

Organizing for the Big One – A Review of Case Studies on Multi-Agency Disaster Response and a Research Agenda

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ABSTRACT

Disaster response operations exceed the capacities of each single organization and thus require cooperation by at least two, often up to some hundred agencies who do seldom interact in their daily operations. The result is a complex problem of cognition, coordination, command and control. This paper presents a review of empirical studies on multi-agency coordination in disaster response operations in order to initiate and facilitate cross-case learning. The review covers 72 empirical studies and highlights the importance of themes such as plans and plan enactment, leadership or personal acquaintance of actors in emergent multi-agency response networks. The analysis also shows that while some themes received extensive coverage in scholarly publications (e.g. training, skills), various important topics have not been studied in sufficient depth (e.g. development of common operational pictures, plan enactment). Based on these insights, the review develops a research agenda and derives various recommendations for practical disaster response management.

Keywords:

Cognition, Communication, Coordination, Disaster Response, Response Plan, Review

INTRODUCTION

Disasters are low probability, high impact events that cause tensions in the social fabric of a collective (Lalonde, 2004). From a global perspective, disasters are a frequent occurrence (Coleman, 2006; Eshghi and Larson, 2008) and anthropogenic conditions increase the probability that disasters strike (Bouwer, 2011; Eshghi and Larson, 2008). Disasters cause human suffering and substantial economic and social damage and thus require an immediate response in the form of rescue or damage containment operations. Disaster response activities involve “providing emergency aid and assistance, reducing the probability of secondary damage, and minimizing problems for recovery operations” (Petak, 1985, p. 3). By definition, disasters cannot be managed with the resources of a single organization alone but require an immediate and effective response from multiple agencies (Shaluf, 2007). This implies an imperative for public administration to develop and maintain the capacity for effective coordinated disaster response management. Numerous records of sub-optimal disaster response operations show that this requirement is often not met (e.g. Schneider, 2005; Birkland and DeYoung, 2011; Moe and Pathranarakul, 2006).

Despite the importance of the topic, the insights we have on effective multi-agency coordination in disaster response management are fragmented. The reason is that, because of the complexity of the disaster event, most studies on disaster response management are in-depth case studies. Case studies are designed to provide “rich insights into a specific situation” (Yin and Heald, 1975, p. 371) and are therefore well suited to study disaster response operations. But learning across cases is difficult, as insights are typically presented in a highly contextualized manner. This is a problem for scholars, practitioners and policy makers alike. If research results remain isolated, it is difficult to draw conclusions or derive recommendations for a specific situation. For scholars, the multitude of case studies complicates the development of theory as well as the conceptualization of study designs, as it is not always clear where the important research gaps are.

This paper sets out to aid both researchers and practitioners by compiling a review of case studies on multi-agency disaster response. I evaluate a rich body of case studies published in the last decades, synthesize insights obtained and develop recommendations for the management of multi-agency disaster response operations. The review also proposes promising fields for future research.

METHODOLOGY

The aim of the following review is to consolidate insights obtained in case studies on multi-agency coordination in disaster response operations in the form of a systematic literature review (Tranfield et al., 2003). In order to keep the review focused, I excluded studies dealing with other stages of disaster management (disaster planning, preparedness and recovery), studies on communication with stakeholders not involved in the disaster response operation (e.g. the media or the general public) and studies focusing on technical aspects of disaster response (e.g. emergency nursing). I then restricted the analysis to papers published in peer-reviewed scholarly journals, in order to insert a lower bond regarding methodological rigor and to obtain an academic focus (cf. Birkland, 2009). I developed a sample of studies and conducted a within-case and cross-case content analysis. Finally, I developed a synthesis of salient issues across the case studies. I consider an issue to be salient when it has been discussed in at least two studies (cf. Beck and Plowman, 2014).

To develop the sample of studies to include in my analysis, I began with a search for the keywords “disaster management” and “emergency management” applying the Google scholar database (for a delineation of these terms from the related term “crisis management” cf. Shaluf et al., 2003). I then followed citation trees up (via the “cited by” mechanism of Google Scholar) and down (via evaluation of references sections). To complement the sample, I read title and abstract of all articles appearing in several particularly relevant outlets, starting with the respective Iss. 1 in 2003: Disasters, the Journal of Contingencies and Crisis Management, Disaster Prevention and Management, Public Administration Review, the Journal of Public Administration Research and Theory as well as *Voluntas*, and *Nonprofit and Voluntary Sector Quarterly*. I collected all articles referring to multi-agency disaster response management in title or abstract. To improve comprehensiveness, a graduate student conducted a comparable, independent literature search. These initial searches led to a sample of 531 articles. From those, I selected empirical studies on multi-agency coordination in disaster response management focusing on specific and identifiable disaster events. All papers who did not meet the inclusion criteria mentioned above were deselected. The result was a final sample of 68 papers providing 72 analyses (various publications provided more than one case study). Table A.1 in the appendix lists the included studies. Although this approach cannot claim exhaustiveness, the resulting sample covers the large majority of academic publications on the issue and is therefore an appropriate basis for a literature review.

I then coded core characteristics of these 72 cases (Hoon, 2013): the type of disaster under observation (natural, technical, terrorist, exercise), the socio-economic setting it took place in (urban/rural, developed/developing country), the level under observation (staff/on scene), and the data source (interviews, secondary data, field observations, personal experience, surveys). I also coded which organizations were in the focus of a study (first responders, professional staff, governmental staff, non-governmental organizations (NGO, e.g. Red Cross or *Medecins Sans Frontieres*), others). The review begins with an in-depth analysis of study content. Afterwards, I study the importance of these case contingencies.

