Inter-organisational cooperation in major incidents - what do emergency services require for smooth operations?

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Abstract

Major incidents such as terrorist attacks or natural disasters demand successful inter-organisational cooperation and communication of emergency services. There is little knowledge about specific requirements of inter-organisational cooperation in the field of safety research, e.g. what kind of information do members of the emergency services expect from other agencies or how the exchange, validation, and integration of information takes place.
Requirements for shared situation assessment in major incidents were investigated in a German government-funded research project (LAGE). Incident commanders from police, urban fire departments, rescue services and civil authorities who need to cooperate in major incidents were interviewed. As common ground for the interviews, a rail accident scenario occurring in the central station of a German city hosting a big event was used. Additional data came from the observations of a German National Crisis Management Exercise (LÜKEX).
Qualitative analysis yielded communication requirements as seen by staff of the emergency services. Relevant technical prerequisites for establishing a shared assessment of the situation are: continuous flow of information between different technical systems and consultants as well as shared language-codes and the possibility to verify sources of information. On the organisational level, knowledge about the other organisations' goals and structures and individuals' willingness to cooperate seem critical factors.

Key words
Major incident; inter-organisational cooperation; communication requirements

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1.   Introduction

Natural disasters, terrorist attacks, and major incidents seem to affect society more and more frequently. In these incidents, several emergency organisations are involved in coping with the disaster. In extraordinary events and under dynamic and chaotic conditions, the first challenge lies in recognizing danger and anticipating damage in the affected area. Next, the demand for resources needs to be allocated. Another challenge in major incidents is the integration of multiple agencies and jurisdiction to manage those extraordinary events. Comfort and Kapucu (2006) discuss the challenges within extreme events such as the World Trade Centre attack 2001. One key to successful management of major incidents seems to be smooth inter-organisational cooperation and communication of emergency services, e.g. first responders and other relevant stakeholders (e.g. Therrien 1995; Comfort & Capucu, 2006).

In major incidents, local agencies bear the brunt of first response and public organisations hold responsibility for the protection of lives and continuity of operations (Comfort & Kapucu, 2006). Although all stakeholders share the main goal of protecting and rescuing, they have different main tasks and focus on different issues within a major incident. Furthermore, the extent to which a stakeholder is involved in the incident, as well as the dependence on other stakeholder´s actions may vary according to the development of the situation. In any case, the need to cooperate and communicate in a meaningful way is a consistent issue for successful operations.

Despite the obvious importance of integration and interaction of multiple agencies in major incidents, safety research has not much to say about requirements, barriers, and factors for success of inter-organisational cooperation to sudden, extraordinary demands of major incidents (Comfort, 1990). Also little is known about the strategies for gathering information, and the procedures for the exchange and validation of information between different stakeholders in a major incident.

Inter-organisational cooperation shares some important features with teamwork although organisational culture plays an important role, too (Hofinger, 2009): Successful teams have shared goals, a common understanding of the situation, knowledge about each other, and clearly defined

responsibilities (Badke-Schaub, 2008). The literature on teamwork sees shared mental models as a key factor for successful teamwork in complex situations (e.g. Stout et al, 1999; Larsson & Rasmussen, 2008). The basis for a shared mental model of the varying organisations involved in a major incident is provided by a shared operational picture. This means that all stakeholders share knowledge about key factors of the current situation, such as the number of injured persons, the resources needed, and the development of the incident. In turn, the basis for a shared operational picture is communication and exchange of information.

As there are only few studies on inter-organisational cooperation in major incidents (e.g. Therrien, 1995; Svedin, 2007), the authors conducted an explorative, qualitative study striving to answer arising questions: What kind of information do members of the emergency services expect from other agencies? Who communicates when, where, how, and with whom? How do exchange, validation, and integration of information take place?

The requirements of creating a shared operational picture in the event of major incidents and the challenges of inter-organisational cooperation in major incidents were investigated in a German government-funded research project (LAGE). Additional data came from the authors' observations of a German National Crisis Management Exercise (LÜKEX). In this article the results of several field studies using different methods are presented. Qualitative data was gathered by observing exercises, expert interviews and in-depth document analysis of the relevant stakeholders. This paper addresses the most prominent issues, the first qualitative results of work in progress.

