Understanding How Humanitarian Logistics Organizations Build Resilience

Abdullah Said Al Hajri (aalhajri@squ.edu.om)
College of Economics and Political Science, Sultan Qaboos University

Amar Oukil
College of Economics and Political Science, Sultan Qaboos University

Nabil Channouf
College of Economics and Political Science, Sultan Qaboos University

Abstract

One of the challenges facing humanitarian organizations is the need to build resilience against natural disasters. A recent review found that previous research has primarily focused on humanitarian operations with little focus on humanitarian development and resilience. In order to fill this gap, this study aims to explore how humanitarian logistics organizations build humanitarian supply chain resilience (HSCRES). An exploratory case study consisting of multiple in-depth interviews and document analysis was conducted. The results suggest that the process is driven by a number of factors including structure of humanitarian supply chain network and flexibility design in fulfillment centers. The end result of the research is a testable model of how resilience can be built throughout the supply chain network.

Introduction

One of the challenges facing humanitarian organizations is the need to build resilience against natural disasters (MacKenzie and Zobel, 2016). A lack of resilience leaves communities vulnerable to disruptions (Tukamuhabwa et al., 2015). The need for resilience has long been recognized by several disciplines including ecology, psychology, organizational science and supply chain management (Ponis and Koronis, 2012, Ponomarov and Holcomb, 2009).

The majority of research within supply chain management literature, however, has focused mainly on what constitutes resilience (Tukamuhabwa et al., 2015). There is far less research on how resilience is built and developed by relevant organizations. On the humanitarian side, Goldschmidta and Kumarb (2016) found that previous research has primarily focused on humanitarian operations with little research done on humanitarian development. Similarly, based on a review of the academic literature, Jahre et al. (2016) found that there is no unified understanding of what constitutes logistics preparedness and how it can contribute to improvements in humanitarian operations and

resilience. Lacking in the literature is an empirically grounded study of the actions taken by humanitarian logistics organizations to enhance resilience.

The present research is an attempt at building a comprehensive model of the factors that enhance humanitarian supply chain resilience (HSCR). We use a set of case studies to identify the factors that enhance resilience during natural disaster times. To arrive at the factors, we first conduct a within-case analysis to understand how humanitarian resilience is developed in each case, and then we undertake a cross-case analysis comparing and contrasting the essence of resilience development in each case to compile key resilience building actions. The end result is a comprehensive model that provides guidance as to the antecedents of resilience.

Literature review
Despite the wide familiarity of the concept of resilience among researchers, there is lack of consensus in the literature on the definition of resilience (Ambulkar et al., 2015). This has contributed to ambiguity of the concept of resilience. Table 1 lists definitions of resilience from representative studies. Specifically, there is disparity of whether resilience is an ability of a system to rebound to its original state, or a capability that could be developed to prepare for and respond to disruptions, or an inherent attribute of a given system.

Inconsistency in the definition of resilience has cascaded to the dimensions that comprise resilience. In a recent literature review, Tukamuhabwa et al. (2015) identified twenty-four different dimensions/strategies of resilience. To complicate matters, it is not clear whether these represent core dimensions of or antecedents to resilience (Ponis and Koronis, 2012, Jüttner and Maklan, 2011, Hohenstein et al., 2015).

Defining and operationalizing humanitarian supply chain resilience (HSCRES)
Although there is an agreement in literature of the importance of resilience in the face of disruptions, scholars of resilience have conceptualized the construct in a number of different, albeit interrelated ways. Generally, resilience studies differed on whether resilience is an output measure (Brandon-Jones et al., 2014), process (Jüttner and Maklan, 2011), or a system property (Kim et al., 2015). Similarly, they differed on whether resilience is pre- and post- disaster construct (Ponomarov and Holcomb, 2009) or as only a post-disaster one (Brandon-Jones et al., 2014). The end result is that resilience does not have a single, accepted definition or operationalization. However, it should be clear from table 1 that the various definitions do have some common themes.

In an attempt to reconcile these views, Zobel (2011) explained that while "resilience is commonly defined as the act of rebounding or springing back from a disaster ……. This ability to recover, however, can also be improved by efforts to mitigate against and prepare for the initial impact of a disaster, and therefore there also exists support for a broader definition of resilience which incorporates both pre-event and post-event activities" (p. 394). Similarly, Hohenstein et al. (2015) arrived at the conclusion that readiness as an ex-ante measure acts as a base layer to resilience in that it reduces the disruption probability and absorbs its possible negative impact. When a risk event has occurred, responsiveness ensures an appropriate reaction and adaptation to disruptions which enables a firm to recover quickly and can significantly reduce the overall disruption impact. Following from this, resilience can be said to have pre- and post-disaster mechanisms.

