# Chapter 10-3 – CASE STUDY 1: NET EFFECT WITH REACH-BACK

## INTRODUCTION

This chapter describes how the emerging C2 Conceptual Model was tested for completeness and validity (i.e., fitness for purpose) through a case study exercise. The case study approach was chosen as a relatively independent way of testing the CM because it would represent an example of use, according to a pre-determined process and with clear goals, and would not, therefore, be wholly dependent on the judgement of the SAS-050 team.

The objectives of this case study were:

1) To test the C2 Conceptual Model against a specific, focussed study problem to find out if it:
   a) Is an effective starting point for the specific study;
   b) Facilitates requisite treatment (by identifying the full range of critical variables and relationships);
   c) Comprises a set of variables rich enough to differentiate adequately between different C2 Approaches;
   d) Encourages broad and innovative thinking; and
   e) Facilitates shared understanding between the nations.
2) To propose improvements to conceptual model.

The case study was conducted according to the process recommended by the *NATO Code of Best Practice for C2 Assessment*. Given the time and resources available and the principal role of the C2 Reference Model in studies, the case study focussed principally on Problem Formulation (see Figure 10-3.1), which the COBP emphasises should be done explicitly before a Solution Strategy is formulated. Problem Formulation (sometimes called "questioning the Question") includes:

- Explicit declarations of assumptions and constraints;
- Identification of independent and dependent variables that will be evaluated; and
- Explicit declarations of high level Measures of Merit (or criteria) by which outputs will be judged for significance.

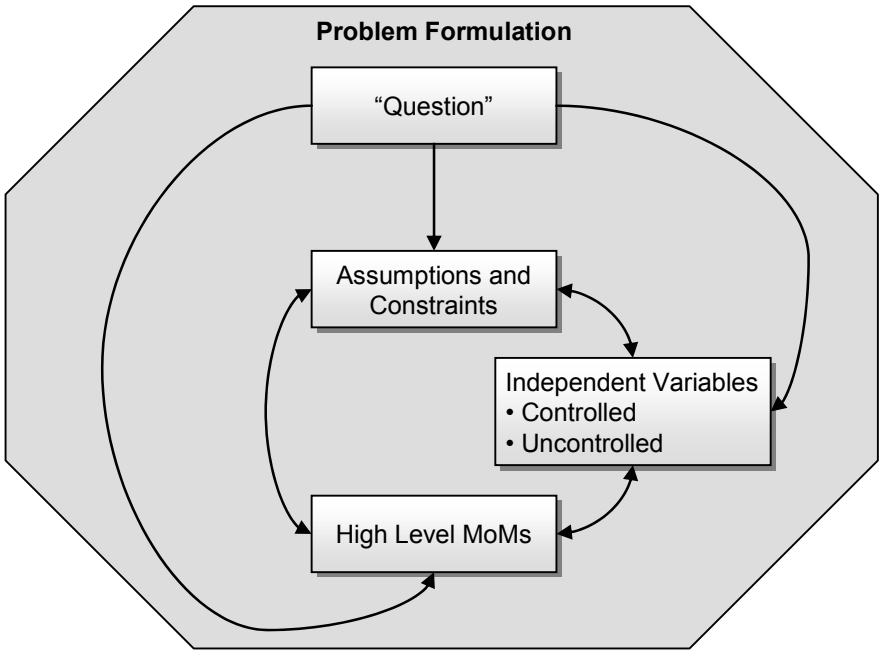


**Figure 10-3.1: Key Parts of Problem Formulation as Defined by the NATO Code of Best Practice for C2 Assessment.**

In line with COBP guidance on Problem Formulation, the case study briefly considered all aspects of the study process in order to obtain early insight into Solution Strategy issues that might shape the nature of the problem that can feasibly be addressed.

The COBP recommends an iterative approach so that all aspects of the problem are re-visited at least twice during the study. The study was conducted from March to September 2004 (based on the Reference Model version current at that time) and involved a series of four workshop sessions that constructed a strawman problem formulation and sought to work the problem systematically. The third of these workshops used a Synthetic Environment experimentation facility to allow participants to immerse themselves in the chosen scenario before discussing the study problem.

The remainder of this chapter outlines the case study context, the "Question" as presented, the results of the Problem Formulation and the initial Solution Strategy adopted. The next section describes the results of the case study in respect of testing the C2 Reference Model.

