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Title:
Decision support tools for the operational planning process

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Abstract:

The Canadian Forces Operational Planning Process (CFOPP) is a methodological team approach to develop plans and orders for Canadian Forces operations. The CFOPP includes but is not limited to analysing the situation, identifying relevant factors, sketching courses of action, developing the commander's guidance and decision, and producing detailed annexes necessary for orders and tasking of CF units. It is based on an Estimate Process. Defence Research and Development Canada (DRDC) is investigating computer-based decision support to improving the decision cycle and timeliness of orders and tasking. In this paper, we focus on key components of the CFOPP. In particular, this paper describes computer-based tools to support center of gravity analysis, decisive point analysis, risk management, criteria management, dynamic link management and decision-matrix management. These tools have been embedded into DRDC Collaborative Operations Planning System (COPlanS), an integrated flexible suite of planning, decision aid and workflow management tools design to support a distributed team involved in the Military Operations Planning Process.

Section 1: Introduction

A computer-based system called Collaborative Operations Planning System (COPlanS) has been developed at DRDC Valcartier to support the different stages of the Canadian Forces Operational Planning Process (CFOPP). COPlanS is an integrated flexible suite of planning, decision-aid and workflow management tools aimed at supporting a distributed team involved in the planning of military operations. While this tool has been mainly developed to support the deliberative planning, it was felt that it could also support the rapid response planning. Therefore, the Operations Planning Process Advanced Decision Support (OPP-ADS) tools have been designed as an extension of COPlanS to support time sensitive planning.

OPP-ADS were developed as part of a larger project called Joint Command Decision Support for the 21st Century (JCDS 21 TD), which aims at demonstrating a Joint Net-enabled, Collaborative Environment to achieve Decision Superiority. Different perspectives were considered to supporting the different stages of the CFOPP that is being executed at the operational level. First, plan management tool is essential to better support the amendment of generic contingency plan to a specific situation, which should

result into a time saving to produce executable plans. The campaign design support would facilitate the development and the sharing of a common understanding of the commander's intent as being translated into line of operations, effects, decisive points, etc. Two related tools were proposed: a center of gravity analysis tool and a decisive point analysis tool. A criteria management tool as well as a decision-matrix management tool is proposed to provide more flexibility in the way the decision-makers want to document the COA analysis process. A risk management tool is designed to facilitate the integration of the risk management process into the execution of the CFOPP. Finally, additional mechanisms are implemented to allow the management of the links and dependencies between different elements of the CFOPP.

This paper describes the different concepts developed to support the CFOPP. Furthermore, a description of COPlanS is also provided.

Section 2: Operational Planning Process

Military Commanders depend on skilled and dedicated multi-disciplinary staff to conduct a timely and flexible planning process and to develop options for employing joint capabilities across the sea, air, land and cyber spectrums. The Canadian Forces Operational Planning Process (CFOPP) is a structured and methodological team approach to prepare plans and orders for Canadian Forces operations. The CFOPP is a systematic approach to analyzing a situation, bringing staff expertise to bear on the relevant factors, narrowing Courses of Action (COAs), obtaining the commander's approval and developing the detailed annexes necessary to produce an executable plan [SJS 2008]. This process is adaptable to the needs and circumstances at stake. It could be accelerated, condensed or abridged as required. The CFOPP is comprised of five main stages with specific outputs [SJS 2008]:

- The Initiation stage results into the activation of the planning staff, and commander's guidelines about the planning process abbreviations, tools, timelines and deliverables to be achieved. Initial warning orders might also being issued;
- The Orientation stage culminates with the release of the commander's planning guidance. Other deliverables might include information brief, situation analysis brief, warning order;
- The Course of Action Development stage results in the production of the CONOPS (CONcept of OPerationS) that identifies the commander's line of action in order to accomplish his/her mission. It presents the COA that will be implemented;
- The Plan Development stage results in a set of orders based on the commander's decision to provide subordinate and supporting units with all of the necessary information to initiate the planning or the execution of operations;
- The Plan Review stage results in a regular review of the plan to evaluate its viability. The review period of the plan depends on the evolution of the situation, the type of operation and the environment.

The CFOPP is employed for Deliberate Planning and Time Sensitive Planning (or Crisis Action Planning).

- Deliberate planning consists of initiating and developing plans in anticipation of a known or anticipated future events or circumstance. It is not subject to the immediate pressures of time or prevailing threats.
- Rapid response planning consists of initiating and developing plans in response to a current or developing crisis. It requires an expeditious co-ordination and approval.

As mentioned above, the CFOPP is a multi-disciplinary and team oriented process; a team of people from different military environments (joint, air, maritime, land) and having different areas of expertise. So, any tool aiming at supporting the CFOPP should support the collaboration within the planning team. Collaborative technologies are typically categorized along two primary dimensions (Figure 1): (a) whether team members are working together at the same time (synchronous interaction) or different times (asynchronous interaction), and (b) whether team members are working in the same place (co-located) or in different places (dispersed/virtual) [Massey 2008].

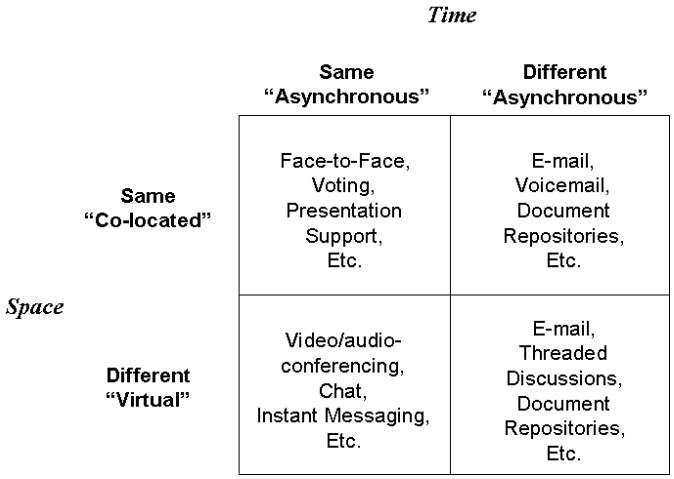

Figure 1 – Time and Space Dimensions

Considering that the planning of operations may require days (even months) of work as well as access to expertise from people in a same room as well as distributed around the world, a planning tool should allow a planning team, being co-located or not, to work at the same time or not. The possible dispersion in time and space of the team requires that a planning tool should also be able to support the planning process itself, facilitating the execution of the different stages of the CFOPP. The lack of tools addressing all these aspects in an integrated way led to R&D activities to support the operational planning process at DRDC Valcartier.