CONTENT ANALYSIS

I apply a modified version of the 4C framework suggested by Comfort (2007) as a structure for the review. The aim of this framework is to arrange multi-agency disaster response activities around “critical terms” (Comfort 2007: 191). These “critical terms” are cognition, communication, coordination & command and control & feedback. Cognition is the process of perceiving signals and utilizing those signals to mentally establish a reliable prediction of future events (Comfort, 2007). Cognition refers to the interpretation of sensory inputs for strategy development and tactical decision-making as well as an input for downstream and upstream communication. Communication concerns the shared development of a continuously updated common operational picture as a basis for coordination and decision-making (Comfort, 2007; Cramton, 2001; Reddy et al., 2009; Wolbers and Boersma, 2013). Coordination addresses the alignment of actions as well as the distribution and commitment of resources, while command is the allocation of decision-making power within an emergent disaster response network as well as the agencies’ ability and willingness to lead or be subjected to leadership (Comfort, 2007; Faraj and Xiao, 2006). In order to successfully manage a complex disaster response operation, all these “critical terms” must be met in a satisfactorily way. Therefore, this structure is a useful anchor for the evaluation of the

cases in my sample. For the purpose of the review, I split the “control & feedback” theme and added feedback to the topic of communication and command to control. The reason is that within the case studies examined in the review, feedback always refers to communication activities and coordination and command are also typically discussed in unison. I therefore found a 3C-adoption most appropriate as a structure of the review. Cognition and communication provide the ground for coordination, which affects disaster response performance. Cognition and communication interact, as communication processes require cognitive evaluations, while communication provides inputs for cognitive activities and is, in turn, affected by the coordination structure of a disaster response system. Figure 1 gives an overview over the framework as applied in the following analysis.

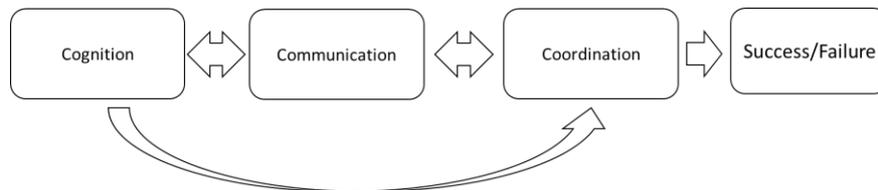


Figure 1: Analytical framework, adopted from Comfort (2007)

COGNITION

The cognitive appraisal of the event is a challenge decision-makers on all levels face. The most prominent issue in the field of cognition is the importance of experience and skills. Experience and skills, acquired through training or practical exposure, are both necessary to develop routines required for performing tasks under conditions of time pressure and situational complexity (Schraagen and Ven, 2011; Kilby, 2008; Telford and Cosgrave, 2007). Experience is also necessary to enact communication and coordination plans, as these typically require familiarity with the respective system and terminology (Lutz and Lindell, 2008). Disasters are rare events for each person; it is therefore unlikely that much practical experience exists. Trainings or exercises are therefore required to provide an environment where skills and experience can be developed.

Stress and physical exhaustion are troublesome for cognitive tasks in disaster response management, as stressors such as time pressure, ethically problematic decisions, high-stake decisions, physical danger and high work load are typical for work under disaster conditions (Flannery and Everly, 2004; Paton and Flin, 1999; Crichton et al., 2005; Connelly, 2006). Stress hampers the ability to develop situation awareness in complex task environments (Endsley, 1995), and causes decision-makers to apply standard behavior and reactive instead of forward-looking planning (Crichton and Flin, 2001) as well as to neglect small clues (Weick, 1990). Stress and physical exhaustion may also lead to decision paralysis and reduced communication capabilities (Schneider, 2005; Waugh, Jr., 2007). Stress is therefore a particular problem for persons in coordination functions. One way to reduce stress and physical exhaustion is careful workload management, another option is to provide means for recovery, for example in the form of recreation areas (Connelly, 2006). Withdrawing key personnel from coordination responsibility early might be a good strategy to avoid costly errors in judgment and decision-making.

Artifacts, such as maps, shared information spaces, whiteboards have been shown to be helpful to structure inputs and thus develop a shared understanding on the staff level (Salmon et al., 2011). The downside of in particular sophisticated tools like shared information spaces is that they are also costly in terms of time and mental capacity, which makes them less useful under conditions of resource strain, high workload and time pressure (Moynihan, 2008). It is therefore recommendable to allow sufficient resources to utilize the options artifacts offer or, if that is not possible, refer to simple tools such as whiteboards or maps.

COMMUNICATION, CONTROL & FEEDBACK

The availability of a technical communication infrastructure is a strong predictor of success or failure in disaster response activities. Large-scale natural disasters often destroy the technical infrastructure (Celik and Corbacioglu, 2010; Yang, 2010; Wise, 2006), but an unreliable technical infrastructure has also been reported independently from the immediate disaster effect (Linnenluecke and Griffiths, 2013; Okumura et al., 1998; Simon and Teperman, 2001). Incompatibility of communication devices employed in different agencies is also a frequent problem (Dawes et al., 2004; Kapucu, 2006; López Carresi, 2008). An inoperational communication infra-

structure hampers or even prevents coordination and command. A reliable communication environment is therefore critical for effective multi-agency disaster response management. Redundant communication systems (e.g. radio, mobile phone, amateur radio networks, text messaging) are recommendable to preserve the ability to communicate under disaster conditions (Kapucu, 2006; Garnett and Kouzmin, 2007).

