Collaboration awareness – a necessity in crisis response coordination

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ABSTRACT

In crisis management involvement of a large number of organizations is required. Not only the first responders need to take action, but also organizations and entities like civil authorities, public utility and crisis teams are responsible for critical infrastructures as well as the community. A key element for effective collaboration is situation awareness; having a common operational picture. So far research has mainly focused on situation awareness. However, several incidents show that situation awareness alone is not sufficient for reaching effective collaboration among the organizations involved. Collaboration awareness is a second key element. Knowing the needs, goals, expectations, culture, capabilities and procedures of the crisis management partners makes collaboration more effective. In this paper we elaborate our research focusing on what organizations need to know about each other in order to collaborate effectively. Finally, we describe the possible measures for increasing the collaboration awareness.

Collaboration, situation awareness, collaboration awareness, crisis partners, networked organization

INTRODUCTION

An airplane crash, flooding, a shooting incident, a car accident or even a small fire… These days a safety incident, regardless of the extent, requires the effort of multiple organizations. Besides the traditional first responders (e.g. firemen, policemen, medical workers) a number of other crisis partners is required to be involved. Consider for example the chemical fire incident in Moerdijk, the Netherlands on the 5th and 6th of January 2011 [1]. A complex mixture of chemical substances was on fire in an industrial zone next to a port area. The smoke and the polluted fire extinguishing water had many environmental and societal consequences, that required the involvement of a broad set of organizations.

First there were the primary emergency services such as the regionalized police, emergency medical services, fire department and the municipalities of and around the municipality of Moerdijk [2]. Next to the regional fire department, also the air force fire fighters and private fire companies provided specialized support.

Second, also other public organization had an interest in the response efforts, such as the port authority Moerdijk as well as the Water Board Brabantse Delta, Rijkswaterstaat (Directorate General for Public Works and Water Management) –the executive arm of the Dutch Ministry of Infrastructure and the Environment– and ProRail that is responsible for the Dutch railways. Furthermore several regional broadcast organizations were gathering information and broadcasting at the scene.

Third at the national level 5 ministries –including a number of executive and coordinating bodies– were involved: Safety and Justice; Defence; Health, Welfare and Sport; Infrastructure and the Environment; Economic Affairs, Agriculture and Innovation.

This example illustrates that in a densely populated and complex society, a safety incident often requires involvement of and collaboration between several tens of organizations. Research into networked collaboration has identified that the key problem in these situations is that organizations depend on each other's expertise in order to coordinate tasks, but have little authority and control over the actions of other organizations [3], [4]. An interesting characterization of this network collaboration problem is created in the work of Hayes, who uses the term endeavour [5]. An endeavour involves a large number of disparate entities whose activities are related to a

Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada, April 2012
L. Rothkrantz, J. Ristvej and Z. Franco, eds.

1

broad range of effects, including safety, social, economic, political, and informational ones. Endeavours are formed because no single actor within the collective is capable of achieving its relevant goals without appropriate activities and behaviours by others. A crucial distinction between endeavours and other types of collectives is that the actors involved in an endeavour do not have a single leader or commander.

A lot of effort has been (and is being) invested in achieving shared awareness and understanding of the situation between these organizations operating in a network. Endsley's model on situation awareness describes three levels of situation awareness [6]; -1- perception of data and the elements of the environment, -2- comprehension of the meaning and significance of the situation, and -3- projection of future states and events. Having a common operational picture is the first step in coming to shared situation awareness. Information management processes and organizations as well as supporting information systems are put in place to maintain a common operational picture and to ensure a sufficient level of situation awareness throughout the endeavour. A common operational picture and shared situation awareness are *essential* but not *sufficient* for effective collaboration. Hayes states that a number of conditions must be met to make an endeavour successful [5], including:

- Trust between and among the actors, regardless of their roles in the endeavour
- Perceptions of competence
- Interoperability (technical, semantic, and willingness to share information and knowledge)
- Shared awareness (situation characterization)
- Shared understanding (cause and effect and temporal dynamics)
- Collaboration about purposes, decisions, planning, and execution

