Key Challenges in Crisis Management

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Jeroen Wolbers
Leiden University
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Kees Boersma
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KEY CHALLENGES IN CRISIS MANAGEMENT

Jeroen Wolbers and Kees Boersma

Introduction: The Turkish Airlines Crash

Wednesday February 25, 2009. Thirty minutes into our interview with a field commander, he abruptly stopped talking when his pager alarm triggered. '*So… a VOS6*', he stated, remarkably calm. '*A VOS6 is something serious…*'. He remained silent for about half a minute, after which he continued his explanation: '*VOS6 stands for aviation accident at Schiphol Airport. Category 6 means the plane has actually crashed and has between 50–250 persons on board. If you don't mind, it's probably best to end the interview*'. He excused himself and headed towards the crash site to assume his role of field commander.

We witnessed the start of the response to one of the largest aviation disasters in the Netherlands. Turkish Airlines Boeing 737–800, flight 1951, stalled on the final approach to runway 18R of Schiphol Airport. The pilots failed to respond adequately to a loss of airspeed caused by a defective radio altimeter, and the aircraft crashed into a field just short of the runway. Unfortunately, nine people including the three pilots lost their lives, and 86 people were injured, including 25 people who sustained serious injuries.

Months later, the first evaluation reports appeared, applauding the professionalism of the response operation. The public opinion about the response operation was positive, with the headline on the national newspaper noting '*No disaster after the disaster*' (NRC-Next, 2009). Although the media applauded the professionalism and promptness of the response operation, the public investigation reports of the Inspectorate of Justice and Safety (IoJS) and the Dutch Safety Board (DSB) noted some significant challenges. First, the emergency services had trouble locating the crash site. This led to a delay of 15 minutes before the first crews arrived on site. Second, the emergency services had difficulty determining the exact number of victims and the severity of their condition. Third, command centers were activated quickly but were deprived of information for several hours. These challenges are similar to the key challenges often experienced in crisis management operations worldwide. They relate directly to four critical processes in crisis management: cognition, communication, coordination, and control (Comfort, 2007).

The following sections review the crisis management literature on cognition, communication, coordination, and control and use insights from this literature to uncover the practical challenges experienced by crisis managers during the Turkish Airlines crash response

operation. In doing so, we pose the following research question: *what is the role of cognition, communication, coordination, and control in crisis management?* To answer this question, we analyse what role these key processes play in crisis management operations, and develop a research agenda to enhance our understanding about the key challenges in crisis management.

The 4Cs of Crisis Management

Crisis management entails organizing the responses of stakeholders and then applying resources to an ambiguous environment in order to bring a disrupted system (an organization or a community) back into alignment (Sommer & Pearson, 2007). This definition of crisis stresses the disruption of a system that requires an intervention to restore the system back to its previous state. Further, crisis management studies often address the dynamics of a response operation and conceive of two broad types of crisis: crisis as an event, and crisis as a process (Williams et al., 2017). When crises are considered specific events, studies typically seek the triggers of the event and attempt to understand how the event disrupted organizational performance (Lagadec, 2007). Important studies have investigated catastrophic events like the Challenger disaster (Vaughan, 1999), the Mann Gulch Fire (Weick, 1993), and the Stockwell shooting in London (Cornelissen et al., 2014). The most frequently used definition of a crisis in these studies is '*a low-probability, high-impact situation that is perceived by critical stakeholders to threaten the viability of the organization*' (Pearson & Clair, 1998, p. 66).

In contrast to the view of crises as events stands a different set of studies that regard a crisis as a gradual process that develops as an organization drifts away from safe practice. There is an incubation phase before the inadequate practice leads to the triggering event that requires a response and resolution (Roux-Dufort, 2016). These studies thus argue that, rather than a sole focus on the triggering event, understanding crisis management requires knowledge of the evolution of a crisis (Turner, 1976). This shifts the primary focus in crisis management from accident investigation to understanding the organization and organizing processes in the production of a crisis (Roux-Dufort, 2016).

Organizing processes play a crucial role in crisis management and influence the capacity to mitigate the effects of crisis. Four key processes underlining organizing and the ability to manage a crisis are conceptualized as the '4Cs': *Cognition*, *Communication*, *Coordination*, and *Control* (Comfort, 2007). *Cognition* entails recognizing the degree of emerging risk and conceiving ways to act on that information. Crisis managers then face the challenge of *communicating* to update an emerging network of actors about the crisis and the response operation. The goal is to create a sufficient level of shared meaning to enable crisis managers from different organizations to understand what is going on and how they can contribute to the operation. Communication feeds into the process of *coordination* where interdependent actors engage in mutual adjustment of their actions to achieve a shared goal. To ensure all actions remain focused on the shared goal, commanders need to guide the process and retain *control*. Next, we discuss the '4Cs' of crisis management in detail and highlight the main debates in which they are discussed.

Cognition

Cognition involves recognizing the degree of emerging risk and developing the ability to act on that information (Comfort, 2007). To recognize a disruptive event, crisis managers need to clearly frame the setting and understand how the setting works. Managers must be able

to recognize the characteristics of different types of crisis situations, and quickly manage to set up the response organization so they can react to the different types of crises.

