

Exploitation of Argumentation Models for Mission Analysis

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Abstract

In a military context, the process of planning operations involves the assessment of the situation, the identification of the most appropriate course of action, the description of the associated plan as well as the review of the plan according to the evolution of the situation. The idea described in this paper is to exploit argumentation models to explain why the conclusions of a mission analysis should be revised considering the evolution of the situation.

Introduction

The Canadian Forces Operational Planning Process (CFOPP) is a systematic approach for analyzing a situation, bringing staff expertise to bear on the relevant factors, narrowing Courses of Action (COAs), obtaining the commander's approval and developing an executable plan (National Defence, 2002). Since there may be a time gap between the development of a plan and its actual execution, the situation needs to be continuously monitored to detect, as soon as possible, any change that may have an impact on the plan. The plan modifications will directly depend on the situation changes. For example, change detection about the availability of resources under our responsibility may require to adjust the plan and if not possible, to develop a new COA. Moreover, if the situation evolves quite differently from what was expected and there is time available, the planning process may have to be restarted from the beginning.

This work investigates the idea of using the models developed in the field of argumentation to support the operational staff when they have to determine if the mission analysis has to be revised. This field of study seems to be appropriate to our problematic since its general objective is "the development of criteria for determining the validity of argumentation in view of its points of departure and presentational layout and to implement the application of these criteria in the production, the analysis and evaluation of argumentative discourse" (Van Eemeren and al., 1996). Accordingly, we think that argumentation models could provide a structure to document the analysis activity and be used to identify and explain why some elements/aspects of the situation would have an impact on the operation, and therefore affect the analysis that has been done. It is expected that using argumentation models to document elements of the situation that may have an

impact on the operation will help to determine if the mission analysis has to be revised.

This paper describes the CFOPP as well as the argumentation model of Toulmin. Then, it presents the idea of exploiting argumentation models to explain why the conclusions of a mission analysis should be revised.

CFOPP

The CFOPP is comprised of five main stages with specific outputs (National Defence, 2002).

- The Initiation stage results in the activation of the planning staff and the commander's guidelines about the kind of planning process to achieve.
- The Orientation stage results in the development of the commander's planning guidance. At this stage, the commander orients his/her staff towards the determination of the nature of the problem and the confirmation of the results to be achieved.
- The Course of Action Development stage results in the production of the CONOPS (CONcept of OPERATION) 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.

In the Orientation stage, the commander must "orient the staff towards the requirements of the new operation". To orient the planning, a mission analysis will be conducted. It is an exercise between the commander and key staff to designate the centre of gravity, the end state and criteria for success for the staff. This is a key activity in the CFOPP, which has two objectives: determine the nature of the problem and confirm the results to be achieved.

At this stage, the planning staff has to develop a good understanding of the situation by covering different aspects such as: critical facts and assumptions, constraints/restraints, key strengths and weaknesses, centres of gravity, etc. Any factor having an impact on the operation as well as the gist of this impact has to be identified. At this time, the question “So what?” has to be answered (Belanger, 2003). Each conclusion is documented in the mission analysis brief that is presented to the commander.

All these analysis efforts conduct to the identification of a mission statement that will answer the following questions:

- Who (what types of forces) will execute the action?
- What type of action (for example attack, defend) is contemplated?
- When will the action begin?
- Where will the action occur (area of operations and objectives)?
- Why (for what purpose) will each force conduct its part of the operation?

The Commander’s Planning Guidance, which is the output of the Orientation stage, will be used to develop the COA (in the COA Development stage) that will be further detailed in the Plan Development stage.

While the situation evolves, some of the conclusions obtained during the mission analysis may be invalidated. As the planning process is executed by a team of many people, it is possible that the details of the analysis (which have mostly been developed in the head of some individuals) have not been shared amongst all the team members even if the end result of the analysis has been shared. Furthermore, the people that will monitor the situation to identify if the plan needs to be revised may not be the ones that have been involved in the planning process. Since the monitoring team would not necessarily be aware of the details of the analysis, it could be difficult for them to identify what elements of the situation may have an impact on the operation that has been planned.

At this point, one can ask if a more structured way to document the analysis done during the mission analysis (Orientation stage) could facilitate the identification of the aspects/elements of the situation that would require to be closely monitored. Since the CFOPP is executed in a context where different people may be involved, it is believed that such documentation would be helpful.

