

How to measure the added value of geographic information in Disaster Management

DISSERTATION

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Abstract

Geographic information supports disaster management in many ways. The analysis and visualization of static and incident specific dynamic geographic information is key for the build-up of a Common Operational Picture and the development of Shared Situational Awareness. Although the use of geographic information and analytical tools seems evident, the concept of using Geographic Information Systems in disaster management is relatively new in The Netherlands. The development of a nationwide geographic data infrastructure for disaster management started only in 2006. Today the disaster management community can access this geographic information present in the Geo Data Infrastructure for Disaster Response and Crisis Management (GDI R&C) and use it in their disaster management processes. The central question in this thesis is: How valuable is geographic information in disaster management, and is the value measurable in any way? The theory of Network Centric Warfare and GDIs have been used as overall concepts to develop the evaluation method. The evaluation method was tested in the large scale exercise Eagle One in March 2008.

Index

Abstract	ii
Index.....	iii
List of Figures.....	vi
List of Tables.....	vii
Glossary	viii
Acknowledgements.....	ix
Disclaimer.....	x
1 Introduction.....	1
1.1 Problem	1
1.2 Theoretical framework	3
1.3 Problem definition and hypothesis	3
1.4 Purpose of the study	4
1.5 Significance of the study.....	4
1.6 Statistical reliability	4
1.7 Outline of this thesis.....	4
2 Network Centric Warfare for Disaster Management.....	6
2.1 Introduction	6
2.2 Information Age Warfare & Information Superiority.....	6
2.3 Network Centric Warfare	8
2.4 Concepts for NCW	10
2.5 Consequences of NCW	10
2.6 Networked Enabled Capabilities	10
2.7 NCW versus NEC	11
2.8 Conclusions.....	11
3 Geospatial Data Infrastructures	12
3.1 Introduction	12
3.2 Geospatial Data Infrastructures	12
3.3 Components of the GDI	13
3.4 GDI and NCDM.....	15
3.5 GDI for Crisis Management in the Netherlands	16
3.6 Conclusions.....	17
4 Disaster Management.....	18
4.1 Introduction	18

4.2	The disaster management cycle	18
4.3	Emergency types and GRIP levels.....	20
4.4	Geo-information and disaster management.....	21
4.5	Networked Enabled Capabilities and Disaster Management.....	23
4.6	Conclusions.....	24
5	Architecture for Disaster Management	25
5.1	Introduction	25
5.2	The Integrated Architecture Framework.....	25
5.3	NCDM Technology?	28
5.4	GDI Technology.....	29
5.5	Eagle One architecture	31
5.6	Conclusions.....	32
6	Metrics for NCDM	33
6.1	Introduction	33
6.2	People	34
6.3	Technology.....	36
6.4	Information.....	38
6.5	Set-up.....	47
6.6	Instruction of observers	48
6.7	Conclusion	48
7	Results	49
7.1	Introduction	49
7.2	Case study.....	49
7.3	General impression of the exercise Eagle One in practice	51
7.4	Response.....	52
7.5	People	53
7.6	Networks.....	58
7.7	Information.....	61
7.8	Questions related to hypotheses	63
7.9	Conclusions.....	64
8	Discussion and Conclusions.....	65
8.1	Introduction	65
8.2	Discussion of results	65
8.3	Conclusions.....	67
9	Discussion of Method.....	68

9.1	Introduction	68
9.2	People	68
9.3	Networks.....	69
9.4	Information.....	69
9.5	Observations.....	69
9.6	Recommendations for further research.....	69
	References.....	71
	Appendix 1: Example instructions for observers	76
	Appendix 2: Questions Eagleone_1	86
	Appendix 3: Questions Eagleone_2	88
	Appendix 4: Questions CTEF instrument.....	89
	Appendix 5: Results questionnaire Eagleone_1.....	108
	Appendix 6: Results questionnaire Eagleone_2.....	112
	Appendix 7: Results CTEF instrument	114

List of Figures

FIGURE 1.1: OUTLINE OF THE RESEARCH PRESENTED IN THIS THESIS	5
FIGURE 2.1: NEC BENEFIT CHAIN.....	9
FIGURE 3.1: COMPONENTS OF A GDI	13
FIGURE 3.2: POSITION OF GDI IN NETWORKCENTRIC DISASTER MANAGEMENT.....	16
FIGURE 4.1: THE DISASTER MANAGEMENT CYCLE	19
FIGURE 4.2: PARTIES INVOLVED IN DISASTER MANAGEMENT.....	20
FIGURE 4.3: CHAIN OF COMMAND FOR DISASTER MANAGEMENT IN THE NETHERLANDS.....	22
FIGURE 4.4: RELATIONSHIP BETWEEN GEOGRAPHIC INFORMATION ITEMS IN THE DISASTER MANAGEMENT COMMUNITY	23
FIGURE 5.1: MODEL OF THE INTEGRATED ARCHITECTURE FRAMEWORK	26
FIGURE 5.2: GEO OOV ARCHITECTURE.....	30
FIGURE 5.3: OUTLINE OF THE NET-CENTRIC ARCHITECTURE FOR EXERCISE EAGLE ONE	31
FIGURE 6.1: ELEMENTS OF NEC AND THEIR RESPECTIVE EVALUATION METHOD	33
FIGURE 6.2: CTEF MODEL WITH BASIC COMPONENTS AND FEEDBACK LOOPS.....	35
FIGURE 6.3: HIERARCHY OF MEASURES	39
FIGURE 6.4: REFERENCE MODEL SITUATIONAL AWARENESS	41
FIGURE 6.5: SHARED SITUATIONAL AWARENESS	42
FIGURE 6.6: VALUE, A FUNCTION OF INFORMATION RICHNESS AND INFORMATION REACH	47

List of Tables

TABLE 2.1: DEFINITIONS OF PRIMITIVES IN INFORMATION AGE WARFARE THEORY	7
TABLE 2.2: CHARACTERISTICS OF MATURE NCW CONCEPT ACROSS THE THREE DOMAINS.....	9
TABLE 4.1: OVERVIEW OF GRIP-LEVELS.....	21
TABLE 6.1: ELEMENTS OF RICHNESS	40
TABLE 6.2: ATTRIBUTES OF INFORMATION REACH	40
TABLE 6.3: FACTORS OF MAXIMUM COLLABORATION.....	46
TABLE 6.4: OVERVIEW OF NEC ASPECTS, THEORY USED AND METHOD OF MEASUREMENT.....	48
TABLE 7.1: RESPONDENTS FOR QUESTIONNAIRE EAGLEONE_1 AND EAGLEONE_2 BY FUNCTION	53

Glossary

C2	Command and Control
CCS	Command and Control System
CTEF	Military Command Team Effectiveness
DCC	Departmental Crisis Coordination Centre
GDI	Geospatial Data Infrastructure
GIS	Geographic Information System
GUI	Graphical User Interface
IAF	Integrated Architecte Framework
IAW	Information Age Warfare
ISO	International Standardization Organization
NCC	National Crisis Coordination Centre
NCDM	Network Centric Disaster Management
NCW	Network Centric Warfare
NEC	Network Enabled Capability
OGC	Open Geospatial Consortium
Plv OL	2 nd IC ROT (Plaatsvervangend Operationeel Leider)
ROT	Regional Operational Team
SDI	Spatial Data Infrastructure
SOA	Service Oriented Architecture
TAM	Technology Acceptance Model
W3C	World Wide Web Consortium

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Disclaimer

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This thesis has not been submitted previously for a degree at any institution.

Signed: _____

Date: _____



1 Introduction

1.1 Problem

The goal of disaster management is to reduce the effects of the disaster as much as possible and take action to get the community's condition back to its pre-disaster state. Participants in disaster management take actions pre-disaster or post-disaster. Ideally these activities would reduce the potential effects of a disaster to the point of elimination. However the nature of disasters make this ideal situation unachievable. Disasters have five major characteristics that make them hard to overcome (NRC, 2007):

1. Disasters are large, rapid-onset incidents relative to the size and resources of an affected jurisdiction;
2. Disasters are uncertain with respect to both their occurrence and their outcomes;
3. Risks and benefits are difficult to assess and compare;
4. Disasters are dynamic events;
5. Disasters are relatively rare.

These characteristics make it difficult for governments to manage disasters. The difficulties are both policy- and practice-related. Spatial data can considerably facilitate disaster management as most of the required information for disaster management has a spatial component (Mansourian et al., 2006). In fact, without spatial data, one cannot expect effective and efficient disaster management (NRC, 2007; Cutter et al., 2003). Since disasters and hazard types vary, the geospatial requirements also vary. Geospatial resources and processes must be able to adapt and respond to the changing situations. In NRC (2007) requirements for geospatial data and analysis were presented and the most prominent requirements are listed below:

1. Ability to assess risk and resilience;
2. Pre-incident forecasts about hazard behaviour, likely damage, property vulnerability, and potential victims;
3. Decision aids to support recommendations for pre-positioning resources and evacuation;
4. Timely, incident-specific locational information with respect to hazards, damage, victims, and resources, including information such as where people went, what kind of help is needed where, and the location of available resources;
5. Ongoing monitoring of evolving hazards, response efforts, and resource status;
6. Insight into the interdependence and status of infrastructure components and awareness of critical infrastructure and facility vulnerability and status.

For most disasters or events the geospatial information needed is maintained by a variety of public and private organizations in multiple jurisdictions. Emergency preparedness and response requires data from many sources, which can be both public and private (NRC, 2007). It is this interoperability of systems which is one of many problems the disaster management community faces. Research in the Netherlands has shown (Neuvel et al., 2006; ACIR, 2005) that the following bottlenecks in disaster management exist:

1. Lack of good communication between the different actors;
2. Lack of information about the ‘information’ (meta-data);
3. Lack of an appropriate platform (user interfaces) for data exchange;
4. Insufficient standardization of processes and protocols;
5. Difficulties in exchange and integration of various data;
6. A variety of narrow specialized systems only for emergency situations;
7. Management of information from the field (reports, images, video, etc);
8. Access to existing data is generally very slow.

Neuvel et al. (2005) propose that building a Geospatial Data Infrastructure (GDI) could be a solution to overcome part of the problems faced by the disaster management community. In the literature contradicting opinions on the suitability of a GDI and the use of GIS for disaster management can be found. Zerger and Smith (2003) evaluate a disaster management exercise and state that the use of GIS can readily fail. The GIS system implemented for the exercise was underutilized for the following reasons:

1. The GIS was unable to provide the answers required in real-time due to technical constraints (computing power and size of the database);
2. Emergency managers were occupied with more pressing evacuation and decision-making concerns than those which the GIS had been designed to address;
3. The GIS was designed without considering the operational requirements of emergency management personnel;
4. Some data layers were too detailed;
5. Inexperience with GIS precluded using it to the full potential; the size of computer screens did not provide the necessary detail;
6. Difficulties in sharing information via a single terminal to multiple users.

Mansourian et al. (2006) consider a GDI to be valuable for disaster management. A GDI makes the geographic information in the event of an emergency readily available and accessible. A GDI is an initiative in spatial data management and can be used as an integrated framework for resolving current problems with spatial data (Mansourian et al., 2006).

In the theoretical framework of this thesis it will be shown that a GDI supports the disaster management community by providing geographic data, information and tools. During disaster management it is not only geographic information which is being exchanged between participants, but also all other forms of information. The disaster management community needs a system in which the GDI is one of the components. The concept which supports this view is the concept of Networked Centric Warfare or Networked Enabled Capabilities.

In all the literature cited (NRC, 2007; Mansourian et al., 2006; Cutter et al., 2003), there is a strong emphasis on the importance of geographic data, information and tools for disaster management. In evaluation reports of recent large-scale exercises held in The Netherlands, the role of geographic data and information is not or only slightly touched upon. A standard method to measure the added value of geographic data, information and tools has not been developed yet. So how can one actually state that geographic information has added value for disaster management? Herein lies the scope of this thesis: showing what is the added value is of geographic data, information and tools for disaster management and developing a method to measure the added value.

1.2 Theoretical framework

The theoretical framework will be described extensively in the following chapters on Networked Enabled Capabilities, Geospatial Data Infrastructure and Disaster Management. The theory of NEC will act as a framework within which the theory of GDI and all aspects to make disaster management successful can be located.

1.3 Problem definition and hypothesis

In the Section 1.1 a description was given on the current state of the use of geographic information in disaster management. In several studies (NRC, 2007; Cutter et al., 2003; Mansourian et al., 2006; Borkulo et al., 2005) it is stated that geographic information can play, or plays, an important role in this. In the recent past the actual value of geographic information in disaster management has never been researched. In several evaluations of large-scale disaster management exercises the role of geographic information is not mentioned or only minimally so. The central problem of this thesis is:

What is the added value of the use of geographic information in disaster management?

For this thesis, five hypotheses have been defined based on the research on the different theoretical frameworks. These hypotheses are:

- 1. The use of geo-information in a net-centric environment improves the situational awareness of all actors involved**

Is there a state of shared situational awareness, and what is the role of geo-information in this process?

2. Geo-information improves the timeliness of the information processing

Does geo-information improve the timeliness of the information processing

3. Geo-information improves the quality of the information

Does geo-information improve the quality of the information?

4. Geo-information improves the decision making process

Does the use of geo-information improve the quality of the decisions?

5. The use of geo-information in the workflow is regarded as positive by the actors

Do actors use geo-information in their workflows and what are the factors that enhance the use?

1.4 Purpose of the study

The goal of this thesis is to develop an evaluation method that is able to measure the improvement that the use of geo-information has on disaster management. The method developed must be reusable for future disaster management activities. The evaluation method will be valid for a GDI in a networked environment. The survey will be limited to the use of geographic information during the response phase of a disaster. The hypotheses will be tested by interviewing or conducting a standard questionnaire immediately after an emergency response exercise.

1.5 Significance of the study

There is extensive research done on Spatial Data Infrastructures (SDI)/Geospatial Data Infrastructures (GDI) for disaster management, the technology side, and the standards are very well described. Best practice manuals concerning the implementation of SDIs have been written. The concept of NEC has only recently been developed and the implementation of NEC is limited at the moment. One of the underpinning concepts of a GDI is the its implementation must be user-driven. No significant research has been done on the use and usefulness of the geo-information provided from a user-perspective. Secondly there is no 'standard' evaluation method for disaster management. The results of this thesis are part of a complete evaluation method for disaster management.

1.6 Statistical reliability

The research in this thesis is focused on the development of a method to measure the added value of geographic information in disaster management. Because there is only a small group of respondents, it was not possible to use the statistics of some of the methods used.

1.7 Outline of this thesis

Figure 1.1 depicts a graphical outline of the research conducted for this thesis. In this chapter the problem definition and research questions have been presented. In Chapters 2, 3, 4 and 5 the theoretical

framework for the research will be given. In Chapter 6 the units of measure or the items that need to be given attention in the surveys are laid out, and the design of the method is explained. Chapter 7 introduces the case study, the disaster management exercise ‘Eagle One’, and presents the results.

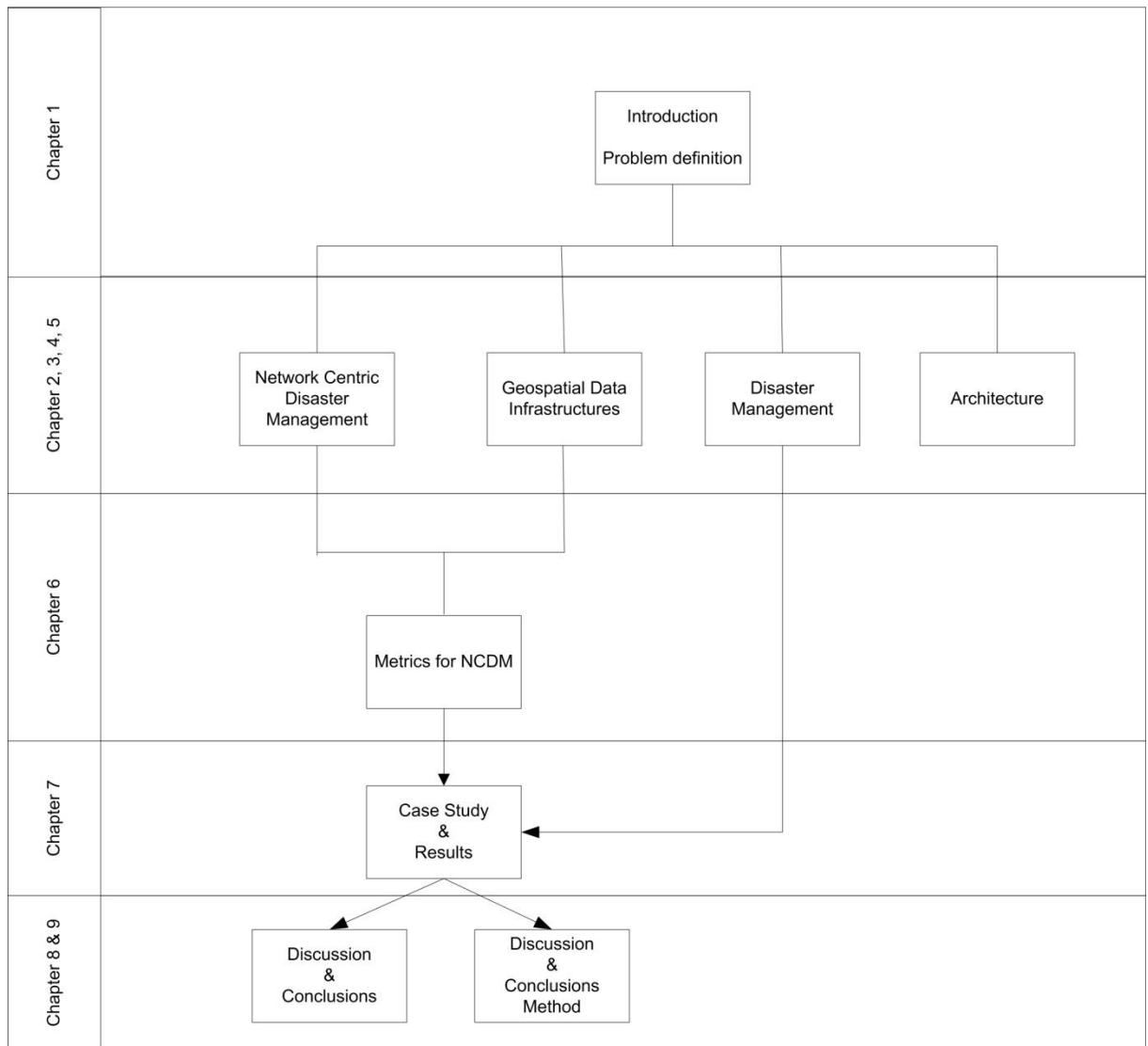


Figure 1.1: Outline of the research presented in this thesis

In Chapter 8 the results of the surveys and observations are analysed. Finally Chapter 9 discusses the method, and a number of conclusions are drawn.

2 Network Centric Warfare for Disaster Management

2.1 Introduction

The concept of Networked Enabled Capabilities (NEC) has proved to be very useful in the development of new capabilities for military operations, disaster management and homeland security. Originally the concept was introduced in the USA as Network Centric Warfare (NCW) in the mid-1990s, together with the concept of Information Age Warfare (IAW) (Alberts et al., 2000; Alberts et al., 2001; Alberts, 2002). In those days, it was solely a United States of America Department of Defence development. At the beginning of the 21st Century, the military powers in Europe and several other countries began to develop their own view on NCW and adopted the term Networked Enabled Capabilities. The term NEC not only sounds friendlier, but there is also a difference between the two concepts (Boyd et al., 2005). Now a few years later, the term NEC is also being used by other government agencies in papers on disaster management and homeland security. In the Netherlands there is a joint initiative of the Ministry of Defence and the Ministry of the Interior called Net-centric Experimentation, where NEC/NCW concepts are used for disaster management and homeland security.

In this chapter the concepts of IAW and NCW will be defined and discussed in Sections 2.2 to 2.6. The difference between NCW and NEC will be explained. In this thesis the term Network Centric Disaster Management (NCDM) will be introduced. This is NCW for Disaster Management.

2.2 Information Age Warfare & Information Superiority

The concept of IAW is based on the emergence of Information Technologies and the role they can play in modern warfare. Information plays an important role in military operations but technological advantages make it possible to provide more complete, more accurate and timelier information to decision makers.

Traditionally military organizations have provided information to forces in three ways (Alberts, 2002):

1. commands (directives and guidance);
2. intelligence (information about the adversary and environment);
3. doctrine (how you are going to do it).

Current operations in Iraq and Afghanistan for example are dominated by the information that can be gathered. In the military, these operations are called Information Operations or Info-ops.

Information Superiority is defined as a ‘state of imbalance in one’s favour (relative advantage) in the information domain that is achieved by being able to get the right information to the right people at the right time in the right form while denying an adversary the ability to do the same’ (Alberts et al., 2000; Alberts et al., 2001).

Information affects military operations and disaster management in three domains: the physical domain, the information domain, and the cognitive domain. The *physical domain* is the place where the situation

that the military seeks to influence exists. The *information domain* is where the information exists. It is the domain where information is created, manipulated and shared. The information that exists in the information domain may or may not truly reflect ground truth. The *cognitive domain* is in the minds of the participants. This is the place where perceptions, awareness, understanding, beliefs, and values reside and where, as a result of sense making, decisions are made. The theory on IAW, as described in Alberts et al. (2000), is underpinned by a number of primitives, which describe how information affects the performance of individuals and organizations (see Table 2.1).

Table 2.1: Definitions of primitives in Information Age Warfare theory (after Alberts et al., 2000)

Primitive	Description	Domain
Sensing	Direct or indirect	Physical
Data	Single observations	Physical
Information	Putting individual observations into some meaningful context	Information
Knowledge	Involves conclusions drawn from patterns suggested by available information	Information/ Cognitive
Awareness	Is the result of a complex interaction between prior knowledge and current perceptions of reality	Cognitive
Understanding	Having a sufficient level of knowledge to be able to draw inferences about the possible consequences of the situation, as well as sufficient awareness of the situation to predict future patterns	Cognitive
Decisions	Choices about what is to be done	Cognitive
Actions	Triggered by decisions in the cognitive domain that either are directly translated into action or have been transported through the information domain to others	Physical
Information Sharing	Interaction that takes place between two or more entities. Is the key to be able to develop shared awareness, as well as to collaborate and/or synchronize	Information
Shared knowledge	Exists to some degree in all human efforts to work together. The extent of sharing varies dramatically.	Cognitive
Shared awareness	When two or more entities are able to develop a similar awareness of the situation.	Cognitive
Collaboration	Takes place between two or more entities and implies working together towards a common purpose	Cognitive
Synchronization	The meaningful arrangement of things or effects in time and space	Physical

A state of shared knowledge can be reached by applying the same training and doctrine, so that troops will understand and react to situations in a predictable way. A state of shared awareness is influenced by multiple factors and degree of shared information and knowledge are two of these factors. Shared awareness is also influenced by similarities and differences in world view, culture, language and perceived interests (Alberts et al. 2000; Nofi, 2000). In order to create a situation of 'shared situational awareness', a term also used in disaster management, it is necessary to educate and train people as much as possible. Training has to be focused on the common task in hand. The members of a multidisciplinary team, which is common in disaster management, have to know each other's roles and knowledge intimately.

The Information Age will not eliminate the fog and friction of war or the uncertainties during disaster management, but it will ultimately reduce the uncertainties. The implementation of Information Age technologies has consequences for current concepts and practices. In general, Information Age technology will have an effect on Doctrine, Leadership and Education, Personnel, Training, Organisation and Material (Alberts et al., 2000).

Information Age technology includes collection, processing, display, and communications technologies. In recent years, advances in these technologies have resulted in an enormous amount of near real-time information being potentially available to individuals anywhere at any time. IAW and NCW are changing predominantly vertical information flows into a mix of vertical and horizontal flows that extend beyond the Department of Defence (Alberts, 2002).

2.3 Network Centric Warfare

NCW is warfare and involves networking in all three domains. When network-centric concepts are applied to operations other than war, the term network-centric operations is used (Alberts et al., 2000). The characteristics of a mature NCW are described in Table 2.2.

The central hypothesis of NCW is that a force with these attributes and capabilities (Figure 2.1) will be able to generate increased combat power by (Alberts et al., 2000):

1. better synchronizing effects in the battle space;
2. achieving greater speed of command;
3. increasing lethality, survivability and responsiveness or agility.

Table 2.2: Characteristics of mature NCW concept across the three domains (Alberts et al., 2000).

Domain	Characteristics
Physical	All elements of the force are robustly networked, thus achieving secure and seamless connectivity and interoperability
Information	The force has the capability to share, access, and protect information to a degree that it can establish and maintain an information advantage over an adversary The force has the capability to collaborate in the information domain, which enables a force to improve its information position through processes of correlation, fusion and analysis
Cognitive	The force has the capability to develop high quality awareness and share this awareness The force has the capability to develop a shared understanding including commanders' intent The force has its capability to self-synchronize its operations

Apart from its technological side, NCW also involves a new way of thinking about military operations. The mental model is focused upon sharing and collaboration to create increased awareness, shared awareness, enabling collaboration, and improved synchronization (Alberts et al., 2000). Thus NCW is not only about networking the battle space by using advanced technology, but the social aspect also plays an equally important role. More on this will be explained in the Chapter on metrics for NCW (Chapter 6).

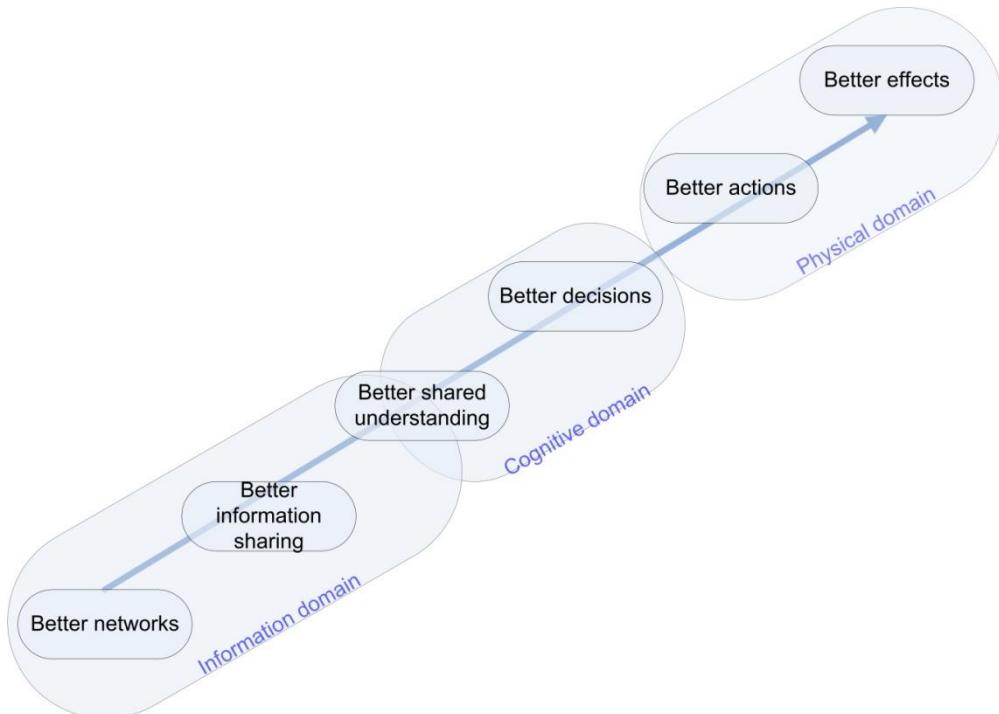


Figure 2.1: NEC benefit chain (after UK MoD, 2005)

2.4 Concepts for NCW

NCW has three key concepts (Alberts et al., 2000):

1. A geographically dispersed force is used. NCW allows moving from an approach based on the massing of forces to one based upon the massing of effects, known as Effects Based Operations (EBO).
2. The force is knowledgeable.
3. Effective linking is achieved among the entities in the battle space.

NCW is a set of war fighting concepts designed to create and leverage information. NCW is the embodiment of Information Age transformation. NCW has been called “the emerging theory of war”. NCW is the organizing principle that guides the military’s adoption and adaptation of information technologies (Alberts, 2002; Alberts et al., 2000).

The result of the implementation of NCW is a common operational picture, which is a synchronized set of information across the battle space.

2.5 Consequences of NCW

NCW will bring about a series of changes that will profoundly affect both the nature of the information available to participants in a mission and how this information will be disseminated and used. Information Age technologies have improved the battle space information and have reduced the uncertainty (fog of war) to a significant extent. The implementation of IAW and its associated technologies also raises concerns. These concerns are: information overload, technology, people, non-networked allies, dynamics on information dissemination, impact on military decision making, cyber attack and command and control design (UK MOD, 2005; Alberts, 2002).

Furthermore, there is no guarantee that hooking things up across the battle space without appropriate organizational and doctrinal changes will increase war fighting effectiveness. In fact, performance can degrade if doctrine, organization, training and other key elements of the process are not changed to adapt to the new situation. To understand and fully exploit the potential of NCW, it is necessary to conduct the necessary analyses and experiments (Alberts et al., 2000).

2.6 Networked Enabled Capabilities

NEC offers decisive advantage through the timely provision and exploitation of information and intelligence to enable effective decision making and agile actions (UK MOD, 2005).

NEC has three overlapping and dependant dimensions: networks, information, and people. All three dimensions need continuous development for NEC to reach its full potential. At the heart of NEC is the network of networks to distribute information. The networked information environment provides the capability to acquire, generate, distribute, manipulate, and utilize information. Information is essential for decision making. Decision makers at all levels will need to identify what information is required and

how to obtain it. The key to NEC is Information Management. Decision support tools will help to reduce the cognitive workload of the decision maker, but ultimately a person will always make the final decision. The people dimension of NEC focuses on the requirement to educate and train people so that they can use their skills, experience and knowledge to exploit and contribute to its future development. Training will be required to build, across organizations, trust and confidence among people who may have to collaborate and to build trust and confidence in the system that is being used. The primary challenge of NEC is to get the people involved and get them to believe in the concept of NEC (UK MOD, 2005).

