

Decision-making and operations in disasters: challenges and opportunities

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Decision-making and operations in disasters: challenges and opportunities

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Abstract

Purpose – Decision-making structures are commonly associated with the logistics challenges experienced during disaster operations. However, the alignment between the operational level and the decision-making structure is commonly overlooked. The purpose of this paper is to provide an analysis of the fit of both levels and its impact on performance.

Design/methodology/approach – The research is developed around a case study in Mexico. Through a review of the disaster management policy in the country, interviews and secondary data, the paper provides an analysis of the current decision-making structure, the logistics activities undertaken by authorities and the impact of the alignment between both components on logistics performance.

Findings – The analysis suggests that several of the challenges commonly associated with centralisation are actually rooted on its alignment with the operational level. The logistics performance is negatively affected by faulty assumptions, poorly planned procedures, inconsistent decision-making and poorly designed structures. The case showed the need to align the operational level with a centralised perspective to increase responsiveness, flexibility and the interaction between different organisations.

Originality/value – This paper identifies the impact of the misalignment between the decision-making structure and the operational level on logistics performance, an area currently understudied. It moves from the current argument about the appropriate decision-making structure for disaster management to the identification of components to implement an efficient and effective disaster management system. Additionally, this paper provides recommendations for best practices in humanitarian logistics, which are applicable to Mexico and other countries using a centralised decision-making approach.

Keywords Developing countries, Humanitarian logistics, Decision processes

Paper type Case study

1. Introduction

Around the world, the number of people affected by disasters has increased. Since 2000, nearly 81.7 million people have been affected by disasters globally, with over 1.3 million reported casualties (CRED, 2018). These numbers highlight the need to design and implement efficient and effective disaster management systems, especially considering the limited resources available to deal with them (e.g., Sienou and Karduck, 2012; Nathan *et al.*, 2017). Recent disasters, however, have shown several shortcomings in the performance of current disaster management systems (Santos-Reyes *et al.*, 2010). Among these are insufficient knowledge during emergency response, poor operational management, absence of leadership, lack of strategies, difficulties in allocating tasks, limited intergovernmental planning and insufficient coordination (Grünewald *et al.*, 2010; Nigg *et al.*, 2006). To overcome these challenges, there are calls for empirical work to analyse the decision-making structures and public policy in disasters (Holguin-Veras *et al.*, 2012; Hart *et al.*, 1993).

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Even after different articles have explored the implications of decision-making structures in disasters (e.g., Takeda and Helms, 2006; Dhouha and Gonzalo, 2013; Manyena, 2006; Scolobig *et al.*, 2015; Drabek, 1985), command and control problems have been identified in several situations (Sienou and Karduck, 2012; Van Wassenhove, 2006; Whybark *et al.*, 2010). These problems lead to the emergence of ad hoc norms during disasters (Drabek and McEntire, 2003), which affect and are affected by operational activities on the ground. Currently, the link and the discrepancies between the decision-making structure and the operational activities on the ground have not been sufficiently researched (Hart *et al.*, 1993). This situation creates the need to look more closely to the link between both levels. The purpose of this is to enhance the performance (i.e. the support provided to disaster victims) achieved by disaster management activities.

This paper contributes to the understanding of the interaction of the components of disaster management response systems and their effect on logistics performance. It has been long thought that the decision-making structure used in a disaster management system has automatic implications on logistics performance (Brouillette and Quarantelli, 1971). However, instead, it has been seen during disaster operations that the performance is commonly affected by the operational decisions made on the ground (Holguín-Veras *et al.*, 2012). Further investigations are necessary to analyse the relationship between the decision-making structure and operational activities on the ground to provide insights about the impact of both on logistics performance. This paper contends that it is the alignment of both components that has an effect on performance.

Disaster management at the organisational level has been studied from the perspective of organisational studies (OS) (Mileti and Sorensen, 1987), whereas operational activities on the ground have been explored in the field of humanitarian logistics with the support of Operations Management (OM) (Gupta, 1995; Taylor and Taylor, 2009). Even though the link between OM and organisational structure has recently been made in the literature (MacCarthy *et al.*, 2016), there is a disconnection between both literatures. As part of OS, problems with centralised and decentralised systems have been identified by focussing on the impact of decision-making structures. Among these articles, however, there is little discussion about the importance of activities on the ground. On the other hand, different models and frameworks have been developed in OM with the aim of improving logistics performance (e.g., Chang *et al.*, 2007; Tofighi *et al.*, 2016; Ransikarbum and Mason, 2016). Unfortunately, these articles neglect the value of the decision-making structure and how it affects the models developed. Both perspectives have valuable insights to support disaster operations and maximise logistics performance. However, a greater understanding of the elements hindering logistics performance may be gained by blending the perspective of OS and OM. This paper represents a step towards such integration.

The central difficulty presented by the perspectives undertaken in the fields of OS and OM is the assumption of a precedence because of hierarchy (Mileti and Sorensen, 1987) and urgency (Wijngaard *et al.*, 2006), respectively. This paper argues that looking at the decision-making structure or at the operational activities on the ground independently can create a disjointed disaster management system with a negative impact on performance. Instead, Ford and Schellenberg (1982) state that an organisation can be assessed based on the extent to which the decision-making structure and the operational activities on the ground converge. Taking up this perspective, this paper considers the manner in which the alignment between both levels can be used to reduce the shortcomings of each one of them. Hence, the purpose of this paper is not to determine which perspective should take precedence, but to consider both perspectives and their relationship to understand the conditions hindering logistics performance.

Empirical data from a case study, a hierarchical decision-making structure, the operational activities on the ground, and their links, are analysed to provide insights to

improve disaster management systems. The purpose is to tackle the following research question:

RQ1. What is the effect of the alignment between the operational activities on the ground and the decision-making structure adopted on logistics performance in disaster management?

From a practical perspective, this research analyses both levels and the fit between them based on empirical data to provide insights about the Mexican disaster management system. Real data were gathered to develop an analysis that could also provide valuable results for practitioners (Charles *et al.*, 2016).

This paper contributes to practice and research in a variety of ways. First, it increases the understanding of the interaction of the components of disaster management response systems and their relationships (i.e. the decision-making structure and the operational activities on the ground). Second, it integrates the perspectives of OS and OM into a holistic approach to improve disaster management systems. Third, this paper proposes a novel perspective to enhance the performance of disaster management systems considering the alignment between the hierarchical decision-making structure and the operational activities on the ground. Finally, the paper provides recommendations for best practices in humanitarian logistics, which are applicable to Mexico and other countries using centralised decision-making. This has the potential to support researchers on OS and OM to develop more comprehensive solutions for disaster management.

This paper is organised as follows: Section 2 introduces relevant articles from the perspective of this research and the methodology used is presented in Section 3. Section 4 describes the Mexican framework for disaster management, and Section 5 introduces the analysis of the case. Section 6 provides a discussion of the results obtained while Section 7 enumerates some policy implications. Concluding remarks are presented in Section 8.