Argumentation Models

In a logical proof, a set of homogenous premises led to a conclusion. There are no real distinctions among these premises. In contrast, in arguments expressed in natural language we can typically observe premises playing

different roles. By identifying these roles, we can present the arguments in a more readily understandable fashion, and also identify the various ways in which the argument may be attacked. Structuring the argument in this way produces an *argument scheme*. One argument scheme that has been widely used in artificial intelligence and law was proposed a long time ago by Toulmin (Toulmin, 1958).

In the domain of philosophy of law, (Toulmin, 1958) introduced a conceptual model of argumentation. He considered a diagrammatic representation for legal arguments, in which six parts are distinguished (figure 1):

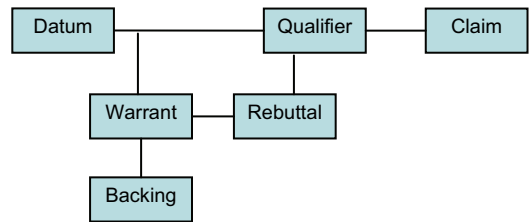


Figure 1 – Toulmin’s model

- *Claim (C)*. An assertion or a conclusion presented to the audience and which has potentially a controversial nature (it might not meet the audience's initial beliefs).
- *Qualifier (Q)*. A statement that expresses the degree of certainty associated to the claim.
- *Datum (D)*. Statements specifying facts or previously established beliefs related to a situation about which the claim is made.
- *Warrant (W)*. Statement, which justifies the inference of the claim from the data.
- *Backing (B)*. Set of information which assures the trustworthiness of a warrant. A backing is invoked when the warrant is challenged. The backing is the ground underlying the reason.
- *Rebuttal (R)*. A statement presenting a situation in which the claim might be defeated.

The Toulmin’s structure may be represented using typical natural language markers:

Given *D* (and Since *W*), Therefore *C*, unless *R*.
W Because *B*.

Toulmin’s model has the advantage of taking into account the different components of an argument structure and the link between these components. Ye (1995) indicated that Toulmin's model is significant in that it highlights the discrete response steps that an expert system explanation facility should follow in order to answer a user’s queries in a convincing way.

Proposed Approach

A computer-based system called COPlanS has been developed to support the 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. At the Orientation stage, COPlanS provides a template to document the analysis. This template is composed of identification fields as well as descriptive fields. The identification fields are:

- A short description statement (the name of the factor being analysed).
- The type of the element analysed (ex. Facts, assumptions, constraints, etc.).
- The category of the element analysed. (ex. Geographical, etc.).

The descriptive fields are:

- A description of the analysis.
- A description of the deduction.

The descriptive fields are mainly text fields used to document the different aspects of the analysis.

Argumentation models could be used to improve the approach implemented in COPlanS. In fact, the elements of the descriptive fields of COPlanS can be associated to some elements of the Toulmin's model:

- The description of the deduction is used as a claim.
- The description of the analysis is used to document the datum as well as the warrant.

Complementing this list of elements with the other elements of the Toulmin's model would allow to explicitly identifying the elements of the analysis as well as the elements of the situation that could invalidate the deductions done during the mission analysis. Furthermore, if added to the model, the explanation of the rebuttal could directly help the operators in the assessment of the impact of the situation evolution on the mission analysis. Accordingly, we propose that each conclusion deduced during the mission analysis be described with the following elements:

- The claim.
- The qualifier.
- The datum.
- The warrant.
- The backing.
- The rebuttal.
- The explanation of the rebuttal (new element to explain the rebuttal).

Even if it might be considered as work overload for the planning staff, there are different advantages to better document the analysis of the different elements of mission analysis. The first one is to facilitate the development of a common mental model amongst the members of the team. By reading the details of the rationale of each conclusion, there is less chance to develop an understanding that will

be different from the one that was initially identified. Another advantage of this documentation is that, by explicitly enumerating the list of facts/evidence that could invalidate any conclusion, they become elements that need to be looked at while monitoring the situations. This could be particularly helpful when the person involved in the Plan Review stage has not participated in the production of the mission analysis.

This approach can be operationalised by using a grid containing questions that would make sense to the operator and that corresponds to the type of information required for each element to be documented. Column 5 of Figure 3 presents an attempt to identify these questions based on a previous work (Bélanger and Auger, 2007). These questions would need to be validated with SMEs and adjusted to better fit the SME's terminology.

