outcome of one action may be a situation factor with respect to a subsequent action. Diamonds are utility nodes, representing consequences in the form of a utility assignment, or degree of preference, to every combination of their parents' states. An action is optimal if it maximizes subjectively expected utility (SEU), which is the sum over consequences of utility multiplied by probability of the consequence given the action.

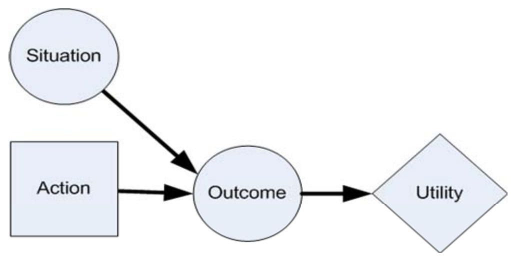

Fig. 3. Simple Influence Diagram

Our experience has been that while the influence diagram convention is new to users it becomes a natural means of representation, even for personnel with no formal training in decision analysis, because this convention maps to the current logical thought process of most users (i.e. tasks → subgoals → goals). In the influence diagram convention tasks map to action nodes, subgoals map to outcome nodes, and goals map to utility nodes.

C. *Decision Support as a Job Training Aid*

Our work in developing and evaluating the DICOP decision support framework has also shown that specific decision making and operational processes can be instantiated in a software toolset to provide the user with a solid structure to formulate effective COAs. In the Army counterinsurgency domain, military decision making processes (MDMP) and counterinsurgency doctrinal processes have been instantiated in our DICOP decision support tool. With these processes embedded in the DICOP system, operational planners ranging from novices to experts are able to more effectively formulate COAs because they have a software tool that provides a clear underlying planning structure in a familiar context.

In practice, the DICOP framework can additionally serve as an on-the-job aid and training aid in three distinct ways:

- First, we encapsulate the COA development process. Thus the user has a structured framework in which operational planning can take place, and which shapes the processing and decision making every time the decision support system is used. This facilitates operational planning during training as well as during real operations.
- Second, we employ a user-friendly, task oriented interface that provides operational planners with the appropriate information, visualizations, and analysis techniques when needed [16]. The task oriented interface "knows" where the user is in the operational planning process, and consequently provides tailored guidance to the user.
- Finally, we focus on capturing the decision making and operational planning processes at the individual and team level. These processes can then be dissected in an after action review (AAR) to determine where the planners had difficulties and what led to these difficulties. Further, the planning processes of a particular user can be compared to other planners and doctrinal templates to determine where discrepancies may exist. Through this process, an effective AAR can be designed that is specific to the needs of the scenario, agency, and individual.

D. *Cognitive Based Visualization*

Effective operational planning requires the processing, comprehension, and monitoring of vast amounts of information. For example, planners have to extract information from various databases and integrate this information to understand current situational conditions, planners have to use this information to develop COAs, which in turn have to be analyzed and reasoned with to evaluate possible outcomes. Finally, the COA must be monitored during the execution phase to ensure success. It is well known that the method in which information is represented (i.e. the types of visualizations used) can have a profound influence on the user's ability to reason with this information.

Poorly-designed visualizations may lead to longer processing times, increased workload, and possibly erroneous conclusions. Well-designed visualizations can facilitate information processing and reduce workload compared to other data representation formats [17][18].

A central component of DICOP is the use of effective visualizations that serve to facilitate cognitive processing during each stage of the planning process. To develop these visualizations, we leveraged principles of visualization design as well as cognitive theories of perception, memory, and information processing. Specifically, we focused on enhancing three critical processes: (1) the extraction of specific information, (2) the integration of multiple data points to determine trends, and (3) the ability to make inferences and project to future outcomes. These visualizations will continue to be developed as we evaluate DICOP.

IV. CORE FUNCTIONAL CAPABILITIES

The DICOP system provides three core functional capabilities: Mission Analysis; Mission Modeling, and Mission Planning. These are described below, followed by a brief description of how the DICOP tools integrate into brigade and battalion planning cycles.

A. *Mission Analysis*

In this mode DICOP provides the user the capability to rapidly categorize incoming information by "tagging" the information for inclusion into relevant categories of the military information formats METT-TC and PMESII-PT; to import tactical situation data onto an available map and to mark up the map with an intuitive toolset; and to quickly assess unit status and availability.