Section 3: COPlanS

COPlanS (Collaborative Operations Planning System) is an integrated flexible suite of planning, decision aid and workflow management tools design to support a distributed team involved in the Military Operations Planning Process (e.g., CFOPP). COPlanS provides the ability to plan an operation in a net-centric environment with integrated collaborative tools. The system offers functions to design and manage multiple concurrent distributed battle rhythms at different planning levels. It helps synchronize workflows, document processes and replaying the decision-making path. The planning tools allow to sketch of Courses of Action (COAs) on maps, to perform time and space synchronization, to manage resources and ORBAT, and to perform limited logistics analyses. The decision aid tools rationalize the process, improve COA evaluation and comparison and rapidly produce documents to support the Commander's decisions.

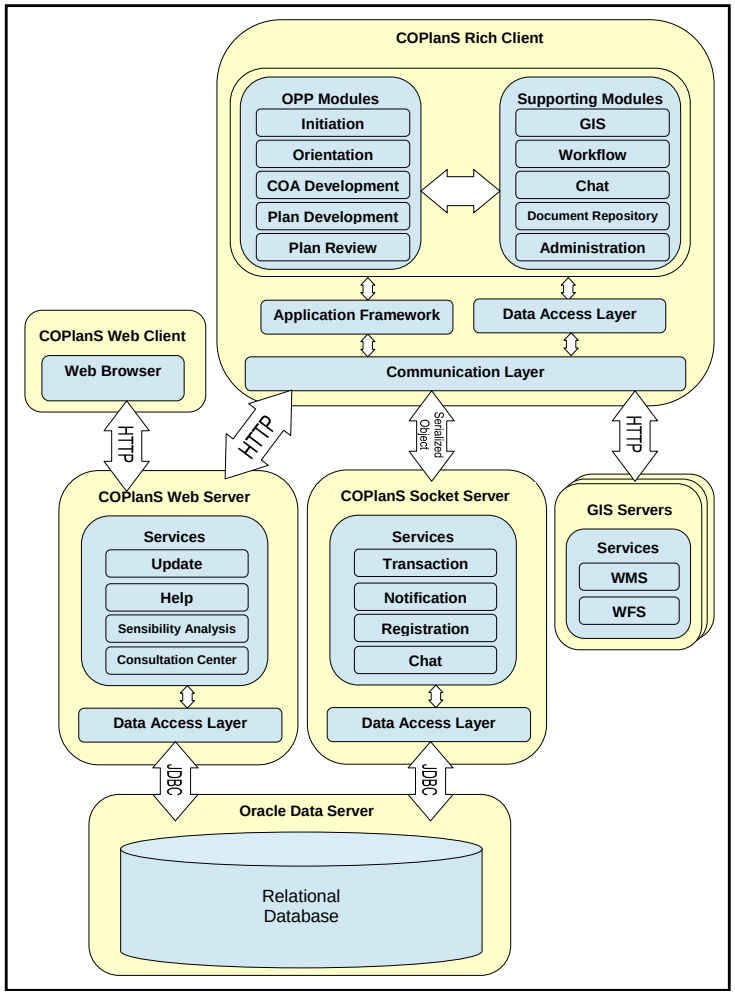

Figure 2 – COPlanS Architecture

COPlanS architecture is based on a client-sever approach and a publish-subscriber model to enable real-time information update on the client (Figure 2). The client is a rich Java application divided in a number of independent and interoperable modules that correspond to the main functional part of COPlanS. Those modules are subdivided into

feature components that address directly or indirectly specific activities of the CFOPP. The feature components are plug-in into COPlanS and can be activated or deactivated and reuse by any modules. Each feature is separated into presentation, business logic and data access layers where the common functional requirements are supported by the application framework. That framework also manages and provides advanced graphical user interface (GUI) components, the persistence of user preferences, the exception handling and recovery, the update mechanism and the contextual help. The presentation layer of the features is based on the Model-View-Controller (MVC) pattern to manage user graphical interface and interaction. The data access layer keeps the data integrity and encapsulates data changes in a transaction to be transmitted to the communication layer. The communication layer is responsible to establish the connection with the servers, send the transactions to the server and process the response. The data and communication layers can be used independently from COPlanS to build 3rd party application able to use and manipulate COPlanS data.

The server side of the architecture is divided in three distinct services providers and one data server. The socket server is the main COPlanS server that provides core services needed by a distributed collaborative environment. More precisely, it ensures the consistency of the data model by managing all the transactions and it updates all clients information by sending notifications of any changes to the client that are registered trough the registration service. One of the most important services of the socket server is to provide chat session management used by the client chat module. The web server is in charge of the update mechanism that keeps the client software version always up-to-date, the help service that maintains the different contextual help content needed by the sub components and gives access to COPlanS plans consultation via a web browser.

The geo-referenced information system (GIS) server provides all the data support needed by the map planning features. The GIS servers can be any map providers that are Open Geospatial Consortium (OGC) compliant, for instance Web Map Service (WMS) and Web Feature Service (WFS).

The COPlanS architecture benefits from the application framework common services to develop more rapidly a new feature component and easily integrate it in the COPlanS application. Using that approach, the concepts related to OPP-ADS have been integrated as new feature components of COPlanS rich client.

Section 4: Plan Management Tool

Plan management tool supports the planning staff in the planning of operations by facilitating the access and the exploitation of existing plans that have been developed using COPlanS. On top of accessing the final results of previous planning effort (i.e. the deliverables being the plan itself, the briefings, etc.), planning staff have access to information and analyses that have been developed while going through the planning process. The computer-based tool provides plan searching and retrieving functionalities within COPlanS databases. It is possible to develop and save contingency plans

(CONPLAN[1]) with generic proprieties such as relative D-Days, fictitious area of operations and generic ORBAT. This contingency plan can be loaded when needed and instantiated according to a specific situation (Figure 3). Then the planning staff will have to review the different analysis elements that were produced at the time of the creation of the CONPLAN and modify them according to the new situation.

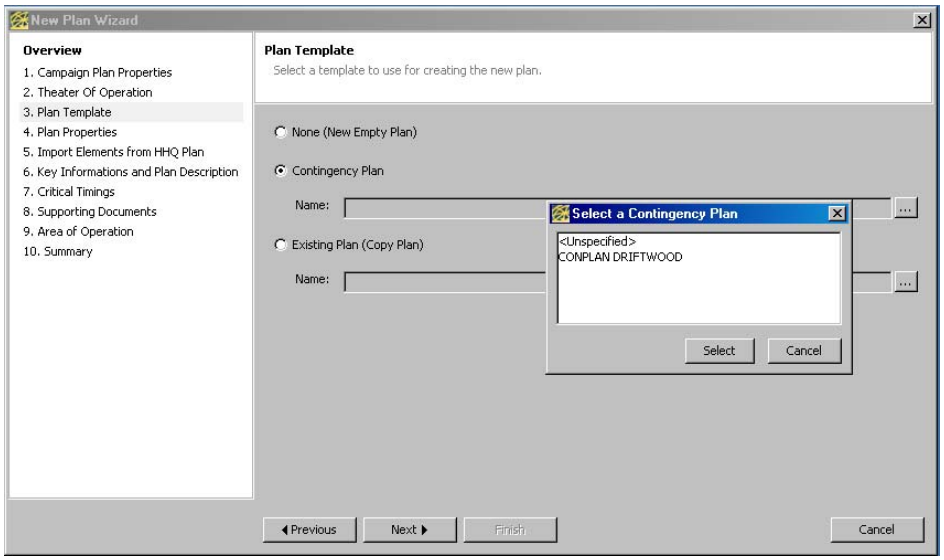

Figure 3– Contingency Plan Creation Window

Search and retrieving functionalities for existing or past similar plans might be used when no CONPLAN has been developed previously. The search might be based on operation category (i.e., domestic, multinational, coalition, UN), force employment scenario (i.e., non-combat extraction, peace support) and the location of the operation. When existing plans have been identified, they can be viewed for reference or duplicated and then modified for use as an OPlan[2]. When a plan is completed, it could be released for distribution.

