Collaborative Synchronization Management Tool
A User's Guide

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Sammanfattning

Detta är en enkel användarhandledning till verktyget Collaboration Synchronization Management Tool (CSMT), avsett att användas vid effektbaserad planering (EBP) under en effektbaserad syn på operationer (EBAO). CSMT använder en s.k. cross-impactmatris som populeras med information om hur olika planeringsobjekt, så som aktiviteter och förväntade effekter, antas påverka varandra positivt eller negativt (stödjer eller motverkar varandra). Denna information skall tas fram genom bedömning under EBP-fasen, och används för att analysera hur de planerade aktiviteterna, stödjande effekterna samt avgörande villkoren kan påverka det militära sluttillståndet. Metoder för att analysera planers stabilitet, samt för att jämföra planalternativ, visas.

Nyckelord: CSMT, cross-impactmatris, morfologisk analys, effektbaserad syn på operationer, EBAO, effektbaserad planering, EBP, effektbaserad utvärdering, EBA.

Summary

A user's guide is presented for the Collaboration Synchronization Management Tool (CSMT), intended for use during Effects-Based Planning (EBP) within an Effects-Based Approach to Operations (EBAO). This tool uses a Cross-Impact Matrix (CIM) which is populated with the cross-impact information about how different planning objects, such as Actions and Effects, are assessed to affect each other in a positive or negative way (support, or counteract each other). This information should be gathered during the EBP phase, and is used for analyzing how the developed Actions, Supporting Effects and Decisive Conditions can affect each other and the Military End State. It is shown how to use CSMT for analyzing plan stabilities and comparing plan alternatives.

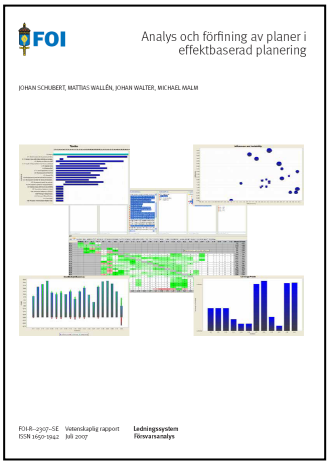
Keywords: CSMT, Cross-Impact Matrix, Morphological Analysis, Effects-Based Approach to Operations, EBAO, Effects-Based Planning, EBP, Effects-Based Assessment, EBA.

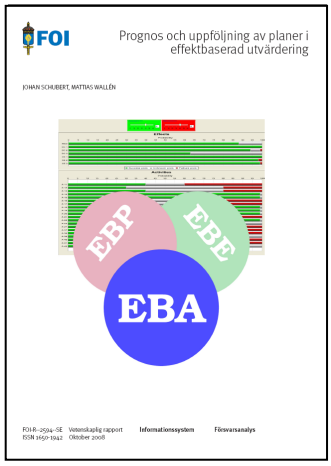
Contents

Läs även:

Schubert, J., Wallén, M., Walter, J. och Malm M. (2007), Analys och förfining av planer i effektplanerad planering. FOI-R--2307--SE, Swedish Defence Research Agency, Linköping.
[Online] http://www.foi.se/upload/projects/fusion/FOI-R--2307--SE.pdf

Schubert, J. och Wallén, M. (2008), Prognos och uppföljning av planer i effektbaserad utvärdering. FOI-R--2594 --SE, Swedish Defence Research Agency, Stockholm.
[Online] http://www.foi.se/upload/projects/fusion/FOI-R--2594--SE.pdf

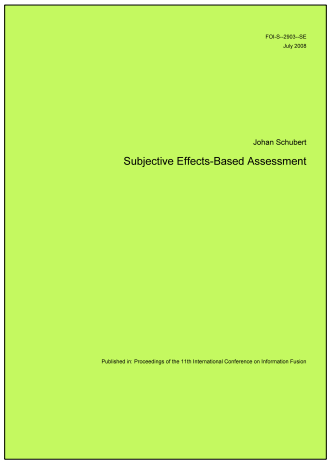




Read also:

Schubert, J., Wallén, M. and Walter, J. (2008), Morphological refinement of Effect-Based Planning, in *Stockholm Contributions to Military Technology 2007*, M. Norsell (Ed.). Swedish National Defence College, Stockholm, pp. 207–220. (FOI-S--2867--SE, Swedish Defence Research Agency, Linköping).
[Online] http://www.foi.se/upload/projects/fusion/fusion60.pdf

Schubert, J. (2008), Subjective Effects-Based Assessment, in *Proceedings of the Eleventh International Conference Information Fusion*, pp. 987994, 30 June–3 July 2008, Cologne, Germany. (FOI-S--2903--SE, Swedish Defence Research Agency, Linköping).
[Online] http://www.foi.se/upload/projects/fusion/fusion63.pdf



1 Introduction

This manual describes the Collaboration Synchronization Management Tool (CSMT) tool in its version 2.0. The tool might undergo subsequent revisions and extensions, and this manual should be regarded as a snapshot of the CSMT functionalities.

This document does not explain the Effects-Based Approach to Operations (EBAO) paradigm to which the acronyms used below can be linked; instead we recommend [1].

CSMT is a tool that helps decision makers and planners to collaborate and synchronize their actions in Effects-Based Planning (EBP) and Effects-Based Assessment (EBA). The key component is the Cross-Impact Matrix (CIM) [2], where the user specifies how each action, via supporting effects and decisive conditions (see below) is expected to influence the Military End State.

In this document, the following planning information objects will be used [1]:

Category 1 consists of the action, supporting effect and decisive condition objects affected by the actions:

- ***Decisive Conditions (DC)***

  A Decisive Condition describes a stipulated condition for a phase transition.

- ***Supporting Effects (SE)***

  A Supporting Effect describes an effect associated with one or several Decisive Conditions.

- ***Actions (A)***

  An Action describes an action or activity needed to fulfill one or several Supporting Effects.

Category 2 consists of the planning objects often used in the Synchronization Matrix (SM) for synchronizing actions.

- ***Phases***

  A Phase describes a phase in the operational plan, during which one or several Actions are executed.

- ***Resources***

  A Resource describes a resource available to carry out one or several Actions.

- ***Areas***

  An Area describes a location where one or several Actions are executed.

- ***Decisions***

  A Decision describes a decision that has to be made, or a window of opportunity.

In the rest of the document, planning information objects will, when referred to in the text, be generalized as “EBAO Objects” and have capitalized first letters as in “Supporting Effect” for easy reference.

CSMT, written in Java, could be easily installed in a web server and run either as a Java applet in a web browser, or as a standalone application using Java Webstart. CSMT could also be installed on a computer as a single jar file together with a library folder with an accompanying toolset and run locally. The data in the Cross-Impact Matrix, and other related information, are stored in an XML file, available locally or over the internet via HTTP. This kind of storage may be replaced in the future when CSMT might be equipped with a web-service interface to a central database with EBP information.