An important concept that explains how the process of cognition shapes the work of frontline commanders is recognition-primed decision-making (Klein, 1993). Klein et al.'s (1986) study of fire-ground commanders noted that conscious deliberation of alternative solutions at the accident scene was rare. Instead, fire commanders classified the situation based on previous experience to generate the most suitable decision from their memory. Klein found that experienced leaders drew upon a repertoire of previous actions to create workable strategies that fit the existing context for action.

A more recent experimental study of frontline decision-making in the London Fire Brigade acknowledged that commanders primarily acted based on previous experience and intuition (Cohen-Hatton & Honey, 2015). However, the analysis also indicated that relying only on previous experience actually diminished the performance of frontline commanders because they were less sensitive to the specific operation, limiting their situational awareness.

Situational awareness, another key concept for crisis management that is often related to cognition, concerns 'the perception of elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future' (Endsley, 1995, p. 36). This definition shows it is possible to attain different levels of situational awareness. The first step is to perceive the status and attributes in the environment. In a fire, this step would involve attending to the specific characteristics of the building, the location of the fire, and the presence of people trapped inside. The second step in attaining situational awareness is to comprehend the situation by relating the situational attributes to the goals of the commander. In a fire, this means the frontline commander assesses the kinds of firefighting tactics necessary to deal with the severity of the fire, and the possibility of people trapped inside. The third step and level in situational awareness involves projection of the future status of the fire based on the knowledge of the dynamics of the situation. A fire commander could, for instance, notice that the color of the smoke is a cue to the imminent risk of a flashover. This might lead to a decision to cool the fire and smoke before attempting a rescue operation.

Situational awareness also supports judgments and skills that are embodied in the craftsmanship and proficiency of professionals (Faraj & Xiao, 2006). Cognition implicitly guides interactions between groups with a similar proficiency through anticipation and dynamic adjustment (Rico et al., 2008). For instance, when firefighters estimate the hose length for frontline teammates, they do not explicitly discuss the fact they will continuously adjust the length during the operation. Similarly, studies of high-reliability organizations point out how organizations operating in high-risk settings can achieve reliable performance through collective mind, which is conceptualized as a pattern of heedful interrelations of action (Weick & Roberts, 1993). Collective mind thus describes how actors are able to synchronize their actions with others by developing a detailed understanding of work in different parts of the organization. Situational awareness is needed to develop collective mind.

However, the concept of situational awareness does not entirely explain how the relation between cognition and action unfolds over time, according to the psychological literature on crisis sensemaking (Weick, 1995). Weickian sensemaking emphasizes how people create meaning through a cycle that interweaves interpretation and action (Weick, 1995). The sensemaking process starts when people's expectations are violated during attempts to develop a plausible explanation for what is going on (Sandberg & Tsoukas, 2015). To find out what is going on, people take action (enactment) and label and connect cues (selection), preserving how these labels fit into their personal cause map (retention) (Weick, 1979). This

sensemaking cycle becomes sustainable over time when individuals interlock their behavior and create consensus on how a task ought to be carried out (Maitlis & Christianson, 2014).

The cycle of enactment, selection, and retention shows that sensemaking differs from situational awareness because sensemaking involves the active framing of events in order to develop understanding (Cornelissen et al., 2014). In other words, people play a crucial role in fabricating the very situation they are trying to comprehend because crisis managers create a frame to render sequences of events meaningful and to classify and predict the behavior of others (Cornelissen et al., 2014). Building substantial common ground is essential to ensuring crisis managers know what is expected of them (Weick & Roberts, 1993). The commitment to a frame is crucial for managing expectations. Yet, it might also entrap crisis managers and hinder their ability to perceive changes in their environment, thus resulting in the collapse of sensemaking if managers act based on a flawed understanding of the situation (Weick, 1993; Snook, 2000; Cornelissen et al., 2014).

In sum, the cognition literature highlights the importance of being sensitive to the environment when managing a crisis. A key insight is that frontline commanders are inclined to fall back on previous experience when the situation intensifies and tend to interpret cues using preexisting frames. The challenge with cognition is thus to be sensitive to changing circumstances and adapt the operation accordingly.

Communication

Communication, a second key challenge, can become problematic when response operations evolve into a distributed structure (Topper & Carley, 1999) where responders cannot see or hear what is happening in other locations (Netten & van Someren, 2011). Therefore, it is crucial for first responders to communicate to enhance their level of shared understanding. Many communication issues in crisis management involve the lack of intersubjectivity, the process through which one knows the subjective meanings of others (Schutz, 1973). Intersubjectivity plays out in various ways during crisis management, as numerous studies highlight issues with missing information, lack of a common vocabulary, and interoperability between information systems (Kapucu, 2006; Manoj & Baker, 2007; Bharosa et al., 2010; Netten & van Someren, 2011).

A key concept that describes the difficulties with information sharing in disasters is variable disjunction of information (Turner, 1976). Disasters scenes are difficult to monitor because unexpected events can rapidly trigger an escalation. Turner (1976) argued that each individual responder collects a slightly different set of information and develops a slightly different idea of what is happening and what needs to occur. The result is that information about the incident varies and additional effort needs to be invested to reduce this variability. Variable disjunction of information, however, cannot be dismissed as a lack of communication (Turner, 1976). Rather, the concept of variable disjunction stresses that when time is short and resources are limited, an imbalance can be created between the amount of information generated and the amount of information needed to fully describe the complexity of the situation. Thus, response operations with high complexity and continuous change make it necessary to be extremely selective in the use of communication (Turner, 1976).