2.7 NCW versus NEC

NEC is the UK adaptation of the NCW doctrine. Although the ultimate goal of NEC is almost the same as that of NCW, there are differences to be found between the two theories. The main differences are (Boyd et al., 2005):

1. NCW is considered to be resource driven, while NEC is resource limited.
2. NCW considers the network to be the primary driver, while NEC views the network as an enabler only.
3. NCW is considered a doctrine, while NEC is considered part of a gradual improvement in force effectiveness.
4. NCW is a planned and structured development of technology roll-out, while NEC is expected to evolve through networking battlefield entities.
5. NCW is limited, by definition, to warfare, while NEC is expected to be applied more widely to Operations Other Than War (OOTW).

The difference between the two plays a role in the assessment mechanisms of the two approaches. NCW-based assessments tend to be more technical and interoperability assessments, while NEC-based assessments tend to be based on cognitive factors and incremental technical improvements in capability.

2.8 Conclusions

In this chapter two almost identical concepts have been described and the differences between them are indicated. NCW is more a doctrine, but the doctrinal aspects of NEC come to the fore in Chapter 6 on Metrics. The two concepts can be seen as higher level theory or architecture which can be used by the disaster management community to improve their business.

3 Geospatial Data Infrastructures

3.1 Introduction

Chapter 2 introduced the concepts of NCW and NEC. One of the key components of NEC and NCW is the Information Infrastructure or Infostructure. Geospatial information is one of the information components in a NEC or NCW environment. A Geospatial Data Infrastructure (GDI) is specifically designed for the distribution of geographic information and as such a GDI can be considered as part of the overall NEC Information Infrastructure or Infostructure. Next, in Section 3.2, a definition and a short history of GDIs is given. Then, in Section 3.3, an overview of the use of GDIs for disaster management and their advantages and disadvantages will be described. In Section 3.4 an overview of standards used to set up GDIs will be given. Finally, in Section 3.5, GDIs will be placed in the context of NEC.

3.2 Geospatial Data Infrastructures

Already in the late 1970s national surveying and mapping agencies recognized the need to create strategies and processes for standardizing the access to, and applications of, geospatial data. The requirements for standards were seen in narrow technical terms. Over time, institutional and organizational issues were incorporated as well (Groot and McLaughlin, 2000). In more recent history many case studies which value the implementation of a GDI can be found. In Burrough and Masser (1997) case studies include the creation of multinational databases, but there is also a need or a wish to connect national geographical databases. This is seen with the establishment of National Spatial Data Infrastructures in several countries since the mid-1990s (Masser, 2005).

In Masser (2005) a new definition of a GDI can be found: a spatial data infrastructure that supports ready access to geographic information. This is achieved through the coordinated actions of nations and organizations that promote the awareness and implementation of complementary policies, common standards and effective mechanisms for the development and availability of interoperable digital geographic data and technologies to support decision making at all scales for multiple purposes. These actions encompass the policies, organizational remits, data, technologies, standards, delivery mechanisms, and financial and human resources necessary to ensure that those working at the (national) and regional scale are not impeded in meeting their objectives.

The GSDI Cookbook (2004) is a bit more comprehensive: the term “Spatial Data Infrastructure” (SDI) is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of, and access to, spatial data. The SDI provides a basis for spatial data discovery, evaluation, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, and academia, and by citizens in general.

In general, both definitions summarize what GDIs are and do and what is needed to make GDIs work. Masser (2005) states that four key concepts underpin all SDIs:

1. An SDI maximizes the use of geographic information.

2. The implementation of an SDI cannot be realized without coordinated action on the part of the government.
3. An SDI must be user driven, as its primary aim is to support decision making for many different purposes.
4. The implementation of an SDI not only concerns data, technologies, standards and delivery mechanisms, but also institutional matters related to organizational responsibilities and overall national information policies and the availability of the financial and human resources needed for the task.

In short, a GDI or SDI arranges the access to geospatial data and information. On the one hand, this is a technological issue, where the same standards have to be used. On the other hand, it is an institutional or policy issue, because the proper arrangements must be in place in order to share the geospatial data and information.

3.3 Components of the GDI

Mansourian et al. (2006) give an overview of the elements of a GDI. The main components are: people, data, access network, policy and standards (see Figure 3.1). These components will be described in turn below.

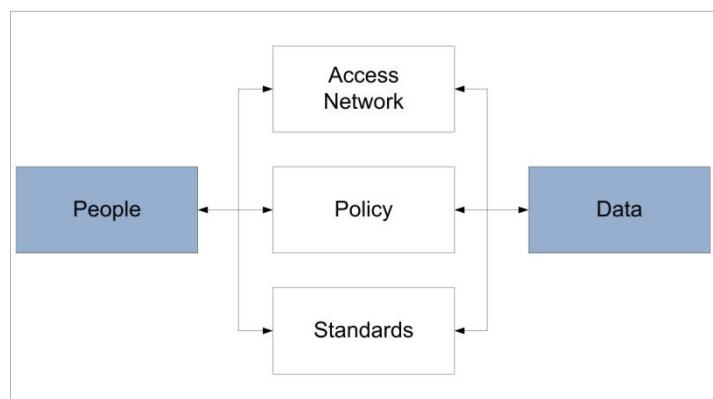


Figure 3.1: Components of a GDI (from Mansourian et al., 2006)

3.3.1 People

People, especially users of the data, expect that the more technological arrangements (network access and standards) and the policies are in place when they actually use the data. The user has to be familiar with all data sets and has to know if the data is fit for purpose and for what purpose.

3.3.2 Data

Data provide the content of the GDI.

3.3.3 Policy

Policy is important in that its agreements are often drafted at a high level, while at the operational level agreements are often informal in nature. But, when data is transferred over networks outside an organization, it changes the way that organization is doing its business. This means that the IT-department is involved and things need to have a formal status. However with formal agreements, access and authorization can be better controlled.

3.3.4 Standards

For the implementation of a GDI it is necessary that it complies with certain standards. In the past, there was a strong focus on data delivery, but in the last few years data discovery and delivery through intranet, internet, and extranets is more common. Apart from national initiatives, there are three main standardization organizations that play an important role in the 'opening up' from the geospatial community. These standardization organizations are the Open Geospatial Consortium, the ISO TC/211 and the W3C.

The Open Geospatial Consortium, Inc (OGC) is an international industry consortium of several hundreds of companies, government agencies and universities participating in a consensual process to develop publicly available interface specifications. OpenGIS® Specifications support interoperable solutions that "geo-enable" the Web, wireless and location-based services, and mainstream IT. The specifications empower technology developers to make complex spatial information and services accessible and useful in all kinds of applications (www.opengeospatial.org, last accessed 20-11-2007). The OGC has a Risk and Crisis Working Group which liaises with ORCHESTRA to synchronize the work being done within ORCHESTRA and the OGC Technical Committee. ORCHESTRA is a European Union Project, which designs and implements specifications for a service-oriented spatial data infrastructure for improved interoperability among risk-management authorities in Europe. The service-oriented spatial data infrastructure will enable the handling of more effective disaster risk reduction strategies and emergency management operations. The ORCHESTRA Architecture is open and based on standards (www.eu-orchestra.org, last accessed 23-07-2008).

The working group TC/211 defines standards in the field of digital geographic information. This group aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth. These standards may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analysing, accessing, presenting and transferring such data in digital / electronic form between different users, systems and locations. The work will be linked to appropriate standards for information technology and data where possible, and provide a framework for the

development of sector-specific applications using geographic data (www.isotc211.org, site last accessed 20-11-2007).

The World Wide Web Consortium (W3C) is an international consortium where Member organizations, a full-time staff, and the public work together to develop Web standards. W3C's mission is: To lead the World Wide Web to its full potential by developing protocols and guidelines that ensure long-term growth for the Web.

W3C primarily pursues its mission through the creation of Web standards and guidelines. Since 1994, W3C has published more than 90 such standards, called W3C Recommendations. W3C also engages in education and outreach, develops software, and serves as an open forum for discussion about the Web. In order for the Web to reach its full potential, the most fundamental Web technologies must be compatible with one another and allow any hardware and software used to access the Web to work together. W3C refers to this goal as "Web interoperability". By publishing open (non-proprietary) standards for Web languages and protocols, W3C seeks to avoid market fragmentation and thus Web fragmentation (www.w3c.org).

3.3.5 Access network

The access network can either be intranets, internet or extranets, and depends on the reach of the policy. There is a trend towards national geospatial data infrastructures, but with the INSPIRE project a European-wide GDI is being developed.

3.4 GDI and NCDM

There are similarities and differences between GDI and NCDM. Keeping the components of a GDI as reference, in the following a comparison between the GDI and NCDM will be made. For the first component 'people' there is a strong similarity between the two theories.

1. In NCDM people are one of the most important elements, because people make or break the whole concept of NCDM. People decide if they want to share information with other people. It is people who turn concepts into realities (Alberts et al., 2000). In a GDI, people use information, but the analysis and the added mono-disciplinary information will result in new geographic information, which has to be shared within the disaster management community. In NCDM people and organizations as a whole have to be managed to facilitate the flow of information. People need to have the technology available to carry out their task (Alberts et al., 2000).
2. The second similarity concerns data or information. In an NCDM the focus is on the development of an information infrastructure. In a GDI, a geographic information infrastructure is built. In the NCDM theory, geographic information is part of the total information flow.

- The third similarity is the access network, without it neither of the concepts can function fully. The network brings the components 'data' and 'people' together. The network could act as the glue in the whole concept.

In NCDM, people cannot function unless the necessary policies are in place. First of all, a nation has to decide that it wants to conduct its disaster management according to the principles of NCDM. That in itself is policy. At the working level, policies or standard operating procedures have to be developed.

In order to get the network of networks intercommunicating, these networks have to talk the same language or translators have to be put in place. Interoperability is one of the key words in NCW theory. Interoperability has to be based on standards. The standards, as laid down by the OGC for the geo-community, will almost certainly play an important role in the exchange of geographic information in NCDM.

Figure 3.2 indicates the reach of the GDI in NCDM. As can be seen from the figure, the GDI is present in the information domain, and supports the aspect of shared awareness in the cognitive domain. However, one could argue that the reach of the GDI is larger than shown, because it also supports the actions in the physical domain.

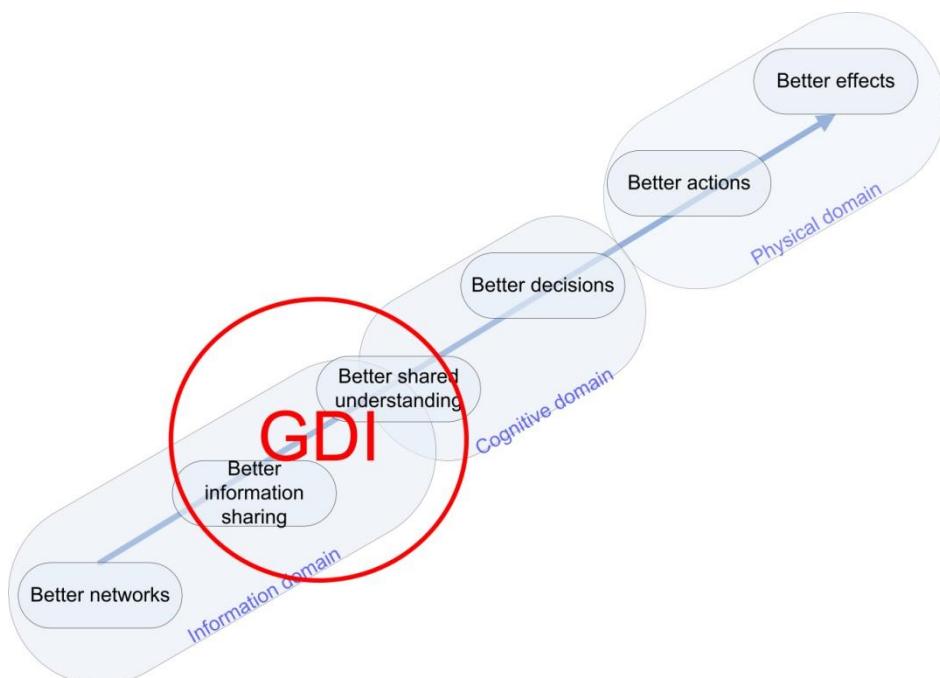


Figure 3.2: Position of GDI in NetworkCentric Disaster Management (modified from UK MOD, 2005)

3.5 GDI for Crisis Management in the Netherlands

The evaluation of the national disaster management nuclear exercise, Borssele, in 2005, and especially the evaluation report on the use of geographic information (Grothe, 2005), showed that departments at the national level had become aware of the importance of geographic information for disaster

management. One of the effects of the evaluation was the formation of the GI Beraad in early 2006. The GI Beraad is an interdepartmental organization, which is responsible for the convergence of geographic information and the requirements for geographic information. It was the GI Beraad which sponsored the first phase of the Geo Data Infrastructure for Disaster Response and Crisis Management (GDI R&C). The scope of the project was ‘the realisation of a Geo Data Infrastructure to be used by the departments for disaster management and during crisis’. The GDI R&C enhances the use of geographic information from other departments, and will support the decision making process in the Departmental Crisis Coordination Centres (DCC) and the National Crisis Coordination Centre (NCC) (Vergouwen, 2007).

The GDI R&C gives access to already present geographic information with the departments. At the end of Phase 1, 17 layers of geographic information were made available. The geographic information was made available through the Haagse Ring and the Rijksweb. This is a classified network that connects the departments in The Hague. Interoperability was assured by using web services and the standards of the Open Geospatial Consortium. Initially only Web Map Services were made available. Phase 1 was evaluated and concluded with a conference in January 2007. During this conference, recommendations for the further development of the GDI R&C were made.

Phase 2 of the project consisted of three separate tracks. Track 1 concentrated on the sustainability of the infrastructure. The infrastructure needs to be structurally available. Track 2 evolved around the theme of development, with the inclusion of more and meaningful services (Web Feature Services), the inclusion of other data layers, and the presentation of dynamic data. Track 3 concentrated on taking the data and the infrastructure to the regional level (Veiligheidsregio). In the Veiligheidsregio the data present in the GDI R&C will enrich the local and regional data. Tracks 1 and 2 were sponsored by the GI Beraad, while Track 3 is sponsored by the Raad MIV.

3.6 Conclusions

In this chapter the concept of GDIs has been described. The GDI has been placed in the context of NCDM, and it is shown that the GDI forms part of the information infrastructure of NCDM. NCDM and GDIs have a great deal in common and the most important aspect is standards. Without standards it is impossible to have interoperability and to exchange information. Exchange and efficient use of information is one of the key factors in NCDM.

4 Disaster Management

4.1 Introduction

Disasters interrupt society by claiming lives, creating victims and destroying infrastructure and houses. Disasters have a negative impact on society, economy and environment, the three main components of sustainable development. This makes the proper management of a disaster an absolute necessity (NRC, 2007; Mansourian et al., 2005). Emergency management is the organization and management of resources and responsibilities for dealing with all aspects of emergencies and disasters (NRC, 2007). Cova (1999) describes emergency management as the discipline and profession of applying science, technology, planning and management to deal with extreme events that can injure or kill large numbers of people, do extensive damage to property, and disrupt communities.

Today, disaster management is on the agenda at all levels of government in the Netherlands. Evaluation of real-world disasters and disaster management exercises has shown that information is not available, not accessible, not usable, not interpreted in the right way, and that information is not structurally being collected (ACIR, 2005). ACIR (2005) also concluded that information is not shared with other authorities (i.e. the Police, Fire Brigade, Municipality, etc), other regions, other levels of command, other ministries and, the press and, the public, and there is not enough coordination and synchronization. This lack of information superiority is attributed to several reasons at different levels. At the governmental/financial level disaster management does not have priority: there is no vision or policy, but there is dominant local autonomy and fights for power and money. At the organizational/operational level, organizations are not familiar with each other and they are competing; there is not enough quality and capacity and the coordination of these organizations is not clear. At the technical level, there is island automation and no access to information of third parties (ACIR, 2005). Furthermore, geographic information is not used to its full extent in disaster management, although geographic information or location can play a big role in all phases of the disaster management chain (Zlatanova et al., 2005; Zlatanova, 2005). Geographic information is regarded as the integrator of data and information (Grothe et al., 2005). This is explained in more detail in Section 4.4.

Section 4.2 discusses the disaster management cycle. Section 4.3 describes national procedures during the response phase. Section 4.4 examines the role of geographic information in disaster management and in Section 4.5 the role of NEC in disaster management. In Section 4.6 conclusions will be drawn.

4.2 The disaster management cycle

ACIR (2005) defined crisis management as the ‘coordinated large-scale deployment of more than one relief organization and decision making at governmental and operational level under uncertain circumstances’.

The Disaster Management Cycle, also referred to as the ‘safety chain’ (Figure 4.1), contains the following stages: pro-action, prevention, preparation, response and recovery (Ministerie van Binnenlandse Zaken, 2003; Grothe et al, 2005). *Pro-action* is the process of creating awareness, performing threat and vulnerability analyses, and designing and constructing resilient systems (excluding risks). *Prevention* is the inventarization and minimization of risks and consequences, the installation of forecasting systems, and issuing regulations and permits (limiting risks). In the *preparation* phase, an emergency plan (including policy and organization) is written, the emergency organisation is installed, trained and tested for its Full Operational Capability (FOC), and the materials and equipment needed are made available. In the *response* phase, the elimination of sources and side-effects is key. In the *recovery* phase the response phase is evaluated and modifications to the emergency plan are made, the damage is repaired and people are compensated (Grothe et al., 2005).

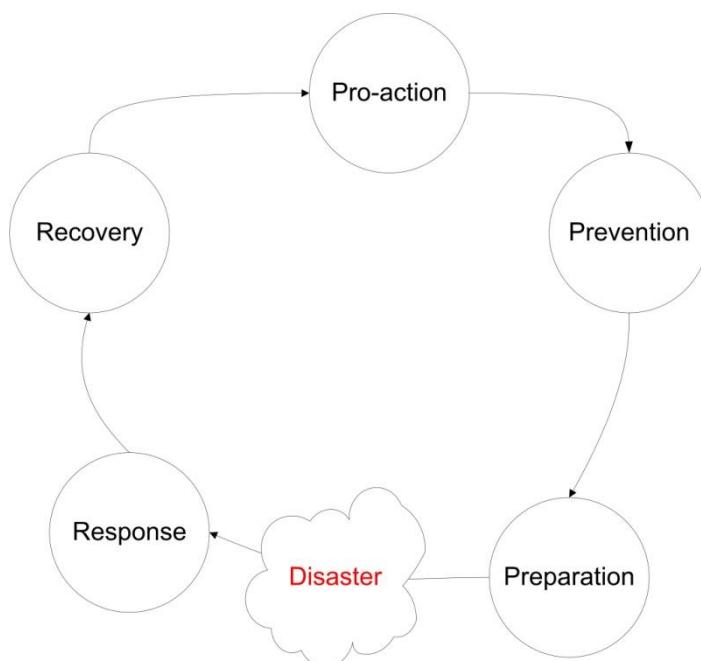


Figure 4.1: The disaster management cycle

Internationally, the terms mitigation, preparedness, response and recovery are often used to describe the emergency management cycle (NRC, 2007; Cova, 1999).

Disaster management is complex (Figure 4.2) in the sense that it involves multi-users (from firemen on the ground to decision makers at local, regional or even international level); it is multidisciplinary (municipalities, police, fire brigade, defence); and decision making is done under time pressure and stress (van Borkulo et al., 2005).



Figure 4.2: Parties involved in disaster management (from van der Sluys Veer and Kusse, 2002)

4.3 Emergency types and GRIP levels

The response to emergencies is laid down by law in the 'Emergencies and Heavy Accidents Act' (De wet Rampen en Zware Ongevallen) and the 'Law of the Safety Regions' (Wet op de Veiligheidsregio's). In this law the tasks and responsibilities of the different authorities are laid down with respect to emergencies in the response phase. The Dutch government has identified 7 emergency categories and 18 emergency types. It is quite possible that a combination of emergency types will occur in one incident. The 7 emergency categories must be seen as a typology to identify the consequences during the preparation phase. The 7 emergency categories are (Ministerie van Binnenlandse Zaken, 2003):

1. Traffic and transportation
2. Dangerous goods
3. Public health
4. Infrastructure
5. Population
6. Natural disaster
7. Emergency at a distance

The *Handboek Voorbereiding Rampenbestrijding* (2003) and van Borkulo et al. (2005) describe the different levels of emergency response, since this is a complex process involving different levels of authorities and others (Police, Fire Brigade, medical assistance, Armed Forces). The complexity of the disaster defines the level. The levels are known in the Netherlands as GRIP-levels (Coordinated Regional

Incident Suppression) 1 to 4. An explanation of the GRIP levels is given in Table 4.1 and an overview of the chain of command is given in Figure 4.3.

Table 4.1: Overview of GRIP-levels

GRIP level	Description
GRIP 1	<ul style="list-style-type: none"> - There is need for structured and coordinated meetings between the emergency response units - The incident can have administrative consequences - There is need for more information and data
GRIP 2	<ul style="list-style-type: none"> - The impact area is bigger than the source of the incident (for instance: a toxic cloud) - The need for one leader in the disaster area (most likely the officer on duty from the Fire Brigade)
GRIP 3	<ul style="list-style-type: none"> - The incident disturbs public safety - Serious threats to persons, animals and materiel interests - The source or impact area of the incident strikes more municipalities - The sirens net is used
GRIP 4	<ul style="list-style-type: none"> - The disaster/impact area crosses the borders of the safety regions or province - Coordination is implemented by the province or on a national level.

4.4 Geo-information and disaster management

Spatial data can considerably facilitate disaster management as most of the required information for disaster management has a spatial component (NRC, 2007; Mansourian et al., 2006; Cova, 1999). In fact, all disasters have both a temporal and a geographic footprint that identifies the duration of impact and its extent on the earth (NRC, 2007). In NRC (2007) the term ‘geospatial data and tools’ is used to refer to the imagery, maps, data sets, tools and procedures that are able to tie every event to a location on the earth. First, Cova (1999) describes how these tools, i.e. GIS, can be used in the four phases of emergency management. In the *mitigation* (or repression) phase (see Figure 4.1) GIS and geographic information is used to perform analytical modelling for long-term planning and forecasting. In the *preparation* and *response* phases, timely and accurate answers to geographical queries are needed to support decision making by the emergency managers. Secondly the GIS is used for information integration and dissemination (command & control). In the *recovery* phase GIS is used as a spatial inventory system for coordinating recovery activities.

But the strength of geo-information is that it can be used for a wide range of applications including: modelling and simulation of disasters; visualization for decision support and in management information systems (Markus et al., 2004). A GDI can be a valuable source of geographic information for all phases of

disaster management since it brings together all geographic information (Figure 4.4). Geo-information supports all aspects of the disaster management cycle.

Spatial analysis is one of the key drivers for using geographic information, and it makes geographic data an integrator of data and information. GIS systems or applications have strong analytical capabilities and this coupled with the explosive growth of geographic data and the ongoing integration of GIS in other kinds of information systems, makes GIS and geographic information an integrator of data and information (Koomen, 2008). There are different methods to move from geographic data to meaningful information. This meaningful information forms valuable input for the decision making process in disaster management. The most common operators for geospatial analysis are: transformation, aggregation, combination, valuation, proximity analysis, and simulation

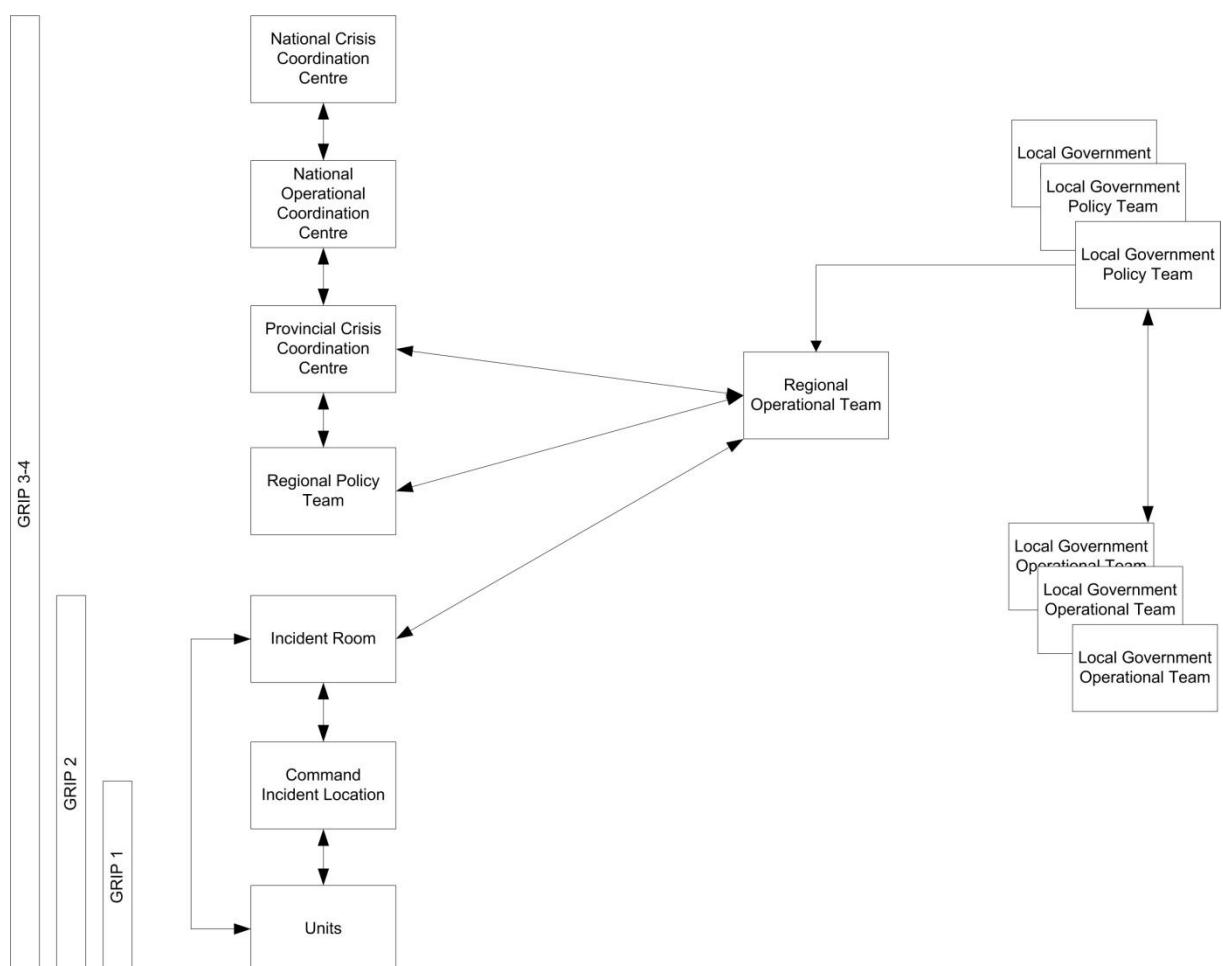


Figure 4.3: Chain of command for disaster management in the Netherlands (modified after Ministerie van Binnenlandse Zaken, 2003; Hanraets, 2007)

Notes: The reach of the GRIP levels is on the left hand side. Arrows indicate information exchange.

(Koomen, 2008). During the repression phase, a combination of these methods will be used for the analysis of geospatial information coming from different sources. Static information will be combined

with the dynamic information gathered during the management of the disaster (Figure 4.4). Figure 4.4 underlines the need for geographic information in all phases of the disaster management cycle. The analysis performed before and during an incident is the input for decision support systems and simple geographic viewers such as Google Earth and Virtual Earth as communication aids.

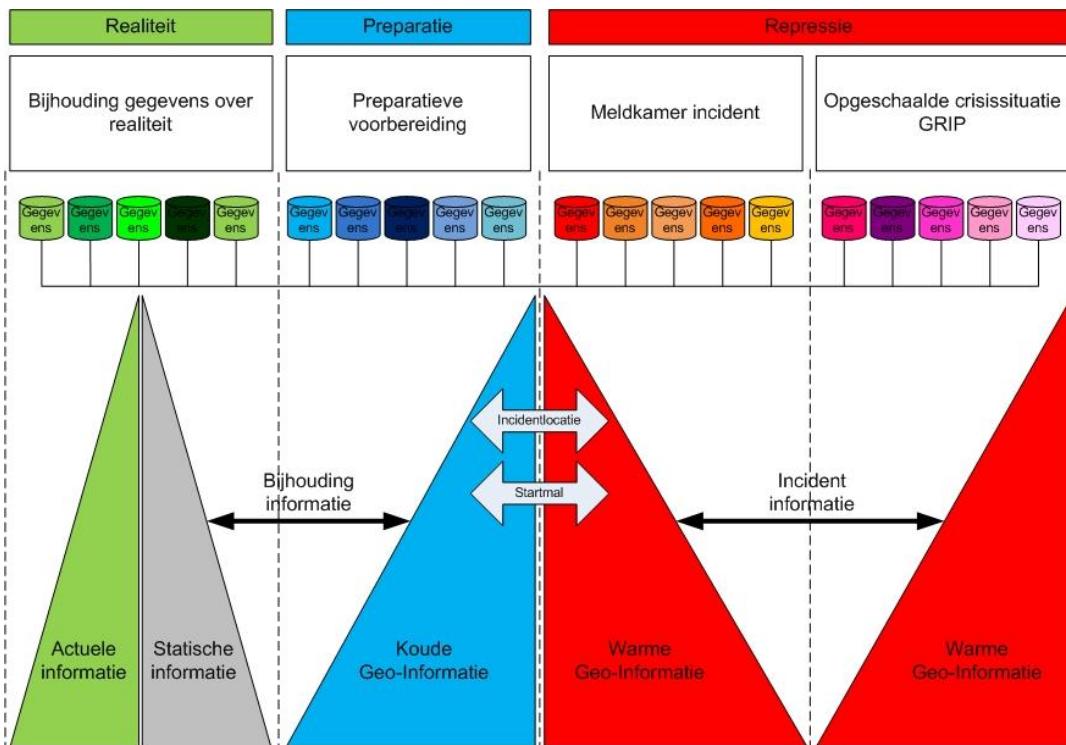


Figure 4.4: Relationship between geographic information items in the disaster management community (from van Capelleveen et al., 2008)

In the Netherlands it was only in 2005 during the National Nuclear Exercise in Borssele that for the first time a very immature form of a spatial data infrastructure was used. This decision was made only a few weeks before the actual exercise, and from the evaluation of the exercise it is clear that the geo-information has a real added value for emergency management (Grothe, 2005).

