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Abstract

Our main concern in this article is whether nation-wide information technology (IT) infrastructures or systems in emergency response and disaster management are the solution to the communication problems the safety sector suffers from. It has been argued that implementing nation-wide IT systems will help to create shared cognition and situational awareness among relief workers. We put this claim to the test by presenting a case study on the introduction of 'netcentric work', an IT system-based platform aiming at the creation of situational awareness for professionals in the safety sector in the Netherlands. The outcome of our research is that the negotiation with relevant stakeholders by the Dutch government has lead to the emergence of several fragmented IT systems. It becomes clear that a top-down implementation strategy for a single nation-wide information system will fail because of the fragmentation of the Dutch safety sector it is supposed to be a solution to. As the US safety sector is at least as fragmented as its Dutch counterpart, this may serve as a caveat for the introduction of similar IT systems in the US.

KEYWORDS: emergency response, common operational picture, nation-wide IT system

Introduction

When a major disaster strikes, many different organizations are called to respond. The amount of distress the disaster causes creates multiple interdependencies between the involved organizations that need to be coordinated in a multi-layered governance system. Police, medical teams and fire services handle direct relief efforts, while governmental agencies and public organizations deal with tasks, such as disseminating information about the disaster to the public, arranging shelters, and taking care of administrative processes. Citizens and private organizations collaborate on an ad-hoc basis to support the relief effort. In the complex, dynamic and uncertain scenario of the disaster, the full scope of operations remains fuzzy, as new actors continue to enter the scene (Kapucu 2009). As a consequence of the distress caused by the disaster multiple uncertainties arise, such as 'what hazards are present; the precise nature of the incident; unpredictable chains of events; unexpected consequences of the incident; the potential for progressive collapse of systems; lack of clarity about other organizations' capabilities and actions; and the factors in the background of the community that may complicate the response' (Cook 2009, 4–5).

A major problem during massive relief efforts is the poor cooperation between the involved organizations: overview, adequate organizational coordination, and effective communication are often lacking. Keeping *situational awareness* and insight in the continuously changing environment is one of the toughest challenges emergency management organizations face (Gorman et al. 2006), but highly necessary: only with situational awareness—that is, a clear perception of the events and developments of a particular disaster within a particular volume of time and space (Endsley 1995) - can the first responders act adequately, work together and share relevant information with each other.

A good example of the organizational complexity is the 456 organizations involved in emergency management during the aftermath of the 9/11 WTC attacks (Comfort and Kapucu 2006). The magnitude of interactions and continuous adaptation such organizations engage in makes 'the effective mobilization of response to extreme events on a large scale one of the least understood problems in public management' (Comfort and Kapucu 2006, 311). Under the dynamic circumstances at times of disaster, emergency response organizations -characterized by a bureaucratic nature - often lack cognition and situational awareness to ensure coordination. The question is *how* the requested collaboration can be achieved, given that the amount and variety of organizations involved at the time of a disaster makes a *shared* situational awareness difficult.

One particular IT infrastructure that has been introduced in many countries - including the Netherlands - as a possible solution to shared situational awareness is *Network Enabled Capabilities* (NEC), a concept from the military (Perry et al.

2002; Fewell and Hazen 2003; Houghton et al. 2006; Houghton et al. 2008). NEC was offered as *the* new paradigm to help communication, coordination and control through offering situational awareness. Interestingly, this concept has been introduced in the civil safety sector where it is perceived to be more than just a new technology, but also a promising new way to organize information sharing practices (Von Lubitz et al. 2008; Moynihan 2009).

The idea is that netcentric work can break through the established, bureaucratic and hierarchical patterns of command and control (Moynihan 2009), by improving the exchange of information between heterogeneous actors involved in crisis and emergency management, and thus creating a common operational picture at times of incidents (Mendonça et al. 2007). In a way, netcentric work is supposed to enable networks of communication within a bureaucratic environment. It is envisaged that netcentric work, by linking individuals and their distributed networks, will—through the rapid and timely sharing of information—create widespread shared understanding of a situation that will in turn allow swifter actions based on better-informed decisions (Houghton et al. 2006). Netcentric work, in other words, is seen as a promising new way of working, enabled by a technological infrastructure, that is supposed to create situational awareness and a possibility for improving response.

The central question in this article is whether a world as fragmented as the safety sector can create the joint communication infrastructure of netcentric work that is required to enable shared situational awareness at times of disasters.

In answering this question, we focus on the likelihood of success of the Dutch Department of Interior's efforts to introduce such a joint information structure for emergency management organizations in the Netherlands. Although the Dutch case of introducing a joint information structure has some particularities, we believe it offers insights that are valuable for the international debate on creating an information infrastructure and shared situational awareness in disasters. First of all, the Dutch safety sector is complex and highly fragmented, given the fact that there are – currently – 25 safety regions each of which is, as an administrative body, responsible for the quality of the risk management and the emergency response. Secondly, as we will show in this article, new information technology (IT) infrastructures or systems have been introduced in the Netherlands in order to facilitate shared situational awareness.

In what follows, we first make an in-depth theoretical analysis of the processes of negotiation about the information infrastructure. This discussion includes a reflection upon the governmental, central actor's implementation instruments. Next, we will describe the features of the Dutch civil safety sector, and outline the technological solutions that the Department of the Interior has been trying to introduce. Finally, we end by questioning the possibility for success of imposing a (national) standard for the information infrastructure, and a plea for

a more flexible, locally rooted solution for the implementation and actual functioning of the information infrastructure.

