Agility and Resilience as antecedents of Supply Chain Performance under moderating effects of Organizational Culture within Humanitarian Setting: A Dynamic Capability View

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Abstract

This study examines the effects of supply chain agility and supply chain resilience on performance under the moderating effect of organizational culture. We have used the dynamic capability view to conceptualize our theoretical models for different phases of humanitarian supply chain (pre-disaster and post-disaster phases). These phases do not have clear boundaries, but overlap chronologically, as well as in terms of ongoing activities. We used partial least squares (PLS) to examine our proposed research hypotheses using 335 responses gathered from organizations in India using survey based questionnaires designed for a single respondent. The results from our data suggest that SCAG and SCRES are two important dynamic capabilities of supply chain, have significant effects on pre-disaster performance (PRE-DP). Moreover, the control orientation does not have significant effect on the path joining SCAG and PRE-DP. However, the control orientation has a significant interaction effect on the path joining SCRES and PRE-DP. Similarly, SCRES has significant effect on post-disaster performance (POST-DP) but SCAG has no significant effect on POST-DP. In contrast to control orientation, the flexible orientation has significant moderation effects on the paths SCAG/SCRES and POST-DP. These findings contribute to our understanding of differential effect of SCAG/SCRES on supply chain performance in different phases under different contexts within the humanitarian setting. The results provide further understanding to practitioners who often struggle to develop appropriate strategies for different phases. Finally, we have noted some limitations of our study and further research opportunities.

Key-Words- Humanitarian supply chain, agility, resilience, dynamic capability view, organizational culture, competing value model, partial least squares.

1. Introduction

Recent years were marked by record humanitarian needs due to protracted complex crises, the escalation of conflict in several countries, climate change-induced vulnerability and a series of natural disasters (Sodhi, 2016; OCHA Annual Report, 2017). Sodhi (2016, p. 101) argue that "the *increasing number and impact of disasters over time has led to posit* vicious cycles *comprising disaster impact and any subset of deforestation, poverty, urbanisation, vulnerability and other factors*". Natural disasters alone cost over $306 billion in the year 2017, nearly double the $189 billion lost in 2016 (Tousignant, 2017). However, whereas disasters may be hard to forecast and prevent, the impacts of natural disasters on human lives and properties can often be attributed to poor management after the event (Altay, 2008; Heaslip et al. 2012; Rodon et al. 2012). The complexity of humanitarian supply chains (HSCs) has attracted serious attention from academia and practitioners (Kovacs and Tatham, 2009).Holguin-Veras et al. (2012) argue that humanitarian supply chain cover a wide range of activities that occur at any one phases of the emergency management, i.e. mitigation, preparedness, response and recovery. The mitigation and preparedness are performed before the disaster to enhance safety and reduce the potential impact on people and infrastructure (Holguin-Veras et al. 2012). In contrast, response related humanitarian supply chain include the transportation of supplies and equipment for search and rescue, and of equipment and material for emergency repairs to the infrastructure.

Major losses may be due to lack of coordination among HSC actors which results in a poor response to disaster-affected areas. Benini et al. (2009) have argued that survivor needs assessment is a more important aspect than managing complex disaster relief logistics. Most of the time the humanitarian team fails to identify the survivors' needs and even when the humanitarian relief team reaches to the affected areas in time, the relief to the survivor is still far from reality (Altay, 2008). HSCs are often formed hastily due to the unpredictable nature of the events (Tatham and Kovacs, 2010). Hence, the design of HSCs is far more complex than design of commercial supply chains (CSCs). The humanitarian supply chains must adopt different strategies to improve their ability to respond rapidly and cost-effectively to emergencies, which are often unpredictable and show increasing levels of environmental turbulence, both in terms of volume and variety (Holguín-Veras et al. 2012; Pedraza-Martinez and Wassenhove, 2016). That is, humanitarian supply chains need to have an agile approach to deal with sudden changes (Oloruntoba and Gray, 2006;

Oloruntoba and Kovacs, 2015; Dubey and Gunasekaran, 2016). In addition to changes in disaster affected victim needs, humanitarian supply chains are vulnerable to disruptions, and consequently, the risk to the disaster relief efforts continuity has increased (Scholten et al. 2014; Jahre and Fabbe-Costes, 2015).

Resilience is referred as the ability of supply chains to cope with unexpected disturbances (Carvalho et al. 2012; Purvis et al. 2016; Ali et al. 2017). Carvalho et al. (2012) argue that both agile and resilient approaches influence supply chain performance and competitiveness. The simultaneous integration of different supply chain management strategies or approaches has attracted increasing attention. For instance, supply chain management scholars have attempted to integrate lean and agile paradigms in total supply chain strategy (see, Naylor et al. 1999; Christopher and Towill, 2002). However, the existing research has not considered the effect of supply chain disruptions on supply chain competitiveness. If supply chain disruption occurs, organizations cannot maintain their performance level and competitiveness. Carvalho et al. (2012) have attempted to address these concerns by proposing an integrated framework of agile and resilient practices and their combined effect on supply chain performance and competitiveness. So, far, however, little empirical evidence has been provided to support the Carvalho et al. (2012) framework in the humanitarian setting. This study focuses on the following research questions:

RQ1: How can agile and resilient approaches be deployed in the humanitarian supply chain context?

RQ2: How can agile and resilient practices contribute to humanitarian supply chain performance?

Eckstein et al. (2015) argue that direct performance effects are often crucial, but they seem incapable of fully capturing the complexity of reality (c.f. Boyd et al. 2012). In previous research, scholars have acknowledged that the performance effects of certain supply chain management practices hinge on the situation (Sousa and Voss, 2008). Exploring the interaction effect of organizational culture may help to address prior concerns (Dowty and Wallace, 2010; Liu et al. 2010; Cadden et al. 2015). On the one hand, organizational culture is found to be a key factor influencing humanitarian supply chain management practices and collaboration among the actors involved in disaster relief operations (Dowty and Wallace, 2010; Balcik et al. 2010; Rodon et al. 2012; Prasanna and Haavisto, 2018). For example, Rodon et al. (2012) argue the cultural fit among the various humanitarian agencies involved in disaster relief operations plays a significant role in the success or failure of such efforts. Despite this practical recognition of the need for disaster relief operations to fit with the cultural context of the humanitarian actors, little empirical evidence has been provided to support the moderating effect of organizational culture on the effect of agility and resilient practices in humanitarian supply chains on performance. In this regard we specify our third research question as:

RQ3: What are the effects of organizational culture on the relationship between supply chain agility/supply chain resilience and humanitarian supply chain performance?

We answer our research questions based on a sample of 355 organizations drawn from the Indian National Disaster Management Authority (NDMA), which co-ordinates government agencies, military organizations and para military forces involved in disaster relief operations. To theoretically substantiate our empirical results, we integrate the dynamic capability view (DCV) (e.g. Teece et al. 1997) and organizational culture, because neither perspective can, its own, explain both the direct performance implications of supply chain agility and supply chain resilience, and the contextual conditions under which they are effective.

The paper is organized as follows. The second section focuses on theoretical foundations of our study and hypotheses development. The third section focuses on research design, including instrument development, sampling design and data collection. In the fourth section, we present our data analyses and results. The fifth section presents our discussion based on our results and the implications of our results to theory and business practice, limitations of our study and further research directions. Finally, we conclude our study.