The aforementioned point was acknowledged by Quarantelli (1997) in the ten criteria he proposed for evaluating the management of disasters. Information is one of the ten key issues in crisis management but is often confused with problems of information technology and interoperability of information systems. Instead, problems stem from what is being communicated, rather than from what means of communication is used. A major contributing

factor in response operations is the fact that information flow moves through fixed channels following the chain-of-command. Moving through the entire chain-of-command can severely slow down communication and decision-making because information needs to flow from the bottom to the top of the command chain, and back again. Thus, it is important to differentiate between mini-second and many-second cycles in response operations (Chen et al., 2008). Mini-second cycles take place on-site when the response is reactive and the time window for action is small, requiring a more direct link between communication and action. Many-second cycles include communication to command centers that operate with a larger time window to deal with tactical and strategic management issues.

Reddy et al. (2009) note that a lack of common ground due to differences in terminology also plays a major part in communication of problems. Each of the emergency services (e.g. police, fire fighters) has distinct backgrounds, specialized operational expertise, and professional jargon. These can give emergency responders a unique and clear professional identity, but can also create misunderstandings between them (Comfort & Kapucu, 2006). For example, the professional cultures of different response organizations hinder them from sharing and interpreting disaster knowledge (Marincioni, 2007; Moynihan, 2012; Tsai & Chi, 2012). In contrast, some response organizations (e.g. the US Coast Guard) address this problem by training their members to understand the different professional languages used by many of the different stakeholders. This practice was a key success factor in the response of the US Coast Guard to hurricane Katrina (Morris et al., 2007).

Another important factor of effective communication in emerging response networks is trust. Personal relations are essential to communication networks since these networks are often organized according to existing (phone) contacts (Landgren & Nulden, 2007; Uhr et al., 2008). When these personal relations are missing, it becomes difficult to share information because responders from different organizations lack mutual trust (Manoj & Baker, 2007). Responders must then rely on swift trust generated by judging the quality of performance and role execution (Majchrzak et al., 2007).

In sum, communication is challenging in crisis situations because variable disjunction of information arises in a distributed response structure. Responders struggle to inform one another while dealing with diverging information flows, differences in terminology, and limited trust. To overcome these challenges, commanders need to adapt on scene by differentiating the information from mini-second and many-second cycles, translating the different terminology to others, and relying on swift trust. This is a key challenge because the time to act is generally limited, the situation can escalate quickly, and responders may be forced to assume that their communication to other stakeholders is adequate and accurately interpreted.

Coordination

Keeping the actions of involved units and organizations synchronized during a response operation is the third key challenge. Coordination concerns linking together different parts of an organization to accomplish a collective set of tasks (Van de Ven et al., 1976). Scholars have long assumed that organizations can be designed in ways that allow individuals to coordinate their actions. Designed coordination supposes that each coordination mechanism has certain information-processing capabilities that can be utilized in different kinds of environments (Lawrence & Lorch, 1982). In stable environments, coordination can indeed be achieved by using procedures that have a low information-processing capability. That is, procedures prescribe a specific way of working, but do not provide a means to transfer

additional information. Standard operating procedures function by structuring the response operation in advance, allowing professionals to fall back upon well-thought-out plans of action, known to everybody in the organization (Okhuysen & Bechky, 2009). In this way, less time is needed in stressful and dynamic environments to structure the organizational response itself. This allows commanders to focus on other priorities in the first hectic moments of a response operation.

Studies on coordination in crisis management settings, focusing on trauma centers (Faraj & Xiao, 2006), emergency response (Wolbers et al., 2017), and police pursuits (Schakel et al., 2016), demonstrate that a rise in volatility makes it increasingly difficult to rely on designed coordination mechanisms because circumstances change more rapidly and unexpectedly. This shows the limits of the information-processing logic that presumes contingencies can be assessed beforehand, and that predefined coordination mechanisms work in the situation at hand (Faraj & Xiao, 2006). Yet, in dynamic situations, the environment is prone to change and predefined interdependencies differ in practice. Hence, classic coordination theories based on an information-processing logic do not fully incorporate the organizing dynamics needed for crisis management operations (Bigley & Roberts, 2001; Klein et al., 2006).

Recent studies illustrate that ongoing adaptation is required as fast-paced environments are often too unstable for aligning coordination mechanisms with predefined contingencies (Bigley & Roberts, 2001; Faraj & Xiao, 2006; Kellogg et al., 2006). In addition to standard operating procedures, mutual adaptation, improvisation, and ad-hoc networking are found to be important elements of coordination that enable first responders to adapt to changing circumstances at the disaster site (Kapucu, 2006; Comfort, 2007; Moynihan, 2009). In that respect, coordination in fast-response settings is much better characterized as 'a temporally unfolding and contextualized process of input regulation and interaction articulation to realize a collective performance' (Faraj & Xiao, 2006, p. 1157).

