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Sylvie Michel, Sylvie Gerbaix, Marc Bidan

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Dimensions and sub-dimensions of emergency supply chain resilience: A case study of Médecins Sans Frontières Logistique during the COVID-19 pandemic.

Sylvie Michel
IRGO, EA4190
Université de Bordeaux
Bordeaux, France
sylvie.michel@u-bordeaux.fr

Sylvie Gerbaix
Montpellier Research in Management
Université de Montpellier
Montpellier, France
macsylvie@orange.fr

Marc Bidan
LEMNA
Nantes Université
Nantes, France
Marc.Bidan@univ-nantes.fr

Abstract

Design/methodology/approach

The methodology of this empirical research paper is based on a qualitative study utilizing semi-structured interviews with key actors of the Médecins Sans Frontières Logistique (MSF Log), NGO during the COVID-19 crisis in 2020 and 2021.

Purpose

This research paper aims to study the dimensions and sub-dimensions of humanitarian supply chain resilience through the case of an NGO logistics organization facing the international COVID-19 pandemic**.**

Findings

The data analysis highlighted four main dimensions of humanitarian supply chain resilience: organizational capacity, collaboration, flexibility, and humanitarian culture. The transversal importance of the information system and that of the humanitarian culture were also pointed out. Furthermore, we have identified the sub-dimensions of each dimension, these sub-dimensions further elaborate the main dimension and provide a more detailed understanding of the concept. These dimensions require both proactive and reactive actions to be effective. Finally, based on these empirical results, a conceptual model of humanitarian supply chain resilience is proposed.

Originality/value

The value of this research is linked to the findings that result not only from literature about resilience but are also founded on an empirical and qualitative study of an NGO logistics organization facing an international crisis. The research provides an in-depth understanding of the practical application of supply chain resilience in a humanitarian context, and the specific challenges and opportunities that arose during the COVID-19 pandemic for MSF Log. It also highlights the importance of information system and humanitarian culture in maintaining the supply chain resilience. The findings of this research can be used as a guide for other humanitarian organizations to improve their supply chain resilience in times of crisis.

Research limitations/implications

Additionally, further research can be done to explore the impact of digital technologies on the humanitarian supply chain resilience, and how these technologies can be used to improve the resilience of humanitarian supply chains. Additionally, future research can also be conducted to explore how to measure the resilience of humanitarian supply chains, and how to develop methods to improve the resilience of these supply chains.

Practical and social implications

The dimensions and sub-dimensions of resilience that have been highlighted may provide a guide for managers to target their actions, both responsively and proactively, in order to act on resilience over time when facing a crisis such as an international pandemic.

Key words:

Humanitarian logistics; Supply chain Vulnerability; Information systems; Case studies; Collaboration

1. Introduction

The COVID-19 pandemic is a major disruption that tests the resilience of global supply chains (Queiroz et al., 2020; Ivanov, 2020; Golan et al., 2020; Black and Glaser-Segura, 2020; Chowdhury et al., 2021; Pimenta et al., 2022). Epidemics and pandemics are considered unique disruptions that are distinct from other disruptions (such as natural disasters, industrial accidents, or terrorist attacks) in that they pose both internal and external systemic threats to entire supply chains (Ivanov, 2020). Literature on supply chain resilience has grown significantly in recent years, indicating a strong interest from both practitioners and researchers. Supply chain resilience is defined as "*the adaptive capability of a supply chain to prepare for and/or respond to disruptions, to make a timely and cost-effective recovery, and ultimately progress to a post-disruption state of operations – ideally, a better state than prior to the disruption*" (Tukamuhabwa et al., 2015, p. 8). However, publications regarding supply chain resilience remain fragmented, with great disparities in definitions, concepts and the relationships between these concepts. Also, even if the number of empirical studies has steadily increased since the initial observation of the lack of them in the area of supply chain resilience (Hohenstein & al., 2015), an opportunity for future research is to conduct empirical studies on the frameworks in order to provide more meaningful information about the proposed interrelationships between concepts, processes, and variables (Centobelli & al., 2020). This is the first gap, regarding supply chain resilience concepts and dimensions, that we are attempting to fill.

The humanitarian supply chain has also garnered a lot of attention because of its key role in disaster response (Fosso Wamba, 2020). With respect to humanitarian logistics, it should be noted that the terms "humanitarian supply chain management," "emergency supply chain," and "Humanitarian supply Chain Management" have been used relatively interchangeably in the literature since the early 2000s (Van Wassenhove, 2006; Kovács and Spens, 2007; Howden, 2009; Dwivedi et al. 2018). Most authors refer to the same definition of humanitarian logistics, initially that of Thomas and Mizushima (2005), "*the process of planning, implementing and controlling the efficient, cost-effective flow of and storage of goods and materials as well as related information, from point of origin* to point of consumption for the purpose of meeting the end beneficiary's requirements" (Van Wassenhove, 2006; Howden, 2009; Kovács and Spens, 2009; Tatham and Pettit, 2010; Kabra et al., 2015; Chiappetta Jabbour et al., 2017). Howden (2009), building on the work of Mentzer et al. (2001), defines humanitarian supply chain management (HSCM) as *"a humanitarian supply chain that refers to the network created through the flow of supplies, services, finances, and information between donors, beneficiaries, suppliers, and different units of humanitarian organizations for the purpose of providing physical aid to beneficiaries*." This definition highlights the different actors involved in the network. Kunz and Gold (2017) note that from an initial strictly logistics perspective, the field has gradually evolved into a Supply Chain Management approach. This involves encompassing not only physical flows, but also information and financial flows, and tasks such as procurement, coordination, and customs clearance. However, Agostinho (2013) notes that the logistics function in the humanitarian sector has been neglected until recently and as a result, humanitarian organizations are fifteen years behind the performance of private sector companies (Thomas and Kopczak, 2005). Consequently, it is now recognized as an important area of research (Charles et al. 2009), and several recent literature reviews have been conducted to identify gaps, avenues, directions that research should take (Chandraprakaikul, 2010; Overstreet et al., 2011; Abidi et al., 2014; Baharmand et al., 2015; Chiappetta Jabbour et al., 2017). This is the second type of gap we are attempting to fill, focusing more specifically humanitarian supply chain management (HSCM) and the identification of its dimensions. Our objective is to propose a conceptual framework for analyzing the

