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Concepts for Command & Control Effectiveness in German Disaster Response

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Abstract

The paper analyzes relevant concepts for command & control effectiveness in the German disaster response system. The concepts are derived from legal text review, an analogy between military and disaster response domain and interpretations of representatives from major German disaster response organizations. The concepts are integrated into a conceptual model.

Keywords: German Disaster Response, Command & Control, Conceptual Model

1   Introduction

Imagine you stay in Munich for vacation and suddenly there is a black out. Small teams of terrorists cut Munich's three main power supply lines. What happens next? Water supply, the traffic network including traffic lights and gas stations, hospitals and the whole industrial life including financial activities rely on electricity. This scenario illustrates both the complexity of and our vulnerability in that scenario. To protect cities like Munich there is a system of disaster management organizations from official administration and private companies.

To allocate and reallocate but also to plan, manage and supervise all disaster response capabilities and forces an effective command and control (C2) system able to prepare forces and lead them during disasters is necessary. Previous studies on German disaster response operations outline that the overall German disaster response system and its C2

system work quite well (Kirchbach, Franke, Biele, Minnich, Epple, Schäfer, Unnasch and Schuster, 2002; Huber, Richter, Römer and Lechner, 2008; Richter, Huber and Lechner, 2009). In a scenario that calls for collaboration of various organizations and which requires agility, C2 capabilities are critical. The disaster response system undergoes a process of transformation to prepare itself for more complex scenarios as terrorist attacks or large-scale natural disasters. Furthermore, we argue that transforming the C2 system leverages the effort of transformation, as management in the information age is fundamentally different from industrial age (Alberts and Hayes, 2003).

To understand which concepts play a major role for transforming the C2 system of the German disaster management system, we raise three questions of concern. 1) Which static organizational structure of German[1] disaster response organizations exists and how does that structure change in case of disaster? 2) Is the analogy between military domain and disaster response domain regarding C2 appropriate? 3) How do deeply involved representatives from disaster response organizations interpret influencing concepts of C2 in the disaster response system? We integrate the analyzed concepts into one coherent conceptual model that describes influence factors on the overall C2 effectiveness of the German disaster response C2 system.

We did not explicitly raise the question about e-trust and e-applications for better inter-organisational C2-collaboration. However, this contribution helps to understand the system of disaster response and can be seen as a very first step also for application development to support disaster response.

2   Method

We adopt an interpretive approach to our object of inquiry – the German disaster response system and its C2 system. We are interested in concepts relevant to Germany's disaster management and the intersubjective meanings embedded in the social system with its interactions generated by its people (Rosen, 1991). The meanings of things, concepts, rules and norms in disaster management organizations arise from people's social interactions and are result of an interpretive process by them (Boland, 1979). To understand these interpretations we conducted interviews with managers of Federal and Bavarian disaster management organizations. To be able to ask rich questions we analysed relevant German and Bavarian legal texts/regulations to understand organizational structure of the disaster response system (see Figure 1).

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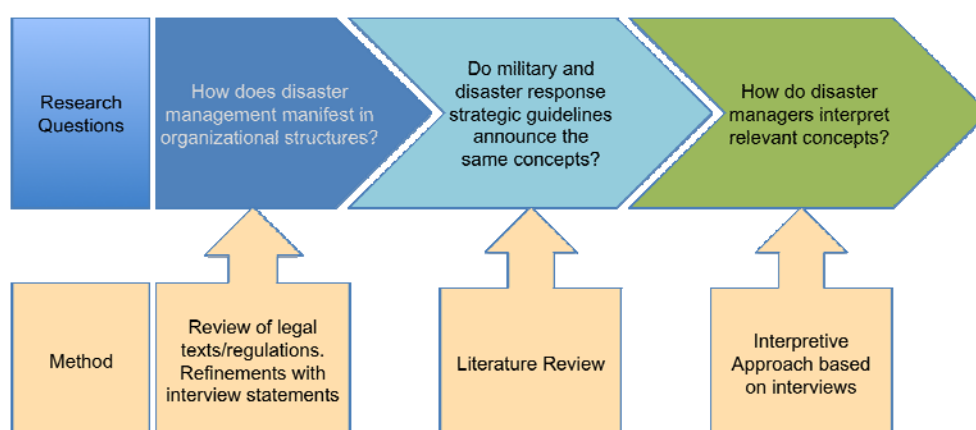
[1] Actauly we analyze the German disaster response system using the federal state of Bavaria as example as all German federal states are self-governed responsible for disaster response and thus not one fully integrated German disaster response system exists.

Figure 1: Research Method

A result of the first research phase (Figure 1) is the identification of an analogy between design principles of military and disaster response C2 systems. In the second phase we researched this analogy more closely. We were interested whether models developed by NATO to manage the military transformation process to become more networked to cope with complex mission scenarios (BMVg, 2004) are known and adopted by the German disaster managers to inform disaster response system transformation. We conducted seven semi-structured, problem-focused in-depth interviews (Bortz and Döring, 2009; Diekmann, 2009) in six German major disaster management organizations with focus on Bavaria during June and July 2009 (Table 1).

We conducted three interviews at the Federal Office of Civil Protection and Disaster Assistance (BBK), a Federal Ministry of the Interior office, responsible to support the Federal Government in all questions of disaster response and to support federal states in disaster management operations when states requesting coordination support. The BBK is also responsible for standardization in disaster response education and training. As Table 1 depicts, the three BBK-interviews were conducted in different sections of BBK. Interview BBK was conducted in the section responsible for overall disaster response and its future development. Interview deNIS took place with the head of the section responsible to develop a standardized disaster response information system and Interview GMLZ was conducted in the section responsible for the overall disaster situational picture.