4.5 Networked Enabled Capabilities and Disaster Management

As described in Chapter 2 on NEC, the goal of NEC is to link all sensors and actors through a network, in order for those actors to, among other things, share information, collaborate, acquire shared situational awareness, and synchronize their actions. In the NEC benefit chain this also leads to better decisions and better actions. Good decision making is associated with (Alberts et al., 2001):

1. reflecting the uncertainty inherent in situations that consider multiple possible futures;
2. keeping the number of alternatives considered within the cognitive limits of most participants;
3. gathering information from, and involving in decision-making councils, all the actors who are relevant;

4. looking ahead to potential counter-measures from opponents to any particular course of action.

Being networked or acting in the same network enhances the information flow from and to actors in the network. Better information leads ultimately to better decisions, and better information can remove many of the uncertainties that disaster managers had before they were part of a networked force.

In the section above better information is regarded as one of the key drivers for NEC. In the UK NEC doctrine (UK MOD, 2005), the building of an information infrastructure is one of the three pillars. Geographic information is part of the information infrastructure. One of the things that has only recently been defined for disaster management purposes is the information need (Snoeren, 2006). An information need is described as the measurable set of information required to plan and/or execute a mission or task (Alberts et al., 2001b). The Veiligheidsregio Arnhem defined 25 disaster management processes, and for one emergency type a number of different processes come in action to manage the disaster. Snoeren (2006) modelled the geographic information need (static as well as dynamic information) by defining use cases and constructing activity diagrams.

4.6 Conclusions

In the last few years, the disaster management community has leaped forward, making use of the latest techniques available. The concept of Networked Enabled Capabilities (NEC) gives the disaster management community a platform on which to build for the future. There is still much to be gained within the community in order to effectively tackle disasters. Many of the current problems can be solved by the implementation of the latest proven technology, but, as in the UK NEC doctrine, people are probably the most important factor to make NEC in disaster management a success. Without the willingness to share information, to collaborate and share knowledge, NEC will fail.

5 Architecture for Disaster Management

5.1 Introduction

Architecture in IT has to support the business and the business processes. But architecture is mostly only thought of as how the technology is used and implemented, but its functionality reaches beyond that. First, in Section 5.2 the Integrated Architecture Framework (Capgemini, 2006) is used to describe the business and the processes in the Regional Operations Team (ROT). There follows a literature study of the technology in NCDM and SDI in Sections 5.3 and 5.4, respectively. In the final Section 5.5 the architecture for the exercise Eagle One will be evaluated, and possible gaps in the architecture will be discussed.

5.2 The Integrated Architecture Framework

5.2.1 The IAF model

The Integrated Architecture Framework (IAF) analyses the business and the IT systems that support business. The method has been developed by the company Capgemini (2006) and is compatible with The Open Group Architecture Framework (TOGAF) and the IEEE 1471-2000 standard ‘Recommended Practice for Architectural Description of Software-Intensive Systems’. The definition of architecture as used in the IAF is directly taken from TOGAF (Capgemini, 2006). Architecture increases the business and IT alignment and delivers value in improved project success. The IAF provides (Capgemini, 2006):

1. A model for architecture development and usage;
2. Describes the format and content of elements of the architecture;
3. Specifies the way in which these elements relate to each other.

The model is broken down into aspect areas and abstraction levels (Figure 5.1). The abstraction levels are the contextual level (why?), the conceptual level (what?), the logical level (how?) and the physical level (with what?). There are seven aspect areas. Five of these aspects focus on the core of the overall architecture: business, information, data, information systems, and technology infrastructure. The other two aspect areas focus on security and governance.

WHY?
Contextual

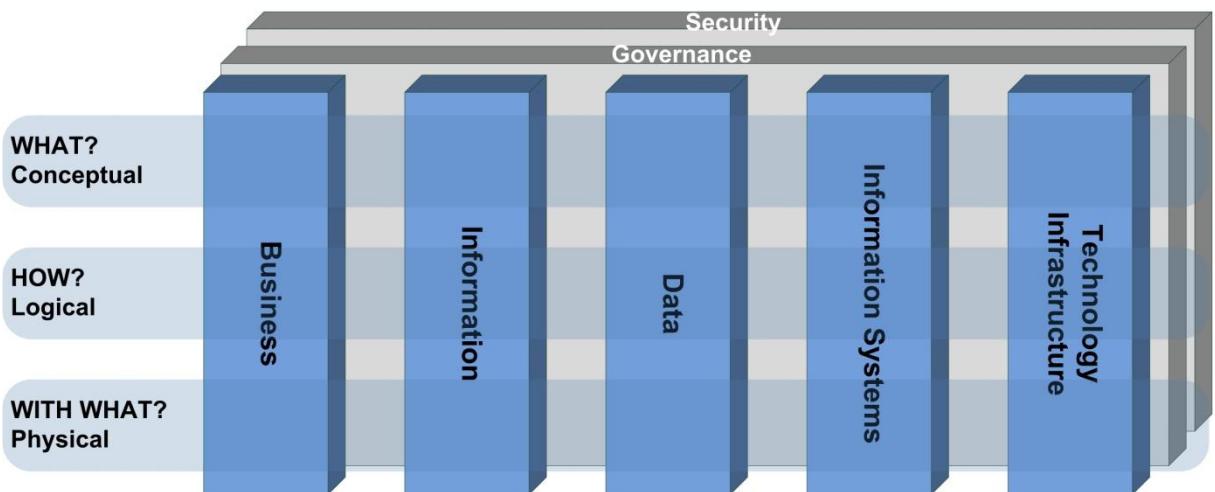


Figure 5.1: Model of the Integrated Architecture Framework (Capgemini, 2006)

5.2.2 The IAF model applied to the ROT

In this thesis the IAF model is applied at the level of the ROT. This helps to get a grip on whether all aspects covered by the ROT are also covered by its architecture. This abstract level was chosen because the whole development of the evaluation method was focused on the ROT. It is also possible to develop architectural views on higher and lower levels, and it can even be applied down to the level of functional areas.

5.2.2.1 *Conceptual level*

Business

The primary business process of the ROT is the interdisciplinary coordination of all incident- or disaster-related processes in the source and effect areas.

Information

Analysis of dynamic and static data with reference to the source and effect areas.

Data

During the incident data is coming from several sources. First of all the data is being reported by all teams present at the incident location. Secondly data is being provided by several levels of government (local, provincial, regional and national). Data consist of geographic and non-geographic data.

Information systems

The following functionality of the information systems is needed: spatial analysis and display of geographic information, the generation of reports with non-geographic incident-related information; push and pull of incident-related information; ability of information system to log all activities of the separate sections for after-action review purposes. Information exchange must be supported by e-mail and possible instant messaging. Sharing of information must be (near) real time and the synchronization of temporarily off-line clients must be automatic. Applications need to be present in both a static and a mobile environment. Graphical User Interfaces need to be intuitive. Applications support the primary processes of the ROT.

Technology infrastructure

The infrastructure needs to support collaboration. Networks need to be connected to enhance information exchange between different networks. Back-up hardware and servers are needed to continue disaster management in the event of system failure.

5.2.2.2 Logical level

Information

The data from several sources is visualized in a Command and Control System (CCS), that supports the decision making process in the ROT. The application of several methods of geospatial analysis (Koomen, 2008) turns geospatial data into meaningful geospatial information. Geospatial analysis functionality is key for the CCS system and the decision-making process.

Data

The ROT uses data coming from several sources, and can be classified as dynamic and static data. *Dynamic data* is incident-related and *static data* comes from databases held by different levels of government or information gathered during the preparation phase.

Information systems

The integration of GIS systems and peer-to-peer collaboration software enhances (near) real-time information exchange. The GIS is used as a communication, visualization, and analysis tool.

5.2.2.3 Physical level

Information

Geographic information is brought together through the coupling of networks and the use of international standards for information exchange. The dynamic information is saved locally on the work station and is distributed using peer-to-peer software. The reports are written in the Groove environment.

Data

The static geographic information is presented using a national infrastructure. Incident-related information comes from the Command in the Place of the Incident (COPI) and the emergency management center (meldkamer). Other dynamic information, such as weather, should be provided by the national infrastructure.

Information systems

In the ROT the following specific applications are being implemented and used: ArcGIS Desktop products and Microsoft Groove. ArcGIS is used for the visualization and analysis of geographic data and information. Groove is used as a collaboration tool. It is a peer-to-peer application, which connects all users in the ROT enterprise and beyond. Dynamic, incident-specific information is being updated using Microsoft Groove.

Situational Awareness outside the ROT can be created using a web viewer, such as Microsoft Virtual Earth.

Technology infrastructure

The ROT uses the local area network of the Veiligheidsregio Gelderland-Midden. This local area network is connected to the OOV-network and the Haagsche Ring. The coupling of these networks assures that the GDI R&C infrastructure can be used by the ROT. On the other hand, the connection of the network makes it possible to communicate through the network with higher commands. Other infrastructure that is being used is the C2000 communication infrastructure, GPRS, UMTS and WiFi.

There is insufficient information available on the hardware used during the exercise Eagle One and this aspect is out of the scope of this thesis.

5.2.3 Conclusions IAF

The IAF method is useful, because it gives structure. Flaws and gaps in the current design of the CCS system as a whole can be made visible. Later, in the section on the CCS system, gaps in the design will be discussed fully.

5.3 NCDM Technology?

In the policy papers of the mid-1990s Alberts et al. (2000) said the following about technology for NCW: the entry fee for NCW will be an information infrastructure that provides all elements of the enterprise with access to high quality information services (Alberts et al., 2000).

Alberts et al. (2000) state that technology will improve the performance of actors and sensors. There will be a move to a thin client architecture. Four differences can be noted between the sensors and actors in a platform-centric environment and a network-centric environment. First, there will be a transfer of intelligence from the sensors to the information infrastructure (or infostructure) and a relocation from

the complexity of the platform to the network. Secondly, there is a decoupling of the sensors from the weapons platforms. The third difference is the decoupling of the sensors from the actors. And, finally, there will be the development of new sensors to sense new types of entities and new actors to provide novel capabilities to damage adversaries.

The architecture of the infostructure or the information infrastructure will enable multiple stand-alone networks to be integrated into an adaptive and reconfigurable network-of-networks (Alberts et al., 2000).

Alberts et al. (2000) do not state it in so many words, but they are actually referring to what is nowadays referred to as a Services Oriented Architecture (SOA). In those days, the term SOA had not yet been invented and probably technology was not as advanced as it is today. In more recent literature and policy papers (e.g. Ministerie van Defensie, 2004; Ministerie van Defensie, 2006; Thomson and Adams, 2005; Russel and Xu, 2006; Russel and Xu, 2007; Russel et al., 2006) it is clearly stated that the preferred architecture for implementing NEC is a SOA. SOA offers a flexible approach to systems engineering with quality of service and evolution characteristics applicable to NEC. Platforms are no longer the acquired products but the delivery is based on the achieved effect (Russel and Xu, 2006).

SOA is a paradigm for organizing and utilizing distributed capabilities that may be under the control of different ownership domains. The noun “service” is defined in dictionaries as “the performance of work (a function) by one for another”. However, service, as the term is generally understood, also combines the following related ideas:

1. the capability to perform work for another;
2. the specification of the work offered for another;
3. the offer to perform work for another.

In SOA services are the mechanism by which needs and capabilities are brought together (OASIS, 2006).

Current SOA technologies like web services and grid services offer incomplete solutions to SOA for NEC. There are still a wide range of problems which have to be solved and solutions have to be found (Russel and Xu, 2006).

5.4 GDI Technology

Typically in the past, the focus of geospatial data access was on the supply side with a strong emphasis on technology and community-based standards and specifications. With the growth of the Internet, in particular Web-based technologies, access has become a demand-driven operation (GSDI, 2004). There is a development from data and data delivery to services. GIS technology and architecture have also changed and evolved. In the beginning, GIS software consisted of collections of computer routines that a skilled programmer could use to build an operational GIS. With advancing software engineering techniques and a growing GIS market in the 1970s and 1980s, there was a demand for higher-level applications with a standard user interface. Later command line interfaces were replaced by graphical user interfaces (GUIs), and a customization capability was added to allow specific-purpose applications to

be created from the generic toolboxes (Longley et al., 2001). Three levels of GIS usage in organizations can be recognised. First of all, there is project GIS, where a single GIS system including technical components are bought for a single, fixed-term project. As the interest in GIS grows, several projects in the same department may be using GIS. This is also called ‘departmental GIS’. Then, as organizations start to implement GIS organization-wide the term ‘enterprise GIS’ is used. The fourth type of implementation is when a nationwide GIS with thousands of users connected through the Internet is implemented (Longley et al., 2001; Batty, 1999).

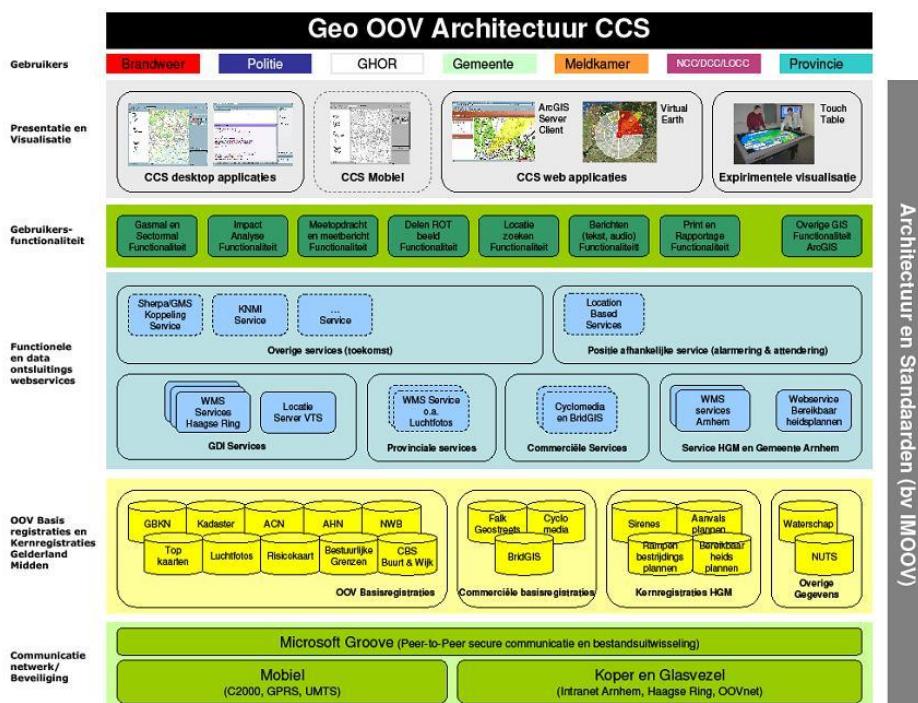


Figure 5.2: Geo OOV Architecture (RMIV, 2007)

The architecture of the four levels of GIS usage in an organization has evolved over recent years. Most innovations can be found in the implementation of enterprise and nationwide GIS. A classic implementation is the three-tier architecture of GIS software. Tier 1 is the data server with the database management system; Tier 2 contains the business logic with the GIS tools; and Tier 3 contains the presentation with the user interface. In a thick client infrastructure is also possible to have a two-tier architecture, where the business logic and the user interface is present on the desktop computer. In a thin client infrastructure, i.e. Internet GIS, the data server and the business logic remain on one or more servers, whilst the GUI is just any web browser (Longley et al., 2001). In a SOA a four-tier architecture is used. Tier 1 consists of the content layer or the data; Tier 2 contains the service layer (or content access); Tier 3 is the service bus (or the business processes), where services can be combined; and Tier 4 is the presentation layer where there is user-interaction (Geonovum, 2007a).

5.5 Eagle One architecture

In Figure 5.2 the current architecture of the CCS system, as used during the exercise Eagle One is presented. In Section 5.2 a structured description using the IAF method was given. In Section 5.3 and 5.4 the architecture for NCDM and GDI was described. Most of these principles have been taken into account in the design of Eagle One architecture. One of the disadvantages of the system is that higher command needs to have Microsoft Groove installed to be able to get the dynamic, incident-specific information. This could partly be solved by letting these institutions use the web client. One of the recommendations for the future would be that the dynamic information should be written to a database. The use of a database makes it possible to install OGC webservices to serve the information to other organizations. At the present time, it is not possible to implement this architecture, because there is no consensus about a database model for dynamic incident-specific information. The exchange of non-geographic information with other organizations has not been accounted for. This is all handled through Microsoft Groove, but reports could be e-mailed to other organizations.

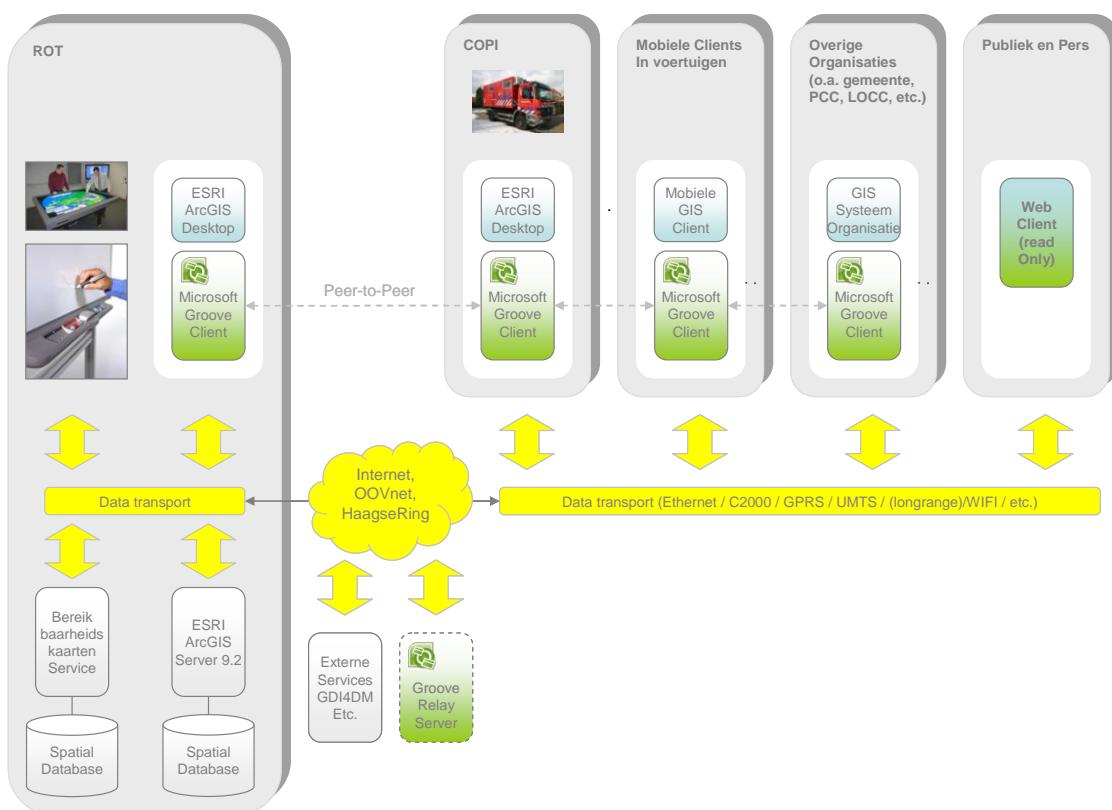


Figure 5.3: Outline of the net-centric architecture for exercise Eagle One (Geodan, 2007a)

The advantages of the architecture as used in exercise Eagle One (see Figure 5.3) is that all connected clients have the dynamic information on the system locally. The architecture could be seen as a network of distributed databases and every client has the same information in the synchronization folder.

Information exchange is near real-time and if clients are not connected for some time, synchronization starts automatically when the connection is re-established.

5.6 Conclusions

In this chapter the IAF model has been applied to the architecture as used during the exercise Eagle One. In the following sections the architecture for NCDM and GDI were presented. In Section 5.5 the architecture of the exercise Eagle One was discussed, taking the NCDM and GDI architecture into account. It can be concluded that the architecture for the exercise Eagle One has been designed using the latest principles and techniques. But there are a few small things that could be improved in the coming years, but these are dependent on other developments in the disaster management community.

6 Metrics for NCDM

6.1 Introduction

In order to evaluate an NEC environment it is necessary to take all components of the NEC environment into account (for an overview, see Figure 6.1). NEC comprises three areas: people, information, and technology. The evaluation is further complicated because the disaster management community is a multi-disciplinary and multi-user environment. A metric is a standard of measurement - without a set of metrics associated with the primitives, there is no standard means of measuring and comparing their characteristics (Alberts et al., 2001). The purpose of this thesis is to develop a standard set of metrics in order to be able to assess the added value of geographic information in disaster management exercises and real disasters in a standardized way.

In Sections 6.2, 6.3 and 6.4 respectively, introduce the metrics for the NEC aspects people, technology and information as used in the evaluation. In Section 6.5 the set-up of the evaluation is presented. In Section 6.6 the instructions to the observers are explained and Section 6.7 concludes this chapter.

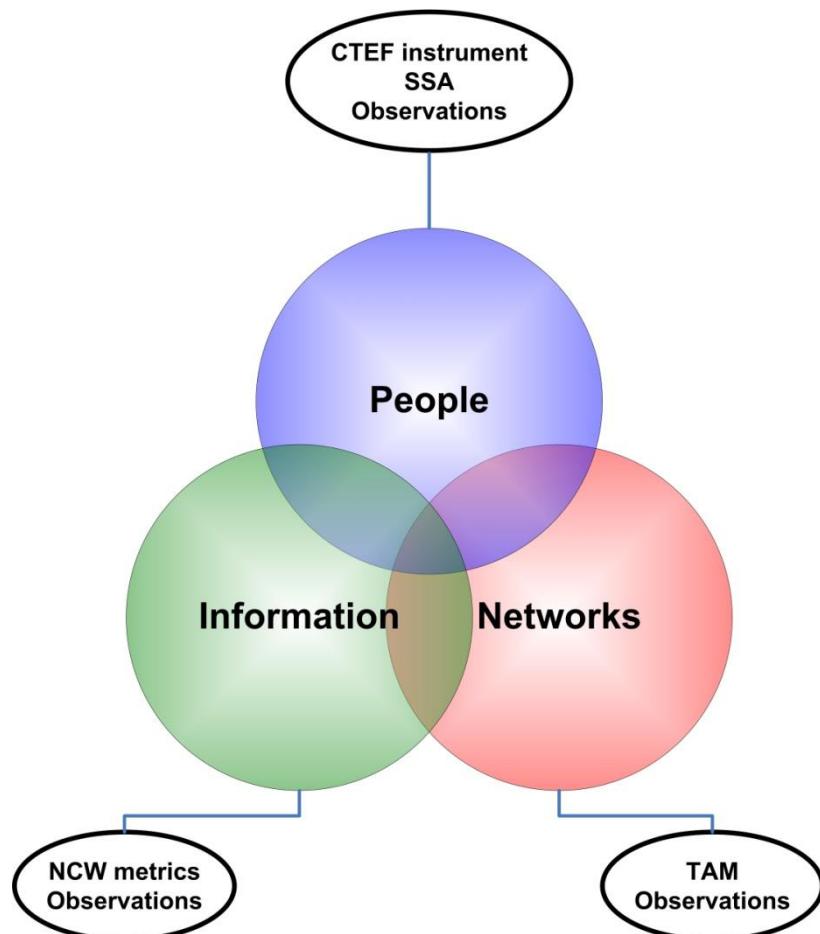


Figure 6.1: Elements of NEC and their respective evaluation method (modified after UK MOD, 2005)

6.2 People

6.2.1 Military Command Team Effectiveness Model

This method was originally designed to evaluate the effectiveness of military command teams. The operations that military command teams encounter today are totally different from the situation during the Cold War. Crisis response, anti-terrorism, peace support, humanitarian operations, and warfare are possible situations in which modern military commanders and their teams can find themselves. The method focuses on the effectiveness of the team. Effective teamwork is a mix of structural factors and process factors that develop in interaction with the dynamics of the operational situation (Essens et al., 2005).

Essens et al. (2005) provide an extensive overview of existing team effectiveness models. From all these models Essens et al. (2005) designed a team-effectiveness model that is tailored to the needs of a military commander. The model focuses on three components: conditions, processes and outcomes (see Figure 6.2) and each component has different aspects and features.

Within Conditions, first, *mission framework* focuses on the conditions of the mission of the team. These are situational uncertainty, stress potential, limiting constraints, and stakes. Second, *task* focuses on the goals the team has to accomplish and the characteristics of the work that will be involved. Characteristics of work are: task complexity, workload, goal clarity and goal stability. The third condition is *organization*, which captures issues related to the larger organization. Characteristics of this condition are: goal congruity, clarity of command structure, autonomy of the team, and organizational support. The fourth and fifth conditions focus respectively on the *leader* and the *team members*. Characteristics that may potentially affect the functioning and effectiveness of the team are addressed. These characteristics are skills and knowledge, and the congruity of personal and organizational goals.

The sixth and final condition is *team* and captures characteristics like composition, size, architecture, maturity, and team goals.

The next part of the model focuses on processes or the behaviour that emerges during the operation. Essens et al. (2005) recognize two relevant components: task-focused behaviour and team-focused behaviour. *Task-focused behaviour* emphasizes on activities directed at the operational task. Characteristics are managing information, assessing the situation, decision making, planning, directing, controlling and liaising with other teams. *Team-focused behaviour* addresses the interaction between the team members. Its characteristics are providing and maintaining vision, maintaining common intent, interacting within the team, motivating, adapting to changes, and providing team maintenance.

The third part focuses on the outcomes of the mission. Essens et al. (2005) describe two components for this part of the model: task outcomes and team outcomes. *Task outcomes* address the intermediate and final results of the mission. The characteristics of task outcomes are achievement of intermediate and end goals; meeting criteria set by the stakeholders; and other stakeholders' satisfaction. *Team outcomes*

address the maturity of the team. The characteristics of this component are mutual trust, morale, cohesion, collective confidence in achieving the goals, shared vision, and mutual respect.

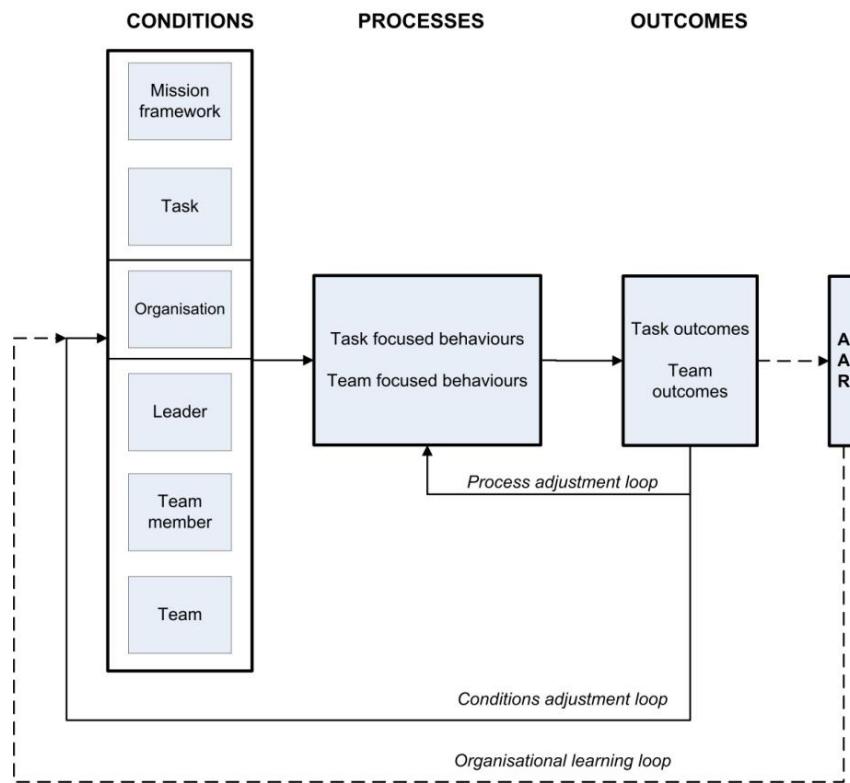


Figure 6.2: CTEF model with basic components and feedback loops (Essens et al., 2005).

According to Essens et al. (2005), the components affect each other. Conditions have an effect on processes, and the processes influence the outcome. In the model, feedback loops are present in order to be able to adjust, learn, and develop as a team. There are three formal feedback loops: the process adjustment loop, the conditions adjustment loop and the organizational learning loop. The *process adjustment loop* addresses required interventions in the management or performance in the task or team process. The *conditions adjustment loop* focuses on changes in the structural basis of the processes, either in personnel, organization, mission or task factors. The *organizational learning loop* addresses the evaluation of all the components which influence effectiveness, the commander and the team's learning cycle, and the advice to the organisation and follow-up commanders.

Apart from the model, Essens et al. (2005) also developed the Command Team Effectiveness (CTEF) instrument. The CTEF model is the basis for the assessment instrument. In the CTEF instrument, the model is applied to assess, control and improve the effectiveness of a team. The CTEF instrument is a questionnaire where the respondent has to judge two things concerning every aspect. First of all, the respondent has to give an objective judgement on the status of a particular aspect of a component. Secondly, the respondent has to assess the potential impact of that status on team effectiveness.

Through the set-up of the CTEF instrument, management data is provided for a commander to lead the team.