## CASE STUDY CONTEXT

The case study was set in a fictional scenario involving a dispute between the countries of Tetlovia and Keswonia. The geography and fielded military forces involved are illustrated in Figure 10-3.2. The following actions were declared to have already taken place:

- Tetlovia invaded Keswonia and seized control of the only deep-water port, which was important to international trade.
- The Keswonian Government was in disarray and local Armed Forces were unable to restore territorial sovereignty.

- Lochland to the north closed its border to refugees and a huge humanitarian crisis, with increasing disorder, was forecast.
- UN resolutions were passed demanding Tetlovian withdrawal and authorising military intervention to return control of the Port to Keswonian authorities.
- NATO was asked to provide the military force needed.
- The UN was conducting humanitarian aid operations and requested NATO protection and support.

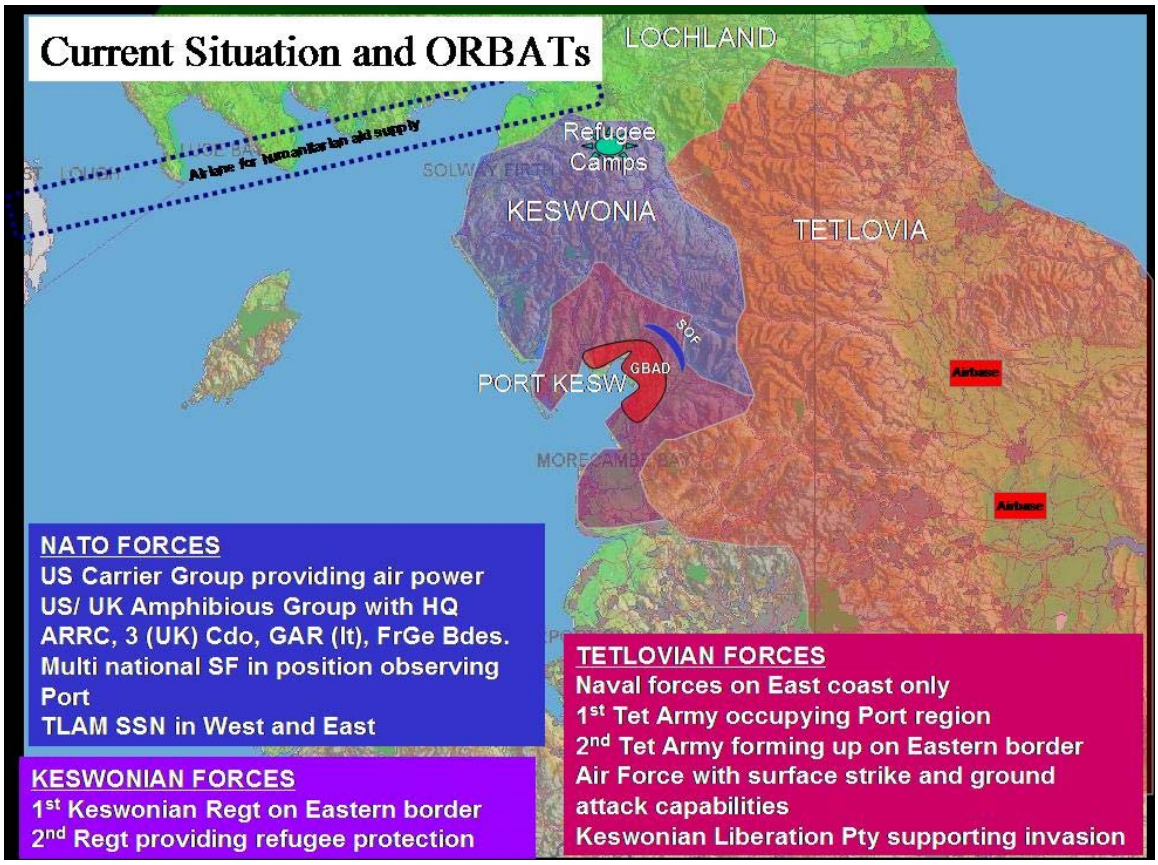


**Figure 10-3.2: Illustration of Case Study Scenario Including Geography and Military Forces.**

NATO's involvement in this situation has been ordered under the name Operation Restore Order, whose political goals and military mission are:

- Political Goals:
  - Visibly oppose Tetlovian invasion.
  - Restore Port Kesw operations.
  - Resolve humanitarian crisis in northern Keswonia.
  - Stabilise region and restore legitimate government.

