

How to assess team performance in terms of control

**- A cognitive systems engineering
based protocol**

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Abstract

This report presents a protocol for assessing team performance in terms of control based on cognitive systems engineering theories. The protocol changes the focus of team performance assessment from good and bad behaviours towards the team's activity. By using Hollnagel's contextual control model (COCOM) a protocol is developed so that team activity can be categorised into four control modes. Data is collected through observation and questionnaires and is analysed in time intervals. Each time interval is then given a control mode. Based on how the control mode changes over time the performance of the team can be assessed. The protocol was tested in a pilot study where commanding staff exercises were analysed. The results show that the protocol can be used to identify differences in team performance. The study also gives empirical validity to COCOM in that the loss of control in emergencies corresponds to an opportunistic or a scrambled control mode.

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Hanna Palmqvist

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Summary

Today when teams are used to solve more or less complex tasks in various situations it has become important to assess how the teams are performing. This is traditionally measured with behavioural markers where performance is rated by assessing cognitive aspects of behaviour, among other things. The performance is then categorised on a scale from poor to outstanding. The problem is, according to cognitive systems engineering (CSE), that cognitive aspects cannot be observed and this would make them difficult to measure objectively and include in the assessment.

In this dissertation, the work of developing a protocol for assessing team performance in terms of control is presented. The protocol is based on the theories of CSE in general and on the contextual control model (COCOM) in particular. The protocol changes the focus of team performance assessment from good and bad behaviours towards the team's activity and the focus is on control and not on the attitudes of the individual.

The process for the development of the protocol started with the definition of the purpose of the protocol. This was followed by the formulation of design criteria and the protocol was then developed based on these criteria. The result is a protocol with the purpose to provide an assessment of team performance based on the theories of CSE. COCOM forms the theoretical basis of the protocol and the theory suggests that team activity can be categorised into four control modes: strategic, tactical, opportunistic and scrambled. These modes vary in terms of subjectively available time, the degree of planning, the evaluation of outcomes and number of goals, among others.

When using the protocol, teams are video and audio recorded while working in their natural environment. After the session the teams answer a questionnaire regarding some of the COCOM parameters. The video and audio recordings and the questionnaires are then analysed by the evaluator in shorter time intervals with respect to COCOM parameters. Thereafter, each time interval is given a control mode and the team performance can be assessed based on how the control modes change over time according to the following alternatives:

- The team moves to a lower control mode and does not return to the higher level.
- The team moves to a lower control mode and returns to the higher level.
- The team maintains the same control mode during the entire session.

- The team moves to a higher control mode, maintains it and did not move to a lower control mode earlier in the session.

The protocol was tested in a pilot study conducted at MSB College Revinge in Sweden where commanding staff exercises were analysed and the performance of the teams assessed. The results show that the protocol identifies differences in performance in terms of changes in control mode and that teams have more control over a situation when they have practiced. The study also gives empirical validity to the theories of COCOM in terms of that the loss of control in emergencies corresponds to an opportunistic or a scrambled control mode and that scrambled and strategic control modes should be less frequent in general.

Sammanfattning (summary in Swedish)

Idag när team används för att lösa mer eller mindre komplexa uppgifter i olika situationer har det blivit viktigt att kunna bedöma hur teamen presterar. Detta mäts traditionellt med beteendemarkörer genom att prestationen bedöms genom bland annat värdering av kognitiva aspekter av beteendet. Prestationen kategoriseras sedan på en skala från dåligt till utomordentligt. Problemet, enligt cognitive systems engineering (CSE), är att kognitiva aspekter inte kan observeras och detta gör dem svåra att mäta objektivt och inkludera i bedömningen.

I denna rapport presenteras arbetet med att utveckla ett protokoll för att bedöma teams prestationer i med hjälp av begreppet kontroll. Protokollet baseras på teorier inom CSE i allmänhet och på the contextual control model (COCOM) i synnerhet. Protokollet flyttar fokus i bedömningen av teams prestationer från bra och dåliga beteenden till teamets verksamhet. Fokus ligger på kontroll och inte på individernas attityder.

Processen med att utveckla protokollet började med att protokollets syfte definierades. Detta följdes av att designkriterier formulerades och därefter utvecklades protokollet med utgångspunkt från dessa. Resultatet är ett protokoll med syfte att ge en bedömning av teams prestationer baserat på teorierna från CSE. COCOM utgör den teoretiska basen för protokollet och teorin föreslår att teams verksamhet kan kategoriseras i fyra grader av kontroll (control modes): strategic, tactical, opportunistic och scrambled. Gradera varierar med bland annat subjektivt tillgänglig tid, graden av planering, utvärdering av resultat och antalet mål.

Protokollet används genom att teamet filmas när de arbetar i sin naturliga miljö. Efter sessionen får teamet besvara en enkät angående några av COCOM-parametrarna. Inspelningarna och enkäten analyseras sedan av utvärderaren i kortare tidsintervall med hänsyn till COCOM-parametrarna. Därefter tilldelas varje tidsintervall en kontrollkategori och teamets prestation kan bedömas baserat på hur kontrollnivån ändras över tiden enligt följande alternativ:

- Teamet sjunker till en lägre kontrollnivå och återvänder inte till den högre nivån.
- Teamet sjunker till en lägre kontrollnivå och återvänder till den högre nivån.
- Teamet behåller samma kontrollnivå under hela sessionen.
- Teamet når en högre kontrollnivå, stannar där och sjönk inte heller till en lägre kontrollnivå tidigare under sessionen.

Protokollet testades i en pilotstudie på MSB Revinge där stabsövningar analyserades och teamens prestationer bedömdes. Resultaten visar att protokollet identifierar skillnader i prestationer uttryckt i kontrollkategorier och att team har mer kontroll över en situation när de har övat. Studien ger också empirisk validitet till COCOM-teorierna genom att bekräfta att förlust av kontroll i ett nödläge motsvaras av opportunistisk eller scrambled grad av kontroll och att scrambled och strategic kontroll generellt sett sällan förekommer.

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Chapter 1 • Introduction

This master's dissertation is written as a part of the Fire Safety Engineering (B.Sc.) programme and Risk Management and Safety Engineering (M.Sc.) programme within the Department of Fire Safety Engineering and Systems Safety at The Faculty of Engineering at Lund University (LTH), Sweden.

The work is a contribution to a current research project at Lund University.

1.1 Background

Today teams are used to a greater extent to solve more or less complex tasks in various situations. The reason for this might be a belief that the extended capacity of a team will result in better decisions and safer performance than the performance of a single individual. Another reason could be that interindividual motivation could promote collaboration. There is a belief that there are only gains from team work, such as higher productivity. But in reality, many teams fail for any number of reasons and this, in addition to the great reliance on teams, makes it important to be able to assess how the team performs (Salas & Fiore, 2004).

Other reasons for team performance assessment are evaluation of the results of implementing new technology in a field or evaluation of the effects of training. Traditionally team performance is measured with behavioural markers (cf. Flin, O'Connor & Crichton, 2008) and the performance and behaviour of each team member is assessed separately. In this view the reasons as to why a person acts a certain way lies in the person's mind and team performance assessment is about trying to describe the functioning and structure of something that cannot be seen. This is difficult, if not impossible, and therefore other measures have to be used.

The most common way to study human behaviour is by describing how a person responds to stimuli, the so called S-O-R framework. The human being is constantly being exposed to large amounts of stimuli and responds in various ways in order to try to stay in control of the events occurring. The human mind and mental processes are considered to be explained by sensory input, motor

behaviour and mental state. This view corresponds to seeing the human as an information processing system (IPS) (Hollnagel & Woods, 2005).

But according to Hollnagel and Woods (2005) there is a fundamental error in this view because human behaviour cannot be understood without taking into consideration the context or situation in which it takes place, which some researchers try to do by analysing human behaviour in a laboratory. Stimulus and response are not separate entities but interdependent factors. In the cognitive viewpoint it is stated that two persons may have different models of the world. This results in different ideas of what is important as well as different knowledge and expectations. The cognitive viewpoint also describes human behaviour as cyclic as in that human action is determined by context and cognition. Compared to the sequential stimulus-response view, human behaviour does not have to start with a stimulus and end with an action. Thus, an observable action does not need to have an observable event as a cause and an observable event does not necessarily lead to an observable reaction. With this view, there was a development from seeing the processes that generates behaviour as “cognition in the mind” to “cognition in the world” where the environment and influences from other people, artefacts and systems affect the behaviour of humans. But this view does not offer a method on how to practically assess team performance, or even a definition of what team performance is.

Cognitive systems engineering (CSE) changes the view from seeing individuals and artefacts, ranging from a hammer to autopilot, as separate parts of a system or a team to seeing them as a joint agency. Of course, the individuals and artefacts are still physically separated but not functionally. CSE finds it more important to describe the functioning of a joint cognitive system (JCS) rather than seeing the parts as separate entities only interacting with each other. Also, in CSE it is more important to understand what a JCS does and why it does it, rather than to explain how it does it (Hollnagel & Woods, 2005).

An important aspect of CSE is that all work is seen as cognitive. The fact that many things can be done without being aware of them does not make them non-cognitive. The difference between tasks can rather be seen as that different levels of control are needed for the various performances. The focus is therefore shifted from cognition to coagency and how control of a situation can be maintained. How a JCS remains control of what it does can be described by a cycle, which offers a good base to study human coagency and team control because:

- Actions are seen together – actions build on previous actions and anticipate future actions.
- Focus is on anticipation as well as response – performance depends on what went on before and what is expected to happen.

- Users are seen as parts of a whole – there is focus on coagency and how actions and events are mutually dependent.
- Influence of situation or context is direct – context can affect the user's way of working.
- Models are functional rather than structural – the emphasis is on performance rather than internal processes (Hollnagel & Woods, 2005).

There is an intimate connection between losing control and the occurrence of unexpected events. This is because control is closely related to having sufficient time, knowing what has happened and what happens, having a limited task load and clear alternatives and capacity to evaluate and plan (Hollnagel & Woods, 2005). It would therefore be possible to assess team performance in escalating situations in terms of control.

1.2 Objectives and research questions

The main objective of the work presented in this dissertation was to develop a protocol to assess team performance in terms of control. In order to achieve this, the following research question was answered:

- How can team performance be assessed in terms of control?

To facilitate the work, the main research question is divided into five sub research questions:

- What is a team?
- What is performance?
- What is control?
- Which aspects of control are relevant for assessing team performance?
- How can these aspects of control be measured?

1.3 Expected results

The expected results from the work can be divided into two categories: academic contributions and practical contributions.

The expected academic contributions of the work were:

- An application of the CSE theories.
- A review of the definition of control and performance and how the CSE approach can be applied on team performance assessment.

- A change in the focus of team performance assessment from good and poor behaviours towards the team's activity.

The expected practical contributions of the work were:

- A development of a language based on the CSE approach to capture the team's work and performance.
- A proposition of a protocol to assess team performance from a CSE approach with focus on control and not on the attitudes of the individual.

1.4 Limitations

The protocol for assessing team performance that is presented in this work was limited to be used for assessing team performance in an environment which easily could be surveyed such as a simulator or in a room or enclosure. The protocol was developed to measure how team performance is affected by escalating situations, but can be used under normal conditions as well.

The protocol was intended to be used in various fields where team performance assessment could be of interest, such as aviation, fire services and health care. However, in the work presented here the protocol was only tested in a fire service environment. The time available for the work limited the number of pilot studies that could be carried out. A fire service environment was chosen mainly because of the author's previous knowledge of the fire service field, which considerably facilitated the pilot study.

Chapter 2 • Method

In this chapter, a short introduction to the methods and techniques used in the work is given.

2.1 Literature studies

The focus of the literature studies was the sub research questions as they formed the basis of the protocol development. Literature relating to for instance cognitive systems engineering (CSE), teams, joint cognitive systems (JCS), the contextual control model (COCOM), method development and data collection techniques was searched for in electronic databases such as ELIN (Electronic Library Information Navigator) at Lund University and search engines such as Google Scholar. Libraries in Lund and in other parts of Sweden have been another source for literature search. Cross-references were also used and seminal works in the field of CSE were provided by the supervisors.

The results from the literature studies regarding CSE, teams, JCS and COCOM are presented in Chapter 3

2.2 Protocol development

A protocol for assessing team performance in terms of control was developed starting from the information retrieved in the literature studies. The process for designing the protocol was retrieved from Abrahamsson (2009).

By using a systematic design process, the aim was to develop a transparent and reliable protocol. Of course, it would be of most interest to find the optimal protocol, but this was regarded as too challenging in the development process. Instead, the focus was to find a satisfactory protocol, which was done with the establishment of design criteria.

The protocol design therefore consisted of three steps:

- Purpose of the protocol.
- Design criteria.
- Construction of the protocol.

In the first step, the purpose of the protocol was defined explicitly. The next step, defining design criteria, was of great importance as the design of the protocol had to conform to these. Thus, they governed the actual construction of the protocol. When the design criteria had been established, the actual construction of the protocol took place.

The development of the protocol is presented in Chapter 4.

2.3 Pilot study

The developed protocol was tested in a pilot study conducted at MSB (Swedish Civil Contingencies Agency) College Revinge in Sweden. The school provides training, drills and development in the field of societal safety and readiness, especially for fire fighters and fire officers. The results from the pilot study were then used to analyse the developed protocol. Based on the analysis, suggestions were given to how the protocol could be further developed so that the design criteria could be fulfilled.

The studied training sessions were four commanding staff exercises which took place at MSB College Revinge on May 17, 18 and 19 2010. The exercises were a part of a nine week course for fire officers¹, of which one of the weeks were dedicated for commanding staff lectures and exercises.

The tasks of a commanding staff and how these exercises are carried out at MSB College Revinge applied well to the developed protocol. They took place in a training environment in a relatively confined enclosure, which facilitated the survey. Also, the scenarios used in the exercises were escalating situations that were intended to affect the performance of the participants.

The pilot study is presented in detail in Chapter 5.

¹ In Swedish: Kurs B - Räddningsledning

Chapter 3 • Theoretical framework

This chapter presents an overview of the research area of team performance and control. The purpose is to identify concepts and a language to be used in the development of a protocol to assess team performance in terms of control.

3.1 Teams and joint cognitive systems

A team is composed of members with high task interdependency and shared common goals. To accomplish their mission the team members have to coordinate and cooperate as task demands shift throughout a performance episode (Salas, Cooke & Rosen, 2008). A group does not qualify as a team if it is too large or short lived (Hackman, 1998). Teams traditionally only consist of human members. In settings where humans, machines and technologies (artefacts) work together, the entities are usually modelled separately and the interaction between them is of primary importance (Hollnagel, 2002a). However, in cognitive systems engineering (CSE) a team is equal to a joint cognitive system (JCS) that can consist of both humans and artefacts (Hollnagel, 1999) and the focus is on the function of the entire system rather on the interaction between the parts of the system (Hollnagel, 2002a).

A cognitive system is defined as a system that can modify its pattern of behaviour on the basis of past experience in order to achieve its goals (Hollnagel, 1999). Thus, a cognitive system's behaviour is goal directed and its actions are controlled (Hollnagel, 2002a; Hollnagel & Woods, 1999). It is adaptive and able to view a problem in more than one way and also uses knowledge about itself and the environment to plan and modify its actions (Hollnagel & Woods, 1999). A cognitive system is defined by what it does rather than what it is (Hollnagel & Woods, 2005).

A consequence of the CSE definition of a team is that it becomes important to define the boundaries between the JCS and the environment. The boundary depends on the function of the JCS rather than on the composition of the system and has to be defined for every system and analysis. Two principles for deciding whether parts should be included in the system or not are (i) they should be

included if they represent a significant source of variation for the JCS and (ii) they should be included if the JCS can control them in a way that affects the outcome (Hollnagel, 2002a).

3.2 Team performance and control

Team performance is the process in which team members manage their individual and team level task work and teamwork. Individual task work is a team member's performance that does not require interdependent interaction with other team members (Salas, Cooke & Rosen, 2008). Team level task work and teamwork are the processes of sharing information and the coordination of activities that the members engage in (Thiruvengada & Rothrock, 2007).

According to the Oxford English Dictionary (2010b) performance is defined as the accomplishment of something undertaken. In CSE the ability of the JCS to achieve its goals and functions is a matter of control, hence the ability to stay in control is closely related to the performance of a JCS (Hollnagel & Woods, 2005).

Control can be defined as the function or power of directing and regulating something (Oxford English Dictionary, 2010a). CSE defines control as the ability to prevent unexpected conditions from occurring, as well as to effectively recover from them if they occur. In order to accomplish this, the system must be able to perceive that something unexpected is about to happen. Humans are actively searching for and selecting information and perception is therefore active and guided. This active seeking can sometimes result in wrong information being found and thereby in wrong actions.

JCS performance, how the system maintains control of what it does and the necessary steps for that can be illustrated by a cycle, see Figure 3-1. The controller has a goal and takes actions based on an understanding (a construct) in the effort to achieve or maintain control over the system. These actions generate responses from the system and the responses serve as feedback to the controller.

In this cyclic view actions are seen together, there is focus on anticipation as well as response, the users are seen as part of a whole, the influence from the context is direct and the emphasis is on performance rather than on internal processes. These factors make the cyclic view a good base for studying a JCS (Hollnagel & Woods, 2005).

In the cyclic view, actions generate feedback that can be used to adjust future behaviour so that control can be maintained. But feedback control is not applicable if it takes too much time to analyse or if the process changes rapidly. In this case, feedforward has to be used. Feedforward means acting on an expected

disturbance before it has occurred. But this requires that the system has a good representation of the process and is able to predict what will happen. It is difficult to anticipate occurrences in the far future and therefore a combination of the two methods is optimal.

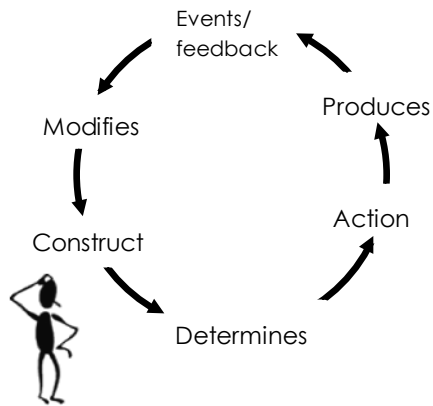


Figure 3-1. The cyclic view of control and JCS performance which also is the base for the contextual control model (COCOM). Adapted from Hollnagel and Woods (2005, p. 20) with permission.

One way to describe JCS performance as a mixture of feedback and feedforward is the contextual control model (COCOM), presented by Hollnagel and Woods (2005). The model is based on competence and control. Here control characterises the orderliness of performance and can be described using four control modes: the scrambled mode, the opportunistic mode, the tactical mode and the strategic mode.

The scrambled control mode is the least efficient and the strategic is the most efficient. JCS performance is in general likely to be a mixture of the opportunistic and the tactical control modes. Control can be described as the ability to maintain a control mode despite disturbing influences, as well as the ability to regain a control mode if control has been lost. Available time is a main influence on control modes and loss of available time can be caused by unexpected events. When there is not enough time it becomes more difficult to make predictions and feedforward and feedback control are impeded. Other conditions that cause lack of control are lack of knowledge, lack of competence and lack of resources. Lack of knowledge and competence includes not knowing what has happened, what is happening and what will happen as well as not knowing what to do. Thus, loss of control is a question of losing goals or selecting inappropriate goals (Hollnagel & Woods, 2005).

As in COCOM, where control was characterised by the orderliness of performance, coordination can also be seen as the orderliness of actions carried out in the JCS. Coordination is based on feedback and feedforward mechanisms and failures in coordination results in the loss of control to some degree (Henriqson, van Winsen, Saurin & Dekker, in press). Thus, there is a connection between coordination and performance through control. This is in line with the definition of team performance provided by Thiruvengada and Rothrock (2007) where coordination of activities is seen as an important aspect. According to Klein, Feltovich, Bradshaw and Woods (2005) effective coordination is a result from mutual predictability, directability and common ground.

Mutual predictability. Coordination depends on the ability to predict the actions of other parties with a reasonable degree of accuracy. Every team member also has a responsibility to make his or her actions predictable for others. The mutual predictability is greatly increased when the parties can take on the perspective of the others (Klein et al., 2005).

Directability. Team members must have the capacity for deliberately assessing and modifying other members' actions as conditions and priorities change. The participants must also response adequately to the influence of other parties (Klein et al., 2005).

Common ground. Common ground is the most important basis for mutual predictability and involves pertinent mutual knowledge, beliefs and assumptions that team members share. Common ground permits team members to use abbreviated forms of communication and still be confident that the message will be understood. Without common ground there would be large coordination costs when every detail in a message would have to be thoroughly explained and confirmed. This is also the most frequent reason as to why teams lose common ground: they fail to monitor confirmation of messages and get confused over who knows what. This confusion is often referred to as the fundamental common ground breakdown. An example of the fundamental common ground breakdown is:

- Party A believes that Party B possesses some knowledge.
- Party B does not have this knowledge and does not know he is supposed to have it.
- Therefore, Party B does not request it.
- This lack of a request confirms to Party A that Party B has the knowledge.