Interview Code	Organization	Position of Interviewee	Interview Duration (min)
Interview BBK	Federal Office of Civil Protection and Disaster Assistance (BBK)	Section-Head of Section I.1 (Basics of crisis management) in Department I (Crisis Management)	120
Interview deNIS	BBK	Section-Head of Section I.4 (German Emergency Preparedness Information System (deNIS)) in Department I	75
Interview GMLZ	BBK	Shift-supervisor in the German Joint Information and Situation Centre (GMLZ)	50
Interview BRK	Bavarian Red Cross (BRK)	Head of units & BRK's disaster management representative	180
Interview THW	Government of Oberbayern	Representative for disaster management in the security and public order section	50
Interview Oberbayern	Federal Agency for Technical Relief (THW)	Head of Section Mission in the Bavarian THW agency	180
Interview Munich	Munich's county administration	Representative responsible for disaster management	165

Table 1: Overview of the Interviewees

With Interview THW we interviewed representatives from a Federal force provider and with Interview BRK a Bavarian force provider. Additionally we interviewed representatives from various political and administrative levels of the disaster response system in Bavaria. Figure 2 sketches the process of question development for interview preparation.

We utilize three central models developed to guideline C2-transformation in military domain. These models are the Network Centric Operations Conceptual Framework (NCO-CF) developed by Garstka and Alberts (2004), the Command and Control Approach Space (C2 Approach Space, see Alberts, 2007) and the NATO Network Enabled Capabilities Command & Control Maturity Model (N2C2M2 developed by SAS-065, 2009) all basing on the premise that only a networked approach is good enough to cope with future challenges. We derive working hypotheses from those models to understand which role the concepts relevant to the C2 system of military domain play in the disaster response domain. These working hypotheses were the basis

for interview question development. We identified topics and structured our questions accordingly. We link the questions to our three objects of interest (see Figure 2). For the full set of questions and a summary of the C2 models see Heumüller (2009).
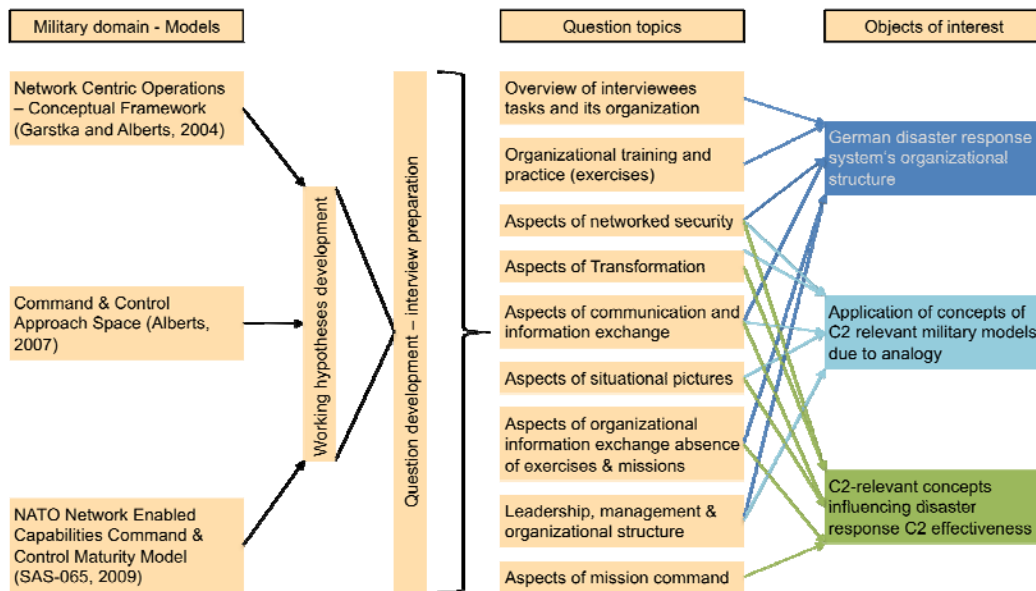

Figure 2: Models, Topics and Objects of Interest

3 Results

We firstly describe an overall organizational structure of the Bavarian disaster response system with its most important organizations and relationships. Secondly, we analyze the analogy between military domain and disaster response in the field of C2 in terms of models, scenarios and interpretation of organizational transformation. Thirdly, we analyse the interpretations of our interviewees to compare them with our findings regarding relevant C2 concepts. We then aggregate the C2 concepts and develop a conceptual model integrating the structural findings from law texts and regulations, the findings from the analogy between military and disaster response domain and the interpretations of our interviewees. The model describes influence factors on C2 effectiveness in the German disaster response system.

3.1 Bavarian Disaster Response System - Its Organizational Structure

We model the organizational view (Figure 3) with regard to relevant German and Bavarian law texts and regulations (Grundgesetz, 2009, BayKSGH, 2009, THW-Gesetz, 2009, Zivilschutzgesetz, 2009). Additionally, we triangulate our findings with a case study on the 2002 Elbe-Flood-Disaster (Richter et al., 2009) and our interviews.

Organizational Structure – Static View

Bavaria as federal state is self-governed responsible for disaster response operations in its area. The Bavarian disaster management law (BayKSGH, 2009) defines three hierarchically organized governmental levels of disaster management authority. These levels are from top to bottom at state level, regional level and county level (Figure 3, left blue/ dark boxes):

- At county level the Lower Disaster Management Authority is primarily responsible for coping with physical effects of a disaster and coordinates disaster management units as e.g. fire fighters or medical response.

- ▪ The Middle Disaster Management Authority at regional level is superior to county level and is primarily responsible for force coordination and administrative and political management supporting subordinated counties.
- ▪ The Higher Disaster Management Authority at state level collocated with the government of Bavaria and subordinated directly to the Bavarian Ministry of the Interior is primarily responsible for political management supporting its regions.