- Military Mission:
  - Take control of Port Kesw protect restoration of ops.
  - Provide security and support to humanitarian ops.
  - Prevent further Tetlovian intervention in Keswonia.

The NATO Joint Force Commander (designate) has an initial campaign plan involving three phases:

1) An amphibious landing and move to re-take the Port.
2) A simultaneous movement to provide military security to the humanitarian activities in the north.
3) Following restoration of Port operations, a stabilisation action to maintain security and deter further Tetlovian aggression.

However, the JFC is aware that the situation could become volatile, possibly requiring rapid adaptation of the plan. He is also aware of possibilities to improve the agility and/or efficiency of his force C2 by fielding new supporting capabilities, but feels the need for some scientific and analytic advice, hence commissioning a study.

## THE CUSTOMER'S "QUESTION"

Joint Force Commander (designate), who was played by a member of the team with suitable military experience, has asked for a study to address the following question:

- "In forthcoming Operation Restore Order, how should I organise my C2 and what support capabilities should I propose to field?"

## PROBLEM FORMULATION: "QUESTIONING THE QUESTION"

Discussions with JFC and his staff clarified and decomposed the question as follows:

- Can JFC reduce the logistics and communications load by using network-enabled HQ staff afloat to support a C2 cell ashore?
- There is an expectation that units involved in humanitarian assistance missions will need rapid, reliable access to regional experts and technical data from homeland sources. How should this be integrated into the C2 process?
- There is a risk that the situation could become volatile with Phase 1 operations overlapping in time and space Phase 2 humanitarian support. What C2 Approach will best enable agile force re-configuration capability? Particularly, how can JFC create an effective agile net-fires capability? (There was also a Civil Military Cooperation aspect to this volatility risk.)
- The JFC has been advised that the use of network-based collaboration technologies will enable agility and improve overall force capability, but he would like an unbiased assessment to guide his planning.
- What are the other benefits and risks of distributing C2 responsibilities between the geographically diverse units of a multi-national force working within potentially different constraints?

The following assumptions and constraints were identified:

- Assumptions:
  - JFC has freedom to modify C2 structure for NATO forces, but can only advise Keswonian force C2. Does not need to modify structure but feels that conventional approach may be cumbersome and is willing to consider other options. Nothing is sacrosanct, but JFC wants to know about constraints.
  - JFC expects to have to be quick on his feet in this situation.
  - UN mandate is clear. NATO C2 is default, with Keswonians independent.
  - Clear arguments are more important to JFC than quantification per se.
  - Some extra C2 equipment could be acquired in time.
  - There are no immediate risks from Tetlovia that prevent LCC going ashore.
- Constraints:
  - Limited effort, very limited time.
  - National ROE are a factor, but do not assume they cannot change. But Legal and national issues are factors.
  - C2 Information Exchange Data Model is across NATO force (but not with Keswonian Forces).

## SOLUTION STRATEGY

Initially, the team sought to use a systematic, path-tracing technique, designed to identify variables from the Reference Model considered relevant to describe and differentiate C2 Approaches while exploiting its network of relationships. This initial approach made little progress because the Model, at that time, was not well enough connected to sustain path tracing from characteristics discriminating C2 Approaches to the value variables representing their implications. Consequently, on the next iteration of the case study, a different method was adopted.

The study plan was re-designed to involve developing and critiquing C2 “solutions” to the case study problem, and selecting Reference Model variables that describe the differences between those options and the force behaviour under specific scenario evolutions:

- Immerse in the scenario and discuss which Reference Model variables characterise it;
- Brainstorm potential C2 solutions;
- Critique the solutions, select a credible sub-set, and describe the differences between them in terms of Reference Model variables (identifying gaps in the model);
- Walk through the scenario to assess the likely impact of a few widely dispersed C2 solutions;
- Review the Reference Model variables needed to describe how the situation might evolve differently under each solution; and
- Identify gaps in the Reference Model and suggest improvements.

Based on the case study context, some postulated future vignettes were developed representing possible evolutions of the Operational situation.