Once all analyses have been documented with an argumentation grid, the information identified by the SME for the rebuttal should be brought back to the Plan Review stage as specific elements that need to be monitored. When one of these elements is detected during the monitoring of the situation, rebuttal explanation should be provided to the operator. This explanation will allow the operator to better evaluate the impact of this change on the overall mission analysis. The operator can then decide if the mission analysis needs to be revised or not, and if so, if all of it or part of it should be redone. In the example of the Figure 3, the operator monitoring the situation would be warned to look for landing sites for the ships (ad-hoc, temporary or permanent) not already being part of the common operating picture. If a new one is detected, then the operator will determine if this site could be used to have access to the city, and based on his deduction decide if the mission analysis needs to be revised.

Since it may be time consuming to complete the argumentation grid for all the elements of information of the mission analysis, it may be more appropriate to complete it only for the elements that are considered crucial to the operation. It is also possible to think about linking each one of the claims with others elements of the analysis as well as elements of the COA development stage. If done correctly, then it would be easy to directly identify all elements that can be affected by a situation change.

Conclusion

This paper describes a way to exploit argumentation models for the execution of the CFOPP. By using an argumentation model as a framework to document the analysis activity, it should be easier to identify which elements/aspects of the situation will have an impact on the operation and why it would affect the mission analysis that has been done.

The use of an argumentation grid to capture the different components of an mission analysis activity has been proposed. Based on the Toulmin's model, which has the advantage of taking into account the different components of an argument structure and the link between these components, the argumentation model identified also allows to justify a rebuttal. By using this argumentation model to further document the different elements of mission analysis, it would possible to bring back internal elements of analysis to support the Plan Review stage of the CFOPP. When monitoring the situation, the operators could use this information to identify potential significant changes in the situation, and use the associated explanation to determine the level of impact that these modifications could have on the plans.

The implementation of such approach can be done considering a manual or automated way while conducting the CFOPP. Different level of automation could be provided to implement it. If automated, it would at least facilitate the reach back of elements of information to be monitored.

It is important to remember that the proposed approach is in its initial stage of conception and needs to be further refined. For example, it is required to validate the grid that would be used for the documentation of the mission analyses with SMEs. Then, the quality as well as the utility of the information captured using the argumentation

models will have to be assessed and qualified considering its ability to identify and explain the need to revised a mission analysis.

References

- Bélanger, M. 2003. *The Estimate Process: Observations*. DRDC Valcartier TM 2003-357.
- Bélanger, M. and Auger, A. 2007. Knowledge elicitation and formalization through argumentation model. 12th International Command and Control Research and Technology Symposium. June 2007
- National Defence. 2002. *Joint Doctrine Manual CF Operational Planning Process*. B-GJ-005-500/FP-00, J7 DLLS 2, Department of National Defence, Canada.
- Toulmin, S. 1958. *The Uses of Argument*. Cambridge University Press, Cambridge, England.
- van Eemeren, F. H., Grootendorst, R., Snoeck Henkemans, F. 1996. *Fundamentals of Argumentation Theory. A Handbook of Historical Backgrounds and Contemporary Developments*. Lawrence Erlbaum Associates.
- Ye, L.R. 1995. The value of explanation in expert systems for auditing: An experimental investigation. *Expert Systems with Applications* 9 (4), 543-556.

#	Elements of COPlanS template	Elements of the Toulmin's model	Elements of the model proposed	Associated Questions	Example
1	Deduction.	Claim.	Conclusion.	What is the claim (what is the result of the deduction)?	The Strait is a choke point.
2		Qualifier.	Qualifier.	What is the degree of confidence associated to this claim (ex. Certain, Presumably, Uncertain)?	Presumably.
3	Analysis.	Datum.	Facts/Evidence.	What are the facts/evidence that lead you to this claim?	- The city is next to the Strait.
4	Analysis.	Warrant.	Analysis.	What is the deduction process used to obtain this conclusion (what is(are) the rule(s) that you used to go from the facts to this claim)?	- The only known maritime access point to the city is the Strait. - The strait does not allow zig-zag manoeuvre. - The strait does not allow more than one ship at a time.
5		Backing.	Backing.	Why is(are) this(these) rule(s) valid?	SOP.
6		Rebuttal.	Rebuttal.	What additional facts/assumptions could lead to the invalidation of this claim?	The existance of temporary landing site for the ships.
7			Explanation of the Rebuttal.	Why these additional facts/assumptions can lead to the negation of the claim?	If there is another landing site for the ships, it could be used to have indirect access to the city.

Figure 3 – Argumentation Grid