When generating a new plan, it may also be required to link this new plan with a higher level plan. Then, appropriate planning information will automatically cascade from higher plan to subordinate plan (Figure 4). Keeping a link between these two plans become very important when some of these elements need to be modified because, in that case, the other plan needs to be notified that some elements require to be revisited.

[1] A CONPLAN is a plan prepared to address possible future security risks or in response to a current or developing crisis. A CONPLAN reflects potential response options but no specific time is set for the operation until higher authority approves the execution of the CONPLAN [SJS 2008].
[2] An OPLAN is a plan prepared through the deliberate planning process to address a known defence mission that will be executed within a specified time period. It is typically produced when the defence mission is critical to national security and extensive coordination of complex issues is required. An OPLAN is a complete and detailed plan that identifies the specific forces, functional support, and resources necessary to implement the plan [SJS 2008].

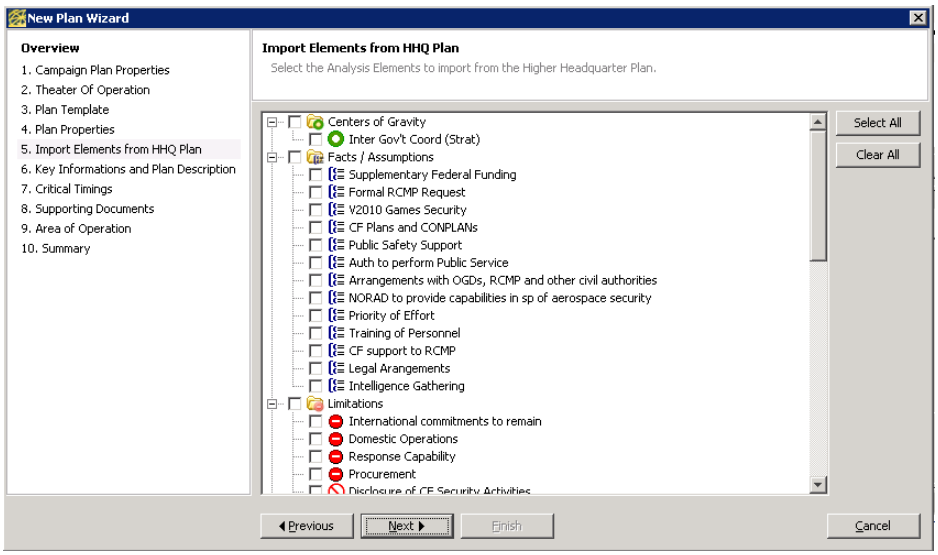

Figure 4 – Importation Functionalities

Section 5: Center of Gravity Analysis Tool

Part of the orientation phase is the conduct of a mission analysis. It is an exercise where the review of the situation as well as the higher command level intents will lead to the designation of the centres of gravity[3], the end states[4] and transition conditions[5]. These are core elements for the development of a campaign plan which will allow the clarification of concepts required for the conduct of operations, engagements and battles toward the achievement of strategic objectives.

Even if not all missions will necessarily be aimed directly at the adversary's centre of gravity, it is expected that all missions must be analyzed in the context of their relationship to the center of gravity of the opposing forces. In fact, the usual expectation is to influence or attack the opposing force's centre of gravity while preserving our own. Understanding and mapping the different links between the situation elements and center of gravity require a very intensive cognitive effort, which is of course function of the complexity of the situation. Dr Joe Strange and Colonel Richard Iron [Strange 2009] have proposed a Center of Gravity Analysis model to facilitate the understanding and analysis of the relationships between centers of gravity and their critical vulnerabilities. Their model is based on four (4) concepts:

- Centers of Gravity (COG): physical, social or virtual (i.e., moral) entities that are the primary components of physical or moral strength, power and resistance;
- Critical Capability (CC): primary ability(ies) of a COG to destroy something, seize an objective or prevent from achieving a mission;

[3] A centre of gravity is defined as the characteristics, capabilities or localities from which a nation, an alliance, a military force or other grouping derives its freedom of action, physical strength or will to fight [NSA 2008].
[4] The set of conditions that describe the achievement of policy goals [SJS 2008].
[5] Transition conditions define the set of desired conditions at the conclusion of a campaign, an operation, or their stages or phases [SJS 2008].

- Critical Requirements (CR): conditions, resources and means that are essential for a COG to achieve its critical capability;
- Critical Vulnerabilities (CV): critical requirements, or components thereof that are deficient, or vulnerable to neutralization of defeat in a way that will contribute to a COG failing to achieve its critical capability.

This CG-CC-CR-CV model helps to analyze existing and potential vulnerabilities of a center of gravity, and determine which of those could be especially critical.

The critical vulnerabilities identified need to be protected (if blue ones) or attack (if opponents' ones) considering the strengths and weaknesses of friendly, allied and opposition forces [SJS 2008]. These critical vulnerabilities can be used to identify the critical events that would be able to pave the way to the end-state. These critical events can be called decisive points (DP) [Dickson 2007]. A decisive point is "a point from which a hostile or friendly centre of gravity can be threatened. The point may exist in time, space or in the information environment" [NSA 2008]. In fact, a decisive point can be better described as an event, the successful outcome of which is a precondition to the defeat or neutralization of a centre of gravity.

A computer-based tool can support the brainstorming of different people working together to identify these concepts (COG-CC-CR-CV-DP) as well as the relationship between them. Using a whiteboard approach, it allows different people geographically distributed to contribute to the creation, modification, delete of any of these elements and the relationships amongst them. While anyone can create a new element anytime, the approach proposed is in line with the CG-CC-CR-CV model, i.e.:

1. Identify the COG (the friendly ones as well as the opponents ones);
2. For each COG, identify the related CC;
3. For each CC, identify the related CR;
4. For each CR, identify the related CV;
5. Based on the existing CV and possibly the existing CR, identify the DP.

Usually, the COG analysis is executed in a sequential way. However, it is important to offer a flexible support for executing this analysis in any order and sequence pursued by the planners; the possibility to go back or forward to any step in order to modify/add/delete any analysis element.