2 The Cross Impact Matrix

A CIM [2] can be used as a way to quantify knowledge about cross-impacts within an analyzed system, and also to support tools for morphological analysis [3]. In morphological analysis we break down the plan into its essential sub-concepts. In the CIM each concept (or here: EBAO Object) will occupy a row with values indicating how much it affects other EBAO Objects, and a column with values indicating how much it is affected by other EBAO Objects.

The CIM could be populated with data on the operational command level by the staff of a joint task force headquarter during planning, execution and assessment of an operation. The purpose of using a CIM is to find inconsistencies in plans developed within the EBP process. The EBAO Objects in the CIM constitute all Activities, Supporting Effects, Decisive Conditions and the Military End State of the plan. It is created by a broad working group which must stepwise assess how each Action influences every other Action and Supporting Effect, how each Supporting Effect impacts every Decisive Condition (and possibly other Supporting Effects), and how every Decisive Condition impacts the Military End State (and possibly other Decisive Conditions).

The CIM will aid the planning staff to find and exploit synergies by making all identified relationships between planned Activities and their influence upon the Supporting Effects, etc. explicit. The values entered in the CIM during planning can be continuously updated during execution of the plan as the staff increases its knowledge of the current operational environment. Together with other information about the operation the explicit values in the CIM can therefore aid decision makers in gaining a shared understanding of the situation, possibly leading to better decisions. The CIM can also be used during assessment of the operation as it should contain the most current view of what influence Supporting Effects have on the Decisive Conditions and what influence Decisive Conditions have on the Military End State.

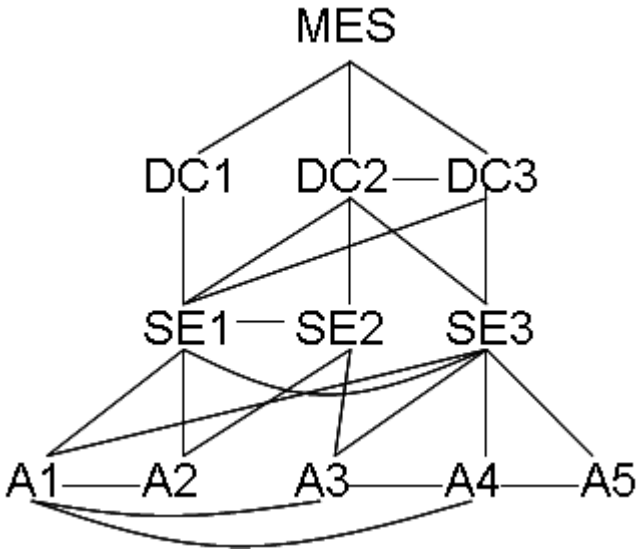
In this user guide we present the CSMT tool in which a CIM may be set up and used in EBP [4, 5] and EBA [6, 7] for plan evaluation, plan refinement, generation of alternative plans and assessment of plans. We briefly show methods for analysing Activities and evaluating and refining plans within EBP. Developing these methods further is the next step taken when extending the tool suite in CSMT.

2.1 The Creation of the Cross Impact Matrix

The CIM will initially be created during the planning process. It should be created by a working group containing key subject matter experts as required by the type of operation planned. The working group will first need to enter all planned activities into the CIM, and it is important that all activities are well defined. They will then have to decide which positive or negative influence each Action will have on every other Action. It is important to note that even if Action A1 has a positive influence on Action A2, A2 might have a negative influence on A1. In the next step the working group must decide what

influence all activities have on the Supporting Effects, what influence all Supporting Effects have on the Decisive Conditions and what influence the Decisive Conditions have on the Military End State.

It is important to note that the CIM will not be able to handle the effects of synergy. If the combined effect of performing activities A1, A2 and A3 simultaneously is higher than the sum of performing each one separately, this can not be modelled within standard CIM analysis. However, it can be managed if A1, A2 and A3 are combined into one Action with several alternatives. It should also be understood that the CIM should only contain the direct first-order influences; indirect influences of an Action on another Action via a third Action (second order effect), and on itself via one or several other Actions ("Control loop") should not be considered in the simple, morphological analysis the CIM is intended to support.



Above we give an example on how the EBAO Objects can affect each other. On the same level, bi-directional influence is allowed. From one level to the next, single-directed influence is allowed. No other influences are allowed.

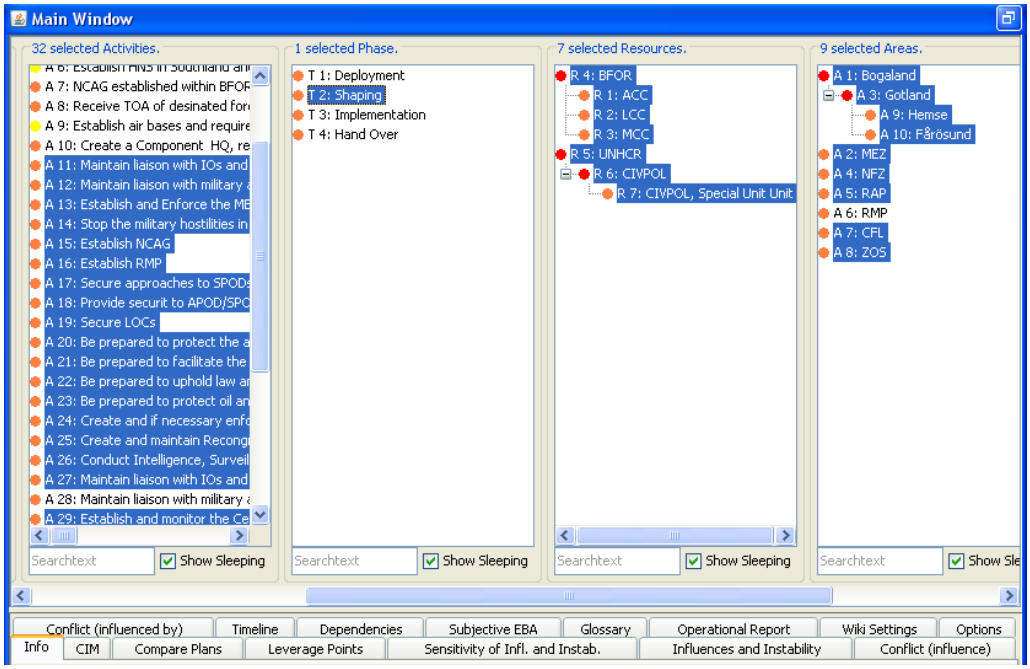
3 The Graphical User Interface

CSMT uses a desktop design. In the main menu, there is a “File” option where the user can load and save the planning information used by CSMT. The “Military End State” choice corresponds to choosing all Decisives that affect the Military End State, which is normally all of them. They are, however, not displayed as “selected” in the selection lists below.

