

# Disaster Supply Chain Management: Responsive Inter-organizational Networks under Pressure

Stavros T. Ponis<sup>#1</sup>, Epaminondas Koronis<sup>#2</sup>

<sup>1</sup>*School of Mechanical Engineering, National Technical University Athens  
Heron Polytechniou 9, Zografos 157 80, Athens, Greece*

[staponis@central.ntua.gr](mailto:staponis@central.ntua.gr)

<sup>2</sup>*University of Westminster Business School*

*35 Marylebone Road London NW1 5LS*

[E.Koronis@westminster.ac.uk](mailto:E.Koronis@westminster.ac.uk)

**Abstract**— Supply Chains are often required to absorb unexpected pressure, turbulent changes in demand and disruptions across their structural components. In this paper, the authors acknowledge both the inter-organizational and collaborative nature of supply chains and explore how established logistics structures respond to conditions of crises as a result of unforeseen natural events and disasters. After a brief review of existing practices in the area of Disaster Supply Chain Management (DCSM) the authors identify and present the sharing 'realities' of inter-organizational networks through a short case study showcasing the situational, complex and temporal nature of responsive networks under pressure.

**Keywords**— Supply chain management, Inter-organisational networks, Responsive networks, Crisis Management, Disaster Supply Chain Management, Case Study

## 1. Introduction

The management of a supply chain includes a large number of challenges and issues that demand decisions and resolution under strict environmental, cost and time constraints. These challenges are amplified in the event of high-impact crises, disasters and catastrophes. While disasters are increasing in frequency and in their impact on humanity, mainly due to populations' continued growth, climate change and human-made errors, it is only in the last few years that the Disaster Management (DM) scientists are beginning to understand the importance of Supply Chain Management (SCM) for the rapid and effective response to a catastrophic event and the relief of its

results on infrastructures and, most importantly, on people that inhabit the affected area.

Our research experience and study indicates two schools of thought in contemporary Disaster Management. The traditional one sets in the epicenter the need to enhance systems performance, resources capacity, responsive procedures and human preparedness in order to handle crises, absorb the consequences and maintain normality [32]. Emergency Planning processes have been based on the development of bureaucracies, processes and the centralized handling of response resources. However, recent events, such as the Haiyan typhoon in Philippines [27] and the most recent massive earthquakes in Nepal indicated that both social science, emergency planning/ disaster management and governments are in need of a more enhanced and enriched view as to how societies prepare for disasters. As Wilson states [40] in his study on hurricane events, "*officials are often allocated excessive responsibility to handle incidents hard to control and often difficult to understand*", "*... the human factor is often forgotten although great solutions often come from participation*" (ibid: 27).

Indeed, a number of studies indicate that the traditional model of disaster management and responses, the one based on capacity accumulation and top-down planning, fails more often than it succeeds to strengthen the resilience of societies exposed to negative high impact incidents. Moreover, the importance of effective and functional supply chains during disasters is beginning to gain more strength as a number of failures indicated that disaster relief efforts heavily rely on the circulation of reliable information, the

mobilization of resources and the planning and implementation processes of dispatching units, volunteers, and resources in the right place at the right time. These are all SCM tasks implicitly used in disaster relief efforts as they move goods, units, volunteers and support throughout a disaster-affected area.

The lessons learnt from our recent reported experiences bring forward the need for more organic, community-based and integrative efforts in order to ensure preparedness and effective response systems. However, although the existing models of Supply Chain Resilience identify the collaborative capacity as of key importance, the theory and practice of developing such collaborations in the case of Disaster Supply Chain Management (DSCM) is rather underdeveloped. In this paper, the authors argue that the formation of inter-organizational networks built solidly on the foundations of trust and information sharing provides the best answer on the problem of supply chain collaboration in a disaster setting, leading to increased resilience and sustainability of the supply chain responsible for the relief of the area suffering the disaster consequences.

## **2. The Networked Nature of Disaster Supply Chains**

A growing number of knowledge views organizational and societal resilience under a network perspective, arguing that inter-organizational networks, communications, coordinated action and definitely relationships should be placed at the centre of theoretical and normative development [36]. Gittel et al. [14] identified the role of 'relational capital' in the business survival and competitive sustainability and crisis management practice has been recently move from operational preparedness to a more networked perspective on crisis and disaster relief mechanisms.