The BBK (Figure 3, left blue/ dark box at federal level) - an agency of the Federal Ministry of the Interior – coordinate upon request by Bavaria large-scale disaster management operations in case other federal states are affected by disaster as well.

The administrative and political management (Figure 3, left blue/ dark boxes) is responsible for disaster preparedness including disaster prevention, development of disaster plans and the evolution of disaster concepts, law texts and regulations. It supervises and coordinates disaster management trainings with force suppliers. In cases of disaster the disaster management authorities are responsible for force coordination for example force allocation, the information of people in affected areas about disaster development, interaction with media and coordination of public life. In daily business the disaster management authorities are small departments of about two people at county level to five at state level. During disasters these authorities constitute the core headquarters for disaster management operations.
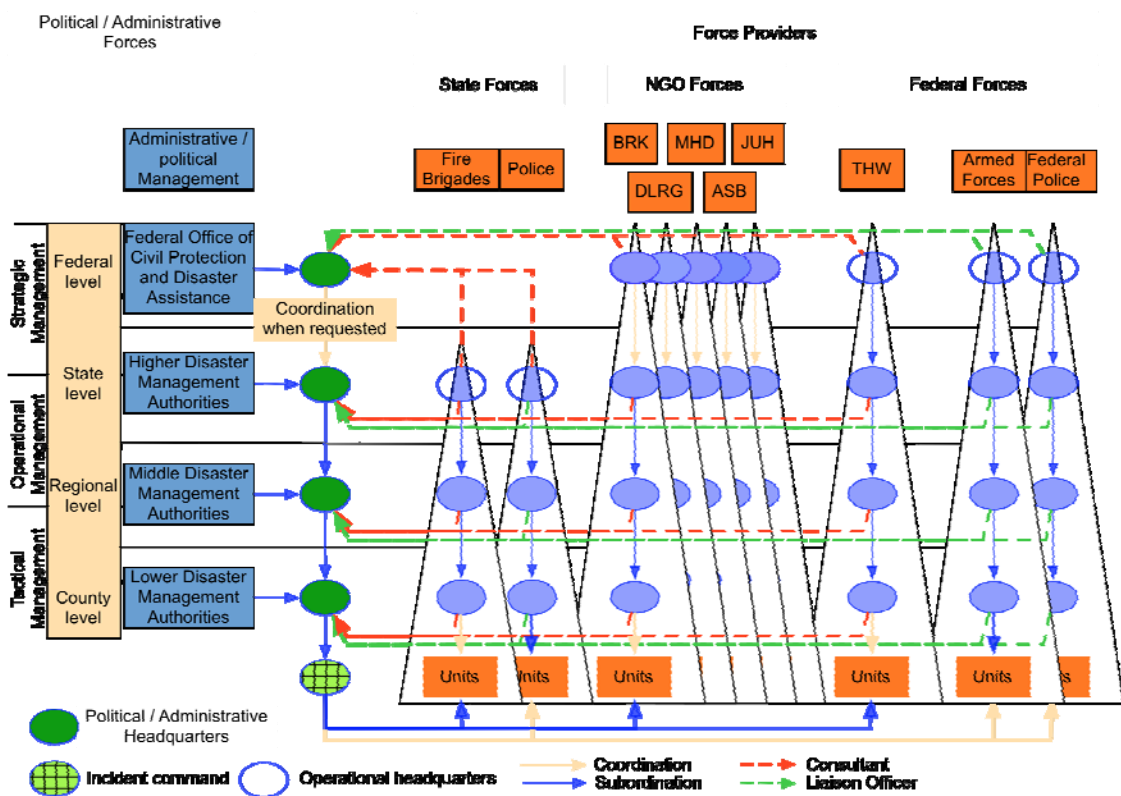

Figure 3: The Overall Organizational Structure of the Bavarian Disaster Response System

The force providers responsible for coping with the disasters in the field are organized

in Bavarian organizations as fire fighting brigades and police[2] and federal organizations as the Federal Agency for Technical Relief (THW), the German Armed Forces (Bundeswehr) and the Federal Police.

There are five major Non-Governmental-Organizations (NGOs) supporting disaster response primarily due to medical rescue, care and all kinds of help necessary during disasters, depicted by Figure 3, triangles on the right side. These NGOs are the Bavarian Red Cross (BRK), the Malteser Hilfsdienst (MHD), the Johanniter Unfallhilfe (JUH), the Deutsche Lebens-Rettungs-Gesellschaft (DLRG, responsible for water rescue) and the Arbeiter Samariter Bund (ASB). These NGOs have a similar organizational structure to optimize collaboration with disaster management authorities. All define a structure with three levels of responsibility at county, regional and state level according to the political management. Nearly all of the NGOs' personnel are voluntary as a lot of fire fighters are as well.

The Organization in Case of Disaster

The Bavarian disaster law defines disaster as an event, endangering or harming life or health of a highly number of people, natural environment or significant material assets to a large extent when danger can only be prevented by the co-operation of public authorities, organizations and force providers under the management of disaster management authorities (BayKSGH, 2009, I (2)).

To be able managing all assets to prevent from disaster development and protect people and nature according to the disaster definition, disaster management authorities found headquarters at every level of authority (Figure 3, green/ dark grey ellipses on the left). These headquarters consist of personnel from disaster management authorities as core staff, personnel from other departments of the respective level of government as e.g. social affairs or financial affairs and consultants or liaison officers from all major force supplier organizations. Consultants appointed by NGOs, THW and fire brigades provide information and advice regarding availability and competencies of their respective organization (Figure 3, red/ dark grey dashed lines). A liaison officer appointed by Police, Bundeswehr and Federal Police advises and additionally requests forces of the own organization supporting disaster managers[3] (Figure 3, green/ light grey dashed lines).