humanitarian supply chain resilience, and to consolidate HSCM resilience definitions and its dimensions.

From a methodological point of view, we propose to collect data in a real context of disaster and emergency. In fact, the lack of access to disaster areas to collect empirical data has been recognized as one of the critical challenges (Fosso Wamba, 2020). That is why studying the case of Médecins sans Frontières Logistique (MSF Log), while confronted with the COVID-19 pandemic, is a rare and unique opportunity to study the HSCM resilience by collecting empirically data in the specific context of a major crisis and an emergency situation. In fact, these empirical data were collected during the first phase of the pandemic (and the first lockdown in France) from March 2020 to spring 2021. At this time, this pandemic was perceived as a major crisis and an emergency situation. Among the many qualitative methodologies for data analysis, we opted for the methodology proposed by Williams and Moser in "The Art of Coding and Thematic Exploration in Qualitative Research" (Williams and Moser, 2019). With an inductive approach, founded on Ground Theory Method (GTM) (Glaser, Strauss, 1967), Williams and Moser propose a methodology for extracting themes, categorizing data in order to construct meaning and generate theory. They adopt a rigorous and flexible approach for data coding, in three successive steps, "open" coding, "axial" coding, and "selective" coding, into a cyclical dynamic process, to understand intimately the data by reading and re-reading the data for the research study focus. Thus, this methodology meets our empirical, methodological and theoretical aims, to extract from our qualitative data major themes and dimensions, in order to construct the meaning and develop the theory of resilience.

Indeed, humanitarian logistics is the very purpose of MSF Log, an NGO that ensures the logistics of materials and medicines for MSF's humanitarian missions. However, with the COVID pandemic, this NGO found itself doubly confronted with the risks of multiplying emergency situations internally and on the missions' sites. To what extent and how was MSF Log able to rely on a resilient supply chain to get through the first phase of the pandemic (and the first lockdown in France) from March 2020 to spring 2021? Which strategies, factors, and dimensions did MSF Log rely on to make its supply chain resilient? What are the characteristics of its humanitarian supply chain resilience? To answer these questions and meet this objective, this case study was conducted through qualitative inquiry, based on semi-structured interviews, as well as secondary literature review.

The first part of this research paper will be devoted to a literature review focusing on the specificities of Humanitarian Supply Chain Management and of supply chain resilience, and the theoretical gap we wish to bridge towards HSCM resilience. The second part will present the methodology used for data collection and thematic exploration within this MSF case study, during the COVID-19 pandemic. The third part will present the results, highlighting the main dimensions and sub-dimensions of resilience deciphered through this thematic exploration within the MSF case. Finally, we will conclude with the main theoretical and practical implications of these highlighted dimensions and sub-dimensions that may improve the resilience of a humanitarian supply chain confronted with a pandemic.

2. Literature review: Specificities and humanitarian supply chain resilience in crisis and emergency situations

2.1 Emergency and humanitarian supply chain: strong specificities

Three main specificities of HSCM can be highlighted.

2.1.1 Emergency and disasters: basic elements of humanitarian supply chain

Disasters and emergencies often occur simultaneously. The World Health Organization defines an emergency as a situation where normal procedures are disrupted, and steps must be taken to minimize losses (Balcik and Beamon, 2008). According to Van Wassenhove (2006), a disaster is "*a disruption that physically affects a system as a whole and threatens its priorities and goals*". Van Wassenhove (2006) proposes a typology of disasters into three groups: those caused by man, such as terrorist attacks, natural disasters, and complex disasters. Humanitarian supply chain management is closely linked to emergency and disaster management as it plays a crucial role in disaster response (Van Wassenhove, 2006; Dwivedi et al., 2018; Shareef et al., 2019). HSCM is activated immediately after a disaster occurs, with the goal of saving lives, alleviating suffering, and reducing the impact on societal stability (Oloruntoba and Gray 2006; Da Costa et al., 2012). This highlights the importance of understanding and improving the resilience of humanitarian supply chains in the face of disasters and emergencies.

2.1.2 The importance of donors

The main stakeholder in an HSCM is the donor. Indeed, NGO donors often request that their funds be spent directly on materials and food rather than on essential but indirect - and therefore less valued - services such as Information System (IS), staff training, marketing, or disaster preparedness (Oloruntoba and Gray, 2006; Van Wassenhove, 2006; Kovács and Spen, 2007; Overstreet et al., 2011; Burkart et al., 2016). Therefore, HSCM management is not limited to providing goods, materials, or information at the point of consumption to alleviate the suffering of vulnerable people, but must also manage the value to donors and other stakeholders. In addition, Kabra et al. (2015) note that most funding sources are typically only available after a disaster has occurred and, therefore, are spent within a very short time frame. Time-limited funding encourages actors such as humanitarian organizations to focus on immediate and direct assistance rather than investing in systems and processes that will improve the effectiveness of relief operations in the long term, such as IS.