2.   Method

2.1   Background

The impetus to conduct research was given by the German Federal government research project LAGE as well as the German national Crisis Management Exercise LÜKEX.

Research project LAGE[1] - Integration of existing information-systems for joint crisis management

The 'Research for Civil Security' programme, adopted by the German Federal government in 2007, focuses among other issues on the improvement of the protection and rescue of citizens in major incidents. The research projects within the programme projects are funded by the German Federal Ministry of Education and Research; they promote innovative security solutions using a holistic approach by including governmental authorities and organisations but also local operators and universities.

The joint research project LAGE in which three of the authors are involved, tries to find solutions in the organisational, semantic and technical interoperability of responders, referred to as stakeholders, using a scenario-based approach. LAGE aims to achieve a shared operational picture, by facilitating the exchange of situation reports and other information. As a frame of reference for the stakeholders in expert interviews, the project uses the scenario of a rail accident occurring at the central station of a German hosting a big event in the vicinity of the station entrance.

German National Crisis Management Exercise LÜKEX[2]

The German Federal Ministry of the Interior contributes to disaster protection at state level through providing equipment and training. In case of a national threat or major incidents occurring across federal state borders, several different command and communication structures of the national government and federal states would align to form a uniform crisis management. In order to practice this, the strategic command exercise LÜKEX has come to play an important role in the efforts for strategic civil protection. LÜKEX has taken place within alternating German federal states regularly since 2004. The concept of LÜKEX mainly includes scenario-based exercises for incident command staff, but additionally involves exercises in some of the participating federal states for all management levels from incident command staff to the responders on-site.

The scenario of LÜKEX 2010 assumed terrorist attacks including chemical, biological, radiological and nuclear agents ('dirty bomb'). One major objective was the revision of inter-organisational

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[1] LAGE stands for 'Integration of existing information systems for joint crisis management' and is funded by the Federal Ministry of education and Research . Project: LAGE - Grant:13N10589

[2] LÜKEX stands for 'Länder Übergreifende Krisenmanagement-Übung/EXercise' (German National Crisis Management Exercise)

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accomplishments across several federal states by the crisis management teams. These had to cooperate closely in different dynamic situations. The authors all had the opportunity to observe components of the exercise.

2.2   Procedure and data analysis

Qualitative analyses include document analyses, semi-standardised expert interviews and non-participant observations.

In LAGE, document analyses for each stakeholder were conducted on official service regulations and web presence (Mayring, 2002). First findings were transferred into a category system including intra-organisational and inter-organisational specifications e.g. intra-organisational hierarchies and procedures, inter-organisational communication and cooperation, leadership and technical systems. Based on the document analyses category system, semi-standardised interview guidelines were developed for each stakeholder focusing on the LAGE scenario. Founded on this conceptual and procedural knowledge, nine semi-structured expert interviews (Flick, 2009; Mayer, 2004) were conducted with responsible persons and experts of seven stakeholders (figure 1 below). At the beginning of each interview, the scenario was verbally illustrated: a tank car accident happened at the main station of a German city where at that time a big event is hosted in the entrance area and the death and injury of many people is gathering.

Each interview was recorded after informed consent and lasted about 1,5h; psychologists and engineers conducted all interviews together. Qualitative content analyses were used to evaluate and summarize the transcribed expert interviews (Mayring, 2002).

In LÜKEX, a team of 12 observers (University of Jena; University of Siegen) carried out non-participant observation (Marshall, 1998): four incidents command staffs were observed as well as two operational commands. Observation protocol templates were developed on the basis of document analyses in LAGE and focused on inter-organisational communication but also on technical media and operational challenges on-site. Every observer recorded observations in written form. Observation protocols and video recordings were evaluated by qualitative content analyses (Mayring, 2002).

2.3   Set of participants - overview of relevant stakeholders

It is clear that a substantial number of diverse emergency services are active in different phases of emergency response. Although it was not possible to integrate all organisations in the study, the most important organisations in regard to the implemented scenarios were invited to participate. Relevant local and public stakeholders in LAGE and in LÜKEX were identified on several levels on a continuum from operational forces and first responders on-site, associate and superordinate strategic staff right up to the highest administrative special action committee members off-site.

Among all potential services involved to manage, the following were identified as most relevant for the assumed scenarios.

