

Visualising Rationale in the CPM

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Abstract— Rationale is being explored by the ITA in planning, for shared understanding of plans, and for capturing dependencies between assumptions/decisions and parts of the plan. Informal rationale captured during evaluation of the Collaborative Planning Model has been explored in terms of alternative visual representations and questions that these raise.

I. INTRODUCTION

Rationale is being used by the ITA in multilevel planning, to capture and communicate shared understanding of a plan, and to determine dependencies between assumptions/decisions made by planning agents and parts of the plan. The evaluation of the Collaborative Planning Model (CPM) [1] showed a stream of rationale available from the planner, some of which was recorded manually [5]. To explore how this rationale may be visualized, captured and analysed, further work has been done using a sample of the recorded rationale.

II. VISUALISING RATIONALE

The evaluation [4] defined a multi-level plan with two planners (2A and 2B) generating subplans to achieve a given high level plan. Two rationales captured from planner 2B are:

Context	Rationale
Choosing an agent for the task SECURE home bank (on left of the river, same side as home forces)	Given that this is line of sight, Armour can be used. Armour is the strongest available resource. We need strongest as the enemy MUST be removed. Therefore use Armd Sqn 4
Choosing an agent for the task SECURE enemy bank (on the right of the river, the opposite side of the home forces)	There is currently no bridge across the river; a bridge is needed; and I assume that the bridge will not be built in time, so can't use Armour. Best remaining is Infantry. Therefore use Inf Coy 2/1. Since the reconnaissance unit is there, we can use them too.

Figure 1 shows the second rationale, created via drag-and-drop, added to the evaluation visualization. The entity r2 is a resource request for a SECURE Enemy Bank task, and the allocation of Inf Coy 2/1 is shown as ALLOC. Rationale is a sequence of propositions: PROP1 (there is no bridge) with an assumption (this will not change in time), leads to PROP3 (Armd Sqn 4 cannot be used); PROP3 together with the assumption (all relevant information is currently available) leads to PROP4 (the best is Inf Coy 2/1); PROP4 together with the decision (commander accepts PROP4) leads to the allocation relation. Diamonds are reasoning steps (dependencies) from preconditions to a postcondition (another proposition or a plan entity). Propositions are defined in

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different ways: PROP1 in Controlled English (CE) [3]; PROP3 as a higher level CNL, transformable to the equivalent CE [6]; PROP4 using Conceptual Graphs [6].

A dependency was added to the evaluation plan, between allocation of Inf Coy 2/1 and the minimum duration (1) of SECURE Enemy Bank. This is not based on military information, but added to explore how the rationale can link to that defined in the evaluation plan. Additional durations were added to plan 2A to cause resource conflict, represented by an inconsistency whose rationale was the timing constraints (e.g. earliest start, minimum duration) on the conflicting requests. Figure 2 shows the inconsistency (red circle) imported back into plan 2B with resource requests that led to the inconsistency (r2 and a 2A request "RR_Arty1"). The CPM import includes the rationale, so the full chain of reasoning can be calculated from the decision to allocate Inf Coy 2/1 and the other assumptions, through to the conflict. Figure 3 displays only those parts of the plan that led to the conflict: requests, rationale for r2 minimum duration and a timing network that led to other r2 time constraints (from high level constraints on "Seize River Crossing Site 2" and its sequence of subtasks).

The first rationale in the table above was analysed using only unstructured text in the propositions, shown in Figure 4. Such a diagram can still provide a visualized rationale.

III. COMMENTS AND FUTURE WORK

Rationale representations have been described: structured text, structured graphics and unstructured text, allowing the system to calculate and visualize the dependencies. It is not clear which are suitable for military planners, especially under operational conditions. Each type will have different costs and benefits. Structured text or graphics has benefit in being analyzable by computer, leading to the potential for greater automated assistance, e.g. the validation of plans. However structure costs more in user effort (ensuring information is correctly input) or development of advanced user interfaces. Unstructured text requires less user effort but supports less automated processing. Experiments are proposed to explore costs and benefits. Metrics might include workload of capturing rationale, utility of rationale for distributed planning, comprehensibility of rationale across multiple planners, and benefits of automated reasoning using rationale representation.

Rationale visualization for specific plan entities and conflicts can be performed, based on information across planning levels. However, it is desirable that the rationale also be shown in a step by step manner, allowing better visualization of how logic flows across plan entities.

Representing the decision "best is ..," as separate from the

proposition “best is ...” shows a decision as having no logical justification, but something that an agent “owns”.