2. Theory Development

Carvalho et al. (2012) argue that some organizations pursue a single strategy: either agility or resilience. The supply chain agility (SCAG) approach is often pursued when supply and demand uncertainties are high (Lee, 2002). The SCAG is designed to respond quickly and cost effectively to unpredictable changes in markets and increasing level of environmental turbulence, both in terms of volume and variety (Christopher, 2000; Christopher and Towill, 2001, 2002; Eckstein et al. 2015; Wang et al. 2017). On the other hand, due to globalization, the length of the supply chains is rapidly increasing. In recent years, natural disasters, industrial disputes, terrorism, and the war in the Middle East have resulted in serious disruptions (Christopher and Peck, 2004). Secondly, under pressure most of the supply chains adopt a leaner model, which often makes them vulnerable (Carvalho et al. 2012; Chowdhury and Quaddus, 2016). Hence, resilient supply chains may not be the lowest-cost supply chains, but they are capable of coping with the uncertainties in the complex environment. Hence, some scholars argue that organizations can simultaneously pursue agility and resilient supply chain strategies by developing an ambidexterity capability (Lee and Rha, 2016). Gibson and Birkinshaw (2004) argue that ambidextrous organizations that can align their business strategies to suit present market demand while also being adaptive enough to the changes in the environment so they will be around tomorrow. Aslam et al. (2018) argue that organizations are increasingly deploying ambidextrous capability, so that they can explore new opportunities and exploit existing resources to gain competitive advantage. The notion of organizational ambidexterity has been extended to the supply chain (see, Im and Rai, 2008; Kristal et al. 2010; Blome et al. 2013b; Lee and Rha, 2016; Rojo et al. 2016; Aslam et al. 2018). However, humanitarian scholars have not fully exploited the ambidextrous notion to design humanitarian supply chain strategies. Blome et al. (2013b) argue for supply chain ambidexterity as an organizational strategic choice to simultaneously pursue both supply chain exploitation (efficiency) and exploration (flexibility) practices. The notion of supply chain ambidexterity is contrary to those scholars' view that organizations should select the right supply chain strategies for their product: efficient supply chain for functional products and responsive supply chain for innovative products (Fisher, 1997). Aslam et al. (2018) argue that supply chain ambidexterity means managers are not faced with an either/ or decision, but can simultaneously have flexible as well as efficient supply chain for a particular product (c.f. Lee and Rha, 2016). Following Lee and Rha's (2016) arguments, we posit that humanitarian supply chain organizations can pursue simultaneously supply chain agility (SCAG), which will enable the humanitarian organizations (HOs) to respond to respond to disaster-affected victims with right humanitarian aids in right time (Charles et al. 2010; L'Hermitte et al. 2017) and supply chain resilience (SCRES), will further help to sustain the humanitarian efforts over the time despite of high degree of environmental uncertainties arising from cultural diversity among humanitarian actors and the political risk (Day et al. 2012) (see Figure 1 and Figure 2).

2.1 Dynamic Capability View (DCV)

Some scholars have expressed their concerns related to the resource based view (RBV) and its implication to dynamic environment (Eisenhardt and Martin, 2000). Scholars argued that the dynamic capabilities view (DCV) provides explanation for the organization's competitive advantage in changing environments (Teece et al. 1997; Sirmon et al. 2010; Eisenhardt and Martin, 2000; Bititci et al. 2011; McAdam et al. 2017; Dubey et al. 2018b). Teece et al. (1997, p. 516) defined dynamic capabilities as "*the firm's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments*". Teece et al. (1997) further argue that dynamic capabilities include the capabilities to sense and shape opportunities, to seize opportunities, and to maintain competitiveness through enhancing, combining, protecting and reconfiguring a firm's resources. Within the context of humanitarian settings, the dynamic capabilities are simple, experiential, unstable processes that rely on rapidly created new insights that enable combination, transformation, or renewal of resources and competencies into capabilities, which are essential for uncertain environment (Starr and Van Wassenhove, 2014; Tabalkar, 2017). Based on these arguments we have considered SCAG (Eckstein et al. 2015; Aslam et al. 2018) and SCRES (Tabalkar, 2017) as dynamic capabilities of HOs.

2.2 Supply Chain Agility (SCA)

Previous studies have attempted to provide diverse conceptualizations, but there are few formal definitions of SCA (Christopher, 2000; Christopher and Towill, 2001; Yusuf et al. 2004; Eckstein et al. 2015). Overall, SCAG literature shows an increasing consensus emphasizing the abilities to sense changes and flexibly respond to changes (Blome et al. 2013a; Wu and Barnes, 2014; Eckstein et al. 2015; Lee and Rha, 2016; Dubey et al. 2018b; Aslam et al. 2018). Eckstein et al. (2015) argue that rapid and flexible response alone may as well considered elements of flexibility; the ability to sense changes is an important dimension of SCAG. Despite the rich body of literature on SCAG, the concept of SCAG in the humanitarian setting is still underdeveloped. Even though existing research has broadly discussed characteristics and benefits of SCAG in HSCs (see, Oloruntoba and Gray, 2006; Charles et al. 2010; Cozzolino et al. 2012; Day et al. 2012;Oloruntoba and Kovacs, 2015), little rigorous empirical testing exists (Charles et al. 2010; Cozzolino et al., 2012). In the context of HSCs, the nature of agility differs between two important areas: *the evacuation process* and *the rehabilitation process*. Harrald (2006) argued that the agility and self-control are two important properties, which may provide a better explanation for disaster response. Thus, we agree that maintaining agility all the time may be a costly affair; however, through improvisation, flexibility and creativity, the level of coordination, collaboration and communication can be improved (Tomasini and Van Wassenhove, 2009). Therefore, maintaining agility in humanitarian supply chains may not be as costly as is argued in commercial supply chains literature due to the investment in technology and training. This may be noted as one of the major differences in humanitarian and commercial supply chains.

2.3 Supply Chain Resilience (SCRES)

Resilience is a multidisciplinary concept (Ponomarov and Holcomb, 2009; Chowdhury and Quaddus, 2016). Following Holling's (1973), seminal work, several scholars have echoed the concept of resilience as a system's ability to recover and return to its original state (e.g. Christopher and Peck, 2004: Sheffi, 2005). In an organizational context, resilience can be understood as the organizational ability that enables the organization to survive in a turbulent environment (Ates and Bititci, 2011). Supply chain resilience (SCRES) has attracted significant attention from scholars because of increased disruptions in global supply chain. Bhamra et al. (2011) attempted to provide an overview of the term resilience in various contexts in management literature. Sheffi (2005) attempted to provide a functional definition of SCRES as the property of a supply chain which enables it to regain its original configuration soon after a major disruption from earthquakes, floods, hurricanes and tropical storms, tornadoes, tsunamis, and diseases. After a disaster, resilience in the humanitarian relief supply chain will determine the speed of returning to normalcy through collaboration among the various actors in the supply chain network (Boin et al., 2010; World Economic Forum, 2013; Ivanov et al., 2013). Matyas and Pelling (2015) argued that resilience is a discrete category and not only the opposite of vulnerability. It should be regarded as both process and outcome, which should be, understood more than bouncing back. Day (2014) attempted to explain the resilience property in a disaster relief supply chain using complexity theory and a systems resilience approach. Day (2014) further identified three key elements in any resilient supply chain: (i) topology (path lengths, redundancies, clustering, etc.); (ii) entities (non-governmental organizations, military, third party logistics providers, government agencies, military, donors, media etc.) and (iii) environment (extreme weather or natural disasters). Sage et al. (2015) have attempted to offer explanation to infrastructure resilience using a socio-ecological approach. Hence, we can argue that disaster resilience has been discussed in recent years; however, the supply chain resilience (SCRES) in humanitarian setting is still relatively a young discipline.

2.4 Organizational Culture

Schein (2010, p.18) defines organizational culture as "*a pattern of shared basic assumptions learned by a group as it solved its problems of external adaptation and internal integration, which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems*". The organizational culture affects how the firm responds to external events and makes strategic choices (Liu et al. 2010). Prasanna and Haavisto (2018) further classify organizational culture into five different models: *values* (what we prefer, hold dear, or desire) (Cameron and Quinn, 2011), stories (verbal or written narratives) (Vaara and Tienari, 2011), frames (filters or brackets that expand the horizon) (Smets et al., 2012), toolkits (sets of stories, frames, categories, rituals, and practices which actors draw upon to make meaning or take action) (McPherson and Sauder, 2013), and categories (social constructions or classifications which define and structure the conceptual differences between objects, people, and practices) (Wry et al., 2014). In our study, we adopt the framework of flexibility-control orientation in the competing value model (CVM) proposed by Quinn and Rohrbaugh (1983). The CVM allows the comparison of value orientations within and between organizations (Liu et al., 2010). Hence, we argue that CVM is an appropriate model for organizational culture studies conducted in different organizations participating in disaster relief operations (Prasanna and Haavisto, 2018). In addition, the CVM offers a reliable quantitative way to study organizational culture (Liu et al., 2010). The validity of its measures has been tested in prior studies (e.g. Deshpandé et al., 1993; Khazanchi et al. 2007; Liu et al. 2010). Hence, the CVM can be adopted in empirical studies to investigate the moderating role of organization culture on the effect of SCAG and SCRES.