Before we start the reader must consider that emergency management organizations have to deal with many different kinds of scenarios, such as incidents (accidents, riots, fires etc.), large public manifestations (crowd control) and disasters (natural or man-made). In the remainder of this article we will mainly refer to emergencies as an encompassing term for these different scenarios.

Implementing IT-solutions for Shared Situational Awareness

Rethinking Nation-wide Emergency Response Infrastructures

Research on the coordination problem between a large number of organizations involved in emergency response frequently identifies information technology as part of the solution; that is, technology is supposed to enable the creation of shared situational awareness. In the *Public Administration Review* special issue of December 2007, Comfort introduced a framework based on *4 C's* - Cognition, Communication, Coordination and Control - to address the need for 'a nationwide information infrastructure that would facilitate the development of a common operating picture in extreme events' (Comfort 2007, 196). Comfort states that implementing proper information technologies is the key to overcoming problems with cognition and coordination. 'Without a well-defined, functioning information infrastructure supported by appropriate technology, the collective response of a community exposed to serious threat will fail' (Comfort 2007, 196–197). In a special issue of *Information System Frontiers* on advances in multi-agency disaster management, a similar call for 'technological innovations' or 'interagency information sharing systems' as a solution to the challenges and obstacles in disaster management operations is voiced (Janssen et al. 2010, 2; Bharosa et al. 2010, 59). Also in the *Journal of Homeland Security and Emergency Management*, the need for improved situational awareness through enhanced information technology is voiced (Johnson, Zagorecki, Gelman, Comfort 2011; Kiltz and Smith 2011; Hsu, Chambers, Herbold, Calcote, Ryczak, DeFraites 2010). Not only the scientific community believes that an IT infrastructure is an important enabler for the creation of shared situational awareness at times of disaster: practitioners in the civil safety sector believe the same.

Yet, critical reflections are made as well, for example by Mendonça, Jefferson, and Harrald (2007). They fear that the demand to achieve shared situational awareness (with the help of standard procedures and systems) constrains the emergency organizations' agility needed for flexible adaptation and

improvisation. Moreover, Perrow (2007) argues that coordination in large organizational - 'mammoth' - structures, such as large IT infrastructures, cannot be achieved by centralization; rather, decentralized systems are needed to incorporate the diverse tasks and skills involved in disaster response. Analysis of federal and local interorganizational networks during the Katrina response efforts confirms this argument, as it is found that more investments should be made at the local level to support disaster response (Kapucu, Arslan and Collins 2010).

Next to the question of whether a nation-wide IT infrastructure is desirable in disaster response, there is the question of whether implementation of such a system is at all possible. We think that the wide spread belief that technology is the solution to overcome coordination problems in emergency management, through the creation of situational awareness between organizations involved in the response phase, needs to be questioned. One might argue that the creation of situational awareness between teams operating in different locations might be challenging, but also the implementation of such an IT system in itself is challenging.

In this respect, there are three separate debates that consider the complex nature of developing a common infrastructure. First of all, inter-organizational systems (IOS) scholars made us aware of the inter-organizational coordination problems as a result of the heterogeneity of organizations involved in developing common IT infrastructures (for the IOS debate for example see: Schooley and Horan 2007; Fedorowicz, Gogan & Williams 2007; Williams, Dias Fedorowicz, Jacobson, Vilvovsky, Sawyer and Tyworth 2009). Secondly, the inter-governmental relations literature has taught us just how problematic centralization is (Wright 1988; 1990; Fleurke and Willemse 2004). Finally, the network governance literature argues that coordination should be sought in networked steering instead of applying top-down measurements (Provan and Milward 2001; Provan and Kenis 2007; Moynihan 2009).

These debates have shown that the implementation and governance of one centralized information infrastructure is very hard to realize. We need to consider that, at a time of a disaster, a well-defined IT infrastructure such as netcentric work only makes sense if all the organizations want to become part of that infrastructure and internalize new ways of working. Given these debates and insights, how has the Dutch Department of the Interior gone about implementing its netcentric information system?

Steering Mechanisms: Sticks, Carrots, Hugs and Trading Zones

In order to understand how the various actors in the fragmented Dutch safety sector have responded and are likely to respond in the future to efforts to introduce netcentric work, we need to realize that in principle a policy maker -

and the Netherlands Department of the Interior is no exception - has, roughly speaking, three kinds of policy instruments at its disposal to push netcentric work through. Following Boulding's work on the *faces of power* these are 'destructive power' based on coercion (the stick), 'economic power' on the basis of exchange (the carrot) and 'integrative power' (the hug) (Boulding 1989: 10, 24-31; compare: Etzioni 1961, 5-6; Hood 1983; Vedung 1998). Applied to the process under study, using the stick would mean adopting a law to force the safety sector to comply with the Department of the Interior, and to adopt and implement a particular netcentric work standard. Using the carrot would mean inducing the safety sector to comply with the ministry's wishes by financial means. Finally, using integrative power would be to create legitimacy for the netcentric solution. The latter is based upon the power to, in Boulding's terms, create relationships, and in this Dutch case comes down to calling a 'Platform Netcentric Work' into being in 2008, where all actors involved can discuss what they believe to be netcentric work.