As can already be derived from the abovementioned conditions, besides shared awareness and understanding a certain level of shared *collaboration awareness* is required as well. Collaboration awareness encompasses knowledge about the formal structures and informal ways in which organizations do work and achieve their goals [7]. Collaboration awareness should support coordination, which is the synchronization of work processes [8], in the cooperation between emergency management organizations. In order to cooperate with the partners in the endeavour a certain amount of awareness about the endeavour is necessary: knowing the other crisis partners during crisis management (including their competences) and knowing the needs, goals, expectations, cultures, capabilities and procedures of the other partners makes collaboration more effective. Research into and development of crisis management support in the Netherlands has mainly focused on shared situation awareness and a common operational picture [9]. Our research focusses on the concept of collaboration awareness. This is crucial because situation awareness refers to the level of consciousness about the environment organizations operate in, but doesn't refer to the actual state of the organizations that collaboration is required with. The concept of collaboration awareness specifically aims to express the level of consciousness about the structure and operations of other organizations.

This paper describes our ongoing research on collaboration awareness. We started with a more in-depth exploration of the concept of collaboration awareness. Secondly we studied a number of evaluation reports on Dutch safety incidents in order to find out to what extent lack of collaboration awareness causes problems. Finally, we came up with a support measure that might enhance the level of collaboration awareness in a networked organization. The structure of the paper follows these three research activities. We conclude with a description of our plans for future research and some preliminary conclusions.

COLLABORATION AWARENESS IN THEORY

Van Aart and Oomes state that the concept of collaboration awareness encompasses everything that is useful knowledge for letting the synchronized joint actions within a networked organization run efficiently and effectively. This means not only monitoring the formal structure and procedures but also showing the informal communication and coordination patterns and allowing the individual members of the organization to adapt their view on the collaboration to their needs [7]. In other words, collaboration awareness is a necessary condition for coordination, the process of interaction that integrates a collective set of interdependent tasks [8]. According to Okhuysen & Bechky studies focusing on coordination have distinguished three integrating conditions for coordination to be successful: accountability, predictability and common understanding. We use these conditions to further operationalize the relation between coordination and collaboration awareness.

Accountability addresses the question of who is responsible for specific elements of the tasks. From this perspective, crisis response in the Netherlands is set up straightforwardly. The organization responsible for a certain area is also responsible for managing crises in that area. For example, the organization responsible for management of electricity infrastructure is also responsible for managing an electricity power failure. At a more detailed level, there can be organization parts with similar capabilities, such as two fire platoons. Different tasks can be assigned to each of the platoons. It is important to explicitly state the division of responsibilities to allow an efficient allocation of tasks.

Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada, April 2012
L. Rothkrantz, J. Ristvej and Z. Franco, eds.

2

Predictability enables interdependent parties to anticipate subsequent task related activity by knowing what the elements of the task are and when they happen. In other words, the predictability condition is about work breakdown, durations and interdependencies enabling anticipation on each other's task contributions.

Common Understanding provides a shared perspective on the whole task and how individuals' work fits within the whole. In a crisis response operation the Common Operational Picture is part of this condition but also the interests and priorities of the organizations involved. The condition Common Understanding also includes the scoping of the crisis response organization, given the size, nature and effects of the incident. Which of the vital interests are threatened and what are the responsible organizations?

COLLABORATION AWARENESS IN DUTCH SAFETY INCIDENTS

In the Netherlands incident response and management are changing and the need for collaboration awareness is growing. First of all the environment of incidents is getting more and more complex; the critical infrastructures of our society are highly interrelated and interdependent. Secondly the number of actors involved during crisis management has grown. All these actors have their own tasks and responsibilities. These changes ask for a new perspective on how to collaborate in a networked setting. Incident evaluation reports show that collaboration in the incident response wasn't always adequate and not only inadequacy of situation awareness was a problem.