The sub-window “Main Window” is initially divided into two parts:

- The upper part of the main window shows seven **selection lists** with the different EBAO (planning) Objects: Decisive Conditions, Supporting Effects and the Actions, together with different objects to associate with the Actions: Resources, Areas, Phases and Decisions.
- The lower part contains a tabbed container with different **views** of the information in the CIM that can be used to illuminate certain aspects of the plan. Each view may, by double-clicking its tab, be opened in its own window and placed anywhere within the CSMT main window. When CSMT starts, the desktop will organize the windows according to how it was organized when the previous session was exited.

3.1 The Selection Lists



As previously mentioned, the upper part of the GUI holds the selection lists. When the user single-selects (as in the figure above, in the “Shaping” Phase), or multiple-selects (consecutive combined ctrl button - mouse clicks) EBAO object(s) in these lists, all other *associated* objects are highlighted. A Decisive Condition, Supporting Effect or Action is associated with another object if it has a non-zero relation with it in the CIM; that is it *affects*, or *is affected by*, the other object. An Action is normally also associated with one or several Phases,

Areas, Resources or Decisions. These are similar to what is used in the Synchronization Matrix (SM) by the JOC. These associations might in future CSMT releases be fetched from a tool used to set up the SM. In the above figure, the selection lists for the Decisive Conditions and Supporting Effects are scrolled out to the left, and the Decisions to the right, to give better visibility of the remaining three categories: Actions, Phases, Resources and Areas.

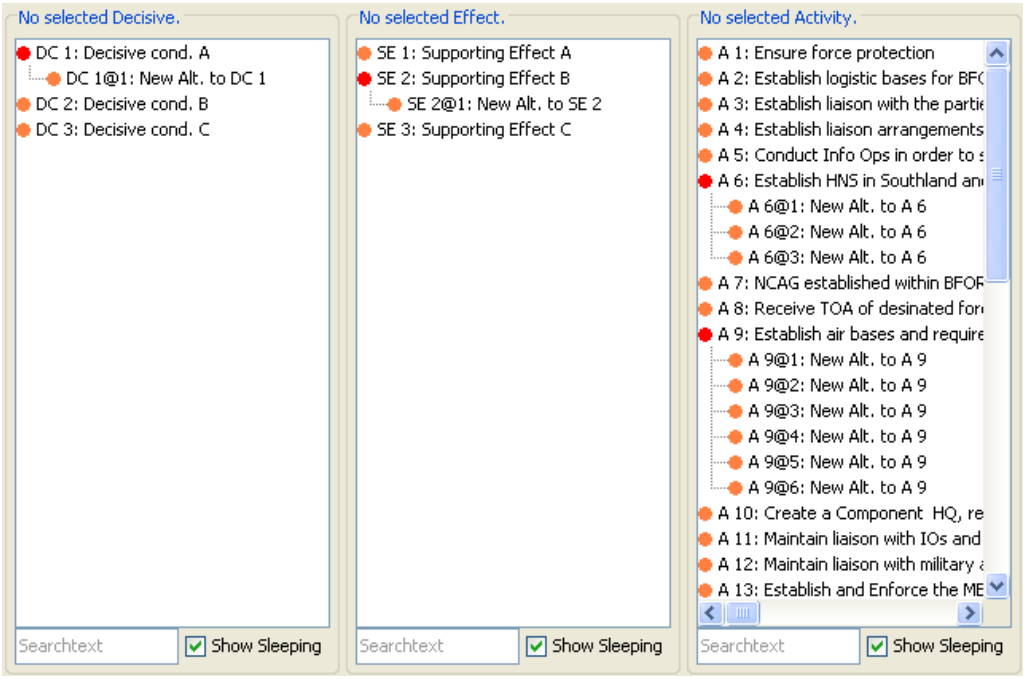
The user may, for example, select the resource Maritime Component Command (MCC). The Actions that are associated with MCC (the Actions delegated to MCC) are then highlighted. The Phases, Areas and Decisions that are associated with these Actions are then also highlighted. As are the Supporting Effects that are influenced by the Actions and the Decisive Conditions that are influenced by these Supporting Effects. See "The Info View" below on how to associate Actions with Resources, Phases, Areas, and Decisions.

To highlight the Actions that are delegated to MCC in the shaping Phase and executed around Gotland: select MCC, deselect all Phases except the shaping Phase and deselect all Areas except Gotland.

New EBAO Objects can be created by right-clicking the mouse in one of the list panels and in the pop-up list choose option "Add new… in end of list".

An EBAO Object without "children" can be removed by right-clicking it and choosing option "Remove…".

3.2 Creating alternatives in the selection lists



3.2.1 New alternatives

In the selection lists for the Decisive Conditions, Supporting Effects and Activities, new alternatives for an EBAO Object belonging to any of these three categories can be created. This is done by right-clicking the mouse on one of these EBAO Objects, and choose "Add empty alternative to…" or "Add equal alternative to" from the pop-up menu. An "empty" alternative does not inherit any values from its parent main alternative. An "equal" alternative inherits its parents' values such as the "affects" and "affected by" values in its row and column in the CIM, and relations to Phases, Resources, Areas and Decisions. The alternatives created get numbered with suffixes "@1, @2, @3, …" in that order. An alternative can analogously be removed by choosing "Remove…".

3.2.2 Active / sleeping alternatives

An alternative can also be toggled between states "active" and "sleeping". Sleeping alternatives in an EBAO Object category are shown in a selection list and in the CIM view only if the checkbox "Show Sleeping" under that selection list is checked. This can be used to not show EBAO Objects that are loaded, but not currently used in the planning process in order not to clutter the selection lists and CIM view.

Every possible combination of multiple object alternatives will form a plan together with all single-object alternatives. Every plan can be analysed, evaluated and compared to any other plan. Remember that the original EBAO Object, now the "parent", is an alternative in itself, the main one. In the above figure Decisive Condition 1 (DC 1) and Supporting Effect 2 (SE 2) have 2 alternatives each, and the activities A 5 and A 9 have 4 and 7 alternatives, respectively. In total, this gives 2 * 2 * 4 * 7 = 112 plans altogether to evaluate. This is so since a new alternative in the CIM must be given new values on how it affects, and is affected by, other EBAO Objects. The main alternative corresponds to the parent object, and the other alternatives are shown as leaves. The single plan that corresponds to the combination of the main alternatives only is the "active plan". That is why the main alternatives are shown as parents to their (inactive) child alternatives. One can now try to improve this plan by creating alternatives and evaluate the new plans then created. Alternatives can be set as main alternatives by right-clicking them, and choose "Set … as main alternative" from the pop-up menu. This can also be done in the "Compare Plans" view, see below.

The views for all but two of the different tabs discussed below are shown for the active plan only. To get the views for other combinations of alternatives, the plan for that respective combination of alternatives has to be set as the main plan. This is most easily done in the Compare Plans view, see section 3.3.10.