2.5 Humanitarian Supply Chain Performance

The disaster relief operations preparation often starts before a disaster even happens. Humanitarian organizations have to forecast the demand for relief supplies, source them, store them and deliver them after a disaster/catastrophic event occurs. Therefore, the effectiveness of a HSC partially depends on the pre-disaster preparations as well as on post-disaster performance. The preparedness phase of humanitarian supply chains is critical to the humanitarian supply chain performance (Duran et al. 2011; Kunz et al. 2014).

2.5.1 Pre-Disaster Phase

Pre-disaster stages of disaster management operations such as mitigation and preparedness help reduce the impact of disasters while also enabling an improved response through preparation and planning (Kumar and Havey, 2013). Haddow et al. (2013) argued that preparedness consists of four basic elements: *preparing a plan*, *acquiring equipment*, *training for the plan*, and *exercising the plan*. Thus, the pre-disaster stages of *prevention*, *mitigation*, *planning*, and *preparedness* contribute to the ultimate goal of vulnerability reduction. Oloruntoba and Gray (2006) argued that agility in humanitarian supply chains enables preparation for disasters and further mitigates vulnerability. Allen (2006) suggested community-based disaster preparedness (CBDP) to reduce vulnerability. CBDP is associated with a policy trend that values the knowledge and capacities of local people and builds on local resources, including social capital. Srinivas and Nakagawa (2008) have argued for natural resource management to build capacity in order to prevent the severe impact of natural disasters. Hence, we believe that capacity building is an important aspect in the pre-disaster phase.

2.5.1 Post-Disaster Phase

The post-disaster phase includes response, recovery and reconstruction. The recovery and reconstruction phases are about restoring all aspects of the disaster’s effect on a community, and the return of the local economy to some sense of normality. The recovery phase can be broken down into two periods. The short-term phase typically lasts from six months to at least a year. It involves the delivery of immediate services to victims in the form of medical aid, food, drinking water, building materials, clothing, and other necessary materials. Communities must access and deploy a range of public and private resources to enable long-term recovery. Abidi et al. (2013, 2014) developed a framework for HSC performance measurement that can considers pre-disaster as well as post-disaster performance in a humanitarian supply chain. Their performance measurement dimensions include income from the community, fund raising expenses per household, donor management, donations per households, federated income per households, stock managed by service agreements, donation-to-delivery to deliver, flexibility, cost effectiveness, stock efficiency, cost recovery, and percent of goods delivered (Abidi et al. 2014).

2.6 Hypotheses Development

2.6.1 Direct effects of supply chain agility (SCAG) and supply chain resilience (SCRES) on humanitarian supply chain performance

SCAGG and SCRES are conceptualized as higher order dynamic capabilities that are able to impact humanitarian supply chain performance. Augier and Teece (2009, p. 412) argue that dynamic capabilities are the organization's ability "*to sense and seize new opportunities, and to reconfigure and protect knowledge assets, competencies, and complementary assets with the aim of achieving a sustained competitive advantage*". Hence, the dynamic capabilities view (DCV) suggests that the organization possesses the capability to modify its distinctive and co-specialized resources in order to respond to the changes in external environmental conditions. Dynamic capabilities in humanitarian supply chain emerge when humanitarian organizations engage their humanitarian workers in understanding disaster-affected victims' requirements and translate these requirements so that they are effectively communicated throughout the humanitarian supply chain (Tabaklar, 2017).

In recent years, operations and supply chain management scholars have extended the DCV beyond the firm boundaries to understand the dynamic supply chain capabilities as supply chain agility (Swafford et al. 2006; Eckstein et al. 2015; Aslam et al. 2018) and supply chain resilience (Jüttner and Maklan, 2011; Chowdhury and Quaddus, 2016). Eckstein et al. (2015) argue that dynamic sensing, dynamic flexibility and dynamic speed are desirable properties of supply chain agility. Many of these studies have found positive relationships between SCAG and supply chain performance (Eckstein et al. 2015; Gligor et al. 2015; Dubey et al. 2018a) and SCRES and supply chain performance (Brandon-Jones et al. 2014; Chowdhury and Quaddus, 2016). Most of these studies have examined the individual effect of SCAG/SCRES on supply chain performance. However, humanitarian supply chains are vulnerable. Carvalho et al. (2012) argue that in such a case, the ability to cope with such unforeseen disturbances will also determine the performance of supply chain. Based on this line of reasoning we hypothesize that SCAG/SCRES have positive effect on humanitarian supply chain performance as:

H1a: SCAG has a significant positive effect on pre-disaster performance.

H1b: SCAG has a significant positive effect on post-disaster performance.

H2a: SCRES has a significant positive effect on pre-disaster performance.

H2b: SCRES has a significant positive effect on post-disaster performance.

2.6.2 Moderating effects of organizational culture

Dowty and Wallace (2010) argue that most organizations have their own operating guidelines, perspectives and regulations. Wentz (2006) further argues that culture often stems from the unique history, mission, structure and leadership of the organization. Schwartz and Davis (1981) argue that successful organizations understand that adopting management practices consistent with their culture improves their performance. Previous studies have generally acknowledged the organizational culture as guide for organizational strategies (e.g. Khazanchi et al. 2007; Liu et al. 2010; Braunscheidel et al. 2010). For example, previous studies have found that organizational culture played a significant role in guiding supply chain strategies (e.g. Khazanchi et al. 2007; Liu et al. 2010). However, organizational culture's effect in humanitarian relief supply chains is yet to be explored (Glenn Richey 2009). Denison and Spreitzer (1991) examined organizational culture through the competing value model (CVM). This model focuses on conflicts within a system such as the conflict between stability and change, and the conflict between the internal organization and the external environment. Two dimensions of orientation characterize CVM: first, the flexibility-control dimension shows the organization's desire for a focus on change or stability. A flexibility orientation values creativity, spontaneity and risk taking (Khazanchi et al. 2007). In contrast, a control orientation focuses on hierarchy, predictability and efficiency (Khazanchi et al. 2007; Liu et al. 2010). The second dimension, the internal-external axis, concerns a focus on activities occurring within or outside the organization. An internal focus emphasizes coordination and smooth operations, while and external focus stresses competition and environmental differentiation. Hence, we can argue that CVM allows the organization to understand competing or conflicting values of a firm's culture to be represented by a profile in a two-dimensional space rather than a single point (Liu et al. 2010). Braunscheidel et al. (2010) found significant association between organizational culture and supply chain integration practices. Within a humanitarian organization, there could be different cultures among office staff and field workers.

Consequently, organizational culture is expected to have a significant effect on the supply chain performance but that effect may be different between pre- and post-disaster phases. Therefore, we suggest that control and flexible orientations may have different influences on how SCAG and SCRES influence pre-disaster and post-disaster activities in humanitarian supply chain. Control orientation focuses on efficiency and hierarchy. In a humanitarian organization, the group focusing on mitigation and preparedness would generally concern themselves with forecasting, stocking and positioning inventory. Their main task is planning and can become routine. Hence, we can hypothesize:

H3a: Control orientation has a positive effect on the path joining SCAG and pre-disaster performance.

H3b: Control orientation has a positive effect on the path joining SCRES and pre-disaster performance.

In contrast, flexibility orientation values creativity, risk taking, and change. The field staff responding to disasters are trained to function in complex, highly dynamic and stressful environments. Their work environment keeps changing from event to event and from location to location. Hence, we can hypothesize it as:

H4a: Flexible orientation has a positive effect on the path joining SCAG and post-disaster performance.

H4b: Flexible orientation has a positive effect on the path joining SCRES and post-disaster performance.

We have included two control variables in our study that may affect the performance in the statistical analyses. Firstly, we control temporal orientation. Building supply chain capabilities is a time consuming effort and requires resource investment over the long term. Secondly, we control for interdependency perception.