The CTEF instrument focuses particularly on information, information sharing, collaboration, communication, command and control, shared situational awareness, and leadership aspects. According to Alberts et al. (2000), these aspects are difficult to measure. It is possible to measure these 'soft' aspects of NEC with the CTEF instrument. Although this instrument will overlap some of the items in the information questionnaire, focuses particularly on geographic information and the richness of the information used in the exercise. It is the first time the CTEF instrument will be used in a disaster management exercise and the use of the CTEF instrument must be evaluated as well.

The CTEF instrument was only sent to heads of sections and the Plv OL (see Chapter 4). The questionnaire has not been modified to suit disaster management. The goal of this questionnaire was to determine if a tool like CTEF is applicable to multidisciplinary teams and disaster management.

6.2.2 Shared Situational Awareness

In the theory of NEC the aspect of Shared Situational Awareness (SSA) plays an important role. It is recognized that the factors contributing to SSA, as described by Nofi (2000) are not fully covered by the CTEF instrument. Although it is difficult to measure the state of SSA during an exercise like Eagle One, where four different scenarios are being played out, it seems relevant for this thesis to get a fair idea of how the participants rate their SSA. In order to get a good measure of SSA, this particular questionnaire should have been filled out after each scenario. This was, however not possible because of time constraints during the exercise.

The original questionnaire from Nofi (2000) was therefore translated and modified to suit the specific demands of disaster management. The aspects on SSA were merged in the questionnaire for the users of the application CCS Sitekst (Questionnaire Eagleone_2).

6.2.3 Observations

The observations can be broken down into the three aspects of NEC (people, networks, information). For the NEC aspect 'people', observers were instructed to focus on communication between actors (oral or written), whether there is a shared situational awareness, and how good the collaboration is between sections.

6.3 Technology

6.3.1 Technology Acceptance Model

Information technology offers the potential for substantially improving performance. Better measures for predicting and explaining system use would have great practical value. Davis (1989) developed the Technology Acceptance Model (TAM) to pursue better measures for predicting and explaining use. The

method is built around two variables, which are: perceived usefulness (PU) and perceived ease of use (PEoU). The PU is defined as the ‘degree to which a person believes that using a particular system would enhance his or her (job) performance’. This is a quantification of the user’s perception of how the new technology can help him or her perform better. PEoU refers to the degree to which a person believes that using a particular system would be free of effort (Davis, 1989). This variable tells something about the possible rejection of the technology by the user, if the user believes that the effort to use the technology is greater than the performance benefits. In recent years, the TAM model has been extensively used and modified by other researcher (Adams et al., 1992; Venkatesh and Davis, 2000; Horton et al., 2001; Porter and Donthu, 2006). Venkatesh and Davis (2000) developed the original TAM model into the TAM2 model, by taking more social influence processes into account. Porter and Donthu (2006) modified the TAM model in order to include the role of access barriers and demographics. The TAM model has also been combined with Task Technology Fit (TTF) theory (Dishaw and Strong, 1999). Dishaw and Strong (1999) believe that TAM and TTF overlap in a significant way, and that a combination of the two models could bring both strong points to the fore.

The original TAM model by Davis (1989) is built around a fixed set of questions with scale items. The user has five choices ranging from ‘completely disagree’ to ‘completely agree’.

A first observation to make is that the strong point of the TAM-model is that it measures the perceived ease of use and the perceived usefulness of an IT system. It is not very good, or may not be suitable at all to measure the value of information. Secondly in order to use the TAM-model to full advantage and to get significant results, it is necessary to have a large population. The population in this study is too small to use the statistical aspects of the TAM model. A third aspect is that technology is not a metric of NEC theory. Therefore, because, for this exercise, new technology has been introduced that supports Net-centric collaboration, it was decided to measure the impact of the new technology.

The standard TAM questions were remodelled to suite the specifics of the applications that were going to be used. One questionnaire was specifically focused on the CCS application Sitplot (questionnaire eagleone_1), and the second questionnaire was focused on the actors using the CCS application Sitekst (questionnaire eagleone_2). In the actual questionnaires, the questions on PU and PEoU were mixed and some questions were posed in a more positive way. The original 14 questions on both PU and PEoU were reduced to 8 and 11, respectively, in the CCS Sitplot questionnaire (Eagleone_1) and to 7 and 11, respectively, in the CCS Sitekst questionnaire (Eagleone_2).

6.3.2 Observations

The characteristics for the NEC aspect ‘technology’ for exercise Eagle One were ease of use of the CCS applications Sitplot and Sitekst. Actors were able to demonstrate their experience with those two applications, and these results will be complementary to the questionnaires.

6.4 Information

Alberts et al. (2001) describe a hierarchy that consists of four bands of measures: richness, reach, command and control, and value (see Figure 6.3). A fifth factor is quality of interaction (Alberts et al., 2001).

The first band, *richness*, contains measures that address the quality of the information content as it exists in both the information and cognitive domains. The second band, *reach*, contains measures that focus on the ability of an organization to share information and develop shared awareness. The third band, *command and control*, measures the products of a command and control process. The fourth band, *value*, provides measures that address the bottom line value of information-related capabilities, i.e. the ability to accomplish military missions and to use that military mission effectiveness to achieve policy success. The fifth band, *quality of interaction*, is described as the nature of the interaction among actors (Alberts et al., 2001).

Measuring the quality of information requires dealing with three interrelated issues (Alberts et al., 2001):

- how good are the individual items in the information system;
- how good is the security of the information system being used;
- how good is the underlying information system with respect to features not directly related to security.

Better information is not an end in itself, and measures of information performance must be related to measures of effectiveness. However, better information will improve important components in other domains (Alberts et al., 2001):

- Situation awareness in the cognitive domain;
- Decision making in the cognitive domain;
- Planning (including collaboration planning) in the cognitive domain;
- Synchronization of action in the reality domain.

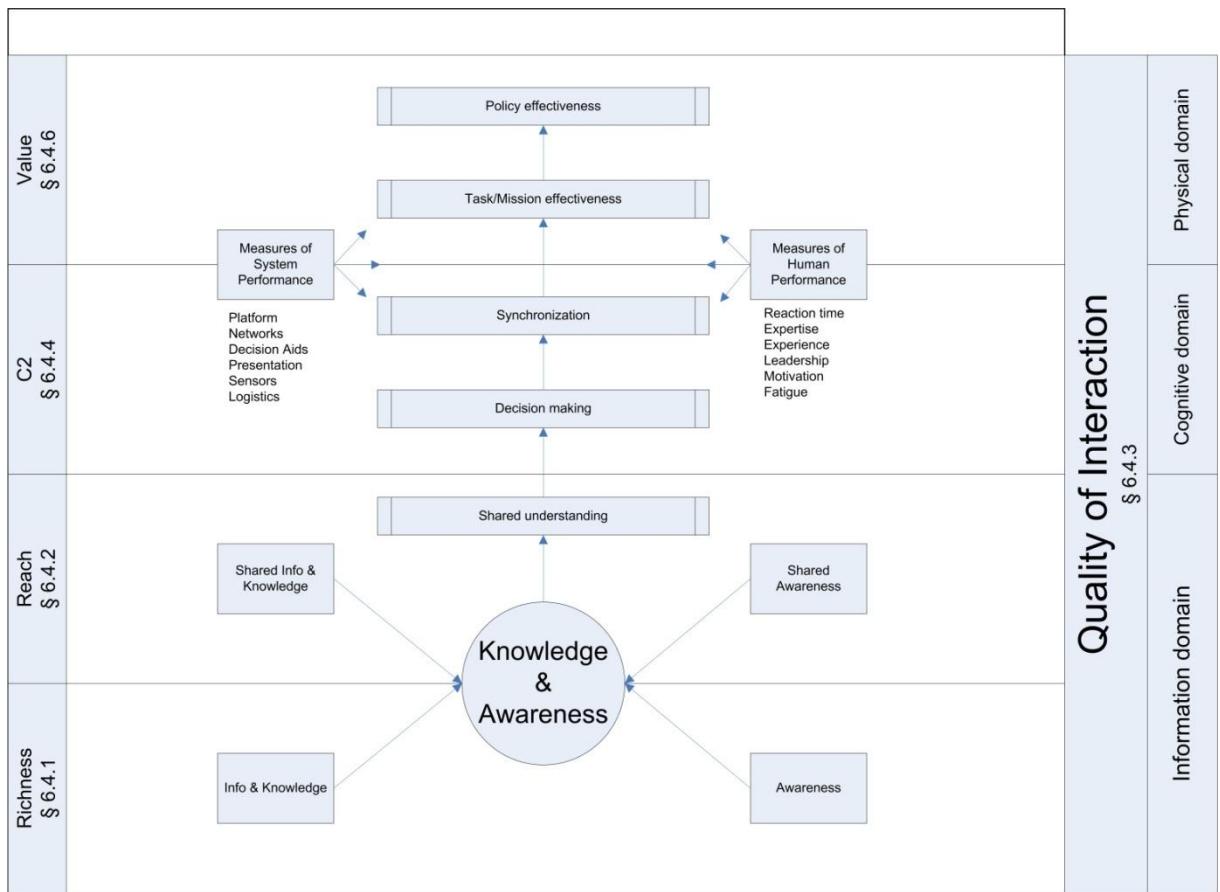


Figure 6.3: Hierarchy of measures (modified after Alberts et al., 2001)

Better information and information systems are expected to improve effectiveness indirectly, and those impacts should be measured when such research is possible (Alberts et al., 2001).

6.4.1 Elements of Information Richness

Richness was defined above. In this subsection the elements of richness will be defined (see Table 6.1).

All elements of Richness reside in the information domain of NCW. The information domain serves as the linkage between reality and the cognitive domain and the medium by which the information is stored, retrieved and disseminated.

The first five attributes are independent, but can be conditioned on the needs for a particular mission. The last three attributes (relevance, timeliness and assurance) are conditional (dependent on the type of situation and actions), as well as dynamic (change over time). These attributes are seen as crucial additions when moving into the Information Age (Alberts et al., 2001), but are difficult to measure because of their dynamic character.

Table 6.1: elements of richness (after Alberts et al., 2001)

Element	Definition
Completeness	All the relevant items should be available, including entities, attributes and relationships between them
Correctness	All the items in the system should be faithful representations of the realities they describe
Currency	Age of the items of information
Accuracy or level of precision	Conditional item and depends on the purpose the user has in mind
Consistency	Across different command centres, functionally specialized arenas and applications
Relevance	Dynamic attribute
Timeliness	Relationship between the age of an information item and the tasks or missions it must support
Assurance	Trust and confidence in the information, and consists of the attributes: privacy, integrity, authenticity, availability and nonrepudiation

6.4.2 Elements of Information Reach

Reach, or distribution, deals with the number and variety of people, work stations, or organizations that can share information. The elements of reach will be described in this section (see table 6.2). The attributes of information reach reside in the information domain.

Table 6.2: attributes of Information Reach (after Alberts et al., 2001)

Elements of reach	Description
Geographic range	Satellite and other systems can cover more of the globe than their predecessors
Continuity over time	Fewer gaps in coverage and mechanical failures
Nodes	More nodes available or active at the same time
Sharing	Consists of four components: 1) more sharing at different levels of security; 2) more sharing across military components; 3) sharing across a broader alliance and coalition organizations; and 4) sharing across more functional areas
Latency	Sharing information sooner, often by having it routed automatically to a variety of users rather than to a central processing location before distribution

There is a significant difference between sharing information and collaboration. Sharing occurs in the information domain and means providing data, information, reports, knowledge or understandings to another actor in the network. Collaboration involves active engagement by two or more parties towards a common purpose (Alberts et al., 2001). Elements of collaboration will be discussed later in this chapter.

Shared awareness is another element of reach, but resides in the cognitive domain. Awareness always exists in the cognitive domain, and can be described as what people know and not what information systems know. Situational awareness can be described as the awareness of a situation that exists in part or all of the battle space at a particular point in time. There are limited tools available to assess or observe cognitive activities (Alberts et al., 2001).

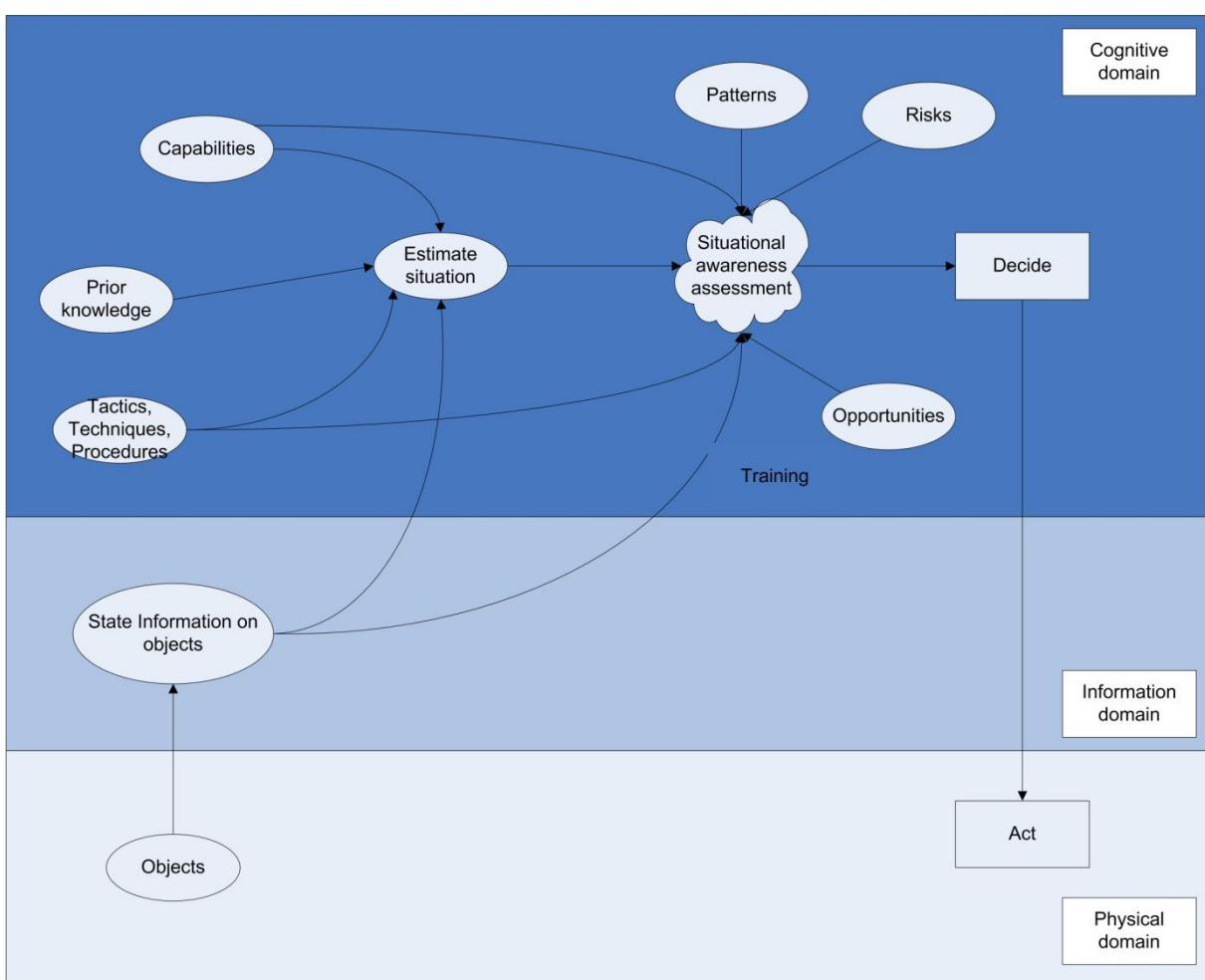


Figure 6.4: Reference model situational awareness (after Alberts et al., 2001)

According to Nofi (2000), situational awareness has a large subjective component. This is because: people have had different experiences in the past, are from a different race, and so on. Part of the situational awareness is objective. Nofi (2000) has tried to describe shared situational awareness as

having a subjective and an objective component and has developed questionnaires for both components. Individual situational awareness also differs from shared situational awareness. Individual situational awareness is very much a personal attribute. We see the world around us in individual terms, based on our cultural background, education, and experiences, not to mention the strengths and limitations of our senses. Factors promoting individual SA are both structural and situational. *Structural factors* are: Religion & Culture, Education/training, Occupation, Experience, Personality, Sex, Age, etc. *Situational factors* are: Mood, Time Pressure, Fatigue, Complexity, Stress, Ambiguity, etc.

Shared situational awareness obviously differs from individual SA because it involves a number of persons trying to form a common picture. To get the members of the group to develop a shared awareness of the situation requires that they:

1. build individual situational awareness within the framework of the mission to be accomplished;
2. share their individual situational awareness, which requires being "aware" of relevant actions and functions of other team members;
3. develop the groups' "shared situational awareness".

A critical element in building a shared situational awareness must necessarily be the existence or establishment of common ground. This will have to be done through training and experience. Communications is the most critical issue in creating shared awareness. And it is reasonable to conclude that sharing our individual model of the situation with other team members is markedly easier in a closed environment than in a distributed environment. The third element in building shared awareness is the integration of the different individual mental models of the situation.

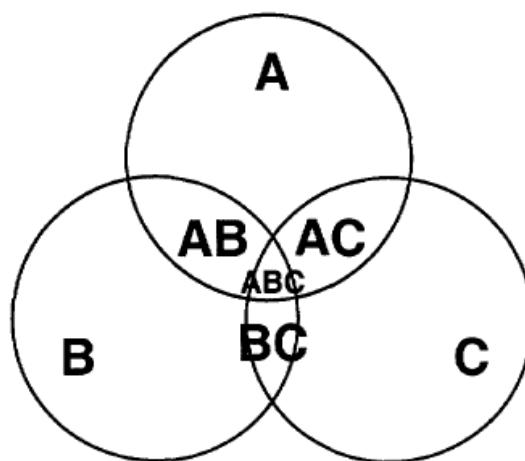


Figure 6.5: Shared Situational Awareness (from Nofi, 2000)

Situational awareness is dynamic, a continuous cycle of perception, comprehension, projection, and prediction. The "situation" changes even as we experience it. And our awareness of the situation will

necessarily change as well. So, although we speak of the "state" of someone's situational awareness, we are really speaking about a transitory phenomenon (Alberts et al., 2001; Nofi, 2000).

Among the factors that enhance situational awareness, which are not yet fully known, degraders of situational awareness are better known and understood. For individual situational awareness, degraders are: ambiguity, fatigue, expectations and biases, physiological stress, misperception, task overload or underload, information overload or shortage, information interruption, information irrelevance, mission complexity, attention narrowing, erroneous expectations and lack of experience. Degraders of group situational awareness are: false group mindset, the tendency to press on regardless, insufficient training or variable skill levels, poor personal communication skills, perception conflict, personnel turbulence, degraded operational conditions, real time vs virtual time, lack of a common environment, insufficient/poor communications and collaboration tools and absence of non-verbal cues to communication.

Subjective criteria of shared situational awareness are listed below (Nofi, 2000). Essentially, these criteria are helpful in suggesting that the process of developing shared awareness is proceeding satisfactorily. Answering questions about them requires some degree of judgment; hence, responses are essentially subjective. Presumably, each of the criteria would have to be addressed several times during the unfolding of the situation in order to obtain a coherent picture of the development of the "common mental model," which would further influence the responses.

We have to ask "How well..."

1. Do members understand the team mission?

Questioning the team members will elicit a reasonable idea of their impression of the mission, which can be compared with the actual mission.

2. Do members understand their individual roles on the team?

Questioning the participants will elicit a reasonable picture of their understanding of their individual roles, which can be compared with what their prescribed role is, but would, however, lead to "studied" answers.

3. Is information flowing into the team?

Essentially, this means trying to determine whether team members are receiving the information necessary to perform their tasks.

4. Is information passing among members of the team?

It seems highly subjective to attempt to determine the degree to which the team members are sharing the information to which they have access. And, in any case, they may be talking up a storm, but may be disseminating little useful information among the team members.

5. Are decisions being made by the team in a timely fashion?

Although the timeliness of the decision-making process can be measured with fair objectivity, the appropriateness of those decisions is likely to be difficult to evaluate; the decisions being made may be wrong.

6. Are appropriate actions being taken by the members of the team?

We have to attempt to measure whether the participants are acting in accordance with the decisions that were collectively made by the team.

Objective measures of shared situational awareness are:

1. Does the team understanding of the situation, at any particular moment, conform to reality?

This probably can be determined by comparing the actual "picture" of the situation with that held by the team members, both individually and collectively. However, efforts to elicit team member views on the current picture would probably produce spurious results, since they would be tempted to edit or revise their conclusions.

2. Is the mission being successfully executed ?

This would not seem to be measurable until the mission is actually completed, but at that point at least we can measure the outcome.

Nofi (2000) also suggests taking measurements on: age and sex, personality and education, art vs. science/talent vs. learning/reflex vs. situational awareness, social complexity and networks, cultural differences, and leadership.

All in all, shared situational awareness is difficult to measure and to get good results actors would have to be questioned throughout the disaster management exercise.

6.4.3 Quality of Interaction

The quality of information sharing can be unlimited if the necessary investments are made in the command and control infrastructure. The nature of information exchange can vary considerably across the spectrum. Ways of exchanging information are (Alberts et al., 2001):

1. data or text exchange;
2. voice;
3. static or dynamic images;
4. interactive or reciprocal information exchange;
5. level of information assurance;
6. real time or delayed information exchange.

6.4.4 Command and Control (C2)

The term 'C2' applies to the organizations, people, processes, and systems that enable commanders to understand a situation and provide intent, plans and/or direction (Alberts et al., 2001). C2 is thus a crucial factor to come to good decision making and synchronization of actions. Good decision making and the quality of decision making is difficult to measure. Synchronization is described as the purposeful arrangement of things and/or actions in time and space in order to achieve the established objectives (Alberts et al., 2001). Its requirements are as follows:

1. Synchronization occurs in the physical domain. It involves the transformation of ideas and concepts from the cognitive domain through the processing and transmission of information. It thus requires the fusing of the cognitive, information and physical domains.
2. To achieve the necessary degree of synchronization will require a C2 organizational concept.
3. Finally synchronization requires vertical as well as horizontal harmonization. In the Information Age synchronization of actions is difficult to achieve due to the increasing complexity, growing heterogeneity, and the faster pace of events and decision making.

According to Alberts et al. (2001) synchronization is a function of richness, reach, and quality of interaction. High quality information, extensive connectivity, and a high degree of sharing and collaboration are enablers of a high degree of synchronization.

6.4.5 Collaboration

Collaboration involves actors actively sharing data, information, knowledge, perceptions or concepts when they are working together towards a common purpose, and knowing how they might achieve that purpose efficiently or effectively (Alberts et al., 2001). Collaboration resides in the information and cognitive domain. According to Alberts et al. (2001), metrics for collaboration can either be measures of performance or measures of effectiveness. Measures of performance show how the same level of effectiveness can be accomplished with fewer resources or how higher performance levels can be achieved with the same level of resources. The focus here is on more efficient mission accomplishment. When the focus is on mission accomplishment itself, the appropriate metrics are either measures of force effectiveness or measures of policy effectiveness.

Collaboration has a number of different dimensions, each of which can vary. The dimensions include media, time required, continuity, breadth, content richness, domain, structure, participant roles and the linkages across which it takes place (Alberts et al., 2001).

Collaboration in the information domain requires greater bandwidth and an increased need for computational power in order to, first, share data in order to develop a common operational picture. The sharing of data will improve the quality of the underlying databases. Secondly, more rapid sharing of information has a synergetic effect so that more command centres are aware of information sooner. Finally, collaboration in the information domain will make it possible to use reach-back to a maximum

extent and gives access to extensive knowledge (Alberts et al., 2001). In the sections above this type of collaboration was called sharing.

Collaboration actually occurs in the cognitive domain as partners interact and develop awareness, knowledge, understanding, and concepts that would not have emerged without these exchanges (Alberts et al., 2001).

Measuring collaboration is a daunting task. Collaboration researchers must continually be aware of the context in which the collaboration takes place. The complexity of the environment and the number of ways collaboration can vary can make it impossible to measure its impact precisely. Alberts et al. (2001) describe the factors of maximum collaboration (see Table 6.3).

Table 6.3: Factors of maximum collaboration (after Alberts et al., 2001)

Factors	Description
Inclusive	All the relevant actors are involved and the collaboration cuts across organizational, functional, spatial, and temporal boundaries
Multi-connected	Every actor has access to all other actors
Unrestricted communication	Between the collaborators
Participatory	All relevant actors are engaged in the process
Continuous	Actors are engaged without disruption
Simultaneous	Synchronous
Media-rich	Face-to-face, with shared images, information, and data
Domain-rich	Involves both the cognitive and the information domains
Content-rich	Involves data, information, knowledge, and understandings

6.4.6 Value

The implementation of the concepts of Information Superiority and Network Centric Warfare enable the creation of value from information. The information environment of today is different to what it was.

The information domain consists of two axes, with information richness on one axis and information reach on the other (Figure 6.3). In fact, value is a function of richness and reach. By getting more of both, there is a move into an extended information environment space. In Network Centric Disaster Management the power of the network is manifested in the following ways:

1. Increased richness through increased reach

Networks enable information richness to be increased by enabling information from multiple sources to be shared, correlated, fused, and accessed.
2. Increased shared awareness

Networks contribute to the generation of shared awareness by enabling richness to be shared.
3. Improved collaboration

Networks enable information sharing which transforms shared awareness into collaborative planning and synchronized actions that create a competitive advantage.

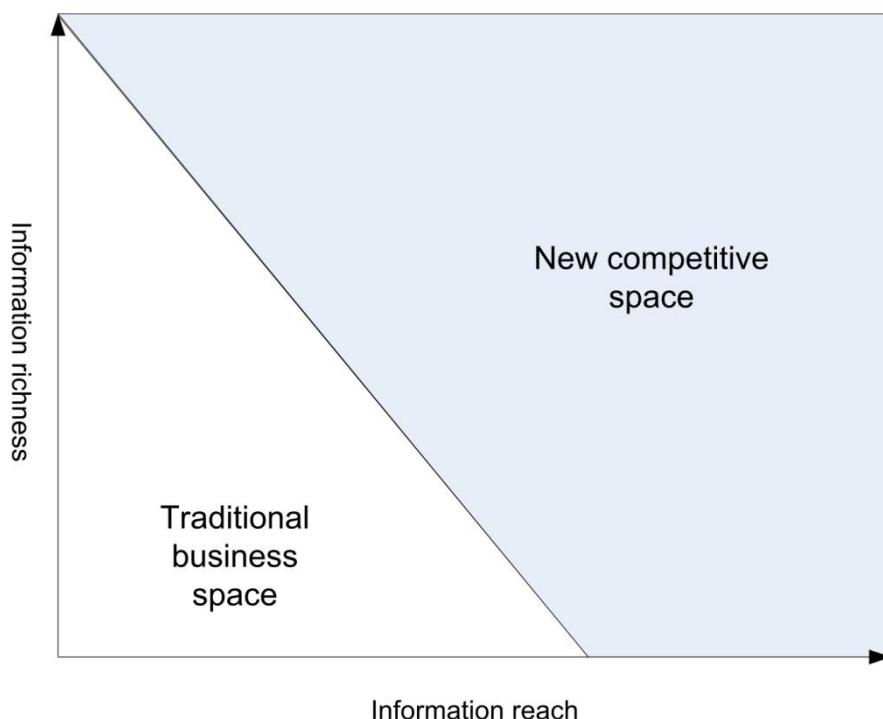


Figure 6.6: Value, a function of information richness and information reach (Alberts et al., 2001)

6.4.7 Observations

Observed characteristics for the NEC aspect information are the assurance and correctness of the geo-information, the intensity with which the geo-information is being used, and the completeness and representation of the geo-information.

6.4.8 Questions related to hypotheses

Seven questions relating to hypotheses were added to the questionnaire Eagleone_1 to further investigate the relationship between the CCS Sitplot system, communication, decision making, responsibilities, tasks and procedures. These questions did not really fit into any of the other questionnaires or theories.

6.5 Set-up

Table 6.4 below gives an overview of the set-up of the research, the method used, and the targeted respondents. The questionnaires for the users of the CCS application Sitekst and Sitplot were put into the online questionnaire application of the VU University Amsterdam. The CTEF instrument was sent to the respondents with a return envelope.

Table 6.4: Overview of NEC aspects, theory used and method of measurement

NEC aspect	Theory	Method
People	CTEF, SSA	Questionnaire CTEF & Eagleone_2
Networks	TAM	Questionnaire Eagleone_1 & Eagleone_2
Information	NEC metrics	Questionnaire Eagleone_1 & observations

6.6 Instruction of observers

In order to get more information on how geographic information is used during the exercise Eagle One every section in the ROT was observed by a student from the VU. Instructions are issued to each participant and they were introduced to the ROT and the new CCS system in order to prepare them for the exercise Eagle One. Before the exercise they were issued with all the necessary paperwork to be fully aware what the scenarios are and what to look for during the exercise. For every scenario standardized forms were issued (see Appendix 1). The handouts contain a section to make remarks, a shortened version of the scenario as a reminder, and a list of geographic information products and layers that are necessary for the decision-making process in the scenario. On every form, the start time and end time of the scenario had to be noted, as well as names of the people observed. The participants in the exercise were instructed to use the observers to make remarks on the technical aspects of the CCS as well. The observers were instructed to evaluate the use of geographic information only, and they took strategic positions behind actors who were using the CCS application Sitplot.

6.7 Conclusion

The evaluation of an NEC environment must include technical (technology), content (information), and social aspects (people) and there is not one method which combines those totally different aspects. In order to get a good view of what happens in an NEC environment it is necessary to single out these three aspects and perform individual assessments, thereby making use of several different theories and research models (see Figure 6.1).