For effective communication, it is important to decide which information to share. Too much information sharing overcrowds communication channels as well as information processing capacities of decision-makers. Too little information sharing results in a situation where decision-makers lack the necessary inputs to develop an accurate operational picture (Reddy et al., 2009; Sobel and Leeson, 2007). Training and practical experience help establish a shared understanding of roles and information demands, either directly, through professional knowledge of the roles of others, or indirectly, via personal acquaintance (Salmon et al., 2011; Olejarski and Garnett, 2010).

Communication plans are generally the simplest and most straightforward means to solve information allocation problems in multi-agency disaster response operations, but those plans need to be up to date when disaster strikes, the more so the more detailed they are. If particular persons or roles accounted for in a communication plan are not actually present or contact information is incorrect, communication plans become a liability (Cygank, 2003; Ahmadun et al., 2003). It is also important to have only one, unifying, plan in place, instead of various parallel plans (Wise, 2006). Personal acquaintance between key people compensates for the lack of formal communication plans, providing a shortcut for information relay (Nolte and Boenigk, 2011; Olejarski and Garnett, 2010; Waugh, Jr., 2007), provided that these key people have a solid working relationship (Garnett and Kouzmin, 2007).

Communication networks in disaster response activities are often centralized (Butts et al., 2007), meaning that few people receive the bulk of the information communicated throughout the network. These network nodes have a filtering function, they collect information from various sources and decide which information to relay (Crichton et al., 2005). The implication of a centralized communication network is a high structural probability that network nodes will be overburdened, in particular if these central persons are also responsible for decision-making and coordination. If these nodes are ineffective, sub-networks might be cut off from information flows (Okumura et al., 1998). In addition, overburdened decision-makers tend to revert to a reactive decision-making style, which has been found to be inferior to pro-active decision-making (Helsloot, 2005; Lalonde, 2004). It is thus critical to identify network nodes in communication networks and either provide the necessary resources to ensure communication efficiency or de-centralize the communication network. López Carresi (2008) suggests different communication channels for different coordination activities to compensate for overcrowded information channels. This comes at a price, though. Parallel communication channels have been shown to cause information loss (Helsloot, 2005), while “listening in” seems to be helpful for coordination (Weeks, 2007).

Individuals and agencies must be willing to share information and must be prepared to be coordinated. This is often problematic when political or strategic interests not related to the disaster response activity intervene, a frequent problem with NGOs (Berlin and Carlström, 2011; Perry, 2007; Telford and Cosgrave, 2007) and political agencies (Birkland and DeYoung, 2011; Olejarski and Garnett, 2010). In such a case, persons or agencies tend to withhold information, act in an uncoordinated way or commit resources based on individual instead of strategic considerations. This phenomenon is well known in social psychology under the term impression management (Leary and Kowalski, 1990; Patriotta and Spedale, 2009). Alongside ineffective information sharing and resource deployment, actions driven by an impression management motive also tend to hamper the development of trust (Garnett and Kouzmin, 2007). Trust, in turn, has been shown to increase the willingness to share information and initiate cooperation (Karp et al., 2007; Dawes et al., 2004; Saab et al., 2013). Through this mechanism, few agencies following an impression management logic have the potential to disrupt the effectiveness of the larger operation. Trust develops through successful cooperation over time (Kapucu, 2006; Saab et al., 2013; Beck and Plowman, 2014) and is thus of particular importance in decentralized disaster response operations where collaboration is not enforced by means of hierarchy (Kapucu, 2006). In the absence of self-serving agendas and problems related to impression management, the involved agencies often develop a shared identity as being part of the disaster response effort (Beck and Plowman, 2014), which in turn encourages prioritizing the overall goals over the tactical or strategic goals of one’s own agency. No strong solutions for the problem of impression management has been brought forward. Self-organization and delegation reduce the need for cooperation and might therefore limit the effect of trust and impression management issues and a strong vertical hierarchy might also mitigate the problem (Adrot and Moriceau, 2013; Kapucu, 2006), but both strong centralization and decentralization come at a price (cf. below).

The willingness to share information and to engage in coordinative activities also depends on personality characteristics of intra-agency decision-makers. Lalonde (2004) found three different archetypes: collectivist, reactor and integrator. Olejarski and Garnett (2010) later added the paralytic as a fourth type. Collectivists communicate

very actively, integrators show a problem-oriented approach towards communication. The other two archetypes tend to stall information flows, which is often problematic. Currently, we have limited understanding of how decision-makers in disaster response activities come to act according to one of these archetypes. It seems likely that intra-personal as well as organizational and situational contingencies play a role.

COORDINATION & COMMAND

Effective coordination requires a clear idea of command structures, the roles involved agencies play in the joint effort and the capabilities and resources these agencies have at their disposal (Stephenson, 2007; Wise, 2006; Comfort, 1994). A coordination plan outlines roles and command structures (Comfort, 1994) and substantive coordination problems occur regularly when such a plan is missing (Moe and Pathranarakul, 2006; Ana et al., 2007; Wise, 2006) or not enacted, e.g. in early stages of a disaster response activity (Beck and Plowman, 2014). Persons and agencies subjected to coordination require a clear understanding of the plan in order to be able to enact it (e.g. Olejarski and Garnett, 2010; López Carresi, 2008; Col, 2007). Dawes et al. (2004) conclude that the main role of disaster response plans should not be to prescribe action but to inform about roles, responsibilities, scenarios and potential threats. The plan needs to be as lean and simple as possible, to limit the amount of training necessary to successfully enact it in a disaster response situation (cf. Moynihan, 2008). Successful enactment of a plan requires training in the form of exercises and/or practical exposure (cf. above). Exercises are also important for plan development. They can serve as stress tests for coordination plans (Salmon et al., 2011; Lutz and Lindell, 2008). If a plan works poorly in a training scenario, re-specification might be required. The presentation of the plan is also important, e.g. through a visualization of each agency's role in the response plan (Salmon et al., 2011; Militello et al., 2007). Physical artifacts also benefit coordination on the operational level, e.g. to clarify roles and identify decision-makers at the disaster site (Ardagh et al., 2012).