Since this exercise is done for friendly as well as opponent COG, some of the opponent CV can be considered as High Value Target. "HVTs are those targets, which the enemy commander is likely to need for the successful completion of his mission and are therefore, of high value to him" [DTFM 2009]. In other words, if attacked, these targets will yield greater benefits to the friendly by its defeat than the resources applied to defeat it. The fact that a CV is considered as a HVT can be identified by clicking on the High Value Target box in the description window for this DP (Figure 5).

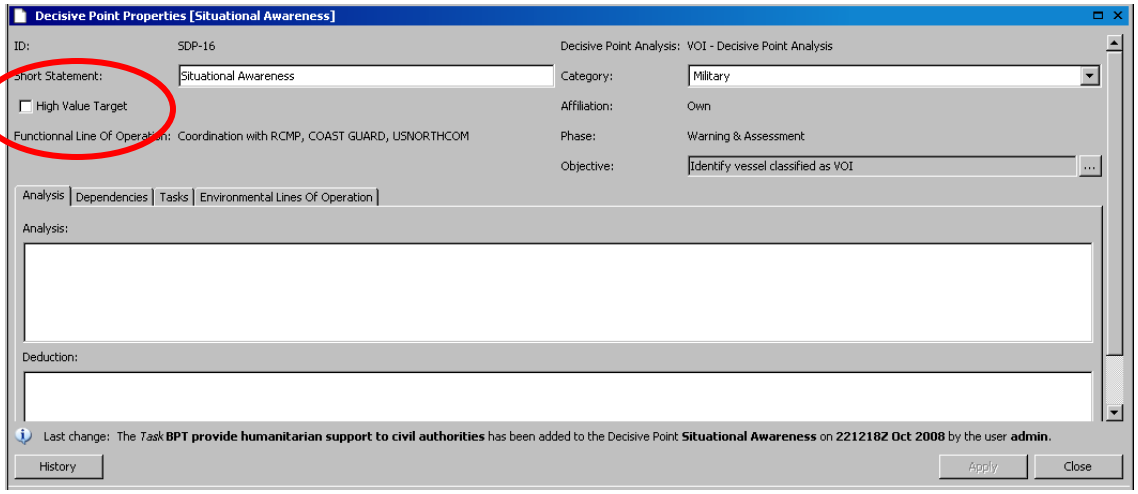

Figure 5 – Decisive Point Description Window

A structured graphical view is proposed to facilitate the analysis of each identified friendly and opposing COG (Figure 6). The tool is based on a drag and drop approach using the tool bar at the top of the screen. Considering that the full name of these elements could be pretty long, it was decided to display the associated acronym. Full name might be displayed by clicking the "show names" box or by moving the mouse over the symbol. Usual editing functionalities (creation, edition, modification, deletion) are available. The implementation of an algorithm automating the disposition of these elements in the appropriate column is also appropriate.

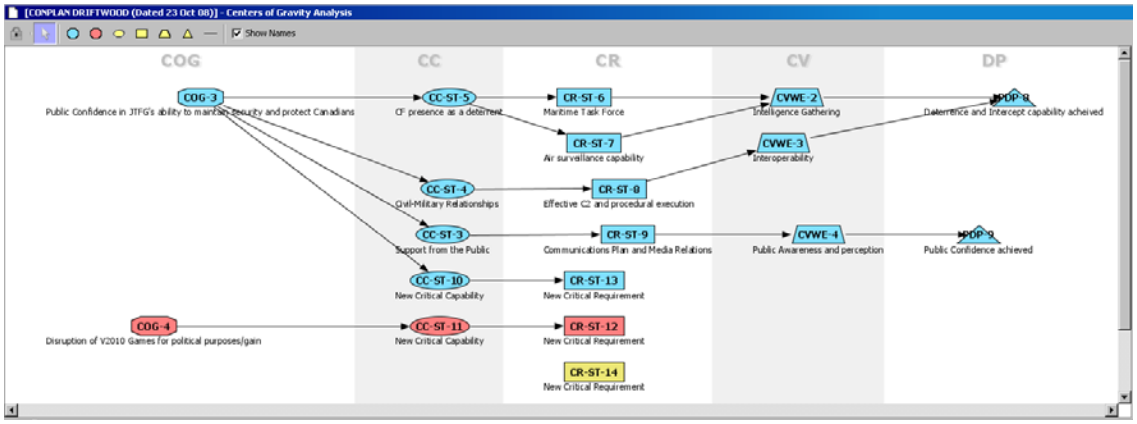

Figure 6 – Center of Gravity Analysis Whiteboard

Section 6: Decisive Point Analysis Tool

Once the decisive points (friendly and opponent ones) have been identified, one needs to logically arrange them in an order that is most likely to achieve the end-state. This is called the sequencing. The concept of Lines of operation allows the establishment of the relationships between decisive points as well as the production of a critical path in time and space along the path to the centre of gravity in order to ensure that events are tackled

in a logical progression. They provide the conceptual orientation along series of decisive points that identify the connectivity between actions leading to the elimination of the opposing centre of gravity and the achievement of the strategic aim (desired end state). In a campaign design, the lines of operations can be used to synchronize joint effort and power of the components to integrate their multiple assets of firepower, deception, manoeuvre special operations, etc. to converge upon the opposition centre of gravity. Where possible, the commander should select a variable direction that offers multiple options or branches, thus providing flexibility and ambiguity to his actions [SJS 2008].

To generate the lines of operations, a decisive point analysis composed of the following set of steps [Thales 2008] can be executed:

- Step 1 - Identifying a Starting Point (Friendly COG) and an Ending Point (Opponent COG): The starting point represents the COG that should be protected and the ending point, the COG that should be taken;
- Step 2 – Identifying the different lines of Operations (functional and environmental): These are two different perspectives to present the sequencing of the DP;
- Step 3 – Ordering and synchronizing the Decisive Points in Lines of Operations (functional and environmental): For each line of operations, we need to identify which DP need to be achieved before or at the same time as the other ones [Zang et al. 2000]. If ordering the DP have be done with the functional view, then the environmental view could be provided automatically if the DP have been provided information about which environment would contribute to their achievements;
- Step 4 - Identifying the Phases: Phasing is a way of organizing the extended and dispersed activities of the campaign or major operation into more manageable parts that allow for flexibility in execution [SJS 2008]. Action verbs or templated phases could be used such as: protect, deter, defeat, consolidate, but there should always be the possibility to develop new ones for a specific situation;
- Step 5 - Identifying the Objectives: Based on the DP associated to a specific phase, it should be possible to identify one or more objectives associated to this phase. An objective can be defined as “a clearly defined and attainable goal for a military operation, for example seizing a terrain feature, neutralizing an enemy’s force or capability or achieving some other desired outcome that is essential to a commander’s plan and towards which the operation is directed” [NSA 2008];
- Step 6 - Identifying the Tasks: Once objectives are clear and well understood, a list of tasks can be associated to each DP [Springman 1998];

- Step 7 - Identifying the Branches[6] and Sequels[7]: From the previous steps, we do have a pretty good idea of what is required to be done in order to attain the expected end-state. However, since a campaign plan needs to be adaptable to changing circumstances, resources and limiting factors, it is required to think about the possible opportunities to adjust the basic plan according to specific conditions that could be reflected into decision points. Called a branch plan, it may be represented by additional DP linked to some part of the basic plan. Furthermore in order to reduce the risk of transition between operations, it might also be appropriate to identify what would be the DP associated to a sequel plan.