As a result, they fail to catch the mismatch in their beliefs about what Party B knows and is supposed to know (Klein et al., 2005).

3.3 Choice of control theory for the protocol

From the different concepts of control related to team performance presented above, COCOM was used as a basis for the protocol development in this work. The model offers a definition of what control is (the ability to maintain a control mode) and thereby also a definition of what characterises loss of control. In CSE control is closely related to JCS and team performance. By using COCOM performance can be characterised. The model also provides concrete language and definitions of the four control modes, which makes the model easy to use when categorising the control of a JCS. Finally, it has been shown that team behaviour reliably can be categorised into the four control modes, which indicates that it could be used to assess team performance (Stanton, Ashleigh, Roberts & Xu, 2001). The model is further elaborated below.

3.4 The contextual control model (COCOM)

The contextual control model (COCOM) implies that actions are determined by the context. The opposite is the procedural prototype model that expresses that there are predefined sequences of actions, which represent a more natural way of doing things than others. At any given time, the next action can be found by referring to the ordering of actions implied by the prototype. Thus, there is a focus on prescribing what performance ought to be and much effort is spent on determining the extent to which actual performance complies with the prescribed performance (Hollnagel, 1993a). According to COCOM it is not possible to determine the next action in regard to the previous as it is based on the current conditions of the situation (Hollnagel, 1993b).

As stated above, COCOM is based on competence and control, which also is shown in Figure 3-2. The main advantage from separating these two is that it makes it possible to consider each aspect by itself. The model of competence is necessary because a person or a JCS has certain competences which are applied according to the current needs and demands. There are numbers of possible actions in a situation but some of them may be more readily available than others because of training or experience. An action cannot be carried out if it is not available as a possible action (Hollnagel, 1993a). However, the focus of this work is control and in COCOM the control part of the model is about how the choice of the next action is controlled. Control is based on planning what to do, which in turn is influenced by the context as well as by knowledge and expectations about how the situation is going to develop (Hollnagel, 1993b).

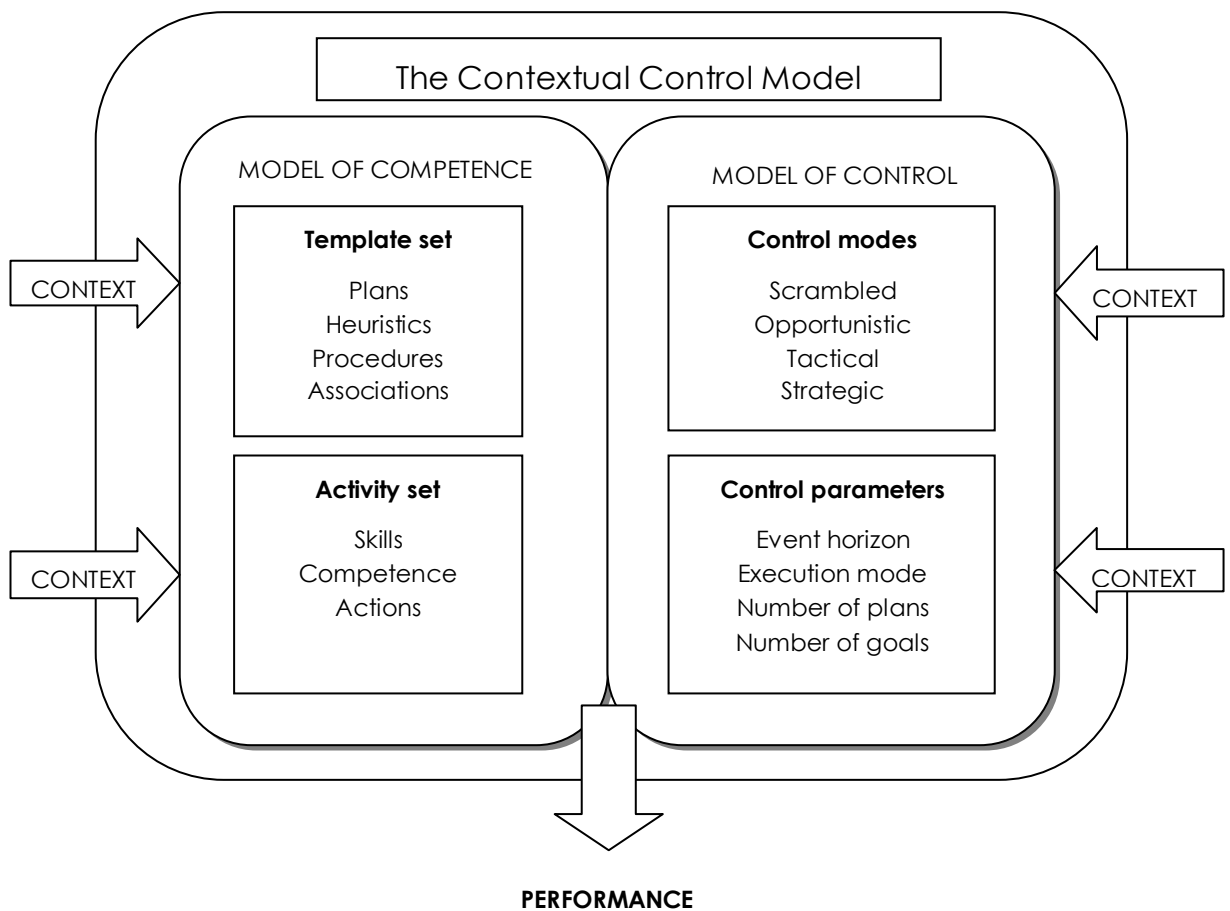


Figure 3-2. An overview of the contextual control model (COCOM). Adapted from Hollnagel (1993c, p. 381) with permission.

Another important factor of control is the available time and control may easily break down when time is too short. According to Hollnagel (2002b), time and control are important to consider when performance is being assessed. These aspects are also the most important in COCOM. Other factors can influence performance, such as emotions, motivation and learning but Hollnagel neglects these with the explanation that they are difficult to deal with.

In COCOM a distinction is made between four control modes: scrambled, opportunistic, tactical and strategic. The four modes are only points in a continuum of control but the assumption is that the differences between modes will be larger than the differences within the modes. The modes differ with respect to how far ahead planning is made, how detailed the feedback is evaluated and the number of goals that are being considered at the same time (Hollnagel, 1993c). Knowledge of the past is another important factor for determining the

control mode, as it is important for the ability to identify disturbances. Two main influences on these parameters are the ability to make prediction about the future, in order to plan what to do next, and to make decisions about future actions and also the subjectively available time, see Figure 3-3 (Hollnagel & Woods, 2005).

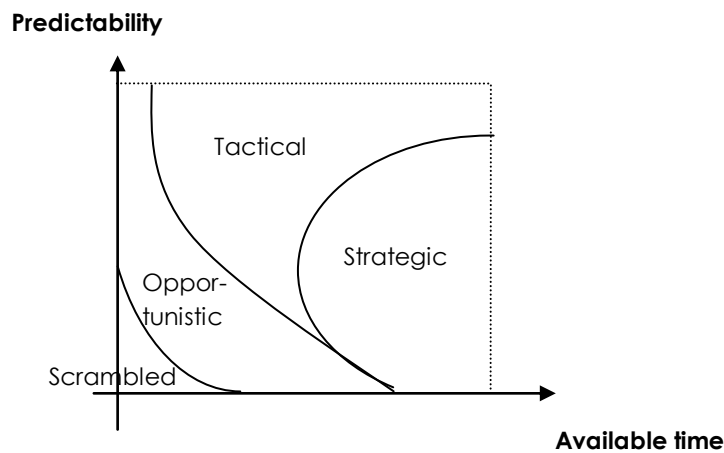


Figure 3-3. The four control modes can be determined by the available time and the JCS's ability to make predictions about future events. As shown, the relationship between the parameters is not simple. Adapted from Hollnagel (2002b, p. 150) with permission.

3.4.1 The scrambled control mode

In the scrambled control mode the choice of the next action is completely unpredictable or haphazard and there is little or no reflection involved. The performance is rather blind trial-and-error. There is little or no correspondence between the situation and the actions. The scrambled control mode borders on the extreme condition of zero control (Hollnagel, 2002b). The goal is a very basic one, such as maintaining physical integrity, escaping from a threatening environment or obtaining a basic substance (such as oxygen). The mode may not be frequently occurring but it is necessary to include as an anchor point (Hollnagel, 1993a).

3.4.2 The opportunistic control mode

The opportunistic control mode is opportunistic in the sense that chances are taken, because there is no time or possibility to do anything better. The choice of the next action is determined by salient or dominant features of the current context, rather than on goals or planning. An example would be a situation where a powerful indicator, for example an alarm, appears. This will attract the system's attention and the action will be chosen in accordance with that, without considering whether this might interrupt ongoing plans. Actions can also be chosen because they generally are the most frequently used, regardless of their

appropriateness in the particular situation. The mode is applied when there is lack of knowledge or expertise and there is only little planning or anticipation. The system might know of or have access to plans, but does not apply them. A realistic scenario for the opportunistic control mode is a situation of functional fixation². It may be found both during diagnosis, when candidate explanations are generated in a seemingly haphazard manner and in remedial action or recovery where alternatives are tried without any greater consistency (Hollnagel, 1993a).

Characteristics of the opportunistic mode are:

- There is not enough time to fully assess the situation.
- The first minimally acceptable decision alternative is accepted and implemented.
- The most salient cues often gain the most attention.
- Information seeking is limited to necessary and salient information.

(Feigh & Pritchett, 2006)

3.4.3 The tactical control mode

In the tactical control mode, the choice of the next action is based on planning, although the time horizon is of limited range. The performance more or less follows a known procedure or rule. If a plan is frequently used, performance may seem as if it is based on a procedural prototype but the regularity is due to the similarity of the context rather than by the inherent nature of performance (Hollnagel, 1993c; Hollnagel, 2002b). It is typical that a system will be in the tactical control mode for long periods of time and the mode corresponds to “normal” performance (Hollnagel, 1993a).

Characteristics of the tactical mode are:

- Actions are determined according to a general pattern or procedure.
- There is sufficient time to assess the situation and use a procedure.
- The amount of information sought is beyond what is immediately observable, but may not be beyond what the routine procedure requires.
- Information is taken from a limited set of preferred sources.
- The procedure may not include evaluating of the outcome from the previous activity to determine the next action.
- The decision alternatives may not be fully evaluated.

(Feigh & Pritchett, 2006)

² Functional fixation prevents us from thinking of a different use for an object that already has a particular use.

3.4.4 The strategic control mode

In the strategic control mode the JCS has a longer time horizon and can look ahead at higher-level goals. The performance is therefore less likely to be influenced by the dominant features of the context or by what just happened (Hollnagel, 2002b). Plans will be used in a flexible manner and serve as guidelines rather than as direct templates. As with the scrambled control mode, the strategic control mode is not frequently occurring (Hollnagel, 1993a).

Characteristics of the strategic mode are:

- The JCS have time to fully assess the situation, without the need for much information filtering.
- Decision alternatives are compared more thoroughly than in other modes to make the best decision possible.
- The amount of sought information is extensive.

(Feigh & Pritchett, 2006)

The main characteristics of the four control modes are summarised in Table 3-1.

Table 3-1. Characteristics for the four control modes in terms of number of goals, available time, evaluation and how actions are selected (Hollnagel & Woods, 2005, p. 148)

Control mode	Number of goals	Subjectively available time	Evaluation of outcome	Selection of action
Strategic	Several	Abundant	Elaborate	Based on models/predictions
Tactical	Several (limited)	Adequate	Detailed	Based on plans/experience
Opportunistic	One or two competing goals	Just adequate	Concrete	Based on habits/association
Scrambled	One – not necessarily task relevant	Inadequate	Rudimentary	Random

The scrambled control mode is in general the least efficient and the strategic is the most efficient. Normal performance is likely a mixture of the opportunistic and the tactical control modes. In these modes, available resources are used efficiently (Hollnagel & Woods, 2005). Change from one mode to another has to do with the characteristic performance in a given mode (Hollnagel, 1993b) and the transition between control modes can be identified by a period of scrambled

control mode (Hollnagel & Woods, 2005). Feigh, Pritchett, Jacko and Denq (2005) suggest that the best performance within a given context will be attained when the most appropriate control mode for the current situation and context is applied. Hence, poor performance corresponds not only to choosing a too low control mode, but also to over optimistic attempts at a higher control mode when there is not enough time or competence to carry them through.

This loss of control, when trying to work on a too high mode of control, can be related to the notion of coordination costs as discussed by Klein et al. (2005). There are four types of coordination costs in JCS performance: synchronisation overhead (time wasted in waiting for one entity to complete its work before the next one can begin), communication overhead (effort to manage the handoff), redirection overhead (wasted time and energy in going in the wrong direction after a new direction is called out but before all entities can be told to change course), and diagnosis overhead (the additional burden of diagnosing a performance problem when multiple moving parts are involved).

In the scrambled control mode, when all actions are haphazard, there would be limited or no coordination costs, as there is no going in the wrong direction or a need for redirection as no plans are followed. There would neither be a need for one member to wait for another member before starting his work. In the strategic mode, on the other hand, there could be great coordination costs when information is sought extensively and the person who is going to put together all the information has to wait for the information to be collected. It is also possible that an action is chosen, but when more information is gathered, it will show that another action was more appropriate and therefore redirection costs will occur.

3.4.5 Transitions between control modes

Since control is defined as the JCS's ability to maintain a control mode despite disturbing influences, it has to be determined what causes transitions between control modes. Stanton et al. (2001) have shown that the progression between control modes is linear and that the transition between control modes follows the patterns shown in Figure 3-4. The only exception is that it in some conditions is possible to go directly between the tactical and the scrambled modes. This jump could be caused by a severe change in the situation. Of course, it is possible to go from one state to itself, that is, to sustain a given control mode (Hollnagel, 1993a).

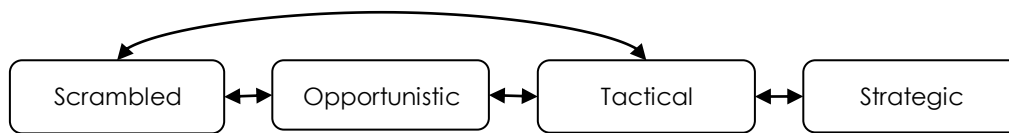


Figure 3-4. The transition between control modes is linear and modes rarely change directly from tactical to scrambled or from opportunistic to strategic et cetera. Adapted from Stanton et al. (2001, p. 113) with permission.

It is assumed that the changes will be transitions between longer periods of stability rather than rapid fluctuations. With COCOM, however, both longer and shorter periods can be modelled (Hollnagel, 1993a). The change can be described in several ways ranging from simple to very complex explanations.

A simple explanation is that transition to a lower level will occur if goals are not achieved at the current level. Conversely, if actions are successful, the JCS will return to a higher level of control (Hollnagel, 1993b). This is summarised below for the different transitions.

To scrambled from opportunistic. The scrambled control mode is typically entered from the opportunistic mode. The specific causes can be that the previous action failed, that the available time is reduced or that there was a sudden change in the environment so that it became completely incomprehensible (Hollnagel, 1993a).

To scrambled from tactical. A shift from tactical control mode to scrambled can be the case if a major accident happens, which leaves the system with a completely unknown situation and little time to do anything about it (Hollnagel, 1993a).

To opportunistic or tactical from scrambled. The way to get out of the scrambled mode is that the system succeeds so that a physical danger disappears or the mental block vanishes (Hollnagel, 1993a).

To tactical from opportunistic. The transition from opportunistic to tactical control mode is due to either an increase in available time or that the previous action succeeds (Hollnagel, 1993a).

To tactical from strategic. The change from strategic control mode to the tactical mode happens if a plan fails to achieve its goals, if the system finds that available time is decreasing, or if a sudden change in the situation occurs where the complexity of the situation increases (Hollnagel, 1993a).

To strategic from tactical. The change to the strategic control mode from the tactical takes place when actions achieve their goals, when everything goes as

planned, when time is abundant and when motivation is sufficiently high. The two modes are quite similar in many ways and the changes between them may be less abrupt than for the other modes (Hollnagel, 1993a).

Another way of explaining the transition is to use three parameters, namely number of failed actions, number of successful actions and number of goals accepted. The number of failed actions indicates the longest sequence of failed actions the system can cope with. If more failed actions occur, control changes to a lower level. The number of successful actions controls the movement in the opposite direction. The number of goals accepted indicates the maximum number of goals the system can cope with on a given level of control. If more goals occur, the system will change to a lower control level. These parameters must be combined with predefined sets of values for the respective parameter (Hollnagel, 1993c).

Unexpected events are closely related to the amount of time available and are signatures of losing control (Hollnagel, 2002b). This is because unexpected events require more efforts in terms of comprehension, taking in the new information and revising expectations, efforts that all reduces the time available. Loss of control in emergencies corresponds to opportunistic or scrambled control modes. If control is regained in an emergency it will typically be on the level of tactical control (Hollnagel, 1993b).

Chapter 4 • Protocol development

This chapter presents the development of the protocol for assessing team performance in terms of control. The process for protocol development was retrieved from Abrahamsson (2009) and is explained in Chapter 2. The first step, the design of the protocol, was followed by a pilot study which is presented in Chapter 5. The results from the protocol development and the pilot study are presented and analysed in Chapter 6 and Chapter 7.

4.1 Design of protocol

The protocol design consisted of three steps:

- Purpose of the protocol.
- Design criteria.
- Construction of the protocol.

Each of the steps is further elaborated below.

4.1.1 Purpose

The overall purpose with the development was to provide a protocol for team performance assessment based on the theories of cognitive systems engineering (CSE). As mentioned in the background, reasons for assessing team performance can be evaluation of the results of implementing new technology in a field or evaluation of the effects of training. The protocol developed in this work is to be used in an environment that reflects the natural environment in which the team normally works, for example in a simulator. The protocol shall also specifically be used to assess team performance in escalating situations.

Given this purpose, a number of design criteria were formulated and elaborated in terms of why they are relevant in relation to the purpose of the protocol.

4.1.2 Design criteria

The protocol was designed according to the theoretical ground of control presented earlier in this report. According to CSE, there is an intimate connection

between control and performance (Hollnagel & Woods, 2005), which makes the use of control appropriate for assessing performance.

The protocol should in particular be based on the contextual control model (COCOM) (Hollnagel & Woods, 2005). By using this model and its concrete definitions of control modes, the team's actions can be categorised according to the definitions of the modes. COCOM also offers a definition of what characterises loss of control, which is common in escalating situations.

The context should be an important factor in the protocol. The CSE view emphasises that actions can only be understood in the context in which they take place (Hollnagel & Woods, 2005). The protocol should therefore be designed to be used in the context where the actions normally take place, as opposed to classical psychological laboratory experiments. The influence from the assessor should also be minimal.

The protocol should not be limited to a certain field of use and should thus be generic. Team performance assessment is of interest for numerous fields where human lives can be at risk in escalating situations, for example aviation, fire services and health care. The protocol should also be user friendly, easy to update and give comparable results.

In summary, the protocol should

- be based on control in general and on COCOM in particular
- be used to assess performance in its natural context
- be generic
- be user friendly
- be easy to update
- give comparable results.

4.2 Construction of protocol

The protocol should provide an assessment of team performance in terms of control with use of COCOM, according to the design criteria presented above. The protocol should focus on how team actions and performance can be categorised into the four COCOM control modes. In order to do this categorisation, data about actions and performance has to be collected with one or more data collection techniques.

It was decided that the protocol were to consist of three steps: recording of the training session (data collection), analysis for deciding control modes and the

assessment of team performance, see Figure 4-1. Each of the steps is explained in further detail below.

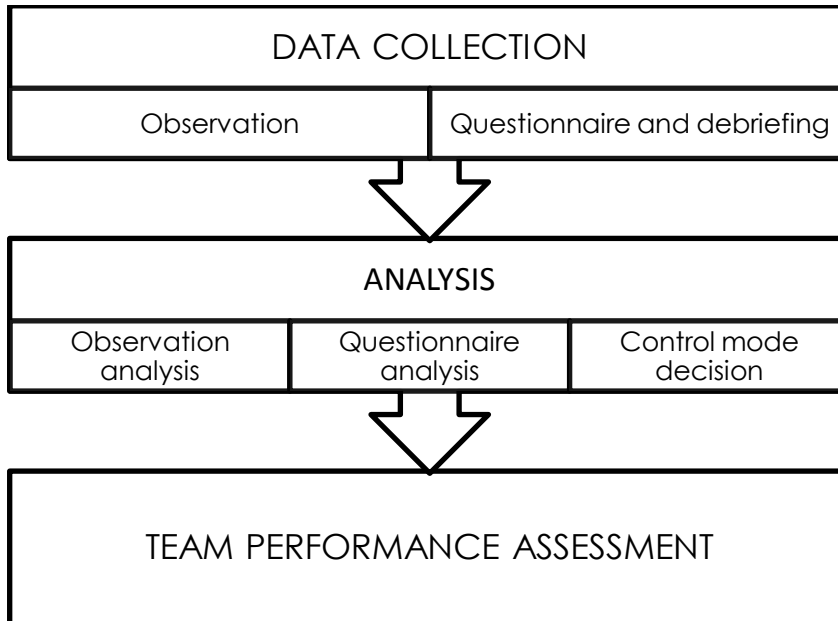


Figure 4-1. Overview of the team performance assessment protocol.