The administrative headquarters are organized as staff elements for the respective commander. Consultants and liaison officers work in staff-cells. When regular staff requires information the cells are integrated ad-hoc. Consultants and liaison officers are evaluated as highly important[4] for disaster managers as they provide the knowledge necessary to coordinate forces to respond to disaster development.

Laws and regulations describe how headquarters are established – who sends staff and who runs it. How is this process coordinated practically? This process is crucial for the overall disaster management operation as all forces suddenly will be coordinated by the political/ administrative headquarters. This process is relevant to understand the C2 structure of the system.

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[2] Police forces can take over special disaster management tasks given by the disaster management authorities dependent on force capacity. Primarily Police has to handle their usual business, which is public security

[3] Source: Interview THW, Interview BRK

[4] Source: Interview Munich, Interview GMLZ, Interview Oberbayern

The leader of the first responders on the spot, typically a fire fighter, becomes incident commander (ICmdr). He establishes an incident command (IC[5]) and reports to the administrative superior at county's Lower Disaster Management Authorities. When an ICmdr, capable to estimate disaster's extent, recommends establishing an administrative headquarters, the administrative manager usually follows and establishes the political/ administrative headquarters at county level and informs superior levels of authority. With more than one critical spot more ICmdrs become responsible and manage respective units, always reporting to administrative headquarters. With more than one county affected the regional headquarters will be established and so on. Thus, the headquarters are established from bottom to top. The required time until a headquarters at state level is fully operational can take several days (Kirchbach et al., 2002).

As Figure 3 depicts, the ICmdr is leader and superior to fire brigade, NGO and THW units. He is not superior to Police, Bundeswehr and federal police units although he coordinates their missions due to direct communication with their commanders typically in the IC. Latter units remain in their chain of command. Accordingly, the units of fire brigades, NGOs and THW shift command with the result that its superior headquarters is responsible only for coordination purposes as allocation of resources (see Figure 3, blue/ light grey ellipses and light arrows). The ICmdr becomes full commander implying that unit's organization has no further access to the unit until the operation terminates[6]. Thus, operational headquarters of fire brigades, NGOs and THW only coordinate tasks insofar as they allocate units for tasks, advise political leaders and superiors and manage information. On the contrary, operational headquarters of police, Bundeswehr and federal police are fully operational and manage their own units and coordinate with ICmdr. This short description of command chains, assignments, responsibilities and headquarters allocation clarifies how complex the disaster response system is and which central value C2 has.

Findings

1) All disaster management organizations are hierarchically structured.

   Force providers are structured according to the political structure with three levels of responsibility in Bavaria. This uniformity of structure enables, that all responsible managers can communicate on their level of responsibility (county, region, state). Thus, fast and clearly structured information exchange is possible.

2) Many units from fire fighters, NGOs and THW shift their command structure in case of disaster.

   The respective ICmdr is responsible for tactical operations in the field. He fully commands fire fighters, NGOs and THW units. Unity of command[7] is design principle (Taylor, 1911; Pearce and Conger, 2003). The ICmdr but also political leaders in the administrative headquarters are focused leaders (Rost, 1993; Stewart and Manz, 1995) – second design principle.

3) Political/ Administrative headquarters consist of disaster managers, managers of other political areas and liaison elements – consultants and liaison officers.

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[5] The ICmdr is responsible to command and control operations on a small regional area. The IC serves as his staff to support coordination, planning and communicating orders.

[6] Source: Interview THW

[7] Unity of command means that only one superior at time exists. Matrix organizations or networks are different designs.

Due to the assembly of people with different competencies from political areas and force suppliers the headquarters become highly interdependent (Gronn, 2002), prerequisite for managing complex missions.
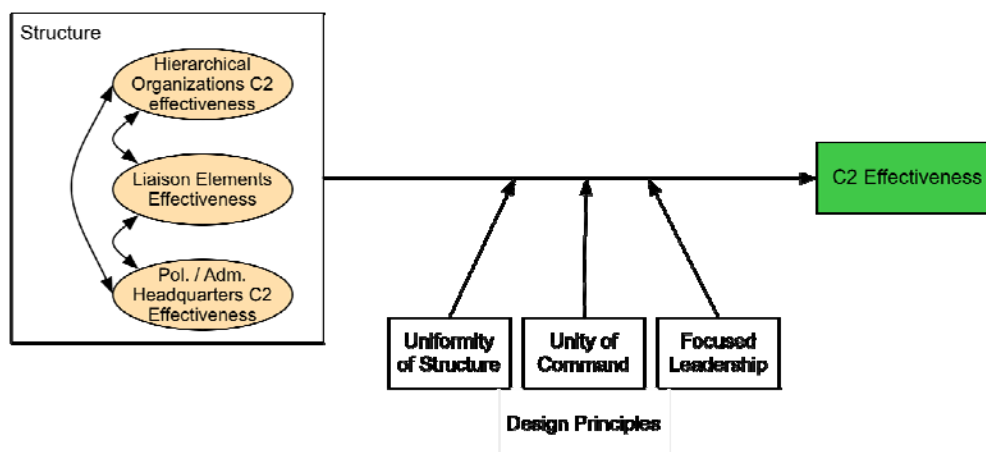

Figure 4: C2 System Concepts - Structure

With regard to the organizational structure of the disaster response system we consider three concepts significantly influencing C2 effectiveness; 1) C2 effectiveness of each hierarchically structured organization, 2) effectiveness of the system of liaison elements and 3) C2 effectiveness of Political/ Administrative headquarters (Figure 4). All three concepts interact as hierarchically structured organizations send personnel as liaison elements, which is adequately trained, motivated and effective, or not. Liaison elements complement Political/ Administrative headquarters and support C2 effectiveness of these headquarters. The headquarters command and control the hierarchically organized organizations during disaster missions. Hierarchical organizations' C2 effectiveness is moderated by uniformity of structure as it supports C2 effectiveness. Unity of command and focused leadership are design principles moderating the whole hierarchy-design-approach and thus the relationship with overall C2 effectiveness (Figure 4).