Moreover, an understanding of organizational practices and business processes has been supported by substantial theoretical work related to organizational networks inter-organizational communication and supply chain relations in particular [29],[15]. Such seminal contributions enriched our understanding of organising practices as transactive networks and particles of wider supply chain and strategic alliances practices. Yet,

these developments currently remain disconnected from the Resilience and the Crisis and Disaster Management agenda as the approaches on incident handling and meeting strategic challenges remain largely focused on in-house organizational operations. Perhaps more paradoxically, the distinct field addressed as Disaster Supply Chain Management, although built on the bases of supply chain and network disruptions, is also in need of more concrete inter-organizational conceptual frameworks and applicable methodologies for the organizations' supply chains integration during the crises handling phase [34].

In this paper, a network approach for supply chains crisis management is presented that draws on the nature, typology and social processes of inter-organizational networks as interplaying with the supply resilience development. Our conceptual considerations begin by analyzing the role of networks in the supply chain crisis management process. Unexpected actors and agents interfere in the supply crisis management situations, competing for resources and affecting processes [38]. Crisis Supply Chain Management, in this rationale, is not organizational but depends on the development of synergies and inter-organizational networks [4].

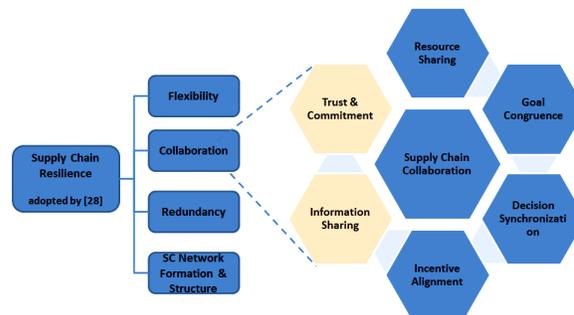
The very nature of networks in this tradition is that organizations are dependent on knowledge management resources and are involved in knowledge exchanges in an effort to reach their goals [17]. Studies have also revealed the knowledge-intensive character of supply chain disruptions, as information needs to be exchanged, knowledge has to flow across the different logistics operations and such knowledge is characterized by complexity [41]. Simply put, during supply chain crises, as supply chains rely on network processes, unstructured or semi-structured knowledge transfer processes need to take place under conditions of limited time and psychological pressure. While the role of knowledge circulation and sharing is crucial, knowledge management and organizational learning theory itself has highlighted the role of social processes, trust, routines and communities of practice in the exchange of knowledge.

It is precisely the aim of this paper to build on the rich tradition of inter-organizational networks and supply chain relations and produce innovative conceptual and normative research for the development of more resilient Disaster

Management Supply Chains. In doing so, focus is turned on the construction of inter-organizational networks for Disaster Supply Chain Management, the role of knowledge exchanges and the effects of the social capital and social practices in the maintenance and utility of such networks under crisis and disaster conditions.

In recent works by [18], [28], Supply Chain Resilience is defined as “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-event robust state of operations, if possible, more favorable than the one prior to the event, thus gaining competitive advantage”. This definition, apart from applying a holistic perspective on SCRes, also introduces the concept of Supply Chain Network, stressing the significance of the inter-organizational supply chain structure in the outcome of management activities towards achieving a resilient and sustainable supply chain operation. Furthermore, the authors propose a framework built on what they believe are the most grounded formative elements of SCRes, i.e. agility, flexibility, velocity, visibility, availability, redundancy, mobilization of resources, collaboration and supply network structure knowledge. In doing so, the authors attempt a grouping of the aforementioned SCRes formative elements into four discrete first level structural elements, based on grounded theory, i.e. flexibility, redundancy, collaboration and supply chain network formation and structure.

In this paper, the authors study the collaboration and supply chain network formative elements by examining the role and effects of strong inter-organizational collaborative networks to support supply chain resilience and sustainability. Our conceptual approach is presented in Figure 1, providing the relationship between the authors’ previous work and the research undertakings presented in this paper.