4.2.1 Choice of data collection technique

Numerous techniques are available for data collection, such as interviews, questionnaires, statistical material and observation. No statistics were found on how COCOM parameters are related to team performance. This made the use of statistical material as a base for categorisation difficult or even impossible.

Observation could be used so that the evaluator defines the control mode of the team during the session, without having to interact with the members. Neither the natural context in which the teams are performing nor the validity of the results would then be affected. To make it easier to categorise the performance into control modes, the session could be video and audio recorded and analysed in peace afterwards by the evaluator. The observation could of course only focus on data that is observable, thus nothing that goes on in the minds of people could be taken into account. This is also an important aspect of CSE where the focus is on cognition in the world rather than cognition in the mind (Hollnagel & Woods, 2005).

If interviews were to be conducted during the session, it could affect the performance of the team; hence the result would become less valid. COCOM also suggests that loss of control is equal to a transition from a higher control mode to a lower. An interview alone would not make it possible to capture exactly when in

the session the transition took place. Interviews could be used during a debriefing session, which would follow the actual training session. By discussing the session with the team afterwards, valuable information could be gained that could help clarify the observed actions of the team during the session. The debriefing session interview should also be recorded so that it could be analysed afterwards.

Hence, the main part of the protocol was chosen to consist of video and audio recording observation of the training and debriefing sessions. But because some of the most important COCOM parameters, such as available time and the ability to make predictions about the future are not observable, the observation was chosen to be complemented with a questionnaire for the team members to fill in. By doing this, the non observable parameters can also be taken into account when categorising performance into control modes. A questionnaire was chosen to complement the debriefing session interviews because the team could then in peace reflect over the answers and not be stressed by an interviewer. Questionnaires are also more user friendly, which was requested in the design criteria, because the answers are easier to analyse. To maintain the possibility to achieve rich answers, which is possible with interviews, the questionnaire was given room for the team to write its comments and clarifications as a complement to the answers. Also, the questionnaire is to be discussed during the debriefing session for further clarifications.

4.2.2 Recording of training session – data collection by observation and questionnaire

The training session for which team performance is to be assessed has to be recorded so that the actions and performance of the team can be categorised into control modes. The categorisation is done by using the COCOM parameters listed below. As available time is a main parameter for deciding control modes (Hollnagel & Woods, 2005, p. 163), each parameter's relation to available time is indicated.

- **Information seeking.** If time is not limited, information can be sought extensively without the need of filtering. If time on the other hand is limited, the information seeking also becomes limited, if not negligible.
- **Comparison between decision alternatives.** When there is unlimited time, decision alternatives can be compared more thoroughly than if time is limited. If time is limited, the first acceptable alternative might be chosen, if there are any alternatives at all.
- **Following of a general procedure.** If the time available is rather satisfying, then there is time to assess the situation and thereafter follow a

known procedure, if such procedure for the specific situation exists. When time becomes limited, the situation cannot be assessed and hence a proper procedure cannot be chosen to be followed.

- **Attraction of attention from a powerful indicator.** When time is limited, chances have to be taken because there is no time to plan for doing anything better. Dominant features of the environment, for example an alarm, can attract the attention and ongoing actions or plans might be interrupted. If time is unlimited, the causes and effects of the alarm can be evaluated before decisions are made.
- **Number of goals.** If time is very limited, there is only time to work towards one basic goal, such as maintaining physical integrity. As time becomes less limited, more goals can be pursued in order to accomplish the given task.
- **Prediction of future events.** It is important to be able to predict future events for the ability to stay in control, because the prediction determines the choice of actions. If time is limited, it becomes more difficult to make predictions about the future.
- **Evaluation of outcomes.** When time is not limited, outcomes can be evaluated so that future actions can be chosen to better fit the situation. If time is limited, there is no time available to do this evaluation.
- **Subjectively available time.** The parameter of subjectively available time is an important parameter for deciding control modes (Hollnagel & Woods, 2005, p. 163), which also is shown in the descriptions of the other parameters above. Lack of available time can be caused by unexpected events, which disrupts ongoing activities and plans.

Observation

In order to develop the observation part of the protocol, the COCOM parameters were first divided into two categories: observable and not observable, respectively.

- **Observable:** information seeking, evaluation of decision alternatives, the following of a procedure, the effect of a powerful indicator.
- **Non observable:** number of goals, subjectively available time, evaluation of outcomes, available plans, selection of action.

However, the non observable parameters could be observable in situations where the team explicitly expresses them. Three recordings of stabs exercises conducted at MSB College Revinge in Sweden in the autumn of 2007 were analysed to verify the division of parameters. It was concluded that the parameters in the non observable category rarely or never were stated explicitly. They were therefore not chosen to be included in the observation part of the protocol.

The recording of the observable parameters shall be done by placing a camera together with audio recording devices so that the activity in the room or enclosure used for the session can be recorded. To avoid influence from the evaluator on the team's behaviour and performance, the evaluator shall not be present in the room and it is therefore important to place the camera correctly before the session starts and that the evaluator thereafter leaves the room.

The debriefing session and the filling in of questionnaires following the actual training session shall also be recorded as it can clarify actions observed and answers indicated on the questionnaire.

If radio or telephones are used for communication and counter play this shall also be recorded in order to capture what is said by parties other than those present in the room which is primarily video and sound recorded.

If possible, pictures shall be taken of white boards used and written notes shall be photocopied if this cannot be seen clearly on the video recording. This information might be useful later in the team performance assessment.

Questionnaire and debriefing

Because some of the most important variables of COCOM, such as subjectively available time and the prediction of future events are not observable, a questionnaire shall be filled in by the participants after the session. Each team member shall first answer the questionnaire individually. Thereafter, the team shall answer only one questionnaire together. This is because it is the team as a whole and their performance that is relevant, not what each individual perceived. This can result in that the team adjusts its answers in order to please all team members. But if the evaluator would do this, he or she would also have to adjust the answers into one final answer and the evaluator may not be able to reflect the subjective view of the team. The purpose of filling in questionnaires individually at first is so that contrasts between participants can be identified and it should also make it easier for the team to fill in a common questionnaire when each member already have though the questions through.

The nine questions to be answered relate to the number of simultaneous goals, the subjectively available time, the predictability of future events and the

evaluation of alternatives and outcomes. But also questions about the observable parameters are asked with the purpose of verifying what is being observed on the video recording. See Appendices A.2 and A.3 for the questionnaire. The questions are answered for three periods of the session, the beginning, the middle part and the end, in order to capture the dynamics of the session. If more time periods were to be used, the answers would become more detailed but also less valid as the team may have difficulties in remembering exactly when actions and events occurred. If the session is very long and there is some way for the team members to remember different steps of the session, it would be possible to add and adjust periods to fit the length of the session. After each question there is room for the team to leave comments or clarifications to their answers. Some of the questions also require the team to elaborate their answers, for example which the goals were and which procedures were used.

When the questionnaires have been filled in, the evaluator shall discuss the answers together with the group. This will further clarify the answers given. As noted above, it is important that the debriefing session and the filling in of the questionnaire are video and audio recorded.

4.2.3 Analysis for deciding control modes

The analysis consists of three parts: observation analysis, questionnaire analysis and the decision of a control mode for five minute intervals, or another appropriate interval depending on the length of the session. The three parts will be explained in detail below.

Observation analysis

When the training session has been recorded it shall be analysed. The observation analysis aims at identifying how the team acts with respect to the observable parameters. The analysis is preferably done by an instructor or a person with great knowledge in the field, the procedures used and knowledge of the participants. If another person does the analysis, it is very important that this person informs himself or herself about procedures that can be used, which information that it is expected of the team to seek and so on.

The evaluator analyses the video in five minute intervals. Another interval can be chosen if that is appropriate but a five minute interval is chosen as guideline because the protocol aims at identifying control modes and later also transitions between control modes. It is therefore important that the time periods are relatively short. If they were longer, it is possible that some transitions would be missed. If the periods on the other hand are too short, it is likely that the team would not have had time to seek information, compare decision alternatives and follow rules and procedures.

If there has been a separate sound recording, for example for recording a telephone conversation, this shall first be synchronised with the video-sound recording so that the telephone conversation can be attended to in its original context.

In the protocol each observable parameter is divided into the four control modes and each mode is given a characteristic action, according to the description of the control modes in Chapter 3.

- **Information seeking**

(e.g. questions are asked, computers and books are used for finding information)

- Scrambled: No information is being sought.
- Opportunistic: Only information that necessarily is needed for the moment.
- Tactical: Information sought is needed both for the moment and in the future, but is only sought from a limited set of sources.*
- Strategic: Information is sought for the moment and for the future, and from all sources available.*

- **Evaluation of decision alternatives**

(e.g. discussion on priorities)

- Scrambled: There are no alternatives.
- Opportunistic: The first identified alternative is accepted.
- Tactical: The alternatives are evaluated.
- Strategic: The alternatives are evaluated.

- **The actions follow a general procedure**

(e.g. steps learned in lectures or during training) **

- Scrambled: No.
- Opportunistic: No.
- Tactical: Yes.
- Strategic: No.

- **A powerful indicator attracts the attention and ongoing plans are interrupted**

(e.g. an alarm goes off, a telephone rings)

- Scrambled: No.
- Opportunistic: Yes.
- Tactical: No.
- Strategic: No.

* Before each session to be assessed, the number of available information sources has to be defined so that the evaluator knows when all sources available are being used and when only a limited number is used.

** Before each session to be assessed, the available procedures have to be defined so that the evaluator knows when such a procedure is being used.

For each parameter, there is also the option “not observed” indicating that it was not possible to observe the parameter.

For each five minute interval of the recording, the evaluator ticks the observed actions for information seeking, evaluation of decision alternatives, whether a procedure was followed and if a powerful indicator affected ongoing plans in an observation analysis form. A new form shall be used for each time interval and the time interval for a given protocol shall be marked in the protocol header.

If some actions are difficult to understand or classify, the evaluator shall also look at what was written on papers or whiteboards in order to comprehend the situation.

When the observation analysis has been carried out for the entire session the characteristic behaviour is translated into a control mode (scrambled, opportunistic, tactical or strategic) for each parameter and this control mode shall be indicated in the right column of the form for each parameter.

Questionnaire analysis

The answer for each question in the questionnaire is transformed to a control mode by the evaluator according to the key presented in Appendix A.4. The control mode for each question shall be marked by the evaluator on the questionnaire at the dedicated place.

Deciding one control mode for each time interval

A specific control mode for each time interval is decided from the observation and the questionnaire analyses together. This is done by filling in the control mode decision form presented in Appendix A.5 using the control modes that the observation and the questionnaire analyses resulted in.

If Question 1 in the observation analysis (information seeking) indicates a tactical control mode, then *Ta* shall be written in the box for Observation analysis 1 and the given time interval. Scrambled control mode is indicated by *Sc*, opportunistic control mode is indicated by *Op* and strategic control mode is indicated by *St*.

Questions 2, 3 and 4 in the observation analysis can indicate one or more control modes depending on the answer. All control modes shall be indicated if that is the result from the observation question.

The results from the questionnaire analysis are indicated in the same way. It is the questionnaire that the team filled in together that shall be inserted into the control mode decision form. The team's answers for the initial part equals the first third of the session, the middle part equals the second third and the last part equals the last third of the session. For example, the session lasts for 60 minutes and the answer to the first question is tactical for the first part. Then tactical shall be registered as the control mode for Question 1 in the questionnaire analysis for the first 20 minutes ($60/3=20$). This has to be modified if other intervals are used in the questionnaire.

If the question is answered as "not observed" or "don't know", this is indicated with a dash (-).

Thereafter, the number of scrambled, opportunistic, tactical and strategic indications are summarised separately for the observation analysis and the questionnaire analysis for each control mode. If there are two control modes indicated at the same position in the control mode decision form they shall be counted as 1/2 each. If three control modes are in the same position, each control mode shall be counted as 1/3. A single control mode is counted as 1. The numbers shall be registered in the sum (observation/questionnaire) column for each control mode. Dashes are not summarised. A simplified example of how this is done is shown in Figure 4-2.

The number of observation analysis indications is four and the questionnaire analysis results in nine indications. To make them comparable the sums have to be standardised. If not doing this and adding more and more questions to the questionnaire in the future, the observation with only four indications would have no effect on the final control mode. This standardisation is done by dividing the observation analysis sum for each control mode by 4 and the questionnaire analysis control mode sum by 9. Thereafter the sums for each control mode can be added and the results shall be written in the standardised sum column for each control mode. This procedure in simplification is presented in Figure 4-2.

The control mode with the highest sum is the control mode to be registered in the most right column (CM=control mode) for each time interval. If two or more

control modes have the same sums, all of them shall be indicated in the CM column.

4.2.4 Assessing team performance from control modes

The team's performance is assessed using the control mode decision form. The control modes indicated in the most right column (CM) can be ranked according to

4. Strategic
3. Tactical
2. Opportunistic
1. Scrambled

where strategic means high control and scrambled means low or no control.

The control mode shall be registered in a team performance assessment diagram, see Appendix A.6, for each time interval and the team performance of the entire session can then be assessed with respect to the following criteria:

- The team moves to a lower control mode and does not return to the higher level.
- The team moves to a lower control mode and returns to the higher level.
- The team maintains the same control mode during the entire session.
- The team moves to a higher control mode, maintains it and did not move to a lower control mode earlier in the session.

Moving to a lower control mode is for example a transition from 3. Tactical to 2. Opportunistic (3→2) or from 4. Strategic to 1. Scrambled (4→1).

Moving to a higher control mode is the opposite, for example moving from 1. Scrambled to 2. Opportunistic (1→2) or from 2. Opportunistic to 4. Strategic (2→4).

The diagram can then, together with the recording of the session, be used to identify which event caused the team to loose control and future training can be planned from this information.

Time interval	Observ. analysis	Quest. analysis			Sums (Observation/Questionnaire)			Standardised sums			CM		
		1	2	3	Sc.	Op.	Ta.	St.	Sc.	Op.		Ta.	St.
1	Sc	Ta St	Op	Sc	1/ 1	0/ 1	1/ 0.5	0/ 0.5	0.83	0.35	0.66	0.17	Sc
2	Ta	-	Op	Op	0/ 0.3	0/ 2.3	1/ 0.3	0/ 0	0.1	0.77	0.6	0	Op
3	Ta	Sc/ Ta/ St	Sc/ Op	Op	0.3/ 0.6	0/ 0.8	1.3/ 0.3	0.3/ 0	0.35	0.27	0.75	0.15	Ta

Figure 4-2. A simplified example of how sums and standardised sums are calculated and presented in the control mode decision form. Note that the number of indications for observation and questionnaire in this example is 2 and 3 respectively, compared to 4 and 9 in the real form. The number of indications is used to standardise the sums.

SUMS (OBSERVATION/QUESTIONNAIRE)

Time interval 1: Sc = 1 (observation analysis) / 1 (questionnaire analysis); Op = 0 / 1; Ta = 1 / 0.5; St = 0 / 0.5

Time interval 2: Sc = 0 / 0.3; Op = 0 / 2.3 (0.3 + 1 + 1 = 2.3); Ta = 1 / 0.3; St = 0 / 0

Time interval 3: Sc = 0.3 / 0.6 (0.3 + 0.3 = 0.6); Op = 0 / 0.8 (0.3 + 0.5 = 0.8); Ta = 1.3 (1 + 0.3 = 1.3) / 0.3; St = 0.3 / 0

STANDARDISED SUMS

Time interval 1: Sc = 1/2 + 1/3 = 0.83; Op = 0/2 + 1/3 = 0.33; Ta = 1/2 + 0.5/3 = 0.66; St = 0/2 + 0.5/3 = 0.17

Time interval 2: Sc = 0/2 + 0.3/3 = 0.1; Op = 0/2 + 2.3/3 = 0.77; Ta = 1/2 + 0.3/3 = 0.6; St = 0/2 + 0/3 = 0

Time interval 3: Sc = 0.3/2 + 0.6/3 = 0.35; Op = 0/2 + 0.8/3 = 0.27; Ta = 1.3/2 + 0.3/3 = 0.75; St = 0.3/2 + 0/3 = 0.15

Chapter 5 • Pilot study

The protocol was tested in a pilot study conducted at MSB College Revinge in Sweden on May 17, 18 and 19 2010. The studied training sessions were four commanding staff exercises. The results from the pilot study are presented in Chapter 6 and the analysis of the results is presented in Chapter 7.

5.1 Participants

The participants in the pilot study were all taking a nine week course for fire officers given at MSB College Revinge. They were experienced fire fighters and had also worked as fire officers at a lower level for several years. A total number of 23 persons took the course in the spring of 2010 and 22 participated in the commanding staff exercises. They were divided into two groups with eleven members respectively. The splitting was made by the instructor responsible for the course and was based on the members domicile. Group 1 had eleven members who were working at fire services in northern Sweden while Group 2 had eleven members working in southern Sweden. It was mandatory to participate in the commanding staff exercises in order to pass the course and nobody opposed the recording of the training session.

5.2 Equipment

Two video cameras and three digital voice recorders were used to record the session. The cameras were used in the two larger rooms in the commanding staff training building. For the two smaller rooms and for recording of the counter play, the digital voice recorders were used. Computers connected to the internet were available in all rooms to enable information seeking. The computers also had software installed such as Bfk (for dispersion calculations). The participants also had access to books of reference regarding hazardous goods. Telephones were available in all rooms for communication with participants in other rooms and with the counter play. One radio was also available for communication with the counter play. Questionnaires developed for the protocol were used at the end of each session. They were first answered individually and then by the team together.

5.3 Task

The general task of a commanding staff applies well to the parameters to be analysed in the protocol. For example, a commanding staff should handle information, make assessments and suggest action alternatives to the commander as well as evaluate outcomes. It is also a fact that the more complex the situation is, the more complex the work of the commanding staff becomes (Svensson, 2007).

The overall aim of the task for the specific scenarios studied was for the team to act as a commanding staff supporting a fire officer in charge of an accident. The commanding staff was said to be working from a remote head office and they could not visit the scene in person. To get information about the accident they would have to communicate by telephone or radio with the staff on scene (that is the counter play). They could also seek information from other sources, such as from the meteorological institute for information about the weather. Two scenarios (A and B) were used and each group played both scenarios.

5.3.1 Scenario A

The first scenario was a plane crash. An airplane with 85 passengers had crashed in a remote area near a lake. The main objectives of this task were for the commanding staff to:

- Plan for taking care of injured and dead.
- Analyse airplane evacuation strategies.
- Give information to media and to the public.
- Coordinate the rescue action with the coast guard, the Swedish Maritime Administration and sea rescue service.
- Organise resources and staff on the scene and in the commanding staff.

To solve the situation the team would at least have to seek the following information:

- Weather information (from the meteorological institute).
- Physical availability to the crash site (from the fire officer in charge).
- Handling of evacuation (from the fire officer in charge).
- The number of injured that could be attended (from the hospital).
- Coordination of the rescue action (from the Swedish Maritime Administration).

5.3.2 Scenario B

The second scenario was a road accident at a freeway exit involving a truck loaded with hazardous goods. For this task, the main objectives of the commanding staff were to:

- Analyse the situation and plan for different developments of the situation.
- Plan for the worst case.
- Plan for evacuation.
- Give information to media and to the public.
- Organise resources and staff on the scene and in the commanding staff.

To solve the situation the team would at least have to seek the following information:

- Weather information (from the meteorological institute).
- Filling degree, transport documents, destination and experts on chemicals (from the road carrier company).
- Closing of roads (from the police).
- Information about the accident (from the fire officer in charge).
- Information about chemicals (from books and databases).

The objectives and the information needed were not given directly to the participants. They were instead given to them by the fire officer in charge (the counter play) throughout the session. But it would be possible for the participants to foresee these objectives and the need of information and thus plan in advance. In order to be able to handle the escalating situation, some degree of anticipation was necessary.

5.4 Procedure

The procedure for the pilot study was as follows:

Day 1

1. The participants were informed about the pilot study and were given the opportunity to oppose the recording of the sessions.
2. A two hour lecture was held focusing on what a commanding staff is, how it can be organised and how the work of a commanding staff is initiated.
3. The participants were then divided into four groups and undertook a one hour training session focusing on the initiation of the commanding staff. The training session was discussed by all four groups together. This session was not recorded nor analysed.

Day 2 (Group 1) and Day 3 (Group 2)

4. A one hour lecture was held focusing on procedures and tools which the participants were recommended to use during the session.
5. The participants were asked to carry out the plane crash task (scenario A). The session lasted for approximately one hour.
6. After the session the participants answered the questionnaire and they were debriefed by the instructor after filling in the questionnaire.
7. Another one hour lecture was held under which more tools and procedures were presented.
8. The participants were asked to carry out the hazardous goods accident task (scenario B). The session lasted for approximately two hours.
9. After the session the participants were debriefed by the instructor and were then asked to answer the questionnaire.