3.2   The Analogy between Military and Disaster Response Domain

We argue that an analogy between military domain and disaster response exists. Furthermore it is promising to analyze modern C2 models and its concepts. Holyoak and Thagard, 1996 argue that analogy means the existence of structural parallels between base domain (military) and target domain (disaster response). When this existence is evident, the assertion that a relational structure observable in base domain can be applied to target domain is sound (Gentner, 1983).

Table 2 depicts strategic ideas of both, military and disaster response domain in column one and two. The strategic ideas are derived from official German strategy papers published in the Federal Ministry of Defence (military domain) and the Federal Ministry of the Interior (disaster response domain)[8]. These ideas are abstracted to C2 relevant concepts in column three of Table 2.

The three C2 relevant models NCO-CF, C2 Approach Space and N2C2M2, all developed in the military domain and mentioned in section 2 rely on the assumption of high (and increasing) mission complexity due to new *scenarios* as e.g. asymmetric

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[8] The most important resources of analysis are BMVg (2006b) - the white book of Germany, BMVg (2004) - the strategic guideline of the Bundeswehr and BMI (2009) - the guideline for modern civil protection.

threats, the increasing influence of mass media and missions in urban terrain. Exactly the same characteristics of missions exist in modern disaster management. The military models support transformational strategies for military organizations implying that a network C2 approach can handle new challenges best. This so-called *net-centricity* is highlighted in the strategic papers for both domains. The key resource of today's missions is information as is prerequisite for plans and decisions. Faster and richer *information exchange* is key for operational tempo (Alberts, 2007).

Military Domain	Disaster Response Domain		Concept
Terrorist attacks across borders and within Germany (BMVg, 2006b)	Terrorist attacks in Germany (BMI, 2009)	⇨	Scenarios
New scenarios and increased importance of factors like mass media, conflicts in urban terrain and multi block conflicts highly increased complexity (BMVg, 2004, 2006b; Smith, 2006)	High due to disasters in urban terrain, influence of mass media, new scenarios as terrorist attacks (Kreutzer, 2008; BMI, 2009)	⇨	High mission complexity
High pressure to adapt to cope with cultural, societal and technological change (BMVg, 2004, 2006b)	High pressure to adapt to cope with cultural, societal and technological change (Geier, 2008)	⇨	Transformation
Orientation on skills and abilities instead of competencies (BMVg, 2004)	Orientation on skills and abilities instead of competencies (BMI, 2009)	⇗	
High mission complexity requires higher interdependence between functional areas (BMVg, 2004)	Disasters increase in strength and complexity implying higher interdependence between disaster response organizations (Kreutzer, 2008; BMI, 2009)	⇨	Net-Centricity
Stabilization and state building as mission goals require inter-organizational approaches (networked security) (Borchert, 2004; BMVg, 2004, 2006b)	The increase in security issues in disaster management require a networked security approach with inter-organizational cooperation (BMI, 2009)	⇗	
Increased interdependence in missions require fluid and borderless information exchange to generate coherent situational pictures (Neujahr, 2004; BMVg, 2006b)	Modern information management systems enable information exchange between all affected organizations in cases of disaster (Kreutzer, 2008; BMI, 2009)	⇨	Information Exchange

Table 2: Similarities between Military and Disaster Response Domain

Findings:

1) Military and disaster response domain are analogous w.r.t. C2 concepts (Table 2).

2) Increasing mission complexity due to new *scenarios* is the underlying assumption in both domains.

3) *Transformation* is a strategically defined change process and necessary to enable disaster response coping successfully with future challenges.

4) *Net-centricity* – a robust network structure of all security-relevant organizations in military and disaster response domain – the so-called whole-of-government approach – is one key goal of Transformation.

5) Information is one explicitly highlighted resource for modern operations and *information exchange* crucial for operational success.

3.3 Conceptual C2 Factors Influencing Disaster Response C2 Effectiveness

We were interested in our interviewees' interpretations of the concepts of Table 2. We analyzed 1) whether our concepts are relevant to the interviewees' organization and 2) whether more C2 relevant concepts exist in the interviewees' interpretations and 3) which relationships exist between these grounded concepts.

Scenarios. Increasing mission complexity due to change of scenarios in scale and diversity is the central challenge formulated by the strategic concepts of military and disaster response domain (BMVg, 2006b; BMI, 2009). These new scenarios are discussed within all interviewed organizations and interviews document that these scenarios play a major role in planning, training and preparation (see Figure 5, row

Scenarios). Only the representative from BRK stated that new scenarios play minor role for BRK, as BRK has to organize first aid and care for injured or evacuated people however the scenario looks like. The interviewee explained that the scale of disaster is more important for BRK and new scenarios often imply more injured people and larger disaster extent. The disaster response system is not responsible for new scenarios. It is sound to think of scenarios as *external factors* with regard to the disaster response system's artificially defined mental boundary. The system has to cope with the impacts of these new scenarios as terrorist attacks or disasters caused by migration or climate change.

Figure 5: Interview-Codings w.r.t the Grounded Concepts[9]

Transformation. New scenarios imply a pressure to transform for organizations. However, the interviewees perceive the concept *Transformation*, differently (Figure 5, row Transformation). The strategic level represented by the BBK[10] define a distinct process named Transformation (as in the Bundeswehr) to clarify the strategic impact and the disruptive change for the disaster management system (BMI, 2009). The representatives from operational and tactical levels accept the need of adaption and change but in a more incremental way. They focus to a lesser extent overall organizational issues but more coordinative issues at tactical level. For example to foster a better coordination between BRK and the medical service of the Bundeswehr due to more mutual training is one special aspect of change relevant for 2010[11]. This reorganization includes communication, coordination and collaboration processes at tactical level in the field in special tasks like pitching a large tent for injured people.

