Supply chain agility in humanitarian protracted operations

Cécile L'Hermitte
National Centre for Ports and Shipping, Australian Maritime College, University of Tasmania, Launceston, Australia
Peter Tatham
International Business and Asian Studies, Griffith Business School, Gold Coast, Australia, and
Ben Brooks and Marcus Bowles
National Centre for Ports and Shipping, Australian Maritime College, University of Tasmania, Launceston, Australia

Received 7 September 2015
Revised 22 February 2016
5 April 2016
Accepted 6 April 2016

Abstract

Purpose – The purpose of this paper is to extend the concept of agility in humanitarian logistics beyond emergency operations. Since the humanitarian logistics literature focuses primarily on emergencies and sees longer term and regular operations as being conducted in relatively stable and predictable environments, agile practices are usually not associated with humanitarian protracted operations. Therefore, this paper explores the logistics and supply chain environment in such operations in order to identify their basic features and determine if agility is an important requirement.
Design/methodology/approach – Using a case study of the United Nations World Food Programme, the authors collected and analysed qualitative and quantitative data on the characteristics of protracted operations, the risks and uncertainties most frequently encountered, their impact, and the ways that field logisticians manage contingencies.
Findings – The research demonstrates that unpredictability and disruptions exist in protracted operations. Therefore, short-term operational adjustments and agile practices are needed in order to support the continuity of humanitarian deliveries.
Research limitations/implications – Future research should focus on a wider range of humanitarian organisations and move from a descriptive to a prescriptive approach in order to inform practice. Notwithstanding these limitations, the study highlights the need for academics to broaden the scope of their research beyond emergencies and to address the specific needs of humanitarian organisations involved in longer term operations.
Originality/value – This paper is the first empirical research focusing exclusively on the logistics features of humanitarian protracted operations. It provides a more concrete and complete understanding of these operations.

Keywords Risk management, Disaster recovery, Agility, Humanitarian logistics, Humanitarian supply chain, Protracted operations
Paper type Research paper

1. Introduction

Logistics has been repeatedly recognised by both academics (Tatham and Christopher, 2014) and practitioners (WFP Logistics, 2013) as a key to the success of humanitarian operations. In disaster environments, logistics activities are frequently conducted in

The authors would like to thank the United Nations World Food Programme (WFP), and in particular, Adrian van der Knaap who made this research possible. The authors are also grateful to the interview and survey respondents for their time and their valuable contribution.

Journal of Humanitarian Logistics and Supply Chain Management
Vol. 6 No. 2, 2016
pp. 173-201

2042-6747
DOI 10.1108/JHLSCM-09-2015-0037

highly volatile conditions and when transporting, storing and delivering relief items, humanitarian organisations encounter multiple risks and uncertainties. This includes unpredictable demand (when, where, and in what quantities the humanitarian goods will be needed), uncertainty in supply, non-existent and/or damaged infrastructure, inadequate logistics resources, volatile political situations, security issues, as well insufficient information (Everywhere – Humanitarian Response and Logistics Services *et al.*, 2011; L'Hermitte *et al.*, 2014). Humanitarian organisations need to be able to respond promptly to these uncertain and/or changing circumstances, and to adapt their operations to the requirements of the field environment swiftly and effectively. In other words, they need to be agile organisations (Charles *et al.*, 2010; L'Hermitte *et al.*, 2015).

Agility is the ability to develop and maintain operational responsiveness and flexibility in order to manage sudden and short-term logistics and supply chain risks and uncertainties. Thus, responsiveness (the ability to sense and identify operational risks and to swiftly draw up suitable responses) and flexibility (the ability to act in a timely manner and to adjust logistics operations rapidly) are seen as two essential components of agility (L'Hermitte *et al.*, 2015).

That said, humanitarian organisations are involved in a great diversity of operations, not least because no two disasters are the same (Tatham and Pettit, 2010; Beresford and Pettit, 2012) and because different disaster situations call for different intervention types (Holguín-Veras *et al.*, 2012). Such interventions range from emergency responses in the immediate aftermath of a disaster in order to help those affected cope with the basic human necessities, to recovery operations where longer term humanitarian assistance is provided in order to return life back to normality, and to long-running development programmes aimed at increasing resilience (Kovács and Spens, 2007). Whilst there is broad agreement that emergencies generate the highest level of uncertainty and require agile practices to cope with multiple disruptions (Tatham and Christopher, 2014), the applicability of agility to other types of humanitarian operations has not been widely discussed in the literature. Rather, academics tend to study the applicability of lean and optimisation principles to the post-emergency phase of disasters and do not see agility as a sustainable requirement in longer term humanitarian operations (Cozzolino *et al.*, 2012). And yet, since humanitarian environments are typically characterised by a significant level of contextual complexity and dynamism (Long and Wood, 1995), considering the extent to which supply chain agility is actually needed beyond the emergency phase of a disaster seems appropriate and relevant.