Mission Analysis, along with the other core DICOP functions, is linked to the brigade and battalion reiterative "targeting cycle" in which suitable targets for NLO or lethal operations are identified and COAs consisting of specific tasks are allocated to those targets within the resources available. As shown in Figure 4, the DICOP features that facilitate

Mission Analysis include:

- Unit Task Organization. This panel allows users to add and assess unit details and availability (hidden from view).
- Staff Running Estimates (left panel). This panel allows the users to create and organize intelligence information in accord with accepted organizational schemas.
- Map Panel (upper right). This panel allows the users to present planning information in a geospatial context.
- Information Panel (lower right). This panel allows users to locate relevant information coming from outside sources (e.g. PASS topics) and to organize mission-related files.

These features greatly facilitate situational awareness for the complete planning cycle.

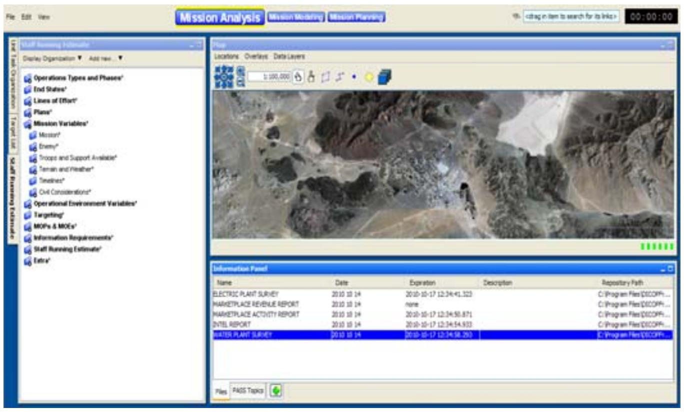

Fig. 4. DICOP Mission Analysis Mode typical screenshot

B. *Mission Modeling*

This mode enables the users to construct campaign/mission models based on doctrinal templates; to assess situational factors and the interdependencies of tasks and objectives to end-states; and to specify the resource requirements for candidate tasks. DICOP provides a set of template-based modeling tools based on selecting desired End-States and working through COIN Lines of Effort and intermediate objectives to determine potential tasks for inclusion in COAs.

As shown in Figure 5, the DICOP features that facilitate Mission Modeling include:

- Target List and Unit Task Organization (hidden from view). The target panel allows users to add detailed targets of interest. Users may assign units and link targets to specific tasks in the Model Composer panel by dragging and dropping the unit or target on to the task node (shown has target icons and unit icons on the task nodes).
- Templates (left panel). This panel includes stored templates for building a diagram in the Model Composer panel. The templates are based on doctrine or on previous experience of the unit. A user can drag and drop a template into the model window and DICOP will suggest other nodes that should be considered for the model. In addition, the user can modify these templates by adding or removing nodes and including situational factors.
- Staff Running Estimate (hidden from view). This panel allows the users to link intelligence information directly to elements of the decision model. The links are displayed as "document" icons on the nodes in the model with additional alerts for expired and new data.
- Model Composer (right). In this panel users to build a model from scratch, from the stored templates, or from a combination of the two.

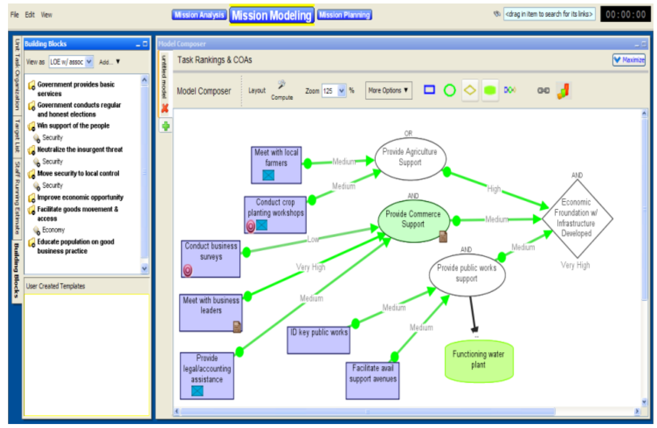

Fig. 5. DICOP Modeling Model typical screenshot

Creating a campaign or mission model, as shown in part in Figure 6, is a new task for most users, but it is readily learned through the use of templates, simple causal relationship rules, and simple methods of assigning values. For example, familiar drag and drop functions allow users to select rapidly from the available functions, and familiar screen formats allow users to apply the various computational and mapping capabilities. In addition, a "wizard" has been developed that walks novice users through the process of creating a model.