7 Results

7.1 Introduction

The theory of NEC and the research method have been described extensively in the foregoing chapters, for an overview, see Figure 6.1. In this chapter the results of the questionnaires and observations will be presented. First, Section 7.2 introduces the disaster management exercise Eagle One. Then Section 7.3 gives a general impression of Eagle One in practice. Section 7.4 discusses the response to the questionnaires. In Sections 7.5, 7.6 and 7.7, respectively, results for the NEC aspects ‘people’, ‘networks’ and ‘information’ will be presented and in Section 7.8 the results from a series of questions related to hypotheses. Finally, in Section 7.9 some conclusions will be drawn.

The questionnaires and the instructions for observation for one of the scenarios can be found in Appendix 1 to this thesis.

7.2 Case study

7.2.1 Introduction

In the recent past, several projects in the public safety sector have been conducted. Quite a few of these projects involved the incorporation of geo-information in the incident room and command and control systems. In the beginning, there was no coordination on architecture, standardization of data formats and standardisation of data models. In short: there was a lack of interoperability.

Today there is the Raad MIV (RMIV - Council for Multidisciplinary Information Provision, www.raadmiv.nl). The RMIV has a separate programme on geographic information, and there are multidisciplinary arrangements on architecture, data formats, exchange standards and data models. And even at a higher government level there is the GI Council, a interdepartmental organization at Secretary-General level. In the disaster management field there is a strong bottom-up approach with experienced disaster managers from different bodies or columns who have an information and technology need. But there is also a strong top-down approach where higher-level government accepts the advice and arrangements made at the operational level and turns this into policy.

The goal of exercise Eagle One is to couple or network existing applications and future applications. The applications will also be connected to the nationwide Geospatial Data Infrastructure for Disaster Management (GDI R&C). During the exercise Eagle One, applications and coupling will be tested on robustness and functioning (Regio Gelderland Midden, 2007). Exercise Eagle One is a multidisciplinary disaster management exercise at the regional level (GRIP phase 3). Exercise Eagle One was held on 5 March, 2008.

In this chapter, a short description of the scenario and the outline of the exercise is given.

7.2.2 The scenarios

During the exercise day, four different scenarios are played out. The exercise time is not synchronous with daytime, and the scenarios start at the moment when the regional crisis centre has to come together. As the scenarios evolve and incidents are played out, the ROT has to use geographic information to support the decision-making process.

1. The first scenario involves a power failure, which has consequences for a nearby chemical plant. At this site, chemical processes are out of control, and a few incidents have resulted in casualties. Toxic fluids and gas have escaped and are now a threat for the population.
2. The second scenario involves the explosion of a power station. Again the consequence is that a part of the region is without power. The repair of the power station will take weeks, but the electricity company is trying to restore the electricity supply within 24 hours. Because of the time of the year (Christmas and cold weather), electricity consumption is high.
3. The third scenario is a situation of avian influenza. A farm within the region is possibly infected with the virus. All poultry within 1 kilometre of the infected farm has to be destroyed. This causes a chain reaction of angry farmers, who demand that their poultry be vaccinated.
4. The fourth scenario is a high water scenario. Extreme rainfall in Switzerland, Austria and Germany causes the water level of the Rhine to rise. The regional crisis team has already been together a few times to discuss the situation. Parts of the region are flooded, and the water is expected to continue to rise.

7.2.3 Products

Each scenario has a list of possible products, where geographic information plays a role or where maps with overlays have to be produced digitally to support decision making or for information services to the public and press releases. Products have to answer where is what, and include static as well as dynamic information and information services.

7.2.4 Technology

In the exercise Eagle One, a new version of the existing command and control system (CCS) is used. The CCS application contains two interfaces. The first is a geographic interface, CCS Sitplot, which is able to view, analyse and generate geographic information that is needed for the decision-making process in disaster management. The geographic interface has all GIS functionality, including the analysis of geographic information. The second interface is a collaboration interface (CCS Sitekst) to communicate between the different actors and do reporting during a disaster. Communication between the two interfaces is possible through a synchronization folder. The two interfaces of the CCS provide the Common Operational Picture of the disaster. The new CCS system is built to work in a Network Enabled environment and will enhance Net-centric collaboration and work (Geodan, 2007a; Geodan, 2007b).

The software used in the CCS comprises ESRI ArcGIS and Microsoft Groove for the CCS Sitekst interface. The ArcGIS interface is custom-built to support the disaster management processes. Actors are able to draw their own features and share them with other actors. Sharing the dynamic geographic information is supported by Microsoft Groove functionality.

During the exercise Eagle One, geographic information present in the GDI R&C is made available to the regional crisis response level for the first time. The GDI R&C presents more than 17 nationwide geographic layers from several departmental organizations. OGC webservices are used to present the information in the geographic interface. During the exercise, the local or regional network is coupled with the national infrastructure.

The actors using the CCS have the obligation to bring the information through the system to the other actors, but they also have to obtain the information themselves.

7.2.5 Set-up of the exercise

Each section in the ROT consists of several actors, and most sections have four actors. In each section there is a head of the section, a person who plots incidents in the Sitplot application of the CCS (the ‘plotter’), a person who works with the Sitekst application of the CCS and most sections have a fourth person present as well.

7.3 General impression of the exercise Eagle One in practice

This general impression is focused around three main themes:

1. The use of geo-information;
2. The completeness, correctness, assurance and portrayal of the geo-information;
3. The contribution of the geo-information to shared situational awareness.

The general impression has been drawn from Riedijk et al., 2008, and van Capelleveen (2008).

7.3.1 Use of geo-information

All sections in the ROT have their own responsibilities. Most of these responsibilities and tasks have a geographical component and can be drawn in the CCS Sitplot application. The separate sections in the ROT all have access to the geo-information, and are able to draw their own sector-specific information. In the past they would need a plotter from the section Information. The delegation of this responsibility to the sections has as a consequence that the joint common operational picture is presented more quickly than normal, and that the Joint Common Operational Picture (JCOP) is also more up to date.

The central plotters in the section Information are now occupied with geospatial analysis questions from the other sections. These geospatial analysis questions are possible because of all the relevant geo-information that is available and the analysis also contributes to the common operational picture and the situational awareness.

Participants indicate that thanks to the Sitplot they have an immediate view of the extent and possible implications of the situation.

The GDI R&C gives the participants access to information they have never had before or which they could only obtain by making numerous phone calls and sending faxes.

7.3.2 Completeness, correctness, assurance and portrayal

The GDI R&C gave participants access to numerous layers of geo-information. However, it was sometimes difficult for the participants to find the right information.

Participants were also not trained extensively in the use of geo-information and this sometimes caused problems with the interpretation of the geo-information. Lack of training also meant that participants were not very critical towards the geo-information that was presented to them.

Because most participants live and work in the area where the disasters took place, they sometimes noticed that the geo-information was not correct and they questioned the validity of the geo-information.

The portrayal of the geo-information was not always evident. There was no legend presented and the meta-data was often hard to find or not available. This contributed to a decrease in the ease of use of the application CCS Sitplot.

7.3.3 Contribution to the SSA

All sections could start their own tasks immediately, and this led to a quick presentation of the JCOP. The situation is kept up-to-date by the different actors using the application CCS Sitplot and Sitekst. This led to Shared Situational Awareness. This is best reflected in the multidisciplinary meetings, where the (contingency) planning could start immediately.

It was observed that actors were not fully aware of the situation. This was because actors had to actively refresh the screen of the application CCS Sitplot.

7.4 Response

Before the results for the different aspects are presented, it is necessary to discuss the response to the questionnaires. Eagleone_1 (Appendix 2) is the questionnaire for the CCS Sitplot users and consists of four parts. The first contains general information, the second part contains questions on NEC metrics, the third contains propositions, and the fourth part is based on TAM, but modified to suit the users of the application CCS Sitplot. The questionnaire Eagleone_2 (Appendix 3) consists of three parts. The first is a general part; the second contains the questions on SSA; and the third contains questions on TAM, modified for the application CCS Sitplot. The third questionnaire was the CTEF instrument (Appendix 4), in which the original questions were not modified (Essens et al., 2005).

The response for questionnaire Eagleone_1 was 16 people and for Eagleone_2 20 people. In the general part of the questionnaires, respondents were asked to state in which section they worked in during the

exercise Eagle One. These results are presented in Table 8.1. Response to the CTEF instrument was relatively low with only 5 people responding.

Table 7.1: Respondents for questionnaire Eagleone_1 and Eagleone_2 by function

Questionnaire	Eagleone_1		Eagleone_2	
	No of respondents	Percentage	No of respondents	Percentage
Police	2	12.50	3	15
Fire brigade	7	43.75	8	40
Paramedics	1	6.25	2	10
Municipality	1	6.25	2	10
Other	3	18.75	1	5
Unknown	2	12.50	4	20

In both questionnaires the Fire Brigade has the highest number of respondents followed by ‘other’ in questionnaire Eagleone_1 and ‘other’ in Eagleone_2. The results from both questionnaires will probably be dominated by the views of the Fire Brigade. It is remarkable that 4 respondents (20 percent) in questionnaire Eagleone_2 did not indicate what authority they represent.

7.5 People

The NEC aspect ‘people’ was evaluated using the CTEF instrument (Essens et al., 2005) and the SSA theory of Nofi (2000). In Section 7.5.1 the results of the CTEF instrument will be presented and in Section 7.5.2 the results of the SSA theory. The raw results of the CTEF instrument are presented in Appendix 7, and the results for the SSA in Appendix 6.

7.5.1 Results of the CTEF instrument

Mission

The response on the uncertainty of the situation is mixed. Most respondents say that there is high uncertainty concerning the validity of the information and high uncertainty concerning the end state of the situation they are in. The response on utilization of resources is also mixed, with three out of five respondents saying that uncertainty is low, and two indicating that uncertainty is high. The effect on team effectiveness is generally none, but in some cases positive and sometimes negative. The aspect of danger is regarded as very low to very high, but has no influence on team effectiveness. The intensity of disaster management is regarded as high to low and has an overall negative effect on team effectiveness. Psychological stressors are considered as low, but are viewed by one respondent as having a negative impact on team effectiveness. The response on environmental factors is mixed, and their impact is thought to be very high to very low. The impact on team effectiveness is seen to be low to high.

Political factors are generally regarded as low to normal and cultural factors are viewed as being very low to moderate. The influence of the media is regarded as very high to low and has no effect on team effectiveness. Time-space coordination is judged as very good. The immediate and long-term impacts of the disaster management process are judged to be high to low. Specifically, the effect of casualties is judged overall to have a high impact on the process. This aspect has an overall negative impact on the disaster management process. The national impact is regarded as high to moderate and the international impact is regarded as not being valid for this exercise.

Task

The complexity and difficulty of the disaster management task is regarded as high and has a positive to no impact on team effectiveness. The number of subtasks, the interdependencies of subtasks, and the subtask interference is regarded as high to very high and has a positive effect on team effectiveness. To do tasks and subtasks well, collaboration and communication are key factors. Physical and cognitive workload and time pressure are judged to be moderate to high and to have a very negative to no impact on team effectiveness. Emotional workload is regarded as low to very low and to have no effect on team effectiveness. The team regards the goal clarity and goal stability to be clear to very clear and these factors have an overall positive effect on the team effectiveness.

Organization

The fit between the mission of the team and the goal of the organization as a whole is considered positive to very positive. The command structure, autonomy of the team and the organizational support is regarded as high to very high. Recognition for what the team has done is judged by one respondent as low, while supportive climate and material support is considered to be positive. Team effectiveness for organization as a whole is regarded as positive to very positive.

Leadership

All aspects of leadership skills are judged as positive to moderate. The impact on team effectiveness of the leadership skills is positive to very positive. The effect of cognitive skills on team effectiveness is regarded by two out of five respondents to be none and one respondent has no opinion. The various aspects of knowledge of the leader are regarded as positive to very positive. An exception is made by respondent 8 on team knowledge, where the leader is judged to have poor knowledge of the team. This aspect is also regarded as having no impact on team effectiveness. The other factors of knowledge are judged to have a positive effect on team effectiveness. The last aspect of leadership, the match of the leaders' personal goals to the organizational goals, is viewed as positive and judged to have positive to no impact on team effectiveness.

Team members

The tactical and social skills of team members are judged to be high overall and their impact on team effectiveness positive. Technical and cognitive skills are judged to be moderate and have a positive to no impact on team effectiveness. Overall knowledge is regarded as moderate, and two respondents have no opinion. The impact on team effectiveness is judged by those two respondents as positive. The different aspects of knowledge are thought of as being high to moderate and the impact on team effectiveness as none to positive. The match of personal goals to organizational goals is viewed as very high by two respondents, and these respondents regard the impact on team effectiveness as positive. The other three respondents judge this aspect as moderate and to have no impact on team effectiveness.

Team

Appropriateness of team composition, mix of skills, and mix of demographic characteristics of the team is judged as low to high, and the impact on team composition is regarded as negative to positive. Both personality traits and the membership stability over time are considered to be moderate to high, and particularly membership stability is judged to have a positive effect on team effectiveness. Team size is considered to be moderate, and has a negative to positive effect on team effectiveness. Team architecture, physical proximity and distribution of tasks are viewed as high, and their effect on team effectiveness is judged to be very positive to negative. The maturity of the team is regarded by two respondents as low and by two respondents as moderate. The effect on team effectiveness is considered to be none to positive. Overall the match of team goals to organizational goals is viewed as high, and has a positive effect on team effectiveness.

Task-focused behaviour

All aspects of information are evaluated as high to very high. An exception is the exchange of information, which two respondents judge to be moderate. The overall effect on team effectiveness is considered to be positive. Decision making and defining the problem space are viewed as high, and both have an overall positive effect on team effectiveness. Time management and the evaluation of options and results are judged by the majority of the respondents as moderate. The effect on team effectiveness is viewed as none to positive. Planning, anticipating and strategy are viewed as high, and anticipating and strategy are regarded as having a positive effect on team effectiveness. Scheduling is considered to be low to high and has a negative to no impact on team effectiveness. The aspects of directing and controlling, organizing and managing are regarded as high, and all three aspects have a positive impact on team effectiveness. The aspect of monitoring progress is judged to be low to high, and two respondents view this aspect as having a negative impact on team effectiveness. Liaising with other teams is considered to be high and it has a positive effect on the team effectiveness.

Team-focused behaviour

Providing and maintaining vision and maintaining common intent are judged to be moderate to high and have a positive to no effect on team effectiveness. Communication within the team is regarded as high, and the impact on team effectiveness is considered to be positive. Coordination and providing feedback are judged to be moderate to low, and the impact on team effectiveness is negative to positive. The factors motivating and rewards, extrinsically and intrinsically, are regarded as moderate to high. The impact on team effectiveness is none to positive. Overall adapting and providing team maintenance are judged as very low to high. The impact on team effectiveness is negative to positive. It is observed that the sub-factors correcting and providing social support are judged to be low and have the most negative impact on team effectiveness.

Task outcomes

Achievement of intermediate goals is regarded as high to very high, and the overall impact on team effectiveness is positive to none. The achievement of end goals is judged to be low to high, and the impact on team effectiveness is negative to positive.

Team outcomes

Mutual trust and morale are considered to be moderate to very high and the impact on team effectiveness is very positive to none. Cohesion and mutual respect are judged to be moderate to high, and the impact of those two factors on team effectiveness is viewed to be very positive to none. Collective confidence in achieving the goal and shared vision is regarded as moderate to very high, and the impact on team effectiveness is judged to be very positive to none.

Conclusions

In general, one can conclude that there are no anomalies to be found in this questionnaire. An aspect can be regarded as good or very good and the impact on team effectiveness is often positive.

It is apparent that disaster management is a complex task. Respondents indicate that there is a strong correlation between their personal goals, the goal of the organization, and the mission of the team. Leadership skills are declared as positive. Overall, the conclusion can be drawn that the ROT consists of well-trained and skilled professionals. The important aspects for NEC are exchange of information, decision making, time management and command and control, all of which were regarded as high. The aspect intermediate goals is valued more highly than the achievement of end goals. This is probably because the scenarios were not played out from the beginning right through to the end.

7.5.2 Results of SSA theory

The questions regarding SSA theory were incorporated into the questionnaire of CCS application Sitekst users. The reasoning for this was that these users do not work directly with the geographic information

and they therefore do not have a 'picture' of the situation. The questions can be divided into five categories: information, situational awareness, communication, collaboration, and sharing. The questions can be found in Appendix 3 of this thesis and the results in Appendix 6.

Questions 1 and 3 refer specifically to the information present in the system. For Question 1, 72% of the respondents think they did have enough information to perform their tasks. Question 3 asks the respondents if they had too much information to make the right decision. Of the respondents 25% agree with this and 56% of the respondents think they do not have too much information.

There are several questions which can be related to situational awareness, specifically Questions 2, 5, 6, 9 and 11. In Question 2, 55% of the respondents agree that decision making is faster due to the sharing of information through maps. Question 5 asks whether actors could have better situational awareness. About 61% of the respondents disagree with this question. Of the respondents, 88% agree with Question 6, that they have a better picture of the situation because the information is shared/presented on maps. Question 11 gives the same picture, where 83% of the respondents agree with that they have better situational awareness due to the applications CCS Sitplot and CCS Sitekst. With regard to shared situational awareness, 56% of the respondents think that other sections have the same picture of the situation as they have, 28% have no opinion and 17% disagree with this question.

The next set of questions can be linked to communication, collaboration and sharing of information. Questions 4 and 8 relate to sharing of information within one section. Of the respondents, 72% agree that other members of their section have the same information as they have, while 94% of the respondents agree that other members of their own section share their information they need with them. Question 7 relates to the sharing of information with other sections. Of the respondents 65% agree that other sections share the information that other sections need, while 35% have no opinion. Question 8 specifically relates to the sharing of information with the Plv OL, where 76% of the respondents think they could not have better informed the Plv OL, while 24% have no opinion.

Conclusions

The following conclusions can be drawn from this questionnaire:

1. The CCS system linked to the GDI R&C provided the actors with enough information to perform their tasks satisfactorily.
2. The CCS system as a whole and the CCS Sitplot system in particular, enhanced communication and the build-up of a common operational picture and shared situational awareness.
3. Communication and information sharing was good within sections and across sections. Sharing information was mainly done through the use of the system, but more conventional methods such as telephone and face-to-face meetings were frequently used as well.
4. Referring to Table 6.3 in Chapter 6, it could be said that almost all factors of maximum collaboration have been met during this exercise.

7.5.3 Observations

The observations were mostly focused on the use of the application CCS Sitekst. The CCS Sitekst application is used to send messages, report actions and ask questions to actors, and to share non-geographic information. The CCS Sitekst application saves all communication and can also serve as a logbook to evaluate the disaster management process. It is observed that many actors communicate face-to-face or by telephone. This rich communication is also used to check if messages and/or important information has arrived or if the meaning is understood.

Shared situational awareness is enhanced because all actors have the same information. During the development of the disaster, information is shared by means of different forms of communication and through the build-up of a common operational picture using the application CCS Sitplot. The Plv. OL and his team of heads of sections are up-to-date about the situation when they gather for the multidisciplinary meetings. This makes the multidisciplinary meetings more useful than before, because planning for future events can start with immediate effect.

The ROT is concentrated in one room. This enhances communication and collaboration between sections. People actively obtain and bring (important) information, and different forms of communication are used. Overall the actors seem to have a constant awareness of what is going on at the location of the disaster because of the communication between sections and the technology at hand.

Conclusions

All forms of communication are used by the actors. The sharing of information has a positive effect on the interaction and collaboration and should lead to better decision making. Multidisciplinary meetings are focused on planning and contingency planning, because everyone has a clear picture of the situation. Although there are reported instances that there was not full shared situational awareness, it can be concluded that for most of the time there was a state of situational awareness.

7.6 Networks

This section contains two subsections. In the first of these the results of the TAM for the CCS Sitplot application will be presented, and in the second the results for the CCS Sitekst application. The scores for the perceived usefulness and the perceived ease of use will be presented for both applications. Because there is only a small group of respondents, it was not possible to use the statistics of TAM. The questions and the full results can be found in Appendix 5 for the CCS Sitplot application and in Appendix 6 for the CCS Sitekst application.

7.6.1 CCS Sitplot application

There are eight questions on perceived usefulness in this questionnaire. Of the respondents, 43% think that their job is more complex without the use of the CCS Sitplot application. On the other hand, 43% of the respondents disagree or strongly disagree with this question. Question 2 asks whether the CCS

Sitplot application gives the user greater control over his or her work. More than half, 64%, of the respondents agree or agree strongly, while 29% are neutral. On the aspect of the CCS Sitplot application that addresses the job-related needs of the respondents, 50% agree or strongly agree and 36% have no opinion. On whether the CCS Sitplot system saves time, 57% of respondents agree, and 29% disagree. Question 5 asks whether the CCS Sitplot application enables them to accomplish tasks more quickly. Only 35% of the respondents agree and 53% have no opinion. More than 70% of the respondents agree with Question 6 that the CCS Sitplot application will improve their quality of work, and 29% have no opinion. The CCS Sitplot application is regarded as useful by 79% of the respondents and 21% are neutral. Opinions are divided on the last question about whether the CCS Sitplot application makes it possible to accomplish more work, where 50% of the respondents agree or strongly agree, 14% are neutral, and 29% disagree or strongly disagree.

Question 1 on PEoU for the CCS Sitplot application asks whether the user often gets confused while using the application. Of the respondents, 71% disagree or strongly disagree. Of the respondents, 54% disagree that they make errors frequently while using the CCS Sitplot application, while 31% agree or strongly agree. More than half of the respondents (57%) do not get frustrated by the CCS Sitplot application, while 29% do get frustrated. More than 50% of the respondents agree that they still need support while using the system, while 22% do not require support. On the question whether the CCS Sitplot application needs mental effort, 42% agree and 50% disagree or disagree strongly. On the flexibility of the system, 50% of respondents agree or strongly agree and the other 50% has no opinion. Only 50% of the respondents agree or strongly agree that the system does what they want, while 29% have no opinion, and 14% disagree or strongly disagree. On the question whether the system behaves in unexpected ways, 21% of the respondents agree, 35% have no opinion and 43% disagree. More than half of the respondents agree that the system is easy to understand, 29% are neutral, and 14% disagree. On the question whether the system is helpful in performing their tasks, 50% of the respondents agree, and 29% disagree. Question 11 asks whether the system is easy to use, 64% agree or strongly agree with this question, and 21% disagree.

Conclusion

Many respondents gave a neutral answer to questions. It is assumed that this is because these people had not worked with that application before or had only had limited training. Many of the negative and neutral answers could probably be linked to these aspects.

It can be concluded that the CCS Sitplot application gives the actors more control over their work. Most respondents did not get confused while using the application, and more than half of the respondents did not make frequent errors while using the system. Only 50% agreed that the system CCS Sitplot was helpful in performing their tasks, but 65% of the respondents agreed that the system is easy to use.

7.6.2 CCS Sitekst application

The questions on Perceived Usefulness are reduced to seven questions for the CCS Sitekst application. In answers to Question 1 concerning whether the task of the respondents is more complex without the CCS Sitekst application, 47% of the population agree, while 24% have no opinion and 29% disagree. On the question whether the respondents have more control over their work with the CCS Sitekst application, 65% agree and 35% disagree. Concerning whether the CCS Sitekst application fulfills the task-related needs, 70% of the respondents agree. On the question whether the CCS Sitekst application will save time, 41% of the respondents agree and 53% have no opinion. Only 35% of the respondents think that the CCS Sitekst application will save time and 53% do not know. The majority of the respondents, 71%, think that the CCS Sitekst application will improve the quality of their job, and 82% agree that the CCS Sitekst application is suitable to perform their task.

Of the respondents, 24% become confused when using the application, and 47% have no opinion. More than half of the population (65%) do not make errors frequently when using the CCS Sitekst application. Only 24% of the respondents get frustrated by the system and 29% do not know if they get frustrated. Of the respondents, 11% still need support while using the system, and 35% do not know if they need support. Most of the respondents, 65%, disagree with the question whether interacting with the system needs mental effort. On the flexibility of the CCS Sitekst application, 24% think that the application is flexible and 29% disagree. Just over half of the respondents say that the system does what they want it to do and, 35% do not know. Of the respondents, 88% say that the system does not behave in unexpected ways, and 76% say that interaction with the system is extremely easy or easy to understand. Just over half of the respondents say that the CCS Sitekst application is helpful in performing their tasks, and 18% disagree. On the question whether the application is easy to use, 65% of the respondents agree or strongly agree, and 24% disagree or disagree strongly.

Conclusion

In general, the respondents gave a neutral answer to the questions. It is assumed that this is because these people had not worked with that application before or had only had limited training. Many of the negative and neutral answers could probably be related to these aspects.

Not even half of the respondents agree that their task is more complex without the CCS Sitekst application, while 65% agree that the application CCS Sitplot gives them greater control over their work. About one quarter of the respondents become confused when using the application. About half of the respondents agree that the system is helpful in performing their tasks, and 65% of the respondents agree that the application is easy to use.

7.6.3 Observations

It was the first time that the applications Sitplot and Sitekst were tested in a disaster management exercise. Although the applications were developed by consulting users and their requirements were taken into account, things are different once they are used. The observers received many comments on the actual applications and requests for changes. This aspect, however, falls outside the scope of this thesis.

7.7 Information

The questions in this section can be related to the elements of richness and reach of information in NCW theory. The results for richness and reach can be found in Appendix 5.

7.7.1 Richness

The first element of information richness is completeness. Four questions can be related to this element. Of all the respondents, 57% could find all the information in the Sitplot system, 14% have no opinion and 29% could not find all the information. Question 2 asks whether all the information needed by the actors is present in the system. More than half the respondents agree with this question, 14% have no opinion and 29% disagree. Question 7 relates the information present in the CCS Sitplot system to the task that has to be performed by the actors. Of the respondents, 83% agree or agree strongly that the Sitplot system contains the information to perform their task. For Question 8, 64% of the respondents agree or agree strongly that some data layers in the CCS sitplot system will never be used to manage a disaster, and 29% disagree with this proposition.

The second aspect of richness is correctness and 14% of the respondents did not find errors in the data present in the Sitplot application, 36% have no opinion and 43% did find errors in the data.

The third aspect is accuracy. Actors were asked whether the information present in the system had too much detail to be used in the exercise. Of the respondents, 21% agree, 29% have no opinion and 50% disagree. This question is closely related to Question 6, where actors were asked whether specific layers of information did not have enough detail to be used in the exercise. About 43% agree with this question, 21% are neutral, and 36% disagree.

The fourth aspect is currency of the information. Of the respondents 54% agree or agree strongly that the information is too dated to perform their tasks, 23% have no opinion, and 23% disagree.

The last aspect is assurance. Assurance has several sub-aspects. Of the respondents, 67% trust the information in the system, 20% are neutral, and only 13% do not trust the information presented. The sub-aspect integrity is measured with two questions. Question 11 asks whether analysis of the data gives the required information to the actors. Of the respondents, 66% agree, 27% are neutral, and only 7% disagree. In answer to Question 16, 36% of the respondents agree that the geographic information and knowledge in the system are valid and reliable. About 50% have no opinion, and 14% disagree. On the subject of privacy, 60% of the respondents think that only authorized users have access to the system,

and 27% do not know. The next question covers the sub-aspect of availability. Of the respondents, 53% say 'yes' to the question whether all users have access to the geographic information at the same time, 13% say 'no', and 33% do not know. The actors are divided on the sub-aspect of authenticity. Only 29% of the respondents say 'yes' to the question whether the source of the data is known or can be traced back in the system, 29% say 'no' and 42% do not know. The last sub-aspect is consistency. The actors were asked if there was enough coherence between CCS Sitplot, CCS Sitekst and the information in the system. Of the respondents 53% say 'yes', 33% are neutral, and 13% disagree with the question.

Conclusions

Richness contains aspects of information quality and these aspects have a positive effect on the creation of value: the better the information, the better the decision making, the higher is the aspect 'value'. For the element completeness, it can be concluded that some respondents were probably not fully aware of what information items the system contained and how they could find these information items. About half of the respondents found errors in the data. For some applications, the level of detail of the information items was not enough and for other applications it was too much. More than half of the respondents thought that the information in the system was too old, but almost 70% of the respondents trusted the information in the system. More than half of the respondents agreed that there was enough coherence between the information in the GDI R&C and the applications CCS Sitplot and Sitekst.

7.7.2 Reach

The aspect of reach has five different attributes. These attributes are: geographic range, continuity over time, nodes, sharing, and latency. A full description of reach can be found in Chapter 6. In the questionnaire the respondents were asked the same question or the same line of question for the CCS applications Sitrap and Sitplot.

The first two questions on reach ask whether the communications have changed because of the implementation of the new CCS Sitplot and Sitekst system. The response for the two questions is the same, with 87% answering 'yes' and 13% do not know.

Questions 3 and 4 ask whether the quality of communication has improved due to the implementation of the application Sitplot and Sitekst. The response to these two questions is almost the same. For the question on Sitplot, 64% of the respondents say 'yes', 21% say 'no', and 14% do not know, and for the question on Sitrap 60% say 'yes', and 20% say 'no'.

Question 5 and 6 do not go into the use of the applications CCS Sitplot and Sitekst, but respondents are asked whether there is enough sharing of information in their own section and with other sections. On sharing of information, 77% of respondents say 'yes', 15% say 'no', and 8% do not know. In answer to the question whether there is enough information flow between the sections, 64% answer 'yes', 21% say 'no', and 14% do not know.

Questions 7 and 8 ask specifically whether information is shared sooner using the application CCS Sitplot and Sitekst. Answers for Sitekst are 77% ‘yes’ and 23% ‘no’, answers for Sitplot are 57% ‘yes’, 29% ‘no’ and 14% do not know.

In Question 9 and 10, respondents are asked if the information is more quickly available using the new CCS Sitplot and Sitrap system. For the Sitplot system, 79% of the respondents answer ‘yes’, 7% say ‘no’, and 14% do not know. For the Sitrap system, 71% say ‘yes’, 7% ‘no’ and 21% do not know.

Conclusions

Respondents indicate that the quality of communication has improved considerably as a result of the implementation of the applications Sitplot and Sitekst. Sharing information within a section and between sections is regarded as high. And respondents agree that information is shared sooner and information is more quickly available.