The fire brigade represented one of the most important stakeholders for the LAGE scenario. However, interviews in LAGE also covered the following stakeholders (figure 1): (State) Police – responsible for the protection of citizens; German Federal Police - with railway-police duties; German Rail Service (Deutsche Bahn AG) – the owner and operating company of the rail station; German Red Cross – one of several rescue services to administer first aid on-site; German Federal Agency for Technical Relief (Bundesanstalt Technisches Hilfswerk - THW) – for technical support in non-standard incidents; and Crisis staff of urban administration – with political and administrative liability.
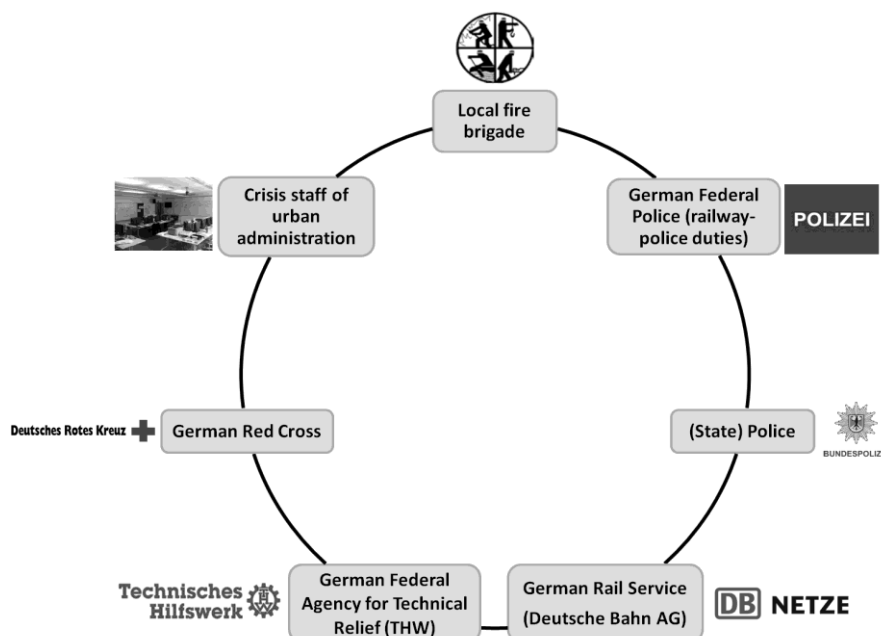

Figure 1: Overview of relevant stakeholders in a major incident in a German railway station (LAGE).

Observations in LÜKEX focused on two operational commands of fire brigades and three incidents command staffs of urban administration in three different German cities (figure 2).
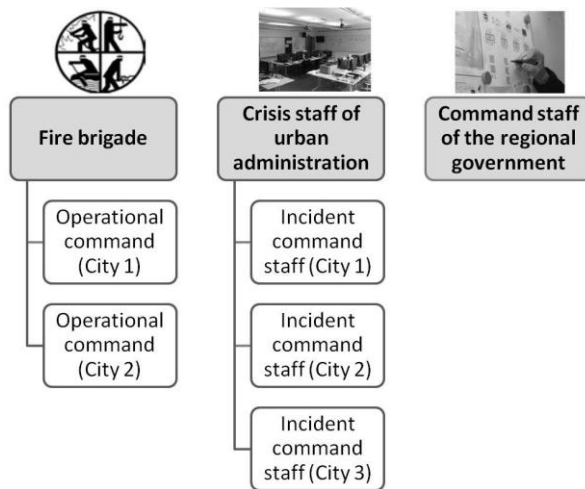

Figure 2: Overview of stakeholders in observations at LÜKEX 2010.

Both the semi-structured interviews in LAGE and non-participant observations in LÜKEX focused on the mid and upper levels of responsibility. They included the in charge personnel on-site, in order to understand their organisational background objectives and communicative needs.

3.   Results: Requirements in inter-organisational communication during operations

The following sections summarize first findings from the document analyses and expert interviews in LAGE and of the observations at the LÜKEX exercise.

Establishing and maintaining a shared operational picture

Stakeholders involved in the assistance at major incidents usually arrive on site at different times, depending on alerting procedures and organisational duties and responsibilities. Having arrived on-site, each stakeholder gathers focused information about the current operation in order to gain a realistic, up-to-date operational picture.