There is a long-standing debate regarding how centralized coordination should be, or, to frame it in terms of network perspectives, to what degree decision-making should be distributed among network actors in a disaster response system (Garnett and Kouzmin, 2007). Centralized coordination and decision-making allows strong strategic planning and resource deployment and facilitates the development of a common operational picture but is also demanding regarding leadership, information processing and decision-making. Decentralization allows more flexible and potentially more resilient operations, at the cost of a loss of capacity for strategic action (Thévenaz and Resodihardjo, 2010; Phillips et al., 2008; Kilby, 2008; Simon and Teperman, 2001; Cheng, 2013). Leonard and Howitt (2010) state that decentralized decision-making is less risky, as it allows quicker reactions to occurrences on scene, in particular when upstream communication is difficult. Centralized coordination creates a bottleneck. If this bottleneck is wide enough, i.e. if the coordinating person or agency is capable (in terms of resources as well as skills) to process incoming information, develop a common operational picture, coordinate action and utilize the available resources, centralized command is superior to decentralization. If the bottleneck is too tight, the damage to the disaster response system is severe, as resources and capabilities will remain under-utilized, decisions might be stalled or not taken at all and a common operational picture will not be in place or be inaccurate, implying a heavily reduced capacity for effective and efficient strategic and operational coordination.

Another coordination problem is lack of leadership, in particular on the staff level, which can result from information or work overload (Linnenluecke and Griffiths, 2013; Helsloot, 2005), lack of mental resilience (Crichton and Flin, 2001; Schneider, 2008) or lack of expertise and experience (Parker et al., 2009; Thévenaz and Resodihardjo, 2010). Lack of leadership leads to reactive or paralytic decision-making on the staff level and uncoordinated and often ineffective action on ground and thus to poor coordination, isolation of efforts, misplacement of resources and duplication of efforts (Lalonde, 2004; Olejarski and Garnett, 2010). This problem tends to be most salient in early stages of a disaster response event, where roles and structures have not been established and time pressure is particularly high (Beck and Plowman, 2014). Observant and careful staffing, intense training as well as an efficient coordination and communication plan are the means to keep this problem under control.

A less studied coordination problem is bureaucratic decision-making. Bureaucratic decision-making has been found to hamper coordination activities in some cases (Sobel and Leeson, 2007; Weeks, 2007), but the insights obtained are isolated. Cultural heterogeneity might be a problem for multi-agency coordination in international operations (Schaafstal et al., 2001; Phillips et al., 2008; Perry, 2007). We have various reports that cultural issues turned out to be problematic regarding the relationship between disaster response agencies and people in need (Cheng, 2013; Phillips et al., 2008), but there is little research on the effect of heterogeneous cultures on communication and coordination between agencies. Trust, as a pre-condition for successful coordination, is also an important topic in the field of coordination & command, as already discussed above.

CONTINGENCY CONDITIONS

The next step in the analysis is to study the significance of case characteristics. The following table (table 1) displays a descriptive analysis of the sampled studies. Based on a cross-tabulation of findings from the studies included in the review, I evaluate if these case characteristics affect the insights obtained.

		Studies in total
Type of disaster	Natural	49 (68 %)
	Technical breakdown	8 (11 %)
	Terrorist attack	10 (14 %)
	Exercise	5 (7 %)
Urbanization	Urban	43 (60 %)
	Rural	29 (40 %)
Economic status	Developed country	56 (78 %)
	Developing country	16 (22 %)
Focal agency	First responder, SAR2, Hospital	17 (24 %)
	Professional staff	16 (22 %)
	Governmental staff	26 (36 %)
	NGO	4 (6 %)
	Other	9 (13 %)
Level	Staff/Command	34 (47 %)
	Operational	23 (32 %)
	Both	15 (21 %)
Methodology1	Interviews	25 (35 %)
	Primary data (surveys etc.)	4 (6 %)
	Personal experience (author was part of the disaster response effort)	3 (4 %)
	Field observations (author observed the disaster response effort)	9 (13 %)
	Secondary data (reports etc.)	55 (76 %)

Table 1: Contingency conditions (1: Various studies build on more than one data source, percentage relates to the total number of studies in the sample and do therefore not sum up to 100 %. 2: SAR: Search And Rescue.)