- Stage 1: ARRC HQ and Div sail for Keswonia. Remainder to follow at time D-3. Plan is for 3 Cdo and GAR Bdes to recapture Port Kesw with FrGe Bde in reserve. Other divisions come ashore through Port Kesw and re-establish Keswonian borders.
- Stage 2: Plan changes because of threat of 2nd Tetlovian Army attack across eastern border, and riots in refugee camp. Operational priority becomes stabilising the Keswonian northern region by relieving suffering in refugee camps and preventing intervention by 2nd Tetlovian Army. 3 Cdo Bde continues on original task. Others re-deploy.
- Stage 3: Imperative of mission to regain control of Port as soon as possible is strengthened because Aid being provided to refugees via the air bridge to Lochland is proving inadequate.

A number of possible C2 Approaches were created using creative thinking techniques and two of these were selected for deeper treatment: a traditional hierarchy and a functional hierarchy.

Under the traditional hierarchy, the JFC and his staff are co-located in an afloat HQ, with staff organised into traditional "J" cells. Commander ARRC and his G-cell staff co-locate in an HQ ashore, with each Brigade HQ deployed with their units. The JFC's J2 is in charge of force ISTAR and, in each HQ, staff conduct operations using traditional planning and battle management procedures. Traditional information architecture is in place supporting common operational pictures across elements of the military force. Liaison with UN, coalition, and NGO entities involves Liaison Officers.

Under the functional hierarchy, functional elements in the force are teamed together under theatre-level functional commanders. Functional elements, including commanders, are mobile and deploy to wherever the focus of action in their functional areas is strongest. For example, the theatre J9 (civil military co-operation) is deployed to the refugee camps in the north and the Logistics commander deploys to the port (once it is taken). Only a small core staff remains in the afloat HQ while commanders can come and go as required, reaching back to their staff using the information network. Liaison Officers are used to help dispersed elements to synchronise. The J2 function is distributed, layered, networked, and robust, with a mixture of autonomous and human resources. Like other functions, elements are able to self-synchronise or be directed, can take multiple tasking inputs, and are supported by an info management and dissemination architecture that facilitates coordination and deconfliction of tasking and resource allocation. Dispersed elements across the force are empowered, within the limit of law, their national ROE and available resources to act and collaborate with peers to satisfy a declared command intent. This requires knowledge of relevant capabilities, intent and authority.

## EVOLUTIONS OF SCENARIO

Each C2 Approach was discussed in the context of the scenario and hypotheses were developed over how the scenario might evolve under each C2 Approach.

## STAFF FOCUS

Under the traditional hierarchy, the conventional staff structure will focus on the primary military mission and is less likely to think outside the box, about the emerging refugee crisis for example. Consequently it might be expected that less force will be available for the main effort due to being forced to divert resources to deal with the refugee crisis once it has fully developed. Under the functional hierarchy, the more collaborative

style of C2 empowers freer thinking of the J9 function (including LOs), which will be less constrained by the J3 main effort. This could allow direct negotiations to be started with SHAPE to enable pre-emptive actions to defuse the refugee crisis, for example by paying Lochland to keep the border open and enable the continued acceptance and care of refugees. Such early pre-emptive action might then leave more force available for the main effort.

## INTEGRATION OF PRE-OPERATIONAL ACTIVITIES

The traditional hierarchy applies to operational forces deployed with the Joint Force, but a different C2 structure, more like the functional hierarchy, applies to a range of pre-operational activities such as INT and IO across force structure. Applying the traditional hierarchy could result in elements that were previously working closely together now being fragmented across the force C2 structure, needing to re-focus onto serving their command node. This could lead to a loss of coherence in the early days of the operation, leading to discontinuity and possible conflict of actions. The functional C2 structuring enables smoother assimilation of functions such as INT, especially HUMINT, and IO from SF, etc. from pre-op actions into JFC structure, or into supporting roles outside the Joint Force structure.

## CO-LOCATION

In the traditional hierarchy, the various C2 functions are more dispersed in terms of footprint with possibly more and smaller groupings requiring greater operative load (e.g., force protection and sustainment). The functional hierarchy could allow more staff to be more co-located and afloat, easing logistic and force protection burdens, facilitating a more robust C2, although also an increased value as a target, due to the geographical concentration. The Reference Model has a well developed treatment of individual and team characteristics and behaviours that plays into the human dimension of co-location.