5.5 Data processing

The video and audio data was coded on a five minute basis into control modes according to the observation analysis form. An attempt was done to analyse the recordings using Adobe Premier, a program in which all the recordings could be synchronised and attended to at the same time. But it turned out to be a time consuming process to transfer the recordings from the voice recorders to the computer. Another complicating factor was that Adobe Premier requires a powerful computer and this would be a limitation for the method. Each recording device was therefore attended to in turn in five minute intervals until the entire session had been coded.

The questionnaires were coded according to the key presented in Appendix A.4. For question 1b (the number of explicitly stated goals) the video recordings were consulted to count the number of goals stated by the team. The video recordings were also used to identify the points when the different answering periods of the questionnaires occurred. Information about the questionnaires used for the two scenarios can be found in Appendices B.2 and C.2 for Group 1 and Appendices D.2 and E.2 for Group 2.

Question number 9 in the questionnaire regarding information overload was not included in the analysis, but the answers to the question are presented in Appendices B.2, C.2, D.2 and E.2 as they might be found interesting in future research.

The results from the observation and questionnaire analyses were indicated in the control mode decision form. As a sensitivity analysis on time intervals, this was done both for five minute intervals, and for ten minute intervals. This was done

by simply adding two five minute intervals and comparing the notes of the observation analysis form from each interval.

The information from the control mode decision forms was finally indicated in team performance assessment diagrams.

Chapter 6 • Results

This chapter presents the results from the protocol development and the pilot study. The protocol is briefly presented here and details about it can be found in Chapter 4. For the pilot study the results from the four sessions analysed are presented followed by the sensitivity analysis on the impact on the result of the time interval.

6.1 Protocol

The purpose is to provide a protocol for team performance assessment based on the theories of cognitive systems engineering (CSE). The CSE theory used as a base for the protocol is the contextual control model (COCOM) (Hollnagel & Woods, 2005).

The protocol, which is schematically presented in Figure 6-1, consists of three major steps: data collection, analysis and team performance assessment. These can in turn be further divided into minor steps, which will be presented briefly.

Data collection. Data is collected by video and audio recording the session to be assessed (referred to as observation). A questionnaire regarding for example goals and available time is filled in after the session by the team members. The evaluator discusses the questionnaire with the participants during the debriefing session.

Analysis. The collected data is analysed according to the COCOM theory using an observation analysis form and a key for the questionnaire. The results from the analysis are entered into a control mode decision form, which in turn generates control modes for different time intervals in the session analysed.

Team performance assessment. The retrieved control modes are used for the team performance assessment. By indicating the control mode as a function of time in a team performance assessment diagram the team performance can be categorised as one of the following alternatives:

- The team moves to a lower control mode and does not return to the higher level.
- The team moves to a lower control mode and returns to the higher level.

- The team maintains the same control mode during the entire session.
- The team moves to a higher control mode, maintains it and did not move to a lower control mode earlier in the session.

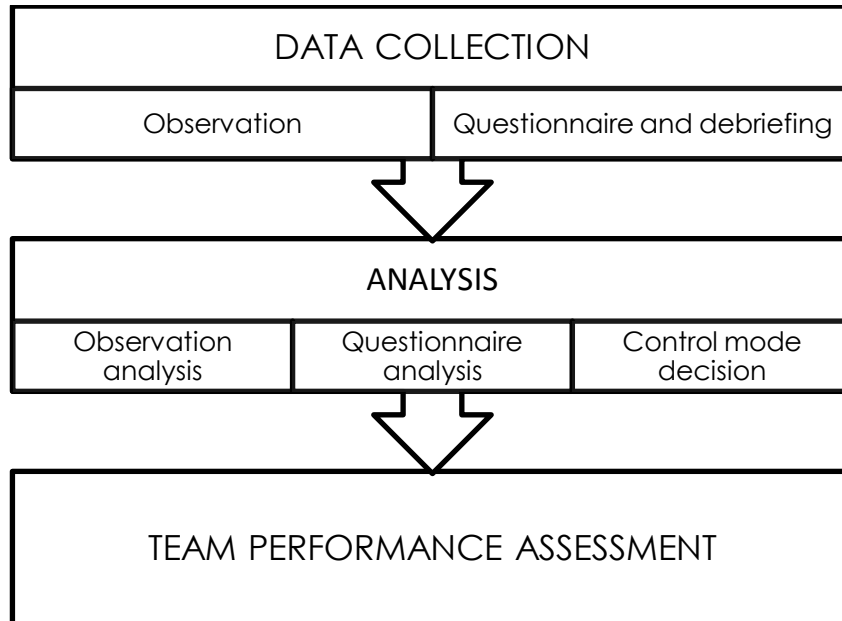


Figure 6-1. A schematic overview of the team performance assessment protocol. The figure is identical with Figure 4-1.

6.2 Pilot study

The results from the pilot study are presented in team performance assessment diagrams (Figure 6-2 to Figure 6-5) with one diagram presenting one session. The analyses on which the team performance assessment diagrams are based can be found in Appendices B, C, D and E. The procedure of transforming the information from the analyses into a team performance assessment diagram is presented as an example for two time intervals in Group 1 – scenario A.

6.2.1 Group 1 – scenario A

The team was fluctuating around the opportunistic control mode. At three points they were working in a scrambled control mode. These periods lasted for five minutes at the time. At one moment, the team reached the tactical control mode and stayed there for five minutes.

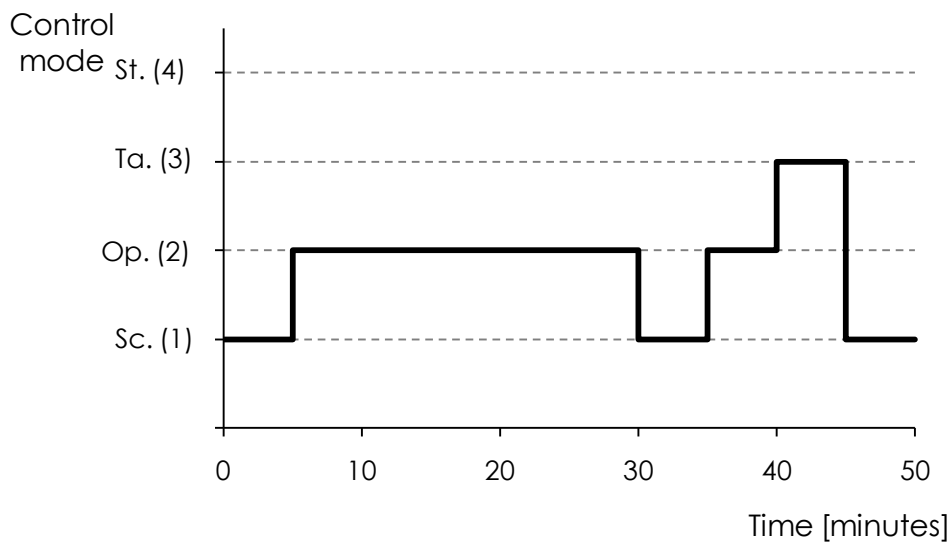


Figure 6-2. Team performance assessment diagram for Group 1 – scenario A.

From analyses to a team performance assessment diagram

To clarify how the team performance assessment diagram presented in Figure 6-2 was retrieved, the steps of the procedure for time intervals 25-30 minutes and 30-35 minutes are shown.

- *25-30 minutes – observation analysis*

Information seeking: the team investigates available recourses from other organisations because the officer in charge asked for the information. This is the only information seeking that can be observed in this time interval and it is information that obviously is needed for the moment only. Therefore, this parameter indicates that the control mode should be opportunistic.

Comparison of decision alternatives: the team sends more rescue units to the accident even though these units were intended to be used to cover up the fire station. There are no discussions on whether there are other units available to be sent to the accident. Thus, this parameter indicates an opportunistic control mode.

The actions follow a known procedure: the team uses commanding staff tools that are appropriate to use in the current situation. This indicates a tactical control mode.

A powerful indicator attracts all attention and ongoing plans and activities are interrupted: this parameter could not be observed and the control mode for this parameter is indicated with a dash (-).

- 25 – 30 minutes – *questionnaire analysis*

The team answered the nine questions in the questionnaire as follows. By using the coding key presented in Appendix A.4, the answers are transformed into control modes. Question 9 is only included in the questionnaire because it might be of interest to use the answers in future studies. Therefore, the question does not generate a control mode in this study.

1. During the session we had goals that we worked towards:
yes → tactical/strategic
- 1b. How many goals were listed in question 1 and at the same time explicitly stated during the session (check the video recording)?
2 → opportunistic
2. We think that we had enough time to handle the situation the way we wanted:
no → scrambled/opportunistic
3. We compared the different decision alternatives that were available and we chose the very best alternative, instead of the first acceptable:
no → scrambled/opportunistic/tactical
4. After accomplishing an action we evaluated the outcome that this action resulted in:
no → scrambled
5. We were able to predict how the situation was going to develop:
no → scrambled/opportunistic
6. We sought information to solve the problem and handle the situation in the following extent:
information needed for the moment only → opportunistic
7. We followed rules and procedures that we had learned for this or similar situations:
yes → tactical

8. We had enough time to use rules and procedures that were appropriate for the situation:
no → scrambled/opportunistic
9. There was too much information and we could not attend to all of it:
yes

- *25-30 minutes – control mode decision*

Table 6-1. The observation analysis part of the control mode decision form for 25-30 minutes of Group 1 – scenario A.

Observation analysis				
	1	2	3	4
25-30	Op	Op	Ta	-

Table 6-1 presents the control modes that the observation analysis gave for each of the four observation analysis indicators.

Table 6-2. The questionnaire analysis part of the control mode decision form for 25-30 minutes of Group 1 – scenario A.

Questionnaire analysis									
	1	1b	2	3	4	5	6	7	8
25-30	Ta/St	Op	Sc/Op	Sc/Op/Ta	Sc	Sc/Op	Op	Ta	Sc/Op

Table 6-2 indicates the control modes that the questionnaire analysis gave for each of the nine questionnaire analysis indicators.

Table 6-3. The sums (observation/questionnaire) part of the control mode decision form for 25-30 minutes of Group 1 – scenario A.

Sums (Observation/Questionnaire)				
	Sc	Op	Ta	St
25-30	0/2.8	2/3.8	1/1.8	0/0.5

In Table 6-3 the number of scrambled, opportunistic, tactical and strategic control modes is summarised for the observation analysis and the questionnaire analysis respectively. This means that for the observation analysis the sum of scrambled control modes is 0 and the sum from the questionnaire analysis for scrambled is 2.8. For the questionnaire analysis, in this case, question 2, scrambled, is counted as 0.5 and opportunistic as 0.5. For question 3 scrambled is counted as 0.33, opportunistic as 0.33 and tactical as 0.33.

Table 6-4. The standardised sums part of the control mode decision form for 25-30 minutes of Group 1 – scenario A.

Standardised Sums					CM
	Sc	Op	Ta	St	
25-30	0.31	0.92	0.45	0.05	Op

When standardising the sums from Table 6-3 above, the observation sum is divided by four and the questionnaire sum is divided by nine. These ratios are then added. For example, the standardised sum for scrambled is calculated as: $0/4 + 2.8/9 = 0.31$ and the standardised sum for opportunistic is calculated as: $2/4 + 3.8/9 = 0.92$. The control mode with the highest standardised sum is indicated in the CM column, in this case opportunistic. This is shown in Table 6-4.

- *25 – 30 minutes – team performance assessment diagram*

The control mode in the team performance assessment diagram for the current time period 25 – 30 minutes is the one indicated in the CM column: opportunistic. This control mode is indicated in Figure 6-2.

- *30-35 minutes – observation analysis*

Information seeking: the team experiences problems with the internal information flow and no information is sought. Therefore, this parameter indicates that the control mode should be scrambled.

Comparison of decision alternatives: this parameter could not be observed and the control mode for this parameter is indicated with a dash (-).

The actions follow a known procedure: the team uses commanding staff tools that are appropriate to use in the current situation. This indicates a tactical control mode.

A powerful indicator attracts all attention and ongoing plans and activities are interrupted: this parameter could not be observed and the control mode for this parameter is indicated with a dash (-).

- 30 – 35 minutes – questionnaire analysis

The team’s answers to the questionnaire for the 30 – 35 minute time interval are the same as for the 25 – 30 minute interval and are not presented again.

- 30-35 minutes – control mode decision

Table 6-5. The observation analysis part of the control mode decision form for 30-35 minutes of Group 1 – scenario A.

Observation analysis				
	1	2	3	4
30-35	Sc	-	Ta	-

Table 6-5 indicates the control modes that the observation analysis gave for each of the four observation analysis indicators.

Table 6-6. The questionnaire analysis part of the control mode decision form for 30-35 minutes of Group 1 – scenario A.

Questionnaire analysis									
	1	1b	2	3	4	5	6	7	8
30-35	Ta/St	Op	Sc/Op	Sc/Op/Ta	Sc	Sc/Op	Op	Ta	Sc/Op

Table 6-6 indicates the control modes that the questionnaire analysis gave for each of the nine questionnaire analysis indicators.

Table 6-7. The sums (observation/questionnaire) part of the control mode decision form for 30-35 minutes of Group 1 – scenario A.

Sums (Observation/Questionnaire)

	Sc	Op	Ta	St
30-35	1/2.8	0/3.8	1/1.8	0/0.5

In Table 6-7 the number of scrambled, opportunistic, tactical and strategic control modes is summarised for the observation analysis and the questionnaire analysis respectively. This means that in the observation analysis the sum of scrambled control modes is 1 and the sum from the questionnaire analysis for scrambled is 2.8. For the questionnaire analysis, in this case, question 2, scrambled, is counted as 0.5 and opportunistic as 0.5. For question 3 scrambled is counted as 0.33, opportunistic as 0.33 and tactical as 0.33.

Table 6-8. The standardised sums part of the control mode decision form for 30-35 minutes of Group 1 – scenario A.

Standardised Sums

CM

	Sc	Op	Ta	St	
30-35	0.56	0.42	0.45	0.05	Sc

When standardising the sums from Table 6-7 above the observation sum is divided by four and the questionnaire sum is divided by nine. These ratios are then added. For example, the standardised sum for scrambled is calculated as: $1/4 + 2.8/9 = 0.56$ and the standardised sum for opportunistic is calculated as: $0/4 + 3.8/9 = 0.42$. The control mode with the highest standardised sum is indicated in the CM column, in this case scrambled. This is shown in Table 6-8.

- *30 – 35 minutes – team performance assessment diagram*

The control mode in the team performance assessment diagram for the current time period 30 – 35 minutes is the one indicated in the CM column: scrambled. This is indicated in Figure 6-2.

6.2.2 Group 1 – scenario B

The team worked in a tactical control mode for the major part of the session. For two five minute intervals they worked on a level somewhere between tactical and optimistic.

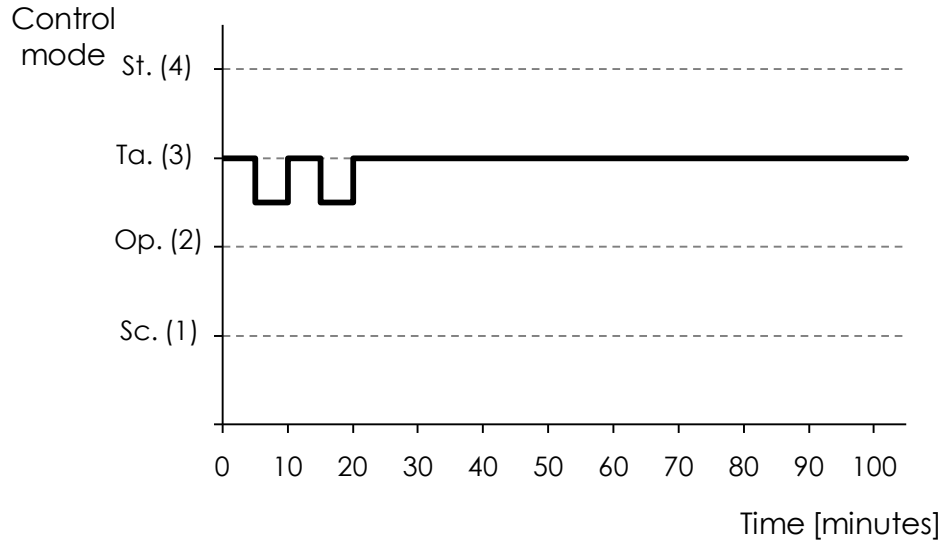


Figure 6-3. Team performance assessment diagram for Group 1 – scenario B.

6.2.3 Group 2 – scenario A

The team worked in a tactical control mode for the entire session.

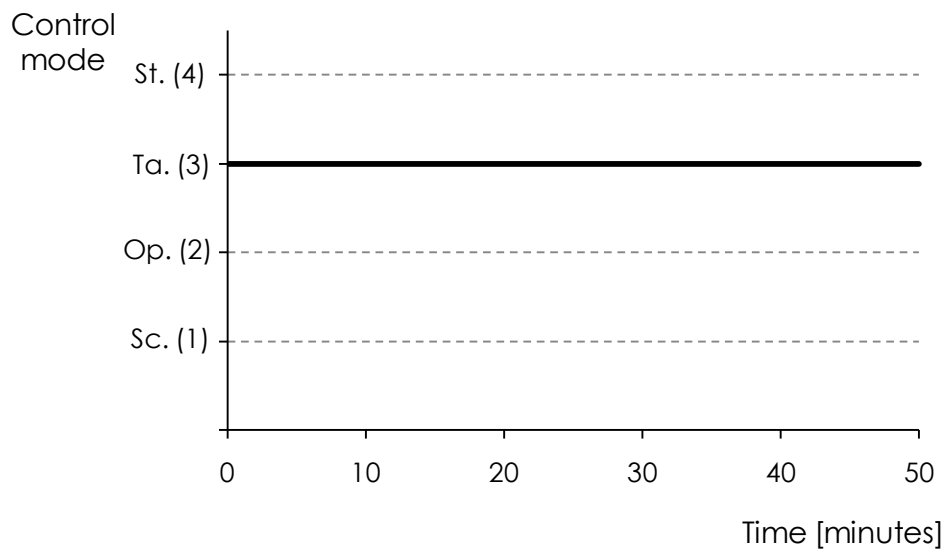


Figure 6-4. Team performance assessment diagram for Group 2 – scenario A.

6.2.4 Group 2 – scenario B

The team worked in a tactical control mode for the major part of the session. At one point they were working on a level somewhere between tactical and strategic. This period lasted for five minutes.

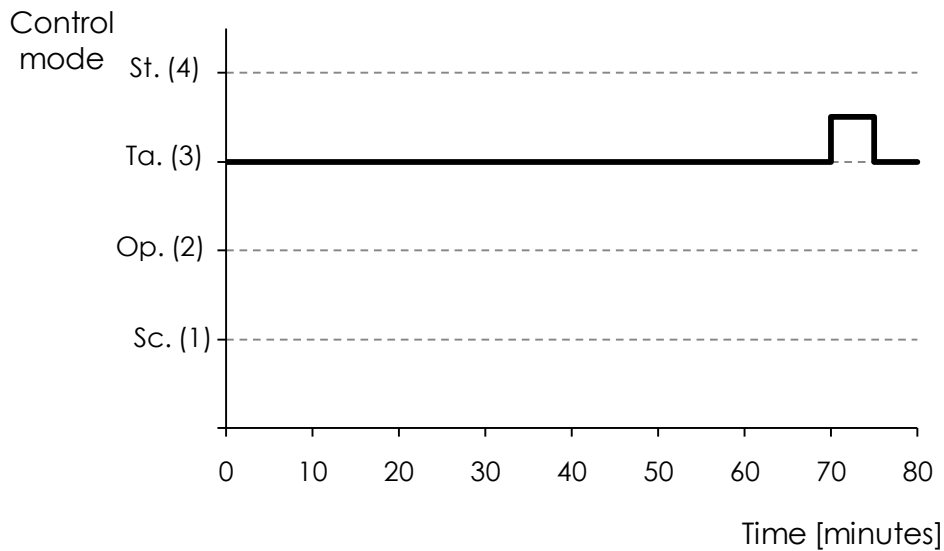


Figure 6-5. Team performance assessment diagram for Group 2 – scenario B.

6.2.5 The impact on result of length of time interval

The results from the sensitivity analysis on time intervals are presented in Figure 6-6 to Figure 6-9. Each diagram shows the team performance assessment diagram based on five and ten minute intervals respectively for one session.