First, we have a focus on developed countries, while disasters in developing countries receive only scarce coverage. Even when disasters in developing countries are in the focus of a case study, those studies often examine the actions of first-world organizations. Examples are cases on western organizations acting in the aftermath of the Pacific Tsunami in 2004 (Telford and Cosgrave, 2007; Perry, 2007) or the Haiti Earthquake 2010 (Yates and Paquette, 2011; Nolte and Boenigk, 2011). Considering that training and planning play a crucial role for successful disaster response (cf. above) and also considering that developing countries seldom have the resources to train personnel in the extent developed countries do, this lack of research regarding disaster response in developing countries is regrettable. Lack of planning (Moe and Pathranarakul, 2006; Bang, 2012), skills and coordination (Ana et al., 2007) have been shown to impair disaster response efforts in developing countries, while autonomy and flexibility have been shown to be helpful (Phillips et al., 2008; Kilby, 2008). These few studies indicate that developing countries would require somewhat modified approaches to multi-agency disaster response management compared to developed countries, likely focusing on local autonomy and flexibility, but the literature is currently too thin to deduct strong recommendations.

Disaster response operations in urban vs. rural environments propose somewhat specific challenges regarding in particular the management of dysfunctional infrastructure or the need to cover large areas in search missions, but the differences coordination, communication, command and control are not substantial in my dataset. In urban environments, information overflow seems to be a somewhat larger problem (Dawes et al., 2004; Butts et al., 2007), while the spatial extension of operations in rural settings occasionally posed a specific challenge for the development of a shared mental model (e.g. Beck and Plowman, 2014; Smith and Dowell, 2000). This implies that in rural environments, an appropriate command structure would involve a larger degree of decentralization,

e.g. in the form of local hubs instead of one central headquarter (e.g. Beck and Plowman, 2014). The effect of other issues, such as skill, coordination and leadership, does not visibly change contingent upon the urbanization of the target area.

The studies sampled for this review show a focus on natural disasters, but there is no indication in the data that the cause of a disaster mattered regarding multi-agency disaster response. Regarding the focal agency, we see a rather specific pattern, based on the roles these actors have in a multi-agency disaster response activity. While first responders and on-scene staff struggle with problems of reconnaissance, the technical infrastructure, technical skills, plan enactment and information sharing (e.g. Lutz and Lindell, 2008; Kapucu, 2006), coordinating staff faces issues such as information overload, communication or (lack of) experience (Comfort, 1994; Wise, 2006). Governmental staffs and NGOs both tend to suffer from lack of experience and, in particular impression management (Parker et al., 2009). In sum, we see that the challenges for the personnel on ground and the staff coordinating a disaster response effort differ. Still, this distinction is straightforward and based on the specific roles in the operation.

Regarding methodology, secondary data, such as available reports prepared for governmental bodies are by far the most relevant data source for case studies in the field. For 39 studies, secondary data was actually the only data source employed to build the case. Considering that secondary data is often of doubtful quality (Birkland, 2009), this is an at least dangerous choice of method. Insights obtained in a case study rest on more solid ground if scholars aim to acquire own data, either in the form of interviews, surveys or observations or, preferably, a combination of different sources and methods (Bansal and Corley, 2011; Gioia et al., 2012). A good example for a study resting on strong data is the case study of Beck and Plowman (2014) on the Columbia shuttle recovery mission in 2003. The authors conducted interviews, evaluated secondary data (e.g. meeting notes and media reports) and archival data and drew on observations. Although it is clear that not all studies can or need to be that broad regarding data acquisition, a multi-source approach is advisable. Still, the choice of method has no visible impact on study results.

DISCUSSION

As a next step in the cross-case analysis, the following framework (figure 2) depicts the relationships emerging from the literature and, considering that it incorporates 72 case studies, it is surprisingly consistent. This is so because insights overlap to a large degree between the case studies. The arrows in figure 2 indicate positive (solid line) or negative (dashed line) relationships. Dotted lines imply that the direction of an effect is contingent upon other conditions.

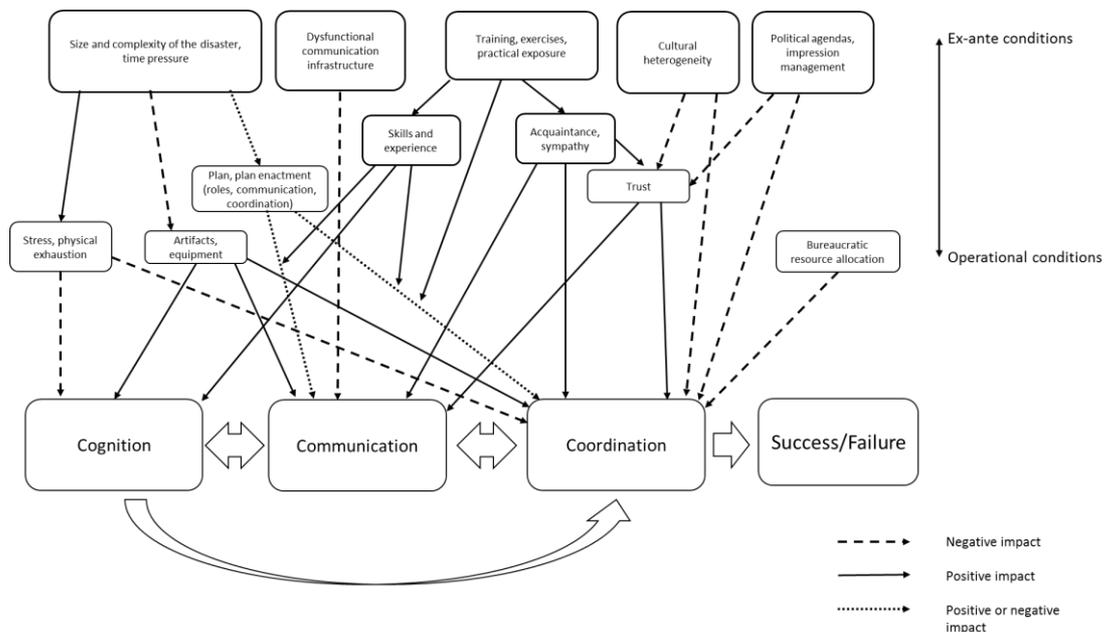


Figure 2: Integrative Framework. Source: the author

Operational conditions or decisions often mediate the relationship between pre-disaster conditions and cognition, communication and coordination. Trust, for example, affects coordination and communication and is affected by acquaintance, training, cultural heterogeneity and political agendas. There are only two cases of moderation in the framework: skills and experience moderate the relationship between plans and communication as well as coordination. Most relationships are clear in direction and causation. Some topics require a discussion, though.