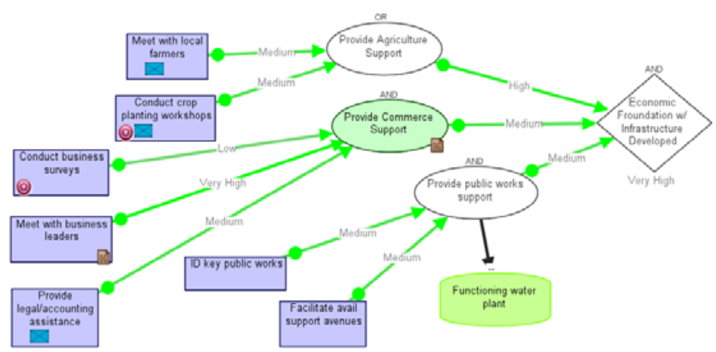

Fig. 6. Sample Mission Model focusing on sustainable security

The objective of modeling is to build a representation of the mission or campaign in which the possible actions/tasks are connected to the end states through objectives that can be influenced by situational factors (shown as rectangles, diamonds, and ovals, respectively, consistent with the described convention). The model provides a way of viewing the relationship between tasks and outcomes not previously available to the planning staff, as well as the basis for *computing the model* – that is, calculating the best COAs (which are sets of tasks) using the estimates of value and connectivity, as well as the actual resources available. Because we have found that it is difficult for users to place hard numbers on the connections between model elements that may represent fuzzy relationships, we provide them with the option of making qualitative assessments, such as “very strong”, “strong”, “weak”, “very weak” and so on.

The assessments in DICOP are provided by the user and are based on the users’ experience. Although there is variability from user to user and the values input by the user are not always based on exact empirical evidence, the exercise of thinking critically about the connections and weights provides a level of analysis that exceeds current process.

C. *Mission Planning*

The main functions in the Mission Planning mode allow users to: (1) develop and compare COAs by assembling potential COAs from identified tasks and actions, and reviewing COA scores and risks computed from the campaign/mission model; (2) generate orders by assigning units to tasks and laying out the timeline and map location.

Perhaps the most important feature of the DICOP approach is the task and COA analysis provided by computing the model. Figure 7 shows the COA comparison screen; the presentation itself is compatible with, and more rigorous than methods currently used by command staff.

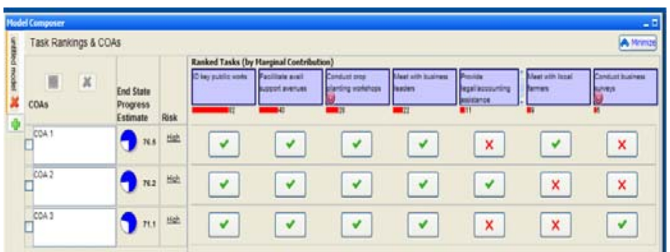

Fig. 7. DICOP COA Comparison and Task Ranking

Key features of the comparison include:

- Task Rankings. The potential actions (or tasks) identified in the Modeling process are displayed in the top portion of the screen along with their utility scores, which represent their relative contribution to the general model.
- Recommended COAs. The top-ranked COAs are displayed as rows. The check mark and “x” buttons indicate whether the task above is executed or not as part of that COA. For example, for the first COA (“ COA 1”), all of the tasks except the third to last and last task can be executed. However, for the second COA (“COA 2”), the last two tasks in the list cannot be executed. In addition, the utility score for each COA is shown to the right of the COA name with a pie chart. In the example above, the top COA has an average utility of 76.5. The higher the utility the more desirable the COA, except for the risk factor, as explained below.

A novel feature of DICOP is the risk score and associated Risk Profile Graph that shows the separate utilities from which the Average Utility for a COA is derived. A sample display is shown in Figure 8. A spread-out risk profile means there are high payoffs, but there are also very low payoffs. A narrow profile means the utilities are more stable over all circumstances. To reduce risk, a user might select a COA with a narrower profile even though it has a lower average utility.