Studies that explore how coordination processes occur in crisis situations show that unambiguous command is needed for the timely direction of, yet flexibility and on-the-spot decision-making are required to adapt to a continuously changing situation (Bigley & Roberts, 2001; Comfort, 2007; Majchrzak et al., 2007; Moynihan, 2009). Coordination at the incident scene is thus a combination of designed and emergent coordination (Bigley & Roberts, 2001; Okhuysen & Bechky, 2009). The challenge of combining designed and emergent coordination means that coordination is no longer straightforward. As contingencies become more complex, locally situated adaptations are necessary to keep the operation in sync. While such adaptations create flexibility, they also increase ambiguity and diminish the predictability of the outcome of designed procedures that partly restrict coordination based on anticipation (Okhuysen & Bechky, 2009).

In sum, dynamic circumstances in crises often force frontline commanders to abandon designed coordination mechanisms and find ad-hoc solutions. The variability of this process depends largely on the specific requirements and dynamics of a crisis, since each new situation requires a different adaptation of structures. Therefore, coordination in crisis response settings requires commanders to keep adapting and informing other stakeholders of the how these adjustments impact work practices and procedures.

Control

The fourth key challenge in crisis management operations concerns keeping the operation and the involved units under control. Control, in this respect, is about the capacity to keep ongoing action focused on a shared goal. While the overarching goal of control is to get

units to work in the same direction, the reputation of control is often rather authoritarian (Alberts & Hayes, 2003). This understanding comes from the early command and control doctrines that stressed a form of top-down command, in which subordinates receive rigid orders that leave little scope to exercise their own initiative (Shamir, 2010). This form of control, also known in military literature as 'Befehlstaktik' (Van Creveld, 1989), supposes that in times of crisis, a one-way directional command approach is beneficial because it increases the commanders' feeling of control. Likewise, in crisis management, for a long time the assumption prevailed that effective crisis management requires authoritarian command and control (Quarantelli, 1977). Directive command works in operations that are relatively stable and predictable, but as a crisis escalates, it turns out that commanders are often unable to retain control because of rapid developments and too many actors that become involved (Comfort, 2007).

A different doctrine proved necessary that could incorporate the capacity to adapt and increase the flexibility of units operating in the frontline. In military doctrine, this was established by the concept of 'Auftragstaktik' (Van Creveld, 1989). Auftragstaktik is based on a goal-oriented approach, in which subordinate leaders understand the intent of the orders, are given proper guidance and training to act independently, and act according to their perception of the commander's intent (Shamir, 2010). NATO incorporated this type of warfare with the concept of 'mission command', which became the leading command and control doctrine of modern Western armed forces (Keithly & Ferris, 1999).

The central principle of mission command is commanders' intent. When a commander gives direction by communicating his/her intent to subordinates, it helps them understand the larger context of their actions. This allows them to depart from the original plan in the heat of battle in a way that is consistent with the aims of the higher commander (Cowper, 2000). Commanders' intent is a specific operational methodology designed to prevent micromanagement and oversupervision of subordinates, while supporting initiative at the lowest possible level. The underlying idea is that frontline commanders are able to operate independently through self-synchronization under a shared goal frame. Self-synchronization pushes decision-making authority down to the lowest level within the organization by relaxing the traditional hierarchical approach to command and control. While the idea is clear in theory, in practice it turns out that developing a congruent mindset remains difficult. A study by Shattuck (1995) showed that in a simulation by the U.S. Army commanders, only 34% of the company commanders' decisions matched their battalion commander's intent.

The arrangement and use of control is a key issue in the field of safety management. Perrow (1999) found that too much control by tight-coupling leaves organizations vulnerable to failure. Tight-coupling means the organization is highly integrated, whereby actions in one unit have a direct effect on actions in another unit. Highly integrated units and dependence on the performance of other units make it easier for low probability, high-consequence failures to spread. Units that are loosely coupled are less dependent on each other and have less unitary designs, making them less vulnerable to cascading effects. While these characteristics are important for organizing safety in normal operations in high-reliability environments, crisis settings bring an additional factor into play. High-tempo operations often feature moments where loosely coupled systems suddenly become highly coupled systems (Weick, 1998). Snook's (2002) analysis of a friendly fire incident where two US Army Black Hawk helicopters were shot down by the US coalition force F-15s in Iraq demonstrates that operators were unable to imagine and assess how the previously loosely coupled systems would interact when they suddenly became tightly coupled (Snook, 2002). This led the coalition forces to overlook the fact that the two Black Hawks had already entered the area

being scanned for enemies by the F-15s. When coupled with the policy of using different (unique) 'squawk codes' to recognize friendly units that had not been integrated properly in the two formerly loosely coupled systems, the Black Hawks' entry into restricted airspace resulted in catastrophe.

Loosely coupled systems are common in emergency response operations because frontline commanders tend to create separate pockets of control (Wolbers et al., 2017). The reason is that crisis managers act on multiple problems at once by delegating task execution to subordinates and engaging in parallel processing of information. The risk is that separate pockets of control can suddenly become tightly coupled when crisis managers encounter critical situations like explosion risks or hazardous materials that pose an imminent threat to all units. Likewise, Bigley and Roberts (2001) noted that loose and tight coupling is an issue in firefighting operations when different units attack different sides of a building. Breaking a window or opening a door at the back can suddenly disturb the smoke balance, triggering a flashover scenario for units entering the front of the building. As interdependencies can change rapidly in response operations, it's crucial for crisis managers to stay aware of the interplay between loose and tight coupling.