Yet, when the Department of the Interior uses the 'hug', to create the 'Platform Netcentric Work', it only creates so-called 'frontstage networks' (compare Goffman 1959) in which the involved (and invited!) actors *formally* meet each other to discuss - in our case - the technical and organizational features of netcentric work. However, the issue of power in social relationships is more complex. Power always takes place in interaction and in more 'hidden' social interactions (e.g. Lukes 1974; Clegg et al. 2006); that is why we have to move away from the somewhat naive idea, that it is the Department of the Interior that can 'decide' on its own whether or not to use the stick, the carrot and/or the 'hug'. Boulding's three faces of power gives (too much) credit to the individual and/or individual organization, critics have argued. It is a rather voluntaristic view of power (Hardy and Clegg 1996). Therefore we need to also study possible 'backstage networks', not created by the Department of the Interior, where important decisions might be taken. It is the dynamics in the *backstage* networks, we feel, that are important for understanding how netcentric work will be adopted and implemented, if at all.

It is crucial to study these backstage networks, because netcentric work is anything but a clear and unambiguous concept. It is, to borrow a term from Pinch and Bijker, subject to 'interpretative flexibility' (Pinch and Bijker 1984), meaning that, although there are some predefined notions, the question of what the characteristics of netcentric work precisely are or should be is the outcome of negotiations, (local) choices and political debates. The fragmented nature of the safety sector networks is not an easy environment to implement one (technical) standard for a concept that is subject to interpretative flexibility. As a consequence, the concept of netcentric work is translated and negotiated constantly (Czarniawska and Joerges 1996) by the relevant actors. This process

involves a) the fashion of netcentric work within the international (academic and practitioners') community of first responders, b) netcentric work locally translated into action, and c) netcentric work becoming enacted in local practices.

The 'Platform Netcentric Work', created by the Department of the Interior's 'hugs', where the process of translation and negotiation takes place, is similar to what Vaughan (1999) would call 'trading zones' (1999, 918, 922-4; see also Galison 1997). In these trading zones heterogeneous partners discuss the meaning of the new (technological) concept of netcentric work. In her study on the Challenger disaster (1986), Vaughan found that at NASA trading zones were places where the different parties involved in the launch of the space-shuttle tried to reach agreement on what had to be done, and where they attempted to create a common language to understand possible controversies. However, at NASA the unintended consequence of these trading zones was 'groupthink' (cf. Mehalik and Gorman 2006). Too many actors involved in the launch of the space-shuttle kept their professional blinkers on making them blind to alternative solutions. Naturally, NASA also had 'backstage trading zones', but the creation of frontstage trading zones meant that backstage networks, which could have functioned as platforms to recognize local variations and actions, were overlooked or ignored (Vaughan 1999).

We will use the four concepts of sticks, carrots, hugs and trading zones to analyze the instruments the Dutch Department of the Interior uses to facilitate the implementation of netcentric work, whilst, at the same time, questioning whether or not there is room for local initiatives and variations. There is, at least at the level of rhetoric, some convergence of ideas and policies with regard to the concept of netcentric work. Yet, at the same time, it is a challenge for those involved in the process of (re)developing the concept to find common ground for understanding the principles of netcentric work and to break away from the idea of networks being imposed at the frontstage.

Methods

This research is based on data collected from February 2008 to December 2010 and after, during a research project on multidisciplinary information management in emergency response rooms, in which we were alerted to a new development called 'netcentric work' in the Dutch safety regions. We followed this pre-implementation policy development in 2008 and intensified research in the period from February 2009 through December 2010, during which the actual implementation process of netcentric work in the safety regions started. This paper is the outcome of an ongoing research into emergency response in the Netherlands under the heading of Amsterdam Research on Emergency Administration (AREA: http://www.area-vu.nl/). We continued our research on

netcentric work in 2011 and 2012 (this article was under review in the Winter of 2011-2012). From July 2011 – January 2012 we did an in-depth study into the multi-disciplinary coordination practices (including the use of the netcentric work system) co-funded by the project Netcentric Work (since early 2012 a project organization of the Netherlands Institute for Safety). Although the main focus of that research was on the emergency response culture, it was also a means to validate the outcomes of our 2009-2010 research.

The data in the 2009-2010 period were collected in semi-structured interviews with respondents who were involved with the development of netcentric work and by observations during the Platform Netcentric Work meetings. We attended three of these meetings in 2009, and 2010 during which we had informal conversations with many officials and attendants from different safety regions and other professional organizations, and we performed participative observations.

Interviews were conducted in 15 of the 25 safety regions, which were selected by looking at geographical characteristics of urban, rural and border regions. Five regions were selected in each category to get a deeper understanding of the environment the regions are responsible for. This sample of 15 regions provides a good overview on the situation in the Netherlands, as these types cover most of the possible risk profiles the regions need to prepare for (see table 1 below). The risk profiles of these different areas call for different types of emergency preparation, expertise and resources. In urban areas (including airports and harbors) these include large traffic accidents, fires and chemical accidents; in rural areas mostly forest/nature fires; and in border regions the collaboration with foreign emergency services.

Table 1 Selection of Safety Regions

Urban	Rural	Border Region
Amsterdam-Amstelland	Gelderland-Midden	Zuid-Limburg
Rotterdam-Rijnmond	Gelderland Zuid	Limburg-Noord
Utrecht	Brabant-Noord	Gelderland-Zuid
Hollands-Midden	Zaanstreek-Waterland	Twente
Zuid-Holland-Zuid	Gooi & Vechtstreek	Noord-Oost Gelderland

Interviews were conducted with twenty senior emergency managers who were involved in the implementation of netcentric work in each safety region (all of them had at least 5 years+ experience with emergency response organizations), and managers of eight different emergency response rooms. On top of that we went to the emergency control rooms of the Military Police at Schiphol Airport, to the safety control room of the Dutch Railways, the control room of the Royal Dutch Touring Club (the Dutch Automobile Association) and the control room of the international security company G4S in Amsterdam. Although the visits to the

latter organizations were meant to understand emergency control room practices, we also took the opportunity to ask the control room managers about their ideas with regard to netcentric operations.