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[9] The rectangles under legend stand for abstact representations of the interviewees statements w.r.t. the respective concept. Thus, same colour represents statement conformity between interviewees.

[10] Source: Interview BBK, Interview deNIS, Interview GMLZ

[11] Source: Interview BRK

Political Will. Our interviewees call for strong *political will* manifesting in precise organizational goals. All interview partners expect that the strategic political management define precisely how to transform the disaster management system. As long as Transformation as process remains unsupported by clear models how to transform, the responsible personnel are not able to bring this process to life. As due to the new scenarios as concrete challenges the idea of Transformation was born, this process is not an end in itself. Thus, new scenarios of course impact political will insofar as the pressure to act for political managers significantly increase when new scenarios bring the disaster response system to shortfall. Thus we think, that political will is also an external factor for the disaster management system, like new scenarios are.

Structure (Hierarchical Organization C2 Effectiveness; Liaison Elements Effectiveness; Political/ Administrative Headquarters Effectiveness). As discussed in section 0 we consider three concepts influencing overall C2 effectiveness significantly; 1) the C2 effectiveness of each hierarchically structured organization, 2) the effectiveness of the system of liaison elements and 3) the C2 effectiveness of political/ administrative headquarters. All disaster response organizations are hierarchically organized with explicitly defined reporting chains and standardized communication acts manifested in several reporting forms for e.g. resource requests or mission orders[12]. We asked, whether inter-organizational communication barriers are an issue. The representative of THW denied and described the approach that external organizations requesting THW forces do not have to matter who within THW is the right addressee for the request. It is task of THW to organize, that the request is passed to right level and person of responsibility[13]. Our interview partner describes that as an "one face to the customer" approach to eliminate barriers as much as possible for external requester. The interviews confirmed support for hierarchical organization designs, notwithstanding the importance of barrier-free inter-organizational networking (see Figure 5).

Net-Centricity. Increasing mission complexity due to new scenarios requires new management approaches. One central idea is networking. The so-called net-centricity is defined as strategic design approach for Bundeswehr (BMVg, 2004) and disaster management (BMI, 2009). All interviewees consider net-centricity as prerequisite for solving complex disaster scenarios, having high value for disaster management. They all accept and support the idea of whole-of-government approaches describing governmental, non-governmental, profit and non-profit organizations working together closely in network coalitions to cope with future disasters. The representative from BRK argues, that networking, as basis for collaboration is even more important between organizations with similar functions as e.g. BRK and JUH. However, this perception expresses relatively low levels of task-interdependence (Wageman, 1995) between BRK-functions and functions of others (e.g. THW). The representatives involved in overall mission planning highlight the necessity to closely work together in collaborations[14]. New scenarios increase their task interdependence. E.g. the power breakdown scenario illustrates how much functionality relies on power supply. Each player in the urban network of the city of Munich has to be incorporated in planning to cope with a power breakdown.

Social Networks/ Trust. The strategic visions calling for net-centricity (BMVg, 2006b; BMI, 2009) left open how these networks should be organized or which nodes and relations these networks establish. Our interviewees emphasized the importance and

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[12] Source: Interview THW, Interview Munich

[13] Source: Interview THW

[14] Source: Interview Munich, Interview BRK, Interview GMLZ, Interview THW

necessity of personal networks within and across their respective hierarchies to increase C2 effectiveness within and across the organization (findings of 0). These "small" networks help establishing networks between the disaster management organizations and take over a mediation function between hierarchies and net-centricity. Our Bavarian interview partners participate in a "disaster round table" which is conducted on a regular basis in a Bavarian pub. These meetings give room to talking, discussing problems and playing cards and are evaluated by all Bavarian interview partners[15] as being strongly beneficial for establishing social networks and trust. Directly asked, several representatives stated that it would be a strong disadvantage for young leaders not having a solid social network within the disaster management organizations[16].

Information Exchange. The main intent to build up networks is to enable the required information exchange between organizations engaged in disaster management. Information is an increasing successes factor in today's missions either in military or disaster management (BMVg, 2004; BMI, 2009). The functional (task), planning (process) and outcome interdependence (Wageman, 1995; Langfred, 2005) between and within organizations in missions is a critical influence factor requiring coordination (Gronn, 2002). In highly dynamic environments like disaster response operations information is fast aging. This requires permanent information exchange implying the ability (organizational rules, technical infrastructure) and will (cultural and organizational rules) to exchange information for planning and coordination purposes. Our interviewees' interpretation on information exchange seems to be heterogeneous (Figure 5, row Information Exchange Intensity). The Interview BBK did not bear the concept of information exchange explicitly. The Interview deNIS clarified the view that deNIS as information system offers a service for disaster management at state level. The IT of deNIS implements the concept that information is offered voluntarily as all participants accept the requirement and advantage of information exchange. Interview partners from force providers and operational and tactical level are aware of the necessity to share information inter-organizationally as barrier-free as possible, albeit within all organizations information exchange and reporting is explicitly regulated.

Situational Picture. A situational picture informs commander and staff about what is going on in the field. Usually it allocates tactical units represented by symbols (e.g. one platoon fire fighters) and its mission plus time estimation (e.g. moving from A to B in 30 min) on a map. The situational picture[17] is really important for headquarters to be aware which units are engaged or which are ready for new orders. An illustration – in large-scale disasters the number and units of respondents become overwhelming. For example more than 100.000 responders helped during the 2002 Elbe-Flood-Disaster (Richter et al., 2009). Information exchange is crucial for establishing situational pictures. The management of an inter-organizational valid situational picture is one of the major challenges in military domain (BMVg, 2006a). The importance of a valid situational picture and the costs, if such a picture lacks is reported in Kirchbach et al., 2002 for the Elbe-Flood-Disaster. All interviewees emphasized the importance of a coherent and valid situational picture for disaster response operations and confirm that their organizations are willing to allocate required information barrier-free to enable the whole system to operate well.