This paper focuses on the concept of protracted operations that are longer term and regular humanitarian operations usually conducted in the recovery phase of a disaster. They are characterised by the absence of immediacy and by the availability of sufficient planning and preparation time (L'Hermitte *et al.*, 2014). In contrast, emergency responses refer to situations where lives are under immediate threat, and thus, require that action is taken without delay. The aim of our research is to investigate the logistics environment of protracted operations in order to determine the extent to which agility is needed (or not needed) in this context. To this end, we will understand why agility is required in humanitarian logistics and supply chain operations by categorising the risks and uncertainties disturbing field operations. We will also identify the main logistics features of humanitarian protracted operations, and in particular, investigate if the risks and uncertainties previously identified are encountered in such operations and if operational adjustments are needed to overcome/mitigate disruptions. On this basis, we will determine if agile practices are a

requirement in protracted operations. Thus, our investigations are guided by the following research questions:

RQ1. Why is agility needed in humanitarian logistics operations?

RQ2. What are the logistics characteristics of humanitarian protracted operations?

RQ3. Are agile practices required in humanitarian protracted operations?

Descriptive research was conducted in order to address these questions. More specifically, we collected both qualitative and quantitative data in order to provide a deeper insight into the logistics environment of protracted operations, and to demonstrate that agile logistics and supply chain strategies are not only required in emergencies but also in the protracted context.

The remainder of this paper is structured as follows. Section 2 explores the concept of humanitarian protracted operations. Section 3 focuses on agility and the reasons why supply chain agility is needed. Section 4 addresses the methodological approach of our research before the results are reported in Section 5. Section 6 discusses the key findings and Section 7 presents the contributions of our work. Section 8 addresses the research limitations and the opportunities for further investigations before the last section provides concluding comments.

2. Humanitarian protracted operations

2.1 Defining protracted operations

In the humanitarian logistics literature, the concept of protracted operations is not commonly used. Rather, authors refer, among other things, to regular humanitarian logistics operations (Holguín-Veras *et al.*, 2012), continuous aid operations (Buatsi *et al.*, 2007), operations in uninterrupted environments (McLachlin *et al.*, 2009), or recovery/reconstruction operations (Kovács and Spens, 2007). Table I recaps the various definitions provided by the above-mentioned authors.

Terms used	Sources	Definitions
Regular humanitarian logistics operations	Holguín-Veras *et al.* (2012)	"Operations in which the main purpose is either long-term recovery or humanitarian assistance" (p. 498)
Continuous aid operations	Buatsi *et al.* (2007)	"Humanitarian logistics in continuum, or strategic relief operations that aim at continuous development and sustenance of life of the vulnerable societies" (p. 4)
Operations in uninterrupted environments	McLachlin *et al.* (2009)	"Uninterrupted environments are reasonably stable in terms of political and economic conditions; logistics infrastructure is in place; and all the actors (customers, suppliers, service providers, and employees) are on the stage" (p. 1051)
Recovery/reconstruction operations	Kovács and Spens (2007)	"Different operations can be distinguished in the times before a disaster strikes (the preparation phase), instantly after a disaster (the immediate response phase) and in the aftermath of a natural disaster (the reconstruction phase)" (p. 101) "The third phase is related to reconstruction and it involves long-term rehabilitation" (p. 105)

Table I.
Related terms used in the literature

A number of academics also discuss humanitarian operations conducted in response to slow-onset (and, thus, foreseeable) disasters (Van Wassenhove, 2006), and suggest that predictability enables the humanitarian intervention to be planned ahead (Apte, 2010). It has, however, been clearly demonstrated that the speed of onset does not necessarily determine the time available for preparation and action, and that humanitarians may have to employ an emergency intervention strategy even in the context of disasters predicted far in advance, as was the case in the 2011-2012 Somali food crisis (L'Hermitte *et al.*, 2014).