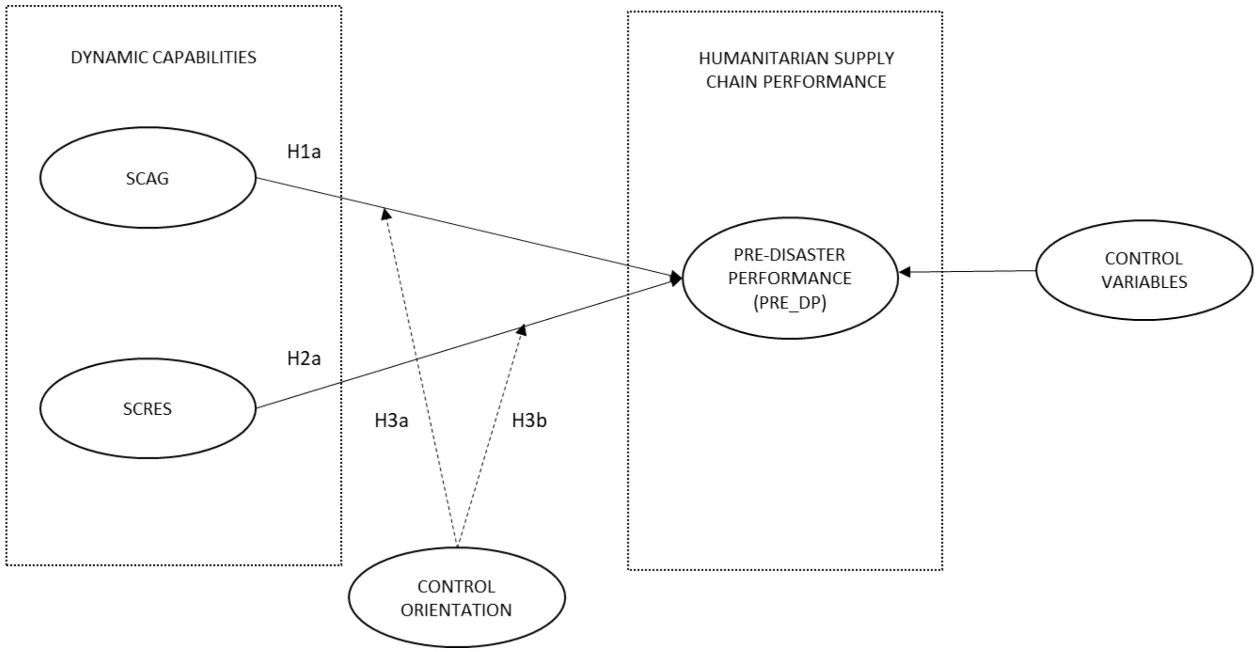

Figure 1: Theoretical Framework (Pre-Disaster phase)

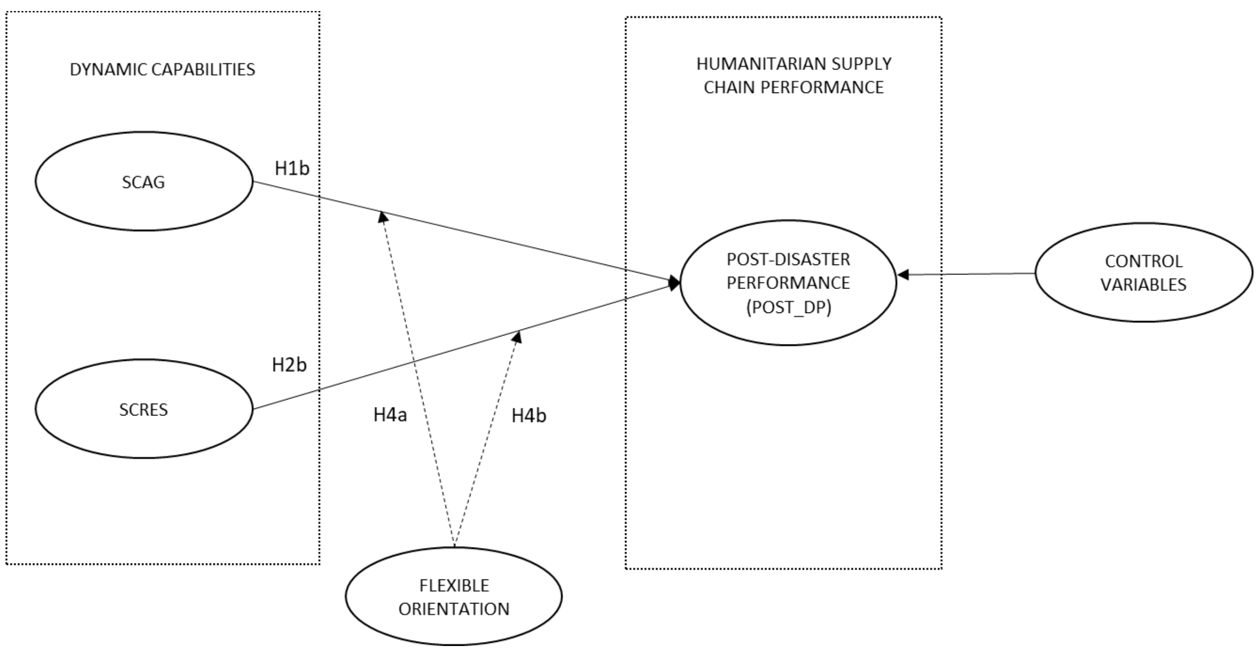

Figure 2: Theoretical Framework (Post-Disaster phase)

2.7 Summary

Figure 1 and Figure 2 illustrates the conceptual model linking the antecedent factors (supply chain agility and supply chain resilience), moderating factor (control orientation/ flexible orientation) and humanitarian supply chain performance (pre-disaster performance/ post-disaster performance). Table 1 provides the definitions of the constructs used in this study.

Table 1: Definitions of the main constructs

Constructs	Definition
Supply chain agility (SCAG) (Eckstein et al. 2015)	The supply chain agility as the ability of the firm to sense short-term, temporary changes in the supply chain and external environment's (e.g. demand fluctuations, supply disruptions, changes in delivery times), and to rapidly respond to those changes with the existing supply chain (e.g. reducing replacement times of the materials, adjusting delivery capacities).
Supply chain resilience (SCRES) (Ponomarov and Holcomb, 2009, p. 131)	Supply chain resilience is defined as 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.
Control orientation (CO) (Quinn and Rohrbaugh, 1983)	The control orientation emphasizes order, predictability and efficiency.
Flexible orientation (FO) (Quinn and Rohrbaugh, 1983)	The flexibility orientation values creativity, spontaneity and risk taking.
Pre-disaster performance (PRE-DP) (Kunz et al. 2014, p. 261)	The disaster preparedness is considered as the most important aspect of disaster relief efforts. The usual methods of preparedness includes such as pre-positioning relief inventory in countries prone to disasters and investing in disaster management capabilities, such as training staff, pre-

	negotiating customs agreements with countries prone to disasters, or harmonizing import procedures with local customs clearance procedures.
Post-disaster performance (POST-DP) (Holguin-Veras et al. 2011)	The post-disaster phase of humanitarian supply chain focuses on initial response and short-term recovery process. The objective of POST-DP in humanitarian supply chain is to minimize the social costs (deprivation+ logistic), in unknown/dynamic environment due to lack of information/ access to site.
Temporal orientation (TO) (Moshtari, 2016)	The extent to which humanitarian supply chain actors are going to work with each other.
Interdependency (I) (Moshtari, 2016)	The degree to which humanitarian actors are dependent on each other.