The execution of these steps facilitates the identification of many elements of a campaign plan, i.e. the lines of operations, phases, objectives, tasks as well as branch and sequel plans. Even if the sequential execution of these steps is the usual way to initiate the execution of this DP analysis, the planners may always go back and forward to any step to modify/add/remove any analysis element. Furthermore, it is also possible to consider additional concepts like effects and their relationships to decisive points.

A computer-based tool can support the planners in their brainstorming to sequence decisive points into lines of operations and to identify the phases of the operation with their associated objectives and tasks (Figure 7). Using a whiteboard approach, it should allow different people being geographically distributed to contribute to the creation, modification, deletion of any of these elements and the relationships amongst them. Here again, a structured graphical view is proposed to facilitate the construct of each line of operation. The tool is based on a drag and drop approach using the tool bar at the up of the screen. As in the COG analysis tool, the full name of a symbol can be obtained by moving the mouse over the symbol or the full name of all symbols can be obtained by clicking the “show names” box.

[6] Branch plans are contingency operations built into the basic plan for adjusting the ongoing operation if necessary to ensure the maintenance of the overall operational design. They can put the execution of a plan back on track after a setback, compensate for the unexpected or take advantage of unexpected opportunity. Branches lead to a single end without tying the commander to a single course of action. They are means of adapting the basic scheme to the specific conditions in the field. A plan with branches permits the commander to fight, decline battle or fight in a different way than he originally intended. [SJS 2008]

[7] Sequels are plans for subsequent operations based upon the probable outcomes of current operations. Planning and executing a sequel will reduce the risks associated with transition between phases. Sequel plans are always included in the planning process because once the sequel is determined, its requirements will influence planning and execution of current operations. Sequel planning extends to conflict termination and redeployment. [SJS 2008]

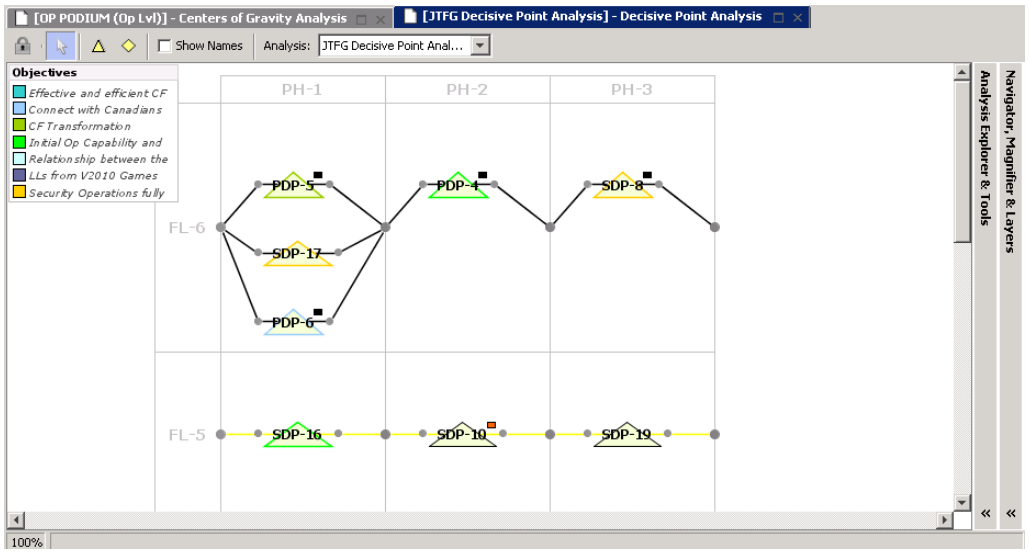

Figure 7 – Decisive Point Analysis Whiteboard

Section 7: Criteria Management Tool

Different courses of actions (COA) can be developed based on the campaign design that has been produced with the Center of Analysis Tool and the Decisive Point Analysis Tool. Each COA should be analyzed and assessed according to a set of evaluation criteria. The identification of these criteria is usually done based on the experience of the planning staff and should represent the different aspects the commander think should be considered while considering the different COAs. To facilitate this process, it is being proposed to develop criteria retrieval functionalities. First, criteria identified in doctrine documents should be easily retrievable. It should also be possible to retrieve criteria that have been used in similar operations. Then, search functionality (Figure 8) should allow the retrieval of similar operations based on operation category (Domestic, Expedition), operation type (ex. Disaster assistance.) and/or operation location (ex. Afghanistan). Having access to these past similar operations will allow to consult their after action reports which may help to determine the criteria to consider and their importance.

Accordingly, the following capabilities are required:

- Criteria creation / criteria parameter settings
- Criteria saving
- Criteria consultation and/or retrieval
    - From operation types
    - From type of criteria (factors)
    - From past similar operations
        - From similar operation type
        - From similar locations
- Criteria post-analysis capture and exploitation
    - Lessons identified related to the criteria itself
    - Lessons identified related to the weight associated to each criteria

These functionalities will help the planning staff to identify the criteria that should be used for the assessment of the COAs according to a specific situation. Then, the team members will have to determine which aspects are more important to consider than others. The assignation of priority to the different criteria may be challenged considering past experiences. The criteria selected by the staff and their level of priority will then be adjusted according to the direction that the commander may provide.