2.1.3 Information Systems: a key element in understanding humanitarian logistics

In most cases, Information Systems (IS) are presented in an instrumental logic, meaning they are seen as functional tools rather than vectors of fiction. Regarding their functional links with HSCM, IS can be seen as both a factor of complexity and added uncertainty (difficulties with implementation, training, evaluation, etc.) related to their mission of producing reliable, useful and up-to-date information, but also as tools for hardware and software solutions aimed at reducing specific uncertainties. For example, Sahebi et al. (2017) focus their research on identifying barriers that prevent HSCM from being even more effective. These barriers include informational barriers (insufficient up-to-date information at the disaster site) and barriers characterizing a lack of informational tools. Paradoxically, in some cases, especially devices that are poorly parameterized, poorly deployed, poorly used, poorly analyzed or poorly updated, can also be at the origin of extreme management situations. In this regard, the work of Natarajarathinam et al. (2009), which follows Christopher and Towill

(2001), offers an interesting review of the literature that synthesizes current practices in SC management in times of crisis, and in particular puts into perspective the notions of agility in supply chains by coupling them to their supporting IS (Özdamar and Ertem, 2015).
The literature on IS in humanitarian supply chain management (HSCM) primarily focuses on its application and specific technical issues. For example, Chen et al. (2008) examine the disruption of the information supply chain caused by inconsistent data standards. Other authors, such as Thomas and Mizushima (2005) and Kovács and Spens (2011), have observed that logistics in the humanitarian field has been isolated from other areas such as finance and IS management, leading to suboptimal efficiency and operational effectiveness.
More recently, Fosso Wamba (2020) highlights the growing importance of advanced technologies such as blockchain, big data, artificial intelligence, and social media to improve coordination and collaboration between key stakeholders and logistics during disaster relief operations. This highlights the importance of keeping up to date with technology advancements and how they can be used to improve the resilience of humanitarian supply chain management.

2.2 Supply chain resilience

The literature on supply chain resilience is vast and varied, with imprecisions in definitions of resilience and characterizations of its dimensions (Pettit et al., 2013; Ali et al., 2017; Chen at al., 2017; Golan, et al., 2020). However, two main recommendations can be gleaned from the literature (Hohenstein et al., 2015; Kamalahmadi, and Parast, 2016; Chowdhury and Quaddus, 2017, Ribeiro and Barbosa-Povoa, 2018, Hosseini et al., 2019; Golan et al., 2020): the first is to conduct empirical studies, and the second is to focus on specific supply chains, which is what we aim to do in this article.

2.2.1 Definition of supply chain resilience

The concept originated in the physical sciences, where resilience can be defined as the ability of a system to adapt and/or rebuild itself very quickly after a disturbance that could destabilize it completely. Regarding the application of the resilience concept to the supply chain, it is necessary to wait for the works of Christopher and Peck (2004), and Ponomarov and Holcomb (2009) who adapt the concept and define it as the capacity to maintain a level of performance and to recover a state of stability in the face of any events and/or disturbances that may occur in the supply chain.
Nevertheless, recent literature reviews on supply chain resilience (Wang et al., 2014; Hohenstein et al., 2015; Tukamuhabwa, et al., 2015; Kamalahmadi and Parast, 2016; Ribeiro and Barbosa-Povoa, 2018; Hosseini et al., 2019) have highlighted the diversity of definitions for supply chain resilience that are not well consolidated. There is a multiplicity of definitions using a fuzzy vocabulary that do not approach the triggering event that requires resilience in a consistent way. Some articles mention disturbances (Tukamuhabwa et al., 2015 ; Kamalahmadi and Parast, 2016 ; Ribeiro and Barbosa-Povoa, 2018; Hosseini et al., 2019), others unexpected or disruptive events (Chowdhury and Quaddus, 2017), still others risks (Jüttner and Maklan, 2011 ; Hohenstein et al., 2015), terrorist attacks (Caniato and Rice, 2003), turbulent changes (Pettit et al., 2010), which include natural disasters, and more recently, pandemics such as the COVID-19 crisis (Golan et al., 2020 ; Ivanov, 2020). Moreover, there are differences among authors regarding the objective of resilience. Some aim to return to the pre-disturbance state (Ribeiro and Barbosa-Povoa, 2018; Hosseini et al., 2019), while others aim to achieve a better state (Christopher and Peck, 2004 b; Sheffi and Rice, 2005; Chowdhury and Quaddus, 2017).

The anticipation phase, also known as proactive resilience, occurs before a disruption or disaster occurs. It involves managers and operational staff trying to anticipate these disruptions and prepare their supply chains in case of expected and unexpected changes in the environment. The resistance phase, the first stage of reactive resilience, is activated as soon as a planned or unexpected disruption is detected in a supply chain. Passive resilience, on the other hand, is an uncoordinated response by the actors, which nevertheless allows the supply chain to adapt. Another point to note in the diversity of these definitions is the addition, for some authors, of the notion of time, speed, and chronology (such as a rapid response or rapid reconstruction). (Sheffi and Rice, 2005; Falasca & al., 2008; Kamalahmadi and Parast, 2016; Ribeiro and Barbosa-Povoa, 2018). Additionally, some authors also take into account the cost of resilience, which should be minimized. (Ribeiro and Barbosa-Povoa, 2018; Hosseini et al., 2019).