3. Research Design

3.1 Research Setting and Sampling

The empirical context of the study consists of organizations such as NGOs, government agencies, military organizations and paramilitary forces, involved in humanitarian operations in Asia. Abidi et al. (2014) argue that humanitarian supply chain is key to disaster relief operations because effectiveness, efficiency and speed in supplying beneficiaries with health, food, shelter, water, medicines and sanitation are essential in case of disaster. Therefore, the theoretical constructs identified in this research are conceptualized to study the dynamic capabilities of supply chain and their influence on pre-disaster and post-disaster performance, viewed from humanitarian organizations point of view. The measures are based on the perceptions of one key informant (Lambe et al. 2002; Moshtari, 2016; Chavez et al. 2017; Srinivasan and Swink, 2017), and the measures used were developed to examine perceptions of the dyad from one partner's viewpoint. The target respondents were expected to have knowledge or experience about supply chain activities in context to disaster relief operations. The target respondents are organizations logistics or procurement head or director, primarily responsible for procurement or storage or transportation of relief materials from warehouse to the disaster affected areas. The website of the NDMA

(National Disaster Management Authority) provided access to key people who assisted us to contact various organizations involved in disaster relief operations. The NDMA is a body owned by the government of India, which was set up following the Disaster Management Act (2005) to deal with various disasters in India.

3.2 Survey Instrument and Pre-test

To test the proposed theoretical model and research hypotheses, we followed a two-step process: construct definition and development of measurement items. Firstly, we reviewed organizational studies and operations management literature, which helped to conceptualize the constructs used in our theoretical model, and then we identified a list of measurement items for each construct verified by previous studies. Secondly, we adapted them to fit the context of humanitarian work. For pre-testing, we requested five professors of humanitarian logistics management and ten humanitarian practitioners to fill out the questionnaire in front of the researcher and further point out any inconsistencies found within. Based on this we established the content validity of the constructs and the reliability of measuring items used in the study.

To increase the response rate we followed Dillman’s tailored design method (Dillman, 2007) which was employed by operations management scholars (Eckstein et al. 2015; Gualandris and Kalchschmidt, 2015; Dubey and Gunasekaran, 2016; Moshtari, 2016; Srinivasan and Swink, 2017). We pre-tested the online-survey with eight practitioners who attended a training program at the National Institute of Disaster Management (NIDM). We finally arrived at the conclusion that the questionnaire had no major concerns related to clarity. However, we made minor modifications related to the wording of some questions, and deleted several unnecessary questions (Blome et al. 2013a; Eckstein et al. 2015; Moshtari, 2016).

3.3 Data Collection

The data collection started in 2013, by sending out an invitation letter to 1735 potential respondents via e-mail followed by two e-mail reminders. In all communications, potential respondents were assured strict anonymity and confidentiality and were incentivized by the promise of an executive summary of the study results. After following up with respondents who did not respond to the earlier questionnaires, the number of responses was 335, which represents a 19.14% response rate. The frequency distribution of the respondents is presented in Table 2.

Table 2: Profile of the responding organizations

Departments	Targeted	Received	%
Military	500	83	16.60
NGOs	400	78	19.50
Para military force	300	30	10.00
Indian Institute of Railway Logistics & Materials Management	150	57	38.00
State Police	300	37	12.33
3PLs	100	50	50.00
Total	**1750**	**335**	**19.14**

A non-response bias test is highly recommended by statisticians for survey data, regardless of the achieved response rate (e.g. Armstrong and Overton, 1977).There are various available non-response bias methods or techniques with different strengths and limitations. In our study, there were two mailing periods:

Wave 1: E-mailing of the online questionnaire accompanied by an information and consent form;

Wave 2: Reminders sent to those who had not responded after six weeks.

The differences in the waves (Wave 1 = initial respondents, and Wave 2 = late respondents) were analyzed. The statistical difference was estimated using Student's t-test, with a p-value of less than or equal to 0.05 being considered to be statistically significant. In this case, we found that the responses from the two waves were not significantly different from each other. Hence, we concluded that nonresponse bias is not a major issue in the study.

3.4 Measures

The pre-disaster (PRE-DP) and post-disaster (POST-DP) humanitarian supply chain performance were the dependent variables of the study. We used Abidi et al's (2014) arguments to develop measures for these two constructs. Next, the study involved two independent variables - supply chain agility (SCAG) and supply chain resilience (SCRES), two moderating variables - control orientation (CO) and flexible orientation (FO), and two control variables - temporal orientation (TO) and interdependency (I). Existing tested scales were adapted from previous studies. The respondents were asked to give a rating on a five-point Likert scale (i.e. 1=strongly disagree, to 5= strongly agree). The exact wording of the items is presented in Appendix A.

4. Data Analysis and Results

We used partial least squares (PLS) technique for data analysis (Peng and Lai, 2012; Akter et al. 2017; Pavlov et al. 2017; Dwaikat et al. 2018). The traditional PLS SEM methods are composite based and not factor based (see Kock, 2017). In traditional PLS SEM methods, latent variables are estimated as weighted aggregations of indicators, without the inclusion of measurement errors (Henseler et al. 2013; Kock, 2017). The measurement errors usually serve as extra indicators that often complement the actual indicators; together the actual indicators and measurement errors constitute factors (Kock, 2017). It is well known that without considering measurement errors, the use of composites instead of factors induces bias. Hence, the path coefficients tend to weaken with respect to their corresponding true values. The recent methodological advancement building upon traditional PLS techniques has helped bridge the gap between factor-based and composite based SEM techniques (Kock, 2015a; Sarstedt et al. 2016). We used Warp PLS 6.0 for our study, which is developed based on limitations of traditional PLS.

4.1 Measurement Model Reliability and Validity

We used confirmatory factor analysis (CFA) to validate the measures and constructs used in this study (see Figure 1 and Figure 2). We examined the constructs' individual-item reliabilities, the convergent validity of the measures associated with each construct and their discriminant validity. Table 3 shows the range of factor loadings (λi), the scale composite reliability (SCR) and the average variance extracted (AVE) of reflective constructs. Factor loadings of all items loaded on each respective constructs are greater than 0.7 and significant at the 0.01 level, indicating convergent validity at indicator level (Bagozzi and Yi, 1998). Secondly, the scale composite reliability of each constructs was greater than 0.7, indicating acceptable reliability (Fornell and Larcker, 1981). Thirdly, all AVE values are greater than 0.50, suggesting significant variance explained by each construct (Peng and Lai, 2012). Hence, based on Fornell and Larcker's (1981) arguments, we can conclude that constructs used in our study possess sufficient convergent validity. In addition, the AVE extracted for each constructs exceeds the threshold values of 0.5 suggested by Fornell and Larcker (1981). Discriminant validity ensures that the measures and constructs used in the model (see Figure 1 and Figure 2) are distinct, and that the items do not cross-load. We used Fornell and Larcker's (1981) conservative test of discriminant validity test to establish that the square root of AVE for each construct was greater than the correlations between the construct and other constructs in the model and the corresponding value of p for correlations (see Table 4 and Table 5). All the constructs used in our study satisfied the condition. Hence, we can argue that constructs used in our study possess both convergent and discriminant validity.

Table 3: Measurement Properties of Constructs

Construct	Items	Factor Loadings	Variance	Error	SCR	AVE
Supply chain agility (α=0.93)	SCAG1	0.74	0.54	0.46	0.97	0.79
	SCAG2	0.79	0.62	0.38		
	SCAG3	0.93	0.87	0.13		
	SCAG4	0.93	0.87	0.13		
	SCAG5	0.95	0.89	0.11		
	SCAG6	0.91	0.83	0.17		
	SCAG7	0.90	0.82	0.18		
	SCAG8	0.92	0.85	0.15		
Supply chain resilience (α=0.95)`	SCRES1	0.97	0.94	0.06	0.97	0.88
	SCRES2	0.97	0.94	0.06		
	SCRES3	0.86	0.73	0.27		
	SCRES4	0.95	0.91	0.09		
Flexible orientation (α=0.68)	FO1	0.57	0.33	0.67	0.80	0.50
	FO2	0.66	0.43	0.57		
	FO3	0.69	0.47	0.53		
	FO4	0.88	0.77	0.23		
Control orientation (α=0.79)	CO1	0.80	0.63	0.37	0.86	0.55
	CO2	0.69	0.48	0.52		
	CO3	0.72	0.52	0.48		
	CO4	0.61	0.37	0.63		
	CO5	0.85	0.72	0.28		
Temporal orientation (α=0.75)	TO1	0.85	0.72	0.28	0.86	0.67
	TO2	0.74	0.54	0.46		
	TO3	0.87	0.75	0.25		
Interdependence (α=0.75)	I1	0.89	0.80	0.20	0.89	0.80
	I2	0.89	0.80	0.20		
Pre-disaster performance(α=0.92)	PRE-DP1	0.67	0.45	0.55	0.94	0.72
	PRE-DP2	0.75	0.57	0.43		
	PRE-DP3	0.94	0.88	0.12		
	PRE-DP4	0.94	0.88	0.12		
	PRE-DP5	0.90	0.80	0.20		
	PRE-DP6	0.86	0.75	0.25		
Post-disaster performance (α=0.82)	POST-DP1	0.81	0.65	0.35	0.90	0.70
	POST-DP3	0.87	0.75	0.25		
	POST-DP4	0.87	0.75	0.25		
	POST-DP5	0.80	0.65	0.35		