Once a COA is selected, DICOP helps the user organize the mission in terms of a general Timeline and Execution Matrix. The Timeline allows the users to lay out the mission plan, specify the time durations for the tasks, and assign units to each task. The Execution Matrix is a detailed plan for the current mission, based on information added to the timeline, including task location and target information.

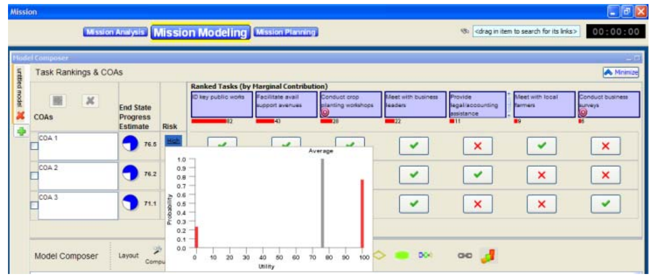

Fig. 8. DICOP COA Risk Profile Display

D. *Integration in Planning Processes*

It is important to emphasize that DICOP does not make command decisions itself, but organizes the information and evaluates the factors on which the actual decisions are made by the commander and staff. *It is truly a support system, not an automation system.*

In that regard, DICOP integrates readily into standard brigade and battalion planning and targeting cycle procedures. During the campaign planning phase, DICOP is used to perform mission analysis, to construct the campaign/mission model, to develop and compare COAs, and to prioritize the Lines of Effort (LOE) tasks in order to complete the initial mission planning process.

During the targeting cycles, which have typical durations from hours to weeks, the focus is on using the available campaign/mission models and interim results to evaluate and to re-prioritize LOE tasks, to assign specific targets to tasks, and to incorporate suggested standard operating procedures/enduring tasks into the overall campaign/mission plan, as needed. The production of standard High Priority Target Lists (HPTLs), OPORDs and FRAGOs is also facilitated by the DICOP processes

V. REVIEW AND EVALUATION

The DICOP capabilities were reviewed and endorsed by US Army command personnel in the context of a realistic field exercise, and as a result the system is being deployed for field evaluation in an actual operational environment abroad. The following sections describe the initial review and the planned field evaluation.

A. *Initial Review*

The DICOP development process was greatly helped by the participation of command personnel from the 4th Infantry Brigade Combat Team of the 3rd Infantry Division (the “4-3 IBCT”), and particularly by the continued close interest of Brigade Commander COL Lou Lartigue. This participation ensured that the resulting product would fit in with actual brigade and battalion operations.

In April 2010 a team of Perceptronics Solutions scientists and engineers observed two 4-3 IBCT targeting and planning cycles during the Brigade's pre-deployment exercise at the National Training Center (NTC), Ft. Irwin, CA. The purpose of our presence at the exercise was to evaluate specific DICOP capabilities to address the targeting cycle tactical process and functions as a planning aid. Our study specifically focused on:

- Model-Based Critical Thinking and Analysis
- Functional Support for Planning/Targeting Workflow
- Information Management

Members of the Perceptronics Solutions team were stationed at the 4-3 IBCT Tactical Operations Center (TOC). Information regarding situational events and actions were used as stimulus for interaction with the DICOP system. All interactions with the DICOP system were performed by the team in a manner consistent with how we anticipate the system being used during actual operations, based on a DICOP Targeting Cycle standard operating procedure developed prior to the exercise. We assessed the system's capabilities during the events of the week by using a set of evaluation criteria we had defined prior to the exercise.

Overall, we achieved our main objectives for the NTC exercise in that we were able to deploy the system under realistic operational conditions and to affirm that the system accurately captures the workflow and processes to support target cycle planning at brigade and below. Most important, reaction of the 4-3 commander and staff to DICOP performance was highly positive. Brigade Commander COL Lartigue was very pleased with our progress and the capabilities the system could provide to support the Brigade's targeting execution. He suggested a number of improvements which have been implemented in the final prototype.

As a result of this positive assessment, COL Lartigue has endorsed the deployment of the prototype DICOP to the 4-3 IBCT as it performs its current mission. Additional funding for the field test was obtained from the US Army SBIR program office, and we are in the process of preparing for 2011 deployment, support, and evaluation of DICOP in the operational field environment, as described below.