2.2.2. The dimensions of a resilient supply chain

Hohenstein et al. (2015) conducted a systematic review of the literature to identify the key components of a resilient supply chain. They reference the seminal work of Christopher and Peck (2004 a, b), who identified four dimensions to characterize supply chain resilience: (1) supply chain reengineering, (2) collaboration, (3) agility, and (4) culture. These four dimensions have been widely cited and used as a framework for subsequent research. Some studies have added additional dimensions or sub-dimensions, while others have removed certain aspects. As an example, Mandal (2012) examined the supply chain resilience principles identified by Christopher and Peck (2004 a,b) on a sample of IT professionals in India. His results indicate that supply chain managers should consider all four principles when designing supply chains. Kamalahmadi and Parast (2016) take Christopher and Peck's (2004 a, b) four main dimensions and refine the sub-dimensions, each subdividing them into two sub-dimensions (Flexibility and Redundancy; Trust and Shared Information; Visibility and Velocity; Leadership and Innovation). Additionally, some dimensions or sub-dimensions have been studied on their own. For example, Durach et al. (2015) developed a framework of antecedents of supply chain robustness.

Some studies focus on the proactive aspects of resilience, such as flexibility, visibility, redundancy, and integration (Jüttner and Maklan, 2011), while others encompass both proactive and reactive capabilities in resilience (Christopher and Peck, 2004a,b; Sheffi and Rice, 2005; Falasca et al., 2008; Pettit et al., 2013). More recently, some authors have used specific theoretical frameworks to study resilience, such as Chowdhury and Quaddus (2017), who propose a conceptualization of supply chain resilience based on the Dynamic Capability Theory, by distinguishing three dimensions: proactive capability, reactive capability, and the quality of supply chain management design.

We can now highlight several important points. The plurality of definitions, theoretical frameworks, dimensions and especially sub-dimensions proposed contribute to maintaining a loose conceptual framework. Furthermore, a gap in resilience modeling and its application to specific supply chains has been noted (Kamalahmadi, and Paras, 2016; Ribeiro and Barbosa-Povoa, 2018, Golan et al., 2020), and the particularity of the humanitarian supply chain has not been taken into account by the literature, which mainly deals with commercial supply chains. Finally, Chowdhury et al. (2021) identify the research opportunities created by the covid-19 crisis in the field of supply chain resilience, and four main avenues are uncovered: the impact of the covid-19 pandemic on supply chain resilience, the resilience strategies implemented, the technologies' role in implementing these strategies, and supply chain sustainability. Thus, in line with our research question, we will now seek to empirically

propose, through a case study, a conceptual framework to decipher the humanitarian supply chain resilience.

3. Methodology

3.1. Case selection

Médecins Sans Frontières (MSF) is an international, humanitarian and medical non-profit organization, created in Paris in 1971 by doctors and journalists. Today, MSF is present in about 70 countries. This NGO provides medical assistance to populations whose lives or health are threatened, mainly in the event of armed conflicts, epidemics, pandemics or natural disasters. From 1979 onwards, for its first large-scale missions in areas where there was a massive influx of refugees, MSF acquired professional resources in the priority sector of logistics. A few years later, in 1986, it created a dedicated logistics department named MSF Logistique, which is located in France, in Mérignac. MSF needs materials, equipment, consumables, ready-to-use kits and vehicles, which must be transported to the site. MSF Log ensures the supply of materials and medicines for MSF programs, both for regular programs and for emergency interventions (displaced populations, epidemics, natural disasters, conflicts). For current programs, orders are prepared periodically and delivered within 4 weeks. For emergency operations, orders are ready in less than 24 hours. To ensure its missions, MSF Log integrates all the professions of the supply chain. The usual steps such as purchasing, storage and warehousing, preparation of orders, palletizing, securing, customs and police formalities and transport of products (land, air, sea) are the responsibility of MSF Log. Today MSF Log has more than 170 employees, 14,000 product-references, 18,000 m2 of storage and ships about 5,000 tons of equipment per year.

3.2. Single Case Study Methodology

MSF Log constitutes a rare research field to study our research question in depth. Thus, although it is unique and not generalizable, a case study seemed to us to be the most suitable to reach a sufficient level of understanding of the phenomenon by paying particular attention to the context of its implementation. To conduct this case study, we drew on the proposals from the literature review and contrasted them with our data (Yin, 2013). Unique case studies have already been carried out in the field of SCM (Spieske et al., 2022; Abdellatif and Graham, 2019; Ruel et al. 2019), because it can confirm, challenge or develop theory and is of interest when it offers opportunities for unusual research access. This case study allows us to study in depth: how and why supply chain resilience was mobilized at MSF Log.

3.3. Data collection from supply chain managers interviews and complementary documents

We collected different materials (Table I)

Table I - Description of primary and secondary data collected

External and internal secondary data about MSF Log were needed to properly prepare the appropriate interviews and also to study the case and its context.