2. Literature review

This paper investigates the link between the decision-making structure and the operational activities on the ground, and the impact of the alignment between them on performance. To place the article in the literature, initially this section introduces the perspective of operational activities on the ground to describe the focus of articles in the area and the importance of logistics performance. Then, the literature on decision-making in disaster management organisations is presented to define the most common perspectives used before in the area (i.e. centralisation and decentralisation). Next, articles related to performance in disaster management are discussed. These sections serve as context to frame the final section which connects the three dimensions.

2.1 Operational activities on the ground

Humanitarian logistics are essential during disaster management to support affected communities promptly (Nathan *et al.*, 2017). This area is closely related to disaster preparedness and response. Caunhye *et al.* (2012) identify evacuation, facility location, stock prepositioning, relief distribution, capacity planning, inventory management and casualty transportation as closely connected activities which have been commonly studied in the literature of humanitarian logistics.

There are several articles developing models and frameworks to achieve successful operations on the field (see Caunhye *et al.*, 2012), even incorporating “social cost” in the performance measures (see Holguín-Veras *et al.*, 2013). Usually, operational activities on the ground are performed in line with policy and procedures (Hart *et al.*, 1993), although many times urgency becomes a factor causing inconsistency (Wijngaard *et al.*, 2006). The reason is because of the inconsistencies between plans and the operational environment (Nathan *et al.*, 2017).

Despite the importance of decision-making structures and the hierarchy between units (Wijngaard *et al.*, 2006), however, most of the articles in the field of humanitarian logistics neglect to incorporate these dimensions.

2.2 Decision-making in disaster management organisations

The organisational design is relevant because the fit within the internal components of the system, as well as the fit between the system and the environment have a significant effect on performance (Ruffini *et al.*, 2000; Dalton *et al.*, 1980; Ford and Schellenberg, 1982). The process and structures involved in decision-making are key dimensions in the organisational structure (Al-Abbadi, 2015). These play an important role in the efficiency of organisations because they affect the kind of problems faced in operations. For instance, in a decentralised system, resource constraints can create divisiveness among groups, something less likely to happen in centralised systems. On the other hand, in decentralised systems, decision-making has to go through fewer layers of authority allowing more responsiveness, unlike centralised systems (Takeda and Helms, 2006).

There has been a considerable discussion about the appropriateness of centralisation and decentralisation in the business sector (Dalton *et al.*, 1980). Encouraging the rationalisation of decision-making with the inclusion of only a few individuals leads to centralisation, whereas promoting wider participation in decision-making leads to decentralisation (Marks, 1978). The former has several layers of managers, whereas the latter has fewer layers and several decisions are made in parallel. Marks (1978) and Dalton *et al.* (1980) provide evidence that decentralisation can be highly efficient and effective in the business environment, although Dalton *et al.* (1980) also argue that a decentralised system needs more time for coordination and the resolution of conflicts. Furthermore, they state that many studies supporting decentralisation are not using “hard” performance measures, limiting the value of the results.

During disaster management, the overarching goal of survival often leads governments to implement centralised decision-making to attempt to control and find optimal solutions (Child, 1972; Quarantelli, 1988). That is the reason that the most emergency management systems are modelled using this approach (Takeda and Helms, 2006). In the literature, Takeda and Helms (2006) discuss the use of bureaucratic models for emergency response and identify centralised decision-making, external knowledge, the complex conditions of the disaster and a lack of flexibility as major issues for the bureaucratic model. Dhouha and Gonzalo (2013) study the impact of centralisation of decision-making during the reconstruction stage using a case from the 2003 flood in Tunisia. Their results showed that the top-down approach achieved a poor level of satisfaction.

Centralisation has been considered a bad model for disasters because of its inherent disadvantages (Quarantelli, 1988). The large number of organisations that require access to the disaster management system (Child, 1972; Boin and Lagadec, 2000; Holguin-Veras *et al.*, 2012), the need for flexibility in the implementation of policy and regulation (Oloruntoba, 2005), and the need of non-programmable responses (Boin and Lagadec, 2000) are reasons why humanitarian organisations are moving their supply chain towards decentralisation (Charles *et al.*, 2016). Manyena (2006) focus on local authorities to explore the link between disaster management and disaster resilience. The author emphasises autonomy for decision-making, fiscal and administrative issues and an appropriate organisational structure as relevant elements to build resilience. Chang Seng (2013) describes the disaster preparedness of a decentralised system in an early warning system in Indonesia. They identify national security and social conflict, challenges of implementing decentralisation policies, funding and resources as the main barriers for institutional advancement in disaster risk reduction.

In view of an evidence against centralisation, Scolobig *et al.* (2015) argue that a people-centred approach could be more suitable for modern conditions given the limitations

in capability of a single organisation, such as the government. Similarly, Kovacs and Spens (2011) mention the value of community-based approaches to integrate beneficiaries in activities. Nevertheless, these approaches have been more commonly adopted under improvised circumstances, such as during Hurricane Sandy. The reason is that decentralised models can be complex (Manyena, 2006) and very challenging to implement in the context of some countries (Chang Seng, 2013). Garschagen (2016) argues that decentralising disaster management in a centralised system, such as a government, faces several challenges in implementation because of the lack of investment in capacity building and procedural adjustment. Furthermore, decentralisation may cause a lack of standardisation and fragmentation, if it is not properly prepared and managed (Drabek, 1985), a major concern for disaster operations.

Therefore, the major decision-making structures in the literature (Garschagen, 2016) have shown several shortcomings at the level of the operational activities on the ground. The current discussion in the field, however, is still not integrating this dimension.

2.3 Performance in disaster management systems

Looking at organisational performance, Santos-Reyes *et al.* (2010) propose a fault-tree model to assess the organisational activities of the government during disasters in Mexico. Later on, Roshan Bhakta *et al.* (2014) provide an analysis of the performance of fire service organisations in emergency conditions in New Zealand. The authors confirm that stability, leadership, stakeholder communication and adaptability are major predictors of organisational success in those settings. Dube *et al.* (2016) study countries affected by man-made disasters with a high State Fragility Index (<http://fundforpeace.org/fsi/>) to explore the motivation and impact of host governments in the performance of international humanitarian organisations. The authors identify four types of hosting governments based on the link of their conflicting strategic goals and enforcement capabilities.