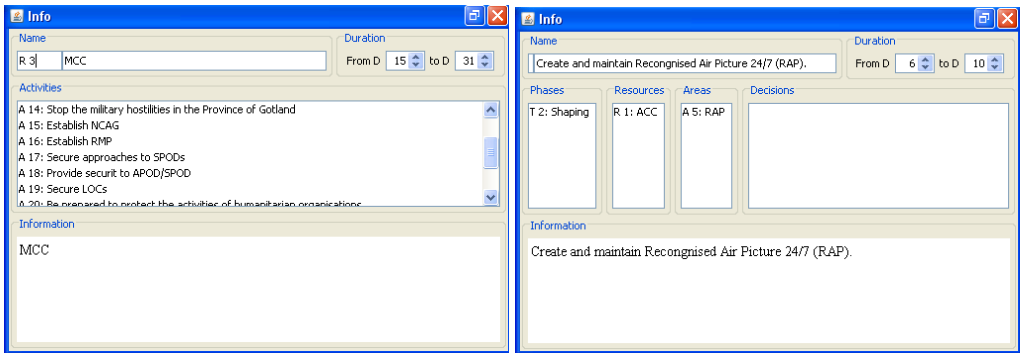
For the "CIM" view, the alternatives can be seen if "Military End State" has been clicked in the main window menu.

For the "Compare Plans" view, the alternatives can be seen if they are not sleeping.

3.3 The Views

The views are all collected in a tabbed container below the selection lists in the lower half of the graphical user interface. When a tab is double clicked the view is opened in a new window and placed on the desktop. If not stated differently, the views only show those EBAO Objects that are highlighted in the upper part. In many of the views, explaining tooltips appear when the mouse pointer is placed over the displayed EBAO Objects.

3.3.1 The Info view(s)

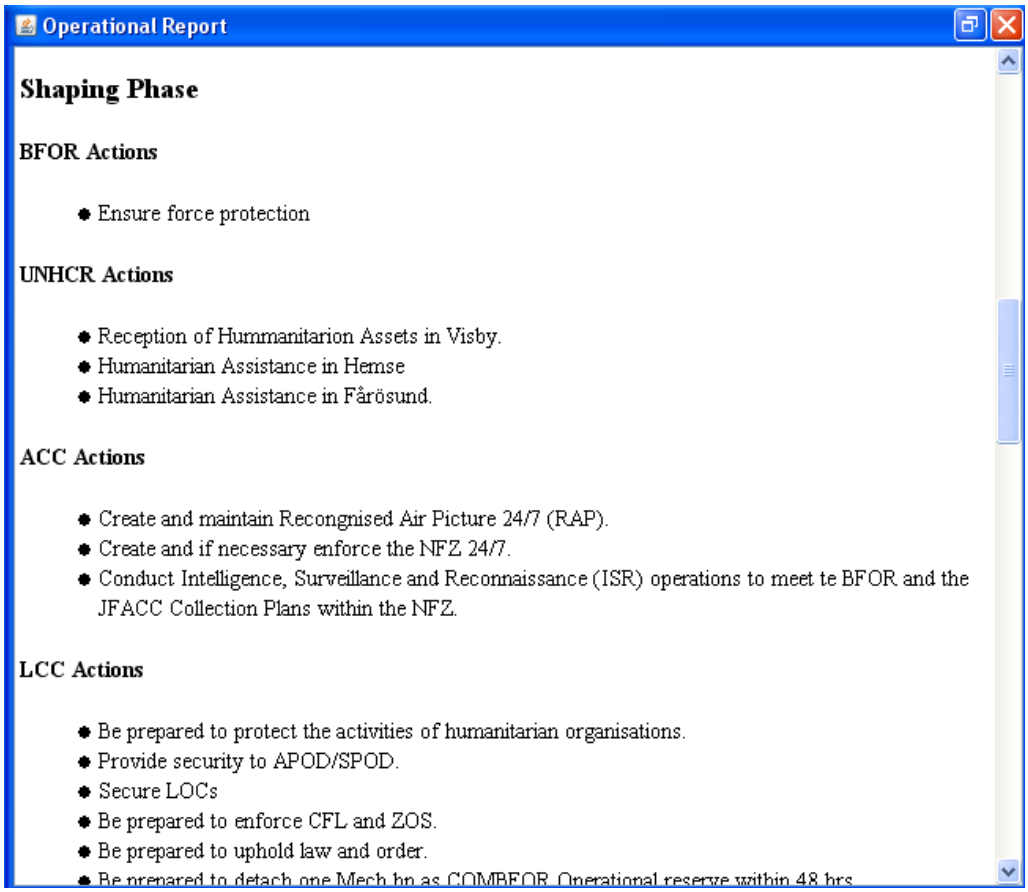


The Info view shows in the Information field a description text of the selected EBAO Object. All words defined as a *Wiki word*, are shown as a link to a Wiki page. The duration, if relevant for that EBAO Object, is also shown.

If a Phase, Resource, Area or Decision has been selected, the Activities associated to it are also shown (left above).

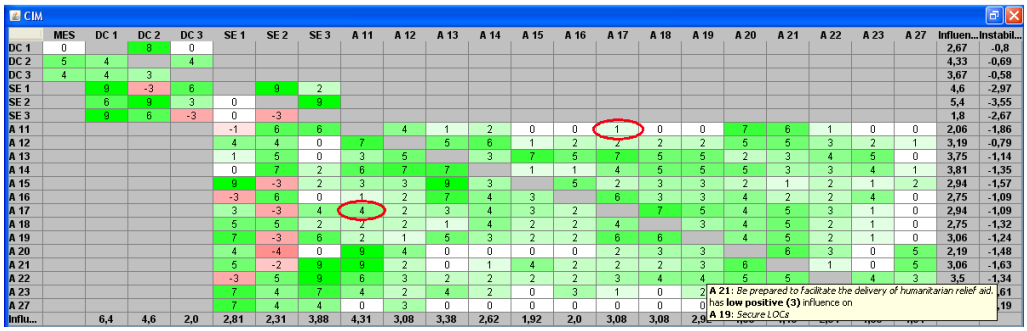
If an Action has been selected, four *tag* lists are also shown. With these the user can tag the Action with the Phases during it takes place, the Areas where it is executed, the Resources it allocates and the Decisions that have to be made. This makes it easier to later filter out objects depending on which of four categories it belongs to. In the upper part, the user can, for example, select some Resources and some Areas to view only the Actions associated with those Resources and Areas.

3.3.2 The Operational Report view



In this view, the Actions are grouped by the Phase when they are active and, under each Phase paragraph, which Resources they then allocate.