α= Cronbach's alpha

Table 4: Construct Correlations

	SCAG	SCRES	FO	CO	TO	I	PRE-DP	POST-DP
SCAG	**0.89**							
SCRES	-0.02	**0.94**						
FO	0.36	-0.06	**0.71**					
CO	0.51	0.35	0.39	**0.74**				
TO	0.13	0.42	0.33	0.46	**0.82**			
I	0.09	-0.03	0.15	0.13	0.09	**0.89**		
PRE-DP	0.01	0.19	0.02	0.30	0.19	0.11	**0.85**	
POST-DP	-0.01	0.12	-0.03	0.08	0.15	0.26	0.24	**0.84**

Notes: 1. SCAG, supply chain agility; SCRES, supply chain resilience; FO, flexible orientation; CO, control orientation; TO, temporal orientation; I, interdependency; PRE-DP, pre-disaster performance; POST-DP, post-disaster performance

2. The square root of AVE is shown in the diagonal of the correlation matrix and the inter-construct correlations are shown off the diagonal.

Table 5: P values for the correlations

	SCAG	SCRES	FO	CO	TO	I	PRE-DP	POST-DP
SCAG	1.00							
SCRES	<0.001	1.00						
FO	<0.001	<0.001	1.00					
CO	0.063	<0.001	0.09	1.00				
TO	0.417	0.004	0.054	<0.001	1.00			
I	0.108	<0.001	0.159	<0.001	<0.001	1.00		
PRE-DP	0.032	0.009	0.009	0.143	0.648	0.12	1.00	
POST-DP	<0.001	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	1.00

4.2 Common Method Bias (CMB)

As with all self-reported data, there is potential for common method bias resulting from multiple sources such as consistency motif and social desirability (Podsakoff et al., 2003; Podsakoff and Organ, 1986). Following Podsakoff and Organ (1986), we attempted to enforce procedural remedies by asking the respondent not to estimate pre-disaster performance and post-disaster performance measures according to personal experience, but to get this information from meeting minutes or documentation. In addition, we performed statistical analyses to assess the impact of common method bias. Podsakoff et al. (2003, p. 889) argue that for the single factor Harmans's test, "*it requires loading all the measures into an exploratory factor analysis, and analyzing the unrotated factor solution with the assumption that the presence of CMB is indicated by the emergence of either a single factor or a general factor accounting for the majority of covariance among measures*". In this case, we fixed the number of factors equal to one, prior to obtaining an unrotated factor solution. A single factor was obtained which explains 29.95 percent of the variance, well below the accepted 50 percent. Next, we tested using the correlation marker technique (Lindell and Whitney, 2001). We used an unrelated variable to partial out correlations caused by CMB. In addition, we determined the significance value of the correlations using Lindell and Whitney's (2001) equations. We noted minimal differences between adjusted and unadjusted correlations. Hence, based on these results we have concluded that CMB might not have a significant effect on our study.

Guide and Ketokivi (2015) argue that causality is an important aspect that must be addressed before testing research hypotheses. In our study, we have conceptualized SCAG and SCRES as exogenous variables to PRE-DP/POST-DP but not the other way round based on DCV. Although we have grounded our model in DCV, still the relationships depicted in our study between constructs were not examined in existing literature. Hence, a causality test was important in our study. Following Kock's (2015b) suggestions, we have calculated the nonlinear bivariate causality direction ratio (NLBCDR). The acceptable value should be greater than 0.7. In our case we noted that NLBCDR=0.917 (see Figure 1 and Figure 2), which is above cut off value. We therefore conclude that causality is not a major issue. We further evaluated the model fit and quality indices (see Appendixes B and C).

4.3 Model Estimation and Analysis

PLS uses a bootstrapping procedure to estimate standard errors (SEs) and significance of the parameter estimates (Peng and Lai, 2012). We have reported the PLS path coefficients and their p-values in the Table 6 (H1a/b, H2a/2b, H3a/3b and H4a/4b) (see Figure 3 and Figure 4).

Table 6: Structural Estimates

Hypothesis	*Effect of*	*Effect on*	*β*	*p-value*	*Results*
H1a	SCAG	PRE-DP	0.23	<0.01	Supported
H1b	SCAG	POST-DP	0.01	0.42	Not supported
H2a	SCRES	PRE-DP	0.75	<0.01	Supported
H2b	SCRES	POST-DP	0.42	<0.01	Supported
H3a	SCAG*CO	PRE-DP	0.03	0.31	Not supported
H3b	SCRES*CO	PRE-DP	0.20	<0.01	Supported
H4a	SCAG*FO	POST-DP	0.14	<0.05	Supported
H4b	SCRES*FO	POST-DP	0.42	<0.01	Supported
Control variables					
	TO	PRE-DP	0.03	0.33	
	I	PRE-DP	0.14	0.02	
	TO	POST-DP	0.05	0.23	
	I	POST-DP	0.11	0.06	

Notes: SCAG, supply chain agility; SCRES, supply chain resilience; FO, flexible orientation; CO, control orientation; TO, temporal orientation; I, interdependency; PRE-DP, pre-disaster performance; POST-DP, post-disaster performance

The paths SCAG→PRE-DP (β=0.23, p<0.01), SCRES→PRE-DP (0.75, p<0.01), and SCRES→POST-DP (β=0.42, p<0.01) tested positive and significant. The control variable temporal orientation (TO), had no significant effect on PRE-DP (β=0.03, p=0.33). However, interdependence (I) had a negative and significant effect on PRE-DP (β=0.14, p=0.02).

Most of the studies in past have claimed that interdependence positively affects reciprocal commitment because dependence increases a partner’s desire to maintain the relationship (Hibbard et al. 2001). Hence, our study corroborates previous arguments. However, in the humanitarian setting how interdependence may influence coordination among the partners in pre-disaster phase is still underdeveloped. Hence, we believe that our results further open the door for new investigation to show how interdependence among humanitarian actors may influence the humanitarian supply chain performance under different conditions.

SCAG→POST-DP ($\beta=0.01$, $p=0.42$) is not found significant. This is a quite interesting observation considering that SCRES is found to have significant effect during POST-DP in comparison to SCAG. From these results, we can argue that SCRES is an important capability of the supply chain in both phases. SCAG is found to be more relevant during the pre-disaster phase. However, during the post-disaster phase, supply chain resilience plays a significant role. Ponomarov and Holcomb (2009) argue that organizations and their supply chains must develop proactive and reactive resilience capabilities to increase the required level of readiness, response and recovery ability during pre-disaster and post-disaster phases. Hence, our results argue that resilience in combination with agility produces differential effects during different phases of the disaster.