Within the resilience literature, the definition of Bruneau et al. (2003) is highly cited in literature. The authors define resilience as "the ability of social units (e.g., organizations, communities) to mitigate hazards, contain the effects of disasters when

they occur, and carry out recovery activities in ways that minimize social disruption and mitigate the effects of future disasters". This is similar to Ponis and Koronis (2012) who states that "resilience is the ability to proactively plan and design the supply chain network for anticipating unexpected disruptive (negative) events, respond adaptively to disruptions while maintaining control over structure and function and transcending to a post robust state of operations, if possible a more favorable one than that prior to the event, thus gaining a competitive advantage."

Table 1– Definitions of resilience in the literature

Definition	Context	Reference
The ability of social units (e.g., organizations, communities) to mitigate hazards, contain the effects of disasters when they occur, and carry out recovery activities in ways that minimize social disruption and mitigate the effects of future disasters.	Humanitarian	Bruneau et al. (2003)
The adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function	Supply Chain	Ponomarov and Holcomb (2009)
A network-level attribute to withstand disruptions that may be triggered at the node or arc level	Supply network	Kim et al. (2015)
The adaptive capability of a supply chain to prepare for and/or respond to disruptions, to make a timely and cost-effective recovery, and therefore progress to a post-disruption state of operations – ideally, a better state than prior to the disruption	Supply chain	Tukamuhabwa et al. (2015)
The supply chain's ability to be prepared for unexpected risk events, responding and recovering quickly to potential disruptions to return to its original situation or grow by moving to a new, more desirable state in order to increase customer service, market share and financial performance.	Supply chain	Hohenstein et al. (2015)
A supply chain can, thus, be resilient if its original stable situation is sustained or if a new stable situation is achieved. In this research, resilience is understood as the ability of a supply chain to cope with change. In order to cope with change and to depart from an unstable state, the nature of interaction with the environment, in general, needs to be either reactive or proactive.	Supply chain	Wieland and Wallenburg (2013)
The ability to proactively plan and design the supply chain network for anticipating unexpected disruptive (negative) events, respond adaptively to disruptions while maintaining control over structure and function and transcending to a post robust state of operations, if possible a more favorable one than that prior to the event, thus gaining a competitive advantage	Supply Chain	Ponis and Koronis (2012)
The capability of the firm to be alert to, adapt to, and quickly respond to changes brought by a supply chain disruption	The firm	Ambulkar et al. (2015)
The ability of a system to return to its original state, within an acceptable period of time, after being disturbed.	Supply chain	Brandon-Jones et al (2014)
The capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change	Humanitarian	Day (2014)

This research is examining resilience building within logistics humanitarian organizations. We follow Bruneau et al. (2003) in defining humanitarian supply chain resilience (HSCRES) for this specific research effort as follows:

The ability of humanitarian logistics organizations to mitigate hazards, contain the effects of disasters when they occur, and carry out recovery activities in ways that minimize disruption to humanitarian supply chain and community and mitigate the effects of future disasters.

This definition, consistent with Ponomarov and Holcomb (2009), Hohenstein et al. (2015), Tukamuhabwa et al. (2015) and others, suggests that resilient systems have the following dimensions:
- Robust or resistant to hazards
- Rapidly respond to contain losses.

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- Rapidly recover to pre-disaster state or a better one especially where the existing resilience level is low.
- Reduce future impact through learning and adaptation (Koliou et al., 2018).

Beyond these, literature provides inconsistent arguments of what constitutes resilience. For instance, Tukamuhabwa et al. (2015) referred to twenty-four different strategies identified through a literature review for achieving SCRES, whereas Hohenstein et al. (2015) referred to thirty-six elements (i.e. dimensions) of SCRES.

Resilience building mechanisms
Three streams of research contributed to resilience building. Resilience capability studies examine strategies to build resilience. Much of the supply chain resilience literature (Tukamuhabwa et al., 2015) falls into this category. Built environment studies of resilience examine how to enhance resilience of life line services such as hospitals (Cimellaro et al., 2010) and electrical utilities (MacKenzie and Zobel, 2016) prior to a disruption through allocation of resources from a fixed budget using quantitative modeling of resilience. In comparison, resilience studies within humanitarian logistics are lacking (Jahre et al., 2016).