B. *Planned Field Evaluation*

Evaluation of the DICOP system in an actual operational environment is a unique opportunity for a R&D program of this nature and will allow us to assess with highest confidence the operational value of the system. Specifically, the proposed field evaluation effort will be directed toward the following objectives:

- Assessing the field usability and operational utility of DICOP for members of the Brigade battlestaff in managing information, prioritizing tasks based on lines of effort and formulating optimal courses of action based on available resources.
- Determining the value of the system processes and outputs on the Commander's decision-making as well as on his confidence in staff estimates and recommendations based on traceability of information and effects tracking.
- Developing conceptual operations for use of DICOP as a component in a broad tactical systems architecture, with particular focus on developing a transition strategy for DICOP as a COIN planning module within the Command Post of the Future (CPoF). Integration with CPoF would be done in a manner consistent with the PM Battle Command Collapse strategy (http : // defensesystems . com / microsites / 2010 – peo - 3t / battle – command - strategy.aspx), which is focused on establishing CPoF as a common front-end for various tactical tools.

Our evaluation approach will be to introduce different capabilities of DICOP during a number of successive 2-week targeting cycles, scaling in complexity until we reach full end-to-end system application.

Our focus will be on comparing traditional targeting cycle processes to targeting processes with DICOP in use. Specifically, we will want to determine whether: (1) Information management is made easier; (2) Users are able to more clearly visualize causal relationships between lines of effort, end states, objectives, and tasks; (3) Users are able to support their decisions/models with situational data and explain their rational for selecting particular COAs; and (4) Mission planning can be accomplished more quickly. During each cycle we will both observe and ask specific questions to assess whether the component(s) in use have achieved the desired effect.

VI. CONCLUSIONS

A. *Progress to Date*

Initial informal user evaluation has demonstrated that DICOP is a powerful tool that fits the needs of the brigade and battalion command team. Users highlighted three key features: (1) the ability to explicitly represent and manipulate operational factors in a modeling framework; (2) the ability to directly associate intelligence in support for or against those factors; and (3) measures of utility and risk for different courses of action. User feedback has also provided useful direction for enhancing the DICOP tools.

B. *Relationship to Future R&D*

The DICOP research and development project is a major step in transforming previous and current DoD investments in net-centric command and control from information and knowledge sharing systems to *cognitive augmentation systems* that can facilitate the active integration of expert judgment with rigorous analytical techniques for tactical and operational planning, COA selection and plan assessment and monitoring.

The model-based approach taken in the present project ensures that shared planning and assessment activities include not just commonly-known information, but also recognition of critical individual and team *uncertainties and divergences*. As a result, information will be more effectively utilized and disseminated, and team members will be able to predict, and in some cases, proactively satisfy one another's information needs both in rapid tactical planning within hours, and also in more protracted non-routine operational situations, i.e., when the stakes are high, some time is available, and the issues resist quick resolution**.**

In summary, the research and development performed here will expand the horizons of future R&D into team planning and decision making and will support the development of mechanisms for cognitive enhancement.

C. Transition and Commercialization Strategy

Transition to operational use and commercialization of the R&D product are the top-level objectives of SBIR projects. We are pursuing several parallel avenues of transition and commercialization while focusing our transition efforts on both near-term and longer-term opportunities. In the near-term, we will capitalize on enablers with whom we have established relationships in this and related projects.

We have also initiated a longer-term process for identifying other potential DICOP users in a variety of areas. Our current longer-term transition targets include the Department of Energy and USSOCOM PSYOP activities, and we plan to identify other potential users as well. We are assisted in this task by our selection as a participant in the DARPA SBIR Transition Support Pilot Program for the DICOP project. Potential areas of assistance that are offered in this program include collaboration partner identification and introductions, outreach and marketing support, and documentation of our Company's transition successes.

The focus of our commercialization strategy will be implementation of the Phase II DICOP system as a set of software modules for use in a variety of tactical and operational applications. We will tailor our product to overcome significant barriers to entry in this market; key features will include: (1) Instant operational utility and usability through familiar Web and graphical based interfaces; (2) Flexibility to integrate with each customer's organization and procedures and to change as the responding organization evolves; and (3) No requirement for special hardware or software. The product modules will be designed for use independently and as an integrated suite.

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