There are extensive studies measuring performance in the supply chain (Beamon, 1999; Helena, 2007). The purpose of the operational activities on the ground is to satisfy the requirements of the victims (Thomas and Mizushima, 2005). Considering the high stakes involved in disaster operations (Kovacs and Spens, 2011), this paper defines logistics performance as the ability to successfully satisfy such needs. Beamon (1999) classify supply chain performance measures in three main types: resources, output and flexibility. Resources account for the input of a process, whereas output involves the organisation's and customers' goals, and flexibility refers to the capability to adapt to fluctuations (Beamon, 1999). The successful achievement of these three measures is linked to the satisfaction of the needs of disaster victims. Operational activities on the ground are performed by a large number of actors, such as host (governments with responsibility over the affected areas) and associated governments, regional authorities, state governments, military units, NGOs, and private and quasi-private organisations (Cozzolino, 2012; Mileti and Sorensen, 1987). Instead of looking at the performance of individual organisations (i.e. the supply side), this research focuses on the ability of the disaster management system to meet the requirements of the victims (i.e. the demand side). This support is linked to the three types of measures described by Beamon (1999).

Focussing on logistics performance, Thompson (2015) assesses the current state of disaster logistics in the Caribbean through eight in-depth unstructured interviews with logistics managers and heads of disaster agencies. Thompson (2015) identify a lack of a coherent and integrated logistics strategy as a common problem. Nigg *et al.* (2006) provide an assessment of governmental activities looking at evacuation and providing shelters and temporary housing after Hurricane Katrina in the USA. The authors point to several issues in terms of shelter management, lack of policies for successful evacuation across states, poor standardisation and disjointed local political cultures.

2.4 The decision-making structure and logistics performance

The research presented so far provides a context for operational activities on the ground, decision-making structures and performance in disaster management. This section includes sources looking at the link between these dimensions.

In view of the variety of organisations involved in disaster management, research has considered different types of organisations. Studies have analysed non-governmental organisations (NGOs) during disaster operations to improve their supply chain (Kumar *et al.*, 2009), proposed an integrated framework for post-disaster reconstruction (Lu and Xu, 2015), determined the location of facilities and the amount to stock to preposition based on decentralisation policies from Red Cross (Charles *et al.*, 2016) and investigated the role of the organisational structure of NGOs in their influence on policy development (Marquez, 2016). Additionally, other studies have looked at the link between NGO's organisational principles and performance (Hilhorst and Schmiemann, 2002) and, thus, offer insights about the challenges for logistics in these organisations (Kovacs and Spens, 2009).

In many countries, the military provides primary assistance in cases of disaster because of its structure and the resources it has available (Cozzolino, 2012; Heaslip and Barber, 2014). Heaslip and Barber (2014) focus on the organisational challenges of the military for disaster operations and how the interaction between coordination, logistics and human resources can improve performance in disaster operations.

Despite the importance of the NGOs and the military, the role of the host government as initiators of disaster response is prominent. These governments have the jurisdiction and authority to allow operations to be carried out (Cozzolino, 2012), and they become responsible for disaster operations abiding by a set of national and international regulations (Dube *et al.*, 2016). Therefore, the decision-making structure of the host government affects the overall performance of disaster operations (Brouillette and Quarantelli, 1971) and its activities on the ground are the reference point for the disaster management system. From that perspective, Westley *et al.* (2008) perform an analysis of bureaucracy based on FEMA following Hurricane Katrina in the USA. The authors point out failures associated with the provision of relief and care to the people affected because of the highly centralised institutional system which hindered the participation of more people in the decision process.

Chandes and Paché (2010) suggest the use of adaptive collective strategies to improve humanitarian logistics. They use a case in Peru to show the potential benefits of collective action. Using participant observation, they analyse the governmental response and describe the importance of a central directive unit, with the purpose of coordinating the multiple civil defence committees. They suggest the inclusion of adapted performance indicators, mass customization and collective action to improve humanitarian operations. Richter *et al.* (2013) propose a decentralised evacuation application on mobile devices for situations in which a centralised system has failed or is non-existent. Using agent-based simulation to test peer-to-peer information communication, the authors show how a decentralised approach can improve evacuation management.

In the literature presented, we found that there is an evidence of the assessment of different systems based on either an organisational view or a logistics perspective; but the fit between them has been neglected. The aim of this paper is to fill that gap by taking a holistic approach to analyse the impact of misalignment between these two dimensions on performance during emergencies.

3. Methodology

3.1 Overall design

In order to analyse the impact of the alignment between the decision-making structure and operational activities on the ground, this study includes a case based on the activities of the

Mexican disaster management system during the worst disaster experienced in 30 years. Given the exploratory nature of the research question:

RQ1. What is the effect on logistics performance of the alignment between the operational activities on the ground and the decision-making structure adopted in disaster management?

A case study approach using empirical data was undertaken to analyse the situation in its natural context (Voss *et al.*, 2002).

Case studies can be used for theory generation, theory testing or theory elaboration (Ketokivi and Choi, 2014) because it is a strategy that allows to understand the dynamics existent within a defined situation (Eisenhardt, 1989). This paper is defined as theory elaboration, which is placed in between theory testing and theory generation (Ketokivi and Choi, 2014). Fisher and Aguinis (2017) define theory elaboration as “[...] the process of conceptualizing and executing empirical research using preexisting conceptual ideas or a preliminary model as a basis for developing new theoretical insights by contrasting, specifying, or structuring theoretical constructs and relations to account for and explain empirical observations” (Fisher and Aguinis, 2017).

A theory can be elaborated through the in-depth analysis of the relationships among different elements considering the general context and previous findings simultaneously (Ketokivi and Choi, 2014). Using constructs and relationships from OS and OM, this research empirically analyses the effect on logistics performance of the relationship between the decision-making structure and the operational activities on the ground. The purpose of the research is to deepen the current knowledge and understanding of the relationship between the decision-making structure and the operational activities on the ground using empirical data, which can lead to the development of more integrated solutions.

3.2 Research planning

For the development of this research, the methodology outlined by Eisenhardt (1989) was followed. Initially, the literature from different areas was analysed and used to define the research question. Next, the case was selected considering the vulnerability of developing countries (Davarzani *et al.*, 2015) and the research question defined. Then, the archival data and interview were selected as data collection methods and data collection was undertaken. After the information was collected, a within-a-case analysis was performed to investigate the relationships between components and their effect in logistics performance. Next, the results were compared and contrasted with the extant literature and closure was reached (Eisenhardt, 1989).

3.3 Case selection

The case study method is one of the most common approaches undertaken in OM studies (Taylor and Taylor, 2009) because it can be used to explain complex real-world phenomena (Peter-Christian and Dmitrij, 2015). It has been used in this research because it can provide relevant insights about the situation (Helena, 2007). Yin (1994) stated that case studies should be used when “a why or how question is being asked about a contemporary set of events over which the investigator has little or no control”. Case studies can deepen the understanding of processes and contexts, and to provide meaningful insights in an underexplored field.

In view of the calls for the empirical work to analyse the decision-making structures and public policy in disasters (Holguin-Veras *et al.*, 2012), a case study can be used to capture the conditions generated by a disaster and evaluate the performance of the disaster management system. Davarzani *et al.* (2015) suggested that it is important to understand the impact and performance of the decision-making structure in settings with political and

economic uncertainty, such as the conditions experienced in developing countries. Accordingly, a case study in Mexico was selected because it fulfils these characteristics. The case was based on the 2007 flooding in Villahermosa.