One of these is plan enactment. The existence of a plan outlining communication and coordination structures is of central importance for successful disaster response. Disaster size and the availability of resources in the command staff are the most important contingency regarding how the coordination plan should look like: For large-scale disasters or those with restricted capacities in central command, plans with decentralized coordination structures are appropriate. For small-scale operations or larger operations with a well-staffed and well-trained command, a stronger centralization is preferable. This is a gradual decision. Communication plans should in both cases be abstract, referring to roles and functions, not to specific persons. The most important function of a plan is the definition of roles, ideally with a hands-on prescription how these roles should be enacted in a disaster situation.

Exercises also have a central place in the framework. Exercises are critical through four mechanisms. Firstly, they provide a platform to develop advanced work-related skills and decision-making capacities (Dunbar and Garud, 2009; Klein, 1995). Larger exercise also create opportunities to learn from other organizations (Moynihan, 2008). Secondly, exercises provide the chance to expose people to the disaster response plan, the roles of the participating agencies, duties and obligations, to information requirements and command structures of other agencies, setting the ground for successful plan enactment. Thirdly, inter-agency training fosters personal acquaintance between key personnel. Personal acquaintance is a powerful tool for self-coordination, a baseline for a shared understanding of roles and information demands and a fallback position when the hierarchical command structure fails (Kapucu, 2006; Cramton, 2001; Phillips et al., 2008; Dawes et al., 2004). Exercises finally allow evaluation and improvement of disaster response plans. If a plan does not work well in an exercise, revising the plan could be a good idea. A good exercise should therefore account for all these training goals. Training can be supplemented by practical experience, but the ability to do so is obviously limited by the rareness of the disaster event. There is also the danger of adverse learning, as success in complex operations might be causally miss-attributed when lucky circumstances caused positive outcomes or vice versa (Dunbar and Garud, 2009; Roese and Olson, 1996; Moynihan, 2008). Serious and honest after-action analyses or other appropriate learning forums improve learning from exercises as well as from practical exposure (Leonard-Barton, 1990; Leonard et al., 2004; Moynihan, 2008).

In general, it seems advisable to think multi-agency disaster response management in terms of contingencies and backup plans (Dawes et al., 2004). What happens if one part of a pre-planned disaster response system fails? What happens if an important factor develops differently than expected? Typical contingencies are the collapse of the communication infrastructure, the absence of key personnel and, subsequently, loss of leadership, or a need to rely on inexperienced personnel. Planning for this type of situations in advance would substantially improve the resilience of a multi-agency disaster response operation.

An unresolved problem is the disruptive role of impression management and un-skilled leadership. The practical solution is to staff key roles with agencies and persons likely not influenced by these motives and to establish a strong command structure. Decision-makers in operational disaster response activities require extensive expertise. Key decision-makers should thus be well-trained professionals from the field and not, for example, politicians or other non-professionals. Political leadership is important, in particular regarding stakeholder communication and legitimation of trade-off decisions, but the operational management of disaster response activities requires expertise political leaders will typically not have and/or will be reluctant to build (Boin and 't Hart, 2003; Schneider, 2005). Accordingly, most studies focusing on decision-makers from a political background conclude that the respective disaster response activity suffered from sub-optimal leadership.

RESEARCH AGENDA

Over all, findings overlap strongly between studies, implying that the consistently reported themes depicted in figure 2 are of general importance for multi-agency disaster response management. These core themes are largely understood. There are various gaps in the literature, however. First, research on disaster response management is currently very descriptive and focused on highly visible phenomena, and we have a very limited understanding regarding the reasons, preconditions and consequences of observed relationships. For example, we know that a clear understanding of roles is important, but we do have, at best, a fragmented idea of how people and agencies in disaster response activities arrive at a clear understanding of roles. Roles need to be enacted by role-typical behavior (Bechky, 2006) and, although the roles of individuals within organizations are fairly stable, the roles of individuals and agencies in complex task environments such as a multi-agency disaster response activity are

often not clear from the outset, but are negotiated and enacted during action (Beck and Plowman, 2014).

We also know little about what personality characteristics discern effective from less effective leaders. The notion of leader archetypes brought forward by Lalonde (2004) is an important step, but the conditions for the emergence of these archetypes are not well understood, neither are the consequences (Moynihan and van Wart, 2013).

The notion that stress plays a role suggests that other factors influencing cognition and decision-making, such as emotions (Barsade, 2002; Catino and Patriotta, 2013; Epstein, 1994) or mindfulness (Dane, 2011; Brown and Ryan, 2003) might also be important. The significance of the sensemaking process for intra-personal and intra-agency decision-making has been shown impressively in other literatures (Weick, 1993; Maitlis and Sonenshein, 2010), still we do not know how sense is made in a multi-agency framework. Considering cognitive and affective underpinnings of effective multi-agency coordination would be the next step towards a theory of disaster response management, which is currently only vaguely visible on the horizon.