In order to understand the perspective of the Dutch government, we spoke to administrators in management functions at the Department of the Interior (we spoke with four different department officials during three occasions). We went to the different (semi) governmental organizations who are – each in their own right – responsible for the execution of the Departments' policy. We talked to various project managers of the 'Project Netcentric Work' and the 'Platform Netcentric Work' (in total we interviewed seven project managers), one instructor of the Police Academy of the Netherlands, four instructors of the Netherlands Institute for Safety and two inspectors of the Public Order and Safety Inspectorate. Finally, we interviewed fourteen external consultants from six different companies (M&I Partners, TNO, CapGemini, Berenschot, Centric and Thales) who were involved in implementation processes of netcentric work and the IT environment of it. These interviews provide a useful source of information to validate the interviews and talks we had with the professionals of the different safety regions.

Interviews focused on the tasks of each respondent, on their experiences with implementing netcentric work in their own organization/region, and on implementation processes in other regions. Semi-structured interviews were used to gather data on the experiences of respondents with netcentric work. Each interview included the following topics: what one believes to be netcentric work, the current status of netcentric work, and the historical development and future development/scenarios of netcentric work. Data were analyzed by coding transcripts of recorded interviews and comparing findings on these topics.

To increase reliability of the analysis we discussed the findings of these topics to categorize the data and discuss possible theoretically driven interpretations of the data. During this process we went back and forth from the codes, categories and conceptual explanations to critically reflect on our thoughts and to develop the connection between the data and theoretical interpretations. Additional documentation was used for contextual analysis, such as incident reports of the Inspectorate Public Order and Safety and the Dutch Safety Board, and documents that described the implementation process in different regions. Finally, since 2009 we organize an annual meeting with professionals from the different safety regions to present our results and to ask for response from the field under the heading of the AREA research group in Amsterdam. We've organized three of these meetings in the period 2009-2012.

The concept of 'Netcentric work' in the Netherlands

In 1995 the Dutch government took the initiative to implement a single national communication network for the police, fire brigades and first aid teams, called C2000 (Wagenaar et al. 2009). Recent national disasters - such as the explosion in a firework factory in May 2000 in the town of Enschede that killed 23 people and injured about 950, and the fire in a Volendam café on New Years Eve of 2001 that killed 14 teenagers and injured about 180 - had put safety and the governance of safety on top of the political agenda (Helsloot 2007). Yet, communication and information-sharing between the various professional groups and the creation of a shared understanding of what is going on at times of disasters remained a problem (Oosting 2001). For that reason, the Dutch government was looking for additional means to overcome this problem.

Netcentric work came up as a solution to enable collective situational awareness at times of emergencies (Van Lier 2009). At the Dutch Ministry of Defense there was enough experience with netcentric operations - e.g. during military operations in the Middle East - to convince the Department of the Interior to introduce this technology to the civil sector (Remkes and Kamp 2006). In the civil sector it was meant to improve the exchange of information between heterogeneous actors involved in crisis and emergency management.

It was the national crisis management system Cedric developed by the Dutch organization for technology transfer and knowledge for business (TNO), that was advocated as the best technical standard by the Department of the Interior. Cedric is a software package that includes all the elements for building a common operational picture. It has a text and a map section, in which information about the emergency can be inserted and shared. In the text section, based on the former police program Multi-Team, situational reports can be arranged in folders and relay information, such as the amount of victims, the presence of hazardous materials, the locations of fire hoses, the medical units available, and the actions and decisions of operational leaders. In the map section, based on the military program Integrated Staff Information System (ISIS), icons can be placed that resemble emergency service units, road blocks, waypoints, wind direction, and the expected development of scenarios, such as a flooding. This information is entered into the system and is simultaneously shared with all responders that have access to the Cedric system. Figure 1 and 2 are examples of the interface of Cedric - the technical standard of netcentric work.
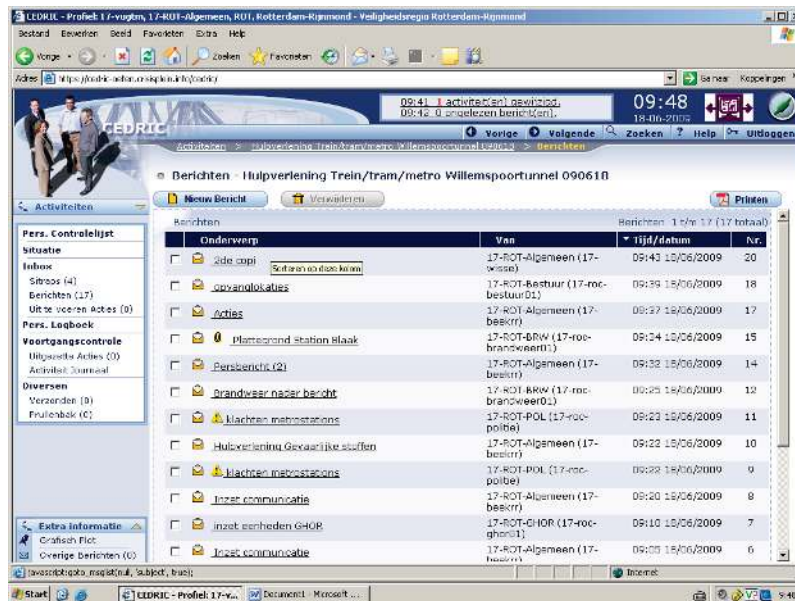
Figure 1. First examples of the Cedric System in-use. The example shows information exchange during an exercise about a metro accident in Rotterdam.
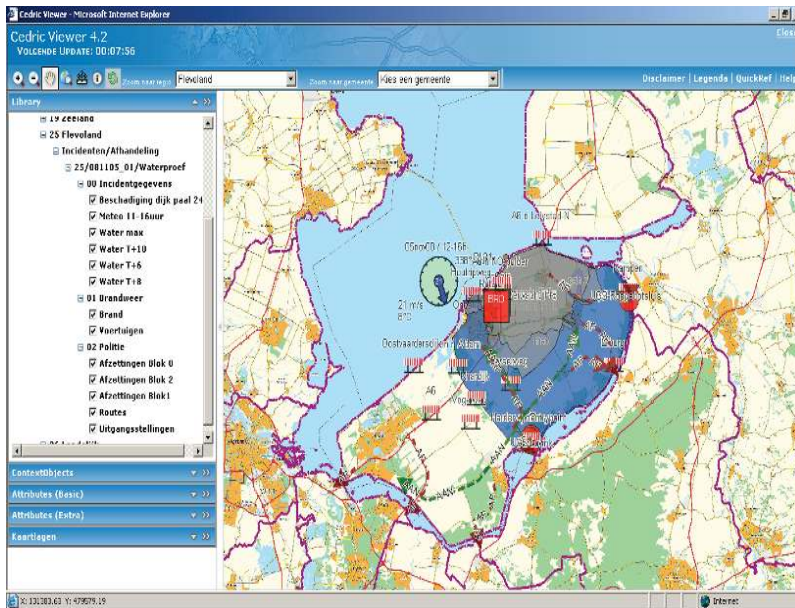