Shared Awareness. Shared Awareness captures how and in which stages and phases organizational members assess their situational environment and negotiate knowledge

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[15] Source: Interview BBK, Interview THW, Interview Oberbayern, Interview Munich

[16] Source: Interview BRK, Interview THW

[17] In this paper we emphasize the artefact of this picture whether on a physical map or technically represented. We do not mean the cognitive picture, shared between e.g. commander and staff.

about the situation, for example in missions (Nofi, 2000). Shared Awareness conceptualizes overlaps in members' individual knowledge and information about the situation and the difference in interpretation. These overlaps enable shared planning and discussing future courses of action in missions. Shared Awareness is assessed as one of the key antecedents for success in complex missions (Nofi, 2000; Richter and Lechner, 2009). This concept was not grounded in our interviews, it stems from the most prominent models in the field (Alberts and Hayes, 2003; Garstka and Alberts, 2004). Information exchange and situational pictures do have to be integrated in plans and courses of actions. The concept of shared awareness explains as cognitive model, how exchanged information in the end influence C2 effectiveness. The mutual cognitive shared situational picture as concept named shared awareness is basis for shared planning.

3.4 A Conceptual Model Aggregating Influence Factors on C2 Effectiveness in German Disaster Response

We analyzed different concepts, influencing the overall C2 effectiveness of the German disaster response system. The result – the concepts and their relationships – is aggregated by the model as depicted by Figure 6.
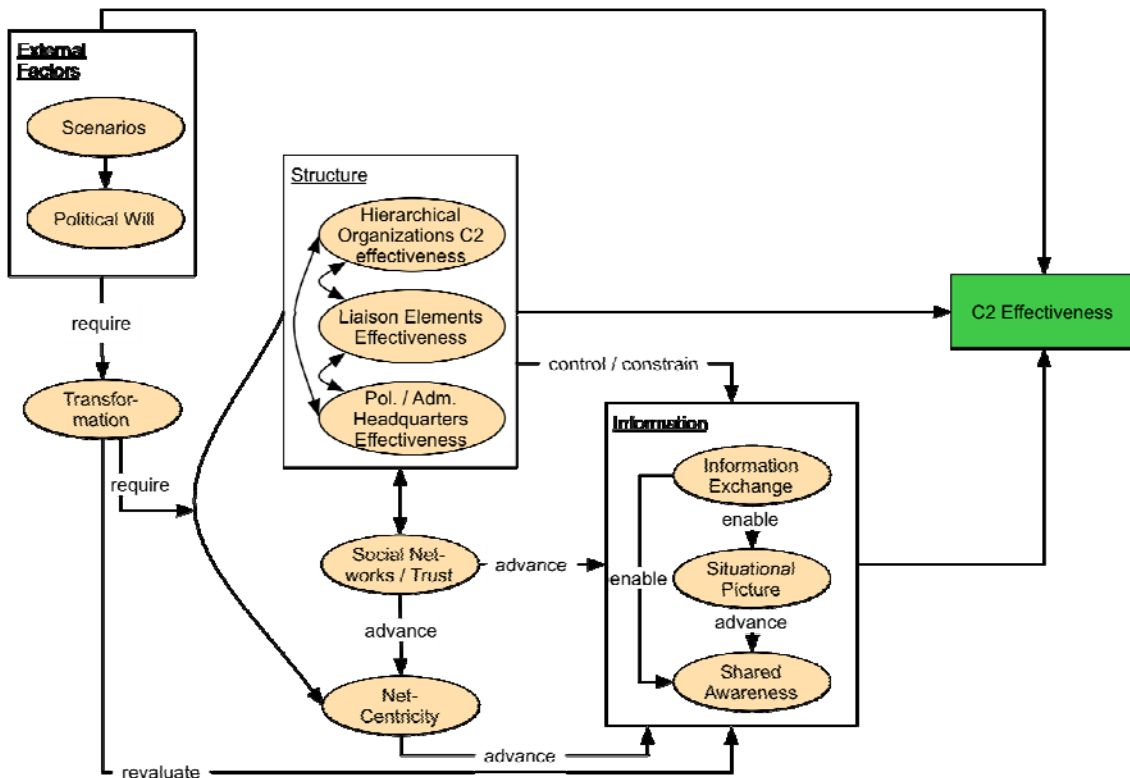

Figure 6: External Factors, Structure and Information as Determinants of C2 Effectiveness - a Conceptual Model

External factors – new scenarios in combination with political will – require a strategic transformational process of change. One major goal of that change process is the restructuring of the disaster response system as a whole. Net-centricity seems to be the future structural concept. Social networks and trust between representatives of all organizations mediate the structure of system of hierarchies and net-centricity. The idea of net-centricity is to enable organizations to exchange information as fluid as possible.

405

Transformation revaluates the impact of information in modern missions. Information is key-enabler of planning and integrating all means and assets of the overall disaster response system. External factors, structure and information as overarching concepts influence C2 effectiveness. The fit and balanced mix of all three is crucial for high C2 effectiveness.

4 Discussion & Future Developments

We modelled concepts influencing C2 effectiveness in the disaster response domain in Germany. We identified our concepts in 1) literature and primarily strategic planning guidelines of the domain, 2) military conceptual C2 models as the analogy with the military and the disaster response domain is helpful and 3) interviews conducted with representatives from major disaster response organizations.