7.7.3 Observations

This was the first time that the GDI R&C was used at the regional level of disaster management. For most actors the information in the GDI R&C was new and sometimes it was not clear what the information really represented. Sometimes actors knew that the information provided was not up-to-date, because they were familiar with the area. Portrayal of the information was not always evident, and there was no legend available to help the users.

The application CCS Sitplot was used intensively by all sections to plot their mono-disciplinary information. Most of this information was shared and contributed to the common operational picture and the shared situational awareness. The application CCS Sitplot was used as a tool to visualize information, analyse information, share information, and communicate with other actors and sections.

7.8 Questions related to hypotheses

Seven questions related to hypotheses were added to the questionnaire Eagleone_1. The questions can be found in Appendix 2, and the results on these questions are in Appendix 5.

The first of these questions asks whether the application CCS Sitplot enhances communication within a section. More than 90% of the respondents agree or strongly agree, while the rest are neutral. The second question asks whether the application CCS Sitplot enhances the communication between sections. Of the respondents 80% agree or strongly agree, 13% are neutral and 7% give the answer ‘other’. The third question asks whether the application CCS Sitplot will reduce the procedures that have to be followed. Of the respondents 33% agree, 40% disagree, and the remainder are neutral. The fourth question asks whether the application CCS Sitplot will simplify procedures. The response is 43% agree, and 29% are neutral or disagree. The fifth question asks whether the application CCS Sitplot will give the sections less responsibility. Of the respondents, 20% agree or agree strongly, and 53% disagree or disagree strongly. The sixth question asks whether the CCS Sitplot system supports the decision making

process. Of the respondents, 80% agree or agree strongly with this hypothesis. The seventh and last question asks whether the application CCS Sitplot improves the quality of the decision making. More than 90% of the respondents agree or agree strongly with this question.

7.9 Conclusions

The use of geographic information certainly had a positive effect on the shared situational awareness and the decision-making process within the ROT. One can question the role of the geographic information, regarding whether the application CCS Sitekst is being used intensively to communicate. In fact, the disaster management community is still only half in the new world and remain half in the old world. The application CCS Sitplot is now being used to communicate as well, and the geospatial analysis function of CCS Sitplot is regarded as very important. On the other hand, much geographically related information is communicated through the application CCS Sitekst. The development of a georeferenced Sitekst would be the next step towards the full use of geographic information.

8 Discussion and Conclusions

8.1 Introduction

In this chapter the results presented in Chapter 7 will be checked against the hypotheses presented in Chapter 1.

8.2 Discussion of results

1. The use of geo-information in a net-centric environment improves the situational awareness of all actors

Is there a state of shared situational awareness and what is the role of geo-information in this process?

The SSA questionnaire reveals that the CCS system as a whole, and the application CCS Sitplot in particular, enhanced the communication within and across sections considerably during the disaster management exercise Eagle One. Communication was based on a common operational picture visualized in the CCS Sitplot application. Communication within and between sections was done using a variety of communication mechanisms, which contributed to sharing information and a shared understanding of the situation. This is supported by the observation that, during the multidisciplinary meetings, no time was spent on explaining the situation, but that the actors could immediately plan actions. The CTEF instrument supports the view that information was actively shared and the acquired information was used in the ongoing disaster management process. The CTEF instrument also supports the view that there was shared situational awareness.

2. Geo-information improves the timeliness of the information processing

Does geo-information improve the timeliness of the information processing?

The aspects of completeness, correctness, and accuracy support the hypothesis that geo-information improves the timeliness of the information processing. Because the exercise was supported by a networked environment, this speeded up the distribution of information considerably and that information was available more quickly. Sometimes the actors could not find the required information in the GDI R&C, but all the information that was needed was present in the system. Because of the GDI R&C, the ROT could do their own spatial analysis, which speeded up the decision-making process considerably.

3. Geo-information improves the quality of the information

Does geo-information improve the quality of the information?

Improvement of the quality of the information was not measured directly, but is the result of communication and collaboration. Communication and sharing information will improve or enrich that information. These aspects have been measured. It was observed that information-sharing was an active process, with people bringing and getting information to and from other actors within the ROT. Sharing information also improved considerably as a result of the application CCS Sitplot.

4. Geo-information improves the decision-making process

Does the use of geo-information improve the quality of the decisions?

The application CCS Sitplot supported the common operational picture on one screen. The quality of decision making is difficult to measure and is one of those items that is a function of other factors. In NEC theory this hypothesis can be linked to the aspect 'value'. Value is dependent on the richness of the information and the reach of the information. The networked environment ensured that the right information would get to the right persons at the right time. Communication was improved considerably and much of the communication was based on pictures. The CTEF instrument supports the view that the criteria set by the stakeholder are met and these are an indication of the quality of the decision-making process. It is certain that geographic information and geospatial analysis speeded up the decision-making process.

5. The use of geo-information in the work flow is regarded positive by the actors

Do actors use geo-information in their work flows and what are the factors that enhance its use?

A driver for the continued use of geographic information is to use intuitively systems and access to well-documented and easy-to-interpret geographic information. Both aspects can be improved, but, overall, the experience with geographic information and the CCS application as a whole are very positive.

The information present in the GDI R&C can be seen as the candy box the disaster manager always wanted to have but never had. It was the first time the GDI R&C was tested on the regional level in the Netherlands, and the actors in the ROT did not have enough experience with the data sets and the content of the GDI R&C. Training and daily use of the GDI R&C will improve the experience with geographic information, and the disaster managers will have an even more positive attitude towards geographic information.

The same can be said about the application CCS Sitplot and Sitekst. The applications were used in an operational setting for the very first time. Actors had just one day of training on the application, but

that is simply not enough for a complicated environment such as a GIS system. Training and daily use of the application will improve the skills.

It is the opinion of the author that as the ROT is able to perform its own geospatial analysis on data presented through the GDI R&C, this is a big driver for the users to keep using geographic information. Assuming that the information comes directly from the source and the source is reliable, much valuable time can be saved in the disaster management process and decisions can be taken earlier.

8.3 Conclusions

This study has tried to measure the added value of geographic information in disaster management. The case study was conducted in an NEC environment and hence the term “Network Centric Disaster Management” was introduced in this thesis. There is proof that geographic information has an added value in disaster management, but because of the human factor it is difficult to put a number on it. This research showed that the decision-making process is faster with instant access to, and use of, a wide variety of national, regional and local geospatial databases. All the necessary information is present within the NEC environment, and there is no need to make time-consuming phone calls and send faxes to the owners of the information. Direct access to the information is only one part of NEC. The people aspect is more important in NEC, and this study also showed that communication within and across sections improved considerably as a result of the presence of geographic information. Communication enhances collaboration, and collaboration is an important aspect in better decision making. Measuring the quality of the decisions was outside the scope of this study, but since the decision making is, first of all, hard to measure, and, secondly is a function of all the aspects measured in this study, the overall conclusion can be that geographic information ultimately leads to better decision making.

9 Discussion of Method

9.1 Introduction

In this final chapter the method will be discussed and suggestions for the improvement of the questionnaires will be given. In the last section suggestions for further research will be made.

9.2 People

For this aspect the CTEF instrument and the SSA theory of Nofi (2000) were used.

The CTEF instrument is a long and difficult questionnaire and not adapted to the disaster management situation. Actors in a ROT are from different authorities, and some liaise with their own organization. Not everybody acting in the ROT at the time of the exercise had experience in disaster management. A few of the anomalies that can be found in the questionnaire could probably be related to those factors. The CTEF instrument could be a useful tool to try and bring certain aspects to the surface. It certainly addresses different aspects than those in the other questionnaires, but the CTEF instrument needs to be shortened in order to be useful and to obtain useful results. Two respondents gave remarks on the questionnaires and it was noted that the phrasing of the questions was not always clear and interpretation difficult. The questions need to be looked at and rephrased.

The questions in the SSA part of the questionnaire added extra information. There was some overlap with questions in the CTEF instrument and the richness and reach parts, but this made validation of the answers possible. The questions on age, sex and experience were left out but could have given more insight into the background of the respondents.

Shared situational awareness is a very dynamic factor and difficult to measure. The situation changes by the minute and the actors in the ROT have to keep up with the latest common operational picture. In the first set-up of the research, it was planned to measure the SSA after each scenario. However, because of time constraints this was not possible. The results of the SSA questionnaire therefore reflect the state of SSA during the four scenarios. There is no distinction made between the different scenarios. The fact that heads of sections arrived fully informed and fully aware of the ongoing situation at the meetings is a sign that at least there was a common operational picture and that there was probably some form of SSA. In that respect, this may not have been the best way to measure SSA, but it was, and probably is, still the best way to do it in the prevailing circumstances.

9.3 Networks

The TAM theory was used to measure the PU and the PEoU of the two new applications CCS Sitplot and Sitekst. Measurement of the performance of the OOV-network, the actual carrier of the geo-information of the GDI R&C, was outside the scope of this study. As there was only a small group of respondents, it was not possible to use the statistics of the TAM-theory, but the use of the questions alone gave useful insight into the experience of the user. If the use of the TAM method adds value, every evaluation is dependent on the situation. In the case of new technology or a different group, the use of TAM would certainly be preferable.

9.4 Information

The aspects of richness and reach provided a good framework to design the questionnaires. The aspects are well-defined by Alberts et al. (2001). Ultimately for unknown reasons, not all aspects of richness but especially of reach were incorporated in the questionnaires. It may be that some of these items were less important or that the questions were covered with other questions. There were no questions on aspects of familiarity or experience with GIS and geographic information. In a future evaluation it is advised to rework the questionnaires and incorporate the missing aspects of richness and reach.

9.5 Observations

The observations added useful information to the questionnaires. The actors in the ROT were also given the possibility to give their comments regarding the geographic information, the network, and the applications CCS Sitplot and Sitekst in free form to the observers. These remarks were noted, and gave a good impression of the actors' general feeling about the whole exercise. It is recommended that, in the future, every disaster management exercise observers should be allowed in the ROT-room.

9.6 Recommendations for further research

The whole NCDM toolbox as it is presented in this thesis needs improvement in certain aspects. These aspects were discussed in the section above.

The case study consisted of four different scenarios, which made it difficult to measure the dynamic aspects of the value of geo-information or the shared situational awareness. In particular, the method to measure SSA deserves further research in the future.

Secondly, the performance of the network itself was beyond the scope of this thesis but is a valuable asset to the NCDM evaluation toolbox.

Strong performance indicators have been defined in medical disaster management and, there are also performance indicators for the Dutch public safety sector. These performance indicators have not been used in this research as most of these performance indicators are time-related. This is difficult to measure in an exercise situation, because all the staff is already present in the ROT and the situation is somehow faked. So there is a problem with when to start the time and when to stop it.

Network Enabled Disaster Management is not only about sharing information and implementing new technology. The implementation of Network Enabled Disaster Management will also have its own effect on doctrine, information flows, leadership, training, and how the disaster management community carries out its business. The influence of NCDM on disaster management has not yet been quantified and would be an interesting topic for further research.

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Appendix 1: Example instructions for observers

Observatieschema Oefening 1: LUXAN			
Naam observator:			
Naam te observeren sectie/team:			
Namen van geobserveerde functionarissen + de afkorting die je voor ze gebruikt + de functie die ze hebben in de sectie:	Naam/Namen	Afkorting	Functie
Tijdstip aanvang oefening:			
Tijdstip einde oefening:			
Startsituatie oefening:	<p>Vanwege het aanstaande opschorten van de bedrijfsactiviteiten bij Luxan worden alle systemen en installaties geleegd en gereinigd. Het ROT is bijeengeroepen. De Meetplanleider heeft de Operationeel Leider telefonisch geïnformeerd. Op het moment van binnentrekking gaan sirenes, het niveau is GRIP 3, omroep Gelderland meldt 'schuilen'. Er is een opslagtank met Xyleen overstroomd, door onbekende oorzaak is grote brand ontstaan met zware rookwolken door giftige verbrandingsproducten. De watersprinklers zijn afgegaan waardoor de plas brandbare vloeistof vergroot. De plasbrand breidt zich verder uit over het terrein. Mensen uit de directe omgeving hebben klachten: hoesten, keelpijn, rode ogen, benauwdheid. Op het terrein zelf zijn 3 slachtoffers gevallen, de slachtoffers worden op het terrein ontsmet. De rookwolken verplaatsen zich in noordelijke richting met beperkte pluimstijging. Het is nog niet bekend of er verder explosiegevaar is, om die reden moet de directe omgeving ontruimd worden, met name delen van het</p>		

industrieterrein Elst. Vanwege de draaiende wind komt binnen een uur het Gelredome in het benedenwindse gebied te liggen. Daar is een grote activiteit gaande waarvoor de vraag is of de mensen daarbinnen voldoende bescherming hebben.

DEEL 1

Van welk type informatie wordt in de sectie gebruik gemaakt:

a) Tijdstip	b) Wie raadpleegt	C) Welk type informatie	d) Hoe wordt het gebruikt	e) Wat valt je op

Noteer dit zo nauwkeurig mogelijk. Vooral van belang om later te relateren aan de gebeurtenissen in andere secties en teams.
Noteer de naam en functie van degene die je observeert

De types informatie kun je onderverdelen naar de verschillende functies van de geteste systemen:

Algemeen situationeel kaartbeeld (delen van tekeningen): per sectietafel kunnen symbolen, lijnen en vlakken op de kaart getekend worden (voorbeeld observatie: voegt locatie afzetting toe). Iedereen tekent in zijn eigen tekenlaag en kan andere kaartlagen bekijken.

Kaartlagen: verschillende kaartlagen zijn aanwezig in CCS, waaronder referentiekaartlagen zoals luchtfoto's en topografische kaarten. Ook thematische kaarten zijn aanwezig: bijv overstromingsscenario's, aanwezigheid vee, bejaardentehuizen. Kaartlagen kunnen worden gecombineerd. Vermeld ook als je ziet dat er geo-informatie wordt gebruikt die niet in CCS aanwezig is, zoals papieren kaarten, Google Earth, Touchtable, Cyclorama panorama's, knmi, etc. Vermeld dus bij je observatie zo nauwkeurig mogelijk welke kaartlaag geraadpleegd wordt. Als je ziet dat een persoon als een gek door allerlei datalagen zoekt omdat hij iets niet kan vinden, dan hoef je niet al die zoekacties bij te houden. Schrijf dat echter wel op dat de persoon lijkt te zoeken maar het niet kan vinden in het 'wat viel op' deel.

Gas- en sectormal: functionaliteit om gebieden aan te geven die bedreigd worden door de uitstroom van gevaarlijke stoffen. Gasmallen en sectormallen kunnen getekend worden en gedeeld worden. Tevens kunnen meetploegen een meetopdracht ontvangen en digitaal een bericht terugsturen.

Impactanalyse: het gebruik van de rekenmodule om berekeningen te kunnen maken over bijvoorbeeld: het aantal mensen in een gaswolk, het aantal stuks vee in het gebied dat dreigt onder te lopen door hoogwater, alle pluimveebedrijven in een gebied selecteren en exporteren naar een Excel bestand. Vermeld dus zo nauwkeurig mogelijk welke berekening gedaan wordt.

Netcentrisch werken via situationele tekst (delen van tekst): iedere sectie (actor) heeft een eigen tabblad waarin tekstuele informatie kan worden ingevuld. Men kan in elkaars tabblad kijken om te zien wat elkaars informatiepositie is. De secties kunnen tevens berichten naar elkaar sturen. De sectie informatie stelt een gemeenschappelijk situatierapport samen op basis van de disciplinaire situatieteksten. Noteer dus in je observatie of er wordt gekeken naar de rapportages van andere secties, of er regelmatig tekst wordt toegevoegd en berichten worden verzonden.

Wordt de geo-informatie gecombineerd met andere informatie? Vormt de geo-informatie de basis voor een analyse? Wordt het gebruikt om te verduidelijken? Om te presenteren?

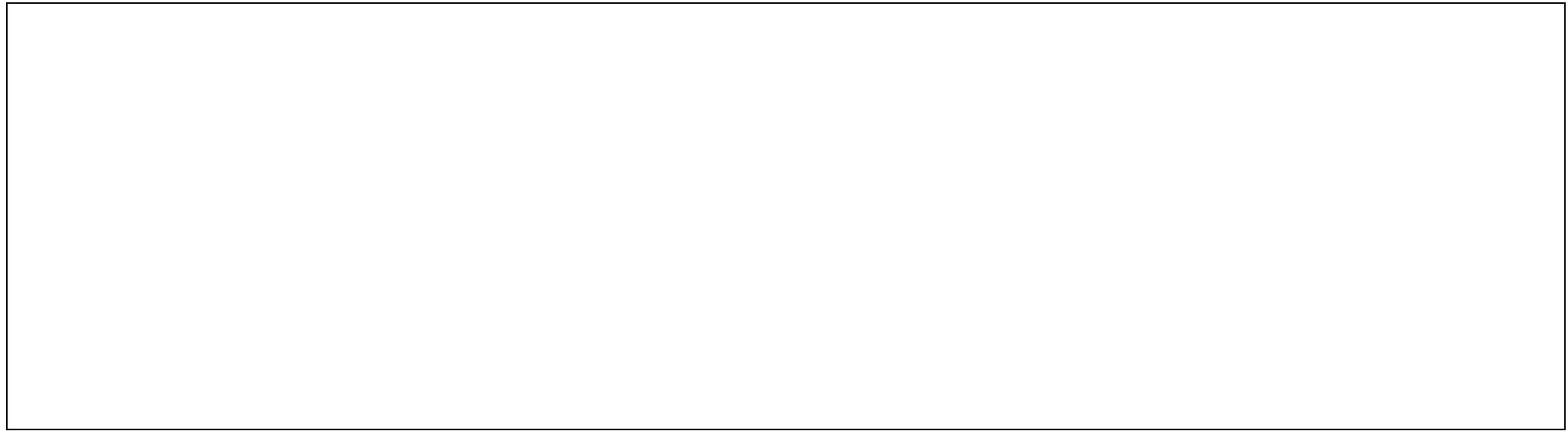
Wat valt je op in het gebruik? Moet hij/zij lang zoeken naar de juiste data? Gaat het snel/langzaam/gemakkelijk? Lijkt de functionaris vertrouwd met de systemen? Moet hij dingen vragen aan anderen over de omgang met de systemen? Antwoord in de trant van: 'M kon de data snel vinden', of 'X heeft M geholpen bij het vinden'.

DEEL 2

Algemeen proces

Beschrijf hier wat je op valt aan het proces dat je observeert:

- **Wat is opvallend aan de samenwerking? Aan de manier van communicatie? Merk je iets van stress, bijvoorbeeld vermoeidheid of frustratie?**
- **Schrijf opmerkelijke quotes en hun afzender ook in dit veld.**



DEEL 3
Informatievragen

Informatievragen:	Van aan:	Vraag beantwoord ja/nee	Sterke punten*	Zwakke punten*
Startsituatie inplotten (centrale plotter)	Plv OL aan ROT			
Overzicht alle huisartsenpraktijken en andere zorglocaties in de omgeving	MKA aan ROT			
Veilige afstand afzetting ivm rookontwikkeling Aamsestraat	OvD-P aan ROT			

Gevaarinschatting Westeraam, want ligt buiten gevarengebied	CMG aan Brw			
Update sitplot nav verdere escalatie ramp	COPI aan ROT			
Kan er veilig gewerkt worden en waar?	OvD-G aan GHOR			
Regelen verkeerscirculering/- omleiding; oa afritten A325 afsluiten?	OvD-P aan ROT			
Bedreigde sectoren vaststellen: aanwezige bevolkingsaantallen, zwaartepunten en zorgbehoevenden.	OL aan Plv OL			
Voorlichting op gang brengen.	OL aan Plv OL			
Wegen afzetten 1 km benedenwinds. Vraag om circulatieverkeersplan, rijroutes voor evacuatie en opvangslocaties.	OvD-P aan ROT			
Benedenwinds zeer ruim in kaart brengen bejaardentehuizen, scholen etc om te benaderen voor ramen en deuren sluiten.	GAGS aan GHOR			
Advies gevraagd: wel of niet uitzetten schuimsprinkler (advies nav op te zoeken meteo gegevens)	COPI aan ROT			
Advies gevraagd ivm milieu- aspecten: in kaart brengen riool en omliggend oppervlaktewater op plot	ROGS aan AGS			

Overzicht schuimleveranciers: waar wordt het schuim aangeleverd? Plan voor bluswatervoorziening, slangenwegen en aan/afvoer gevraagd.	OvD-B aan ROT			
Maak een plot met voorlichting voor mensen die thuis zitten en mensen die zelf naar huisarts gaan. Relevante info voor omwonenden benedenwinds gebied.	OL aan Plv OL			
Meetresultaten grote Molenstraat en Rijksweg noord aangeven in plot.	MPL aan AGS			
Is er bekend hoeveel personen opgevangen moeten worden uit het te ontruimen gebied?	GMT aan ROT/gem			
Is er al een inschatting te geven van de blootstelling voor de bevolking: welke stoffen; concentratie; duur blootstelling; aantal blootgestelde mensen.	GAGS aan AGS			
Wind staat over het spoor + station Elst: treinverkeer stilleggen?	OvD-P aan ROT			
Moet het Westeraamcollege binnen blijven?	Meldkamer politie aan ROT			
Wat te doen met de mensen op het station?	OvD-P aan ROT			
Zijn er opvanglocaties voor werknemers van bedrijven uit de omgeving?	OvD-P aan ROT			

Zodra windrichting verandert, gas- en sectoren mal aanpassen.	MPL aan AGS			
Geef aan waar boeren hun vee binnen moeten halen of niet moeten laten grazen. Maak beeld van (rund)veebedrijven benedenwinds	GMT aan ROT			
Mal aanpassen.	MPL aan AGS			
Kan geplande oefening duikers in Rijkerswoerdse plassen gewoon doorgaan ivm schadelijke rook?	RAC aan ROT brw			
Vanwege draaiende wind komt Gelredome in benedenwinds gebied. Overzicht evenementen en aantal bezoekers.	MPL aan AGS			
Welke bedrijven worden ontruimd?	GBT aan ROT			

* Denk aan snelheid van antwoorden, complexiteit van de opdracht, samenwerking, gebruik maken van verschillende informatiebronnen

Appendix 2: Questions Eagleone_1

Form name eagleone_1

Form title Vragenlijst voor CCS-plot gebruikers Eagle One

1. Ik vind het goed dat de VU Amsterdam contact opneemt voor eventuele verdere vragen.
2. Vink aan bij welke organisatie u werkzaam bent.
3. Ik heb alle nodige informatie in het sitplot systeem kunnen vinden
4. Alle informatie die ik nodig heb gehad was in het sitplot systeem aanwezig
5. Ik heb geen fouten kunnen ontdekken in de gegevens in het sitplot systeem
6. De informatie die ik zoek is makkelijk te vinden in het sitplot systeem
7. De informatielagen in het sitplot systeem waren te gedetailleerd om te gebruiken voor de oefening
8. Er waren informatielagen in het sitplot systeem die niet gedetailleerd genoeg waren om te gebruiken voor de oefening
9. Het sitplot systeem biedt de informatie die ik nodig heb voor het uitvoeren van mijn taak
10. Ik kan me voorstellen dat ik sommige gegevens in het sitplot systeem nooit bij een calamiteit zou gebruiken
11. Een deel van de in het sitplot aangeboden informatie is te gedateerd voor het uitvoeren van mijn taken
12. Ik vertrouw erop dat het sitplot systeem de juiste informatie bevat
13. Ik vertrouw erop dat bewerkingen van het sitplot de juiste informatie opleveren
14. Hebben alleen geautoriseerde gebruikers toegang tot de geografische informatie?
15. Hebben alle gebruikers op hetzelfde moment toegang tot de geografische informatie?
16. Is er voldoende samenhang tussen de verschillende systemen (bijv. tussen sitplot en sitekst*) en de inhoud van de systemen?
17. In welke mate is de geografische data, informatie en eventueel kennis in het systeem valide en betrouwbaar?
18. Is de geografische informatie in het systeem te traceren naar de bron?
19. Is de communicatie over en weer tussen de actoren in het ROT veranderd door de invoering van het vernieuwde sitplot systeem?
20. Is de communicatie over en weer tussen de actoren in het ROT veranderd door de invoering van het vernieuwde sitekst systeem?
21. Is de kwaliteit van communicatie verbeterd door de invoering van het vernieuwde sitekst systeem?
22. Is de kwaliteit van de communicatie verbeterd door de invoering van het vernieuwde sitplot systeem?
23. Wordt informatie voldoende gedeeld binnen de eigen sectie?
24. Wordt informatie voldoende gedeeld met andere secties?
25. Wordt informatie sneller gedeeld door de invoering van het nieuwe systeem voor sitekst?
26. Wordt informatie sneller gedeeld door de invoering van het nieuwe systeem voor sitplots?
27. Is informatie sneller beschikbaar door het nieuwe sitplot systeem?
28. Is informatie sneller beschikbaar door het nieuwe sitekstsysteem?
29. Het sitplot systeem zal de communicatie tussen u en uw sectiegenoten ondersteunen
30. Het sitplot systeem zal de communicatie tussen uw sectie en andere secties ondersteunen
31. Het sitplot systeem zal het te volgen aantal procedures verkleinen
32. Het sitplot systeem zal procedures vereenvoudigen
33. Het sitplot systeem zal het aantal verantwoordelijkheden van uw sectie verminderen
34. Het sitplot systeem zal het eenvoudiger maken om beslissingen te nemen
35. Het sitplot systeem zal uw sectie helpen betere beslissingen te maken
36. Het sitplot systeem frustreert me vaak
37. Mijn werk is complexer zonder het sitplot systeem
38. Het sitplot systeem is makkelijk te begrijpen
39. Door het sitplot systeem heb ik meer controle over mijn werk
40. Het sitplot systeem vind ik vaak verwarring
41. Het sitplot systeem voldoet aan mijn taak-gerelateerde behoeftes

- 42. Het vergt veel energie van mijzelf om met het sitplot systeem te leren werken**
- 43. Met het sitplot systeem heb ik een goed overzicht van de taken die mij te doen staan**
- 44. Het sitplot systeem doet wat ik vraag**
- 45. Ik maak vaak fouten als ik het sitplot systeem gebruik**
- 46. Het sitplot systeem bespaart me tijd**
- 47. Door het sitplot systeem kan ik meer werk verrichten in dezelfde tijd**
- 48. Over het algemeen vind ik het sitplot systeem gebruiksvriendelijk**
- 49. Het sitplot systeem verbetert de kwaliteit van mijn werk**
- 50. Het sitplot systeem is flexibel**
- 51. Over het algemeen vind ik het sitplot systeem bruikbaar in mijn werk**
- 52. Ik heb nog ondersteuning nodig bij het werken met het sitplot systeem (via handleidingen, help functie of coach)**
- 53. Het sitplot systeem gedraagt zich vaak onverwachts**

Appendix 3: Questions Eagleone_2

Form name eagleone_2

Form title Vragenlijst voor CCS-plot + CCS-sitekst gebruikers

Number of questions 31

1. Ik vind het goed dat de VU Amsterdam contact opneemt voor eventuele verdere vragen.
2. Vink aan bij welke organisatie u werkzaam bent.
3. Er waren tijdens de oefening situaties waarin ik te weinig informatie had om mijn taken te volbrengen
4. Doordat informatie op kaarten gedeeld werd kon ik sneller keuzes maken
5. Er waren tijdens de oefening situaties waarin ik te veel informatie had om goede keuzes te maken
6. Mijn sectieleden hadden dezelfde informatie als ik had
7. Ik had tijdens de oefening een beter beeld kunnen hebben van wat er in het veld gebeurde
8. Doordat informatie op kaarten gedeeld werd had ik een beter beeld van de situatie
9. Andere ROT-secties deelden de informatie die ik nodig had met mij
10. Mijn sectieleden deelden de informatie die ik nodig had met mij
11. Andere ROT-secties hadden hetzelfde beeld als ik had
12. Ik had de Plv Operationeel Leider niet beter kunnen lichten
13. Door de sitplots en siteksten* had ik een beter beeld van de situatie ter plekke
14. Het sitekst systeem frustrert me vaak
15. Mijn werk is complexer zonder het sitekst systeem
16. Het sitekst systeem is makkelijk te begrijpen
17. Door het sitekst systeem heb ik meer controle over mijn werk
18. Het sitekst systeem vind ik vaak verwarrend
19. Het sitekst systeem voldoet aan mijn taak-gerelateerde behoeftes
20. Het vergt veel energie van mijzelf om met het sitekst systeem te leren werken
21. Met het sitekst systeem heb ik een goed overzicht van de taken die mij te doen staan
22. Het sitekst systeem doet wat ik vraag
23. Ik maak vaak fouten als ik het sitekst systeem gebruik
24. Het sitekst systeem bespaart me tijd
25. Door het sitekst systeem kan ik meer werk verrichten in dezelfde tijd
26. Over het algemeen vind ik het sitekst systeem gebruiksvriendelijk
27. Het sitekst systeem verbetert de kwaliteit van mijn werk
28. Het sitekst systeem is flexibel
29. Over het algemeen vind ik het sitekst systeem bruikbaar in mijn werk
30. Ik heb nog ondersteuning nodig bij het werken met het sitekst systeem (via handleidingen, help functie of coach)
31. Het sitekst systeem gedraagt zich vaak onverwachts

Appendix 4: Questions CTEF instrument

Command Team Effectiveness (CTEF)

Inleiding

Voor u ligt de enquete gebaseerd op de Command Team Effectiveness methode. Het doel van deze enquete is om te meten hoe het team naar uw idee gefunctioneerd heeft tijdens de oefening Eagle One. Met het team wordt in dit geval het ROT als geheel bedoeld en niet uw individuele sectie (die ook als team aangemerkt zou kunnen worden).