We examined the moderation effect of CO/FO in different phases. We found that H3a ($\beta=0.03$, $p=0.31$) was not supported. However, H3b ($\beta=0.20$, $p<0.01$) was supported. From these results, we can interpret that the effect of supply chain agility on PRE-DP may not influenced by control orientation. However, the effect of pro-active capability of resilience, which is the ability to recognize, anticipate and defend against the changing shape of the risk, on the PRE-DP, improved significantly. H4a ($\beta=0.14$, $p<0.05$) and H4b ($\beta=0.42$, $p<0.01$), were found to be supported. From these results we can interpret that flexible orientation had positive and significant effects on paths connecting SCAG and SCRES and POST-DP. Hence, our results contribute to the understanding of differential effects of SCAG/ SCRES under control/flexible orientations. We have further examined the explanatory power of our proposed theoretical models (Figure 1 and Figure 2). For these models, we examined the explanatory power (R^2) of the endogenous constructs (i.e. PRE-DP and POST-DP). The R^2 of PRE-DP is 0.61 and POST-DP is 0.21 (see Figure 3 and Figure 4). Moreover, we have determined the effect size (f^2) of each predictors (SCAG and SCRES), using Cohen's f^2 formula to give f^2 of SCAG on PRE-DP (0.11) and SCRES on PRE-DP (0.46). Similarly, the f^2 of SCAG on POST-DP (0.002) and SCRES on POST-DP (0.029) are greater than the cut-off value of zero. Next, to examine the model's capability to predict, we calculated Stone-

Geisser's Q^2 for PRE-DP (0.44) and POST-DP (0.211), indicating significant predictive relevance (Peng and Lai, 2012).

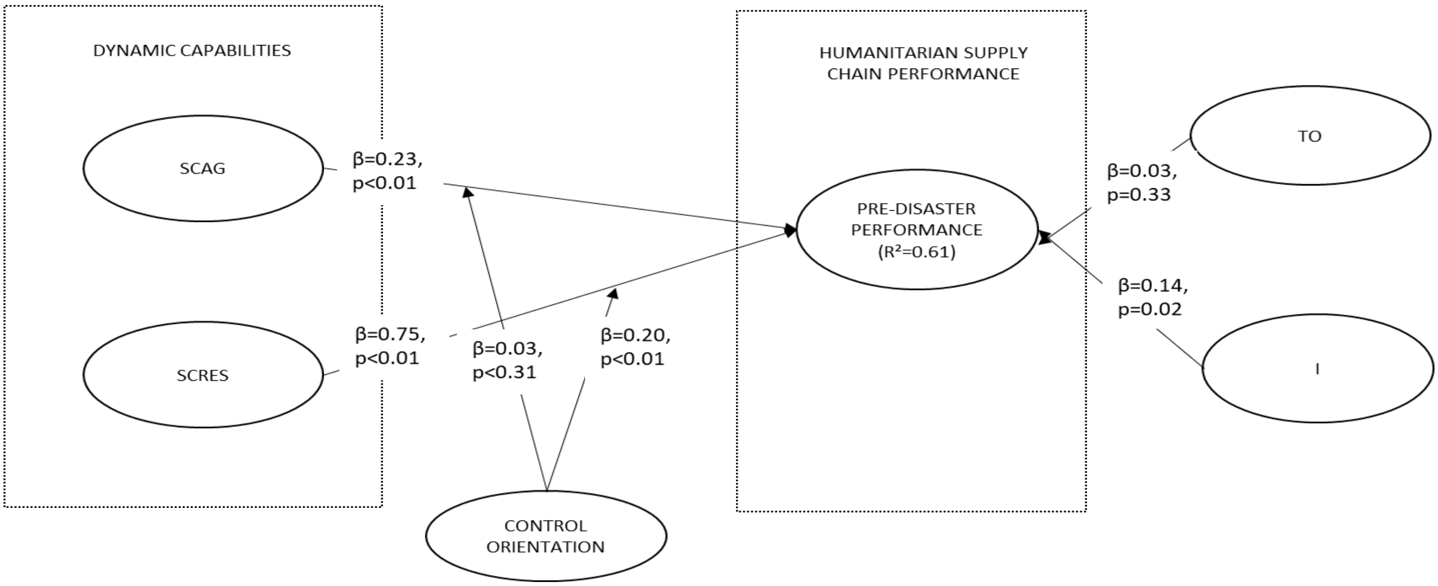

Figure 3: Final Model 1

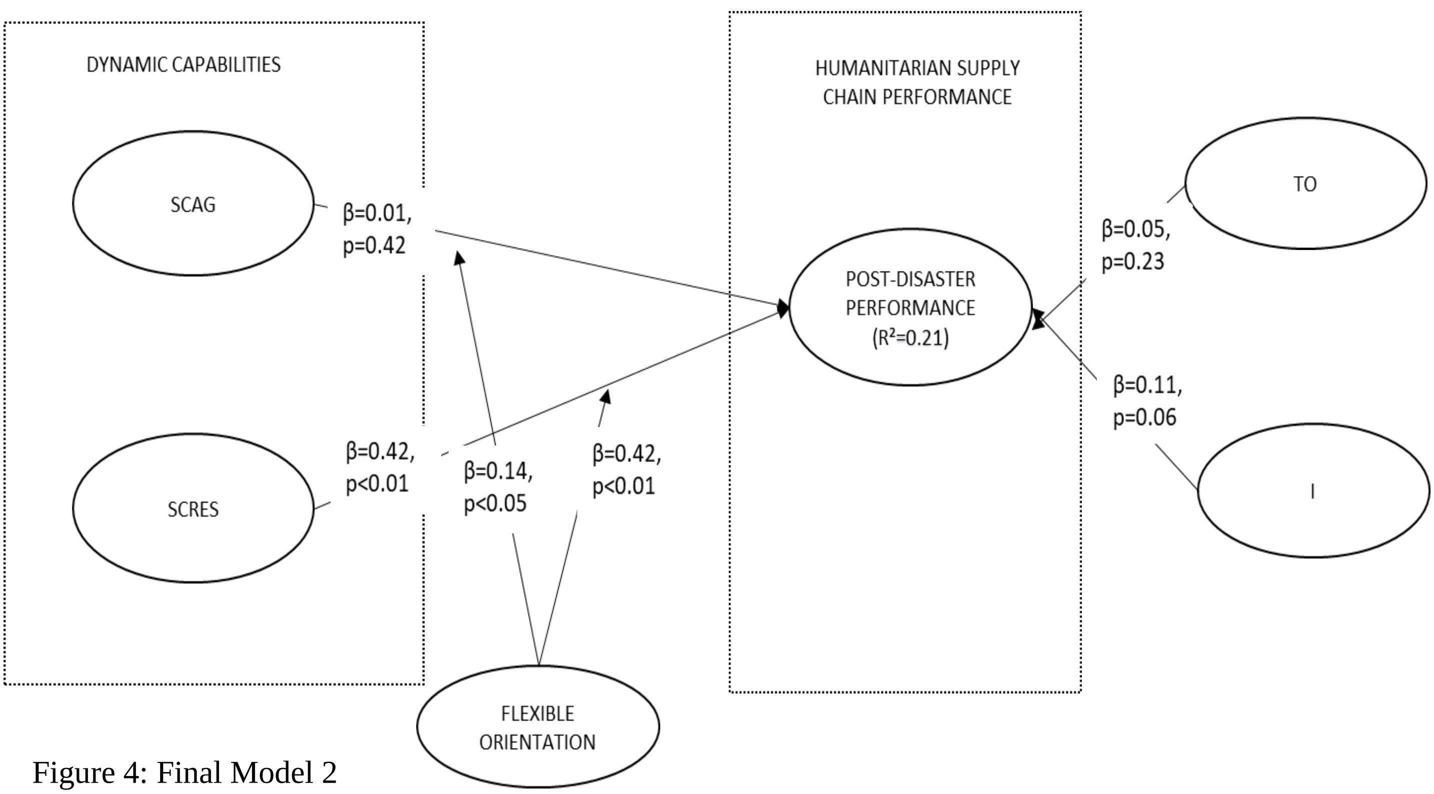

Figure 4: Final Model 2

5. Discussion of Results and Implications to Theory and Practice

5.1 Implications for Theory

Our foregoing empirical results paint an interesting picture of associations and complementarities among supply chain agility, supply chain resilience and organizational culture in disaster relief operations. Our results contribute to the better understanding of two important dynamic capabilities of supply chain in humanitarian context. Previous studies have acknowledged the relevance of the combined effect of supply chain agility and supply chain resilience on supply chain performance (Carvalho et al. 2012). However, in the humanitarian context most of the existing studies have either examined the effect of supply chain agility (Oloruntoba and Gray, 2006; Oloruntoba and Kovacs, 2015; L'Hermitte et al. 2017) or resilience (Tabaklar et al. 2017) on supply chain performance. We have grounded our debate in the view that supply chain agility and supply chain resilience are two dynamic capabilities of supply chain. This study addresses the notion of an ambidextrous strategy in the context of supply chain strategy. Originally, because of the scarcity of the resources and limitations of the managerial scope, the SCAG and SCRES were often considered substitutes. The traditional view often posits that organizations would be better off if they either honed their SCAG capability or extended their SCRES capability. Meanwhile, some scholars believe that SCAG and SCRES are complementary capabilities (Carvalho et al. 2012). Our results corroborate the view of some of these scholars that SCAG and SCRES may be complementary capabilities during the pre-disaster phase. However, during the post-disaster phase SCRES has a significant effect on performance. These findings are our main contribution to literature. In this way, we have addressed our two research questions (RQ1 and RQ2).