At the beginning of an operation, the first situation report of each stakeholder mainly summarises information about task-specific requirements, necessary to manage the current scene at once. Even though all stakeholders seem to gather information about so-called key aspects only a few stakeholders use defined standards to develop operational pictures. Key aspects are needed to determine the amount

and type of resources (responders and material) required to manage the disaster and achieve access to timely, valid information. Depth and detail of necessary information may vary. Later on, steady briefings about accomplishments and further tasks are included into situation reports. All stakeholders create their own operational picture as a basis for managing the different phases of the operation, e.g. allocation of personal resources. The stakeholder-specific situation reports provide the basis for inter-organisational communication (see figure 3).
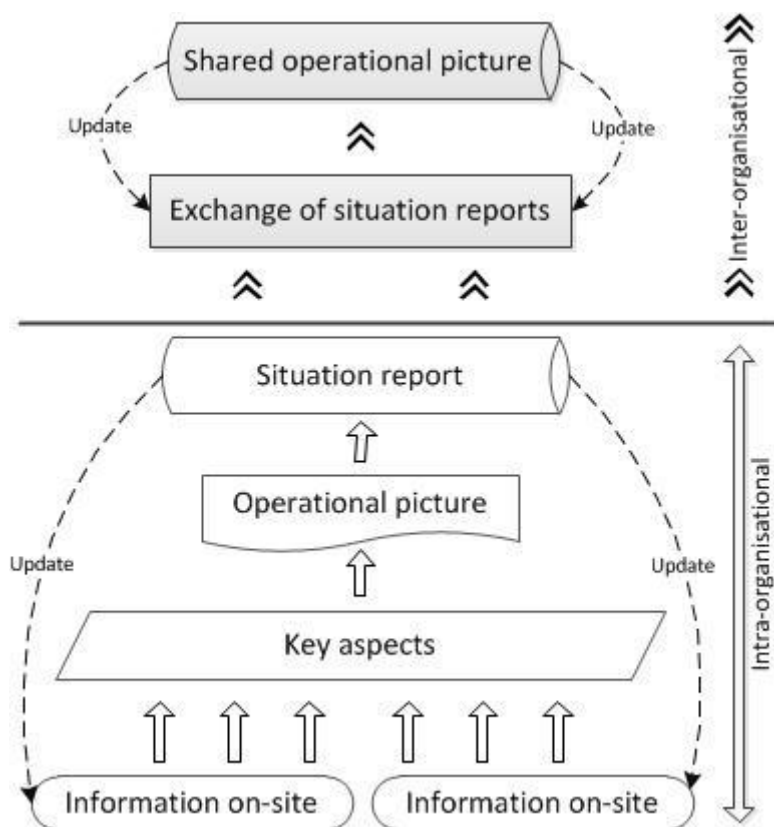

Figure 3: Building a shared operational picture on the basis of stakeholder-specific information.

Because of their crucial role for inter-organisational information exchange, the most important key aspects are described here in detail:

Information about the site of operation – This encompasses information on characteristics concerning the site of the operation. In LAGE, the site of operation is a central train station. Characteristics such as the exact location of platforms and waiting areas within the station, the size of the affected area and the unique features of railway stations, e.g. voltage on tracks, determine the site of operation. The site

and scale of the incident as well as the assumed duration of operation influence the number and relevance of stakeholders who have to come into action.

Number of affected and injured individuals – Major incidents may include large numbers of affected individuals. A mass-casualty incident can be described by the number of people affected and the severity of casualties of personnel and equipment.

Presence of acute (life-threatening) danger – The presence of hazardous substances or acute (life-threatening) danger increases the risk for individuals and responders being affected on-site. Especially at the beginning of an operation the cause and scale of the incident is unknown. Stakeholders need to find the reason and type of on-site danger to appoint further steps in operation accomplishment. With respect to cause and scale of acute danger, affected individuals may have to be evacuated from their homes and from the site of operation. Evacuation requires s additional time and personnel and needs to be planned well in a short space of time. The presence of hazardous substances requires, in most cases, special protective clothing and equipment for personnel. Specialists have to be requested and separate treatment areas have to be established, e.g. decontamination areas.

Weather conditions and forecast – Depending on the cause, scale and effects of the on-going operation, weather conditions must also be considered and communicated. Spread of noxious fumes or gas clouds might be influenced by directions of wind and rain. Extreme sunlight or heavy snow fall could influence the treatment and transportation of affected people and complicate operations for stakeholders. Consequently, stakeholders' personnel may need special clothing for protection.