3.3.3 The CIM view



The Cross Impact Matrix view shows the Decisive Conditions, Supporting Effects and Actions that are currently highlighted in the upper selection lists, and how they influence one another. The notation used is such that the EBAO Objects to the left influence the EBAO Objects on the top with a strength corresponding to the value of the matrix element at the common row and column. The left oval, for instance, indicates how much Action A17 influences Action A11. The right oval indicates how much Action A11 influences Action

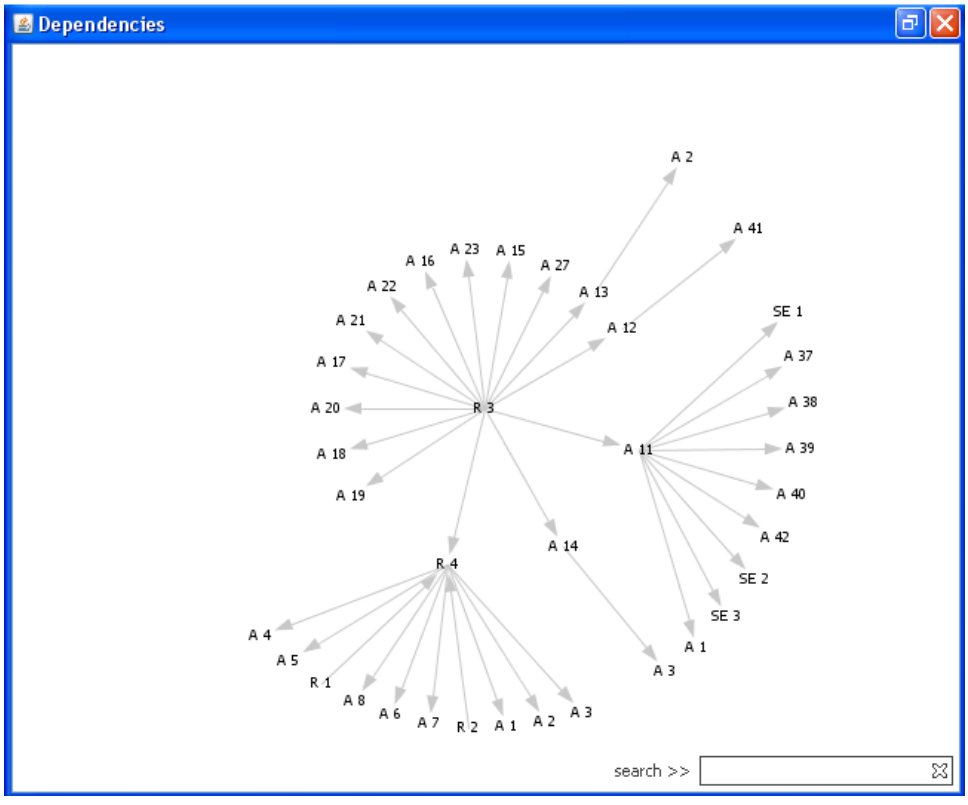
A17. The (integer) values range from -9 (large negative influence) to 9 (large influence). Grey cells are always zero. A value can be set by selecting the corresponding matrix element and typing it on the keyboard. It can also be set by double-clicking it, which launches a small editor where the value can be entered together with associated information, such as a motivation why a certain number was chosen. This motivation is important to store for later reference.

In the CIM view above, no alternatives are shown. The CIM values for created EBAO Object alternatives is set in the complete Military End State view of the CIM obtained by clicking “Military End State” in the main menu of the CSMT window. The rows and columns for the non-main alternatives are then coloured in cyan to differ them from the rest of the EBAO Objects.

It should be understood that the numbers in the CIM constitute all numerical data used to extract the information shown in most of the views discussed below. A CIM not filled with relevant cross-impact values between the EBAO Objects will give false impressions in these views.

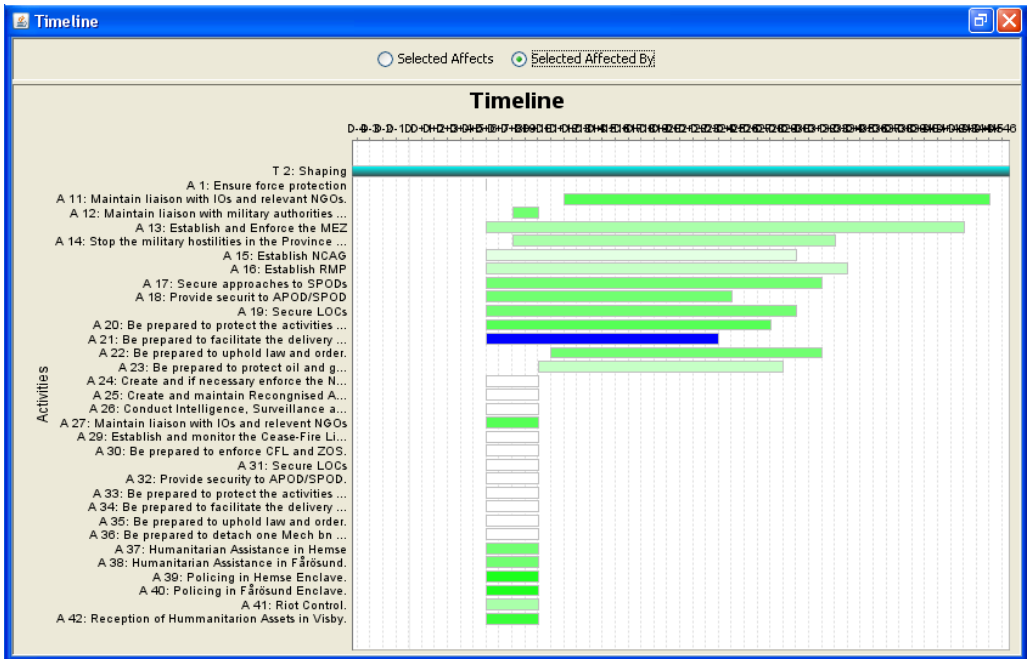
The CIM also shows how much an EBAO Object, on the average, *influences* all other EBAO Objects, as shown in the *influences* column. Also how much an EBAO Object, on the average, is *influenced by* all other EBAO Objects, as shown in the bottom row. In the *instability* column it is shown how *unstable* an EBAO Object is. An EBAO Object is unstable if it influences - and is influenced by - other EBAO Objects both positive and negative. For more information on influence and stability, see [4, 5].