Next, our study findings support the interaction effects of SCAG/SCRES and organizational culture on performance. In existing operations, management literature provides some insight into how organizational culture may affect supply chain integration practices (Braunscheidel et al. 2010; Prasanna and Haavisto, 2018). Complementing these studies, the present study suggests that motivation for disaster relief operations in humanitarian supply chain stems from dynamic capabilities of the organization and supply chain. The organizational culture is a stable element of the organization (Liu et al. 2010) which sheds new light on the interaction effect of the organizational culture on the effects of SCAG and SCRES on performance in different phases of disaster relief operations. In this way we have addressed our third research question (RQ3). While these results provide nuanced understanding, it further opens a new avenue for research on how interdependencies on humanitarian actors may influence the performance.

5.2 Implications for Practice

The findings of the study may offer some interesting guidelines to practitioners who are engaged in disaster relief operations. Our results provide nuanced understanding of SCAG/SCRES and its effects on performance in different phases of the disaster. Holguín-Veras et al. (2012), argued in their study that the focus of post-disaster humanitarian logistics is different from pre-disaster logistics or commercial logistics. Complementing the Holguín-Veras et al. (2012) arguments, we argue that controlled orientation improves the dynamic sensing ability which is an important characteristics of supply chain agility. Secondly, the controlled orientation further helps organizations to build proactive capabilities such as redundancy, reserve capacity, robustness, integration and efficiency. On the other hand, during the post-disaster phase, flexible orientation of the organization helps to focus on reactive capabilities of the organization such as rapidity and recovery. The post-disaster phase focuses on recovery, rehabilitation and reconstruction, often building on preparation activities undertaken during the pre-disaster phase. During this stage, effective collaboration is the often considered as the key to success. Hence, not only transparency and accountability are important for each organization, but the relationship with stakeholders is also extremely important. Thus, based on results we can argue that an organization with a flexible orientation can experience better performance from combined effects SCAG and SCRES. Thirdly, based on findings we can argue that focus on building SCAG and SCRES capabilities can enhance the pre-disaster performance (explanatory power of 61%). However, in post-disaster phase SCAG and SCRES explain only 21% of the post-disaster performance. Thus, organizations can develop appropriate strategies for different phases of the disaster.

5.3 Limitations and Future Research Directions

We caution our readers to evaluate our study results and findings in context of its limitations. Firstly, we tested our hypotheses using cross-sectional data. We acknowledge that despite various efforts, the possible effects of CMB on our study results cannot be completely eliminated. A longitudinal study would further enrich our understanding. Secondly, we grounded our arguments in dynamic capability view and organizational culture. In future, researchers could increase the scope by using a multi-methods approach to develop a theoretical model using in depth multi case studies approach followed by empirical validation of the research propositions. In this, way we can provide a better understanding of the present debate, which is a relatively young discipline in comparison to commercial supply chains. Finally, we need to extend the studies to understand the effects of interdependency and temporal orientation on differential effects of SCAG and SCRES on performance. Currently, our understanding of the effects of interdependency and long-term orientation is limited.

6. Conclusion

Despite several studies focusing on supply chain agility and supply chain resilience in context of humanitarian supply chain, little rigorous empirical testing exists. Moreover, while some researchers have conceptually distinguished between supply chain agility and supply chain resilience, no rigorous theory driven empirical testing of their distinct performance effects in context to humanitarian supply chain exists. Finally, theory on effects of supply chain agility and supply chain resilience in context to humanitarian supply chain remains fragmented and lacks grounding in established theoretical perspectives. In this study, we have focused on two performance criteria (pre-disaster performance and post-disaster performance) and addressed three research questions. The results of our study offer some useful implications for theory and practice. Finally, we hope that our study constitutes a necessary first step on which future studies can build.

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Appendix A: Operationalization of Constructs (all constructs were of Reflective type)

Construct and Derivation	**Measures**
Supply chain agility (SCAG) Adapted from Blome et al. (2013a) and Gligor and Holcomb (2012)	Our organization can quickly detect changes in our environment (SCAG1) Our organization can quickly identify opportunities in its environment (SCAG2) Our organization can quickly sense threats in its environment (SCAG3) Our organization continuously collects information from suppliers (SCAG4) We make quick decisions to deal with changes in environment (SCAG5) When needed we can adjust our supply chain operations to the extent necessary to execute our decisions (SCAG6) Our organization can increase its short-term capacity as needed (SCAG7) We can adjust the specification of orders as requested by our partners (SCAG8)
Supply chain resilience (SCRES) (Brandon-Jones et al. 2014)	Our organization can easily restore material flow (SCRES1) Our organization would not take long to recover normal operating performance (SCRES2) The supply chain would quickly recover to its original state (SCRES3) Our organization can quickly deal with disruptions (SCRES4)
Temporal Orientation (Moshtari, 2016)	Long-term goals in their relationship (TO1) Partners expect to work together for a long time (TO2) Participating organizations concentrate their attention on issues that will affect targets beyond the next (TO3)
Interdependency (Brown et al. 1995)	It would be costly for our organization to lose its collaboration with the partner (I1) This partner would find it costly to lose the collaboration with our organization (I2)
Flexible Orientation (adapted from Liu et al. 2010)	Less formal structure (flat structure) (FO1) Less focus on traditions (FO2) Our organization believes in equality and merit (FO3) Commitment to innovation and development holds the organizations together (FO4) Less concerns for security (FO5)

Control Orientation (adapted from Liu et al. 2010)	Highly structured, hierarchical and oriented toward chains of command (CO1) Loyalty and tradition holds our organization together (CO2) Our organization respect age, experience and seniority (CO3) Focused on attaining mission goals (both explicit and implied) (CO4) Trained to be secretive for operational security (CO5)
Pre-disaster performance (Kunz et al. 2014)	Our organization provides readiness training for overcoming crises (PRE-DP1) Our organization have forecasting for meeting demand disruptions (PRE-DP2) Our organizations have response team for mitigating crisis (PRE-DP3) Our organization have strong security system to prevent crisis (PRE-DP4)
Post-disaster performance (Abidi et al. 2014)	Our organization responds quickly to disruptions (POST-DP1) Our organization get recovery in short time (POST-DP2) Our organization have the ability to absorb huge loss (POST-DP3) Our organization can reduce the impact of loss by our ability to handle crisis (POST-DP4) Our organization can help recover from crisis at less cost (POST-DP5)

Appendix B: Model fit and quality indices (Model 1)

Model fit and quality indices	*Value from analysis*	*Acceptable if*	*Reference*
APC	0.231, p<0.001	p<0.05	Rosenthal and Rosnow (1991)
ARS	0.609, p<0.001	p<0.05	
AVIF	2.556	Acceptable if less than 5, ideally less than 3.3	Kock (2015b)
Tenenhaus GoF	0.580	Large if ≥0.36, medium if ≥0.25	Tenenhaus et al. (2005)

Appendix C: Model fit and quality indices (Model 2)

Model fit and quality indices	*Value from analysis*	*Acceptable if*	*Reference*
APC	0.134, p=0.013	p<0.05	Rosenthal and Rosnow (1991)
ARS	0.213, p<0.001	p<0.05	
AVIF	1.944	Acceptable if less than 5, ideally less than 3.3	Kock (2015b)
Tenenhaus GoF	0.335	Large if ≥0.36, medium if ≥0.25	Tenenhaus et al. (2005)