Information about these and other aspects aggregates to an operational picture. When communicated to a higher management level, information is cumulated and summarised. Depending on the management level, operational details are given or the overall assessment of the situation is communicated. Not every detail is provided to the highest management levels; at each level situation reports provide high information density in order to support decision-making.

Exchanging information horizontally and vertically

The analysis of interviews and observations showed instances of inter-organisational communication in command staffs and between responders on-site. Also, different types of communication were found: face-to-face, in person by liaison officers, via radio/phone or via exchange of electronic documents. The particular challenge for all stakeholders is the continuous flow of information between different technical systems and consultants in order to manage the major incident. Yet, intra-organisational rules of communication may collide with this need, e.g. the regulations for sharing videos taken on-site.

The fire brigade represents one of the most important links within the communication network. In most incidents, the fire brigade takes the role of overall operation command. Inter-organisational communication takes place at different levels of operational hierarchies, horizontally and vertically: The overall operation command interacts and communicates with the other stakeholders' management levels whereas the fire brigade's local operation commanders assume the crucial role of contact person on-site for persons in charge of the other relevant stakeholders. As sometimes other stakeholders work under control of the fire brigade's operation command (e.g. the Red Cross), the fire brigade's operation commander has to communicate with his or her own operations sections commanders in addition to operation sections commanders of other organisations. This means that communication must not only transfer information but must also show awareness of the communication codes of hierarchy and status in cooperating organisations.

Some of the relations in this complex network of cooperation and communication are shown in figure 4.
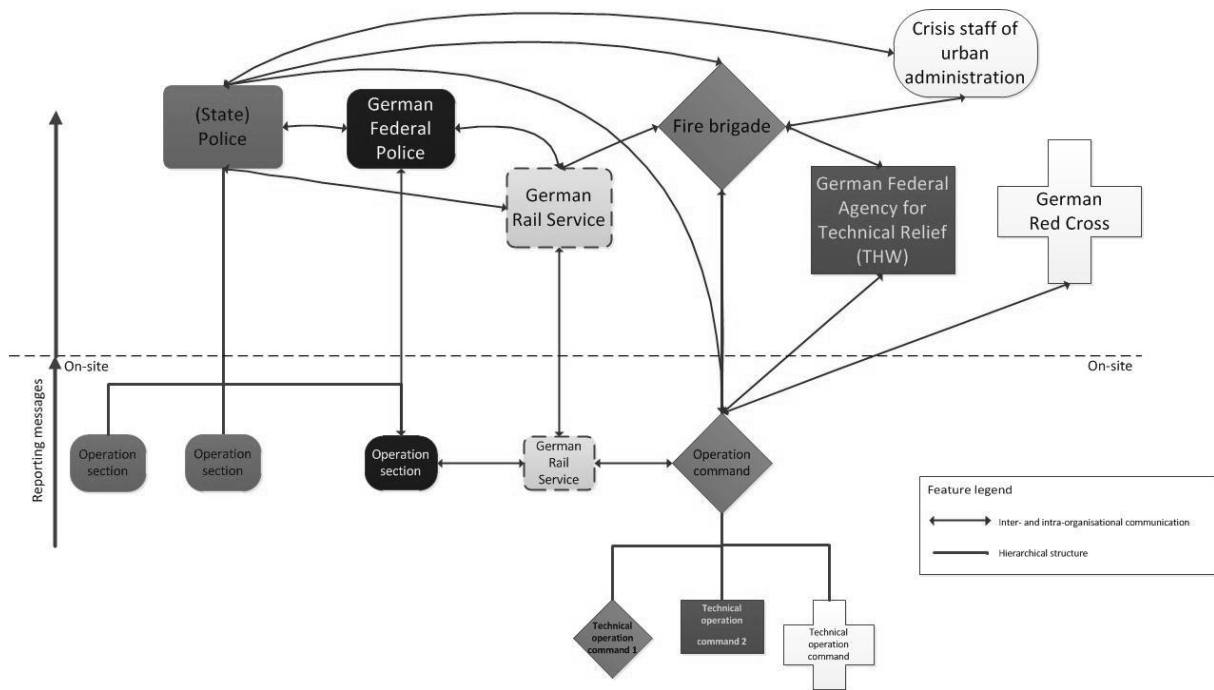
Figure 4: Structures of inter-organisational cooperation and communication in major incidents (exemplified picture on a railway station scenario).