**Figure 1:** Research Conceptual Approach

The paper draws on the analysis of the concepts of disaster management, inter-organizational networks and focuses on research conducted on a case study of a complex supply chain under pressure. A process of informalization, dependence and lack of structured responsiveness is presented supporting the argument that the networked nature of supply chains create important challenges in the event of disruptions or crises, including unexpected increases or reductions in demand. Our analysis recognizes the current trends and changes in the Disaster Management models: first the increasing need to involve organizations as cells of resilience and second, the growing urgency for the development of disaster-oriented processes and technologies for better supply chain management. Most importantly, this paper brings forward the need to establish inter-organizational practices across organizations, suppliers and partners thus preparing the supply chain for a structured response to crises or disasters.

### 3. Nature and Practice of Disaster Supply Chain Management

Disaster Supply Chain Management (DSCM) is a multidisciplinary field that addresses the technical, social and management problems of meeting the resources demand in times of critical incidents and high-impact events [33]. As a research area, it includes a variety of approaches that examine how supply chains operate, suffer and should be adjusted to the pressure of disasters as systems collapse, demand for delivery of resources increases dramatically and conditions of limited information and time constraints apply [41]. While, in principle, this would be expected to be a branch of supply chain management scholarship, there are important differences that make it a special body of knowledge with different requirements.

It is commonly argued in literature that DSCM differs from traditional Supply Chain Management in that the "client" is a term used to identify affected areas and regions, victims of disasters while the supply chain entities include a variety of transportation, information management and human factors that are not met in normal logistics operations (e.g. volunteers). As [34] argues and [3] describe in their investigations in Sudan, although DSCM is often in need of a leading organization and bureaucracy, it is often the case that "no single organization can independently create and maintain comprehensive information concerning the overall relief effort" [12]. DSCM is therefore not organizational but depends on the development of synergies and inter-organizational networks. Additionally, DSCM although based on the same principles with normal logistics it requires the rapid adjustment of the system in conditions of pressure and lack of information. As the authors argue in [1], DSCM has to deal with shortened life-cycles, reduced information resources and situation where urgent responsiveness is required under high uncertainty and often political pressure.

It is therefore valid to say that as Disaster Relief Supply Chains do not relate to individual firms or organizations and consist of situational and complex networks of entities, it is not a surprise that research and propositions are surprisingly scarce, although their importance is critical in saving lives, ensure social continuity and affected communities' sustainability [34], [12]. However, a number of perspectives and approaches may be identified in current research and practice. First, a "strategy approach" investigates the role of Disaster Logistics in the overall Disaster Management process and studies its role within the existing policies and processes.

Advances in DSCM have been provided by studies on Resilience and what one might label as the more "social aspects". For instance, Sheffi's work in business literature considers the role of flexibility as equally important to the development of resource planning, building capacity and accumulating redundancy. His argument is that, precisely in times of disasters, social systems need to prove that they possess abilities relying on social capital, trust, adaptiveness and flexibility to change [31], [8]. In these studies, communities begin to evolve into crucial actors in the disaster management processes, as cells of disaster handling

and resilience. Although this is not new, given the initial view [32] of disaster planning as taking place in five levels (international, national, organizational, communities, families), studies recognize that in recent decades disaster management placed more emphasis on building capacity and governmental institutions than in developing social systems of response. Moreover, a cultural dimension is analyzed by scholars who saw in disaster logistics a high impact of human participation, history, culture, language and politics [10], [11], [9].

In order to overcome the above limitations and challenges, studies argue that we are in need of technological solutions, people participation and the appropriate preparedness and mentality. In their famous work on resilience, the authors argue that effective crises information sharing requires a pre-existing mindset, a set of skills and a number of technologies that are embedded in the system [35]. Finally, a stream of literature has focused extensively -but not conclusively- on the development of DRSCM metrics and performance measurement with an emphasis on building databases, operational indicators and time-based thresholds [24], [23], [37].