In October 2005 there was a fire in a detention centre at Amsterdam Airport. Eleven people were killed and fifteen people were injured. During the evaluation ([10]) it turned out that the coordination between the fire department and the detention centre had been insufficient. The emergency services of the detention centre were not aware of the fact that – given the complex approach route – the fire department wasn't able to be ready for deployment at the incident location earlier than fifteen minutes after the initial alarm.

In the introduction of this paper we referred to the chemical fire incident in Moerdijk, the Netherlands on the 5th and 6th of January 2011 ([1]). The smoke and the polluted extinguishing water had many environmental consequences and also caused societal concern in a large area. Despite of this – as a result of a lack of common understanding – there was insufficient awareness of the need for administrative coordination. One of the consequences was that the coordination of crisis communication was inadequate.

These examples show that insufficiency in situation awareness alone is not sufficient to explain the problems in crisis management. Collaboration awareness is just as important. In the next paragraph we will elaborate our view on collaboration awareness.

ELABORATION OF COLLABORATION AWARENESS

Based on safety incident evaluations, workshops and interviews we extended the theory on collaboration awareness with an indication of what should be known about the other organizations and thus what should be shared. Table 1 gives an indication of relevant aspects for each of the three conditions of coordination. Dependent on the type of incident and the organizations involved some aspects may be more relevant than others.

Table 1 – exemplification of the three conditions for coordination

Elaboration of conditions	*Examples of relevant aspects*
Accountability	
• **Roles**	tasks.
• **Responsibilities**	mandate, commitment, conditions (what is allowed and what not?).
Predictability	
• **Organizational structure**	command structures, size, span of control.
• **Dependencies**	from whom?, from what?
• **Capabilities**	bottlenecks, personnel, materiel, network, sustainability.
• **Method**	coordination needs, decision making processes way of working, processes and procedures, tactics.
• **Planning**	ordering of activities, interdependencies of tasks.
• **Actual status**	activities, availability, location, operational information progress, work load.
• **Communication**	points of contact, communication means and modalities, semantics, coordination moments, meeting times
Common Understanding	
• **Vision / mission**	ambition, goals, success / fail factors.
• **Interests**	priorities, personal interests, hidden agenda.

Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada, April 2012
L. Rothkrantz, J. Ristvej and Z. Franco, eds.

3

Elaboration of conditions	Examples of relevant aspects
• **Expectations**	with respect to collaboration and with respect to progress of work.
• **Culture**	background, values, perceptions, jargon.
• **Social aspects**	collaboration willingness / motivation, knowing each other, mutual trust, personalities.

The distinctions made in the coordination debate, between planned vs. emergent action [8] and explicit vs. implicit coordination [11], are helpful to embed the concept of collaboration awareness with the operational environment. The planned and emergent categories – the horizontal axis in figure 1 – relate to way in which coordination can be arranged upfront, or is to be regarded as an on-going process. The distinction between explicit and implicit coordination – the vertical axis in figure 1 – relates to the awareness and knowledge that actors have about coordination processes. Explicit means that