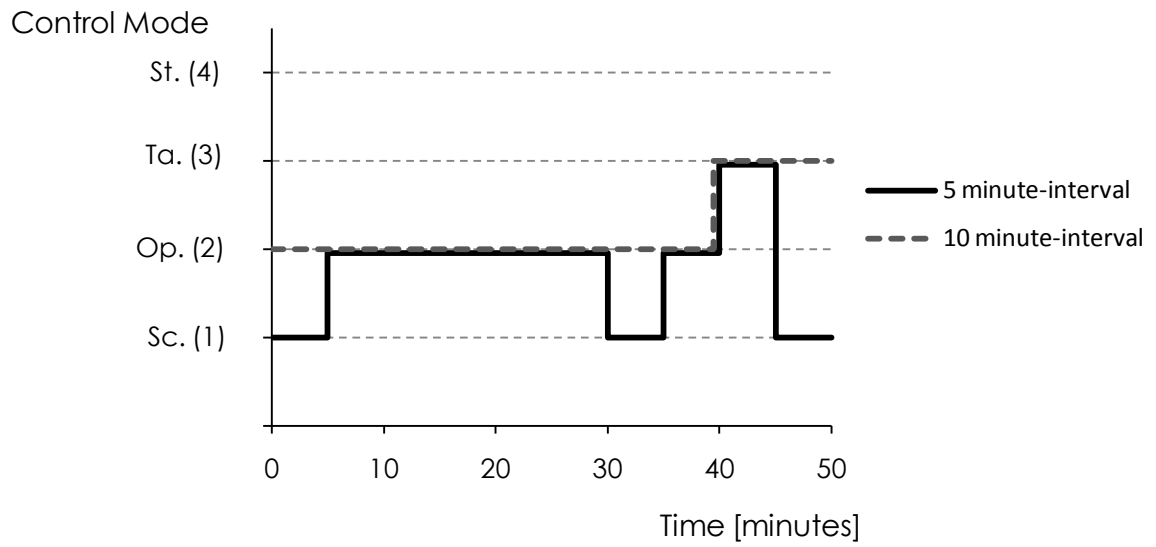


Figure 6-6. Sensitivity analysis on time intervals for Group 1 – scenario A.

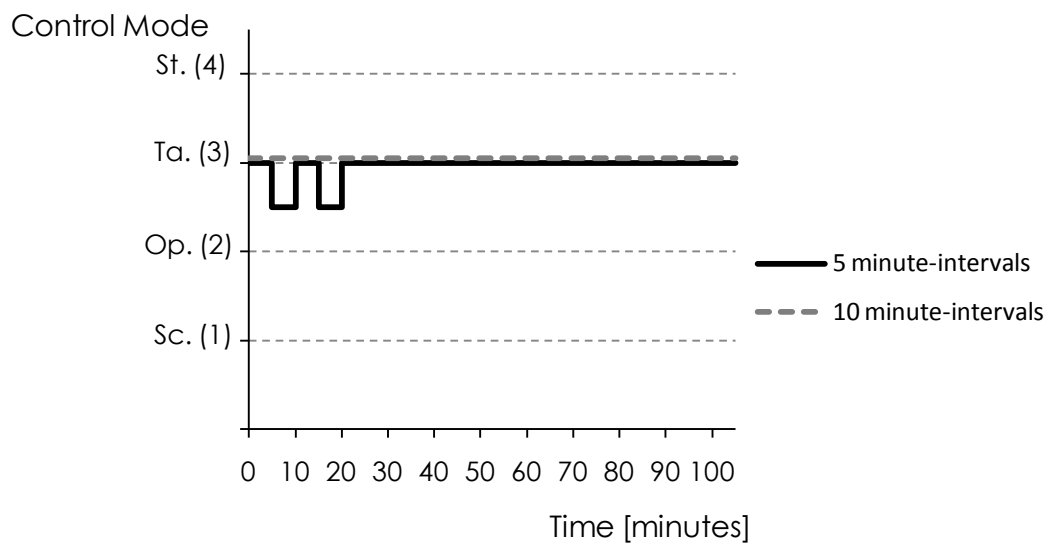


Figure 6-7. Sensitivity analysis on time intervals for Group 1 - scenario B.

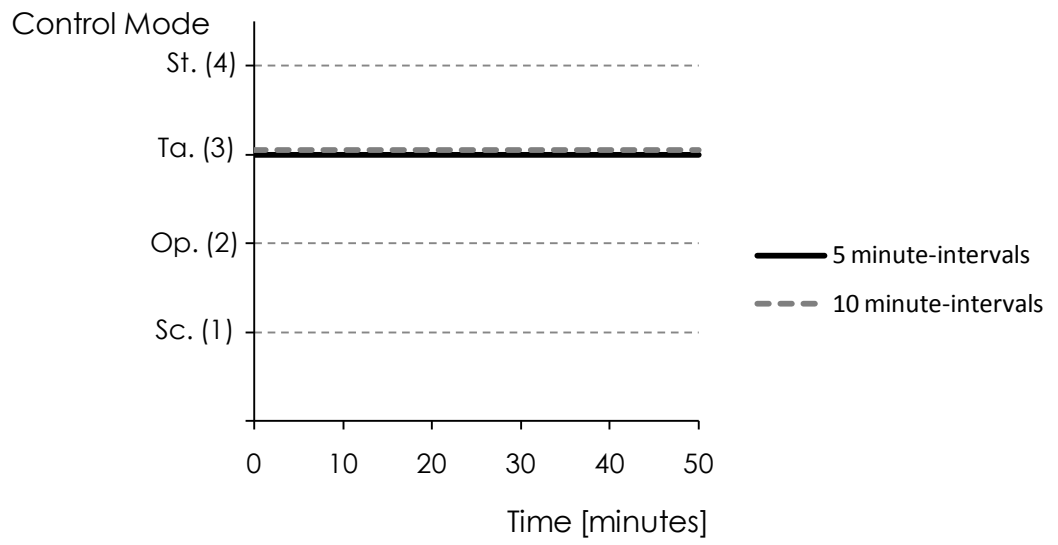


Figure 6-8. Sensitivity analysis on time intervals for Group 2 – scenario A.

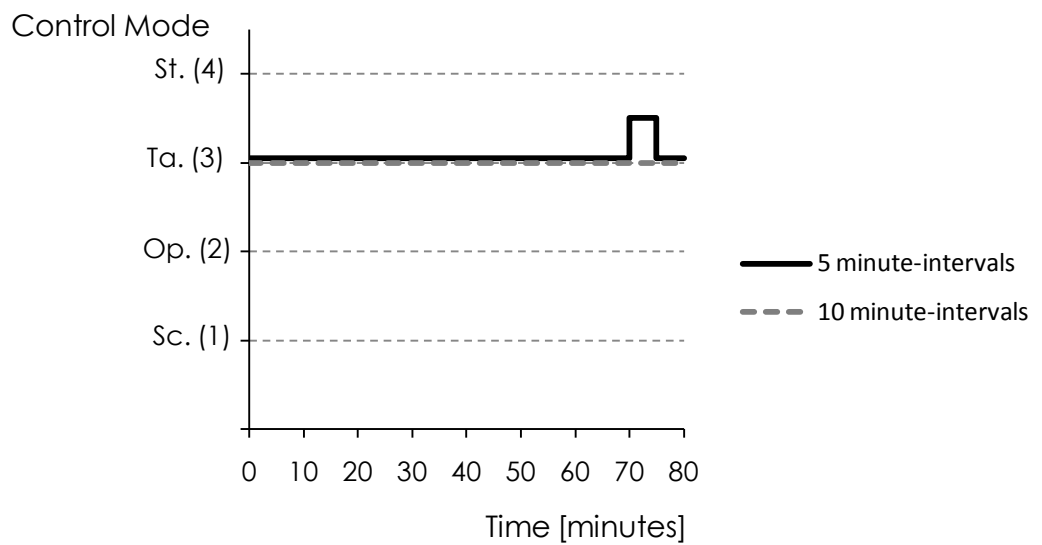


Figure 6-9. Sensitivity analysis on time intervals for Group 2 – scenario B.

Chapter 7 • Analysis of results

Based on the results of the protocol development and the pilot study the protocol was analysed with respect to its design criteria and the team performance assessment process. The purpose was to identify the parts of the protocol that works and the parts that needed to be further developed in future research and studies.

7.1 Design criteria

The six design criteria that were established in Chapter 4 were evaluated one at the time. The purpose was to identify which design criteria that had been fulfilled by the protocol and which had not.

7.1.1 The protocol shall be based on control and COCOM

The protocol is based on the contextual control model (COCOM). No modification of the protocol is needed for this criterion.

7.1.2 The protocol shall be used in natural context

The commanding staff training building at MSB College Revinge is built to be as similar as an ordinary commanding staff space as possible. The protocol can therefore be used in a training environment built to be a copy of the natural environment (not a laboratory). No modification of the protocol is needed for this criterion.

7.1.3 The protocol shall be generic

Nothing can be said about this design criterion at the moment as the protocol only has been tested in a fire service environment. Further studies have to be conducted in other fields to verify the fulfilment of this criterion.

7.1.4 The protocol shall be user friendly

The protocol is not user friendly if several rooms are used during the session. It becomes difficult and time consuming to synchronise and analyse all the different recordings. It is therefore suggested that the protocol is limited to be used in situations where only one or a maximum of two rooms are used during the session. One should also weigh the merits and demerits of letting each participant

having their own microphone for sound recording in order to make it easier to hear conversations between participants.

7.1.5 The protocol shall be easy to update

The questionnaires can easily be adjusted to fit different situations by changing the time periods for which the questions shall be answered. It is also easy to add or remove questions from the questionnaire. The observation analysis can also be adjusted easily by changing the time interval for which the recording is to be analysed and parameters can easily be added or removed. The number of video cameras and sound recorders can also be adjusted to fit the session to be analysed. No modification of the protocol is needed for this criterion.

7.1.6 The protocol shall give comparable results

The results from the pilot study presented in Chapter 6 were compared both within each group (Group 1 scenarios A and B, Group 2 scenarios A and B) and between the groups.

The results show that the first performance of Group 1 (scenario A) fluctuates around the opportunistic control mode with four changes in control mode during the session. The second performance (scenario B) fluctuates around the tactical control mode with two changes in control mode during the session. The conclusion is that the control mode is generally higher in the second performance than in the first and that fluctuations are less frequent in scenario B than in scenario A.

The results from the first performance of Group 2 (scenario A) show a static tactical control mode. No fluctuations are identified. The second performance (scenario B) is rather similar to the first performance with the tactical control mode being dominant. However, the difference between the two performances is that the team manages to reach a level between tactical and strategic control modes in scenario B.

When comparing the first performances (scenario A) between the two groups the conclusion becomes that for Group 1 the performance fluctuates around opportunistic control mode whereas for Group 2 the performance is steady at the tactical control mode. Thus, the control mode is generally higher for Group 2 than for Group 1.

For the second performances (scenario B) both teams were working around the tactical control mode. Group 1 had two fluctuations towards opportunistic control mode and Group 2 had one fluctuation towards the strategic control mode. Thus, the performance of Group 2 was at moments in a higher control mode than the performance of Group 1.

According to the teams themselves they performed better in the second session than in the first. This was also the opinion of the instructors who also found that Group 2 generally performed better than Group 1.

When comparing the results from the team performance assessment with the opinions of the team members themselves and the instructors, it seems as if the result given by the protocol reflects reality. There is an indication, at least for this type of sessions, that the protocol gives comparable results. The protocol does not have to be modified regarding this design criterion for the moment. Further research should be undertaken to thoroughly verify this finding.

7.2 Data collection

The collection of data through observation and questionnaires was analysed with the purpose of identifying improvements for this step that could be used to update the protocol.

7.2.1 Observation

With so many as eleven participants (and another two in the counter play) there were many persons and actions to record. The large number of persons also created a lot of extra noise (from moving chairs et cetera) which later became disturbing during the analysis. It is recommended that the number of persons in a session is limited. If the task requires a larger team it is suggested that each participant has a microphone that records the speech from each person. This would make the protocol less user friendly.

7.2.2 Questionnaire and debriefing

The questionnaire was presented in English for the first session of day 2 (Group 1 scenario A). The participants had difficulties understanding the questions and in order to complete the questionnaire the questions had to be translated into Swedish ad hoc. For the remaining three sessions the entire questionnaire was translated into Swedish beforehand. This was appreciated by the participants. It is thus recommended to translate the questionnaire to a language that the participants are familiar and comfortable with.

The participants gave remarks on questions 1 and 7 in the questionnaire. A question where the answer “yes” results in that the answer has to be elaborated may cause false answers to the question (“no” or “don’t know” when the actual answer would be “yes”). This problem did not occur in this pilot study but the evaluator should be observant and look for this when the participants are debriefed after the session.

Question number 3 regarding comparison of decision alternatives was the question most frequently not answered or answered “don’t know”. Questions number 7 and 8 regarding the use of rules and procedures were also among the questions less frequently answered. This was the fact regardless of the language of the questionnaire. Thus, it should not depend on whether the participants had difficulties understanding the question in the first scenario for Group 1 when the questionnaire was in English.

One reason as to why question number 3 frequently was not answered or answered “don’t know” could be that this was a commanding staff exercise. Their task was not to make any decision but to retrieve decision alternatives and present them to the officer in charge. But if question number 3 generates similar patterns in future studies it should be considered to reformulate or remove the question.

Questions number 7 and 8 might be less frequently answered due to the lack of experience from the participants in this field. For most of the participants it was the first time that they encountered commanding staff work. They may therefore not have had any experience of the rules and procedures appropriate for such work. They did have approximately three hours of lectures regarding commanding staff work before the sessions but this might have been too little or too close to the sessions. The instructors responsible for the exercises also stressed that this short introduction to commanding staff work would not make the participants full fledged commanding staff members. It would only give them a starting point for future training in the field.

Concerning the specifications of goals, rules and procedures in questions 1 and 7 it could be said that they were answered in the individual questionnaires but not in the team questionnaire. Answering the individual questionnaire takes time, especially when the answers shall be clarified. It could be an idea to have the specifications only on the questionnaire of the team as the clarifications are of more importance and interest for that questionnaire. By doing so, more focus is put on the team questionnaire and less on the individual.

7.3 Analysis

The analysis part of the protocol was assessed for each of the three steps separately. The purpose was to clarify which parts of the analysis worked and which needed improvement.

7.3.1 Observation analysis

Recording what was said in the counter play was valuable as it enhanced the understanding of the situation. With much noise in the room it was sometimes

difficult to hear what the team members were talking about on the telephone or over the radio. It was then instead possible to listen to what the counter play was saying and in that way finding out what the participants were talking about.

All parameters in the observation analysis form could not be seen in all time intervals. This was expected as time intervals were kept relatively short. It might be so that in other types of environments more parameters can be identified during the same time interval.

Having four parameters to look for in the observation analysis was enough. Looking for more parameters would make it easier for the evaluator to miss something or become confused or stressed by the task.

The comparison of decision alternatives in an explicit way occurred more often than expected. The comparisons tended to become explicit when team members were working together to solve the same task because they then discussed the problem out loud. But it is likely that many decisions were compared only in the minds of the participants and were therefore not recorded. Therefore it should be considered to remove this parameter from the observation analysis and only include it in the questionnaire.

A difficulty arose during the observation analysis due to ambiguity in the alternatives in relation to “not observed” in the observation analysis form. It was for example difficult to separate “no information seeking” from “not observed”. In the pilot study it was chosen to indicate “no information seeking” when the participants clearly just passively sat and waited for information to come to them instead of actively seeking information. When the team members were busy with other tasks, the information seeking parameter was marked “not observed”. The difference between the two alternatives and how they shall be used have to be clarified for the future.

When video recording the session it is important to place the camera so that it records as much of the room as possible. When analysing the recording it was frustrating to know that there was something interesting to watch outside the screen but not being able to “turn the camera”. Apart from frustration, this might also cause errors in the observation analysis.

If the evaluator is experienced in analysing the performance using the parameters in the observation analysis form and if the team only uses one room for the session it might be an idea to do the observation analysis without recording the session. The evaluator could then fill in the form while watching the team perform in real time.

7.3.2 Questionnaire analysis

The time available for filling in the questionnaires during the pilot study was limited. It was also done just before lunch and just before the end of the day. The situation therefore became stressed and no clarifications or comments were left on the questionnaire of the team. This made the questionnaire analysis somewhat difficult. Especially when the teams in question 1 had stated that they worked towards goals but did not specify them. During the analysis it was chosen to use the team's positive answer to working towards goals for control mode decision in question 1. In question 1b on the other hand, the answer could be zero goals at the same time as the team had answered yes to question 1. Guidelines for how this situation is going to be handled must be available for future use of the protocol.

Another problem that arose during the questionnaire analysis was how to decide a control mode for question 1b if the number of goals was zero. Today, the key says that one goal corresponds to scrambled, two to opportunistic and three or more to tactical and strategic. For the pilot study zero goals were chosen to correspond to scrambled control mode, as having zero goals could be seen as having little control. Another solution for future studies could be that zero goals results in a dash (-).

Questions 1 and 1b regarding goals were difficult for the participants to answer and for the evaluator to specify a number of goals. The truth might be that it is rare for teams to explicitly set up goals for their work. If the same difficulties arise in future studies, it maybe should be considered to reformulate or removing questions 1 and 1b from the protocol. But it would also be possible to change the way teams work so that they set up goals to a greater extent instead of changing the questionnaire. Having defined goals could be something that could enhance team performance and thus be desirable.

In this pilot study the teams did not see the questions before the first session. When they were to fill in the questionnaire after the second session, they had obviously seen the questionnaire before. There was a difference in how the team discussed the questions after the second session compared to after the first. It seemed as if they reflected more over the questions the second time. The reason could be that when the team knew the questions beforehand, they had the possibility to reflect about their performance in terms of the questions during the session. This should give higher validity to the team's answers to the questionnaire. For future studies, it might therefore be a good idea to present the questionnaire to the team before the session.

7.3.3 Control mode decision

The control mode decision form could be filled in without difficulties. If the protocol is to be widely used it could be an idea to make a script in Microsoft Excel, or similar software, that would facilitate the calculations that determines the control modes.

7.4 Team performance assessment

Five minute intervals were used for the analysis of control modes. This was complemented by a sensitivity analysis where ten minute intervals were used. The results from this, presented in Chapter 6, show that when longer periods were used some of the changes in control modes are missed.

Having a too short time interval could on the other hand result in that many parameters are indicated as “not observed” because the team did not have enough time during that interval to both seek information, compare decisions and use rules and procedures.

With respect to that control modes ought to last for longer coherent time periods, except for when disturbances and shifting of tempo occurs, it is suggested that longer time periods are used as a basis for the analysis. The time intervals could be made shorter at points where changes in control modes are expected to occur. But as the team performance assessment diagrams in Chapter 6 show, the control modes tend to last for longer periods of time. Using as short as one minute intervals is therefore not recommended. For the scenarios studied in this work, a five minute interval seemed to capture the changes in control modes.

The scrambled and strategic control modes should not be frequently occurring (Hollnagel, 1993a). The result of the pilot study shows that most time is spent in the opportunistic and tactical control modes while little or no time is spent in scrambled and strategic. Thus, the results from the pilot study are in line with the theories of Hollnagel.

Hollnagel (1993b) also states that loss of control in emergencies corresponds to opportunistic or scrambled control modes and if control is regained it will typically be on the tactical level. This can be seen in the results from the pilot study where Group 1 stayed on the opportunistic level during the first session and on the tactical during the second session.

The transition between control modes in the pilot study also follows Hollnagel's (1993a) theory that the transitions are linear but that transitions can take place between tactical and scrambled, but it is rare. In the pilot study all transitions were

linear except for one transition in Group 1's scenario A where the control mode changed directly from tactical to scrambled.

7.5 Other reflections

The protocol should not be used for assessing team performance when team members are complete beginners in a field (unless the purpose is to compare the performance of novices and experts). It is easier to verify whether procedures and rules are followed if the participants have some experience and are fully aware of the procedures and rules they ought to follow. Hopefully, experienced participants states clearer goals for their work than beginners.

The team members worked in different rooms and worked as several smaller teams rather than as one team. This was clearly seen when the participants were filling in the questionnaires because the members that had been working together filled in their questionnaires more similar comparing to the rest of the team. The same applies to the observation. It was in this case chosen to see all sub groups as one large group when analysing the recordings. For example if information seeking was only carried out in one of the rooms, it was said that the team in general sought information. This problem would be smaller if the team was to work together in one room only. For this reason, it is recommended that the protocol is limited to be used in situations where the team members are not separated.

7.6 Summary

The analysis, and specifically the points where the protocol has to be modified, is summarised below.

Design criteria

- Test the protocol in other environments to assess if it is generic.
- Limit the number of rooms or number of data collection equipment to facilitate analysis and make the protocol more user friendly.

Data collection

Observation

- Improve sound recording or limit the number of participants to avoid disturbing noises.

Questionnaire and debriefing

- Translate the questionnaire into an appropriate language.
- Consider reformulating or removing questions 1 and 1b.
- Ask for specifications of answers only in team questionnaire.
- Consider presenting the questionnaire to the participants before the session.

Analysis

Observation analysis

- Clarify the difference between "not observed" and for example "no information is being sought".
- Consider removing the comparison of decision parameter from the observation analysis and only include it in the questionnaire.

Questionnaire analysis

- Specify how the answers to question 1 and 1b shall relate to each other.