3.3.4 The Dependencies view



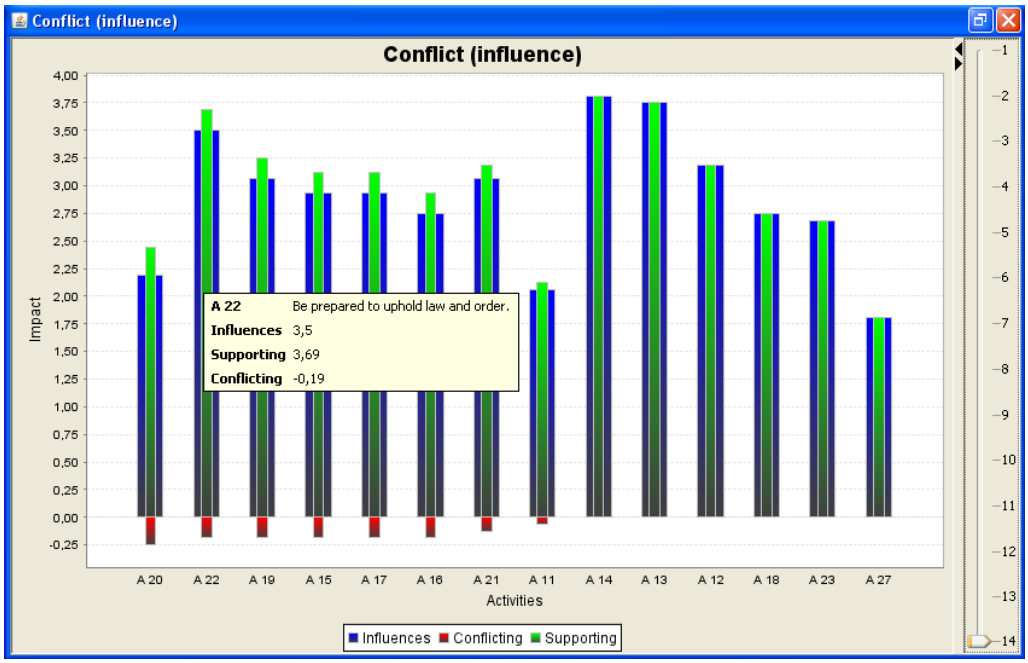
This “spider view” shows an egocentric network with all selected EBAO Objects and how they are associated. The view shows associations down to a depth two levels below the chosen EBAO Object. This view can be used to show the cascading effects if a resource no longer is operational.

3.3.5 The Timeline view



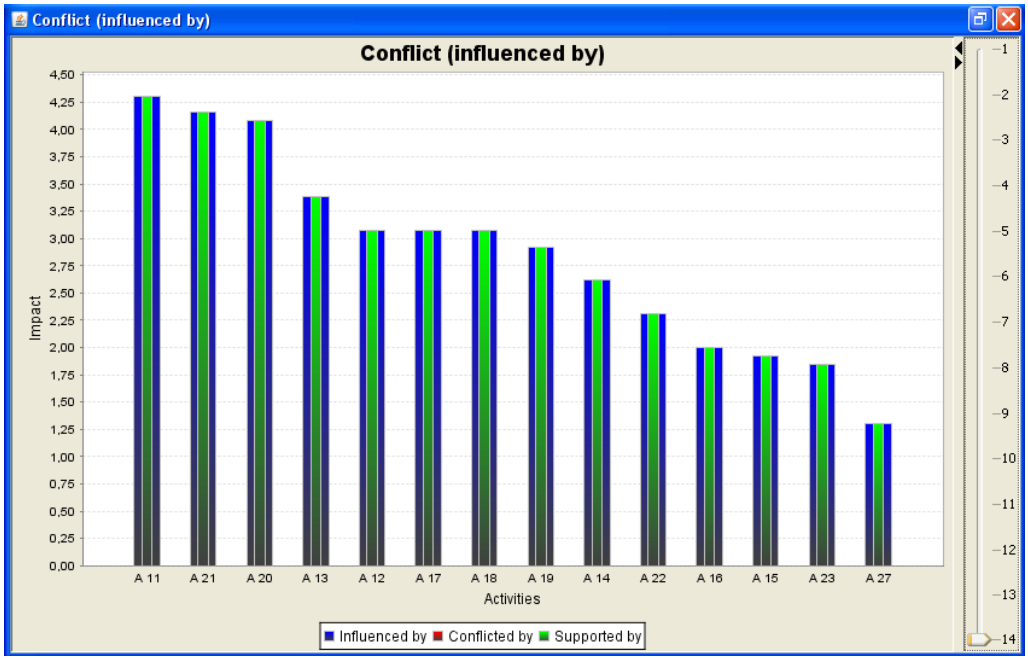
The timeline view simply shows a Gantt chart for when the Actions are to be performed. An Action can be clicked, and then the other Actions are coloured like the colours in the corresponding row (how much selected Action affects the other Actions) or column (how much the selected Action is affected by the other Actions, as in the example above) cells in the CIM view. The two radio buttons above the Timeline view choose which of the two (affects / affected by) that is shown.

3.3.6 The Conflict (influence) view



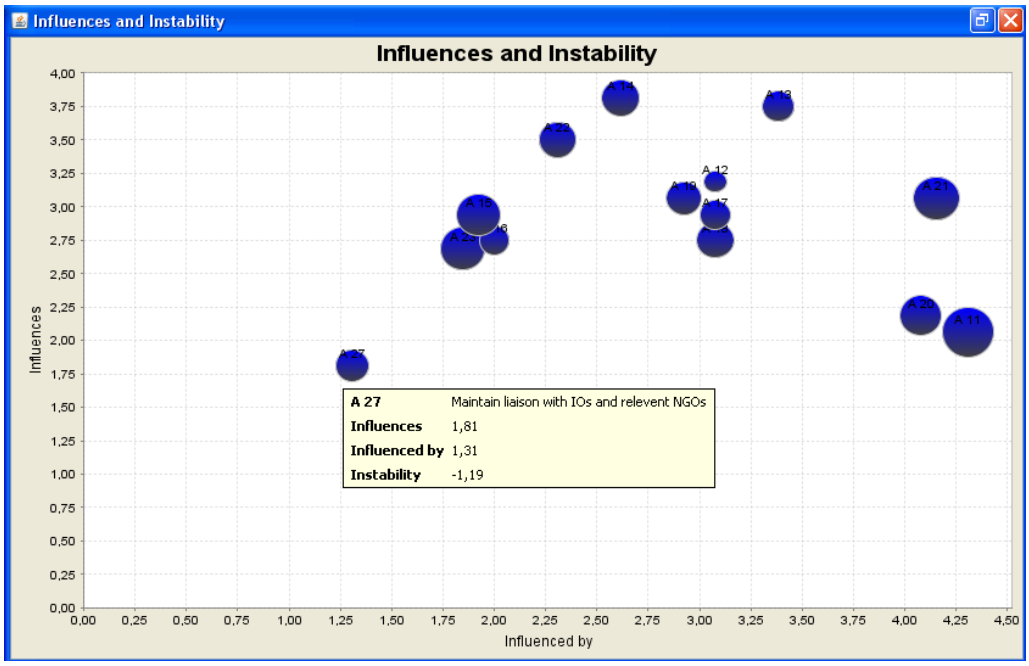
This view shows a bar graph of the selected Actions and for each of them, their total *influence* (blue, total sum) on all other Actions [4, 5]. The bars are separated into their positive (green, summing only positive) and negative (red, summing only negative) influence on all other Actions. Hence, the blue bar is the sum of the green and the red bars.