Figure 1 - Information needs necessary for collaboration awareness

it is recorded and accessible by means of documents or information systems for example. Examples are capabilities and organizational structure. Examples of implicit information items are social aspects and cultures. By relating the concept of collaboration awareness to these coordination dualisms we can identify what kind of information is used and might be necessary to increase the level of collaboration awareness.
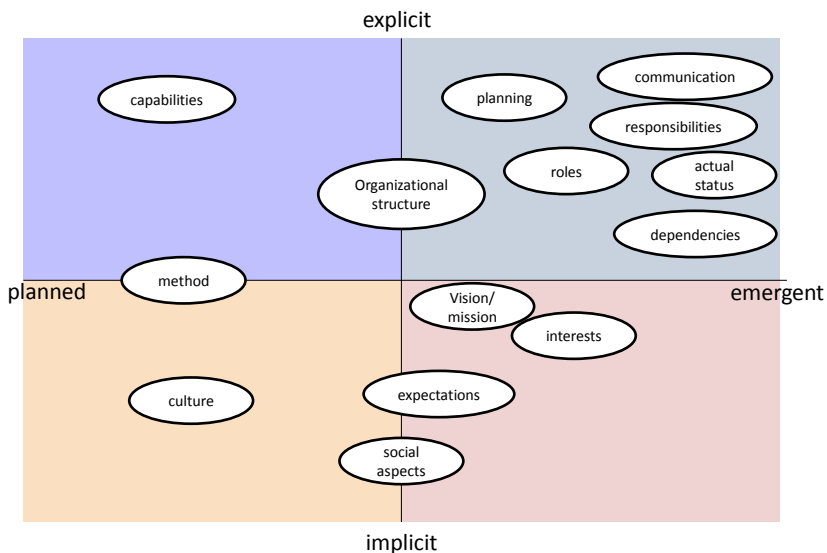
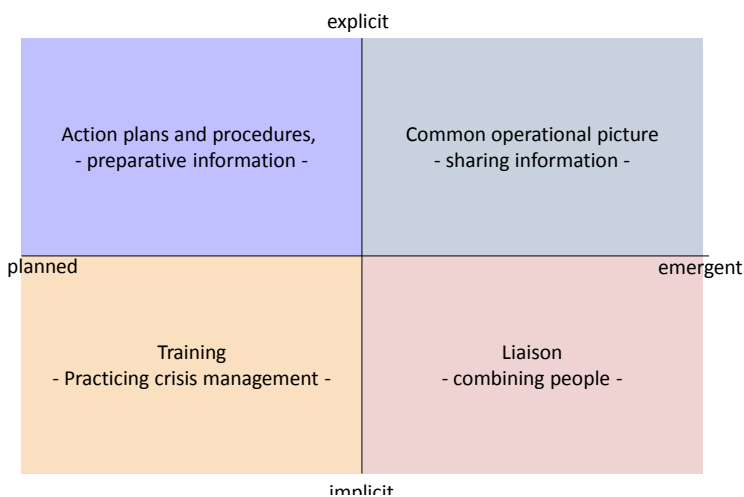## TOWARDS A SOLUTION - ONGOING RESEARCH

Figure 2 - Methods for enhancing collaboration awareness

In order to share these types of information each quadrant typically lends itself for a specific method (see Figure 2). The information needs in the upper-left quadrant can typically be supported with action plans described in written documents. In the upper-right quadrant information systems can typically be used to share dynamic information. In the lower-left quadrant collaboration in a training setting is an invaluable measure to maintain the level of collaboration awareness. In the lower-right quadrant exchange of liaisons is a typical measure.

The above-mentioned information exchange methods are not new. Most of them are well-known and frequently used. Nevertheless, inadequate

collaboration awareness appears to be problematic.

So, the next step in our research plan is to zoom in on the concept of collaboration awareness. We do this by validation and population of the three integrating conditions for coordination: accountability, predictability and common understanding. In a number of workshops with operational experts followed by one or more experiments we will find out what the minimal or typical information requirements are to achieve a satisfactory level of collaboration awareness.

Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada, April 2012
L. Rothkrantz, J. Ristvej and Z. Franco, eds.

4

In parallel we develop and iteratively try-out support measures. An idea for a support measure in the upper-right quadrant (Figure 2; explicit, emergent information) is to make use of a Dynamic Network View. This view depicts the actual networked organization, shows the interrelations, lines of command and lines of communication. An indication of the availability and status of the organizations can also be included. The view can be made 'clickable' for easy access to more details such as contact and task progress information.

CONCLUSION

This article emphasized and illustrated collaboration awareness as a necessary condition for an effective and efficient coordination during crisis response management. Based on real-life incident reports consequences of lacking collaboration awareness were illustrated. Further we related the concept of collaboration awareness to the three conditions for coordination accountability, predictability and common understanding , in order to describe what organizations at least should know about each other to be able to collaborate successfully. Additionally some typical measures to enhance the level of collaboration awareness were highlighted and the concept of a Dynamic Network View was introduced. Finally we described our plans for further research.

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Proceedings of the 9th International ISCRAM Conference – Vancouver, Canada, April 2012
L. Rothkrantz, J. Ristvej and Z. Franco, eds.

5