Our model can help disaster response managers to identify leverage points to increase overall C2 effectiveness. Does the organization reflect new scenarios adequately and is the political will to cope with these scenarios the right way strong enough? Is the structure and effectiveness of the organization adequate? How can transformation be supported? Are information exchange processes within the organization and across sound for complex missions? How and in which ways does the organizational structure with its cultural and organizational impacts impede information flows? To raise and answer these questions help to diagnose the organizational fit for future and complex scenarios for disaster response managers w.r.t. C2 effectiveness.

Understanding modern C2 approaches for future disaster response scenarios is crucial and the proposed model can help to enable understanding. Future research should highlight the role of leadership approach in the overall disaster response system as hierarchies and focused leadership seem to fit but shared leadership fits better with networks (Gronn, 2002; Pearce and Conger, 2003). Here empirical research is the next step.

References

Alberts, D. S. (2007). Agility, Focus, and Convergence: The Future of Command and Control. The International C2 Journal. 1(1). 1-30.

Alberts, D. S. & R. E. Hayes. (2003). Power to the Edge. Command...Control... in the Information Age. Washington: CCRP.

BayKSGH (2009). Bayerisches Katastrophenschutzgesetz. GVBl. S. 282, BayRS 215-4-1-I.

BMI. (2009). Strategie für einen modernen Bevölkerungsschutz. 1-66.

BMVg. (2004). Konzeption der Bundeswehr (KdB). Bundesministerium der Verteidigung (Ed.), Berlin.

BMVg. (2006a). Teilkonzeption Vernetzte Operationsführung (TK NetOPFü). Berlin: Bundesministerium der Verteidigung.

BMVg. (2006b). Weißbuch 2006 zur Sicherheitspolitik Deutschlands und zur Zukunft der Bundeswehr. Bundesministerium der Verteidigung (Ed.), Berlin, www.weissbuch.de.

Boland, R. J. (1979). Control, Causality and Information System Requirements. Accounting, Organizations and Society. 4(4). 259-272.

Bortz, J. & N. Döring. (2009). Forschungsmethoden und Evaluation für Human- und Sozialwissenschaftler. 4. überarbeitete Auflage. Heidelberg: Springer.

Diekmann, A. (2009). Empirische Sozialforschung. Grundlagen, Methoden, Anwendungen. 20. Auflage. Reinbeck: Rowohlt.

Garstka, J. J. & D. S. Alberts (2004): Network Centric Operations Conceptual Framework Version 2.0, Evidence Based Research, Vienna, VA.

Gentner, D. (1983). Structure-mapping: A theoretical framework for analogy. Cognitive Science. 7(2). 155-170.

Gronn, P. (2002). Distributed leadership as a unit of analysis. The Leadership Quarterly. 13(4). 423-451.

Grundgesetz (2009). Grundgesetz für die Bundesrepublik Deutschland. Bundesgesetzblatt Teil III, Gliederungsnummer 100-1.

Heumüller, E. (2009). Vernetze Sicherheit – Was kann vom Katastrophenschutz gelernt werden? Diplomarbeit betreut durch U. Lechner & S. Richter. Universität der Bundeswehr München. Professur für Wirtschaftsinformatik.

Holyoak, K. J. & P. Thagard. (1996). Mental Leaps: Analogy in Creative Thought. Cambridge: MIT Press.

Huber, R. K., S. Richter, J. Römer & U. Lechner (2008). Assessment of C2 Maturity against the Background of Complexity of Disaster Relief Operations: Two Case Studies of the Tsunami 2004 and Elbe Flood 2002. 13th International Command and Control Research and Technology Symposium. Bellevue, Washington.

Kirchbach, H.-P. v., S. Franke, H. Biele, L. Minnich, M. Epple, F. Schäfer, F. Unnasch & M. Schuster (2002): Bericht der Unabhängigen Kommission der Sächsischen Staatsregierung Flutkatastrophe 2002. Dresden, http://www.emergency-management.net/pdf/14_10_2003/KommissionsberichtElbeflutkatastrophe2002.pdf, last access: 12.01.2009.

Langfred, C. W. (2005). Autonomy and performance in teams: The multilevel moderating effect of task interdependence. Journal of Management. 31(4). 513-529.

Nofi, A. A. (2000). Defining and measuring shared situational awareness.

Pearce, C. L. & J. A. Conger. (2003). All Those Years Ago. The Historical Underpinnings of Shared Leadership. In C. L. Pearce & J. A. Conger (Eds.), Shared Leadership. Reframing the Hows and Whys of Leadership (1-18). Thousand Oaks, London, New Delhi: Sage.

Richter, S., R. K. Huber & U. Lechner (2009): The Elbe Flood 2002 - A Case Study on C2 Systems and Inter-organizational Coordination prepared for the NATO Working Group SAS-065, Universität der Bundeswehr München and ITIS eV, Munich.

Richter, S. & U. Lechner (2009). Transactive Memory Systems and Shared Situation Awareness: A World of Warcraft Exeriment. International Conference on Organizational Learning and Capabilities. Amsterdam.

Rosen, M. (1991). Coming to Terms with the Field: Understanding and Doing Organizational Ethnography. Journal of Management Studies. 28(1). 1-24.

Rost, J. C. (1993). Leadership for the Twenty-First Century. Westport: Praeger.

SAS-065. (2009). NATO NEC C2 Maturity Model. NATO SAS-065 Research Task Group (Ed.), http://www.dodccrp.org/html4/research_nato.html.

Stewart, G. L. & C. C. Manz. (1995). Leadership for self-managing work teams: A typology and integrative model. Human relations. 48(7). 747-770.

Taylor, F. W. (1911). Principles of scientific management. New York: Harper & Brothers.

THW-Gesetz (2009). THW-Helferrechtsgesetz. BGBl. I S. 118.

Wageman, R. (1995). Interdependence and Group Effectiveness. Administrative Science Quarterly. 40(1). 145-180.

Zivilschutzgesetz (2009). Zivilschutz- und Katastrophenhilfegesetz. BGBl. I S. 726.