3.3.7 The Conflict (influenced by) view



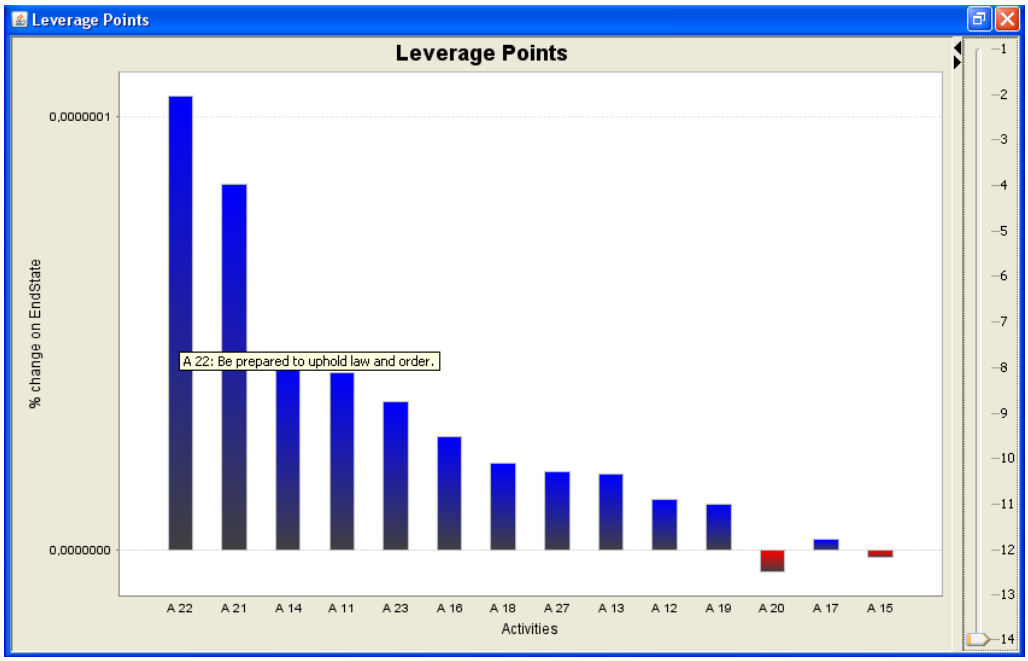
This view shows a bar graph of the selected Actions and for each of them, how much they are *influenced by* (blue, total sum) all other Actions [4, 5]. The bars are separated into their positive (green, summing only positive) influenced-by and their negative (red, summing only negative) influenced-by all other Actions.

3.3.8 The Influences and Instability view



The Influences and Instability view shows the Actions as bubbles [4, 5]. The more they *influence* other Actions, the higher up they are depicted. The more they are *influenced by* other Actions, the further to the right they are depicted. The size of the bubble is dependent on how *unstable* the Action is; the larger the more unstable. Thus, Actions with big bubbles in the upper right corner are the ones that need some extra attention.

3.3.9 The Leverage Points view



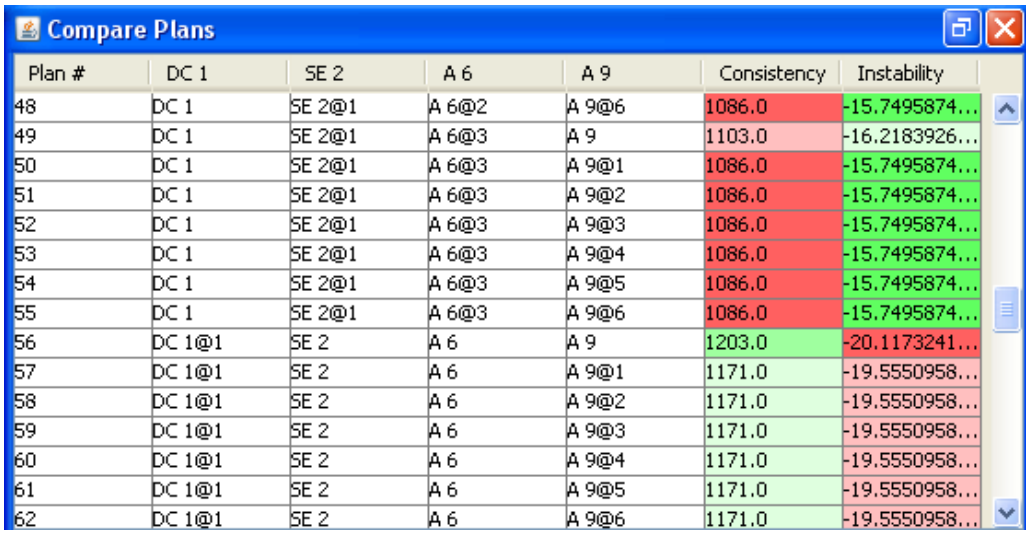
The Leverage Points view shows a bar graph of the selected Actions, indicating how much the Action affects the outcome of the Military End State [4, 5].

The value is calculated as follows: The probability (p_{100}) for a successful Military End State is calculated given the assumption that all Actions succeed to 100%. The probability for a successful Military End State is then calculated with the assumption that one Action only succeeds to 99%. This probability is usually lower than p_{100}, except for those Actions that have negative influences on their Supporting Effects. How much lower the probability of a successful Military End State, given that one Action only succeeds to 99%, is depicted in the Leverage Points view.

We see that Actions A22, A41, A40 and A21 have the highest influence on the Military End State and it is therefore important that these Actions succeed.

The vertical scale to the right could be adjusted for how many bars that should be visible.