Other

- Do not use protocol to assess team performance when team members are complete beginners.

Chapter 8 • Discussion

In this chapter the findings of the work presented in this dissertation are discussed in terms of fulfilment of objectives and research questions, and strengths and weaknesses of the work. Finally, areas for future research are suggested.

Through the development of the team performance assessment protocol the objective of the work has been met and the protocol also gives an answer to the research question “How can team performance be assessed in terms of control?”

In relation to the now widely used behavioural marker protocols the protocol developed in this work assesses the performance without using vague terms such as thoroughly, effective or properly that need to be interpreted by the evaluator. The protocol presented in the dissertation also tries to avoid the limitations of the behavioural marker system, for example observer bias and overload.

A control mode is not something that objectively can be observed but something that is created by the evaluator through the observation. However, the creation of control modes is based on observing parameters in the team’s activity that are clear and unambiguous. Thus, the focus is on cognition in the world rather than on cognition in the mind. Also, the result of the assessment is not presented in terms of good and poor, which is the case for the behavioural marker system where the interpretations of the evaluator can affect the assessment.

Changing the focus from good and poor behaviours towards the team’s activity was one of the expected academic contributions of the work presented in Chapter 1. The two other expected academic contributions, an application of the cognitive systems engineering (CSE) theories and a review of the control and performance definitions have also been reached. The work has also given some empirical validity to the CSE theories by verifying the theories on how transitions between control modes ought to occur, which control modes that should be expected in emergencies and how long a team should stay in one control mode. The data is somewhat limited and further studies could give opposite results. However, the two practical expected contributions are fulfilled through the development of the protocol and the pilot study presented in this work.

The protocol shall according to the design criteria be generic, thus it shall be designed to be used in various fields of interest for team performance assessment. It shall also be generic in that it can be used for scenarios with different complexity within a certain field. With the protocol developed in this work, this should be possible and the hypotheses would be that when complexity increases this could trigger degradation in control mode and difficulties to reach higher control modes. Hence, the difference would be revealed through differences in control modes.

Team performance shall be assessed in a training environment when using the designed protocol. The purpose of using it could for example be to investigate effects of training. In a real world scenario, where stress can be higher and real human lives can be at stake, it is not certain that the relative difference in learning and experience will be the same as in the training environment. This is important to have in mind when assessing how teams would perform in real scenarios.

During the development of the protocol one of the biggest challenges was seen as the process of defining control parameters as observable or non observable. But categorising the parameters wrong should not be a problem because if a non observable parameter mistakenly was to be categorised as observable it would result in that it was indicated “not observed” throughout the evaluation. Thus, it would not affect the assessment as it would not generate a control mode. In the protocol all parameters, both observable and non observable, are examined using the questionnaire so that all parameters will be analysed in one way or another. This is in contrary to the behavioural marker system where cognitive (that is non observable) parameters are assessed by the evaluator and not by using a questionnaire.

One question to be addressed is whether the categorisation of parameters into observable and non observable parameters actually can be done. The fact that some parameters have to be perceived subjectively, such as subjectively available time, at least indicates that non observable parameters exist. At the same time, the parameters that are non observable for the evaluator can be observable and perceived by the participant. Because of this, the observation analysis is well complemented by the questionnaire analysis. The pilot study also confirms that some parameters can be seen such as information seeking and the effect of a powerful indicator on ongoing activities. The conclusion would therefore be: yes, the categorisation of parameters into observable and non observable can be done.

When control modes are decided for each time interval in the studied session, the control modes indicated through the observation and questionnaire analyses are weighed equally and standardised. Today, no information is available on how the different parameters relate to each other in importance and thus there is no

guidance in how this standardisation and weighing should be done. It is also difficult to decide if the control modes from the observation data, created by the evaluator, should weigh more or less than the control modes indicated by the questionnaire filled in by the team. One could argue that one of the most important parameter for deciding control modes, subjectively available time, is subjective and is therefore best answered by the team itself. But at the same time, the team may have difficulties remembering exactly when things occurred during the session and this may affect the control modes retrieved from the questionnaire analysis. This problem, with determining when in time things happened, will not occur in the observation analysis as the session is recorded. Hence, if deciding to weigh the parameters differently, today this would also be a subjective decision and no better than weighing them equally.

The observable parameter “comparison of decision alternatives” ought to be discussed in terms of naturalistic decision making. It is in the protocol assumed that the choice of the first acceptable alternative is a result of a lower control mode. This would be true for novices that do not have experience from the field and similar scenarios. But according to the theories of naturalistic decision making (cf. Lipshitz, Klein, Orasanu & Salas (2001)) an expert with experience from the field can, by using cognitive heuristics, choose the first acceptable alternative but still have control over the situation. This problem has not been handled in this work but should be noted in future studies.

Question 3 in the questionnaire is also on the comparison of decision alternatives and it was unclear whether it was difficult for the participants to reflect over this or not. But the answers to the questionnaires and the recordings of the team filling in the questionnaire do not reveal that there were more difficulties for the team answering this question than any other question.

The question in the questionnaire regarding information seeking (question 6) was complemented with question 9 on data overload. Question 9 was not used for assessing team performance in this study but was added to the protocol because information handling is not just about seeking information. There are also situations when teams are bombarded with information without seeking it. Both are related to the handling of information but in different ways. Information seeking can be seen as a result of the degree of control (if the situation is controlled the team knows which information that has to be sought and has time to do it). Data overload on the other hand affects the degree of control because too much information results in that the time for handling the information becomes limited and with limited time comes loss of control. So this aspect of information handling is interesting for assessing the degree of control of a team and should be further investigated in future research.

During the pilot study the evaluator, together with an instructor, were present in the room where the participants were working. This is against what was said in Chapter 4. The impression from the pilot study is however that this did not affect the team and their performance. They were most of the time fully engaged in the task and did not seem to pay attention to the instructor and the evaluator. But it is obviously impossible to know how the teams would perform in the pilot study if nobody except the team members was present in the room. If, however, the evaluator can be present in the room without affecting the team it would be a benefit. For example could the performance of pilots be assessed by an evaluator being present in the cockpit during a regular flight.

Due to limited time for the teams to fill in the questionnaire, the questionnaires were not discussed with the participants after filling them in. Neither were the answers regarding goals and procedures specified. This was a disadvantage for the analysis and if this would have been done more deeply it might have resulted in clearer answers to the questions and in deeper understanding of the team's opinion. To avoid this in the future, there should be enough time available after the session for filling in the questionnaire. Twenty to thirty minutes which was available in this study, was clearly not enough. Being an added part to an already existing exercise was not optimal for evaluating the developed protocol.

In the conducted pilot study, the observation analysis was only carried out by one person. If there had been time for a debriefing session, this would also only have been done by one person. No investigation has been done on how a person's way of analysing the collected data and how a person's way of discussing the questionnaire with the team affects the control modes and in turn also the team performance assessments. But, it is difficult for the evaluator to be completely objective when doing the assessment and two persons will to some degree always make different assessments. The important thing to remember is instead to make the assessment clear in that assumptions and thoughts shall be noted so that another person afterwards can judge how the assessment was done.

The teams working in the pilot study were rather large teams, sometimes working individually in separate rooms. The question is how this individual work, when the team members might not interact very much with each other, should relate to the entire team's work. One way to handle this is that the evaluator just clearly notes his or her observations regarding the subject and that these observations for a qualitative complement to the team performance assessment based on the developed protocol.

The protocol has not been tested in such extent that it now can be used to assess team performance in terms of control. However, when the protocol has been further validated through more studies, the goal is that the protocol shall be used

to assess team performance in various fields, such as aviation, in fire services and in health care.

8.1 Future research

Based on the results from the work presented in this dissertation, some areas can be identified for further studies.

- For future studies the protocol has to be updated according to the findings from this work. These are summarised in section 7.6 and specifically presented throughout Chapter 7.
- In order to validate the protocol and to fulfil the design criteria the protocol has to be further tested, also in other domains than fire services. The question to be answered is: Is the protocol generic?
- Do the theories of naturalistic decision making regarding novices and experts affect the team performance assessment protocol? Shall there be different protocols for novices and experts that take into account that experts can choose the first available alternative and still be in control of the situation? These are interesting questions to address in future research.
- In what way does data overload affect the team's control of the situation? The contextual control model (COCOM) only addresses the question about information seeking and does not reflect over how data overload affects control modes. More studies are needed to look into this question.

Chapter 9 • Conclusions

In order to answer the research question “How can team performance be assessed in terms of control?” a literature study was conducted. Taking off from the literature, a protocol for assessing team performance in terms of control was developed based on the theories of cognitive systems engineering (CSE). This protocol was then tested in a pilot study. The main points of the work are summarised below.

- A protocol for assessing team performance in terms of control has been developed. This was done by reviewing the definition of control and performance from CSE and by creating a language for capturing the team’s work and performance.
- The developed protocol changes the focus of team performance assessment from good and poor behaviours toward the team’s activity.
- The pilot study shows that it is possible to identify differences in performance by using the protocol.
- The pilot study also gives empirical validity to the field of CSE by verifying the theories of the contextual control model (COCOM).

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Appendix A • Protocol

This appendix contains:

- The observation analysis form (A.1).
- The questionnaire (A.2 and A.3).
- The coding key to the questionnaire (A.4).
- The control mode decision form (A.5).
- The team performance assessment diagram (A.6).

A.1 Observation analysis form

Time interval: _____

1. Information seeking

(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from _____* number of sources (tact.)
- For the future and from and from _____* number of sources (strat.)
- Not observed

Control mode: _____

2. Comparison of decision alternatives

(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: _____

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: _____

4. A powerful indicator attracts all attention and

ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: _____

* Before the observation analysis takes place, the number of possible sources for information seeking has to be defined. For strategic, the maximal number of sources shall be indicated. For tactical, the number shall be lower than the maximal number.

A.2 Questionnaire (individual)

Questionnaire - Individual

This questionnaire is about how well you think the group worked during the session and is a complement to the video recording that was done during the practice. This questionnaire shall be answered individually. Then one questionnaire shall be answered by the group together and the answers shall reflect the group's general view of the work.

Each question shall be answered for three different time intervals: the first third of the session, the second third of the session and the last third of the session. Check one of yes/no/no answer (or another corresponding alternative) for each time interval on every question. Thus, each question shall be answered three times. For questions 1 and 7 you are asked to specify your answers. There is also room for you to comment each question and clarify the answers.

Below is an example of what an answer can look like.

Example: We were hungry, tired and thirsty and this affected our work.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			X
No	X		
Don't know		X	

Comments and clarifications: We do not remember how we felt in the middle of the session because the work was very stressful at that time and we did not have time to reflect on how we felt.

1. During the session we had goals that we worked towards.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

If yes, specify the goals for each time interval:

Comments and clarifications:

2. We think that we had enough time to handle the situation the way we wanted.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

3. We compared the different decision alternatives that were available and we chose the very best alternative, instead of the first acceptable.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

4. After accomplishing an action we evaluated the outcome that this action resulted in.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

5. We were able to predict how the situation was going to develop.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

6. We sought information to solve the problem and handle the situation in the following extent:

	In the beginning of the session	In the middle of the session	In the end of the session
No information seeking			
Just what was needed for the moment			
Both information needed for the moment and information needed for future decisions and actions			
Don't know			

Comments and clarifications:

7. We followed rules and procedures that we had learned for this or similar situations.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

If yes, specify the rules and procedures:

Comments and clarifications:

8. We had enough time to use rules and procedures that were appropriate for the situation.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

9. There was too much information and we could not attend to all of it.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

A.3 Questionnaire (team)

Questionnaire - Team

This questionnaire is about how well the group worked during the session and is a complement to the video recording that was done during the practice. One questionnaire shall be answered by the group together and the answers shall reflect the group's general view of the work.

Each question shall be answered for three different time intervals: the first third of the session, the second third of the session and the last third of the session. Check one of yes/no/no answer (or another corresponding alternative) for each time interval on every question. Thus, each question shall be answered three times. For questions 1 and 7 you are asked to specify your answers. There is also room for the group to comment each question and clarify the answers.

Below is an example of what an answer can look like.

Example: We were hungry, tired and thirsty and this affected our work.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			X
No	X		
Don't know		X	

Comments and clarifications: We do not remember how we felt in the middle of the session because the work was very stressful at that time and we did not have time to reflect on how we felt.

1. During the session we had goals that we worked towards.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

If yes, specify the goals for each time interval:

Comments and clarifications:

2. We think that we had enough time to handle the situation the way we wanted.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

3. We compared the different decision alternatives that were available and we chose the very best alternative, instead of the first acceptable.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

4. After accomplishing an action we evaluated the outcome that this action resulted in.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

5. We were able to predict how the situation was going to develop.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

6. We sought information to solve the problem and handle the situation in the following extent:

	In the beginning of the session	In the middle of the session	In the end of the session
No information seeking			
Just what was needed for the moment			
Both information needed for the moment and information needed for future decisions and actions			
Don't know			

Comments and clarifications:

7. We followed rules and procedures that we had learned for this or similar situations.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

If yes, specify the rules and procedures:

Comments and clarifications:

8. We had enough time to use rules and procedures that were appropriate for the situation.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

9. There was too much information and we could not attend to all of it.

	In the beginning of the session	In the middle of the session	In the end of the session
Yes			
No			
Don't know			

Comments and clarifications:

A.4 Coding key to questionnaire

Question 1b is not answered by the participants but can be answered by the evaluator according to the team's answer to question 1 together with analysing the video recording.

1. **We knew which our goals were for the session and we worked towards them.**

Yes: tactical, strategic

No: scrambled, opportunistic

Don't know: -

- 1b. **How many goals were listed in question 1 and at the same time explicitly stated during the session (check the video recording)?**

One: scrambled

Two: opportunistic

More than two: tactical, strategic

Don't know: -

2. **We think that we had enough time to handle the situation the way we wanted.**

Yes: tactical, strategic

No: scrambled, opportunistic

Don't know: -

3. **We compared the different decision alternatives that were available and we chose the very best alternative, instead of the first acceptable.**

Yes: strategic

No: scrambled, opportunistic, tactical

Don't know: -

4. **After accomplishing an action we evaluated the outcome that this action resulted in.**

Yes: opportunistic, tactical, strategic

No: scrambled

Don't know: -

5. **We were able to predict how the situation was going to develop and we could plan our work in advance.**

Yes: tactical, strategic

No: scrambled, opportunistic

Don't know: -

6. **We sought information to solve the problem and handle the situation in the following extent:**

No information seeking: scrambled

Just what was needed for the moment: opportunistic

Both information needed for the moment and information needed for future decisions and actions: tactical, strategic

Don't know: -

7. **We followed rules and procedures that we had learned for this or similar situations.**

Yes: tactical

No: scrambled, opportunistic, strategic

Don't know: -

8. **We had enough time to use rules and procedures that were appropriate for the situation.**

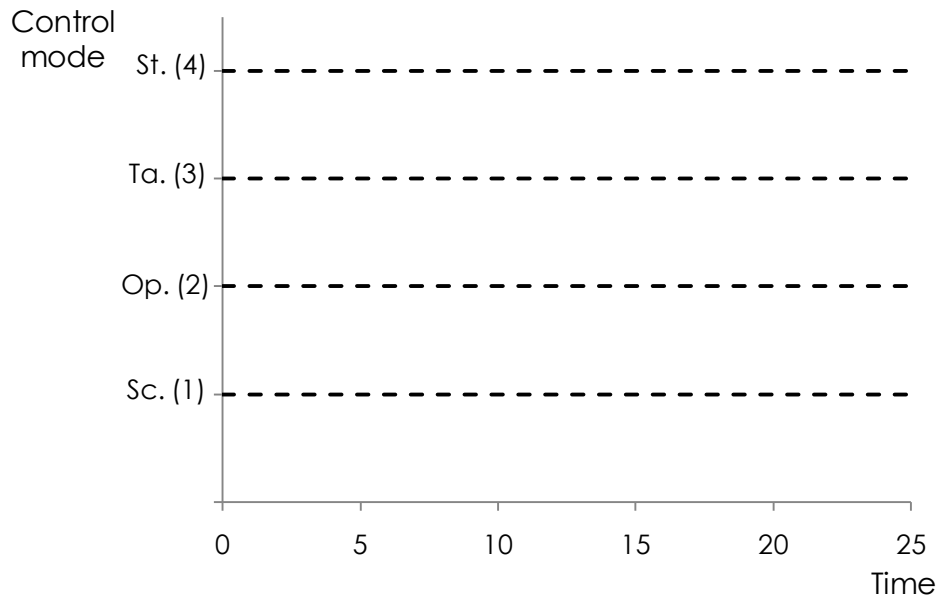
Yes: tactical, strategic

No: scrambled, opportunistic

Don't know: -

9. **There was too much information and we could not attend to all of it.**
Question number 9 was included in case the pilot study would show that this was a relevant question for the analysis.

A.6 Team performance assessment diagram



Appendix B • Group 1 – scenario A

This appendix contains results from the analysis of Group 1 – scenario A (plane crash). The results presented are:

- The observation analysis (B.1).
- The answers to the questionnaires (B.2).
- The control mode decision form (B.3).

B.1 Observation analysis

Time interval: 0:00 – 5:00

1. Information seeking (questions are asked, information is sought in computers, books etc.)

Control mode: Scrambled

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤5 sources (tact.)
- For the future and from and from 5 sources (strat.)
- Not observed

Acting very passively, just waiting for someone to call and give them information.

2. Comparison of decision alternatives (e.g. discussions on priorities)

Control mode: -

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Time interval: 5:00 – 10:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Opportunistic

The officer in charge on scene is asked about units on scene and about the crash.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: -

Time interval: 10:00 – 15:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Opportunistic

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

The officer in charge on scene is asked about the conditions on the scene.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: -

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.
Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 15:00 – 20:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Opportunistic

The officer in charge on scene is asked about units on scene and units on their way.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)**
- Not observed

Control mode:
Scrambled/tactical/strategic

Telephones are ringing but don't interrupt the meeting.

Time interval: 20:00 – 25:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Scrambled

- No information seeking (scrambled)**
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

Acting passively. Sharing of information within the team and repeating of information already known.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: Opportunistic

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)**
- The alternatives are evaluated (tactical, strategic)
- Not observed

Discussions on how fire stations are going to be staffed during the accident.

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 25:00 – 30:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Opportunistic

Resources from other organisations are investigated as an assignment from the officer in charge.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)**
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Opportunistic

Units planned to cover up at the fire station in the previous interval are sent to the accident.

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: =

Time interval: 30:00 – 35:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Scrambled

- No information seeking (scrambled)**
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤5 sources (tact.)
- For the future and from and from ≥ sources (strat.)
- Not observed

Problems with the internal information flow. No time to seek information.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: _

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: _

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 35:00 – 40:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Scrambled

- No information seeking (scrambled)**
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Only receiving information from officer in charge. No information is sought actively by the team

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: Opportunistic

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)**
- The alternatives are evaluated (tactical, strategic)
- Not observed

Discussions on staffing of fire stations.

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: =

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 40:00 – 45:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Tactical

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from \geq sources (strat.)
- Not observed

Information about weather is sought from meteorological institute. (For the future).

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: _

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: _

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 45:00 – 50:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Scrambled

- No information seeking (scrambled)**
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Passively waiting for information.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: _

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: _

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

B.2 Questionnaire

The answers have been divided into different tables for the different time intervals. All the individual answers are presented together with the answers from the team's questionnaire.

The questionnaire was answered for two time intervals:

1. From the beginning of the session and until they found out that there were 80 passengers left in the airplane. Time: 0 – 13 minutes. See Table B-1.
2. From the point they found out that there were 80 passengers left in the airplane and until the end of the session. Time 13 – 50 minutes. See Table B-2.

Table B-1. Questionnaire answers for the first time interval (0-13 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	Yes	Yes	Don't know	No	No	Moment only	Yes	Yes	No
	2	Yes	Yes	-	No	No	Moment only	-	-	-
	3	Yes	Yes	No	No	No	Moment only	Yes	Yes	No
	4	Yes	No	-	No	No	-	Yes	No	Yes
	5	No	No	No	No	No	Moment only	No	No	Yes
	6	No	No	No	No	No	-	Yes	No	-
	7	Yes	Yes	Yes	No	No	Moment only	Yes	-	-
	8	Yes	No	No	No	No	Moment only	Yes	No	Yes
	9	Yes	No	Don't know	No	No	Moment only	Yes	No	Yes
	10	Yes	Yes	Yes	No	No	Moment only	Yes	No	Yes
	11	-	No	Yes	No	No	Moment only	Don't know	Don't know	Yes
Team	Yes	No	No	No	No	Moment only	Yes	No	Yes	

Table B-2. Questionnaire answers for the second time interval (13-50 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	Yes	No	Don't know	No	No	Moment only	Don't know	Yes	No
	2	Yes	Don't know	-	No	No	None	-	-	-
	3	Yes	No	No	No	No	Moment & future	Yes	Yes	No
	4	Don't know	Don't know	-	No	No	-	Yes	No	No
	5	Yes	No	No	No	No	Moment only	Yes	No	Yes
	6	Yes	No	No	No	No	-	Yes	No	-
	7	Yes	Yes	Don't know	Yes	Yes	Moment & future	Don't know	-	-
	8	Yes	No	No	No	No	Moment & future	Yes	No	Yes
	9	Don't know	No	Don't know	No	No	Moment & future	Yes	No	Yes
	10	Yes	No	No	No	No	Moment & future	Yes	No	-
	11	-	No	Yes	No	No	Moment & future	Don't know	Don't know	No
Team	Yes	No	No	No	No	Moment only	Yes	No	Yes	

B.3 Control mode decision form

Two control mode decision forms are presented. The first, presented in Table B-3, is for the original analysis of five minute intervals. The second control mode decision form, Table B-4, is a result from the sensitivity analysis on time intervals where a ten minute interval was used.