So what is the next step or the first step in building DSCM? In their recent work in the *Journal of Supply Chain Management* [13], argue that Disaster Relief and Humanitarian Supply Chain Management suffers from a diversity of approaches and terminological plurality (e.g. logistics vs. supply chain) and that a wide number of complexity factors remain unexplored. Some analysts argue that as disaster events increase and their impact is growing, the research community is in need of a convergence of different models into one integrated field of study focusing on technology, processes, information management and social aspects of DSCM [30]. The authors in [5], in their editorial in the *International Journal of Production Economics* argue that different fields (supply chain management, humanitarian assistance, crisis management, public administration etc.) and various approaches (information, process-based, resilience) inevitably lead to the formation of an emerging field: the study of disaster relief supply chain management. By placing an agenda, they revisit a number of existing issues and the need to build homogenized disaster supply chain management frameworks that

incorporate the organizational, legal, performance measurement, planning and technological particularities that make this field unique and special. Moreover, similar to the argument in [19] they call for dialogicity between the business field of logistics, communities and disaster management and they propose the construction of bridges between the concepts and frameworks. Finally, it is evident that information and knowledge sharing become of primary importance and value as they make improvement possible and support the DRSCM performance and identity [20], [21].

#### 4. Understanding Inter-Organizational Networks

In organization and management studies, the role of inter-organizational networks has been extensively studied. Despite differences, nearly all definitions address a relatively common base of topics including social interaction, relationships, connectedness, collaboration, collective action, trust and cooperation. In [6] a network is seen as “a set of nodes and the set of ties representing some relationship, or lack of relationship, between the nodes.” The authors in [26] include in their definition of inter-organizational networks a variety of forms of cooperation, including mergers, joint ventures, alliances, collaborations and consortia. In [2], the authors provide an overview of the different types of inter-organizational relationships and analyze how each is different. Networks are defined as constellations of organizations that come together through the establishment of social contracts or agreements, rather than legally binding contracts. The very nature of networks in this tradition is that organizations are dependent on resources and are involved in transactions in an effort to reach their goals [25], [39].

With the above studies revealing ‘why organizations form networks’, different streams of thinking addressed more critical questions related to the domains of inter-organizational collaborations (focusing on learning, innovation, strategic development etc.). Other studies, relevant to this thesis explored the social conditions that enable organizations to effectively build networks. Among those, a number of scholars indicated the role of social capital [16], [7].

With a wide number of themes discussed in the theory of inter-organizational networks, this paper

sees in this tradition both a source of insights to be explored and transferred in the DSCM area (particularly as to which factors enable collaboration) as well as an opportunity to contribute by investigating the nature, development and operability of emergency organizational relationships. As neo-institutional theorists argued, the formation of inter-organizational networks is more of an attempt of organizations to adapt to a challenging environment, rather than a self-reflective autonomous process of strategizing. Their effort to shape groups and transform collaborations into systemic and stabilized routines of networking indicates their adjustment to a demanding ecology and their effort to reproduce their role within a complex structure.

In this paper, the authors identify a problem in the formation of inter-organizational identities, as organizational processes of identification may lead people to resistance and distancing from these forms of collaboration. Second, inter-organizational networks are based on the development of mutual trust and aspects of social capital. Informal processes of sense-making, understanding and committing in networks require a degree of informal relations that are based on the implicit acceptance of basic routines and practices. Such approaches recognize that to some extent all networks are emerging from social relations and symbolic transactions based on trust, before they reach to the stage of symbolic signification and formalization. As Giddens acknowledges, by placing trust on somebody or something we are involved in a process of simplification of complex realities and problems. In inter-organizational networks, trust is a fundamental aspect as different actors decide to share a view of the problem in an attempt to diffuse complexity and increase the resolving power. Third, the formation of inter-organizational networks requires a degree of functional transferability of resources, both tangible and intangible.

With a wide number of themes discussed in the theory of inter-organizational networks, this paper sees in this tradition both a source of insights to be explored and transferred in the DSCM area (particularly as to which factors enable collaboration) as well as an opportunity to contribute by investigating the nature, development and operability of emergency organizational relationships. It is not the aim of this paper to

address all the above issues but rather to provide insights into the reality, challenges and processes of DSCM with an emphasis on the role of networks in the development of effective responses. In doing so, a mini-case that allows the investigation of the inter-organizational processes for humanitarian provision while also preserving the integrity and operability of a supply chain, is utilized.