Semi-structured interviews were conducted with the six primary managers of MSF Logistics' supply chain during the early stages of the COVID-19 pandemic, from March 2020 to April 2021. This period marked a significant increase in contamination, with no vaccine or easy testing available, and procurement challenges. The interviews, conducted remotely, lasted approximately one hour each. These interviews questioned the specificities of the supply chain and the actions implemented before and during the pandemic. More specifically, our interview guide contained four themes: the presentation of the interviewee (position, background, seniority, motivations for working at MSF Log); theme 2 made a transition to the specificities of the humanitarian supply chain and its necessary qualities, such as resilience; theme 3 addressed the humanitarian supply chain resilience in times of health crisis; and theme 4 went into more depth on the notion of resilience, its dimensions, the points raised by the interviewees, etc. (Appendix 1).
For each interviewee, there were one to three interviews to take into account their availability because they were particularly busy during the pandemic and we also wanted to take into account any changes that occurred during this period. Moreover, for each interview, we received written feedback from the interviewees on the transcribed interviews. This allowed us to support qualitative data analysis using an iterative review process associated with the coding cycle and the transition from codes to themes, toward constructing meaning from the data. (Williams and Moser, 2019).

3.4. Qualitative data analysis

Once the interviews were transcribed, they were subjected to a thematic content analysis, and the data and verbatim were triangulated. We coded the data, with the aim to arrange things in a systematic order, to make something part of a system or classification, this permits data to be "*segregated, grouped, regrouped, and relinked in order to consolidate meaning and explanation*" (Lincoln and Guba, 1985, p.21). Coding of the data was done in several stages (Williams and Moser, 2019). For the first step, we started with manual open coding, which allowed us to identify distinct concepts and themes. Thus, the sub-dimensions of supply chain resilience emerged, leading to the sub-proposals: robustness of IS architecture, formalized processes, mobilization of competences, internal and external collaboration, organizational velocity and IS agility, emergency culture, culture of duty. Afterwards, concerning the second step, we carried out an "axial coding", in order to refine, align, and categorize the themes. "*Axial coding identifies relationships between open codes, for the purpose of developing core codes. Major (core) codes emerge as aggregates of the most closely interrelated (or overlapping) open codes for which supporting evidence is strong*" (Strauss, 1998, p. 109). It is at this stage that the resilience dimensions of the humanitarian supply chain resilience emerged as aggregates of our previously identified "open codes": reorganization, collaboration, flexibility, humanitarian culture. Selective coding is the third level of coding. This approach to data framing enables the researcher to work continually towards thematic specificity and, in turn, theory creation. In selective coding, degrees of causality or predictability can emerge from the thematic refining process, allowing the researcher to

identify sets of circumstances in which certain responses elicit unique and differentiated responses. With the work of selective coding towards our thematic specificity, resilience, we move towards developing theory and ultimately constructing meaning. Indeed, this analysis and coding allowed us to highlight components or sub-dimensions that are linked with the main dimensions of resilience and thus enable us to enrich the conceptual model. (Appendix 2)

4. Results

For the organization's managers, this COVID crisis was perceived as a real shock. In this context, our results show that MSF Log was able to rely on its supply chain resilience to face the crisis, in the sense that MSF Log implemented a number of measures in a reactive (on-the-spot) and anticipatory (proactive) manner.
MSF Log Humanitarian supply chain resilience is composed of four dimensions: reorganization capacity, collaboration, flexibility, and humanitarian culture. Our results also allow us to detail the sub-dimensions of these four main dimensions of humanitarian supply chain resilience. Two elements seem decisive: the IS role, which is present in all dimensions, and culture, which also seems to have a moderating role on the other variables. These dimensions and sub-dimensions appear through our coded data (Table 2).

4.1. Reorganization capacity: a dimension of HSCM resilience

MSF Log relied on a humanitarian logistics chain that was capable of reorganizing itself in response to crises through reactive measures, as well as anticipating such crises through proactive measures. Indeed, the reorganization dimension is one of the dimensions of resilience. We thus state the following proposition:
P1: The HSCM resilience is composed of the reorganization dimension.
The reorganization dimension is composed of three sub-dimensions.

4.1.1 Robustness of IS architecture

In addition to utilizing proactive measures, MSF Log also underwent a significant transformation of its information systems (IS) prior to the COVID-19 pandemic to enhance its robustness. The IS organization department (DOSI) had replaced all fixed computers with laptops (about 200) in anticipation of a future need for flexibility. Additionally, all meeting rooms were equipped with cameras and video conferencing capabilities, which allowed for strong interaction between those who worked on-site and remotely during the pandemic. Before the crisis, Microsoft Teams, while an installed but little-used application, proved to be crucial during the crisis. To ensure security, MSF Log also decided to keep all its servers on-site. The organization and design of the IS, its ability to withstand stress, and the equipment provided are all essential for effectively responding to an emergency. We propose the following propositions:
P1a: Robustness of the information system allows the humanitarian supply chain to reorganize itself during a disaster or emergency.

4.1.2 Mobilization of competences

MSF Log was able to quickly mobilize its resources to respond to the increased demand for its services both in terms of quantity and quality. To meet this increase in activity caused by the crisis, MSF Log modified working hours and implemented a new organizational structure (3x8, 7 days a week) to manage the increased workload of stock management and restocking. Additionally, MSF Log mobilized the expertise of MSF France in epidemiology to quickly put in place measures to prevent the spread of the virus within the warehouse. To effectively reorganize, the humanitarian logistics chain must be able to rely on both internal and external resources and skills. Based on these findings, we propose the following proposition:
P1b: Mobilization of competences allows the humanitarian supply chain to reorganize itself during a disaster or emergency.

4.1.3 Formalized processes

MSF Log had anticipated potential challenges by designing and testing business continuity and recovery plans. These formalized processes have been effective in maintaining operations during an emergency. Having pre-established measures in place before an emergency occurs is a crucial aspect of maintaining resilience in the supply chain. Therefore, it can be proposed that:
P1c: Formalized, efficient processes enable the humanitarian supply chain to quickly and effectively reorganize during a disaster or emergency.