Figure 2. Second example of the Cedric System in-use. This example shows the Geographical Incident Map of an area affected by flooding during an exercise.

A fragmented Safety Response Sector

Given the complex nature of emergencies, the safety response sector - in which netcentric work is being introduced - is subject to fragmentation. The fragmentation of the safety response sector takes place at, at least, two levels.

In the first place, the emergency itself creates a complex system of interdependencies between organizations (in)directly affected by the emergency. The distress caused by the emergency affects many private and public organizations and civilian groups, such as private oil companies, infrastructure companies, public transportation agencies, public utility companies, water boards and even spontaneously emerging civilian groups organizing themselves through social networking sites (e.g. Lutz and Lindell 2008). Each of these organizations has its own emergency response structure that becomes active once a crisis situation emerges. There are clear interdependencies between these organizations, but little formal structures in place to coordinate this interdependency. The emergent coordination processes enacted by different organizations at the same time and the lack of shared situational awareness brings a fragmented system into being in which organizations have no clear view of what interdependencies exist and how different organizations take different actions to solve the problems caused by the emergency. The lack of formalized structures causes coordination to take place on an ad-hoc basis.

In the second place, the fragmentation and ambiguity (Martin 2002) in the response system is situated at the administrative level (compare Comfort 2007). The organization of the Dutch safety sector itself can be characterized as a fragmented world (Boersma et al. 2009). In this, the Dutch situation is no different from other countries such as the US or the UK (see Coaffee et al. 2009 on the UK). Since the early 1980s Dutch mayors have been in charge of municipal emergency management operations (Scholtens 2008). In the Netherlands there are at present 421 municipalities, each one responsible for preparedness and disaster response in their jurisdiction. At the next level, the provincial government has been in charge of examining the activities of the mayor and assessing the municipal disaster preparation and prevention plans. In case of a large emergency, a provincial coordination center would be created. At the national level, the Department of the Interior has been responsible for generating the laws and rules, the testing of the quality of the emergency response chain, the financing of part of the regional costs, and taking care of additional facilities for large response operations, such as communication systems, public alarm systems and heavy equipment (Wagenaar et al. 2009). Next to the administrative responsibility, representatives of the ministries had a seat in the National Coordination Center during large incidents. The Dutch sector is still largely

organized in this way, except for the official introduction in 2010 of the so-called safety regions, meant to combat this fragmentation.

Safety Regions

The decentralization of the Dutch safety sector began to frustrate inter-municipal coordination efforts during several disasters in the Netherlands - notably the disasters in Enschede and Volendam - and thus the decision was made (in 2010) to organize the Fire Department and Medical Services into twenty-five safety regions geographically similar to the twenty-five police regions that already existed (see figure 3 below). The rationale for this division was to create equal public bodies on the regional level, that should improve coordination during preparation and response. The safety regions are new public bodies that house both the Fire Department and Medical Services. In addition, the safety regions are responsible for the organization of emergency response rooms, the technical equipment of the first responders and a functioning system of information management when emergencies occur.

The recognition of the safety regions as public bodies gives them administrative and decision-making power, and their own funding. However, municipal influence is still present, since the mayors officially remain in charge of the emergency management operations. That is why the board of directors of the safety regions consists of the mayors of the involved municipalities. One can argue that, in this way, the safety sector is organized at four levels: municipal, regional, provincial and national, each with their own independent administrative powers.