Table B-3. Control mode decision form with five minute intervals for Group 1 - scenario A.

Time interval	Observation analysis				Questionnaire analysis								Sums (Observation/Questionnaire)				Standardised sums				CM	
	1	2	3	4	1	1b	2	3	4	5	6	7	8	Sc	Op	Ta	St	Sc	Op	Ta		St
0-5	Sc	-	Ta	-	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	1/2.8	0/3.8	1/1.8	0/0.5	0.56	0.42	0.45	0.05	Sc
5-10	Op	-	Ta	-	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	0/2.8	1/3.8	1/1.8	0/0.5	0.31	0.67	0.45	0.05	Op
10-15	Op	-	Ta	-	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	0/2.8	1/3.8	1/1.8	0/0.5	0.31	0.67	0.45	0.05	Op
15-20	Op	-	Ta	Sc/Ta/St	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	0.3/2.8	1/3.8	1.3/1.8	0.3/0.5	0.39	0.67	0.53	0.13	Op
20-25	Sc	Op	Ta	-	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	1/2.8	1/3.8	1/1.8	0/0.5	0.56	0.67	0.45	0.05	Op
25-30	Op	Op	Ta	-	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	0/2.8	2/3.8	1/1.8	0/0.5	0.31	0.92	0.45	0.05	Op
30-35	Sc	-	Ta	-	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	1/2.8	0/3.8	1/1.8	0/0.5	0.56	0.42	0.45	0.05	Sc
35-40	Sc	Op	Ta	-	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	1/2.8	1/3.8	1/1.8	0/0.5	0.56	0.67	0.45	0.05	Op
40-45	Ta	-	Ta	-	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	0/2.8	0/3.8	2/1.8	0/0.5	0.31	0.42	0.70	0.05	Ta
45-50	Sc	-	Ta	-	Ta/St	Op	Sc/Op	Sc	Sc/Op	Op	Op	Ta	Sc/Op	1/2.8	0/3.8	1/1.8	0/0.5	0.56	0.42	0.45	0.05	Sc

Table B-4. Control mode decision form with ten minute intervals for Group 1 – scenario A.

Time interval	Observation analysis								Questionnaire analysis								Sums (Observation/ Questionnaire)						Standardised sums			CM
	1	2	3	4	1b	2	3	4	5	6	7	8	Sc	Op	Ta	St	Sc	Op	Ta	St	Op	Ta	St			
0-10	Op	-	Ta	-	Ta /St	Op	Sc/ Op /Ta	Sc	Sc/ Op	Op	Ta	Sc/ Op	0/ 2.8	1/ 3.8	1/ 1.8	0/ 0.5	0.31	0.67	0.45	0.05	Op					
10-20	Op	-	Ta	Sc/ Ta /St	Op	Sc/ Op /Ta	Sc	Sc/ Op	Op	Ta	Sc/ Op	0.3 / 2.8	1/ 3.8	1.3 / 1.8	0.3 / 0.5	0.39	0.67	0.53	0.13	Op						
20-30	Op	Op	Ta	-	Ta /St	Op	Sc/ Op /Ta	Sc	Sc/ Op	Op	Ta	Sc/ Op	0/ 2.8	2/ 3.8	1/ 1.8	0/ 0.5	0.31	0.92	0.45	0.05	Op					
30-40	Sc	Op	Ta	-	Ta /St	Op	Sc/ Op /Ta	Sc	Sc/ Op	Op	Ta	Sc/ Op	1/ 2.8	1/ 3.8	1/ 1.8	0/ 0.5	0.56	0.67	0.45	0.05	Op					
40-50	Ta	-	Ta	-	Ta /St	Op	Sc/ Op /Ta	Sc	Sc/ Op	Op	Ta	Sc/ Op	0/ 2.8	0/ 3.8	2/ 1.8	0/ 0.5	0.31	0.42	0.70	0.05	Ta					

Appendix C • Group 1 – scenario B

This appendix contains results from the analysis of Group 1 – scenario B (road accident involving a truck loaded with hazardous goods). The results presented are:

- The observation analysis (C.1).
- The answers to the questionnaires (C.2).
- The control mode decision form (C.3).

C.1 Observation analysis

Time interval: 0:00 – 5:00

1. Information seeking

(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

Control mode: Tactical

Resources for chemical accidents are inventoried. (For the future).

Weather information from

meteorological institute. (For the future).

Officer in charge on scene is asked about hazardous goods.

2. Comparison of decision alternatives

(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Control mode: Tactical/Strategic

Press releases are discussed.

How units shall be used is discussed.

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: -

Time interval: 5:00 – 10:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Opportunistic

*Information is sought about the
chemical.*

*The officer on scene is asked about the
leakage.*

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: -

Time interval: 10:00 – 15:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

Control mode: Tactical

Resources for handling accidents with trucks are discussed with officer on scene.

Dispersion calculations are made. (For the future)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: -

Press releases are discussed.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 15:00 – 20:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: -

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤5 sources (tact.)
- For the future and from and from 5 sources (strat.)
- Not observed**

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: -

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: Opportunistic

- Yes (opportunistic)**
- No (scrambled, tactical, strategic)
- Not observed

The meeting is postponed due to radio

conversation with the officer on scene.

Time interval: 20:00 – 25:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤5 sources (tact.)
- For the future and from and from 5 sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made. (For the future)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode:
Opportunistic, Tactical, Strategic

Site for press conference.

How to use resources.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode:
Scrambled, Tactical, Strategic

Telephones and radios are left ringing.

Time interval: 25:00 – 30:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Analysis for various developments of the accident. (For the future).

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Tactical, Strategic

Dispersion of tasks within team.

Information to the public.

How to use resources.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: =

Time interval: 30:00 – 35:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Opportunistic

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

Police is contacted for information on closing of roads.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: Tactical, Strategic

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Closing of roads around IKEA.

Changing of staff.

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 35:00 – 40:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Police is contacted for information on closing of roads.

Contact with emergency service centre about units to be used in the future. (For the future).

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Tactical, Strategic

Entrances for rescue vehicles.

Resources for chemical accidents.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: =

Time interval: 40:00 – 45:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

Control mode: Tactical

Calculations on dispersion and on closing of roads. (For the future).

Contact with the municipality's officer in charge. (For the future).

Contact with officer on scene about evacuation. (For the future).

Contact with the road carrier company.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Tactical, Strategic

Entrances for rescue vehicles.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 45:00 – 50:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: -

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed**

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: Tactical, Strategic

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Discussions on evacuation.

Entrance for rescue vehicles.

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 50:00 – 55:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

Control mode: Tactical

Officer on scene is asked about resources.

Specialised units for chemical accidents are sought in other organisations.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: _

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: _

Time interval: 55:00 – 1:00:00

**1. Information seeking
(questions are asked, information is sought in computers, books etc.)**

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Calculations on dispersion. (For the future).

Specialised units for chemical accidents are sought in other organisations. (For the future).

Officer on scene is asked about future resource needs. (For the future).

**2. Comparison of decision alternatives
(e.g. discussions on priorities)**

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Control mode: Tactical, Strategic

Evacuation is discussed.

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: _

Time interval: 1:00:00 – 1:05:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from \geq sources (strat.)
- Not observed

Control mode: Tactical

Calculations on dispersion.
(For the future).

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Opportunistic

Resources from nearby airport.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 1:05:00 – 1:10:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Contact with nearby airport about resources.

Calculations on dispersion.

(For the future).

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Tactical, Strategic

Resources from nearby airport vs. own resources.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 1:10:00 – 1:15:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from \leq sources (strat.)
- Not observed

Control mode: Tactical

Contact with nearby airport about resources.

Meteorological institute for weather.

(For the future).

Calculations on dispersion.

(For the future).

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Tactical, Strategic

Changing of staff.

Discussion and evaluation on

commanding staff tools used.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 1:15:00 – 1:20:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Calculations on dispersion.

(For the future).

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: _

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: _

Time interval: 1:20:00 – 1:25:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

Control mode: Tactical

Calculations on dispersion.

(For the future).

Chemical rescue units are contacted.

(For the future).

The county's officer in charge is contacted.

(For the future).

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Tactical, Strategic

Evacuation is discussed.

Information on web page is discussed.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 1:25:00 – 1:30:00

**1. Information seeking
(questions are asked, information is sought in computers, books etc.)**

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

The county's officer in charge is contacted. (For the future).

**2. Comparison of decision alternatives
(e.g. discussions on priorities)**

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Control mode: Tactical, Strategic

*Airport and landings are discussed.
Handling of spilled chemical is discussed.*

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: -

Time interval: 1:30:00 – 1:35:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Opportunistic

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

Officer on scene about sealing the leak.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: Tactical, Strategic

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Entrance for rescue vehicles.

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 1:35:00 – 1:40:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Tactical

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤5 sources (tact.)
- For the future and from and from 5 sources (strat.)
- Not observed

Officer on scene is asked about pollution problems.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: _

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: _

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Time interval: 1:40:00 – 1:45:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Tactical

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from \geq sources (strat.)
- Not observed

Calculations on dispersion.
(For the future).

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: Tactical, Strategic

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Discussions on evacuation.

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

C.2 Questionnaire

The answers have been divided into different tables for the different time intervals. All the individual answers are presented together with the answers from the team's questionnaire.

The questionnaire was answered for two time intervals:

1. From the beginning of the session and until the attempt to seal the leak.
Time: 0 – 48 minutes. See Table C-1.
2. From the attempt to seal the leak and until the end of the session. Time
48 – 105 minutes. See Table C-2.

Table C-1. Questionnaire answers for the first time interval (0-48 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	Yes	No	Yes	Yes	No	Moment & future	Yes	Yes	No
	2	Yes	Yes	Yes	Yes	Yes	-	-	-	-
	3	Yes	Yes	Yes	Yes	Yes	Moment only	Don't know	Yes	Don't know
	4	Yes	Yes	No	No	Yes	Moment & future	No	No	No
	5	No	Don't know	Don't know	Don't know	Don't know	Moment & future	Yes	Yes	No
	6	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	No
	7	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	Don't know
	8	Yes	No	Yes	Don't know	No	Moment only	Yes	Yes	Don't know
	9	No	Yes	Don't know	No	Yes	Moment & future	Don't know	Don't know	No
	10	Yes	Yes	Don't know	No	No	Moment & future	Yes	Yes	No
	11	Yes	No	Yes	Yes	Yes	Moment & future	Yes	Yes	Yes
Team	Yes	Yes	Yes	Yes	No	Moment & future	Yes	No	No	

Table C-2. Questionnaire answers for the second time interval (48-105 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	No
	2	Yes	Yes	Yes	Yes	Yes	-	-	-	-
	3	Yes	Yes	Yes	Yes	No	Moment only	Don't know	Yes	Don't know
	4	Yes	Yes	No	No	No	Moment & future	No	No	No
	5	Yes	Don't know	Don't know	Don't know	Don't know	Moment & future	Yes	Yes	No
	6	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	No
	7	No	No	Don't know	Don't know	No	Don't know	No	No	Don't know
	8	Yes	Yes	Yes	Don't know	No	Moment & future	Yes	Yes	Don't know
	9	Don't know	Yes	Don't know	No	Yes	Moment & future	Don't know	Don't know	No
	10	Yes	Yes	Don't know	No	Yes	Moment only	Yes	Yes	No
	11	Yes	No	Yes	Yes	Yes	Moment & future	Yes	Yes	Yes
Team	Yes	Yes	Yes	Yes	No	Moment & future	Yes	No	No	

C.3 Control mode decision form

Two control mode decision forms are presented. Table C-3 (two pages) presents the original analysis of five minute intervals. The second control mode decision form, Table C-4, is a result from the sensitivity analysis on time intervals where a ten minute interval was used.

Table C-3. Control mode decision form with five minute intervals for Group 1 – scenario B.

Time interval	Observation analysis								Questionnaire analysis								Sums (Observation/ Questionnaire)				Standardised sums				CM	
	1	2	3	4	1	1b	2	3	4	5	6	7	8	Sc	Op	Ta	St	Sc	Op	Ta	St	Sc	Op	Ta		St
0-5	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	0.11	0.31	0.94	0.44	Ta
5-10	Op	-	Ta	-	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	1/2.8	1/2.8	0/2.8	0.11	0.56	0.56	0.31	0.11	0.56	0.56	0.31	Op/Ta
10-15	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	0.11	0.31	0.94	0.44	Ta
15-20	-	-	Ta	Op	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	1/2.8	1/2.8	0/2.8	0.11	0.56	0.56	0.31	0.11	0.56	0.56	0.31	Op/Ta
20-25	Ta	Op/Ta/St	Ta	Sc/Ta/St	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0.3/1	0.3/2.8	2.6/2.8	0.6/2.8	0.19	0.39	0.96	0.46	0.19	0.39	0.96	0.46	Ta
25-30	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	0.11	0.31	0.94	0.44	Ta
30-35	Op	Ta/St	Ta	-	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	1/2.8	1.5/2.8	0.5/2.8	0.11	0.56	0.69	0.44	0.11	0.56	0.69	0.44	Ta
35-40	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	0.11	0.31	0.94	0.44	Ta
40-45	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	0.11	0.31	0.94	0.44	Ta
45-50	-	Ta/St	Ta	-	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	1.5/2.8	0.5/2.8	0.11	0.31	0.69	0.44	0.11	0.31	0.69	0.44	Ta
50-55	Ta	-	Ta	-	Ta/St	Op	Ta/St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2/2.8	0/2.8	0.11	0.31	0.81	0.51	0.11	0.31	0.81	0.51	Ta

Time interval	Observation analysis				Questionnaire analysis								Sums (Observation/Questionnaire)				Standardised sums				CM	
	1	2	3	4	1	1b	2	3	4	5	6	7	8	Sc	Op	Ta	St	Sc	Op	Ta		St
55-60	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
60-65	Ta	Op	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	1/2.8	2/2.8	0/2.8	0.11	0.56	0.81	0.31	Ta
65-70	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
70-75	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
75-80	Ta	-	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	0/2.8	2/2.8	0/2.8	0.11	0.31	0.81	0.31	Ta
80-85	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
85-90	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
90-95	Op	Ta/St	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	1/2.8	1.5/2.8	0.5/2.8	0.11	0.56	0.69	0.44	Ta
95-100	Ta	-	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	0/2.8	2/2.8	0/2.8	0.11	0.31	0.81	0.31	Ta
100-105	Ta	Ta/St	Ta	-	Ta/St	Op	Ta/St	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta

Table C-4. Control mode decision form with ten minute intervals for Group 1 – scenario B.

Time interval	Observation analysis				Questionnaire analysis								Sums (Observation/Questionnaire)				Standardised sums			CM		
	1	2	3	4	1	1b	2	3	4	5	6	7	8	Sc	Op	Ta	St	Sc	Op		Ta	St
0-10	Ta	Ta/St	Ta	-	Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
10-20	Ta	Ta/St	Ta	Op	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	1/2.8	2.5/2.8	0.5/2.8	0.11	0.56	0.94	0.44	Ta
20-30	Ta	Op/Ta/St	Ta	Sc/Ta/St	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0.3/1	0.3/2.8	2.6/2.8	0.6/2.8	0.19	0.39	0.96	0.46	Ta
30-40	Ta	Ta/St	Ta	-	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
40-50	Ta	Ta/St	Ta	-	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
50-60	Ta	Ta/St	Ta	-	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
60-70	Ta	Op/Ta/St	Ta	-	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0.3/2.8	2.3/2.8	0.3/2.8	0.11	0.39	0.89	0.39	Ta
70-80	Ta	Ta/St	Ta	-	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
80-90	Ta	Ta/St	Ta	-	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
90-100	Ta	Ta/St	Ta	-	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta
100-105	Ta	Ta/St	Ta	-	Op/Ta/St	Op	St	Op/Ta/St	Sc/Op	Ta/St	Ta	Sc/Op	Sc/Op	0/1	0/2.8	2.5/2.8	0.5/2.8	0.11	0.31	0.94	0.44	Ta

Appendix D • Group 2 – scenario A

This appendix contains results from the analysis of Group 2 – scenario A (plane crash). The results presented are:

- The observation analysis (D.1).
- The answers to the questionnaires (D.2).
- The control mode decision form (D.3).

D.1 Observation analysis

Time interval: 0:00 – 5:00

1. Information seeking (questions are asked, information is sought in computers, books etc.)

Control mode: Opportunistic

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

The emergency service centre is asked questions about the crash.

2. Comparison of decision alternatives (e.g. discussions on priorities)

Control mode: _

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: _

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Time interval: 5:00 – 10:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Opportunistic

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

The officer on scene is asked about his position.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: -

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 10:00 – 15:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Opportunistic

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

The officer on scene is asked about the conditions on the scene.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: Tactical, Strategic

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Discussions on units.

Discussions on how to inform the public.

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 15:00 – 20:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Opportunistic

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Contact information to sea rescue services is sought.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: -

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: -

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 20:00 – 25:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from \leq sources (strat.)
- Not observed

Control mode: Tactical

Information on evacuation strategies
(suggested by the officer on scene, thus
for the moment).

Information about preparedness for
another accident.
(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and
ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: -

Time interval: 25:00 – 30:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Opportunistic

*Coast guard is asked about available
harbours for transportation of injured.
(Suggested by the officer on scene,
thus for the moment.)*

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: -

Time interval: 30:00 – 35:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode:

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤5 sources (tact.)
- For the future and from and from 5 sources (strat.)
- Not observed**

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode:

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode:

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 35:00 – 40:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: _

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤5 sources (tact.)
- For the future and from and from 5 sources (strat.)
- Not observed**

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: _

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: _

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 40:00 – 45:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from \leq sources (strat.)
- Not observed

Control mode: Tactical

Officer on scene is asked about the situation for future information to the public.

The municipality's emergency management team is contacted regarding information on the internet.

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 45:00 – 50:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.) moment.**
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Opportunistic

The coast guard is asked about aero photos of the scene. (Suggested by the officer on scene, thus for the moment.)
The emergency service centre is asked for information on buses for transportation of injured. (Suggested by the officer on scene, thus for the moment.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: -

D.2 Questionnaire

The answers have been divided into different tables for the different time intervals. All the individual answers are presented together with the answers from the team's questionnaire.

The questionnaire was answered for three time intervals:

1. From the beginning of the session and until they found out that there were 80 passengers left in the airplane. Time: 0 – 15 minutes. See Table D-1.
2. From the point they found out that there were 80 passengers left in the airplane and until all passengers had been apprehended. Time: 15 – 45 minutes. See Table D-2.
3. From the point they found out that all passengers had been apprehended and until the end of the session. Time 45 – 50 minutes. See Table D-3.