Finally, there is an evident need to develop insights into disaster response operations in developing countries, i.e. under conditions where resources are scarce, the infrastructure is not overly well developed and frequent training and generous staffing cannot be had. Currently, we have very limited insights into how multi-agency systems could work effectively under these conditions.

CONCLUSION

This paper synthesized the findings of 72 case studies on disaster response management. Although the cases under observation are very heterogeneous on various dimensions, a limited number of themes emerge, with rather stable observed relationships. For practical disaster response management, the main insights are that the development of a well-tailored plan and effective training are of paramount importance. A disaster response plan should outline roles and responsibilities and prescribe a command structure as decentralized as necessary and as centralized as possible. A good disaster response strategy should also include what-if thinking. Some conditions pose frequent problems for disaster response plans, in particular the collapse of telecommunication infrastructure, a shortage of skilled personnel and an unanticipated magnitude of the disaster event. Disaster response plans should allow for these contingencies. Training provides skills, informs about roles and responsibilities, builds informal networks and serves as a stress test for disaster response plans. Regarding theory and research needs, we see plenty of open questions, which would require deductive research approaches. Sensemaking processes, the dynamics of role-taking, cognitive and affective processes in leadership and coordination all require scholarly attention. We came a long way in understanding multi-agency coordination in disaster response, but the impression is that the journey has just begun.

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Appendix

Table A1: Studies included in the review

Author	Title	Journal	Year
Okumura, Tetsu et al.	The Tokyo Subway Sarin Attack Disaster Management, Part 1: Community Emergency Response	Academic Emergency Medicine	1998
Nohrstedt, D.	Explaining Mobilization and Performance of Collaborations in Routine Emergency Management	Administration & Society	2013
Cheng, Shuhui Sophy	Crisis Communication Failure: A Case Study of Typhoon Morakot	Asian Social Science	2013
Leonard, Herman B.; Howitt, Arnold M.	Organising Response to Extreme Emergencies: The Victorian Bushfires of 2009	Australian Journal of Public Administration	2010
Weeks, Michael R.	Organizing for disaster: Lessons from the military	Business Horizons	2007
Militello, Laura G.; Patterson, Emily S.; Bowman, Lynn; Wears, Robert	Information flow during crisis management: challenges to coordination in the emergency operations center	Cognition, Technology & Work	2007
Schraagen, Jan Maarten; Ven, Josine	Human factors aspects of ICT for crisis management	Cognition, Technology & Work	2011
Kapucu, Naim	Interorganizational Coordination in Dynamic Context: Networks in Emergency Response Management	Connections	2005
Simon, Ronald; Teperman, Sheldon	The World Trade Center Attack: Lessons for Disaster Management	Critical Care	2001
Connelly, Mary	IMERT Deployment to Baton Rouge, Louisiana in Response to Hurricane Katrina, September 2005	Disaster Management & Response	2006
Cyganik, Kimberly A.	Disaster preparedness in Virginia Hospital Center-Arlington after Sept 11, 2001	Disaster Management & Response	2003
Sariego, Jack	CCATT: A Military Model for Civilian Disaster Management	Disaster Management & Response	2006
Ahmadun, Fakhru 'L Razi; Shalu, Ibrahim M.; Aini, Mat Said	Review of an incident at a petrochemical plant	Disaster Prevention and Management	2003
Moe, Tun Lin; Pathranarakul, Pairote	An integrated approach to natural disaster management: Public project management and its critical success factors	Disaster Prevention and Management	2006
Ana, G.R.E.E.; Sridhar, M.K.C.; Olakunle, E. O.; Gregory, A. U.	Bomb explosions, environment and health: a Nigerian experience	Disaster Prevention and Management	2007
Phillips, Brenda; Neal, Dave; Wickle, Thomas; Subanthore, Aswin; Hyrapiet, Shireen	Mass fatality management after the Indian Ocean tsunami	Disaster Prevention and Management	2008
Salmon, Paul; Stanton, Neville; Jenkins, Dan; Walker, Guy	Coordination during multi-agency emergency response: issues and solutions	Disaster Prevention and Management	2011
Hur, Joon-Young	Disaster management from the perspective of governance: case study of the Hebei Spirit oil spill	Disaster Prevention and Management	2012
Bang, Henry Ngenyam	Disaster management in Cameroon: the Lake Nyos disaster experience	Disaster Prevention and Management	2012

