Supporting defence foresight analysis with Cognitive Work Analysis: Is it applicable, helpful, and practical?

Penelope Sanderson¹, Maureen Hassall², and David Crone³

¹School of Psychology, The University of Queensland, Australia
²Minerals Industry Safety and Health Centre, The University of Queensland, Australia
³Joint and Operations Analysis Division, Defence Science and Technology Organisation, Australia

1. Introduction

Foresight analysis is conducted by many science and technology advisory bodies in order to guide future resourcing and planning. Foresight analysis is usually concerned with anticipating technical, economic, social, and political changes that might threaten security or provide opportunities to gain strategic advantage (Crone & Gartner, 2013). Defence organisations are concerned with foresight analysis in order to resource and manage national readiness for potential future threats and to reduce surprise.

There are many different methods for foresight analysis, but none by itself covers all needs. Cognitive Work Analysis (CWA) is an approach to the analysis of complex sociotechnical systems that focuses on identifying the factors that shape or constrain human activity (Vicente, 1999). CWA might assist foresight analysis by helping analysts speculate how constraints and opportunities could change over time.

CWA has five phases that identify different shaping and constraining factors: the domain in which the work takes place (Work Domain Analysis); the activity that must be carried out for the domain to function (Control Task Analysis); the strategies possible for carrying out the activity (Strategies Analysis); the ways work can be organized between individuals and teams (Social and Cooperation Analysis); and the competencies that individuals must have (Worker Competencies Analysis).

CWA has already been used widely in defence, and its outputs have been used to guide the design of new systems, which is in itself involves prediction (Naikar, 2013; Jenkins et al., 2009). However CWA has not been used for predictions extending 10 years and beyond (Benda & Sanderson, 1998; 1999). Our objectives for this project therefore were threefold: first, to identify whether CWA is applicable to foresight analysis; second, to determine whether it is helpful to foresight analysis; and third, to determine whether it is practical for foresight analysis.

2. Methods

Our methods included (1) developing “background” CWA analyses that foresight analysts could annotate with their predictions, (2) developing prototype CWA-based processes to specify the steps that analysts should take when performing foresight analysis, (3) conducting three workshops with Defence Science and Technology Organisation (DSTO) scientists who used the prototype CWA-based processes to perform foresight analysis, and (4) analysing outputs and comments from the workshops to address our three objectives. The workshop participants worked in small teams, systematically using the CWA-based processes to annotate the background CWA analyses with their foresight inferences, before taking part in final plenary discussions.

For the first two workshops we focused on testing the applicability and helpfulness of the CWA-based process itself for foresight analysis, rather than on the immediate relevance or plausibility of the future technology being explored. In the first workshop we explored how the Work Domain Analysis and Control Task Analysis phases of CWA could help participants predict the impact of teleportation on Australia’s national security. In the second workshop we explored how the Strategies Analysis, Social Organisation and Cooperation Analysis, and Worker Competencies phases might help analysts determine the impact of telepathy on platoon operations.
In the third workshop we selected a capability of current interest to DSTO, bionic vision, and we focused on evaluating a foresight method based on multiple stakeholder perspectives on bionic vision (stakeholder Work Domain Analyses). At the end of each workshop we conducted a plenary discussion with participants, and collected the foresight analyses they had produced.

3. Results
An examination of the foresight analyses produced, and an analysis of participants’ comments at the end of each workshop, indicated that participants were able to use the background CWA analyses and the proposed CWA-based process to make foresight inferences. However, CWA does not provide “analytic templates” for handling the evolution or impact of constraints over different timeframes, or successive intervals of time, and participants noted the lack of tools for representing timeframes. In the third workshop, basic templates were created to represent timeframes, but further development would be needed.

Participants reported that the background CWA analyses let them move quickly to thinking broadly about the impact of new technologies. The stakeholder Work Domain Analysis approach used in the third workshop proved to be especially powerful for producing foresight predictions. However, participants noted that because the workshops were shorter than normal foresight sessions, lacked technical subject-matter experts, and were generally not motivated by a pressing national question, it was not possible to fully assess the helpfulness of the CWA-based method for providing advice to DSTO clients.

In the first workshop, participants raised concerns about the sustainability of the process, but by the third workshop, participants who had attended all three workshops recognized it would be relatively easy to preserve and evolve the background CWA analyses so that they could support new foresight problems.

4. Discussion
In summary, the outputs of the workshops suggested that CWA has potential as an applicable, helpful, and practical method for foresight analysis, especially if complemented by other methods. Different foresight questions may benefit from input from different phases of CWA, but it is not yet determined how analysts would select the most appropriate phase to emphasize. Further streamlining of CWA-based foresight processes is required before it is a fully helpful and practical adjunct to existing foresight methods.

References