In sum, the literature on control shows that in crisis situations, commanders often retain flexibility by giving the initiative back to frontline commanders based on the principle of commanders' intent. This enables units on scene to adapt and operate within the broader operational mandate through self-synchronization. Organizing control in this way works when the operation remains loosely coupled. However, the risk is that operations tend to become tightly coupled in unexpected moments, resulting in unintended consequences for the actions of other units. The challenge of control is thus to retain flexibility while avoiding the creation of intended and unintended effects on the operations of other units involved in responding to the crisis.

The 4Cs in Action: Operational Challenges during the Turkish Airlines Crash

In the following sections, we will explore how the 4Cs of crisis management play a role in the response operation to the Turkish Airlines crash. We will use the public investigation reports that appeared in the aftermath of the crash as an illustration of the main challenges in response operations (Inspectorate of Justice and Safety, 2009; Dutch Safety Board, 2010). Our analysis indicates that cognition, communication, coordination, and control each have a distinct role to play in the response operation, but also directly and indirectly influence each other.

Locating the crash site. The first challenge in the report of the DSB (2010) identified that the first fire engines responding from both Schiphol Airport and the regional fire stations had trouble locating the crash site. Crash tenders drove down the runway and did not see the aircraft, because it crashed behind a dike that obscured the view from the runway. Accidentally, around the same time, an ambulance passing by on the A9 highway from the adjacent safety region 'Noord-Holland-Noord' spotted the aircraft. The driver passed the information to his Emergency Response Center (ERC) in Alkmaar. However, the location of the crash site was not communicated to the ERC in Haarlem, which was responsible for the dispatch to the crash site. In the ERC in Haarlem, several calls came in from citizens who had seen the crash site, but this information was not shared with the dispatchers in the ERC working in the same room, in the first chaotic moments of the response operation (often symbolically characterized as the 'fog of war'). Consequently, as the first official call

came from the Schiphol tower that had lost the aircraft on the radar, the ERC dispatchers (incorrectly) activated the VOS6 procedure meant for a plane crash on the Schiphol Airport grounds. However, the actual crash occurred in a ploughed field just outside the Schiphol Airport perimeter. The consequence was that all incoming units were directed to UGS A (a designated staging area at Schiphol), as the VOS6 procedure prescribes, instead of directly to the crash site.

The logic behind the VOS procedure is that emergency services cannot freely drive on the airport grounds, but must be marshaled by airport police to avoid collision with aircrafts and other airport traffic. The activation of the VOS6 procedure thus let first responders believe that they were responding to a crash on the airport grounds. When they could not locate the crash site on the airport grounds, a new search had to be initiated in the surrounding areas. Valuable time was lost due to this confusion. The DSB concluded that '*the consequence of activating a VOS6 was that the regional fire department reached the crash site only after approximately half an hour*' (DSB, 2010, p. 6).

In the first moments of the response operations, we see that responders are challenged by a combination of communication and coordination issues. Variable disjunction of information occurred when the location of the crash site was not shared immediately between two different ERCs in the cities of Alkmaar and Haarlem, who developed their own perspective on the incident. The disjunction of information prompted the ERC in Haarlem to activate the VOS6 protocol, as they were under the assumption that the plane crash occurred on the Schiphol Airport grounds.

The trouble with locating the crash site and the discussion around activating the correct (and ultimately incorrect) procedures illustrates that crisis managers have to make quick decisions, often based on incomplete information. These decisions, in the first moments of the response operation, are often hard to revise once they have been made. Like the actual use of the VOS6 procedure shows, contingencies in the response operation often turn out to be more complex than anticipated in the original procedures. As a consequence, once responders arrive at the disaster scene, predetermined plans need to be adapted to the dynamically unfolding situation at hand.

We thus have to question the effectiveness of coordinating based on predefined plans and procedures in fast-paced environments. Still, the activation of the VOS6 procedure also had a positive side to it. When we interviewed the field commander several months after the response operation, he explained that for him and other units, it was a blessing that VOS6 procedure had been activated. Once the crash site was located, it meant that the Schiphol military police units were positioned at strategic points on the airport to guide the emergency units from the UGS to the crash site. This allowed a faster guidance of units and resources, once the crash site was located.

Counting the number of victims. The second challenge described in the public investigation reports was that common understandings between different organizational actors were compromised and disrupted at several moments. A problematic understanding of the number of victims who were transported to different hospitals occurred during the response operation (IoJS, 2009, p. 13).

> At a certain point no-one knows who is doing what. That the victims are transported to hospitals rather quickly, is because of the professionals in the field who just transported the patients to a hospital, despite of a missing command structure.
>
> *(IoJS, 2009, p. 97)*

Tactical and strategic command units had trouble getting validated information from the field. Improvised action at the crash site by medics triggered new information flows and obstructed existing information flows in the network of collaborating actors. The following example shows clearly how this occurred.