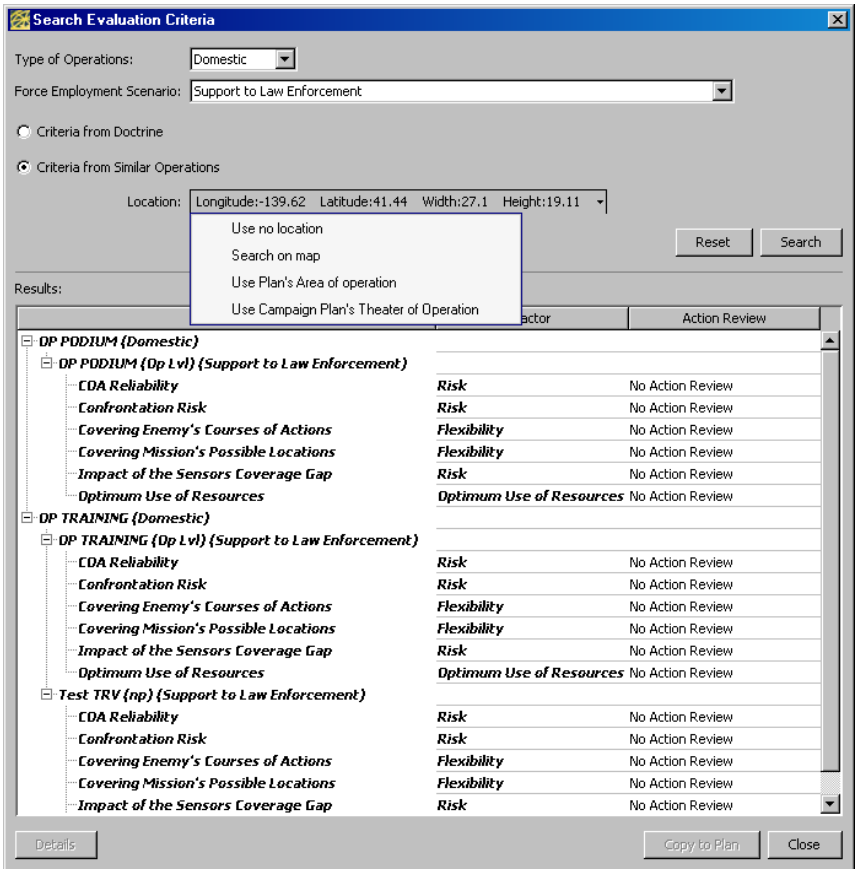

Figure 8 – Criteria management windows

Section 8: Decision-Matrix Management Tool

COAs comparison identifies the COA to be recommended to the Commander based on his guidance and the situation at hand. The evaluation of each COA based on each criterion (selected in the Criteria Management tool) is then used for comparison. To support the planning staff in the comparison of COAs, two different approaches were identified to provide flexibility according to the preference that the user may have. The two approaches were to provide the possibility to work with a qualitative analysis (descriptive comparison) as well as a quantitative analysis (numerical and ordinal comparison).

In the qualitative analysis grid (Figure 9), the planner is given the opportunity to document any advantage or disadvantages that are identified for each COA according to

each criterion and present them in a grid. A text field is provided for the edition of the advantages and another one for the disadvantages. These two types of information are then globally presented for each COA in a grid using color coding (green for an advantage and red for a disadvantage). In the quantitative analysis (Figure 10), the planner will have to determine the evaluation of each COA according to each criterion. The scale of the evaluation can be cardinal or ordinal, according to the definition of the criteria. The COA will then be compared using a MultiCriterion Decision Aid (MCDA) approach to produce a ranking of the COAs with the associated explanations (Figure 11).