Mexico is located in a very active seismic area and in the path of hurricanes and tropical storms coming from the Atlantic and the Pacific (Saldana-Zorrilla, 2015). From 1950 to 2015, the country has been the most disaster prone nation in the Americas after the USA (CRED, 2016). Mexico's case is also interesting because it has the second largest economy in Latin America, while at the same time, nearly half the population lives in poverty conditions (INEGI, 2012). Despite having a disaster policy in place, recent experiences have demonstrated that the support provided to disaster victims using a top-down centralised decision-making structure is not achieving the expected results (Santos-Reyes *et al.*, 2010).

Developing countries, such as Mexico, commonly use a "military" approach for decision-making because it provides a known and manageable structure. Activities can be delegated depending on technical skills and expertise using a centralised model of management involving a single "leading" organisation (Scolobig *et al.*, 2015). However, it has been pointed out that how this approach is focused more on the process than in the outcome (Takeda and Helms, 2006).

The organisational and decision-making structure of the Mexican disaster management system was acquired through a review of Mexican regulations, white papers and research articles. The operational procedures employed by the Mexican organisations involved in humanitarian logistics in the field included rules and regulations from organisations involved in disaster relief operations, as well as guidelines provided by Plan Marina and Plan DN-III (Disaster management plans for the most serious disasters) from the navy and the military, respectively. Additionally, the emergency relief request process for the Natural Disaster Fund (FONDEN) was analysed along with the process to request medicines in case of emergency.

3.4 Data collection methods

Data collection was performed through a combination of interviews and the gathering of archival data. Information about medical services and procedures was obtained from an interview with CENAPRECE (National Centre of Preventive Plans and Disease Control (CENAPRECE), personal communication, 2 September 2014). An interview with a representative from the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) was carried out to understand the procedures undertaken by them and other organisations for disaster situations in Mexico (OCHA, personal communication, 28 August 2014). Additionally, an exploratory interview was undertaken with members of the disaster management unit from the Mexican National Defence Secretariat (SEDENA) (SEDENA, personal communication, 11 March, 2010). This interview involved a set of written questions answered by the officials prior to the meeting, and then open-ended questions about general procedures and practices during the interview.

Secondary information about the circumstances of the disaster was obtained through a series of freedom of information (FOI) requests directed to relevant local, state and national government agencies. Participants other than the government were incorporated using reports and press releases from these other organisations. This included the relief aid sent by other governments and international organisations.

The data collected provided insights about the implications of the current system in performance. The database collected included the organisational decision-making structure and the logistics activities performed on the ground in the country. Having both sides is essential to explore the impact of the alignment between them on performance. Therefore, both sides can be analysed to draw conclusions from a holistic perspective, with the purpose of identifying the real challenges affecting performance beyond the common constructs associated with the operational or the organisational view.

3.5 Data analysis

Data analysis is the least standardised part of the application of the case study method (Eisenhardt, 1989). The data from the interviews and FOI requests were initially used to draw a picture of the logistics activities performed by authorities during the disaster. Based on that, an analysis of supply and demand was carried out. The information about the resources deployed by the organisations was contrasted to the demand of disaster victims based on the operational parameters (i.e. personnel required per activity, service capacity of the products, shelter requirements) provided by the organisations, policy and guidelines publicly available. This section of the analysis was clustered based on the logistics activity to identify patterns present in the case.

Based on the performance of the logistics activities, the results were analysed from the lens of the decision-making structure used in Mexico using the three types of metrics described by Beamon (1999). From that point onwards, the analysis included comparing and contrasting the results with the extant literature (Eisenhardt, 1989) to evaluate the accuracy of considering an OS or OM perspective alone. Then, the alignment between the decision-making structure and the operational activities on the ground was investigated, and its effect on logistics performance was analysed.

4. Disaster management in Mexico

4.1 National Civil Protection System

Decision-making in disaster situations in Mexico uses a centralised, top-down structure to avoid uncertainty in the control and management of operations (Parnell, 2015), with the National System for Civil Protection (SINAPROC) as the coordinating body in charge of developing and overseeing plans from different participants for disaster management.

Humanitarian logistics in Mexico involves three main activities: the provision of food shelter and medical attention (Ordaz and Zeballos, 2007). These activities are carried out with support from SINAPROC based on the guidelines established as part of the policy.

4.2 Disaster management structure

Disaster management in the country includes four main branches: executive coordination, technical coordination, technical support and co-responsibility. SINAPROC works as the coordinator of the different branches to manage emergency situations. Each branch has a different purpose:

- Executive coordination: the Ministry of Interior is the entity responsible for working with organisations of the three government levels (namely, national, state and municipal).
- Technical coordination: organisations with the capability and expertise to provide technical counsel for the planning, operation and assessment of activities related to disaster management in any emergency.
- Technical support: organisations with the necessary capabilities to provide aid and advice for a specific disaster.
- Co-responsibility: organisations charged with the responsibility of providing supplementary support along with human and material resources to the emergency activities on top of their normal duties.

4.3 Guidelines for disaster response

After a disaster strikes a community, the first agency on location should provide aid to the victims, and then municipal authorities have to take over to continue the relief activities.

If local authorities can cope with the disaster they oversee the whole operation, otherwise they have to notify state authorities to ask for support. That procedure is repeated for the case of state and federal authorities, until the full resources of SINAPROC are deployed (Ordaz and Zeballos, 2007). This approach is consistent with other governmental systems, in which, as the disaster develops response structures at local, regional and national level need to be requested to deal with the situation. (Roshan Bhakta *et al.*, 2014).

For initial supplies after an event, authorities in Mexico use stock prepositioning because this strategy can prevent response delays. Mexican authorities use a prepositioning policy for food kits, whereas for medicines, some kits are stocked at local units, but most of the medicines are available on request after the disaster strikes (SEGOB, 2012). Information about the method to determine the level of stock, however, is not clearly defined.

For the ongoing supply of relief, authorities can request relief items based on needs assessment. The level of demand is established by regional authorities to request support and supplies from FONDEN. Consumable goods are arranged in kits to provide support for four people for four days. The rest of the items are provided based on the composition of the population. The products listed in the “Agreement for the operation of the fund for natural disasters” can be charged to FONDEN (SEGOB, 2012), using them as standard units for distribution.

Medicine requests are submitted through the National Centre for Preventive Planning and Disease Control, namely, CENAPRECE (SEGOB, 2012). A council is in charge of evaluating the requests based on the information available about the emergency. If the request is approved, the items are gathered/procured and sent to the area (National Centre of Preventive Plans and Disease Control (CENAPRECE), personal communication, 2 September 2014).