## “SURPRISE” EVENTS

Under the traditional hierarchy, surprise events require ISTAR reporting, checking, new plans, negotiation, authorisation of asset release, and dissemination of new orders. This is likely to mean better management of criticalities and coordination of activities, but slower and less appropriate responses to events. Under the functional hierarchy, a more widely shared appreciation of events and a willingness to allow low level tasking requests via links to distributed J2 and J3 cells allows lower level options generation. This may result in faster, more responsive resourcing and execution, but needs management of knock-on effects and bigger picture appreciation.

The case study took the last of these possible scenario evolutions, surprise events, and developed it further, but detailed a particular sequence of events related to the concept of network-enabled effects generation.

## STORY OF NET-EFFECTS EPISODE IN SCENARIO

The effect of the two C2 Approaches on the vignette concerning the Tetlovian incursion on the eastern border was developed by telling the story of the episode from the perspective of the C2 system. Within the vignette, an intelligence failure leads to Keswonian forces being surprised by the Tetlovian incursion, which threatens to over-run their positions.

Figure 10-3.3 illustrates how events unfold under the traditional C2 hierarchy. The Liaison Officer with the 1st Keswonian Regiment contacts JFHQ and reports the position, passing on a request for reinforcement. JFHQ immediately revises its plan and negotiates changes to the mission requirements with the CAOC and ARRC Division HQ. Each of these HQ issue revised tasking down their respective command chains resulting in coordinated air and land recce, manoeuvre, and strike missions to achieve the desired effect of repulsing and further deterring the Tetlovians.

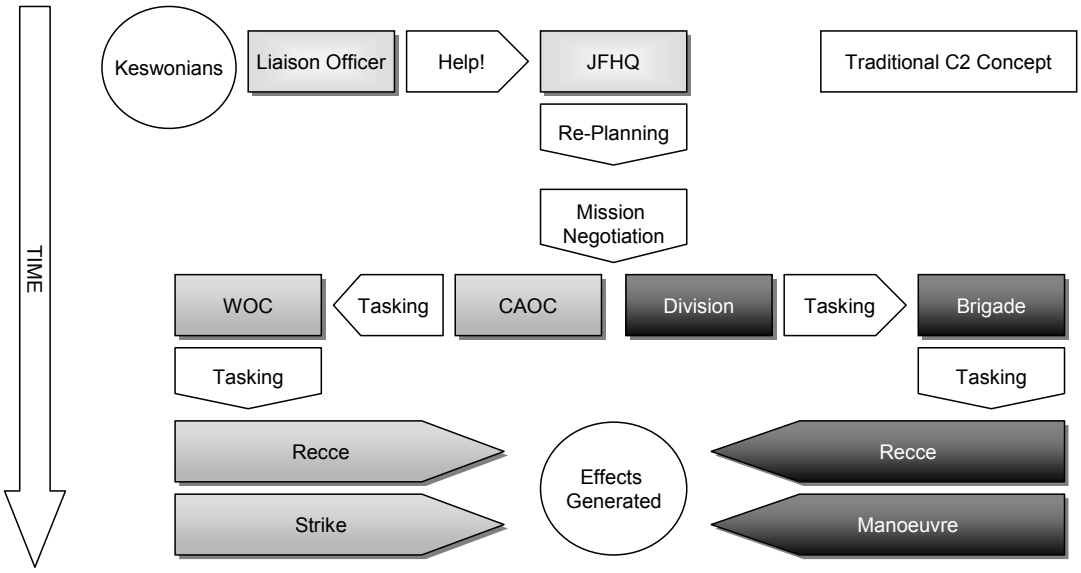


**Figure 10-3.3: Illustration of Course of Events in Tetlovian Incursion Vignette under the Traditional C2 Hierarchy Assumption.**

Figure 10-3.4 illustrates how the same situation might unfold under the alternative functional C2 hierarchy. The LO reports the situation to JFHQ, but is empowered to directly contact the Brigade HQ, which he knows from information on the network is in a position and has capabilities that could assist the Keswonians. The Brigade recognises that, while it can manoeuvre to stabilise the situation, it cannot do so quickly enough. However, the Brigade is aware of air component capabilities that could provide the rapid effect needed to fix the Tetlovians, thus allowing the Brigade to manoeuvre forces into a position to stop the Tetlovians and force them to retreat.