4.2. Collaboration: a dimension of HSCM resilience

The MSF Log supply chain resilience was built on the collaboration of both internal and external actors, which was facilitated by the Information System. Another key dimension of resilience in the humanitarian supply chain management (HSCM) is collaboration. We propose the following proposition:
P2: The HSCM resilience is composed of the collaboration dimension.
The collaboration dimension is composed of two sub-dimensions.

4.2.1 An internal collaboration

As soon as a health crisis is recognized, a crisis management system is established with crisis units. From an internal perspective, everything was negotiated with the Works Council (CSE), and the emergency coordination was approached with a co-management approach. For example, a computer hotline composed of two teams (application and networks - both belonging to the DOSI) was set up. This hotline was heavily used during the crisis due to the increase in telecommuting, which required increased support for users. However, this increased workload was managed by sharing schedules and on-call days. Our findings lead us to propose the following proposition:
P2a: The internal collaboration mediated by a transversal IS allows the humanitarian supply chain to collaborate during a disaster or emergency.

4.2.2. An external collaboration

Proactive external collaboration has played a crucial role in strengthening the resilience of MSF Log's supply chain. One example is the selection of a local service provider in

Bordeaux, which allowed MSF Log to quickly request an increase in bandwidth when the lockdown was announced. This efficient information sharing, both internally and externally, is facilitated by a robust transverse IS. Furthermore, actively collaborating with suppliers and partners is a vital aspect of maintaining resilience in the supply chain.
P2b External collaboration mediated by the IS allows the humanitarian supply chain to collaborate during a disaster or emergency.

4.3. Flexibility: a dimension of HSCM resilience

MSF's supply chain was able to adapt and respond effectively to crises due to its flexibility. The third dimension of resilience in the humanitarian supply chain management (HSCM) is flexibility.
P3: The HSCM resilience includes the flexibility dimension, which allows the supply chain to adapt and respond effectively to crises.
This flexibility is composed of two sub-dimensions: organizational velocity and IS agility. Organizational velocity refers to the ability of the supply chain to quickly adapt its operations and processes in response to changes. IS agility refers to the ability of the information systems to adapt and to evolve with changing needs.

4.3.1 Organizational velocity: from telecommuting to 3*8 shifts for warehouses

From the start, MSF Log recognized the need for swift reorganization. A large number of employees switched to teleworking, with around 70 out of 180 employees (in full-time equivalent) working remotely. For the warehouse staff, the objective was to continue providing emergency shipments while minimizing the risk of contamination from the COVID-19 virus. MSF Log reorganized the work of the teams by implementing a 3x8 hour schedule and reorganized the flow of people on the site to ensure teams did not cross paths. Speed of adaptation, or organizational velocity, is a key aspect of flexibility. In a crisis, actors in the humanitarian supply chain must be able to rapidly adapt and reorganize their tasks. We propose the following proposition:
P3a: Organizational velocity allows the humanitarian supply chain flexibility during a disaster or emergency.

4.3.2 Information System Agility

The health crisis has necessitated the sudden implementation of telework. Prior to the crisis, the IS already included tools for communication and remote work, such as meeting and remote work software, an internal hotline for technical support, secure connections through a Virtual Private Network (VPN) channel, and international communication tools commonly used by international project managers, but these tools were only used by a small number of people. Within a ten-day period, the teams were able to set up IS equipment for secure teleworking for around 100 people, including business laptops, increased bandwidth, opening of the required VPN, and implementation of a management software for remote devices with anti-attack protections. IS agility is a critical aspect of resilience in the supply chain management, as it provides flexibility to adapt to changes. Based on these findings, we propose the following proposition:
P3b: Agile IS allows the humanitarian supply chain flexibility during a disaster or emergency.

4.4. Humanitarian culture: a dimension of HSCM resilience

Finally, the fourth dimension that appears to be specific to the resilience of the humanitarian logistics chain is a strong humanitarian culture. This culture is characterized by a strong commitment to the humanitarian mission and values, which guides the actions and decisions of all actors involved in the supply chain. We propose the following proposition:
P4: The HSCM resilience is composed of a humanitarian culture.
Humanitarian culture is composed of two sub-dimensions a culture of emergency and a culture of duty.

4.4.1 Emergency culture

The culture of emergency refers to the ability of the supply chain actors to respond quickly and effectively to unexpected events and crises. The culture of emergency, as well as the international culture with interventions in 70 countries and international purchases, are central to the daily operations of MSF Log employees. They are well equipped to respond quickly and effectively to unexpected events and crises. The culture of emergency is ingrained in the DNA of all humanitarian logistics workers, who are accustomed to working in emergency and international situations. Based on these findings, we propose the following proposition:
P4a: Emergency culture allows the humanitarian supply chain to maintain a humanitarian culture during a disaster or emergency.