Richardson, Sandra; Ardagh, Michael	Innovations and lessons learned from the Canterbury earthquakes: Emergency department staff narratives	Disaster Prevention and Management	2013
Buckland, Jerry; Rahman, Maritur	Community-based Disaster Management during the 1997 Red River Flood in Canada	Disasters	1999
Kendra, James M.; Wachtendorf, Tricia	Elements of Resilience After the World Trade Center Disaster: Reconstituting New York City's Emergency Operations Centre	Disasters	2003
Celik, Suleyman; Corbacioglu, Sitki	Role of information in collective action in dynamic disaster environments	Disasters	2010
Celik, Suleyman; Corbacioglu, Sitki	Role of information in collective action in dynamic disaster environments	Disasters	2010
Telford, John; Cosgrave, John	The International Humanitarian System and the 2004 Indian Ocean Earthquake and Tsunamis	Disasters	2007
Karp, Erez; Sebbag, Gilbert; Peiser, Jochanan; et al.	Mass casualty incident after the Taba terrorist attack; an organizational and medical challenge	Disasters	2007
Yang, Yungnane	The 9/21 earthquake in Taiwan: a local government disaster rescue system	Disasters	2010
López Carresi; Alejandro	The 2004 Madrid train bombings: an analysis of pre-hospital management	Disasters	2008
Kilby, Patrick	The strength of networks: the local NGO response to the tsunami in India	Disasters	2008
Smith, Wally; Dowell, John	A case study of co-ordinative decision-making in disaster management	Ergonomics	2000
Yates, Dave; Paquette, Scott	Emergency knowledge management and social media technologies: A case study of the 2010 Haitian earthquake	International Journal of Information Management	2011
Reddy, Madhu C.; Paul, Sharoda A.; Abraham, Joanna; McNeese, Michael; DeFlitch, Christopher; Yen, John	Challenges to effective crisis management: Using information and communication technologies to coordinate emergency medical services and emergency department teams	International Journal of Medical Informatics	2009
Perry, Marcia	Natural disaster management planning: A study of logistics managers responding to the tsunami	International Journal of Physical Distribution & Logistics Management	2007
Thévenaz, Céline; Resodihardjo, Sandra L.	All the best laid plans...conditions impeding proper emergency response	International Journal of Production Economics	2010
Thévenaz, Céline; Resodihardjo, Sandra L.	All the best laid plans...conditions impeding proper emergency response	International Journal of Production Economics	2010
Olejarski, Amanda M.; Garnett, James L.	Coping with Katrina: Assessing Crisis Management Behaviours in the Big One	Journal of Contingencies and Crisis Management	2010
Helsloot, Ira	Bordering on Reality: Findings on the Bonfire Crisis Management Simulation	Journal of Contingencies and Crisis Management	2005
Crichton, M.; Lauche, K.; Flin, R.	Incident Command Skills in the Management of an Oil Industry Drilling Incident: a Case Study	Journal of Contingencies and Crisis Management	2005
Comfort, Louise K.	Risk and Resilience: Inter-organizational Learning Following the Northridge Earthquake	Journal of Contingencies and Crisis Management	1994

	of 17 January 1994		
Carrel, Laurent F.	Epidemic in Switzerland: Description of a Strategic Leadership Exercise by the Swiss Government	Journal of Contingencies and Crisis Management	2005
Lutz, Leslie D.; Lindell, Michael K.	Incident Command System as a Response Model Within Emergency Operation Centers during Hurricane Rita	Journal of Contingencies and Crisis Management	2008
Parker, Charles F.; Stern, Eric K.; Paglia, Eric; Brown, Christer	Preventable Catastrophe? The Hurricane Katrina Disaster Revisited	Journal of Contingencies and Crisis Management	2009
Adrot, Anouck; Moriceau, Jean-Luc	Introducing Performativity to Crisis Management Theory: An Illustration from the 2003 French Heat Wave Crisis Response	Journal of Contingencies and Crisis Management	2013
Lalonde, Carole	In Search of Archetypes in Crisis Management	Journal of Contingencies and Crisis Management	2004
Crichton, M.; Flin, R.	Training for emergency management: tactical decision games	Journal of Hazardous Materials	2001
Choo, Chun Wei; Nadarajah, Indrani	Early warning information seeking in the 2009 Victorian Bushfires	Journal of the Association for Information Science and Technology	2014
Linnenluecke, M. K.; Griffiths, A.	The 2009 Victorian Bushfires: A Multilevel Perspective on Organizational Risk and Resilience	Organization & Environment	2013
Nolte, Isabella M.; Boenigk, Silke	Public-Nonprofit-Partnership Performance in a Disaster Context: The Case of Haiti	Public Administration	2011
Cigler, Beverly A.	The "Big Questions" of Katrina and the 2005 Great Flood of New Orleans	Public Administration Review	2007
Comfort, Louise K.	Crisis Management in Hindsight: Cognition, Communication, Coordination, and Control	Public Administration Review	2007
Farazmand, Ali	Learning from the Katrina Crisis: A Global and International Perspective with Implications for Future Crisis Management	Public Administration Review	2007
Morris, John C.; Morris Elizabeth D.; Jones, Dale M.	Reaching for the Philosopher's Stone: Contingent Coordination and the Military's Response to Hurricane Katrina	Public Administration Review	2007
Schneider, Sandra	Administrative Breakdowns in the Governmental Response to Hurricane Katrina	Public Administration Review	2005
Wise, Charles R.	Organizing for Homeland Security after Katrina: Is Adaptive Management What's Missing?	Public Administration Review	2006
Derthik, Martha	Where Federalism Didn't Fail	Public Administration Review	2007
Waugh, William L. Jr.	EMAC, Katrina, and the Governors of Louisiana and Mississippi	Public Administration Review	2007
Waugh, William L. Jr.	EMAC, Katrina, and the Governors of Louisiana and Mississippi	Public Administration Review	2007
Col, Jeanne-Marie	Managing Disasters: The Role of Local Government	Public Administration Review	2007
Col, Jeanne-Marie	Managing Disasters: The Role of Local Government	Public Administration Review	2007
Elkenberry, Angela M.;	Administrative Failure and the International	Public Administration	2007

Arroyave, Verónica; Cooper, Tracy	NGO Response to Hurricane Katrina	Review	
Garnett, James L.; Kouzmin, Alexander	Communication throughout Katrina: Competing and Complementary Conceptual Lenses on Crisis Communication	Public Administration Review	2007
Moynihan, Donald P.	Learning under Uncertainty: Networks in Crisis Management	Public Administration Review	2008
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