At the moment the first ambulance arrived at the crash site 18 minutes after the crash at 10:44 AM, its crew started a triage of the amount and the severity of wounded victims. The incident report describes that this is immediately problematic, as several victims have already left the crash site by themselves and were transported to a temporary shelter, a nearby barn, with help from bystanders, fire department, and police units (IoJS, 2009). Sometime later, two trauma doctors arrived at the temporary shelter, observed the situation, and decided to intervene. They believed it was necessary to perform a second triage. The trauma doctors assessed that 19 victims were incorrectly identified as slightly wounded (Triage Category 3); 17 were seriously injured (Triage Category 2), and 2 of them were severely injured (Triage Category 1). In addition, the doctors judged that all of these victims needed to be transported to the hospital to check for a 'high energetic trauma', due to the severity of the crash speed of 180 km/h (IoJS, 2009, p. 91). As a result, the 19 victims were transported to the hospital immediately; the remaining passengers were transported at a later stage.

The information about the second triage and the new triage status of the victims never reached the other crisis management teams (IoJS, 2009, p. 66). Due to the different locations where the triage took place, different numbers of victims with different triage statuses spread throughout the continuously evolving and expanding response network. For a long time, it was unclear to the public authorities how many wounded there were and what their status was. In the end, it took *four* days to validate the incomplete lists gathered from various on-site medical teams with lists in the 13 involved hospitals (IoJS, 2009, pp. 93–94). The final count showed that 57 victims were transported in ambulances from the crash site, 42 victims were transported from the temporal wounded facility, and 25 victims were transported with own means of transportation. These numbers illustrated the diffuse situation the crisis teams had to deal with.

Triage is a medical decision-making process meant for prioritizing transport of injured to the hospital, and for assessing the medical capacity required for the transport (Koenig & Schultz, 1994). Yet, the previous situation shows that triage information is also used for interpreting the number and the severity of wounded by other (non-medical) response organizations. It is a well-known concern in response operations that crisis managers with different backgrounds, specialized operational expertise, and different professional languages need to coordinate across their jurisdictional and organizational boundaries (Comfort & Kapucu, 2006). This offers a multilayered coordination challenge, as the gathering of victim information requires the crossing of jurisdictional boundaries, which includes the regulation of authority, legitimization, and the application of expertise. This was especially the case for communicating information about the number and severity of wounded. Providing the correct number of victims is an important aspect for different response organizations in their (public) crisis communication. When multiple response organizations use and interpret triage information, misunderstandings about the status and number of victims will likely reverberate throughout the entire response network, causing extensive challenges. Moreover, the expert assessment of passengers needing to be checked for a high energetic trauma in a hospital posed a formidable logistical task for the medical agencies.

In the aftermath of the Turkish Airlines crash, the responders faced a combination of challenges. A key element underlying the problematic administration of victim numbers is cognition. The trauma doctors made sense of the consequences the impact of the crash could have on the trauma of the patients. This enabled them to make a future projection in their

situational awareness. The 'expert' on-scene reassessment for another triage by the trauma doctors also directly fed into the variable disjunction of information. Processes of cognition and communication became intertwined in the course of events, as professionals in different locations developed a diverging understanding of the triage process. By undertaking the reassessment, trauma doctors also directly intervened in ongoing coordination processes. The second triage conflicted with the ongoing administration of triage classifications, and thus influenced the validity of the ongoing triage numbers between the involved command centers. The issue of triage can also be viewed from the challenge of control in terms of tight and loose coupling. Normally medical aid on the disaster site is loosely coupled, as medical teams take care of individual patients and perform multiple rounds of triage updates. The reason is that the condition of patients can change over time because of treatment. In this case, reassessing the triage status of all passengers created a tightly coupled system, which caused extensive control and coordination problems with other actors in the response system.

The triage process in the aftermath of the Turkish Airlines crash showed that the interdependence between cognition, communication, coordination, and control develops too fast to engage in extensive and continuous consultation. Crisis managers need to work in an environment that is unknown, difficult to oversee, and that is characterized by unexpected and continuous change. This dynamic environment, in combination with various information system-mediated communication, makes it very difficult to develop and sustain common understanding (Gephart, 2004). Moreover, action and expertise are often distributed and need to be employed immediately, to prevent the situation from escalating or deteriorating.

Command Centers are Deprived of Information. The third challenge described in the public investigation reports was the information management between the different crisis management teams, operational in the GRIP3 emergency state. Several agencies and teams were active quite rapidly, but were deprived of information for several hours (IoJS, 2009, p. 66). This led to coordination problems between the medical organizations in the now rapidly expanding response network. Providing care for 86 wounded persons overwhelmed the local medical response capacity, but fortunately the VOS6 protocol didn't only designate staging areas; it also activated the procedures to call 3 Mobile Medical Trauma teams and 64 ambulances to the crash site (IoJS, 2009). Furthermore, it notified dispatchers that between 7 and 13 hospitals had to be warned to create trauma room capacity. Emergency response centers throughout the Netherlands received the call and rerouted their ambulances to the crash site.

While the initial dispatch of 64 ambulances was fast, the quick capacity buildup created additional problems. In the heat of the moment, dispatchers only warned six hospitals and failed to call in the three mobile medical trauma teams in first instance (DSB, 2010). As the focus was on building ambulance response capacity, limited attention was paid to the information needs of other partners in the medical response network. This led to several problems in the periphery of the network. As no calls came in, several hospitals anticipated on a large amount of wounded at own initiative, kept trauma rooms at bay, and called in additional surgical capacity. This forced several hospitals to cancel their planned surgeries to keep trauma care available, but they were not notified when the number of severely wounded was far less than expected (IoJS, 2009).