The relief is sent to communities and facilities supported by authorities. Civil protection authorities must select places in which acceptable living conditions can be provided to disaster victims to serve as shelters prior to any emergency (SEDENA, personal communication, 11 March 2010). Risk atlases should be developed to show graphically the levels of danger in different regions. Using these atlases, a list of suitable shelters is provided to people before the disaster strikes to ease evacuation procedures and allow them to move to these facilities in cases of emergency (Saldana-Zorrilla, 2015).

5. Disaster management in the flood of Villahermosa in 2007

5.1 Villahermosa, Mexico

Villahermosa is the county seat of the Municipality of Centro (CENTRO) and the capital of the State of Tabasco. The links of Villahermosa to natural gas production and ports for oil exports make the area economically important for the country. Nonetheless, around 49.6 per cent of the population are living in poverty (INEGI, 2012).

Villahermosa is surrounded by the rivers Grijalva and Carrizales, it borders with the water body “Laguna de los Espejos” and it is close to the “Las Peñitas” dam system. This makes the city very prone to flooding. In the absence of a successful relocation policy for the community, disaster management in the area is a priority for the state government.

5.2 Conditions of the 2007 flood in Villahermosa

A severe cold front caused strong rainfall in several parts of the country, especially in Villahermosa. This situation, combined with the opening of the floodgates of the “Peñitas” dam, created a catastrophic event with nearly 80 per cent of Tabasco covered by water (approximately 19,800 Km²), with water heights of four metres and more than one million people affected (Santos-Reyes *et al.*, 2010). Around 90 per cent of the area of Villahermosa was covered by water.

5.3 Data collected about the flood in Villahermosa

Most of the data collection was done through FOI requests submitted to national and state authorities using the list of organisations involved in logistics activities during disasters. The list was available from the guidelines for disaster management in the country. A total of 134 requests were directed to eight regional authorities and 128 requests were filed to nine national authorities. Of the 17 agencies approached, 13 agencies stated they had participated and were included in the analysis. At a regional level, the municipality of Centro, family services (DIF), State Health Ministry of Tabasco (STABASCO), Public Security Secretariat (SSP), Social Security Institute of the State of Tabasco (ISSET), civil protection (PC) and the Transport and Communications Secretariat (SCT). At national level, information was collected from DICONSA, Social Security Mexican Institute (IMSS), Health Ministry (SMEXICO), SEDENA, Ministry of Interior (SEGOB) and the Navy (SEMAR). Given that large-scale situations require other sources to support local capacity, relief aid sent by other governments recorded by Mexican authorities was also included.

Concerning operations after the disaster occurred, other organisations were contacted to enquire for reports about their involvement in relief activities. Online reports and press releases were gathered as well. Information about organisations such as the Presbyterian Mission Agency, Action by Churches Together International, Aktion Deutschland Hilft, Samaritan's Purse, Malteser, World Vision, and Search and Rescue Assistance in Disasters was obtained, as well as information about the Mexican Red Cross.

An overview of the data collected can be seen in Table I. The table includes information about the source institution and the official document reference (if applicable). Information collected included emergency facilities used, demand served, relief items prepositioned, personnel employed, vehicles involved, the variation of demand per period, international aid and supply capacity from the organisations involved.

5.4 Logistics activities in Villahermosa

Based on the activities considered by Caunhye *et al.* (2012), the information gathered was used to analyse the operations during the flood in Villahermosa. Unfortunately, there was no information available about casualty transportation, capacity planning, or inventory management, so the analysis is focussed on evacuation, facility location, stock prepositioning and relief distribution.

Evacuation and facility location. The information from civil protection, the Social Security Institute of the State of Tabasco and the Mexican National Defence Secretariat showed that around 99,000 people were sheltered during the emergency. The number of evacuees was even higher considering the number of people fleeing the area to stay in other accommodation. The authorities reported to have around 367 land transportation vehicles, 17 boats and 4 helicopters during the emergency, which considering the capacity of each vehicle and the time horizon of one day, ought to be enough for the evacuation activities.

Before the flood of 2007, the public catalogue of facilities for Villahermosa consisted of 107 shelters with a total capacity of 26,380 people. The catalogue considered the use of some police stations to provide support for four to ten people. These facilities can arguably be appropriate to serve as shelter for disaster victims. Beyond that, the limited capacity of these facilities creates the need to serve several facilities under disaster conditions, which represents a challenge for relief distribution.

Contradicting the evidence that shelters usually are underused (Nigg *et al.*, 2006), there was insufficient capacity in the shelters listed by authorities to accommodate the evacuees. There was a need to improvise, even to the point of using private homes as shelters. The result was the use of around 676 shelters in the area. Shelters declared to have been used by authorities during the emergency were identified and georeferenced in TransCAD®, using a layer of the road network available from INEGI.

Type of data	Source	FOI
Shelters used	PC, ISSET	700106513, 06401914
Facility cleaning cost	DIF	1236000003414
Distribution centres used	SEDENA, DICONSA	700003414, 2015000000714
Procurement per product	DICONSA	R2015000008113
Required personnel per activity	SEDENA, PC, IMSS, DICONSA	700003214, 00001514, 00430914, 00432114, 64101320214, 700004914, 2015000010414
Number of personnel per activity per organisation	DICONSA, DIF, IMSS, ISSET, PC, SMEXICO, STABASCO, SCT, SEDENA, SEGOB, SEMAR, SSP	2015000001314, 2015000003814, 2015000004014, 06399914, 0064100438914, 06644914, 06402614, 06402714, 0001200006714, 06400314, 06243714, 0000700031014, 0000700144314, 0000700106513, 0000400264914, Press release 148/2007, 05924314
Total personnel per agency	DICONSA, DIF, IMSS, ISSET, PC, SMEXICO, STABASCO, SCT, SEDENA, SEGOB, SEMAR, SSP	2015000001314, 2015000003814, 2015000004014, 06399914, 0064100438914, 06644914, 06402614, 06402714, 0001200006714, 06400314, 06243714, 0000700031014, 0000700144314, 0000700106513, 0000400264914, Press release 148/2007, 05924314
Vehicles used	CENTRO, DICONSA, DIF, IMSS, PC, SMEXICO, STABASCO, SEDENA, SEGOB, SEMAR, SSPSEDENA	05923014, 05923214, 2015000001014, 2015000003714, 2015000003914, 06400114, 0064100439014, 0064100439414, 06402814, 0001200006814, 05923814, 05924014, 0000700002614, 0000700031114, 0000700031314, 0000700106513, 0000400264914, Press release 148/2007, 05924414
Medicines delivered	SEGOB	0000400160314
Flood mask	CENAPRED	0413000000214
Technical reports of the situation	SEMAR, CENAPRED	0064100439014, 0413000000514
International aid	SRE	0000500088214
Elevation models of the region	United States Geological Survey (www.usgs.gov) and the website of the National Institute of Geography and Statistics (INEGI) in Mexico (www.inegi.org.mx/)	
Road network	Software developed by INEGI, namely SCINCE 2010 (www.inegi.org.mx/)	
Neighbourhoods	Software developed by INEGI, namely SCINCE 2010 (www.inegi.org.mx/)	
denominated Basic Geo-Statistical Area (AGEBs)		
Demographical data	Software developed by INEGI, namely SCINCE 2010 (www.inegi.org.mx/)	
Resources from NGOs	Online reports from the Mexican Red Cross, Presbyterian Mission Agency, Action by Churches Together International, Aktion Deutschland Hilft, Samaritan's purse, Malteser, World Vision, Search and Rescue Assistance in Disasters, Medical Teams International, Adventist Development and Relief Agency, Americares and the World Food Programme	

Table I.
Data collected for the case of Villahermosa

The results of the analysis agree with reports of facilities flooded and the demand exceeding the capacity provided by the authorities (Santos-Reyes *et al.*, 2010). It is believed that more than one million people affected by the disaster could not find shelter (Santos-Reyes *et al.*, 2010).