#### 4. The Case

Our empirical investigation attempts to contribute in this area of research. The article investigates the case of a Supply Chain disruption within the context of a security operation, coordinated by the British Army and implemented by a private firm in a foreign country. Given a sudden change of conditions and a mini weather disaster, the need for a complete reconfiguration of the supply chain demand and capacity has not been addressed as the different parts of the supply chain have remained in a state of knowledge isolation, resulting to insufficient delivery of fuel resources.

##### 4.1 Entering the Disaster Period/ Collective Sense-making

On the 21st of March of 2011, the Logistics Officials in the UK HQ were informed that change of weather would affect operations abroad and that it would be critical to increase the quantity of fuel that would make future operations possible. However, when placing a request and informing the on-site officials they got the response that such demand should be communicated to a local agent who could not be located. Further communication lead to the assumption that the request was depending heavily on the ability of the local logistics company and the supplier (2 different companies working under the same management) to respond to the demand.

Two days later, events at the location increased the number of operations dramatically and consequentially the demand for fuel. In the words of a sergeant, *"we soon realized that we were asked to feed a jungle instead of the zoo that was our job a few hours before the events"*. As the crisis progressed, the supply chain started to fail to meet the demand and at that time an officer on-site discussed with the headquarters the possibility of finding alternative fuel suppliers. A few hours later he contacted the HQ and informed them that the current supplier could actually cover the demand but that he requested for additional fees and more time to respond. *"It has been obvious that there was a problem of bad communication.... everybody was doing a great job but it was nobody's job to*

*talk to these [locals]"* (Officer at HQ).

Moreover, a discussion on contracts, obligations and plans was initiated in the middle of a complex negotiation about the delivery of fuels and the possibility of storage. In March 27th an officer admitted that *"weather disruptions have been so severe that we needed to transport ten times the weekly amount of fuel within a few hours per day"*.

##### 4.2 Informalization of Supply Chain Relations

While the immediate conclusion could have been focusing on the lack of cohesiveness across the supply chain, in fact further analysis reveals that the supply chain was relying heavily on informal relations between officers and the local supplier. As a sergeant said, *"normality and good relations lead to the assumption that we would be able to respond to any demand...shaking hands and smiles, that's what it was all about"*.

However, this situation lead to the depreciation of the role of knowledge exchanges, scenario playing and information sharing. The informalization of the relations was followed by the construction of a culture of "perceived resilience" which was not based on realistic assumptions. The meetings, contractual discussions and chats with the suppliers have been institutionalized as "processes" thus excluding knowledge exchanges from the tasks and duties. This lead to the orphanization of knowledge as well as the loss of the absorptive capacity and learning processes.

##### 4.3 Images of Disruption

After the end of the disruption period (April 4th), research on the post-disaster period indicates that relations with the suppliers became much more technical in an attempt to restore a sense of normality while assessing the needs for fuel in the recovery period. A key conclusion has been that the relationship with services and fuel suppliers should be based on "negative-scenarios" and formalized procedures of prediction while also establishing communication channels that would ensure the immediate and appropriate response.

#### 5. Conclusions

Our research acknowledges and validates the role of networks and established inter-organizational practices in supply chains under pressure. Three key dimensions are identified. First, the ability of the supply chain to transfer order messages and the appropriate demand changes, across different partners. In order to do so, communication needs to be formalized and relying on established and tested

practices of information exchange. Second, inter-organizational relationships, particularly in the event of disasters and under conditions of time pressure need to use pre-existing knowledge sharing and adaptation processes. Such processes must be developed in the pre-crisis period by ensuring that knowledge transfer capacities are enriched and that the active partners will be part of the crisis management processes. In this respect, resilience of the supply chain and an effective networked disaster supply chain system must build strong ties across the different parts of the operations but also to achieve a degree of formalization of processes.

Finally, this case analysis reveals the need for the integration of people, processes and communications under a unified disaster supply chain management system that would meet the increased demand or processual challenges. Returning to the argument made in [31], it is precisely in times of disasters, social systems need to prove that they possess abilities relying on social capital, trust, adaptiveness and flexibility to change. Such values need to allow inter-organizational networks to evolve into situational communities of practice and emerging networks of response.

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