It is a well-known phenomenon in acute medical care that organizing a coherent triage, transportation, and registration during mass casualty situations leads to coordination issues (Tierney, 1985; Koenig & Schultz, 1994). Monitoring the status and location of casualties

requires consistent communication between a wide spectrum of medical actors: the medical officer, casualty transport coordinator, mobile field hospital commander, ambulances crews, emergency response centers, national ambulance dispatch center, and hospitals. To make matters more complicated, police and municipalities share responsibility for casualty registration and communicating information to victims' relatives.

An important coordination challenge of networked coordination is that as new organizations are included in the network, information sharing becomes increasingly complex, as information flows through network from various positions at different times. This occurs because response organizations have operational field units at different levels, different functional command structures, and separate back-offices for information and resource management (Comfort & Kapucu, 2006). Therefore, a rapidly evolving network triggers an information flow that is in flux.

The common solution for structuring communication and enabling fast decision-making is to increase control by employing a centralized command and control structure, in which communication lines and authority are formalized. Command and control structures are known for their hierarchical decision capacities and clear role structures, and are a powerful instrument for accomplishing tasks characterized by repetition and uniformity (Quarantelli & Dynes, 1977). Its underlying premise is that when the organizations involved in the response operation match the existing command structure, centralized coordination forms a quick and effective solution. Yet, such a system is difficult to maintain in a dynamic environment in which a large number of organizations become involved and membership fluctuates over time. In these situations, command and control structures insufficiently account for the decentralization and flexibility that are required during the response operation.

Similarly, the coordination process in the aftermath of the Turkish Airlines crash shows that the dynamics occurring around medical logistics cannot be completely understood in

Table 2.1 The 4Cs in Action during the Turkish Airlines Crash Response Operation

	Locating the crash site	*Counting number of victims*	*Deprived of information*
Cognition	VOS6 procedure activated for crash on airport grounds, while actual crash site was still unknown	Trauma doctors found it necessary to perform a second triage on-scene because of high-energetic trauma	Teams at tactical and strategic level were unable to make sense of the situation in the first hours
Communication	112 calls with correct location reached response center in adjacent region and were not communicated	Information about second triage never reached other crisis management teams	Hospitals and trauma teams were initially not warned and received little updates
Coordination	VOS6 procedure directed units to incorrect staging area	Second triage collided with coordination of ongoing transportation	Ambulances took patients to a range of hospitals, while others kept trauma capacity available
Control	Response center in control was too busy to receive other information	Many different actors responsible for triage and registration	Actors responsible for coordination received little information and had limited overview

terms of command and control. The problems response organizations are confronted with outgrow the span of control of the existing command and control structure, as organizational and jurisdictional boundaries need to be crossed. This calls for a coordination structure that is able to account for the distributed nature of this problem. Due to its enhanced capacity for adaptation to fluctuations in the environment, networked collaboration is found to be more effective to deal with the distributed nature of information and decisional challenges under pressure (Moynihan, 2008; Moynihan, 2009). Therefore, centralized command structures become gradually extended with or transformed into interorganizational networks to provide a structure through which distributed crisis response activities can be coordinated (Topper & Carley, 1999; Moynihan, 2008) (Table 2.1).

Key Dilemmas Across the 4Cs: Toward a Research Agenda

The case of the Turkish Airlines crash illustrates that adapting to the contingencies of the crisis creates tensions between cognition, communication, coordination, and control. Crisis management organizations excel in mounting a rapid operation according to plan, but as the events on the incident scene often turn out to be more complex and unpredictable, plans need to be adapted. The role of the 4Cs in the Turkish Airlines crash teaches us that it is crucial to adapt, but it also suggests that when people confront turbulent and hazardous situations they seek structures to create stability.

This tension is well known in the literature on resilience that offers some important insights on the challenge of adapting in turbulent and volatile settings. Resilience is often defined as '*the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back*' (Wildavsky, 1988, p. 77). Some have argued that bouncing back is not enough, and that true resilience also means being able to come away from the event with a greater capacity to prevent and contain future errors (Weick et al., 1999). In any case, what is central in the research on resilience is that managing by anticipation – that is to predict and prevent potential dangers before damage is done – turns out to be an ineffective strategy when uncertainty and volatility increase (De Bruijne et al., 2010). In the organizational and management literature, an important work on resilience is the functioning of high-reliability organizations (Weick & Sutcliffe, 2001). Findings from this literature indicate that organizations develop the capacity for high-reliable performance when they are able to combine anticipation with adaptation (LaPorte & Consolini, 1991).

In crisis management, the dilemma of anticipation and adaptation is prominent when crisis managers are forced to adapt, while they are also inclined to hold on to existing structures. Crisis managers are trained to deal with this dilemma by adapting elements of incident command structures (Bigley & Roberts, 2001). In order to facilitate a fast response, many of the organizing processes on the incident scene have been prestructured through incident command structures (Boersma et al., 2014). In practice, crisis managers are specifically trained to elaborate these structures, and switch between different roles in the command structures (Bigley & Roberts, 2001). Such adaptation strategies are known in organization and management studies as 'bricolage'. Bricolage is a way to respond to surprises by experimenting with alternative courses of action by rearranging existing structures (Bechky & Okhuysen, 2011). In terms of resilience, bricolage relies on a combination of anticipation and adaptation, as the elements of the structures have been created in advance. The issue with bricolage is that in order to do so, actors require shared social cognitive resources to foster the collectively held knowledge about how a task should be performed (Duymedjian & Rüling, 2010). However, in response operations where professionals from different response

organizations need to come together at unexpected moments, these shared social cognitive resources do not always exist (Comfort & Kapucu, 2006; Uhr et al., 2008).