Communication needs over time

Inter-organisational communication changes with the change in informational needs during the course of an operation. For example, the first responders arriving on-site have to identify the person in charge of further relevant organisations. This may be difficult if there are no clear symbols (e.g. markings on warning vests) declaring themselves prepared for operation. As more units move in, information is needed regarding approach coordination of the emergency vehicles and the spatial order, e.g. where to park or where to establish a treatment unit.

When exchanging situation reports between the stakeholders, the different informational requirements of every organisation have to be taken into account. Thus, a situation report is more meaningful to the other stakeholders if they know in advance the type of information required by the others in a certain phase of an operation. This is illustrated in the following example: The information on whether a fire is caused by accident or with intent is essential for every stakeholder. For the police however, it is more relevant in the early stages of the operation in deciding if the site should be declared a crime scene or not. If there is the possibility of a terrorist attack, t receiving information in this early phase is

also crucial for the fire brigades: the possibility of a secondary attack changes the tactics used in fighting the fire in order to be able to respond.

Towards the end of the operation, information is needed concerning the coordination when withdrawing forces and returning back to „daily routines".

The role of personal communication: liaison officers

As a way of inter-organisational support and in the exchange of information, stakeholders' liaison officers play a crucial role. In general, two ways of liaison officers' deployment can be found within an operation:

First, liaison officers may operate within an incident command staff of another stakeholder, continually delivering information about the on-going operation, resources, capacities and operational options of their own organisation. For example, a liaison officer of the German Federal Agency for Technical Relief might give an initial briefing to the fire brigade about available technical equipment. Besides bringing knowledge about their own organisation into the command staff, the liaison officer has to make sure that data, decisions, and enquiries are transferred quickly from the incident command staff to their own organisation.

Second, liaison officers can operate on-site. There, they are designated to transfer information to the operation command, e.g. the leading paramedic delivers status reports. He or she also serves as contact person for questions concerning medical treatment for the fire brigade or the police on-site.

Liaison officers ideally have many years of experience, hence – besides knowing what they are talking about – they can also rely on implicit knowledge about their own organisation and adjust communication to the organisational needs of their own and their liaison organisation. Since they are not authorised to make decisions about organisational operations, their role as consultants is based on respect. In the interviews it was found that liaison officers have often gained personal knowledge of liaison officers from other organisations. In so doing, they implement their personal acquaintance to simplify communication - In the same way shortcuts detouring the formal paths of hierarchies are found; an exchange between command levels officially not meant to communicate is possible (cf. Mc

Master and Baber, 2009). This kind of personal relation makes communication and cooperation effective (but may lead to replacing verification of information by trust in a person). The problems of generational change and the related loss of interpersonal contact have to be faced by the stakeholders in the future and will be explored in follow-up studies.

Exchanging and integrating information by technical means

Other than this personal channel of inter-organisational communication, stakeholders are technically in touch through (digital) exchange of current operational pictures, maps and operation log books. It was found that the technical exchange of information has its pros and cons:

A possible gain of technically transferred situation reports and maps is the reciprocal overview of current stakeholder-specific situation reports, which is a prerequisite for establishing a common operational picture. Despite electronic transfer, combining the different data of all stakeholders to meaningful information needs some active effort by operation command staff. If the technical systems could merge the situation reports automatically, the comparison and integration of data would become easier. In any case, integrating information accumulated by different stakeholders requires a high technical and mental effort.

Familiarity with the other organisations

The quality of relation between the liaison officers has been mentioned as an important factor. But also the level of familiarity of the organisations in general is relevant. Interviewees stressed the importance of shared experience: coping with real incidents certainly build strongest bonds, but also common exercises and trainings prior to the present operations help to build trust between organisations (e.g. Zinke, Hofinger & Strohschneider, 2010).

4.   Discussion: Communication challenges in processes and structures of organisations

Interviews and observations revealed some major communication problems. Mostly, it is not personal relations that hinder communication but misfits in structures and processes. The problems mentioned by interviewees are similarly found in the literature (e.g. Mc Master & Baber, 2009; see also Zinke, Hofinger & Strohschneider, 2010; Hofinger, Scheuerer, Zinke & Strohschneider, 2009). Factors that cannot be influenced during operations but in planning of inter-organisational cooperation are: technical and semantic interoperability, and structural fits of leadership concepts.