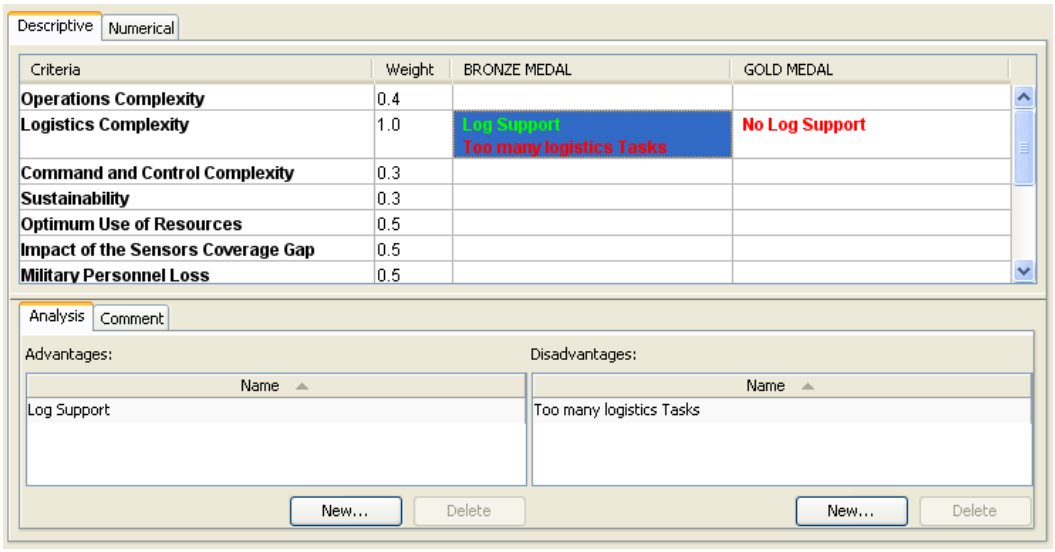

Figure 9 – Qualitative Analysis Grid

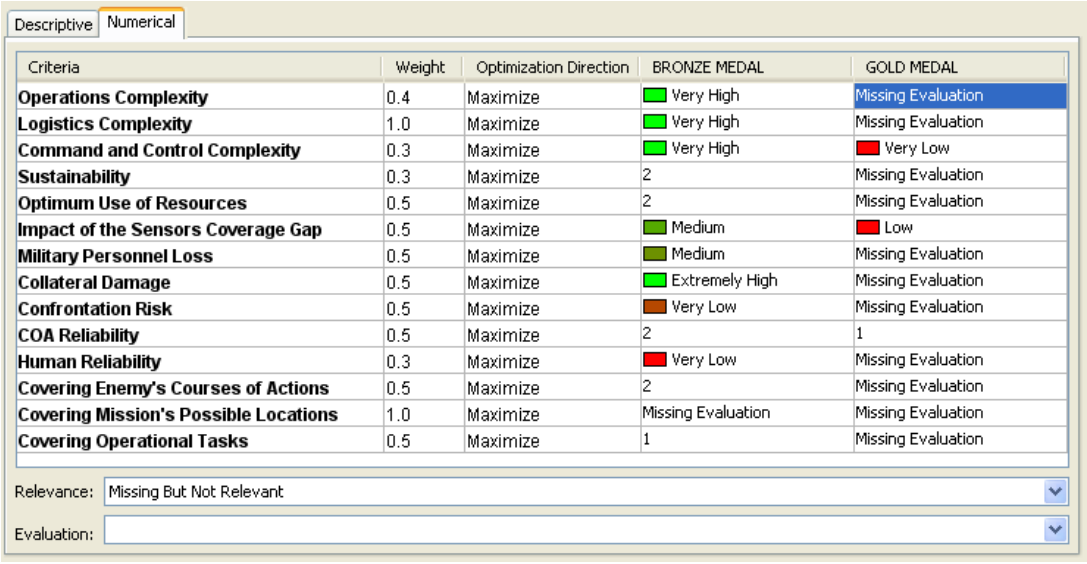

Figure 10 – Quantitative Analysis Grid

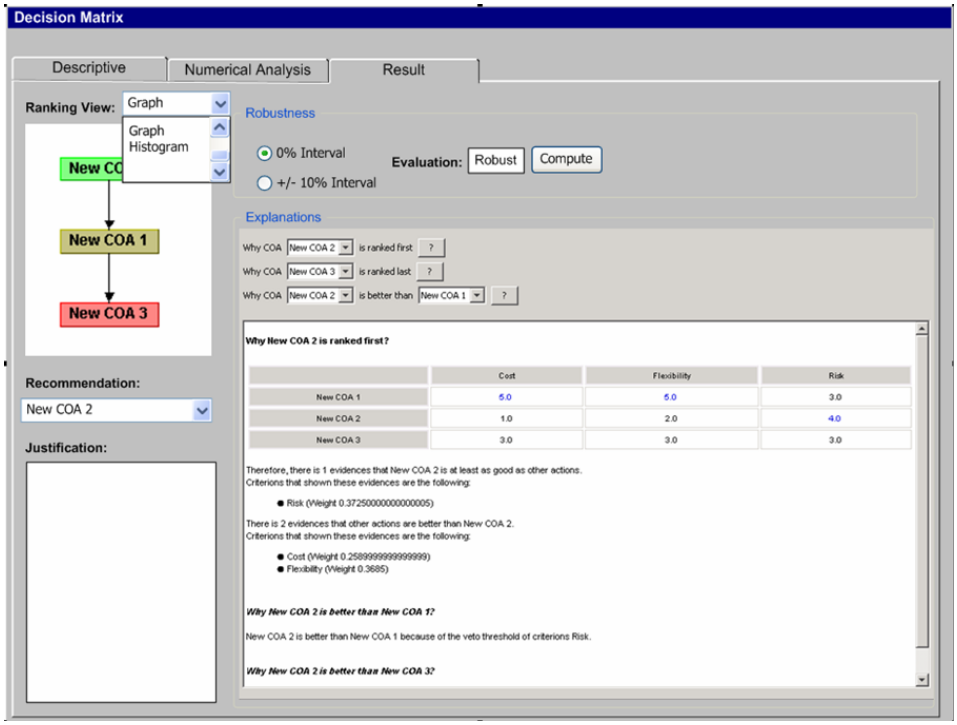

Figure 11 – Ranking Results

Section 9: Risk Identification Tool

Due to the nature of military operations, the identification and mitigation of risks need to be performed often and across all the processes. In military operations, the failure to manage risk can lead to the loss of resources, lives and ultimately catastrophic mission failure. Accordingly, the Canadian Forces have developed a risk management methodology to identify, analyse, evaluate and mitigate risks across the CFOPP stages. Its key aim is to ensure that significant risks are identified and that appropriate action is taken to minimize these risks balanced against operational objectives [Joint Doctrine Branch 2007].

The fundamental goal of risk management is to enhance operational capabilities and mission accomplishment, with minimal acceptable loss. The commander will use his judgment to balance the requirement for mission success with the inherent risks of military operations. The risk management process is a tool that can assist the decision-makers in identifying the most appropriate course of action (COA).

A Risk management tool has been developed to support the risk identification and mitigation strategies in the planning process. The risk concepts implemented should be an expression of a possible loss or negative mission impact stated in terms of probability and severity (Figure 12). For each element of risk identified, a qualitative assessment can initially be provided for the military functional aspects (C&C, sense, act, shield, sustainability). Based on these different perspectives, a planner can then determine what the global estimation for this element of risk is. Then for each COA developed, a

mitigation strategy can be described as a set of control processes, and a revaluation of the risk for this COA can be done.

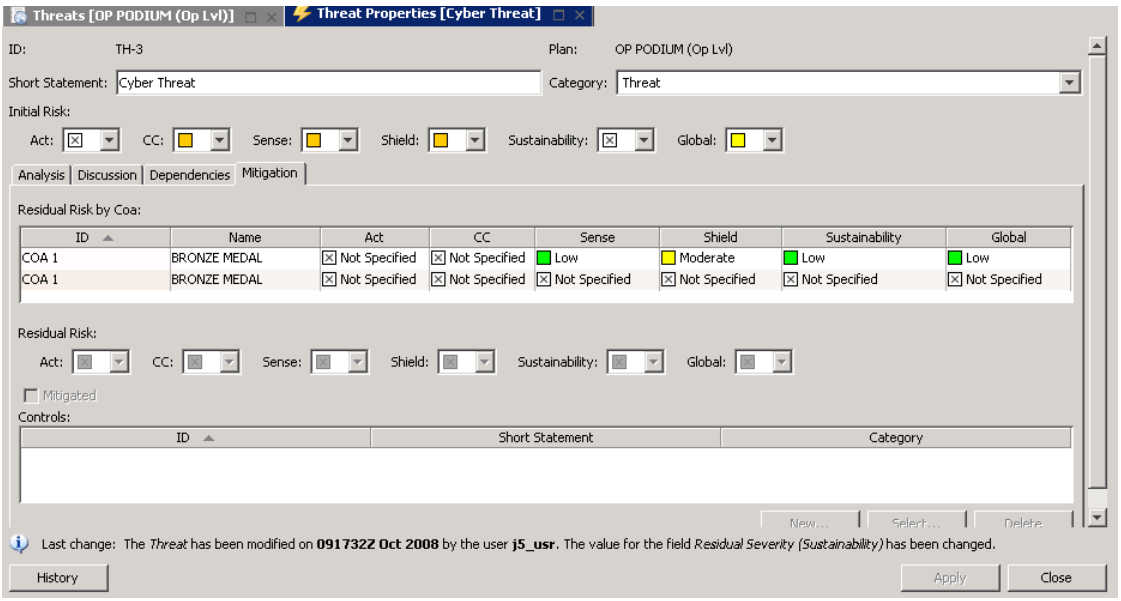

Figure 12 – Risk Assessment Grid

A global view (Figure 13) presenting the number of risk elements that have been initially associated to each risk assessment couple (severity, probability) followed by a global view of the risk assessment associated for each COA.