Table D-1. Questionnaire answers for the first time interval (0-15 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	No	Yes	No	No	No	Moment & future	No	Don't know	No
	2	No	No	No	No	No	Moment only	Yes	No	No
	3	Yes	Yes	Yes	No	No	None	Don't know	Don't know	No
	4	Yes	Yes	No	Yes	No	None	Don't know	Don't know	No
	5	No	No	No	No	No	Moment only	Yes	Yes	No
	6	Yes	Yes	Yes	No	No	None	Don't know	Don't know	No
	7	Yes	Yes	Don't know	Yes	No	Moment & future	Yes	Yes	No
	8	Yes	Yes	Don't know	Yes	No	Moment & future	Yes	Yes	No
	9	Yes	No	Don't know	No	No	Moment only	Don't know	Don't know	Yes
	10	Don't know	No	No	No	No	None	Yes	No	No
	11	Yes	Yes	Don't know	Yes	No	Moment only	Yes	Yes	Yes
Team	Yes	Yes	No	Yes	No	Moment only	Yes	Yes	No	

Table D-2. Questionnaire answers for the second time interval (15-45 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	Yes	Yes	No	No	Yes	Moment & future	Yes	Yes	No
	2	Yes	Yes	No	No	Yes	Moment & future	Yes	Yes	Yes
	3	Yes	Yes	No	No	Yes	Moment & future	Don't know	Don't know	Yes
	4	Yes	Yes	Yes	Don't know	Don't know	Moment & future	Don't know	Don't know	Don't know
	5	No	Yes	Yes	No	No	Moment only	Yes	Yes	No
	6	Yes	Yes	Yes	No	Yes	Moment & future	Don't know	Don't know	-
	7	Don't know	Yes	Don't know	Yes	No	Moment & future	Don't know	Don't know	Yes
	8	No	Don't know	No	Yes	No	Moment & future	No	No	No
	9	Yes	No	No	Yes	No	Moment only	Don't know	Don't know	Yes
	10	Yes	-	No	No	-	Moment only	Yes	Yes	No
	11	Yes	Yes	Don't know	Yes	Yes	Moment only	Yes	No	No
Team	Yes	Yes	No	Yes	Don't know	Moment & future	Yes	No	Yes	

Table D-3. Questionnaire answers for the third time interval (45-50 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	No	Yes	No	No	No	Moment & future	Don't know	Don't know	No
	2	-	-	-	-	-	-	-	-	-
	3	No	Don't know	No	No	Don't know	Moment only	Don't know	Don't know	Yes
	4	Yes	Yes	-	Don't know	Don't know	None	Don't know	Don't know	Don't know
	5	Yes	Yes	Yes	No	Yes	Moment only	Yes	Yes	No
	6	Yes	No	Yes	No	Yes	Moment only	Don't know	Don't know	-
	7	Don't know	Yes	Don't know	Don't know	No	Moment & future	Don't know	Don't know	Don't know
	8	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know
	9	Don't know	Don't know	Yes	Yes	Yes	Moment & future	Don't know	Yes	Yes
	10	Yes	Yes	No	No	-	Moment only	Yes	Yes	No
	11	No	-	-	-	-	-	-	-	-
Team		Yes	Yes	No	Yes	Yes	Moment & future	Yes	Yes	Yes

D.3 Control mode decision form

Two control mode decision forms are presented. The first, presented in Table D-4, is for the original analysis of five minute intervals. The second control mode decision form, Table D-5, is a result from the sensitivity analysis on time intervals where a ten minute interval was used.

Table D-4. Control mode decision form with five minute intervals for Group 2 – scenario A.

Time interval	Observation analysis				Questionnaire analysis								Sums (Observation/Questionnaire)				Standardised sums			CM	
	1	2	3	4	1b	2	3	4	5	6	7	8	Sc	Op	Ta	St	Sc	Op	Ta		St
0-5	Op	-	Ta	-	Sc	Ta/St	Sc/Op/Ta	Op/Ta/St	Sc/Op	Op	Ta	Ta/St	0/1.8	1/2.1	1/3.1	0/1.8	0.2	0.48	0.59	0.2	Ta
5-10	Op	-	Ta	-	Sc	Ta/St	Sc/Op/Ta	Op/Ta/St	Sc/Op	Op	Ta	Ta/St	0/1.8	1/2.1	1/3.1	0/1.8	0.2	0.48	0.59	0.2	Ta
10-15	Op	Ta/St	Ta	-	Sc	Ta/St	Sc/Op/Ta	Op/Ta/St	Sc/Op	Op	Ta	Ta/St	0/1.8	1/2.1	1.5/3.1	0.5/1.8	0.2	0.48	0.72	0.33	Ta
15-20	Op	-	Ta	-	Sc	Ta/St	Sc/Op/Ta	Op/Ta/St	-	Ta/St	Ta	Sc/Op	0/1.8	1/1.1	1/3.1	0/1.8	0.2	0.37	0.59	0.2	Ta
20-25	Ta	-	Ta	-	Sc	Ta/St	Sc/Op/Ta	Op/Ta/St	-	Ta/St	Ta	Sc/Op	0/1.8	0/1.1	2/3.1	0/1.8	0.2	0.12	0.84	0.2	Ta
25-30	Op	-	Ta	-	Sc	Ta/St	Sc/Op/Ta	Op/Ta/St	-	Ta/St	Ta	Sc/Op	0/1.8	1/1.1	1/3.1	0/1.8	0.2	0.37	0.59	0.2	Ta
30-35	-	-	Ta	-	Sc	Ta/St	Sc/Op/Ta	Op/Ta/St	-	Ta/St	Ta	Sc/Op	0/1.8	0/1.1	1/3.1	0/1.8	0.2	0.12	0.59	0.2	Ta
35-40	-	-	Ta	-	Sc	Ta/St	Sc/Op/Ta	Op/Ta/St	-	Ta/St	Ta	Sc/Op	0/1.8	0/1.1	1/3.1	0/1.8	0.2	0.12	0.59	0.2	Ta
40-45	Ta	-	Ta	-	Sc	Ta/St	Sc/Op/Ta	Op/Ta/St	-	Ta/St	Ta	Sc/Op	0/1.8	0/1.1	2/3.1	0/1.8	0.2	0.12	0.84	0.2	Ta
45-50	Op	-	Ta	-	Ta/St	Ta/St	Sc/Op/Ta	Op/Ta/St	Ta/St	Ta/St	Ta	Ta/St	0/0.3	1/0.6	1/4.6	0/3.3	0.05	0.32	0.76	0.37	Ta

Table D-5. Control mode decision form with ten minute intervals for Group 2 – scenario A.

Time interval	Observation analysis				Questionnaire analysis								Standardised sums				CM				
	1	2	3	4	1b	2	3	4	5	6	7	8	Sc	Op	Ta	St		Sc	Op	Ta	St
0-10	Op	-	Ta	-	Sc	Ta /St	Sc/Op /Ta	Op /Ta /St	Sc/Op	Op	Ta	Ta /St	0/1.8	1/2.1	1/3.1	0/1.8	0.2	0.48	0.59	0.2	Ta
10-20	Op	Ta /St	Ta	-	Sc	Ta /St	Sc/Op /Ta	Op /Ta /St	Sc/Op	Op	Ta	Ta /St	0/1.8	1/2.1	1.5/3.1	0.5/1.8	0.2	0.48	0.72	0.33	Ta
20-30	Ta	-	Ta	-	Sc	Ta /St	Sc/Op /Ta	Op /Ta /St	-	Ta /St	Ta	Sc/Op	0/1.8	0/1.1	2/3.1	0/1.8	0.2	0.12	0.84	0.2	Ta
30-40	-	-	Ta	-	Sc	Ta /St	Sc/Op /Ta	Op /Ta /St	-	Ta /St	Ta	Sc/Op	0/1.8	0/1.1	1/3.1	0/1.8	0.2	0.12	0.59	0.2	Ta
40-50	Ta	-	Ta	-	Ta /St	Sc/Op /Ta	Op /Ta /St	Op /Ta /St	Ta /St	Ta	Ta /St	Ta /St	0/0.3	0/0.6	2/4.6	0/3.3	0.03	0.07	1.00	0.37	Ta

Appendix E • Group 2 – scenario B

This appendix contains results from the analysis of Group 2 – scenario A (plane crash). The results presented are:

- The observation analysis (E.1).
- The answers to the questionnaires (E.2).
- The control mode decision form (E.3).

E.1 Observation analysis

Time interval: 0:00 – 5:00

1. Information seeking (questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from \geq sources (strat.)
- Not observed

Control mode: Tactical

*Meteorological institute is contacted
about the weather information.*

(For the future.)

*The officer on scene is asked about the
situation and the need of expertise.*

2. Comparison of decision alternatives (e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: _

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: _

Time interval: 5:00 – 10:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

*The officer on scene is asked about
closing of roads and railroads.*

(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: -

Time interval: 10:00 – 15:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from \leq sources (strat.)
- Not observed

Control mode: Tactical

*The road carrier company is contacted
for information. (For the future.)*

Information about chemicals is sought.

(For the future.)

Dispersion calculations are made.

(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

**4. A powerful indicator attracts all attention and
ongoing plans and activities are interrupted**

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 15:00 – 20:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made.

(For the future.)

*The officer on scene is contacted about
breakpoint.*

*Expertise on chemicals is contacted for
Information. (For the future.)*

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode:

Opportunistic, Tactical, Strategic

The first expert found is chosen.

Discussions on available units.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 20:00 – 25:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made.

(For the future.)

Officer on scene is asked about chemical rescue resources and backup.

(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Control mode: Tactical, Strategic

Alternatives for keeping IKEA's costumers safe.

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: -

Time interval: 25:00 – 30:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made.
(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Tactical, Strategic

Alternatives for chemical rescue units.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: =

Time interval: 30:00 – 35:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from \leq sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made.

(For the future.)

Officer on scene is asked about breaks

for personnel.

(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: _

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: _

Time interval: 35:00 – 40:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

*Dispersion calculations are made.
(For the future.)*

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: _

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode:
Scrambled, Tactical, Strategic

Telephones are ringing during the meeting but don't interrupt the ongoing activity.

Time interval: 40:00 – 45:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from \leq sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made.

(For the future.)

Officer on scene is asked whether

Works Department, the county and the hospitals should be informed.

(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: -

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 45:00 – 50:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made.
(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Control mode: Tactical, Strategic

Breaks for personnel is discussed.

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: =

Time interval: 50:00 – 55:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Tactical

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from \leq sources (strat.)
- Not observed

Dispersion calculations are made.
(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: _

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

3. The actions follow a known procedure

Control mode: Tactical

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: _

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Time interval: 55:00 – 1:00:00

**1. Information seeking
(questions are asked, information is sought in computers, books etc.)**

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made.

(For the future.)

*Officer on scene is contacted about
information to the public.*

(For the future.)

*Information from road carrier company
on pumping of chemicals.*

(For the future.)

**2. Comparison of decision alternatives
(e.g. discussions on priorities)**

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)**
- Not observed

Control mode: Tactical, Strategic

*Evacuation vs. closing of doors and
windows.*

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed**

Control mode: _

**4. A powerful indicator attracts all attention and
ongoing plans and activities are interrupted**

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: _

Time interval: 1:00:00 – 1:05:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made.

(For the future.)

Officer on scene is contacted about

information to the public.

(For the future.)

Officer on scene about resource needs.

(For the future)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Control mode: Tactical, Strategic

Information to the public or to contact

an expert on chemical accidents.

3. The actions follow a known procedure

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff tools are used.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Control mode: -

Time interval: 1:05:00 – 1:10:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)**
- For the future and from and from ≤ 5 sources (strat.)
- Not observed

Control mode: Tactical

Dispersion calculations are made.
(For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed**

Control mode: _

3. The actions follow a known procedure

- Yes (tactical)**
- No (scrambled, opportunistic, strategic)
- Not observed

Control mode: Tactical

Commanding staff meeting is held.

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed**

Control mode: _

Time interval: 1:10:00 – 1:15:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: _

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤ 5 sources (tact.)
- For the future and from and from ≥ 5 sources (strat.)
- Not observed

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: _

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

3. The actions follow a known procedure

Control mode: _

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: _

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

Time interval: 1:15:00 – 1:20:00

1. Information seeking
(questions are asked, information is sought in computers, books etc.)

Control mode: Tactical

- No information seeking (scrambled)
- Only information that obviously is needed for the moment (opp.)
- Also for the future, and from ≤5 sources (tact.)
- For the future and from and from 5 sources (strat.)
- Not observed

Officer on scene is asked about need of personnel. (For the future.)

2. Comparison of decision alternatives
(e.g. discussions on priorities)

Control mode: Tactical, Strategic

- There are no alternatives (scrambled)
- The first identified alternative is chosen (opportunistic)
- The alternatives are evaluated (tactical, strategic)
- Not observed

Evacuation vs. closing of doors and windows.

3. The actions follow a known procedure

Control mode: _

- Yes (tactical)
- No (scrambled, opportunistic, strategic)
- Not observed

4. A powerful indicator attracts all attention and ongoing plans and activities are interrupted

Control mode: _

- Yes (opportunistic)
- No (scrambled, tactical, strategic)
- Not observed

E.2 Questionnaire

The answers have been divided into different tables for the different time intervals. All the individual answers are presented together with the answers from the team's questionnaire.

The questionnaire was answered for three time intervals:

1. From the beginning of the session and until they found out about IKEA. Time: 0 – 7 minutes. See Table E-1.
2. From the point when they found out about IKEA and until the attempt to seal the leak Time: 7-33 minutes. See Table E-2.
3. From the attempt to seal the leak and until the end of the session. Time 33 – 80 minutes. See Table E-3.

Table E-1. Questionnaire answers for the first time interval (0-7 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	Yes	Yes	Yes	Yes	Yes	Moment only	Yes	Yes	No
	2	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	Yes
	3	Yes	Yes	Yes	No	No	Moment only	Yes	Yes	No
	4	Yes	Yes	Yes	Yes	Yes	None	Yes	Yes	No
	5	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	6	No	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	7	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	No
	8	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	No
	9	Yes	Yes	Yes	Yes	No	Moment only	Yes	Yes	No
	10	Yes	Yes	No	Yes	No	Moment & future	Yes	Yes	No
	11	Yes	Yes	Yes	No	Yes	Moment & future	Yes	Yes	No
Team	Yes	Yes	No	Yes	No	Moment only	Yes	Yes	No	

Table E-2. Questionnaire answers for the second time interval (7-33 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	Yes	Yes	No	Yes	No	Moment only	Yes	Yes	Yes
	2	Yes	Yes	Don't know	Don't know	No	Moment & future	Yes	Yes	Yes
	3	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	4	Yes	Yes	Yes	Yes	Yes	None	No	Yes	No
	5	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	6	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	7	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	No
	8	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	No
	9	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	10	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	No
	11	Yes	Yes	Yes	No	Yes	Moment & future	Yes	Yes	No
Team	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No	

Table E-3. Questionnaire answers for the third time interval (33-80 minutes).

		Question								
		1	2	3	4	5	6	7	8	9
Participants	1	Yes	No	No	Yes	No	Moment only	Yes	No	Yes
	2	Don't know	Yes	Don't know	Don't know	No	Moment & future	Don't know	Don't know	Yes
	3	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	4	Yes	Yes	Yes	Yes	Yes	None	Yes	Yes	No
	5	Yes	Yes	Yes	Yes	Yes	-	Yes	Yes	No
	6	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	7	Yes	Yes	Yes	Yes	No	Moment & future	Yes	Yes	No
	8	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	9	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No
	10	Yes	Yes	Don't know	Yes	No	Moment & future	Yes	Yes	No
	11	Yes	Yes	Yes	No	Yes	Moment & future	Yes	Yes	No
Team	Yes	Yes	Yes	Yes	Yes	Moment & future	Yes	Yes	No	

E.3 Control mode decision form

Two control mode decision forms are presented. Table E-4 (two pages) presents the original analysis of five minute intervals. The second control mode decision form, Table E-5, is a result from the sensitivity analysis on time intervals where a ten minute interval was used.

Table E-4. Control mode decision form with five minute intervals for Group 2 – scenario B.

Time interval	Observation analysis				Questionnaire analysis								Sums (Observation/ Questionnaire)				Standardised sums			CM		
	1	2	3	4	1	1b	2	3	4	5	6	7	8	Sc	Op	Ta	St	Sc	Op		Ta	St
0-5	Ta	-	Ta	-	Ta /St	Sc	Ta /St	Ta /St /Ta	Op /Ta /St	Sc/ Op	Op	Ta	Ta /St	0/ 1.8	0/ 2.1	2/ 3.1	0/ 1.8	0.2	0.23	0.84	0.2	Ta
5-10	Ta	-	Ta	-	Ta / St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0/ 1	0/ 0.3	2/ 3.8	0/ 3.8	0.11	0.03	0.92	0.42	Ta
10-15	Ta	-	Ta	-	Ta / St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0/ 1	0/ 0.3	2/ 3.8	0/ 3.8	0.11	0.03	0.92	0.42	Ta
15-20	Ta	Op /Ta /St	Ta	-	Ta / St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0/ 1	0.3 / 0.3	2.3/ 3.8	0.3/ 3.8	0.11	0.11	1.0	0.50	Ta
20-25	Ta	Ta/ St	Ta	-	Ta / St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0/ 1	0/ 0.3	2.5/ 3.8	0.5/ 3.8	0.11	0.03	1.05	0.55	Ta
25-30	Ta	Ta/ St	Ta	-	Ta / St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0/ 1	0/ 0.3	2.5/ 3.8	0.5/ 3.8	0.11	0.03	1.05	0.55	Ta
30-35	Ta	-	Ta	-	Ta /St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0/ 1	0/ 0.3	2/ 3.8	0/ 3.8	0.11	0.03	0.92	0.42	Ta
35-40	Ta	-	Ta	Sc/ Ta /St	Ta /St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0.3 / 1	0/ 0.3	2.3/ 3.8	0.3/ 3.8	0.19	0.03	1.0	0.50	Ta
40-45	Ta	-	Ta	-	Ta /St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0/ 1	0/ 0.3	2/ 3.8	0/ 3.8	0.11	0.03	0.92	0.42	Ta
45-50	Ta	Ta/ St	Ta	-	Ta /St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0/ 1	0/ 0.3	2.5/ 3.8	0.5/ 3.8	0.11	0.03	1.05	0.55	Ta
50-55	Ta	-	Ta	-	Ta /St	Sc	Ta /St	Ta /St	Op /Ta /St	Ta /St	Ta	Ta	Ta /St	0/ 1	0/ 0.3	2/ 3.8	0/ 3.8	0.11	0.03	0.92	0.42	Ta

Time interval	Observation analysis				Questionnaire analysis								Sums (Observation/ Questionnaire)					Standardised sums			CM	
	1	2	3	4	1	1b	2	3	4	5	6	7	8	Sc.	Op.	Ta.	St.	Sc.	Op.	Ta.		St.
55-60	Ta	Ta /St	-	-	Ta /St	Sc	Ta /St	Op /Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	0/ 1	0/ 0.3	1.5/ 3.8	0.5/ 3.8	0.11	0.03	0.80	0.55	Ta
60-65	Ta	Ta /St	Ta	-	Ta /St	Sc	Ta /St	Op /Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	0/ 1	0/ 0.3	2.5/ 3.8	0.5/ 3.8	0.11	0.03	1.05	0.55	Ta
65-70	Ta	-	Ta	-	Ta /St	Sc	Ta /St	Op /Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	0/ 1	0/ 0.3	2/ 3.8	0/ 3.8	0.11	0.03	0.92	0.42	Ta/ St
70-75	-	-	-	-	Ta /St	Sc	Ta /St	Op /Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	0/ 1	0/ 0.3	0/ 3.8	0/ 3.8	0.11	0.03	0.42	0.42	Ta
75-80	Ta	Ta /St	-	-	Ta /St	Sc	Ta /St	Op /Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	Ta /St	0/ 1	0/ 0.3	1.5/ 3.8	0.5/ 3.8	0.11	0.03	0.80	0.55	

Table E-5. Control mode decision form with ten minute intervals for Group 2 – scenario B.

Time interval	Observation analysis				Questionnaire analysis								Sums (Observation/ Questionnaire)				Standardised sums			CM		
	1	2	3	4	1	1b	2	3	4	5	6	7	8	Sc.	Op.	Ta.	St.	Sc.	Op.		Ta.	St.
0-10	Ta	-	Ta	-	Ta/St	Sc	Ta/St	Op/Ta/St	Sc/Op/Ta	Op/Ta/St	Op	Ta	Ta/St	0/1.8	0/2.1	2/3.1	0/1.8	0.2	0.23	0.84	0.2	Ta
10-20	Ta	Op/Ta/St	Ta	-	Ta/St	Sc	Ta/St	Op/Ta/St	Ta/St	Ta/St	Ta/St	Ta/St	Ta/St	0/1	0.3/0.3	2.3/3.8	0.3/3.8	0.11	0.11	1.0	0.5	Ta
20-30	Ta	Ta/St	Ta	-	Ta/St	Sc	Ta/St	Op/Ta/St	Ta/St	Ta/St	Ta	Ta/St	Ta/St	0/1	0/0.3	2.5/3.8	0.5/3.8	0.11	0.03	1.05	0.55	Ta
30-40	Ta	-	Ta	Sc/Ta/St	Ta/St	Sc	Ta/St	Op/Ta/St	Ta/St	Ta/St	Ta	Ta/St	Ta/St	0.3/1	0/0.3	2.3/3.8	0.3/3.8	0.19	0.03	1.0	0.5	Ta
40-50	Ta	Ta/St	Ta	-	Ta/St	Sc	Ta/St	Op/Ta/St	Ta/St	Ta/St	Ta	Ta/St	Ta/St	0/1	0/0.3	2.5/3.8	0.5/3.8	0.11	0.03	1.05	0.55	Ta
50-60	Ta	Ta/St	Ta	-	Ta/St	Sc	Ta/St	Op/Ta/St	Ta/St	Ta/St	Ta	Ta/St	Ta/St	0/1	0/0.3	2.5/3.8	0.5/3.8	0.11	0.03	1.05	0.55	Ta
60-70	Ta	Ta/St	Ta	-	Ta/St	Sc	Ta/St	Op/Ta/St	Ta/St	Ta/St	Ta	Ta/St	Ta/St	0/1	0/0.3	2.5/3.8	0.5/3.8	0.11	0.03	1.05	0.55	Ta
70-80	Ta	Ta/St	-	-	Ta/St	Sc	Ta/St	Op/Ta/St	Ta/St	Ta/St	Ta	Ta/St	Ta/St	0/1	0/0.3	2.5/3.8	0.5/3.8	0.11	0.03	1.05	0.55	Ta