The twenty five Dutch safety regions

1. Groningen
2. Fryslân
3. Drenthe
4. IJsselland
5. Twente
6. Noord- en Oost-Gelderland
7. Gelderland Midden
8. Gelderland-Zuid
9. Utrecht
10. Noord-Holland Noord
11. Zaanstreek-Waterland
12. Kennemerland
13. Amsterdam-Amstelland
14. Gooi en Vechtstreek
15. Haaglanden
16. Hollands Midden
17. Rotterdam-Rijnmond
18. Zuid-Holland Zuid
19. Zeeland
20. Midden- en West-Brabant
21. Brabant-Noord
22. Zuid-oost Brabant
23. Limburg-Noord
24. Zuid-Limburg
25. Flevoland

Figure 3: the official map of the 25 Safety Regions (in Dutch *Veiligheidsregio's*) in the Netherlands.

Implementing Netcentric Work as a Solution to the Lack of Organizational Coordination

On the front stage of the implementation of netcentric work the Department of the Interior has, as already stated, three policy instruments at its disposal to influence the safety regions: the stick, the carrot and the hug. In the following empirical analysis we will show how the Dutch Department of the Interior has used these three instruments to influence the implementation of netcentric work.

The Stick

Once the decision for the national roll-out of NEC was made by the Dutch Department of the Interior, the question who would lead the national implementation naturally emerged. Until the NEC project, the history of Dutch emergency management organizations was generally marked by expanded decentralization with the realization of large-scale projects, which resulted in a proliferation of IT systems. To prevent this from happening again, the Department of the Interior took a leading position in co-ordinating the national roll-out.

The first step in this co-ordinating role was to draft a law that would create a framework for the overall quality standards for the safety regions, including netcentric work as a means for improving the information management capabilities. The basic framework in the law needed to provide enough direction for the safety regions to translate the Department of the Interior's legal demands into actual policy implementations.

By putting references to these quality standards into a law the Department of the Interior had the stick in its hands by which it could force the safety regions to comply with its standards. Yet, the reference to the quality measures itself lacked the precision necessary to back up the leading position of the Department of the Interior. The law on the safety regions does not define the concept of netcentric work, nor its standards. Hence, the law proved to give too little direction on how to maintain the information exchange facilities and left sufficient room for the safety regions to organize their own standards. Regions could still choose their own way of implementing netcentric work.

The Carrot

The second step taken by the Department of the Interior to reinforce the implementation of the netcentric standards in the safety regions was to provide a full software package to enable netcentric work, Cedric. As we have seen, Cedric combines the Integrated Staff Information System (ISIS) - a geographic information system in use by the Dutch military - and Multi-team - a text-based police system for information sharing.

To give more momentum to the implementation, the national steering group provided Cedric for free. Yet, things looked more promising than they actually were for the safety regions. Their use of Cedric was subject to a clause which stated that the Department of the Interior would only pay the implementation and maintenance costs for the first year; after that the system would cost 15€ct per inhabitant per year. Costs for just the software would therefore be approximately €40.000 per year for the smaller regions, and up to €180.000 per year for the larger ones. Combined with the license costs for the use

of the maps and training of personnel, total operation costs would be almost double the software costs.

Initially Cedric looked like a cheap solution for enabling emergency management in the regions, and a good reason to comply quickly with the national standards of information management. The adoption of Cedric turned out to be rather costly, however. The Department of the Interior's economic incentive was critically judged by several safety regions, and some decided to build and maintain their own software system.

The hug

The third and last instrument in the hands of the Department of the Interior was that of integrative power or 'the hug'. In order to overcome the fragmented safety landscape, the Department of the Interior decided to establish the 'Platform Netcentric Work', at which professionals, policy makers, technicians, advisors, knowledge workers and other relevant actors, could meet each other regularly to discuss the features of netcentric work. The first meeting was held in September 2008. During this meeting a civil servant from the Department of the Interior announced, via a video-message, that the platform was meant to support the safety regions in the development and implementation of netcentric work. Although he recommended the regions to implement the Department of the Interior software, Cedric, he also said that the Platform would do justice to other operating practices that had already been adopted in the regions. For him, the Platform was an enabler in bringing insights from theory and practice together.

Since the first meeting, the members of the Platform have shared their ideas, exchanged information about best practices and discussed implementation strategies. In early 2010, the 25 safety regions committed themselves to the implementation of netcentric work by signing a formal agreement with the Department of the Interior. Nonetheless, it is still up to the individual safety regions to decide about the *way* netcentric work will be introduced and which technical standard will be adopted. The Dutch safety sector might end up with various versions of netcentric work as a result of the agreement.

The platform is an instrument used by the Department of the Interior intended to provide the safety sector with a common goal and a collectively shared idea about netcentric work; it is also intended to energize the organizations. It truly is what Vaughan would call a 'trading zone' (Vaughan 1999) where the various actors involved actively give meaning, not just to the implementation process, but to the entire concept of netcentric work.

Translation and Enactment of Netcentric Work: Early Adopters, Laggards and Followers

What is important to notice is that the Platform functions as, what we called, a front-stage network, created by the Department of the Interior to steer and control the implementation and actual use of netcentric work. As we have indicated, the actions and negotiations that take place in the context of a front-stage network, such as the 'Platform Netcentric Work', are not free from politics. Quite the opposite. The Department of the Interior has been advocating - in a subtle way - Cedric as the technical standard for netcentric work, whereas, as we will see in more detail below, some safety regions had already implemented other standards before the creation of the platform. As we will also see, there is competition between different IT-systems, and the Department of the Interior has no steering function towards the way NEC is developed and implemented. It only provides the basic system Cedric.