3.3.10 The Compare Plans view

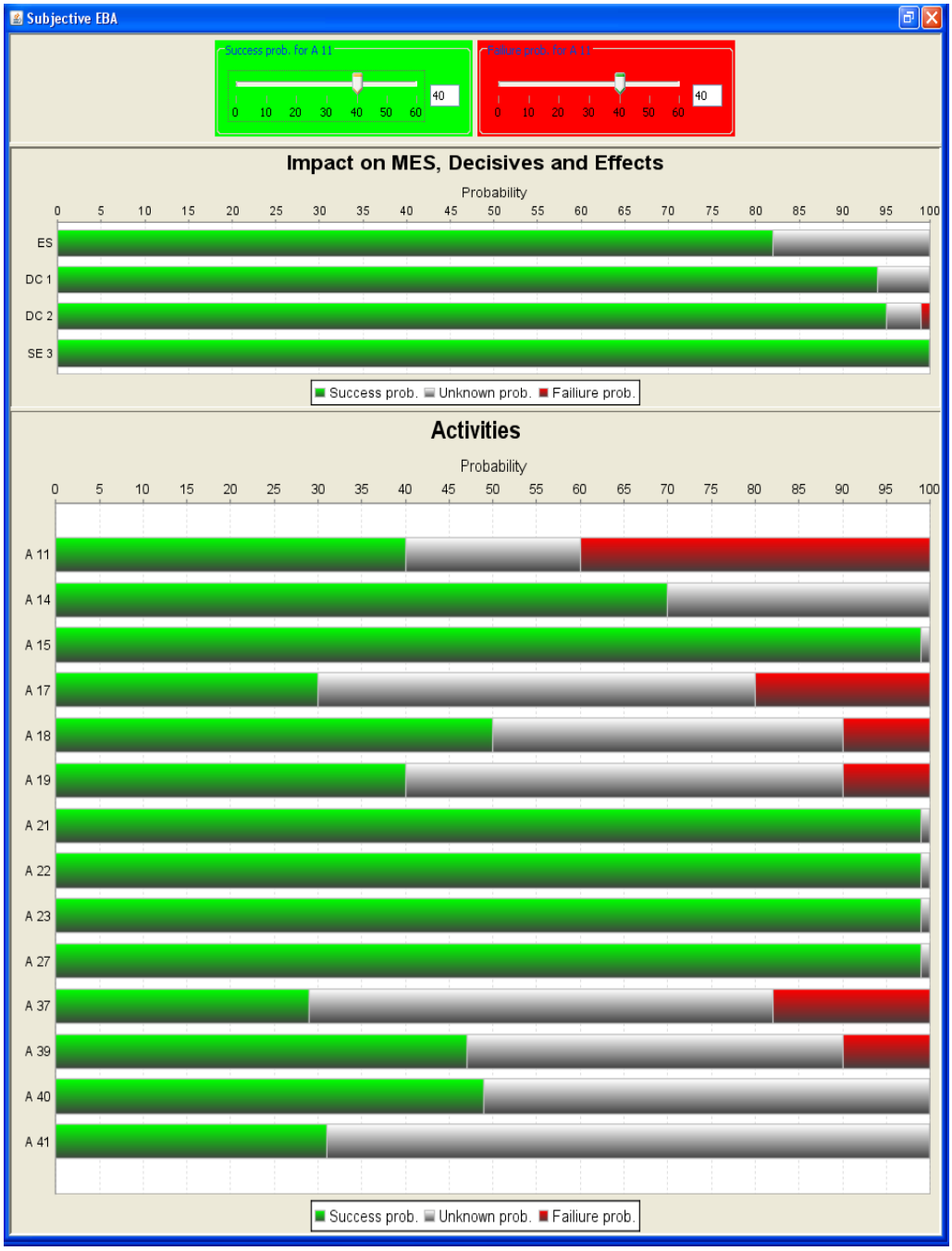


Plan #	DC 1	SE 2	A 6	A 9	Consistency	Instability
48	DC 1	SE 2@1	A 6@2	A 9@6	1086.0	-15.7495874...
49	DC 1	SE 2@1	A 6@3	A 9	1103.0	-16.2183926...
50	DC 1	SE 2@1	A 6@3	A 9@1	1086.0	-15.7495874...
51	DC 1	SE 2@1	A 6@3	A 9@2	1086.0	-15.7495874...
52	DC 1	SE 2@1	A 6@3	A 9@3	1086.0	-15.7495874...
53	DC 1	SE 2@1	A 6@3	A 9@4	1086.0	-15.7495874...
54	DC 1	SE 2@1	A 6@3	A 9@5	1086.0	-15.7495874...
55	DC 1	SE 2@1	A 6@3	A 9@6	1086.0	-15.7495874...
56	DC 1@1	SE 2	A 6	A 9	1203.0	-20.1173241...
57	DC 1@1	SE 2	A 6	A 9@1	1171.0	-19.5550958...
58	DC 1@1	SE 2	A 6	A 9@2	1171.0	-19.5550958...
59	DC 1@1	SE 2	A 6	A 9@3	1171.0	-19.5550958...
60	DC 1@1	SE 2	A 6	A 9@4	1171.0	-19.5550958...
61	DC 1@1	SE 2	A 6	A 9@5	1171.0	-19.5550958...
62	DC 1@1	SE 2	A 6	A 9@6	1171.0	-19.5550958...

In this view, the different plans that are formed by combining different EBAO Object alternatives, are shown and compared. Here, all plan permutations are listed together with the values of Consistency and Stability for each plan, see [4, 5]. A more saturated green background in these fields means better, a more saturated red means worse. There is one column in this view for every EBAO Object that has at least one alternative. The figure corresponds to the case shown in section 3.2 with 112 plans altogether. In this view, all permutations are shown (in the figure only for plans 48 – 62, the rest are scrolled out), each corresponding to a plan. One can sort the plans by clicking on the header name, and also right-click with the mouse on an alternative in a column and show only the plans containing that alternative, and also cumulatively build up a filter. Also, one could choose to select a certain combination of alternatives to be the new main plan by right-clicking that plan number in the leftmost column, and select it in the pop-up menu. This will also swap the chosen alternatives to be the main alternatives in the upper selection lists, and the former main alternatives will be changed to ordinary alternatives (children in the selection list trees).

The values to the left are the Consistency and Instability values that can be used as indicators of the “goodness” of the plan [4, 5]. The colouring of those values is in increasing order of “goodness” from red (lowest value) to green (highest value). In the above example, the values for many alternatives are the same, because the CIM has not been filled by any cross-impact information for them. When alternatives have got their CIM entries filled, the values for Consistency and Instability would be different.

3.3.11 The Subjective EBA view



Here, the success and failure probabilities are shown for the Military End State, Decisive Conditions and Supporting Effects, given the expected success for the Actions [6, 7]. They are calculated using Dempster-Shafer theory [8, 9]. The view can be used in plan assessment and war gaming. If the user estimates the probabilities for success as well as failure for different Actions, he will see the success and failure probabilities for the Military End State, Decisive Conditions and Supporting Effects that are influenced by any of the Actions. To change the success- or failure probability for an Activity, simply select the Activity and adjust the values with the scrollbars at the top. Note that the failure probability need not be one minus success probability, as is the case for

Bayesian probabilities; instead the third (gray) interval is assigned to ignorance, i.e., lack of knowledge[1]. Only as much probability as is judged to explicitly support a success or failure should be committed to them, respectively.

3.3.12 The Glossary view

A glossary with the most common military abbreviations is available for reference.

3.3.13 Future extension of number of views

The views discussed above are the ones currently available, mainly focusing on how the content in the CIM could be analyzed. The information in the CIM, and the association of the EBAO Objects could be analyzed in other ways as well. Also, if CSMT becomes one tool of several others in an EBP software toolsuite, views of information produced in these other tools could be shown here.

[1] Here, success probability (green) plus ignorance probability (grey) plus failure probability (red) equals 100%.

4 References

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