Het doel van de enquete is om meer te weten te komen over het functioneren van het ROT tijdens/bij Netcentrisch werken. De vragen dienen geïnterpreteerd te worden vanuit het Netcentrisch werken en denken. Aangezien de oefening Eagle One de eerste keer is dat u Netcentrisch gewerkt heeft, dient de oefening Eagle One als referentiekader voor deze enquete.

Een voorbeeld: onzekerheid mbt de verkregen informatie

Was er tijdens een van de scenario's in Eagle One onzekerheid mbt de verkregen informatie?

Invulinstructie

Bij ieder item of vraag staat in cursief een korte uitleg of toelichting met betrekking tot deze vraag. De beantwoording van de vragen bestaat uit twee delen. In het eerste deel wordt u gevraagd een objectief oordeel te geven met betrekking tot de vraag. De antwoorden variëren van erg laag tot zeer hoog op een schaal van vijf. Daarnaast dient u een oordeel te geven of het gevraagde van invloed was op de effectiviteit van het team op een schaal van zeer negatief tot zeer positief. Het kan voorkomen dat een negatieve score in het eerste deel van de vraag, niet of nauwelijks effect heeft op de effectiviteit van het team. Andersom is natuurlijk ook mogelijk.

De vragenlijst is specifiek ontwikkeld voor gebruik in een militaire omgeving. Nu kan het zijn dat bepaalde vragen niet relevant zijn voor het rampenbestrijdingsdomein. De methode biedt de mogelijkheid om 'niet van toepassing' aan te kruisen.

Tot slot

Het is de eerste keer dat deze vragenlijst voorgelegd wordt aan functionarissen uit het rampenbestrijdingsdomein. Naast het bepalen van de mate van samenwerking (collaboration) en effectiviteit van het team (een van de factoren van Netcentrisch werken) is de tweede doelstelling te onderzoeken of deze methode ook toepasbaar is in het rampenbestrijdingsdomein.

De onderliggende vragenlijst is erg uitgebreid. U moet dan ook rekening houden met een 30 tot 45 minuten voordat u alle vragen hebt beantwoordt. Om tot een gewogen oordeel te komen of deze methode toepasbaar is binnen de rampenbestrijding wil ik u vragen om de vragenlijst zo volledig mogelijk in te vullen.

Ik wens u veel succes bij het invullen en ik dank u hartelijk voor uw respons.

Patrick Brooijmans
MSc student Vrije Universiteit

MISSIE

De onderwerpen in dit deel van de questionnaire proberen de kritische aspecten van de operationele omgeving in kaart te brengen.

Item	Beoordeling van missie aspecten						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Onzekerheid m.b.t. de situatie <i>Missen van informatie van en over objecten of begrip over objecten en hun eigenschappen in de omgeving</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Onzekerheid m.b.t. de verkregen informatie <i>Is de verkregen informatie valide?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Onzekerheid m.b.t. de afloop van de situatie <i>Is er voldoende informatie bekend over de situatie om een gewogen oordeel te kunnen maken?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Onzekerheid m.b.t. de benodigde middelen <i>Hoeveel personeel is benodigd en is dit beschikbaar? Beschikbaarheid van speciale hulpmiddelen? Is er voldoende personeel en speciale hulpmiddelen beschikbaar?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Onzekerheid m.b.t. het gebruik van de middelen <i>Zijn er externe factoren die de inzet van de benodigde middelen kunnen beïnvloeden, zoals logistieke problemen?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Stress	1	2	3	4	5	-2	-1	0	+1	+2	
Gevaar <i>Lopen hulpverleners fysieke risico's door de aard van de ramp?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Intensiteit van de rampenbestrijding <i>Zijn hulpverleners blootgesteld aan tijdsdruk, slaaptekort en/of een overvloed aan informatie?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Psychologische factoren <i>Zijn de rampenbestrijders onder invloed van persoonlijke of interpersoonlijke problemen? Wat is de waarschijnlijke mentale impact van de operatie?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Randvoorwaarden en beperkende factoren <i>Zijn er externe factoren die de bewegingsvrijheid van de in het veld aanwezig teams negatief beïnvloeden?</i>	1	2	3	4	5	-2	-1	0	+1	+2	

Omgevingsfactoren <i>Wat is de invloed van terrein, weer, gevaarlijke stoffen en evt. ziekten?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Politieke factoren <i>Zijn er wetten die de rampenbestrijding in de weg staan? Zijn er eventueel lokaal beperkende regels?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Culturele factoren <i>Wat is de invloed van lokale religie, gebruiken en hoe is de samenwerking met ketenpartners?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Media <i>Wat is de lokale, nationale en internationale perceptie op de ramp en de bestrijding ervan?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Tijd/ruimte factoren <i>Hoe worden acties in ruimte en tijd gemanaged?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Belangen <i>Wat is de korte en lange termijn consequentie van het eindresultaat?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Slachtoffers <i>IS er sprake van gewonde of gedode hulpverleners en burgers?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Nationale impact <i>Wat is de politieke, economische en publieke perceptie op de beslissingen genomen tijdens het bestrijden van de ramp?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Internationale impact <i>Wat is de politieke, economische en publieke perceptie op de beslissingen genomen tijdens het bestrijden van de ramp?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Score MISSIE											

TAAK

Dit deel van de questionnaire beschrijft de kerntaken van het rampenbestrijdingsteam. De focus ligt op aspecten die direct van invloed zijn op de processen en het resultaat.

Item	Beoordeling van taak aspecten						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Complexiteit van de taak		1	2	3	4	5	-2	-1	0	+1	+2
Moeilijkheidsgraad van de taak <i>Wat is de cognitieve en fysieke belasting van de subtaken die ieder teamlid uitvoert?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Aantal subtaken <i>Worden subtaken parallel of in serie uitgevoerd?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Afhankelijkheid van de subtaken <i>Zijn de subtaken gerelateerd aan elkaar en zo ja in welke mate?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Invloed van subtaken op elkaar <i>Wat is de potentiële invloed van een subtaak of subtaken op de uitvoering van andere subtaken</i>		1	2	3	4	5	-2	-1	0	+1	+2
Werkdruk <i>Werkdruk is gerelateerd aan de eisen die van buitenaf gesteld worden aan de huidige situatie</i>		1	2	3	4	5	-2	-1	0	+1	+2
Fysieke werkdruk <i>Speelde vermoeidheid een rol bij het beoordelen van de situatie en en het nemen van beslissingen?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Cognitieve werkdruk <i>De taak kan te complex worden door information overload of doordat het team teveel gedachtesprongen moet maken</i>		1	2	3	4	5	-2	-1	0	+1	+2
Emotionele werkdruk <i>Zijn er conflictsituaties binnen het team ontstaan uit de emotionele impact die beslissingen kunnen hebben?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Tijdsdruk <i>Moesten er teveel taken in een te korte tijd worden uitgevoerd?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Onduidelijkheid over het doel		1	2	3	4	5	-2	-1	0	+1	+2

<i>Mate waarin het team begrijpt wat het doel en de prioriteiten zijn</i>											
<i>Zijn de gestelde doelen stabiel door de tijd?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
<i>Als de gestelde doelen stabiel zijn, kan het team zijn activiteiten op een te voorspellen manier managen</i>											
Score TAAK											

ORGANISATIE

Dit deel van de questionnaire focust zich op de organisatie in de breedste zin van het woord. De organisatie kan een positieve of negatieve uitwerking hebben op de manier waarop het team functioneert.

Item	Beoordeling van organisatie aspecten						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Overeenkomst tussen missie van het team en het doel van de organisatie <i>Is er een fit tussen de doelen van het team en het doel van de organisatie?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Duidelijkheid over de commandostructuur <i>Is het duidelijk wie geautoriseerd is voor het geven van opdrachten aan het team?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Zelfstandigheid <i>Heeft het team het mandaat/vrijheid om tot een bepaalde hoogte zelfstandig beslissingen te nemen?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Steun van de organisatie <i>Wordt het team dat de missie moet uitvoeren voldoende gesteund door de organisatie?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Erkenning <i>Is er waardering voor wat een persoon of het team heeft gedaan en doet?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Sfeer <i>Is de organisatie in staat het team fouten te vergeven en deze te zien als leermomenten?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Materieel <i>Krijgt het team de middelen die het nodig heeft om de taak uit te voeren op een efficiënte en effectieve manier. Worden de middelen zowel voor als tijdens de missie/taak toegewezen?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Score ORGANISATIE											
LEIDERSCHAP											

Een goede leider heeft een positieve invloed op de resultaten van het team. De leider draagt de taak van het team over aan de teamleden, stuurt de teamleden aan en beïnvloedt hen bij de uitvoering van hun taak. De leider is ook verantwoordelijk voor de communicatie met het hogere niveau. De focus in dit deel van de questionnaire ligt bij de capaciteiten van de leider en niet hoe hij of zij haar taak uitvoert.

Item	Beoordeling van leiderschap aspecten						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Leiderschapsvaardigheden <i>Focus op de vaardigheden die benodigd zijn om een multidisciplinair rampenbestrijdingsteam te leiden.</i>		1	2	3	4	5	-2	-1	0	+1	+2
Tactische vaardigheden <i>Heeft de leider (i.c. plv OL) de benodigde vaardigheden om tactische problemen op te lossen?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Technische vaardigheden <i>Heeft de leider de benodigde expertise om alle taken uit te voeren?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Sociale vaardigheden <i>Is de leider in staat om de teamleden te coachen en te motiveren? Kan hij/zij conflicten oplossen? Is de leider in staat om het team te laten leren? Is de leider in staat het team zoveel zelfvertrouwen te geven dat taken als vanzelf uitgevoerd worden?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Cognitieve vaardigheden <i>Is de leider in staat om creatief te denken en heeft de leider analytisch vermogen?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Kennis <i>Heeft de leider voldoende kennis om het team de missie te laten volbrengen.</i>		1	2	3	4	5	-2	-1	0	+1	+2
Kennis m.b.t. de uit te voeren taken <i>Heeft de leider voldoende kennis en ervaring over de door het ROT uit te voeren taken?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Kennis m.b.t. het team <i>Kent de leider de zwakke en sterke punten van zijn eigen team, de teamleden en de cultuur van het team?</i>		1	2	3	4	5	-2	-1	0	+1	+2
Kennis m.b.t. de organisatie <i>Kent de leider de organisatie (het grotere geheel) voldoende en heeft de leider de juiste contacten om opgelegde beperkingen te kunnen opheffen?</i>		1	2	3	4	5	-2	-1	0	+1	+2

Overeenkomst tussen persoonlijke doelen en organisatie doelen <i>Hoe groter de overeenkomst, hoe beter het resultaat van het team, omdat de leider beter gemotiveerd is.</i>		1	2	3	4	5	-2	-1	0	+1	+2
Score LEIDERSCHAP											

TEAMLEDEN

Competenties van teamleden hebben een grote invloed op de effectiviteit van een team.

Item	Beoordeling van teamlid aspecten						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Vaardigheden <i>Focus op de vaardigheden die teamleden moeten bezitten/beheersen om hun taken in teamverband te kunnen uitvoeren.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Tactische vaardigheden <i>Hebben de individuele teamleden de capaciteiten om toekomstige taken te kunnen onderkennen en plannen?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Technische vaardigheden <i>Hebben de individuele teamleden de capaciteiten om vereiste taken uit te voeren?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Sociale vaardigheden <i>Kunnen de individuele teamleden samenwerken en communiceren met anderen binnen en buiten het team?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Cognitieve vaardigheden <i>Vaardigheden op het gebied van kritisch denken, probleemoplossend vermogen, besluitvaardigheid en het kunnen vormen van een mentaal model</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Kennis <i>Kennis doelt op de vereiste informatie, wijsheid en ervaring die een teamlid bezit</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Kennis m.b.t. de uit te voeren taken <i>De informatie, wijsheid en ervaring van de individuele teamleden over de te volbrengen taak</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Kennis m.b.t. het team <i>Kennen de individuele teamleden de zwakke en sterke punten van zijn eigen team, de teamleden en de (ongeschreven) teamcultuur?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Kennis m.b.t. de organisatie <i>Zijn de individuele teamleden voldoende bekend met de</i>	1	2	3	4	5	-2	-1	0	+1	+2	

<i>grotere organisatie waarin ze als team opereren (hierarchie, informatiesysteem, cultuur)?</i>											
Overeenkomst tussen persoonlijke doelen en organisatie doelen <i>Hebben de organisatie en de individuele teamleden een gezamenlijk doel om naar toe te werken?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Score TEAMLEDEN											

TEAM

In dit deel van de questionnaire wordt ingegaan op de aspecten van het team, die een mogelijk effect zouden kunnen hebben op de effectiviteit.

Item	Beoordeling van team aspecten						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Samenstelling <i>Focus op de in het team aanwezige personen en persoonlijkheden.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Vaardigheden <i>Zijn de vaardigheden benodigd voor het volbrengen van de taak evenredig verdeeld over het team?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Demografische eigenschappen <i>Is de mix van leeftijd, geslacht, etniciteit en culturele verschillen de juiste om het team optimaal te laten presteren?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Mix van persoonseigenschappen <i>De persoonseigenschappen bepalen hoe individuen in een team samenwerken en hoe ze presteren.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Stabiliteit van team samenstelling gedurende een bepaalde tijd <i>Hoe langer een team bij elkaar is, des te beter zullen de teamleden elkaar vertrouwen en kennen. Hierdoor zal de effectiviteit van het team toenemen.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Grootte <i>Ishet aantal individuen die deel uitmaken van het team voldoende om de opgelegde taken goed uit te voeren?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Architectuur <i>Teamarchitectuur verwijst naar de organisatie en verdeling van subtaken en rollen en op welke wijze deze met elkaar samen hangen.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Fysieke afstand <i>Werken de teamleden bij elkaar op een locatie, in een ruimte of zijn de geografisch verspreid over verschillende locaties?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Verdeling van taken <i>Zijn de taken toegewezen aan de personen met de juiste</i>	1	2	3	4	5	-2	-1	0	+1	+2	

<i>expertise?</i>											
Volwassenheid <i>Hoe lang heeft een team al samengewerkt? De volwassenheid van een team kan afgemeten worden aan: zelfsturend, aanpassen aan omstandigheden, inschatten van behoefte van andere teamleden.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Overeenkomst tussen team doelen en organisatie doelen <i>Zijn de doelen voor het team duidelijk en wat is de awareness voor deze doelen. Heeft het team de doelen geaccepteerd en heeft het team de intentie om de gestelde doelen te halen.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Score TEAM											

TAAK GEORIENTEERD GEDRAG

In dit deel van de questionnaire wordt gekeken naar de processen gericht op het uitvoeren van de taak.

Item	Beoordeling van aspecten taak georienteerd gedrag						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Informatiemanagement <i>Op welke wijze wordt er met informatie en kennis omgegaan door/binnen het team?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Verkrijgen van informatie <i>Wordt er actief gezocht/verzocht om informatie door het uitzetten van vragen?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Verwerken van informatie <i>Wordt de verkregen informatie gebruikt en geïntegreerd met de al bestaande/bekende informatie?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Uitwisselen van informatie <i>Wat is de tijdigheid, correctheid en compleetheid van de verkregen informatie?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Beoordelen van de situatie <i>Bestaat er een volledig begrip van de situatie tijdens het bestrijden van de ramp?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Besluitvorming <i>De effectiviteit van besluitvorming wordt gedefinieerd door de kwaliteit van de besluiten en de efficiency waarmee de besluiten genomen worden</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Probleemdefinitie <i>Is het team in staat om een goede probleemdefinitie te formuleren?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Time management <i>Is er genoeg tijd om een gewogen besluit te nemen, of is de tijdsdruk dusdanig dat alleen voor snelle, praktisch uitvoerbare oplossingen wordt gekozen?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Evaluatie van opties en resultaten	1	2	3	4	5	-2	-1	0	+1	+2	

<i>Worden de mogelijke oplossingen systematisch geanalyseerd?</i>										
Planning <i>Focus op het proces waarbij de acties worden bepaald om het gestelde teamdoel te bereiken.</i>	1	2	3	4	5	-2	-1	0	+1	+2
Anticiperen <i>Wordt er geanticipeerd op mogelijke taken en gebeurtenissen in de toekomst?</i>	1	2	3	4	5	-2	-1	0	+1	+2
Rooster <i>Wordt er een planning gemaakt van benodigd personeel, materieel gerelateerd aan tijd?</i>	1	2	3	4	5	-2	-1	0	+1	+2
Strategie <i>Is er een specifieke aanpak om het doel te bereiken (procedures, beleid,...)?</i>	1	2	3	4	5	-2	-1	0	+1	+2
Bevelvoering	1	2	3	4	5	-2	-1	0	+1	+2
Organisatievermogen <i>Hoe implementeert het team het voorgenomen plan?</i>	1	2	3	4	5	-2	-1	0	+1	+2
Management <i>Wordt het team dusdanig aangestuurd dat het de taak tot een succesvol einde kan brengen?</i>	1	2	3	4	5	-2	-1	0	+1	+2
Voortgang <i>Worden tussendoelen en doelstelling geformuleerd en wordt ook in de gaten gehouden of deze worden gehaald?</i>	1	2	3	4	5	-2	-1	0	+1	+2
Contacten met andere teams <i>Contacten met andere teams kunnen zorgen voor nieuwe informatiestromen, nieuwe samenwerkingsverbanden en uitwisseling van kennis.</i>	1	2	3	4	5	-2	-1	0	+1	+2
Score TAAK GEORIENTEERD GEDRAG										

TEAM GEORIENTEERD GEDRAG

In dit deel van de questionnaire wordt gekeken naar de processen gericht op het functioneren van het team

Item	Beoordeling van aspecten team georienteerd gedrag						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Visie <i>Bepalen en in stand houden van richting en (hogere) doel van het team. Vaak een functie van de teamleider.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Intentie <i>Is gericht op het in stand houden van het gedeelde mentale beeld van gestelde doelen en hoe deze te bereiken.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Communicatie binnen het team	1	2	3	4	5	-2	-1	0	+1	+2	
Communicatie <i>Wordt er positief gecommuniceerd binnen het team?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Coordinatie <i>Worden subtaken die verschillende teamleden uitvoeren gecoördineerd om conflicten en dubbele uitvoer van taken te voorkomen?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Terugkoppeling <i>Wordt binnen het team advies gegeven over hoe de efficiency, effectiviteit en prestatie verbeterd kunnen worden?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Motiveren <i>Het proces om richting, intensiteit en doorzettingsvermogen te beïnvloeden.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Extrinsiek <i>Het belonen en stimuleren van goede prestaties d.m.v. gratificaties</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Intrinsiek <i>Inspireren van teamleden om de interesse in het werk en de taken te verdiepen door het instellen van een mentorfunctie of</i>	1	2	3	4	5	-2	-1	0	+1	+2	

<i>ontwikkeling.</i>											
Aanpassing <i>In hoeverre veranderen teamleden hun gedrag en relatie met andere teamleden als gevolg van veranderingen in de omgeving of in het team</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Monitoren <i>Teamleden observeren en beoordelen zichzelf en elkaars prestaties, met als doel de prestaties te verbeteren.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Corrigeren <i>Het geven van feedback of begeleiding om de uitvoering van taken te verbeteren</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Geven van back-up <i>Het steunen van teamleden door compensatie, b.v. het overnemen van taken.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Team building Gericht op acties om het team bij elkaar te houden	1	2	3	4	5	-2	-1	0	+1	+2	
Sociale steun <i>Gericht op het vormen van een buffer tegen stress. Binding en loyaliteit met andere teamleden wordt groter.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Reguleren van emoties <i>Beïnvloeden van emoties of het onderhouden van de balans tussen teamleden.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Ontwikkelen en onderhouden van de teamband <i>Is er solidariteit en/of teamgeest?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Conflict management <i>Op welke wijze worden binnen het team conflicten opgelost.</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Score TEAM GEORIENTEERD GEDRAG											

TAAK RESULTAAT

Het resultaat is een belangrijke indicatie of het team de gestelde doelen heeft gehaald.

Item	Beoordeling van taak resultaat						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Tussendoelen <i>Focus op de tijd, welke doelen zijn gehaald en wat moet er nog gebeuren om alle einddoelen te halen</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Zijn de door de stakeholder (GBT, RBT) gestelde criteria gehaald?	1	2	3	4	5	-2	-1	0	+1	+2	
Zijn eventueel andere stakeholders tevreden met het (te verwachten) resultaat?	1	2	3	4	5	-2	-1	0	+1	+2	
Is het team bij de uitvoering van de taak binnen de gestelde regels en grenzen gebleven?	1	2	3	4	5	-2	-1	0	+1	+2	
Einddoel <i>Heeft het team als de opdracht is voltooid of de deadline is verstreken de gestelde doelen gehaald?</i>	1	2	3	4	5	-2	-1	0	+1	+2	
Zijn de door de stakeholder gestelde criteria gehaald?	1	2	3	4	5	-2	-1	0	+1	+2	
Zijn eventueel andere stakeholders tevreden met het (te verwachten) resultaat?	1	2	3	4	5	-2	-1	0	+1	+2	
Is het team bij de uitvoering van de taak binnen de gestelde regels en grenzen gebleven?	1	2	3	4	5	-2	-1	0	+1	+2	
Score TAAK RESULTAAT											

TEAM RESULTAAT

Het resultaat is een belangrijke indicatie of het team de gestelde doelen heeft gehaald.

Item	Beoordeling van taak resultaat						Impact op team effectiviteit				
	N.V.T.	Erg laag	Laag	Gemiddeld	Hoog	Zeer hoog	Zeer negatief	Negatief	Niet	Positief	Zeer positief
Wederzijds vertrouwen <i>Wederzijds vertrouwen kan gebaseerd zijn op langdurige samenwerking (persoon) of op het herkennen van bepaalde persoonseigenschappen (categorie)</i>		1	2	3	4	5	-2	-1	0	+1	+2
Moraal <i>Enthousiasme en doorzettingsvermogen van groepsleden om deel te nemen aan het groepsproces</i>		1	2	3	4	5	-2	-1	0	+1	+2
Binding <i>Binding in het team is nauw gerelateerd aan team prestaties</i>		1	2	3	4	5	-2	-1	0	+1	+2
Collectief vertrouwen <i>Vertrouwen zorgt voor collectieve kracht waardoor het team effectief gaat presteren</i>		1	2	3	4	5	-2	-1	0	+1	+2
Gedeelde visie <i>Een gedeeld beeld van de intentie van de leider zorgt ervoor dat de intenties worden gehaald en dat het team beter presteert</i>		1	2	3	4	5	-2	-1	0	+1	+2
Wederzijds respect <i>Teamleden proberen elkaar te begrijpen ondanks de onderlinge verschillen. Respect heeft een positieve invloed op de effectiviteit.</i>		1	2	3	4	5	-2	-1	0	+1	+2
Score TEAM RESULTAAT											

Appendix 5: Results questionnaire Eagleone_1

	Aantal		
Politie	2	14,29%	12,50%
Brandweer	7	50,00%	43,75%
GHOR	1	7,14%	6,25%
Gemeente	1	7,14%	6,25%
Anders	3	21,43%	18,75%
Onbekend	2		12,50%
Totaal	16	100,00%	100,00%

Richness

No	Vraag	Zeer eens	Eens	Neutraal	Oneens	Zeer oneens
3	Ik heb alle nodige informatie in het sitplot systeem kunnen vinden	0,00%	57,14%	14,29%	28,57%	0,00%
4	Alle informatie die ik nodig heb gehad was in het sitplot systeem aanwezig	0,00%	57,14%	14,29%	28,57%	0,00%
5	Ik heb geen fouten kunnen ontdekken in de gegevens in het sitplot systeem	0,00%	14,29%	35,71%	42,86%	0,00%
6	De informatie die ik zoek is makkelijk te vinden in het sitplot systeem	0,00%	46,15%	15,38%	38,46%	0,00%
7	De informatielagen in het sitplot systeem waren te gedetailleerd om te gebruiken voor de oefening	0,00%	21,43%	28,57%	50,00%	0,00%
8	Er waren informatielagen in het sitplot systeem die niet gedetailleerd genoeg waren om te gebruiken voor de oefening	14,29%	28,57%	21,43%	35,71%	0,00%
9	Het sitplot systeem biedt de informatie die ik nodig heb voor het uitvoeren van mijn taak	25,00%	58,33%	16,67%	0,00%	0,00%
10	Ik kan me voorstellen dat ik sommige gegevens in het sitplot systeem nooit bij een calamiteit zou gebruiken	21,43%	42,86%	7,14%	28,57%	0,00%
11	De in het sitplot aangeboden informatie is te gedateerd voor het uitvoeren van mijn taken	7,69%	46,15%	23,08%	23,08%	0,00%

12	Ik vertrouw erop dat het sitplot systeem de juiste informatie bevat	13,33%	53,33%	20,00%	13,33%	0,00%
13	Ik vertrouw erop dat bewerkingen van het sitplot de juiste informatie opleveren	13,33%	53,33%	26,76%	6,67%	0,00%
		ja	nee	weet niet		
14	Hebben alleen geautoriseerde gebruikers toegang tot de geografische informatie?	60,00%	13,33%	26,67%		
15	Hebben alle gebruikers op hetzelfde moment toegang tot de geografische informatie?	53,33%	13,33%	33,33%		
16	Is de geografische informatie in het systeem te traceren naar de bron?	28,57%	28,57%	42,86%		
		voldoende	neutraal	onvoldoende		
17	Is er voldoende samenhang tussen de verschillende systemen (bijv. tussen sitplot en sitrap) en de inhoud van de systemen?	53,33%	33,33%	13,33%		
18	In welke mate is de geografische data, informatie en eventueel kennis in het systeem valide en betrouwbaar?	35,71%	50,00%	14,29%		

Reach

		ja	nee	weet niet
19	Is de communicatie over en weer tussen de actoren in het ROT veranderd door de invoering van het vernieuwde sitplot systeem?	86,67%	0,00%	13,33%
20	Is de communicatie over en weer tussen de actoren in het ROT veranderd door de invoering van het vernieuwde sitrap systeem?	86,67%	0,00%	13,33%
21	Is de kwaliteit van communicatie verbeterd door de invoering van het vernieuwde sitrap systeem?	60,00%	20,00%	20,00%
22	Is de kwaliteit van de communicatie verbeterd door de invoering van het vernieuwde sitplot systeem?	64,29%	21,43%	14,29%
23	Wordt informatie voldoende gedeeld binnen de eigen sectie?	76,92%	15,38%	7,69%
24	Wordt informatie voldoende gedeeld met andere secties?	64,29%	21,43%	14,29%

25	Wordt informatie sneller gedeeld door de invoering van het nieuwe systeem voor sitraps?	76,92%	23,08%	0,00%
26	Wordt informatie sneller gedeeld door de invoering van het nieuwe systeem voor sitplots?	57,14%	28,57%	14,29%
27	Is informatie sneller beschikbaar door het nieuwe sitplot systeem?	78,57%	7,14%	14,29%
28	Is informatie sneller beschikbaar door het nieuwe sitrap systeem?	71,43%	7,14%	21,43%

Stellingen

		Zeer eens	Eens	Neutraal	Oneens	Zeer oneens
29	Het sitplot systeem zal de communicatie tussen u en uw sectiegenoten ondersteunen	26,67%	66,67%	6,67%	0,00%	0,00%
30	Het sitplot systeem zal de communicatie tussen uw sectie en andere secties ondersteunen	13,33%	66,67%	13,33%	0,00%	0,00%
31	Het sitplot systeem zal het te volgen aantal procedures verkleinen	0,00%	33,33%	26,76%	40,00%	0,00%
32	Het sitplot systeem zal procedures vereenvoudigen	0,00%	42,86%	28,57%	28,57%	0,00%
33	Het sitplot systeem zal het aantal verantwoordelijkheden van uw sectie verminderen	13,33%	6,67%	26,67%	26,67%	26,67%
34	Het sitplot systeem zal het eenvoudiger maken om beslissingen te nemen	6,67%	73,33%	13,33%	6,67%	0,00%
35	Het sitplot systeem zal uw sectie helpen betere beslissingen te maken	20,00%	73,33%	6,67%	0,00%	0,00%

TAM SITPLOT

	Bruikbaarheid	Zeer eens	Eens	Neutraal	Oneens	Zeer oneens
36	Mijn werk is complexer zonder het sitplot systeem,	14,29%	28,57%	14,29%	21,43%	21,43%
37	Door het sitplot systeem heb ik meer controle over mijn werk.	21,43%	42,86%	28,57%	7,14%	0,00%
38	Het sitplot systeem voldoet aan mijn taak-gerelateerde behoeftes.	21,43%	28,57%	35,71%	14,29%	0,00%
39	Het sitplot systeem bespaart me tijd.	7,14%	50,00%	7,14%	28,57%	0,00%
40	Door het sitplot systeem kan ik meer werk verrichten in dezelfde tijd.	0,00%	35,29%	52,94%	11,76%	0,00%

41	Het sitplot systeem verbetert de kwaliteit van mijn werk.	21,43%	50,00%	28,57%	0,00%	0,00%
42	Over het algemeen vind ik het sitplot systeem bruikbaar in mijn werk.	14,29%	64,29%	21,43%	0,00%	0,00%
43	Door het sitplot systeem kan ik meer verrichten in dezelfde tijd	7,14%	42,86%	14,29%	21,43%	7,14%
	Gebruiksvriendelijkheid					
44	Het sitplot systeem vind ik vaak verwarringend.	7,14%	21,43%	0,00%	35,71%	35,71%
45	Ik maak vaak fouten als ik het sitplot systeem gebruik	7,69%	23,08%	15,38%	53,85%	0,00%
46	Het sitplot systeem frustreert me vaak.	7,14%	21,43%	14,29%	50,00%	7,14%
	Ik heb nog ondersteuning nodig bij het werken met het sitplot systeem (via handleidingen, help functie of coach)	14,29%	42,86%	14,29%	14,89%	7,14%
48	Het vergt veel energie van mijzelf om met het sitplot systeem te leren werken.	0,00%	42,86%	7,14%	35,71%	14,29%
49	Het sitplot systeem is flexibel.	21,43%	28,57%	50,00%	0,00%	0,00%
50	Het sitplot systeem doet wat ik vraag.	7,14%	42,86%	28,57%	7,14%	7,14%
51	Het sitplot systeem gedraagt zich vaak onverwachts.	14,29%	7,14%	35,71%	35,71%	7,14%
52	Het sitplot systeem is makkelijk te begrijpen.	14,29%	42,86%	28,57%	7,14%	7,14%
	Met sitplot systeem heb ik een goed overzicht van de taken die mij te doen staan.	7,14%	42,86%	21,43%	28,57%	0,00%
54	Over het algemeen vind ik het sitplot systeem gebruiksvriendelijk.	7,14%	57,14%	14,29%	14,29%	7,14%