Conversely, human resources exceeded the needs of the situation. From the co-responsibility branch of the disaster management hierarchy in Mexico, there were

13,124 members of staff from seven organisations for support on shelters, and 3,150 teams (including one doctor, a nurse, a dentist and two helpers) from five organisations for healthcare in shelters as well. The military provided guidelines of six members of shelter staff to serve 90 people for activities, such as cooking, security, organising leisure activities, among others, meanwhile it was required to have one healthcare team for every 90 people sheltered. Following these guidelines, it seemed authorities had roughly enough personnel to serve around 196,860 people in terms of shelter care and 283,500 people in terms of healthcare. Considering the estimated demand of 99,000 people, the authorities had nearly two and three times the employees required for shelter care and healthcare, respectively. The number of staff in the area was more than that required to serve the highest number of people estimated by national authorities at any point (150,000 people).

Stock prepositioning. DICONSA, the organisation in charge of procurement and social programmes, reported a stock of 2,500 prepositioned food kits available for distribution in the area. In terms of medicines, there was a local supply of medicines from the health authorities (national and state). Distribution of the initial stock was planned to take place right after the disaster giving time to undertake needs assessment. With knowledge about demand, state authorities could request food and medicines from FONDEN and CENAPRECE, respectively.

It is evident that the magnitude of the event exceeded the capacity held by authorities. There were enough items to satisfy the needs of a little over 10 per cent of the population in terms of food, and enough medicine to cover less than 3 per cent of the population in the first days of the emergency. Because of the magnitude of the event, this is understandable. However, considering the objective of stock prepositioning is to reduce lead time, the process to determine the number and location of stock to preposition is essential. Currently, there is no information on a clear policy to determine the amount of stock to preposition other than the available budget. For instance, after the flood of Acapulco in 2013, authorities increased the 2,500 food kits held before the emergency to 10,000 food kits (DICONSA, 2014), which was around the amount of people sheltered in the state during the flood. The stock was subsequently reduced to 5,000 three years after the flood.

In the case, the amount of food and medicine prepositioned seemed arbitrary. The number of items was similar to the number kept in other regions of the country, without regard to vulnerability and the demographic composition. Therefore, the prepositioning policy did not provide the expected result of enhancing performance. Moreover, the analysis emphasises the need to determine the number of items to preposition based on an analysis of previous events, the demographic conditions and prospective scenarios.

Relief distribution. Mexican authorities deployed large quantities of items to Tabasco using the FONDEN, being the Centro Municipality the main focus of the aid. Water and food were the focus of authorities, although sand bags along with blankets and mattresses were also supplied in large numbers.

A list of items shipped by the authorities, obtained from SINAPROC and cross-referenced with information from the Ministry of Interior provided information about demand estimates of national and state authorities, along with the number of items shipped to the Centro Municipality. There were discrepancies between national and state authorities regarding the estimated number of people affected ranging from 22,500 to 367,500 people. Inaccurate figures show the potential for underestimation; but a common problem in reality is overestimation caused by a “false” sense of urgency (Kovacs and Spens, 2011). There were some stages in which the estimations of state authorities were more than three times the estimation of national authorities, with a sudden decrease days later. These discrepancies reveal poor information management. Even if only half of the food sent by authorities reached the area, it would have been more than twice the food required for the people

sheltered. Including the relief sent from other organisations, the amount of food provided was considerably more than what was needed. Additionally, a lack of information updates was identified, which led to the oversupply of some resources (i.e. food) and the undersupply of others (i.e. diapers and towels).

Despite all the efforts of the participants, relief distribution became a significant issue as demonstrated by reports of shortages of food (Santos-Reyes *et al.*, 2010), medicines and supplementary items. According to the information, the problem was the shortage of items at the first stage and delays to deliver the relief, which confirms the failure of the stock prepositioning policy. This occurred partly because of uneven coverage due to political interference (Dudley, 2007), impeding the provision of relief to high priority communities.

5.5 The alignment between the decision-making structure and operational activities on the ground and its effect on logistics performance

The impact of the fit between the decision-making structure and operational activities on the ground in performance is based on three types of measures: resources, output and flexibility (see Beamon, 1999).

Resources. Resources in disaster management include vehicles, relief aid, human resources and facilities, among others. This research shows a significant misalignment between the centralised system and operations in terms of resources. Looking at human resources, the Mexican system works through the activation of different layers, depending on the magnitude of the situation. The purpose is to allow the decision-maker to authorise enough resources to manage the emergency, thereby using resources efficiently. However, the activation of one layer (i.e. local, regional and/or national) means in fact the activation of many organisations, which at the operational level are deployed with the purpose of reaching as many people as possible. This was shown in the case, where the healthcare and shelter care needed could have been achieved with fewer organisations. Therefore, the policy of minimising the use of resources at the top of the structure is clearly contradicted at the bottom of the system, caused by the limited visibility of the decision-maker. The overcrowding of people can be evident for field agents, but it is hardly noticed at the top layers of the hierarchy. The result is convergence of people, which hinders operations by complicating coordination and allowing the overlapping of activities (Oloruntoba, 2005).

Regarding stock prepositioning, the amount of prepositioned stock is set depending on budget, instead of determining the number of items required based on other criteria such as vulnerability, previous disasters and the demographic composition of the country. Nevertheless, for the case study this was reflected in a very limited capacity for immediate supply compared to needs, which delayed responses and complicated the scenario at the initial stages of the disaster. Hence, this policy is unable to provide insurance of immediate response, which further complicates the successful use of centralised decision-making because of the possibility of slow response (Takeda and Helms, 2006).

Facility location is left for co-responsibility branches. However, the central decision-maker needs to oversee this activity carefully. Shelter location is performed independently from distribution centre location. The former is carried out by civil protection authorities using public facilities, whereas the latter is undertaken by DICONSA based on preowned regional facilities. Therefore, decisions are fragmented, which is a contradiction to the centralised system. Focussing on shelters, there are three major issues identified. The first is the absence of risk maps, the second is the use of unsuitable facilities because of the lack of well-defined criteria and the third is the absence of scenario planning to manage demand. These problems are a result of the misalignment between the decision-making structure and the operational activities on the ground, which causes poor facility location and management.