4.4.2 Sense of duty,

The culture of duty refers to the commitment and sense of responsibility of all actors in the supply chain to serve the humanitarian mission and values. Both these sub-dimensions are essential to create a robust and resilient humanitarian logistics chain.
The employees of MSF Log are not there by chance; many of them come from different backgrounds and have chosen to work for MSF Log because they are looking for a sense of purpose in their work. This is the case of the network/infrastructure director who previously worked for a large digital services company, or the project manager who worked for an insurance company. The meaning of their work is to care for others. Thanks to this moral imperative that employees adhere to, the supply chain is based on a very strong principle that offers it a high degree of resilience. The sense of purpose that employees find in working for a humanitarian organization translates into a high level of availability. Despite the demanding and tiring work, employees do not hesitate to make sacrifices and give it their all. For example, warehouse teams had to switch from traditional working hours (8 a.m. to 5 p.m.) to a 3*8-hour schedule, including night shifts. Similarly, the infrastructure team that provides IT support to remote users and warehouse technicians also saw an increase in working hours during the crisis. Through this case study, we are able to characterize the dimensions of resilience in the humanitarian supply chain (Table 2). The sense of duty, or the special dedication to saving lives, is a crucial aspect that gives meaning to their work. It enables employees to be willing to sacrifice time, make themselves very available and aim for success at all costs. This culture of duty is one of the pillars that allow the humanitarian supply chain to be resilient. We propose the following proposition:
P4b: Sense of duty allows the humanitarian supply chain humanitarian culture during a disaster or emergency.
.

4.5 The humanitarian culture dimension moderates the relationship between the three others dimensions and HSCM resilience

The humanitarian culture seems to be a variable that moderates the relationship between the others dimensions and HSCM resilience. We thus make the following proposition.
P5: The humanitarian culture moderates the relationship between the flexibility dimensions and HSCM resilience
P6: The humanitarian culture moderates the relationship between the collaboration dimensions and HSCM resilience.
P7: The humanitarian culture moderates the relationship between the reorganization dimensions and HSCM resilience.

Table II - Characterization of MSF Log's humanitarian supply chain resilience: verbatim, examples and propositions

Thus, we propose a conceptual model (Figure 1). Humanitarian supply chain resilience is composed of four dimensions: reorganization capacity, collaboration, flexibility, and humanitarian culture. The dimension of reorganization includes sub-dimensions such as robustness of IS architecture, mobilization of competences, and formalized processes. The dimension of collaboration includes sub-dimensions such as internal and external collaboration. The dimension of flexibility includes sub-dimensions such as organizational velocity and agility. The dimension of humanitarian culture includes sub-dimensions such as emergency culture and culture of duty.
Two elements seem decisive: the IS role, which is present in all dimensions, and culture, which also seems to have a moderating role on the other variables.

Figure 1 - Conceptual Model Proposal: the dimensions and sub dimensions of humanitarian supply chain resilience

Thus, we have proposed a conceptual framework for emergency supply chain resilience. Our results allow us to characterize MSF Log's humanitarian supply chain resilience through four dimensions: the capacity to reorganize, which relies on a robust Information System (IS) architecture, on process planning, and on the mobilization of competences; collaboration (enabled by the IS), which is both internal and external (with partners); flexibility, composed of organizational velocity and an agile IS, which is a capacity that is mobilized essentially through proactive actions; and a humanitarian culture, which is enabled by the culture of emergency and duty. We show that certain actions must be proactive to allow for reactivity when a crisis occurs. Finally, two elements emerge as essential: the IS role, and the importance of humanitarian culture in achieving resilience in the humanitarian supply chain.

5 - Conclusion

The results of this empirical research allow us to consider theoretical and managerial implications and avenues for future research.

5.1 Theoretical contributions

5.1.1 Resilience built on four dimensions

One of our theoretical contributions is consolidating the field of supply chain resilience research (Golan et al., 2020) by confirming two key points in the literature (Golan et al., 2020). The first is the four dimensions of resilience we highlight (reorganization, collaboration, flexibility, humanitarian culture) that contribute to consolidating the conceptual framework of supply chain resilience (Ponomarov and Holcomb, 2009; Jüttner and Maklan, 2011; Melnyk et al., 2014; Hohenstein et al., 2015; Tukamuhabwa et al., 2015, Ali et al., 2017). Our results also show that resilience can be achieved through a combination of anticipatory (proactive) and reactive measures, through planning and response, supporting the literature's distinction of different phases. Specifically, our results indicate that the dimensions of reorganization and collaboration require a balance of both proactive and reactive measures. As for flexibility, the measures are primarily reactive. In contrast, the humanitarian culture of MSF Log, which is focused on care, is clearly proactive.

5.1.2 A resilient humanitarian supply chain that highlights the crucial roles played by IS and humanitarian culture

Our study highlights the crucial role of IS in humanitarian supply chain resilience (Michel and Bidan, 2018). IS plays a critical role in three of the dimensions (reorganization, collaboration, and flexibility) by providing robustness, agility, and transversality. As previously shown by Melnyk et al. (2014), investments in IT can foster resilience. Therefore, the role of IT is increasingly recognized as central to resilience, especially during times of crisis such as the current pandemic (Hosseini et al., 2019; Chowdhury, et al., 2021; Gu et al., 2021; Dennehy et al., 2021). Our results align with those of Pimenta et al. (2022) who found that technology was one of the pillars of resilience during the COVID crisis in reorganizing the workforce. Therefore, our study confirms the IS role as an instrument to implement resilience strategies.

Our study also emphasizes the importance of humanitarian culture for resilience. This has been previously highlighted in other studies, including organizational culture (Sheffi; 2005; Black and Glaser-Segura, 2020), mutual support among employees (Pettit at al., 2010), risk (Christopher and Peck, 2004a, Sheffi and Rice, 2005; Mandal, 2012), leadership (Christopher and Peck, 2004b), and innovation (Akgün and Keskin; 2014). In our case, it is represented by a culture of urgency and a sense of duty. This culture seems to have an impact on the other three dimensions, enabling the chain to reorganize in real-time, the acceptance of the switch to 3*8, the establishment of a hotline, and the quick establishment of collaborations both internally and externally. Although our analysis is based on a single case, it supports previous findings in the literature.