Appendix 6: Results questionnaire Eagleone_2

	Aantal		
Politie	3	18,75%	15,00%
Brandweer	8	50,00%	40,00%
GHOR	2	12,50%	10,00%
Gemeente	2	12,50%	10,00%
Anders	1	6,25%	5,00%
Onbekend	4		20,00%
Totaal	20	100,00%	100,00%

Shared Situational Awareness

		Zeer eens	Eens	Neutraal	Oneens	Zeer oneens
3	Er waren tijdens de oefening situaties waarin ik te weinig informatie had om mijn taken te volbrengen	5,56%	11,11%	11,11%	55,56%	16,67%
4	Doordat de informatie op kaarten gedeeld werd kon ik sneller keuzes maken	5,56%	50,00%	38,89%	5,56%	0,00%
5	Er waren tijdens de oefening situaties waarin ik teveel informatie had om goede keuzes te maken	6,25%	18,75%	18,75%	56,25%	0,00%
6	Mijn sectieleden hadden dezelfde informatie als ik had	11,11%	61,11%	22,22%	5,65%	0,00%
7	Ik had tijdens de oefening een beter beeld kunnen hebben van wat er in het veld gebeurde	5,56%	16,67%	16,67%	61,11%	0,00%
8	Doordat de informatie op kaarten gedeeld werd had ik een beter beeld van de situatie	17,65%	70,59%	11,76%	0,00%	0,00%
9	Andere ROT-secties deelde de informatie die ik nodig had met mij	0,00%	64,71%	35,29%	0,00%	0,00%
10	Mijn sectieleden deelden de informatie die ik nodig had met mij	5,88%	88,24%	5,88%	0,00%	0,00%
11	Andere ROT-secties hadden hetzelfde beeld als ik had	5,56%	50,00%	27,78%	16,67%	0,00%
12	Ik had de Plv OL niet beter in kunnen lichten	5,88%	70,59%	23,53%	0,00%	0,00%
13	Door de sitplots en siteksten had ik een beter beeld van de situatie ter plekke	5,56%	77,78%	11,11%	5,56%	0,00%

TAM SITEKST

	Bruikbaarheid	Zeer eens	Eens	Neutraal	Oneens	Zeer oneens
14	Mijn werk is complexer zonder het sitekst systeem,	0,00%	47,06%	23,53%	29,41%	0,00%
15	Door het sitekst systeem heb ik meer controle over mijn werk.	0,00%	64,71%	35,29%	0,00%	0,00%
16	Het sitekst systeem voldoet aan mijn taak-gerelateerde behoeftes.	5,88%	64,71%	17,65%	11,76%	0,00%
17	Het sitekst systeem bespaart me tijd.	0,00%	41,18%	52,94%	5,88%	0,00%
18	Door het sitekst systeem kan ik meer werk verrichten in dezelfde tijd.	0,00%	35,29%	52,94%	11,76%	0,00%
19	Het sitekst systeem verbetert de kwaliteit van mijn werk.	5,88%	64,71%	17,65%	11,76%	0,00%
20	Over het algemeen vind ik het sitekst systeem bruikbaar in mijn werk.	0,00%	82,35%	17,65%	0,00%	0,00%
	Gebruiksvriendelijkheid					
21	Het sitekst systeem vind ik vaak verwarringend.	5,88%	17,65%	47,06%	29,41%	0,00%
22	Ik maak vaak fouten als ik het sitekst systeem gebruik	0,00%	0,00%	35,29%	64,71%	0,00%
23	Het sitekst systeem frustreert me vaak.	0,00%	29,41%	29,41%	41,18%	0,00%
24	Ik heb nog ondersteuning nodig bij het werken met het sitekst systeem (via handleidingen, help functie of coach)	0,00%	11,76%	35,29%	52,94%	0,00%
25	Het vergt veel energie van mijzelf om met het sitekst systeem te leren werken.	0,00%	11,76%	23,53%	58,82%	5,88%
26	Het sitekst systeem is flexibel.	0,00%	23,53%	47,06%	29,41%	0,00%
27	Het sitekst systeem doet wat ik vraag.	0,00%	52,94%	35,29%	11,76%	0,00%
28	Het sitekst systeem gedraagt zich vaak onverwachts.	0,00%	0,00%	11,76%	88,24%	0,00%
29	Het sitekst systeem is makkelijk te begrijpen.	5,88%	70,59%	17,65%	5,88%	0,00%
30	Met sitekst systeem heb ik een goed overzicht van de taken die mij te doen staan.	0,00%	52,94%	29,41%	17,65%	0,00%
31	Over het algemeen vind ik het sitekst systeem gebruiksvriendelijk.	5,88%	58,82%	11,76%	5,88%	17,65%

Appendix 7: Results CTEF instrument

Item	Respondent						Respondent				
	N.V.T.	1	4	5	8	9	1	4	5	8	9
Onzekerheid m.b.t. de situatie <i>Missen van informatie van en over objecten of begrip over objecten en hun eigenschappen in de omgeving</i>		3	X	2	2	2	0	X	0	0	-1
Onzekerheid m.b.t. de verkregen informatie <i>Is de verkregen informatie valide?</i>		3	4	2	4	3	0	1	0	1	0
Onzekerheid m.b.t. de afloop van de situatie <i>Is er voldoende informatie bekend over de situatie om een gewogen oordeel te kunnen maken?</i>		3	4	4	3	4	0	1	1	0	-1
Onzekerheid m.b.t. de benodigde middelen <i>Hoeveel personeel is benodigd en is dit beschikbaar? Beschikbaarheid van speciale hulpmiddelen? Is er voldoende personeel en speciale hulpmiddelen beschikbaar?</i>		2	3	3	4	2	1	0	0	1	0
Onzekerheid m.b.t. het gebruik van de middelen <i>Zijn er externe factoren die de inzet van de benodigde middelen kunnen beïnvloeden, zoals logistieke problemen?</i>		4	2	2	2	4	0	0	1	0	-1
Stress			X	3	X	3		X	0	X	0
Gevaar <i>Lopen hulpverleners fysieke risico's door de aard van de ramp?</i>		5	1	3	1	3	0	0	0	0	0
Intensiteit van de rampenbestrijding <i>Zijn hulpverleners blootgesteld aan tijdsdruk, slaaptekort en/of een overvloed aan informatie?</i>		4	4	3	2	4	-1	-1	0	0	-1
Psychologische factoren <i>Zijn de rampenbestrijders onder invloed van persoonlijke of interpersoonlijke problemen? Wat is de waarschijnlijke mentale</i>		3	2	3	X	2	-1	1	0	X	0

<i>impact van de operatie?</i>											
Randvoorwaarden en beperkende factoren <i>Zijn er externe factoren die de bewegingsvrijheid van de in het veld aanwezig teams negatief beïnvloeden?</i>	4	x	1	2	3	0	x	1	0	0	0
Omgevingsfactoren <i>Wat is de invloed van terrein, weer, gevaarlijke stoffen en evt. ziekten?</i>	4	3	3	1	5	-1	1	0	0	-1	
Politieke factoren <i>Zijn er wetten die de rampenbestrijding in de weg staan? Zijn er eventueel lokaal beperkende regels?</i>	1	4	3	1	3	1	-1	0	0	0	0
Culturele factoren <i>Wat is de invloed van lokale religie, gebruiken en hoe is de samenwerking met ketenpartners?</i>	3	3	3	1	1	0	0	0	0	X	
Media <i>Wat is de lokale, nationale en internationale perceptie op de ramp en de bestrijding ervan?</i>	5	4	3	1	4	0	1	0	0	0	0
Tijd/ruimte factoren <i>Hoe worden acties in ruimte en tijd gemanaged?</i>	5	3	4	4	5	0	0	-1	0	0	0
Belangen <i>Wat is de korte en lange termijn consequentie van het eindresultaat?</i>			X	4	X	2		X	1	X	0
Slachtoffers <i>IS er sprake van gewonde of gedode hulpverleners en burgers?</i>	5	4	4	X	1	0	-1	-1	X	0	
Nationale impact <i>Wat is de politieke, economische en publieke perceptie op de beslissingen genomen tijdens het bestrijden van de ramp?</i>	5	?	3	X	4	-1	?	0	X	1	
Internationale impact <i>Wat is de politieke, economische en publieke perceptie op de beslissingen genomen tijdens het bestrijden van de ramp?</i>	3	?	3	X	1	0	?	0	X	0	
Score MISSIE											

TAAK

Dit deel van de questionnaire beschrijft de kerntaken van het rampenbestrijdingsteam. De focus ligt op aspecten die direct van invloed zijn op de processen en het resultaat.

Item	Respondent						Respondent					
	N.V.T.	1	4	5	8	9	1	4	5	8	9	
Complexiteit van de taak		4	X	3	4	4	2	X	0	0	0	
Moeilijkheidsgraad van de taak <i>Wat is de cognitieve en fysieke belasting van de subtaken die ieder teamlid uitvoert?</i>		4	4	3	3	X	1	0	0	0	X	
Aantal subtaken <i>Worden subtaken parallel of in serie uitgevoerd?</i>		4	X	4	3	3	2	X	1	0	0	
Afhankelijkheid van de subtaken <i>Zijn de subtaken gerelateerd aan elkaar en zo ja in welke mate?</i>		5	4	4	4	5	2	0	1	1	2	
Invloed van subtaken op elkaar <i>Wat is de potentiële invloed van een subtaak of subtaken op de uitvoering van andere subtaken</i>		5	4	4	4	4	2	-1	1	1	2	
Werkdruk <i>Werkdruk is gerelateerd aan de eisen die van buitenaf gesteld worden aan de huidige situatie</i>		5	X	3	X	4	-1	X	0	X	1	
Fysieke werkdruk <i>Speelde vermoeidheid een rol bij het beoordelen van de situatie en en het nemen van beslissingen?</i>		3	4	1	X	3	-1	-1	0	0	-1	
Cognitieve werkdruk <i>De taak kan te complex worden door information overload of doordat het team teveel gedachtesprongen moet maken</i>		4	5	1	3	3	-1	-2	0	0	0	
Emotionele werkdruk <i>Zijn er conflictsituaties binnen het team ontstaan uit de emotionele impact die beslissingen kunnen hebben?</i>		2	2	1	2	2	0	0	0	0	-1	
Tijdsdruk <i>Moesten er teveel taken in een te korte tijd worden uitgevoerd?</i>		4	3	3	3	4	0	-1	0	0	-1	
Onduidelijkheid over het doel <i>Mate waarin het team begrijpt wat het doel en de</i>		5	4	1	3	5	2	1	0	0	2	

<i>prioriteiten zijn</i>											
Zijn de gestelde doelen stabiel door de tijd?	4	3	4	3	4	1	0	0	0	0	0
<i>Als de gestelde doelen stabiel zijn, kan het team zijn activiteiten op een te voorspellen manier managen</i>											
Score TAAK											

ORGANISATIE

Dit deel van de questionnaire focust zich op de organisatie in de breedste zin van het woord. De organisatie kan een positieve of negatieve uitwerking hebben op de manier waarop het team functioneert.

Item	Respondent						Respondent				
	N.V.T.	1	4	5	8	9	1	4	5	8	9
Overeenkomst tussen missie van het team en het doel van de organisatie <i>Is er een fit tussen de doelen van het team en het doel van de organisatie?</i>		5	4	4	X	5	2	1	1	X	2
Duidelijkheid over de commandostructuur <i>Is het duidelijk wie geautoriseerd is voor het geven van opdrachten aan het team?</i>		5	4	4	3	5	2	1	1	0	2
Zelfstandigheid <i>Heeft het team het mandaat/vrijheid om tot een bepaalde hoogte zelfstandig beslissingen te nemen?</i>		4	4	5	4	4	2	1	2	1	1
Steun van de organisatie <i>Wordt het team dat de missie moet uitvoeren voldoende gesteund door de organisatie?</i>		4	4	4	4	5	2	1	1	1	2
Erkenning <i>Is er waardering voor wat een persoon of het team heeft gedaan en doet?</i>		4	2	4	4	5	1	0	1	1	2
Steer <i>Is de organisatie in staat het team fouten te vergeven en deze te zien als leermomenten?</i>		3	3	4	4	4	-1	0	1	1	1
Materieel <i>Krijgt het team de middelen die het nodig heeft om de taak uit te voeren op een efficiënte en effectieve manier. Worden de middelen zowel voor als tijdens de missie/taak toegewezen?</i>		4	3	4	4	4	1	0	1	1	1
Score ORGANISATIE											

LEIDERSCHAP

Een goede leider heeft een positieve invloed op de resultaten van het team. De leider draagt de taak van het team over aan de teamleden, stuurt de teamleden aan en beïnvloedt hen bij de uitvoering van hun taak. De leider is ook verantwoordelijk voor de communicatie met het hogere niveau. De focus in dit deel van de questionnaire ligt bij de capaciteiten van de leider en niet hoe hij of zij haar taak uitvoert.

Item	Respondent						Respondent				
	N.V.T.	1	4	5	8	9	1	4	5	8	9
Leiderschapsvaardigheden <i>Focus op de vaardigheden die benodigd zijn om een multidisciplinair rampenbestrijdingsteam te leiden.</i>		4	X	4	4	4	1	X	1	0	1
Tactische vaardigheden <i>Heeft de leider (i.c. plv OL) de benodigde vaardigheden om tactische problemen op te lossen?</i>		4	4	4	4	4	2	1	1	1	1
Technische vaardigheden <i>Heeft de leider de benodigde expertise om alle taken uit te voeren?</i>		4	4	3	4	4	1	1	0	1	1
Sociale vaardigheden <i>Is de leider in staat om de teamleden te coachen en te motiveren? Kan hij/zij conflicten oplossen? Is de leider in staat om het team te laten leren? Is de leider in staat het team zoveel zelfvertrouwen te geven dat taken als vanzelf uitgevoerd worden?</i>		4	3	3	X	4	1	0	0	X	1
Cognitieve vaardigheden <i>Is de leider in staat om creatief te denken en heeft de leider analytisch vermogen?</i>		4	4	3	X	4	1	1	0	X	1
Kennis <i>Heeft de leider voldoende kennis om het team de missie te laten volbrengen.</i>		4	5	4	4	4	1	1	1	1	1
Kennis m.b.t. de uit te voeren taken <i>Heeft de leider voldoende kennis en ervaring over de door het ROT uit te voeren taken?</i>		5	5	4	4	4	2	1	1	0	1
Kennis m.b.t. het team <i>Kent de leider de zwakke en sterke punten van zijn eigen team, de teamleden en de cultuur van het team?</i>		4	4	3	2	4	1	0	0	0	1

Kennis m.b.t. de organisatie <i>Kent de leider de organisatie (het grotere geheel) voldoende en heeft de leider de juiste contacten om pgelegde beperkingen te kunnen opheffen?</i>		4	5	4	3	4	1	1	1	0	1
Overeenkomst tussen persoonlijke doelen en organisatie doelen <i>Hoe groter de overeenkomst, hoe beter het resultaat van het team, omdat de leider beter gemotiveerd is.</i>		5	3	4	X	4	1	0	1	X	1
Score LEIDERSCHAP											

TEAMLEDEN

Competenties van teamleden hebben een grote invloed op de effectiviteit van een team.

Item	Respondent						Respondent				
	N.V.T.	1	4	5	8	9	1	4	5	8	9
Vaardigheden <i>Focus op de vaardigheden die teamleden moeten bezitten/beheersen om hun taken in teamverband te kunnen uitvoeren.</i>		4	X	3	X	3	1	X	1	X	1
Tactische vaardigheden <i>Hebben de individuele teamleden de capaciteiten om toekomstige taken te kunnen onderkennen en plannen?</i>		4	4	4	4	3	1	1	1	1	1
Technische vaardigheden <i>Hebben de individuele teamleden de capaciteiten om vereiste taken uit te voeren?</i>		4	3	4	3	3	1	0	1	1	1
Sociale vaardigheden <i>Kunnen de individuele teamleden samenwerken en communiceren met anderen binnen en buiten het team?</i>		4	4	4	3	3	1	1	1	0	1
Cognitieve vaardigheden <i>Vaardigheden op het gebied van kritisch denken, probleemoplossend vermogen, besluitvaardigheid en het kunnen vormen van een mentaal model</i>		4	3	3	3	3	1	0	0	0	1
Kennis <i>Kennis doelt op de vereiste informatie, wijsheid en ervaring die een teamlid bezit</i>		4	X	3	X	3	1	X	0	X	1
Kennis m.b.t. de uit te voeren taken <i>De informatie, wijsheid en ervaring van de individuele teamleden over de te volbrengen taak</i>		4	4	3	4	3	1	1	0	1	1
Kennis m.b.t. het team <i>Kennen de individuele teamleden de zwakke en sterke punten van zijn eigen team, de teamleden en de (ongeschreven) teamcultuur?</i>		4	3	4	X	3	1	0	1	X	1
Kennis m.b.t. de organisatie <i>Zijn de individuele teamleden voldoende bekend met de grotere organisatie waarin ze als team opereren (hierarchie, informatiesysteem, cultuur)?</i>		4	4	4	3	3	1	1	1	0	0

Overeenkomst tussen persoonlijke doelen en organisatie doelen		5	3	5	3	3	1	0	1	0	0
<i>Hebben de organisatie en de individuele teamleden een gezamenlijk doel om naar toe te werken?</i>											
Score TEAMLEDEN											

TEAM

In dit deel van de questionnaire wordt ingegaan op de aspecten van het team, die een mogelijk effect zouden kunnen hebben op de effectiviteit.

Item	Respondent						Respondent				
	N.V.T.	1	4	5	8	9	1	4	5	8	9
Samenstelling <i>Focus op de in het team aanwezige personen en persoonlijkheden.</i>		X	X	4	3	4	X	X	1	0	1
Vaardigheden <i>Zijn de vaardigheden benodigd voor het volbrengen van de taak evenredig verdeeld over het team?</i>		4	2	3	3	4	1	-1	0	1	1
Demografische eigenschappen <i>Is de mix van leeftijd, geslacht, etniciteit en culturele verschillen de juiste om het team optimaal te laten presteren?</i>		X	2	3	4	4	X	-1	0	1	1
Mix van persoonseigenschappen <i>De persoonseigenschappen bepalen hoe individuen in een team samenwerken en hoe ze presteren.</i>		4	4	3	3	4	1	1	0	0	1
Stabiliteit van team samenstelling gedurende een bepaalde tijd <i>Hoe langer een team bij elkaar is, des te beter zullen de teamleden elkaar vertrouwen en kennen. Hierdoor zal de effectiviteit van het team toenemen.</i>		4	4	4	X	4	1	1	1	X	1
Grootte <i>Is het aantal individuen die deel uitmaken van het team voldoende om de opgelegde taken goed uit te voeren?</i>		4	2	3	3	4	1	-1	0	0	1
Architectuur <i>Teamarchitectuur verwijst naar de organisatie en verdeling van subtaken en rollen en op welke wijze deze met elkaar samen hangen.</i>		4	4	4	3	4	1	1	1	0	1
Fysieke afstand <i>Werken de teamleden bij elkaar op een locatie, in een ruimte of zijn de geografisch verspreid over verschillende locaties?</i>		5	4	4	4	3	2	1	1	0	-1
Verdeling van taken <i>Zijn de taken toegewezen aan de personen met de juiste</i>		5	3	4	4	3	2	0	1	1	1

<i>expertise?</i>											
Volwassenheid <i>Hoe lang heeft een team al samengewerkt? De volwassenheid van een team kan afgemeten worden aan: zelfsturend, aanpassen aan omstandigheden, inschatten van behoefte van andere teamleden.</i>	3	4	2	2	3	0	1	0	0	0	1
Overeenkomst tussen team doelen en organisatie doelen <i>Zijn de doelen voor het team duidelijk en wat is de awareness voor deze doelen. Heeft het team de doelen geaccepteerd en heeft het team de intentie om de gestelde doelen te halen.</i>	4	3	4	4	4	1	0	1	1	2	
Score TEAM											

TAAK GEORIENTEERD GEDRAG

In dit deel van de questionnaire wordt gekeken naar de processen gericht op het uitvoeren van de taak.

Item	Respondent						Respondent				
	N.V.T.	1	4	5	8	9	1	4	5	8	9
Informatiemanagement <i>Op welke wijze wordt er met informatie en kennis omgegaan door/binnen het team?</i>		4	4	4	4	4	1	1	1	1	2
Verkrijgen van informatie <i>Wordt er actief gezocht/verzocht om informatie door het uitzetten van vragen?</i>		4	4	4	4	4	1	1	1	1	1
Verwerken van informatie <i>Wordt de verkregen informatie gebruikt en geïntegreerd met de al bestaande/bekende informatie?</i>		4	5	4	4	4	1	2	1	1	1
Uitwisselen van informatie <i>Wat is de tijdigheid, correctheid en compleetheid van de verkregen informatie?</i>		3	4	4	3	4	1	1	1	0	1
Beoordelen van de situatie <i>Bestaat er een volledig begrip van de situatie tijdens het bestrijden van de ramp?</i>		3	4	4	4	4	0	1	1	1	1
Besluitvorming <i>De effectiviteit van besluitvorming wordt gedefinieerd door de kwaliteit van de besluiten en de efficiency waarmee de besluiten genomen worden</i>		4	X	4	3	5	1	X	1	0	2
Probleemdefinitie <i>Is het team in staat om een goede probleemdefinitie te formuleren?</i>		4	4	4	4	3	1	1	1	1	0
Time management <i>Is er genoeg tijd om een gewogen besluit te nemen, of is de tijdsdruk dusdanig dat alleen voor snelle, praktisch uitvoerbare oplossingen wordt gekozen?</i>		3	3	4	4	3	0	0	1	1	0
Evaluatie van opties en resultaten <i>Worden de mogelijke oplossingen systematisch geanalyseerd?</i>		3	4	3	3	3	1	1	0	0	0
Planning		4	X	4	3	4	1	X	1	0	1

Focus op het proces waarbij de acties worden bepaald om het gestelde teamdoel te bereiken.											
Anticiperen <i>Wordt er geanticipeerd op mogelijke taken en gebeurtenissen in de toekomst?</i>		4	4	4	4	4	1	1	1	1	1
Rooster <i>Wordt er een planning gemaakt van benodigd personeel, materieel gerelateerd aan tijd?</i>	X	2	3	4	3	X	-1	0	0	0	0
Strategie <i>Is er een specifieke aanpak om het doel te bereiken (procedures, beleid,...)?</i>	4	4	4	4	3	2	1	1	1	1	0
Bevelvoering	X	X	4	X	4	X	X	1	X	2	
Organisatievermogen <i>Hoe implementeert het team het voorgenomen plan?</i>	4	4	4	4	4	0	1	1	0	2	
Management <i>Wordt het team dusdanig aangestuurd dat het de taak tot een succesvol einde kan brengen?</i>	4	4	4	4	4	1	1	1	1	1	2
Voortgang <i>Worden tussendoelen en doelstelling geformuleerd en wordt ook in de gaten gehouden of deze worden gehaald?</i>	4	2	4	3	2	1	-1	1	0	-1	
Contacten met andere teams <i>Contacten met andere teams kunnen zorgen voor nieuwe informatiestromen, nieuwe samenwerkingsverbanden en uitwisseling van kennis.</i>	4	4	4	4	3	0	1	1	1	0	
Score TAAK GEORIENTEERD GEDRAG											

TEAM GEORIENTEERD GEDRAG

In dit deel van de questionnaire wordt gekeken naar de processen gericht op het functioneren van het team

Item	Respondent						Respondent				
	N.V.T.	1	4	5	8	9	1	4	5	8	9
Visie <i>Bepalen en in stand houden van richting en (hogere) doel van het team. Vaak een functie van de teamleider.</i>		4	X	3	3	4	1	X	0	0	1
Intentie <i>Is gericht op het in stand houden van het gedeelde mentale beeld van gestelde doelen en hoe deze te bereiken.</i>		4	X	4	3	4	2	X	0	0	1
Communicatie binnen het team		X	X	4	4	2	1	X	1	1	-1
Communicatie <i>Wordt er positief gecommuniceerd binnen het team?</i>		4	4	4	4	3	1	1	1	1	0
Coordinatie <i>Worden subtaken die verschillende teamleden uitvoeren gecoördineerd om conflicten en dubbele uitvoer van taken te voorkomen?</i>		3	4	4	4	2	0	1	1	1	-1
Terugkoppeling <i>Wordt binnen het team advies gegeven over hoe de efficiency, effectiviteit en prestatie verbeterd kunnen worden?</i>		2	3	4	3	2	-1	0	1	0	-1
Motiveren <i>Het proces om richting, intensiteit en doorzettingsvermogen te beïnvloeden.</i>		4	X	3	3	4	X	X	0	0	1
Extrinsiek <i>Het belonen en stimuleren van goede prestaties d.m.v. gratificaties</i>		X	X	3	X	3	X	X	0	X	0
Intrinsiek <i>Inspireren van teamleden om de interesse in het werk en de taken te verdiepen door het instellen van een mentorfunctie of ontwikkeling.</i>		X	4	3	X	3	X	1	0	X	0

Aanpassing <i>In hoeverre veranderen teamleden hun gedrag en relatie met andere teamleden als gevolg van veranderingen in de omgeving of in het team</i>		X	4	3	X	3	X	1	0	X	0
Monitoren <i>Teamleden observeren en beoordelen zichzelf en elkaars prestaties, met als doel de prestaties te verbeteren.</i>		3	3	3	X	3	1	0	0	X	0
Corrigeren <i>Het geven van feedback of begeleiding om de uitvoering van taken te verbeteren</i>		3	2	3	3	2	1	-1	0	0	-1
Geven van back-up <i>Het steunen van teamleden door compensatie, b.v. het overnemen van taken.</i>		3	4	3	X	1	0	1	1	0	-1
Team building <i>Gericht op acties om het team bij elkaar te houden</i>		X	X	4	X	1	X	X	1	X	-1
Sociale steun <i>Gericht op het vormen van een buffer tegen stress. Binding en loyaliteit met andere teamleden wordt groter.</i>		X	4	3	X	2	X	1	0	X	-1
Reguleren van emoties <i>Beïnvloeden van emoties of het onderhouden van de balans tussen teamleden.</i>		X	2	3	X	3	X	0	0	X	0
Ontwikkelen en onderhouden van de teamband <i>Is er solidariteit en/of teamgeest?</i>		X	4	4	3	2	X	1	1	0	-1
Conflict management <i>Op welke wijze worden binnen het team conflicten opgelost.</i>		3	?	3	X	3	1	?	0	X	0
Score TEAM GEORIENTEERD GEDRAG											

TAAK RESULTAAT

Het resultaat is een belangrijke indicatie of het team de gestelde doelen heeft gehaald.

Item	Respondent						Respondent				
	N.V.T.	1	4	5	8	9	1	4	5	8	9
Tussendoelen <i>Focus op de tijd, welke doelen zijn gehaald en wat moet er nog gebeuren om alle einddoelen te halen</i>		4	4	4	4	3	1	1	1	1	0
Zijn de door de stakeholder (GBT, RBT) gestelde criteria gehaald?		4	4	4	4	3	1	0	1	1	0
Zijn eventueel andere stakeholders tevreden met het (te verwachten) resultaat?		4	X	4	3	4	1	X	1	0	1
Is het team bij de uitvoering van de taak binnen de gestelde regels en grenzen gebleven?		5	4	4	4	4	1	1	0	1	1
Einddoel <i>Heeft het team als de opdracht is voltooid of de deadline is verstreken de gestelde doelen gehaald?</i>		X	3	4	3	2	X	0	1	0	0
Zijn de door de stakeholder gestelde criteria gehaald?		4	4	4	3	2	0	1	1	0	-1
Zijn eventueel andere stakeholders tevreden met het (te verwachten) resultaat?		4	X	4	3	3	0	X	1	0	0
Is het team bij de uitvoering van de taak binnen de gestelde regels en grenzen gebleven?		4	4	3	4	3	0	1	0	0	0
Score TAAK RESULTAAT											

TEAM RESULTAAT

Het resultaat is een belangrijke indicatie of het team de gestelde doelen heeft gehaald.

Item	Respondent						Respondent				
	N.V.T.	1	4	5	8	9	1	4	5	8	9
Wederzijds vertrouwen <i>Wederzijds vertrouwen kan gebaseerd zijn op langdurige samenwerking (persoon) of op het herkennen van bepaalde persoonseigenschappen (categorie)</i>		4	4	5	4	4	2	1	2	1	1
Moraal <i>Enthousiasme en doorzettingsvermogen van groepsleden om deel te nemen aan het groepsproces</i>		4	3	5	4	4	2	0	2	1	1
Binding <i>Binding in het team is nauw gerelateerd aan team prestaties</i>		4	4	4	3	4	1	1	1	0	1
Collectief vertrouwen <i>Vertrouwen zorgt voor collectieve kracht waardoor het team effectief gaat presteren</i>		3	3	5	3	4	1	0	2	0	1
Gedeelde visie <i>Een gedeeld beeld van de intentie van de leider zorgt ervoor dat de intenties worden gehaald en dat het team beter presteert</i>		4	3	4	3	4	1	0	1	0	1
Wederzijds respect <i>Teamleden proberen elkaar te begrijpen ondanks de onderlinge verschillen. Respect heeft een positieve invloed op de effectiviteit.</i>		4	4	5	3	4	2	1	2	0	1
Score TEAM RESULTAAT											