One of our interviewees states the problem: '[T]here is no resistance from the regions to the idea of NEC, but how it should be organized is a different subject'. Another interviewee explains why: 'The safety regions are to a certain extent autonomous, because they have the financial means to act on their own. The Department of the Interior can give one possible solution, but the regions can always choose to take another path'. Unsurprisingly, then, the Department of the Interior is an important driver behind the introduction of netcentric work in the Dutch safety regions, but it is not the only one. As it happens, some regions had started with something closely resembling netcentric work before the Department of the Interior had even introduced the term. If we look at the way the regions have adopted netcentric work, we find we can plot them on a continuum, in line with Rogers' ideas of innovation diffusion (1983), ranging from early adopters, to followers, to laggards.

Early adopters

Some safety regions were already introducing netcentric work before the Department of the Interior had even started to think about it. Hence, alternative information systems were already at hand before the Department of the Interior's policy on the matter materialized. For example, the safety region Gelderland-Midden already had a project with a large software company, only to learn later that the project its local entrepreneurs had been working on was elsewhere known as netcentric work. The complete netcentric information system it developed is called 'Eagle One'. It is much easier to operate than Cedric and is also more advanced, so it is claimed. Gelderland-Midden theoretically runs the risk of having to abandon its system if use of Cedric is made mandatory, but tries to

make the Department of the Interior copy as much of its functionality as possible, and also believes that it does not really matter which technology is used.

The safety region Gelderland Zuid-Oost has long worked together with the military to put out forest fires, and this partnership has been responsible for a very early transfer of netcentric work from the military to the civilian world. In the development phase of its IT system the safety region cooperated with Gelderland-Midden and used 'Eagle One' based technology. After a while both regions decided that they had different preferences for functionality and abandoned the joint system development. Gelderland Zuid-Oost now has its own netcentric system, called 'Command and Control System' (CCS). CCS currently only has a Geographical Information System (GIS) and a chat function, but will soon be augmented with text functionality. As Gelderland Zuid-Oost will be combined with the neighbouring region of IJsselland in the near future, two regions will start working with CCS soon.

Brabant-Noord is one of the few other regions next to Gelderland Zuid-Oost already using netcentric work. It also adopted its netcentric work from the military. The region hosts a large air show, which necessitates co-operation with the air force. It is in this way that netcentric work, and the information system 'ISIS' was transferred from the military to the regional civil authorities.

Finally, a cluster of border regions has consciously developed its own netcentric work platform, because they need to be able to cooperate with emergency workers across the border. The border regions Zuid-Limburg, Limburg-Noord, Gelderland-Zuid and Twente have their own Internet-based system called 'Safety Net', which allows cooperation with Belgian and German emergency services. Because Safety Net does not require installing new software on computers, safety workers can access it from their private computers at home.

Followers

Some safety regions began introducing netcentric work when the Department of the Interior began introducing its plans. For example, the region Hollands Midden currently works with 'Multiteam', but will most likely change to Cedric, as Cedric is a mere extension of Multiteam. This region trains everybody involved, and does not worry about technological standards. Instead, it invests heavily in getting all the relevant functionaries in its 28 municipalities committed. It has prepared New Years Eve 2009 celebrations - which have a tendency to escalate into violence in the Netherlands - in the region using netcentric work, hence using it for policy making rather than execution.

The region Kennemerland, of which Schiphol airport is part, is a competent follower as well. It is waiting to adopt the Department of the Interior's netcentric IT-system. It has already appointed officers called 'multi process

coordinators' (MPCs), who manage the streams of information when emergencies happen. In the future this region will have specialized information managers at all levels of the organizations dealing with emergencies.

Whereas in Hollands Midden people come first, the region Rotterdam-Rijnmond puts technology first. This region has already hired information managers, as well as a functionary resembling the Kennemerland MPC. Interesting is that in this region netcentric work has also emerged spontaneously. During an exercise one of the operators involved used his cell phone to photograph an aerial picture of the site of a major incident (these types of pictures often decorate the walls in emergency response rooms). He transferred the photo to a laptop using Bluetooth, and imported it in the word processor Word, to be able to insert drawings in the picture. He then emailed it to his colleagues elsewhere, and very soon everybody was working netcentrically.

Laggards

Some safety regions still keep clear from netcentric work because of other priorities. For example, the region Zuid-Holland-Zuid is convinced that netcentric work should be part of daily routines, once it is introduced, and not just used in case of very large disasters, as these are simply too rare. Officials in the region feel that information-sharing and co-operation between the emergency services involved in current practices should be the real spearhead, not the struggle towards one new technological standard. Therefore, drawing up policy plans for multidisciplinary co-operation should be a first priority.

Amsterdam-Amstelland is the only safety region in which the governmental organizations that should adopt netcentric work, the fire brigade, the medical teams and the police, are not yet working in one joint emergency response room (Boersma et al, 2009). That means that it is difficult for this region to find a place from which it can govern and co-ordinate netcentric operations. Only recently has the Amsterdam-Amstelland region decided to implement a netcentric work standard.

The interpretative Flexibility of Netcentric Work

What becomes clear is that netcentric work was already being implemented in some regions when the Department of the Interior first introduced the idea. Therefore, it is not just the IT-systems that vary. The driver behind these bottom-up activities seen in a number of safety regions is their personnel who already communicated in their private lives in a 'netcentric' fashion (e.g. by the use of mobile applications), and naturally began applying that concept to their jobs, used social network software and other shared information platforms such as email and

Twitter. We can also see some important regional contingencies, such as civil-military collaboration and cross-border incidents acting as important drivers for the bottom-up implementation. The reason most of the regions did not wait for the Department of the Interior to come up with something, was that it had simply failed to take the initiative in the earlier stages; furthermore, it had not supported the regions' own netcentric activities wholeheartedly.