5.2 Practical Implications

One managerial contribution of this study is that it provides a guide for managers to identify the four dimensions and sub-dimensions of supply chain resilience. This allows managers to target their decisions and actions on the dimensions that will enable them to act on resilience. Additionally, the study emphasizes the need for managers to plan for resilience over time, by proactively planning actions while also accepting uncertainty and allowing for organizational improvisation.

Furthermore, to anticipate and facilitate the reorganization dimension, it is necessary for managers to proactively identify and formalize all the processes in the supply chain and the organization. This can be achieved through precise mapping, for example.

Similarly, to the question of "what can we do next time", MSF prefers to answer "how can we be better prepared and better anticipate future crises? Modifying crisis plans is a major avenue for improvement. Capitalizing on this experience is already being studied.

In addition, managers should consider the importance of organizational transversality, as demonstrated by the creation of the Information Systems Organization Department (DOSI). This will allow for the efficient mobilization of resources, especially if they have been identified beforehand.

To enhance external collaboration, managers should consider integrating their organization's IS with that of their suppliers and partners, or at least prioritize interoperability when making digital purchases. Similarly, internal collaboration should be enabled by a cross-functional Information System, designed to be easily accessible by different departments, even during times of crisis.

With regards to flexibility, the case study illustrates the benefit and challenges of proactive anticipation. Therefore, the information system should be able to adapt quickly to high demands, this should be taken into account when making decisions about capacity, suppliers, security, etc.

In terms of the cultural dimension, it is important to capitalize on the strengths of humanitarian action, the culture of emergency, and the sense of duty. The HR department should integrate these cultural dimensions into its actions, particularly in terms of recruitment, training, and motivation.

Thus, to conclude, we can say that thanks to its SCM resilience, MSF LOG was able to overcome great difficulties during the COVID-19 pandemic. They were able to quickly implement remote working, computer connection of all members, prevent infection of the teams working in the warehouse, complete the reorganization of the warehouse teams, maintain shipments, and maintain motivation. This demonstrates the importance of having a resilient supply chain management system in place, particularly in emergency situations.

In conclusion, this article explores the concept of humanitarian supply chain resilience by studying a single case of MSF Logistics. Through this case study, we have identified four key dimensions of resilience: the capacity to reorganize, collaboration, flexibility, and humanitarian culture. We have found that the information system and humanitarian culture play a crucial role in the overall resilience of the supply chain. Our findings confirm previous research on the dimensions of resilience and also highlight some additional dimensions. However, this study is based on a single case and further research is needed to confirm the validity of this conceptual framework in other cases and contexts. More research in the humanitarian sector is needed to test the generalizability of this model and to explore other potential dimensions of resilience.

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Appendix

Appendix 1 - Interview Guide This interview guide focuses on four main themes. Theme 1 is about a presentation of the interviewee (position, background, seniority, motivations for working at MSF Log). Theme 2 introduces the specificities of the humanitarian supply chain and its necessary qualities, such as resilience. Theme 3 addresses the humanitarian supply chain resilience in times of health crises. Theme 4 delves deeper into the effectiveness of resilience making, its dimensions, the points raised by the interviewee, etc.

T1 / Presentation of the interviewee (position, background, seniority, motivations for working at MSF Log)

- Who are you and what is your position and seniority within MSF Log?
- What was your background before joining MSF Log?
- Why did you decide to join this specific NGO?
- Is there anything else you would like to add to introduce yourself?

T2 / Transition to the specificities of the humanitarian supply chain and its necessary qualities, such as resilience

- In your opinion, what factors enabled MSF Log to successfully navigate this health crisis?
- On which specific elements was MSF Log able to rely: its information system, its supply chain, its personnel, its strong corporate culture, its past experiences?
- Are there any other factors you would like to mention?
- Has this health crisis led to significant transformations within MSF Log?
- Or is it ultimately a normal situation for you?
- What elements were particularly useful in this particular context?
- What elements have malfunctioned or been an obstacle?
- Do you think that MSF Log encountered any specific challenges in regards to its supply chain during this crisis?

T3 / The humanitarian supply chain resilience in times of health crisis

- What are your thoughts on the implications of this crisis for MSF Logistics?
- How has this crisis affected your supply chain?
- How has it affected your information system?
- Can you tell us if your experience in the field of humanitarian logistics has been useful in dealing with the consequences of this pandemic?
- If so, did you still encounter any specific difficulties?
- If not, have you noticed any major transformations within your supply chain?
- Can you tell us generally if it is relevant to talk about the “resilience” of your supply chain?

T4 / More depth on the notion of resilience (dimensions, points raised by the interviewee)

- Can we talk about an accelerated digital transformation?
- Can we talk about an accelerated organizational transformation?
- Can we speak explicitly of “disruption” (before and after “radically” different)?
- Can you tell us more about what has become “disruptive” with COVID-19?
- In practices and routines?
- In the technologies used?
- In the information system?

- In the supply chain?
- In the general organization of MSF Log?
- Can you tell us more about what was not impacted (before and after almost identical)?
- In practices and routines?
- In the technologies used?
- In the information system?
- In the supply chain?
- In the general organization of MSF Log?
- Do you have anything else you would like to add that could help with this research?

Appendix 2 - The coding process