To visualize rationale across different planning levels requires a representation of rationale within the plan model that is exchanged. This is more than the type of information in a model such as JC3IEDM. Rationale can be represented in CPM, but future simplification work is planned [7], together with links to related ITA work on argumentation.

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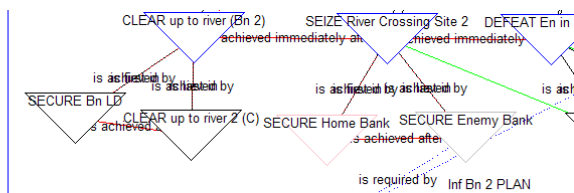


Figure 1 – rationale for allocation

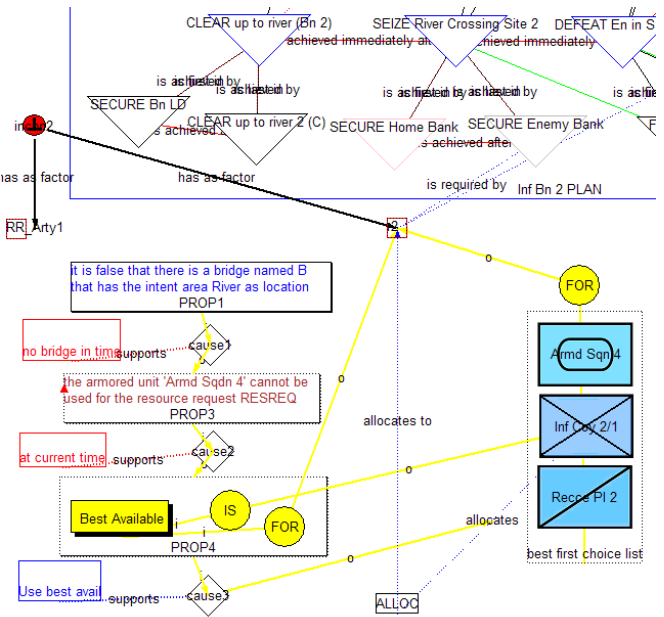


Figure 2 imported resource conflict

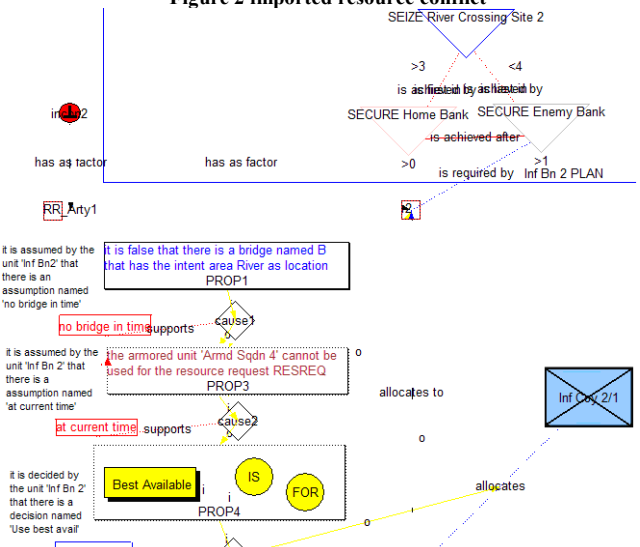


Figure 3 rationale for resource conflict

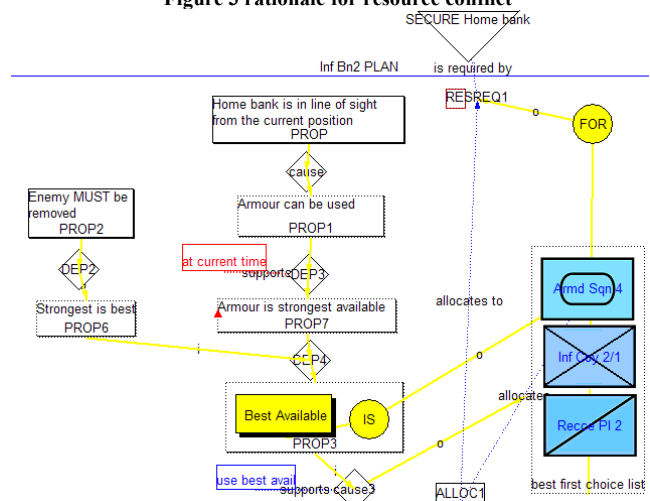


Figure 4 rationale using unstructured text