As a result, there appear to be numerous - often mutually exclusive - definitions of netcentric work. According to some of our interviewees netcentric work is 'an umbrella term for highly different practices and techniques', or 'simply the new buzzword'. It is defined as 'a clever intertwining of information systems to make direct communication between all emergency workers on all levels possible'; 'a reorganization of the entire organization'; 'a mindset, a change in culture'; 'sharing information to enable the coming into being of a joint view of an incident'; 'a way to facilitate decision-making'; or 'just a way of managing information, but not a goal in itself'.

Interviewees also differ on their view of the goal of netcentric work, which is defined as 'speeding up decision-making by improving the dissemination of information'; 'taking away bottlenecks in the flow of information'; 'making information more reliable and timely'; 'improving the sharing of information during the first hour of an incident'; 'enabling the flow of information from the shop-floor to the decision-making levels of the emergency organizations during an incident'; 'the sharing of decisions instead of information'; or 'getting the relevant information to the right people at the right moment'.

Views on the scope of netcentric work vary just as much. To some the emergency response rooms should be at the heart of netcentric work, as information clearing houses; to others, emergency response rooms should hardly have a role. Some interviewees hope that netcentric work will improve the flow of information between the executive and decision-making levels of the emergency organizations involved in a large emergency, others see it as a tool mainly for decision-makers. Then there are differences over involving outside parties in netcentric work, like the utility companies or the water boards for instance.

Discussion and conclusion

In this article we have analyzed the introduction of netcentric work in the Netherlands at a national level. The problem is that with the introduction of one national system local solutions are neglected or seen as potential bottle necks for new ways of working. In the US, where solutions for the coordination problem are sought in information infrastructures at the national level as well, authorities are likely to run into similar problems. This makes it important to draw lessons from the Dutch case. The question is whether it is advisable to implement a

centralized technological solution, or whether to decentralize the system; the latter encourages a better adaptation to local circumstances, but risks fragmentation.

Given the problematic situation that the civil safety organizations face during incidents and crisis in terms of information-sharing, it is no wonder that the new paradigm of netcentric work has been seen as a promising solution. Netcentric working means adopting information sharing practices through which the professionals can work towards a common operational picture at times of incidents and crisis. However, the interpretative flexibility of the netcentric work concept and the fragmentation of the safety sector makes the actual implementation of netcentric work (including its IT component) *demanding* rather than promising.

As we have seen, netcentric work is reinterpreted and redefined constantly as it 'travels' through the safety sector in The Netherlands. Not only do the definitions, the goals, and the ways of implementation of netcentric work vary, but the technology turns out to be just as malleable. One of the reasons behind this constant (re)interpretation is that netcentric work travels in all directions. Emergency management is by definition a multi-organizational and multi-jurisdictional environment, where each organization has its own interests in changing the system's functionalities to suit local peculiarities. The implementation of *Netcentric Work* in the Netherlands has taught us that when a centralized system is implemented in a fragmented world of emergency management, the system is bound to disintegrate into local variations.

Moreover, we know from information systems literature that when the system is actually put into use - a thing that has not yet happened with netcentric work in the Netherlands at the time of data collection - we need to consider other mechanisms as well. When systems are implemented, 'structuration' and 'drift' - the alteration of (the use of) the information systems under the influence of local operational practices - will soon cause diversification of the system (Ciborra 2002; Orlikowski 2000). Therefore, even if one does succeed in getting local partners to accept a national information system, it will nonetheless gradually transform into local varieties on the shop-floor. During the observations in the safety regions we were confronted with the early stages of 'structuration' and 'drift'. Further research is needed to study what influence these processes have on the fragmentation in the safety sector and how these systems might be further adapted to local peculiarities once netcentric work is actually put into use, but clear is already that Mendonça, Jefferson, and Harrald (2007) need not fear too much. A national system will not go against local rationality for very long. In the end it will be adapted to it.

The Dutch Department of the Interior itself can do very little about this situation. In this article we have seen that in an environment, where power and influence is fragmented, 'sticks' and 'carrots' do not work. The Department of the

Interior cannot impose its definition of netcentric work on the safety sectors by force or incentives, and is left only with the possibility of using 'integration power', or the 'hug'. As it turns out, however, this type of power also has setbacks. The Department of the Interior has created a front-stage 'trading zone' (i.e. the Platform Netcentric Work), to create another 'trading zone' (i.e. what netcentric operations is actually about), which resulted in a multitude of local trading zones (i.e. all different local versions of netcentric work). Thus, paradoxically, the implementation of a system that should enable coordination between organizations eventually results in a diversification of systems. These then frustrate the coordination processes on a higher level, that is, the level of coordination between the safety regions.

As said in the theoretical section, from the inter-organizational systems literature, the inter-governmental literature and the network governance literature it is well-known already that the introduction of nation-wide IT infrastructures is complicated and challenging. Despite this large body of literature, we still see scholars and practitioners believing in the promising IT-infrastructures. Centralization – and the accompanying information systems – are still seen as solutions to the problems facing nowadays emergency management. With our contribution we would like to argue that it is naive to think that the top-down introduction of such systems will be the solution. Instead, we think that central government should not force the users of those systems in a certain direction. It can set the conditions for the introduction of IT-systems, and make sure that the different systems are compatible and able to 'talk to each other', but it should let the local end-users decide about functionalities and particularities.

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