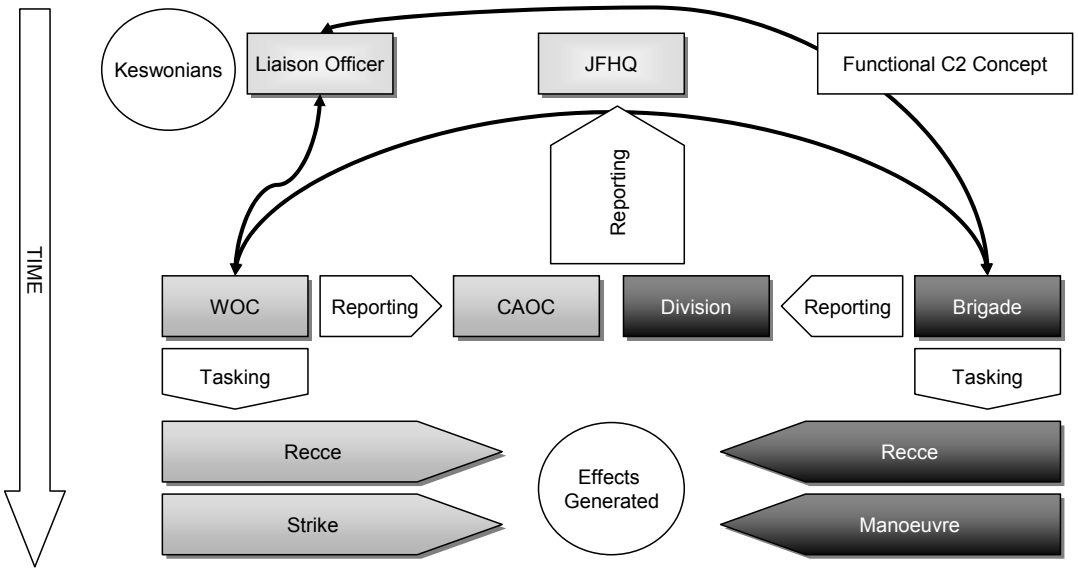


**Figure 10-3.4: Illustration of Course of Events in Tetlovian Incursion Vignette under the Functional C2 Hierarchy Assumption.**

The Brigade reports up to Division, but is empowered to contact the Wing Operations Centre directly to negotiate a coordinated tasking, The WOC reports to the CAOC, but is empowered to complete negotiations with the Brigade, liaising with the LO attached to the Keswonian regiment, and initiating tasking to recce and strike assets.

The anticipated result of the functional C2 hierarchy is that effects can be generated faster in response to surprise events, although this comes at the risk of disrupting higher level plans, and the higher formation HQ may need to countermand actions initiated lower down.

## RELEVANT VARIABLES

Consideration of the case study, including all the evolutions identified under the case study scenario, confirmed the significance of a wide range of the variables already in the Reference Model. This indicated that the study-specific model was not greatly reduced in complexity when compared with the Reference Model as a whole from which it was derived. This was somewhat surprising, but it is a finding confirmed by national work carried out in the U.K. in a similar context.

A number of gaps in the Reference Model were identified in covering the following areas:

- Formal vs. Informal “Organisation”;
- Vulnerability Variables (e.g., signature);
- Individual Experience;
- “Followship” (i.e., the complement to Leadership);
- Decision Rights (e.g., Rules of Engagement); and
- Competence with Autonomy.

Also, a number of areas were identified as needing refinement:

- Enhance Description of Trust;
- Extend Will to apply at multiple levels;
- Refine thinking on Information "Generators" (e.g., sensors);
- Refine thinking on Information "Movers" (e.g., Comms); and
- Move Variables into Physical Domain where appropriate.

## VARIABLE LINKAGES

Early attempts to do systematic manipulation of the Reference Model showed that it did not (then) have nearly enough completeness of variable linkage to sustain such rigorous manipulation. In order to explore the extent of this incompleteness and test the correctness of the links between variables in the Reference Model, a study-specific network of variables was created. This study-specific network was then compared with the Reference Model to identify missing links and variables. Figure 10-3.5 illustrates both the study-specific variables and linkages (abstracted from the scenario evolution discussion outlines above and coloured blue in the figure) with the Reference Model equivalent variables and linkages (coloured in black).