Technical and semantic interoperability

An often stated and prominent problem is the weakness of communication networks (e.g. Bytheway & Dhillon, 1996), especially the use of different IT systems and the lack of compatibility between them. Although inter-organisational information systems are known to entail greater interdependence (Williams, 1997), technical interoperability seems not to be on the agenda. So, exchanging electronic material and data is a challenge, even in the 21st century. As McMaster and Baber (2008) put it in their talk, "the case of technological interoperability is made by its absence".

But even when data transfer works, access to information is sometimes legally protected (e.g. police databases), so information cannot be used. The process of data exchange is complicated by the use of different and inconsistent formats and symbols in the operational pictures of each stakeholder. For example, the fire brigade uses a visual approach with symbols and characters on maps whereas the police operation command operates mainly with a verbal format in situation reports. This shows that technical interoperability is only one prerequisite for successful inter-organisational communication – semantic interoperability is another major challenge.

Semantic interoperability concerns linguistic and semantic standards. These are seen as crucial by interviewees (see also Vlaar, van den Bosch & Volberda, 2006). The variable use of keywords, technical terms and abbreviations easily leads to misunderstandings. One example is the classification of situations or injuries. For example, the stakeholders use different labels for serious incidents and do not always know the other classifications.

The scenario used in LAGE can be a "mass-casualty incident", a disaster, a major incident, a catastrophe etc. Also, the term "seriously injured" person (in German ‚Schwerverletzter') is not clearly defined between the organisations but relevant for all of them. As the semantics of a linguistic representation vary from organisation to organisation, even identical terms may trigger different mental images of the situation. Consequently, appraisals of the needs of resources (e. g. number of responding forces and type of equipment) do not match.

Beyond the standardisation of language and symbols, the stakeholders struggle with the lack of conventions for inter-organisational communication. Responders often simply do not know which other stakeholder urgently needs to receive specific information. There is no common regulation of the quantity and quality of shared information. Above all, this is why questions such as 'who needs which information from whom and when?' often remain ambiguous and unclear.

Structural fit

Another challenge for stakeholders lies in organisational differences. Each stakeholder might pursue, besides the overarching objective to manage the major incident, stakeholder-specific objectives conflicting with operation strategies and leadership concepts of another stakeholder. One example is the difference between fire brigade, State Police and Federal Police. Whereas fire brigade establishes an on-site leadership authority with general liability for decisions made, police operation command is situated off-site. The same holds true for the emergency control centres of the German Rail Service which sends its emergency manager to the accident location and may even direct p from another city. The leadership concept of the German Federal Agency for Technical Relief allows for management with an optional appointed off-site coordinating authority. Similarly to the German Red Cross on-site, it will most likely be subordinate to the operation command of the fire department in major incidents. As a result, responsible persons may be faced with the problem of losing contact due to spatial separation.

5.   Conclusion

Successful inter-organisational cooperation and communication of emergency services seems to be a complex challenge dependent on various factors, before the incident and during operations.

At the onset of extraordinary events, all stakeholders need to recognize existing damage and danger on-site by gathering information about key aspects in operational pictures. During operations, stakeholders complete and validate their information from other stakeholders. Therefore, the coordinated, unhindered and constant flow of information represents the basis of a shared operational picture among all organisations involved. In reference to the exchange of information, technical and semantic interoperability have to be given more attention in order to transfer intended information and achieve successful, meaningful exchange of data. In the course of the operations, each organisation's situation assessment has to be sensitive to the potentially different relevance a given situation may have for other stakeholders.

Technical solutions could offer a means for building shared operational pictures. But they cannot (and should not) replace the liaison officer. Personal communication remains relevant, relying on trust and familiarity. Furthermore, technical solutions seem to require common standards for reports which at the moment exist only within the stakeholders' organisations.

Besides solutions based on technical support, shared experience could foster awareness of different leadership concepts and other organisational issues such as resource allocation, hierarchy structures, (political) management levels, responsibilities and organisational culture. Common exercises seem to be one way to gain this kind of knowledge, as are opportunities for interaction during routine work.

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