Resilience capability studies focus on outlining strategies for improving the resilience of a supply chain to disruption. Depending on which dimension of resilience a particular strategy will have major influence, strategies have been organized into two categories - proactive and reactive strategies (Wieland and Wallenburg, 2013). Proactive strategies are related to disruption mitigation and resistance whereas reactive strategies are related to disruption response and recovery. Some of these strategies however, have dual influence on both categories. For example, Hohenstein et al. (2015) identified collaboration, human resource management, inventory management, predefined contingency plans, redundancy and visibility as proactive strategies that have the potential to anticipate and mitigate the impact of disruptions. Whereas, agility, collaboration, flexibility, human resource management, and redundancy provide the ability to cope with and adapt reactively to unexpected disturbances.

Based on an assessment of the research on supply chain resilience strategies, Tukamuhabwa et al. (2015) noted that while proactive strategies have the potential to mitigate vulnerabilities, managers may be reluctant to apply them because potential disruptive events may not ultimately occur. Hence, there is a need to focus on how firms can actually develop or implement these strategies.

Humanitarian logistics studies focused mainly on the response phase of disaster management with slight research on preparedness stage, albeit with little reference to resilience (Jahre et al., 2016). Literature in this stream suggests that natural disaster response activity needs to be viewed holistically in the context of a disaster management planning and that involvement of local logisticians is crucial for effective response (Perry, 2007). Studies have also examined critical success factors in the emergency relief chain (Pettit and Beresford, 2009). For instance, Oloruntoba (2010) identified some key success factors in the emergency relief effort of Cyclone Larry in Australia classified into pre-disaster and aftermath. Issues related to preparedness phase include routine cyclone awareness and education campaigns, specific early warning about Cyclone Larry, prior standing pre-cyclone plans and strategic planning. Issues relating to response phase include government unity of direction and whole of government response, the Australian Defence Force and tactical ERC planning and execution. Scholten et al. (2014) and Gabler et al. (2017) are the two attempts which make their research endeavour to enhance resilience. Scholten et al. (2014) utilize the resilience capability literature to map humanitarian operations activities to resilience.

Gabler et al. (2017) investigated disaster resilience through public–private short-term collaboration.

The literature review highlights a significant gap in the literature. Majority of resilience research cited has focused on investigating resilience in commercial supply chains. The humanitarian logistics literature, in contrast, does not offer clear guidelines on how to develop resilience within humanitarian logistics organizations (Jahre et al., 2016, Goldschmidta and Kumarb, 2016). Lacking in the known literature is any guidance as to how humanitarian logistics organizations actually create resilience. The model in Figure 1 is derived from the disparate literature. The model provides some suggestions but it is far from complete.