Output. In disaster management, the perspective of the beneficiaries is essential. A significant aspect affecting the perception of the disaster victims is relief distribution. The distribution becomes a problem in a centralised system because distribution plans ought to be draughted after assessing the state of the infrastructure (Holguin-Veras *et al.*, 2012). In view of the multi-layered structure behind a centralised system, draughting the plans and approving them can be very time consuming and, therefore, unsuitable for disaster operations. There are two strategies embedded in the Mexican system to alleviate this problem; the development of maps of the disaster to draft distribution plans in advance, and stock prepositioned for immediate deployment to allow for planning time. However, plans based on untested assumptions about the operational environment can affect the success of operations (Nathan *et al.*, 2017). The strategy assumes that operational authorities have risk maps and enough prepositioned stock, the latter being arbitrarily determined as discussed previously.

Regarding risk maps, currently the national atlas (the repository of risk maps) is still seriously incomplete and local atlases are in even poorer conditions (Alexander, 2015). The reasons for this are the lack of archive material, financial resources and human personnel (CONAGUA, 2011). Consequently, the disaster planning is not based on the analysis of hazard scenarios nor geographical factors (Alexander, 2015); so there is a high risk of choosing unsuitable facilities. Therefore, distribution plans at the operational level are indeed draughted after the disaster. The case of Villahermosa provided an example of this problem. The lack of a well-prepared risk atlas prevented authorities from developing distribution plans, which complicated the selection of suitable routes and effective shelter location. The result was the need for improvisation at the operational level and delays in the provision of relief items.

Flexibility. The capacity to react to variations in demand and adapt to different conditions is closely related to information management. Several issues for information management have been identified in centralised systems, such as one-way communication (Scolobig *et al.*, 2015), complicated the access to the system (Boin and Lagadec, 2000) and the inability to consider external information (Takeda and Helms, 2006). In the case presented, information sharing was a challenge that led to poor needs assessment and made centralised decision-making highly inefficient. The centralised approach relies on accurate information filtered through the layers of the hierarchy, but reality showed contradictions in demand estimates between national and state authorities. Independent data gathering and analysis can be useful to get robust results, but poor information sharing makes the effort fruitless.

A centralised system should use few comprehensive information systems (Marks, 1978). Conversely, each agency handled its own information without sharing it, which can lead to unreliable data and duplication of efforts. It can be argued then that information management during disasters in Mexico is mostly decentralised, as different data is collected from various agencies and handled independently. This contradiction leads to a centralised system with conflicting and incomplete information for decision-making, and operational activities on the ground with decisions based on inaccurate conditions. The result is an inflexible disaster management system with fragmented information.

Also related to flexibility, the case showed infrequent updates of needs assessment. As there was work involved in collecting and analysing information for each agency, the time between one assessment and the next could be extended to weeks or even a month. In view of the dynamic conditions of disaster management, that situation prevented the disaster management system adapting and reacting to variations effectively.

Overall, this research has identified misalignment between the decision-making structure and operational activities on the ground in terms of information collection and sharing, facility location procedures, the prepositioning policy and distribution planning. The result has been the conflicting use of resources, poor satisfaction of disaster victims and an inflexible disaster management system affecting logistics performance.

6. Discussion

The analysis shows the poor logistics performance as a result of significant disagreements between centralisation and operations. The first area to consider is to strengthen preparedness and response to support centralisation. The slow response associated with this approach (Takeda and Helms, 2006) can be alleviated by placing resources and attention in disaster preparedness. The operational activities on the ground are often more concerned with disaster response, but appropriate planning can reduce ambiguity (Wijngaard *et al.*, 2006) and response times. Planning, however, has to include input from different stakeholders at different levels to make the plans useful, achievable and sustainable. This integration relates directly to distribution, facility location and stock prepositioning.

The alignment of goals is another important aspect to bear in mind. In a centralised system, it is expected that the goals from top layers guide the entire system, but in a collaborative environment, such as disaster management the goals of different stakeholders, governmental and non-governmental, can affect the result. Logistics performance in the case of Villahermosa was affected by conflicting goals at different levels, even when the overarching goal was to prevent death and suffering. Instead of having the operational activities on the ground working within the boundaries established by the top layers of hierarchy, the objectives and guidelines need to be properly agreed across participants to have consistent operations.

The information management is an essential area to achieve high logistics performance. The case showed the impact of having a centralised structure without collaborative and reliable information systems. The duplication of efforts and the unreliability of information severely affects decision-making and complicates operational activities on the ground. Therefore, a collaborative and interactive system needs to be developed to support the decision-making structure at the top and to allow communication and the development of robust information to support operational activities on the ground. Mechanisms to aggregate and cross-reference information can help reduce the number of overlaps between different participants and provide a better quality of information to top layers of the disaster management system.

According to the interview with the representative from OCHA, the clarity about the decision-maker in the current system allows them to quickly approach them to offer support. This is an important revelation because even though Mexican authorities are commonly reluctant to ask for external help, when needed, international organisations can promptly provide support to the government, recognising the legitimacy of the authority. This aligns with the view that having a clear strategic centre and collective vision can be beneficial for operations (Chandes and Paché, 2010). This view is contradicted, however, by smaller organisations which struggle to get in touch with the government and relevant decision-makers (Hernández, 2009). This is expected because in this type of system there is the possibility of an input overload (Hart *et al.*, 1993). Adding more actors to the system can complicate control even further, which leads authorities to ignore less recognised organisations. This is a problem because self-initiated participants are a reality in emergencies, and movements such as occupy Sandy have shown the potential of people-centred initiatives. Therefore, following the findings of Khan and Rahman (2007), a participation and collaboration mechanism that joins community members and different stakeholders can be valuable to improve disaster management in the country considering the centralised decision-making structure. Although working partnerships can emerge from disaster response activities, there is a need to develop agreements and policies in advance for the joint participation between different organisations and the Mexican government. Such agreements can ease coordination, clarify functions and improve overall operations by empowering different organisations and the wider society to work with the government instead of passively following them.

Needs assessment is one of the most important activities in the first hours after disaster (Charles *et al.*, 2016), but the case showed poor management of this activity. Inaccurate needs assessment caused problems, such as shortages of relief and uneven distribution. The flow of low-priority products can hinder operations (Holguin-Veras *et al.*, 2012), because of the space and resources required. Needs assessment and procurement policies for disaster management should follow reliable and well-planned guidelines for a centralised system to work. These policies should ensure that the flow of resources is able to meet different requirements in a timely manner and account for operational capabilities. Currently that is an area for improvement for Mexico.