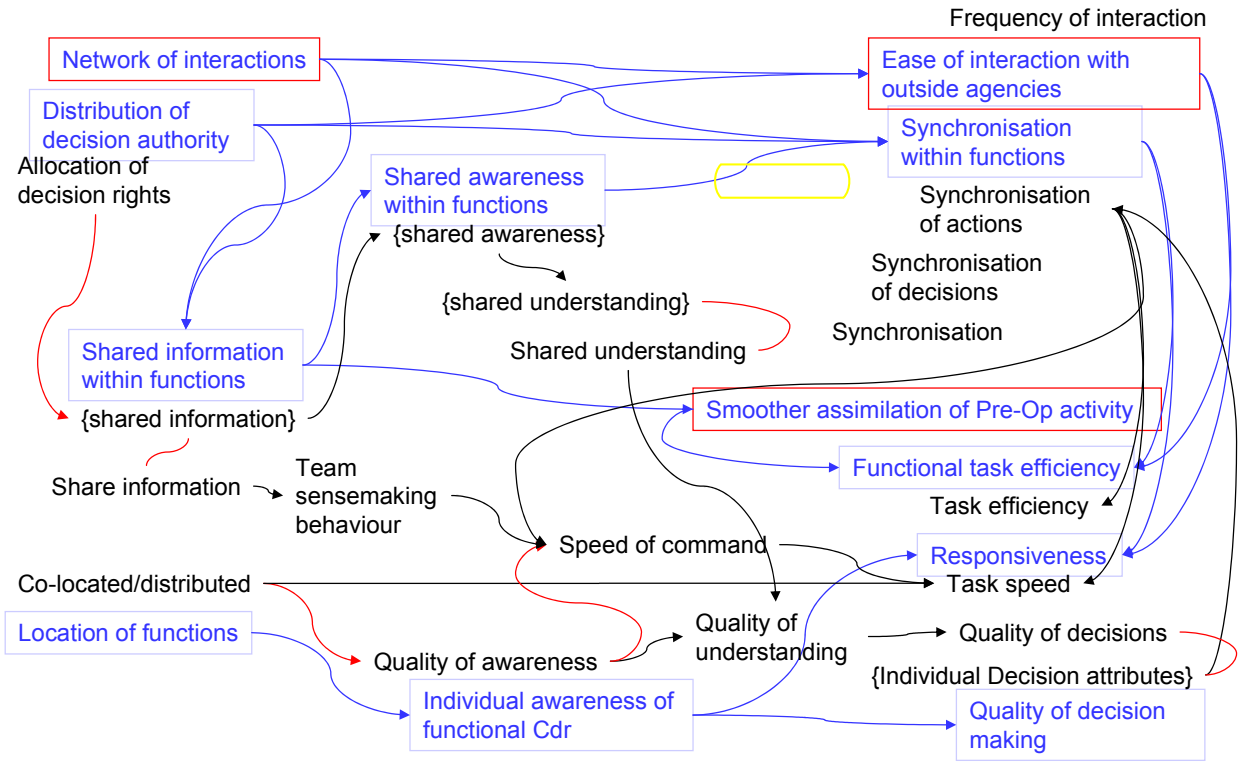


**Figure 10-3.5: Example of a Comparison between a Study Specific Network of Variables and Linkages (coloured blue) and the Equivalent Variables and Linkages from the Reference Model (coloured black). Missing variables and links, i.e. those in the case specific model but with no equivalent in the Reference Model, are coloured or outlined in red.**

Missing variables and links (i.e., ones in the study-specific model but with no equivalent in the Reference Model) are outlined or coloured in red. This exercise was carried out for more than one of the scenario evolution areas discussed above, indicating many gaps.

## RESULTS

Case Study 1 demonstrated that the Reference Model contained the majority of the variables needed to describe the different C2 Approaches considered, but that it needed more development in terms of completing the map of linkages between those variables if it was to be capable of sustaining rigorous analysis.

The case study demonstrated the power of rigorous systematic analysis and the value of having a well formed Reference Model to sustain it.

The case study indicated that the type of C2 problem for which the Reference Model was being developed might not be reducible to a small number of key variables and relationships, presaging the need for rigorous and systematic methods of use for the RM.