The tension between anticipation and adaptation in crisis management provides the foundation for a future research agenda concerning the 4Cs. Based on our analysis of the role of the 4Cs in the response operation to the Turkish Airlines crash, we highlight three research themes: *ad-hoc teaming*, *command tactics*, and *information management*.

First, the tension between anticipation and adaptation highlights the role of ad-hoc teaming. As a crisis intensifies the nature of the on-scene, collaboration tends to become more ad-hoc and distributed (Majchrzak et al., 2007). Crises like the Norway Breivik terror attack (Rimstad & Sollid, 2015) and the attacks in Paris (Hirsch et al., 2015) have shown that response operations unfold in unexpected ways and take place at multiple sites. The key challenge for crisis management research is to investigate how ad-hoc teams in the frontline react to an unexpected event, how they adapt, and how they can be managed. Research on adaptation has predominantly explored the structural means of adaptation, such as structure elaborating and role switching (Bigley & Roberts, 2001). Future research may address the dynamics that takes place outside formal response structures, as ad-hoc adaptation is likely to emerge when the crisis takes an unexpected turn, or requires a simultaneous response in different locations. The processes of cognition, communication, coordination, and control are likely to play a foundational role in fostering adaptation and improvisation. This will feed into, and requires more knowledge, about challenges of keeping situational awareness, interpreting in what way people adapt from standard operating procedures, and how to retain control over a response that is characterized by improvisation.

Second, as ad-hoc teaming and adaptation become increasingly important, the command tactics also have to be updated. It is difficult to account for the unexpected and multi-sited dynamics of crisis situations with traditional hierarchal command and control tactics. The consequence of ad-hoc teaming in crisis situations is that decision-making is pushed down to the frontline (Gephart, 1993). When multiple teams engage in different aspects of the response operation, it creates separate pockets of control, which results in the variable disjunction of information (Wolbers et al., 2017). Coordination based on anticipation gets increasingly difficult as different teams adapt in an unpredictable manner. Instead, crisis managers will need to adapt their command tactics toward more open-ended tactics like commander's intent. The key challenge for future crisis management research is to explore how response teams are commanded in a distributed setting, so that they are able to synchronize their actions and information sharing at different hierarchical levels and at different times. It might very well be the case that this requires crisis managers to adopt a more diverse set of command tactics in different phases of a response operation. Adapting the command tactics will affect the processes of cognition, communication, coordination, and control. Giving more freedom to the frontline operations means that it becomes more difficult to interpret what is going on, assess when to or not to communicate, understand what kind of new interdependencies arise, and keep track of when units reinterpret their commander's intent.

Third, when the nature of teaming and command tactics changes, this must be supported by a more flexible and agile information management process. To date, the common response in developing information management technology entails centralizing information streams in a shared platform so that different actors and organizations can develop a common operational picture (COP) (Comfort, 2004). The underlying premise of a COP is that when all units can access relevant information, they are able to self-synchronize. The COP research has a predominant technical focus, as most attention is given to how information

can be collected, sorted, and represented. However, studies into information management have pointed out important caveats like information overload (Bharosa et al., 2010), insufficient evaluation/validation of the information (Rake & Nja, 2009), insufficient attention to sharing data with others (Dearstyne, 2007), scarce attention to the role of sensemaking (Wolbers & Boersma, 2013), and limited collaboration awareness (Treurniet et al., 2012). These issues show that the information management process is far more extensive than only collecting and sorting information. Future research may address what role information management plays in fostering cognition, communication, coordination, and control so that it supports a more flexible crisis management process. Key issues are how to retain situational awareness using a common operational picture as the response is underway, how to translate meanings and interests between different actors, and how to develop swift trust for sharing information between actors that are not familiar with each other. Overall, information sharing should trigger a process where actors develop a better idea of what is going on, while they challenge each other's action and assumptions to be able to question dominant beliefs and frames of the situation. How this process unfolds and can best be supported provides an interesting avenue for future research into crisis management.

Conclusion

In this chapter we have sought to answer the research question: *what is the role of cognition, communication, coordination, and control in crisis management?* Our discussion of the literature indicates that through the process of *cognition*, crisis managers strive to recognize the degree of emerging risk. Subsequently, they face the challenge of *communicating* the state of affairs to other stakeholders, and jointly advance a *coordinated* response. Throughout this process, crisis managers need to retain *control* to keep all actions focused on a shared goal. Our analysis of the Turkish Airlines crash response operation shows that these four crisis management processes are highly interrelated. Organizing an effective response entails awareness in all these four processes. As the nature of the on-scene collaboration in crisis is volatile and distributed, the future challenge is to study the 4Cs of crisis management in relation to ad-hoc teaming, command tactics, and information management.

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