The purpose of this research is then to begin to move humanitarian logistics research from focusing only on response operations to prescribing actions that can facilitate efforts at building resilience. The following section details the methods used by this study to begin to identify the antecedents to resilience in this context.
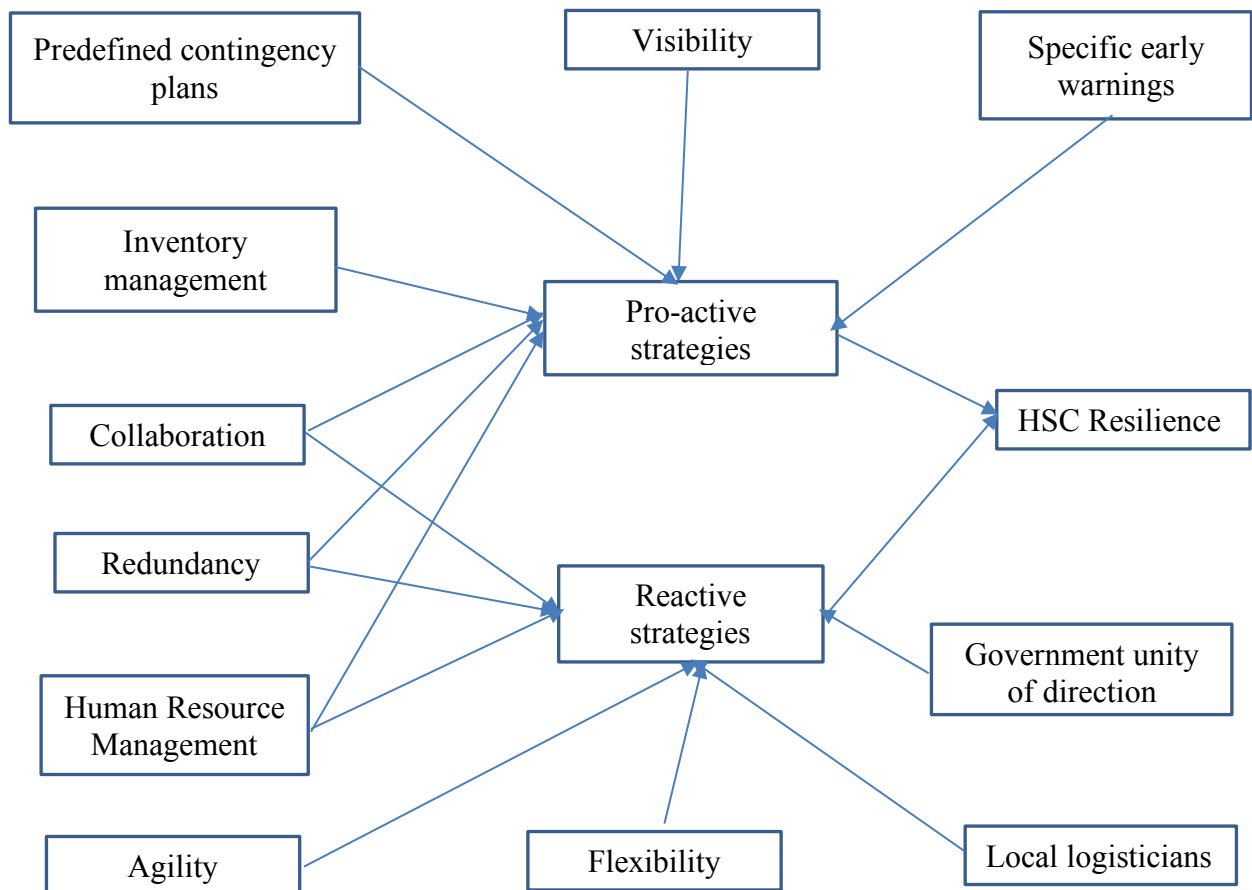

Figure 1- Key drivers of HSC resilience based on literature

Design/methodology/approach

Little is known about the processes used to enhance resilience within humanitarian logistics organizations. Therefore, an exploratory case study consisting of multiple in-depth interviews and document analysis was conducted. The field-based data collection helped us to understand the actions taken, their timings, and how they contributed to the different dimensions of resilience. We followed the grounded theory development methodology suggested by Glaser and Strauss (1967) and the guidelines given in

Eisenhardt (1989), and Yin (1994) were also incorporated. The end result was a series of case studies, where each case was treated as a replication.

Sample selection

Following the recommendation of Eisenhardt (1989), theoretical sampling was used. According to Tukamuhabwa et al. (2015), resilience of a supply chain is not the result of an individual firm's actions in isolation. Instead, it is a network phenomenon arising from connectivity between firms. This suggests that the primary unit of analysis should be supply chain rather than individual firm. Hence, in selecting humanitarian organizations to interview, the team first approached one governmental organization which is involved with disaster relief. This initial meeting was useful in identifying organizations responsible for the activities of humanitarian supply chain. In addition, the meeting helped with contextualizing the research plan and interview protocol.

Interview protocol

To aid with data collection, a humanitarian logistics research plan, interview protocol and interview guide were developed based on the guidelines in Yin (1994). Interview questions were developed based on resilience literature, humanitarian logistics literature and business logistics capability literature. The questions covered general background information about the organization, activities of organization, role in humanitarian supply chain management, pre-disaster mitigation and preparation, post-disaster response and recovery activities, collaborations, learning processes, and performance assessments. The interview protocol called for at least two semi-structured interviews with each organization (an executive manager and operations manager), direct observations of organization activities in relation to humanitarian logistics, documents, and archival records.

Data collection and analysis

Data collection

The sample consisted of five humanitarian logistics organizations in the Sultanate of Oman. All five organizations had extensive experience with at least two major cyclones that hit the country in 2007 and 2010 and several tropical storms. Hence, these organizations had the time and exposure to develop their logistics processes for better humanitarian supply chain resilience. For all five organizations the team worked on to have separate meetings with the two managers, however at times both managers (i.e. top executive manager and operations manager) were available at the same meeting. The interview time in each organization and with each manager ranged from 2 to 4 hours which were then transcribed from Arabic to English by professional translators. Along with the interviews conducted and tours, the team was able to collect rich profiles of qualitative and quantitative data pertaining to previous disasters and actions taken. Table 2 details the sample.