Standardisation is one of the key aspects required to align centralisation and operational activities on the ground. The case revealed that standardisation of relief items was a significant success for distribution after the initial phase, as it allowed more optimal use of transportation resources and to make the distribution process more efficient. This idea has to be extrapolated to procedures and guidelines to improve logistics performance. The needs assessment process showed that procedures are not standardised, allowing each organisation to operate under their own terms. This approach created discrepancies among organisations, which affected the level of service. For centralised decisions to achieve the expected results, the system has to create the right conditions through proper guidance and support to the operational activities on the ground, which has to be informed by the perspective of different stakeholders.

The presence of a set of regulations and an organisation overseeing the resources can support the stream of literature developing optimisation models (Caunhye *et al.*, 2012). Models commonly aggregate resources to provide an optimal response, which is in principle better than the sum of optimised responses from each actor. Nevertheless, models have to be robust enough to account for the uncertain conditions of disaster management and the set of unforeseen challenges encountered, combining reliability and responsiveness.

Beyond the measures discussed, there are alternatives in the literature that could be useful. Investment in disaster management capabilities, as mentioned by Kunz *et al.* (2014), to improve the flow of resources within the country and from outside, and agility and leanness in humanitarian operations could be approaches to improve responsiveness that can be supported by a centralised system (Cozzolino, 2012). On the other hand, flattening the decision-making structure in disaster management could also allow for a speedy response.

Overall, this analysis emphasises the importance of looking at the alignment between the decision-making structure and operational activities on the ground. Instead of approaching the disaster management system from the perspective of the decision-making structure or the operational activities on the ground, the alignment between them has to be considered to enhance performance. The analysis suggests that appropriate alignment between both dimensions can alleviate some of the shortcomings of centralisation and improve the performance of the disaster management system. Several of the issues commonly associated with centralisation are due to the misalignment between the decision-making structure and operations. This is a relevant finding because it moves away from the current argument about the appropriate decision-making structure for disaster management to the identification of components to implement an efficient and effective disaster management system. It shows that the key for high performance is embedded in the integrated design of the system and the alignment between its components; this might prove a more feasible approach than moving from one decision-making structure to another, especially considering the evidence of problems associated with both approaches.

7. Policy implications

The analysis presented provided a set of implications that are relevant for practice. The implementation of a decision-making structure has to be supported by sensible

assumptions at the operational level. This would prevent significant variations between policy and logistics activities.

The use of a centralised decision-making structure in Mexico faces challenges related to responsiveness, information management and poor collaboration. The current response processes are designed to use resources efficiently, but these require gathering, compiling and presenting information to decision-makers at higher layers of the system, thereby increasing response time. That information is not always shared across participants to find a collaborative solution, and this complicates joint operations. Additionally, distribution is performed by local branches of the government, which can use disaster relief for political purposes. It is important to create an inclusive disaster management system to facilitate operations, prevent delays, allow the participation of unbiased actors and be able to adapt to the dynamic environment posed by disasters. This requires a revision of disaster management policies and the structure of the disaster management system.

The activation of agencies based on layers of government has to be thoroughly revised. Sending every organisation available to the field is not the solution unless the right resources are at their disposal. In view of the logistics activities performed during disasters, the activation could be linked to the deployment of organisations based on the area of expertise and the needs assessment to prevent congestion and idle participants. Therefore, the policy has to be developed to ensure resources are being properly managed and that guidelines are in place to improve operations.

Quality assurance processes for facility location, stock prepositioning and needs assessment have to be properly designed and implemented. This research identifies several challenges related to the lack of control and proper management of those activities. Moreover, these quality assurance processes have to be shared across participant organisations to identify shortcomings (such as the lack of risk atlases or the absence of facility selection guidelines) and achieve high-performance operations. In that sense, policy about disaster management has to provide guidance for clear boundaries and responsibilities of different participants, with the inclusion of potential self-initiated actors.

8. Conclusions

This paper provided an analysis of the impact of the alignment between centralisation and operations in the activities performed in the flood of Villahermosa in 2007. Data gathered from governmental and non-governmental organisations were used to look into the logistics operations carried out during the emergency and assess the performance of the disaster management system.

The centralised decision-making structure implemented in Mexico faces challenges of communication and responsiveness, as shown by several challenges arising from the case. The information showed discrepancies in the estimation of victims between state and national authorities, infrequent information updates and delays in the initial stages of distribution. However, it was found that these problems were not only inherent to the decision-making structure, but were also a result of the misalignment between centralisation and the operational activities on the ground. This paper argues that aligning both dimensions can reduce some of the challenges and enhance logistics performance in the disaster management system. Considering the nature of centralisation, the implementation of investments in disaster capabilities, agility and leanness can help align the decision-making structure and the operational activities on the ground to improve the logistics performance of the system.

Since coordination and collaboration are of paramount importance in disaster management (Balcik *et al.*, 2010), these should be strengthened by information sharing and clear agreements about guidelines for operation, to avoid duplication of efforts and uneven coverage. In the case of Villahermosa, the information gathered showed that poor

collaboration led to the supply of more than twice the food required. Additionally, uneven coverage took place because of political reasons and the improvised facilities used by authorities. It is important to adapt the centralised structure to allow dialogue across levels and organisations to provide a more responsive system under uncertain conditions at the operational level. This requires several layers of managers in a centralised system (Christensen and Knudsen, 2010) and the potential of introducing better information systems and well-designed operational procedures on the ground to ease collaboration.

Generalisation is one of the challenges of the use of case studies. However, several of insights obtained from the case can be extrapolated to other centralised decision-making systems. The analysis was based on logistics activities commonly performed by host governments in disasters as stated by Caunhye *et al.* (2012), which makes this approach suitable to other similar systems. For instance, the argument about policy and plans based on untested assumptions shows a gap in the disaster management structure that can be found on several developing countries. Therefore, the analysis of the alignment between the decision-making structure and operational activities on the ground could deliver interesting results in similar settings. However, there are limitations in terms of the type of disaster management structure, the level of development of the country, the financing structure and the governmental stability, and these could restrict the generalisation of some of the practical implications identified.

The analysis of procedures and policy is based on documentation and interviews whereas the logistics performance was assessed using secondary information. Therefore, information from the interviews could be affected by bias or experience, and inaccurate records of the activities during the emergency could affect the data. In order to try to avoid those problems, information was cross-referenced and accounts checked with other sources, such as newspapers and academic articles. However, information could be a limitation of this research. Furthermore, information about transportation during evacuation and casualty transportation was not available from authorities, complicating the analysis. Finally, the analysis performed was focussed on logistics performance based on the activities identified by Caunhye *et al.* (2012), without considering their link to other emergency activities.

This analysis showed the importance of looking at the alignment of the decision-making structure and the operational activities on the ground to achieve successful operations during disasters. This area could be further researched in the future using: primary information for the assessment of logistics performance, cross-case analysis to identify variations between countries, assessments of the logistics performance of a decentralised disaster management system to draw comparisons, and data on the interaction of information management, collaboration agreements and decision-making structures to achieve high-performance humanitarian operations.

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