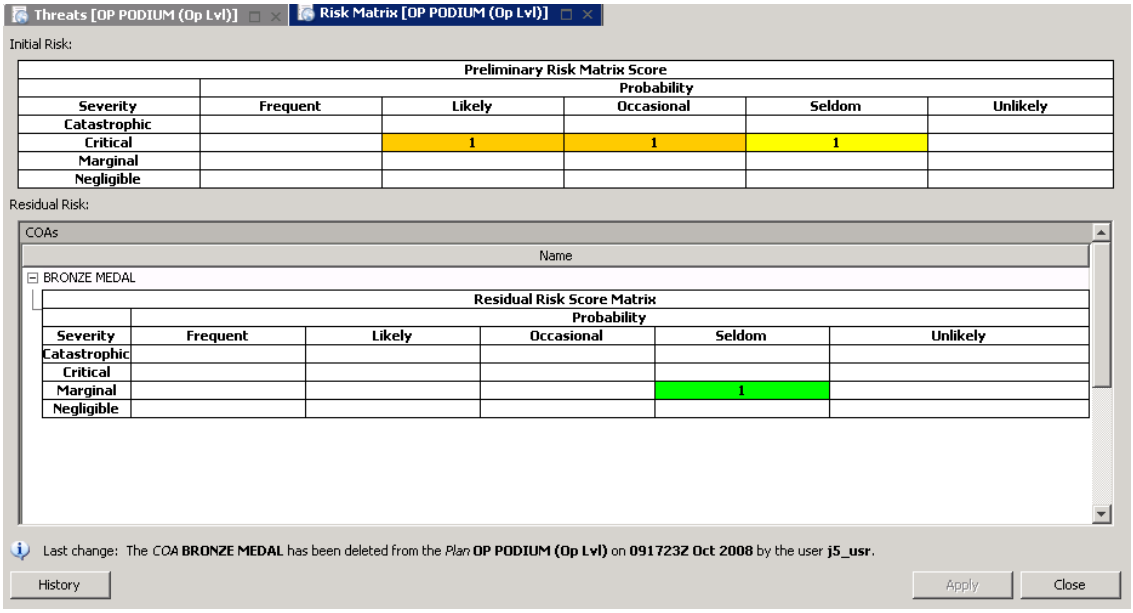

Figure 13 – Global Risk Assessment Grid

Section 10: Dynamic Link Management Tool

The CFOPP should be seen as a structured problem solving process. The execution of this process leads to the identification of information elements essential to understand the different aspects of a complex situation and produce genuine operational plans. These elements are more or less linked to each others. Strength of the approach proposed is the ability to dynamically link different keys CFOPP elements of a same plan (such as mission analysis elements, COA elements and plan elements) or of different plans (ex. between strategic plan and operational plan). By allowing the visualization of these relationships, it enables the planners to easily identify the mission analysis and plans elements that would be affected by potential changes in the situation. It also allows the linkages of strategic plan elements to operational plan elements and operational plan elements to tactical plans elements.

The possibility to link the CFOPP elements together required the possibility to have different types of links such as:

- Links indicating an influence between elements, for example for inheritance of info (e.g., strategic to operational);
- Links indicating time and space synchronization relationships (e.g., sequencing, concurrence);
- Links representing a refinement of an object (ex. Decomposition).

Accordingly, a decision support tool dedicated to support the CFOPP should consider links as objects that can be manipulated. Each link should have a type, an element source and an element target, a type as well as the status of the link (Figure 14). This status indicates if the link is valid or if modifications of the elements of the CFOPP have invalidated that link. In that case, it would indicate that the link's target element would benefit to be reviewed by someone in the planning staff. Eventually, a graphical view of the elements of the CFOPP that are linked together should be provided to facilitate a good appreciation of the relationships of the elements.

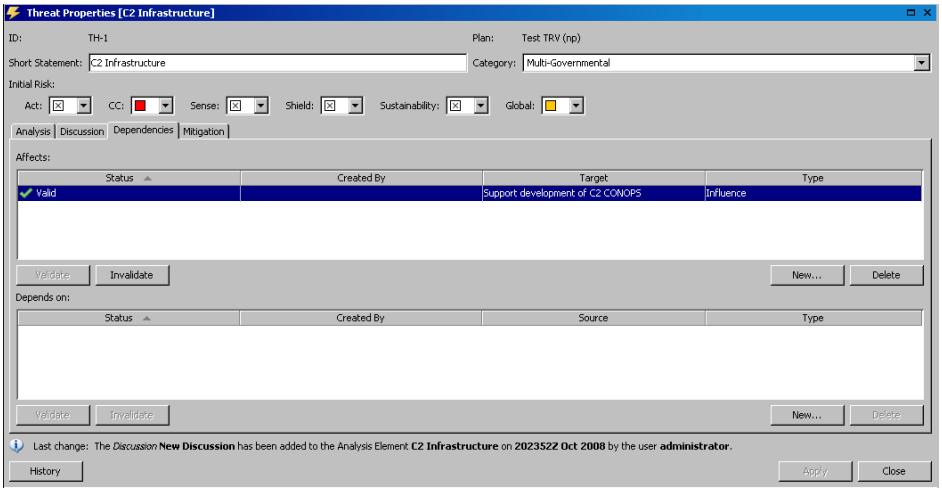

Figure 14 – Link Tab

Section 11: Conclusion

The investigation conducted at DRDC Valcartier to develop decision support tools for the CFOPP in a rapid response planning context led to the identification of seven (7) different tools:

- A Plan Management tool providing the flexibility to search and retrieve different types of contingency plans (CONPLAN) and to instantly upgrade them according to specific situations. It also provides functionalities to search for existing or past plans based on an operational category (domestic, international), force employment scenario (noncombat extraction, peace support) and the location of the operation. When existing plans have been identified, they can be viewed for reference or instant upgrading and modified for use as an OP Plan duplicated for modification. When a plan is completed, it is released for distribution;
- A Center of Gravity Analysis tool supporting planners in their brainstorming to identify the relationship between critical elements (critical capabilities, critical requirements, critical vulnerabilities) influencing friendly as well as adversary centers of gravities (COG). It leads to the sketching of a first iteration of decisive points;
- A Decisive Point Analysis tool supporting the planners in their brainstorming to sequence decisive points into lines of operations and to identify operational phases with their associated objectives and tasks. It provides the grounds to initiate the thinking required to identify possible branch plans and/or sequel plans where transition conditions are desired;
- A Criteria Management tool providing management functions for COA evaluation criteria. This provides access to different repositories of COA evaluation criteria (e.g. different sets of evaluation criteria are associated with Expeditionary Operations or Domestic Operations respectively) as well as to COA evaluation criteria used in previous, relevant operations and copies them over for use in the current operation being planned;
- A Decision-Matrix Management tool supporting decision-matrixes with the flexibility to use quantitative as well as descriptive analytical approaches;
- A Risk Management tool supporting the planners in the identification of risk elements (with their causes), their assessment and a mitigation strategy throughout the different stages of the Canadian Forces Operational Planning Process (CFOPP);
- A Dynamic Link Management tool providing the capacity to link key CFOPP elements (such as mission analysis elements, COA elements and plan elements) together. By allowing the visualization of these relationships, it enables the planners to easily identify the mission analysis and plans elements that could be affected by potential situational changes. It also allows linkage of strategic plan elements to operational plan elements and operational plan elements to tactical plan elements.

The existence of a baseline tool allowing the collaboration of a distributed team in the execution of a structured planning process is a prerequisite to operationalize such

concepts. In the current investigation, we used COPlanS which provides such appropriate network-enable planning environment.

The work described in this paper is the result of a first implementation effort to demonstrate decision support tools for the design of campaign plans as well as the utilisation of contingency plans in order to reduce the time required to produce executable plans. The refinement of these concepts will require empirical validation and assessment as well as more R&D efforts. It is acknowledged that, this effort did not exhaustively address all the concepts that could be integrated to support the CFOPP. For example, the integration of concepts such as the implications of second and third order effects will have to consider in the future.

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