Table 2– Sample Characteristics

Organization	Sector	Role in Humanitarian Supply Chain	Interview time (total for each organization)
A	Government	Food relief storage and supply (e.g. Rice, flour, sugar, lentils, land transportation prior to disaster onset, receives food donations	5 hours
B	Government	Non-food relief storage and supply (e.g. Beds, blankets, pillows), land transportation prior and post disaster onset, receives non-food donations	5 hours
C	Government	Cash relief for people in need and for local committees to purchase relief supplies, last mile delivery, management of relief chain, receives monetary donations, decides on which sheltering locations to open	4 hours
D	Government	Coordination among relief organizations	2 hours
E	Government	Meteorological information for relief supply chain members, advising on best locations for shelters	6 hours

Data analysis

The primary unit of analysis is the humanitarian supply chain network, focusing on the individual's perception of the network. Furthermore, there is one additional embedded unit of analysis, the individual organization engaged in the network. The intent was to collect data on the humanitarian supply chain network as well as on how internal operations support resilience. The analysis is to be done using two main components: within and cross case analyses. Within case analysis helps us to examine resilience in a single context, while cross case analysis serves as a form of replication (Yin, 1994) where the constructs of interest in one setting are tested in other settings.

Eisenhardt (1989) explained that theory-building research is begun as close as possible to no theory. Investigators should avoid thinking about specific relationships or variables, except at the outset, when conducting their research. Otherwise preordained propositions may bias and limit the findings. Hence, beyond the interview protocol, the research team approached every organization with an open mind.

The within case analysis aimed to identify constructs of importance within each organization and constructs at the network level. This process had two key steps. First, all factors influencing resilience in the organization and at the network level were identified. These are initially displayed in a tabular form. As the interview protocol is divided into pre- and post-disaster, variables divided naturally into the different resilience dimensions. Second, relationship among the different factors and resilience were determined.

Between case analysis is concerned about identifying patterns across the five organizations which is facilitated by a number of tactics aimed at reducing the data and displaying it in a meaningful way. According to Eisenhardt (1989), One tactic is to select categories or dimensions, and then to look for within-group similarities coupled with intergroup differences. All similar factors which were identified in the within case analysis were placed in categories. These categories formed our constructs.

Results

Structure

Preliminary results indicate that structure of the humanitarian supply chain is related to the robustness to hazards and rapid response to contain losses dimensions of HSC resilience. The cross-case analysis revealed a structure similar to that of cellular design with wave-like ordering process. This structure was adopted as a result of the lessons

learnt from the first Cyclone that hit the country in June 2007 which had a rainfall exceeding 900 ml in mountainous areas and an onset wind speed of 95 knots. Within this structure, each of the interviewed companies had very specific roles in the handling of humanitarian logistics functions in which it has extensive experience as indicated in table one.

Scenario analysis
Scenario analysis appeared as an important variable which affect resistance and rapid response. This helps with better distribution of items.

Flexibility
Flexible organization design is related to all the dimensions of resilience. Each of organizations A, B, and C are existing organizations with year-round activities. Their processes are already matched with the requirements during disasters. For instance, organization A maintains a country wide distribution network of basic foods. Its main mission is to prevent market monopoly and price increases to basic items. Part of its mission is to support the country during disaster times. Hence, the company maintains sufficient flexibility to adapt during emergent times to humanitarian supply chain structure with only minor changes to the organizations existing structure.

Temporary redundancy
During the response time, we have found that the local logisticians require a redundancy in terms of access to varying transport modes. This helps with reaching

Efficient supply chain structure
During recovery times, each of the A, B, and C organizations will continue to deliver items to displaced people until their return to their homes is facilitated by organization C. However, each of them will use their normal year-round activities and hence will need to adjust back to their normal operations.

Conclusion
Importance of resilience in minimizing vulnerabilities is not unclear. However, literature is lacking in terms of providing guidance on how resilience can be practically built and sustained. Extant research has advocated flexibility over redundancy as an important resilience capability. However, implementation of flexibility in a real-world scenario hasn't seen major attention. This research provides a practical example of how this construct could be applied along with other key factors such as the concept of temporary redundancy during response times. Hence, this research takes a first step in moving resilience research in humanitarian context from the descriptive to the prescriptive.

   However, this research, like most studies also suffers from limitations. The most obvious is that the sample cannot be used to generalize to the all types of natural disasters and to all countries. Additional studies need to be conducted with heterogeneous samples.

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