That said, researchers generally agree that there is a differentiation between humanitarian operations characterised by urgency vs those with a long-term orientation. In this paper, the latter is encapsulated by the term "protracted operations", a concept that covers both responses to anticipated disasters that allow for planning and preparation, and responses in the recovery phase of a disaster. Therefore, we define humanitarian protracted operations as longer term operations in response to disaster situations that are anticipated and/or planned for.

Protracted operations are, arguably, characterised by the absence of immediacy and/or by regular delivery patterns that allow for longer response times and for a more established and repetitive approach to the flow of goods (L'Hermitte *et al.*, 2014). Protracted operations are, nevertheless, not expected to be smooth and free of the multiple disruptions that impede the assistance efforts. This is because humanitarian organisations typically operate in countries where, among other things, insecurity prevails, administration and business practices are inefficient, the infrastructure is not appropriately developed or has been destroyed, and/or the logistics capacity is inadequate (Vaillancourt and Haavisto, 2015).

It should be noted that protracted operations are not the same as continuous development programmes that aim to achieve profound transformations in order to reduce poverty and increase the resilience and self-reliance of communities living in developing countries (Stephenson, 1994). Thus, whilst both protracted operations and development programmes aim to deliver humanitarian aid on a longer term basis and must be supported by robust logistics solutions, humanitarian goods are delivered in response to a disaster in the case of protracted operations, and in response to endemic and structural vulnerabilities in the case of development programmes.

2.2 Protracted operations in the humanitarian logistics literature

Despite recognising that there are different types of humanitarian operations and that each of them is conducted in a different environment with unique characteristics (Holguín-Veras *et al.*, 2012), the humanitarian logistics literature does not widely discuss protracted operations. Rather, the research to date has primarily focused on responses to sudden emergencies (Kovács and Spens, 2011a). More specifically, in their review of the humanitarian logistics literature, Kunz and Reiner (2012) found that only 11 of the 174 papers reviewed (i.e. 6 per cent) focused on continuous aid aspects compared with 86 per cent discussing emergency disaster relief. Likewise, only ten papers dealt with the reconstruction phase of a disaster. Similar conclusions are drawn by Altay and Green (2006) who reviewed the disaster management literature and identified 109 articles in the field of operations research and management science. Among those, only 11 (i.e. 10 per cent) focused on the recovery phase of disasters.

As a consequence, longer term and regular operations remain underreported in the literature just as they are regularly omitted from media coverage (Wisner and Gaillard, 2009), possibly because sudden spectacular disasters are more likely to capture interest than long-lasting events (Alexander, 2005). Notwithstanding the limited information

available, some of the logistics characteristics of protracted operations can be found in the literature. In particular, Holguín-Veras *et al.* (2012) touch on what they call "regular humanitarian logistics operations" that relate to either longer term recovery or to development work. These authors argue that such operations are carried out in relatively predictable, stable and organised (even though challenging) environments, and they note a number of similarities with commercial logistics operations. These relate to, for example, the regularity and repetitiveness of the flow of supplies (which enables logisticians to focus on operational optimisation and efficiency), the availability of structured operational and decision-making processes, the possibility of forecasting demand with reasonable accuracy, and/or the proper performance of logistics networks. Despite these similarities, clear differences between regular humanitarian logistics and commercial logistics exist, and consequently, Holguín-Veras *et al.* (2012) position regular humanitarian logistics as being halfway between commercial logistics and emergency humanitarian logistics.

Along the same lines, Giroux *et al.* (2009) differentiate emergency situations (where standard supplies are pushed down the supply chain based on the perceived needs of beneficiaries) from protracted operations where goods can be pulled through the supply chain and regularly replenished based on the assessment of actual demand. However, Giroux *et al.* (2009) highlight the point that local circumstances may be unstable, and even well-established and regular supply chain operations may need to be adjusted rapidly in response to sudden disruptions.

Venkatesh *et al.* (2013) also contrast the supply chain operations conducted in immediate disaster relief with those conducted in the context of continuous aid (protracted disasters or development programmes), and conclude that the higher level of stability in the case of continuous aid operations allows for a greater degree of operational control.

2.3 Supply chain practices and strategies applicable to protracted operations

When the logistics and supply chain practices applicable to protracted operations are discussed in the humanitarian logistics literature, such operations are mostly associated with strategies of efficiency and operational optimisation. This is, mainly, because longer planning horizons are available (Kovács and Spens, 2009). In addition, cost minimisation and efficiency improvements are more easily achieved in the recovery phase of a disaster than in the early stage of an emergency when speed is essential (WFP, 2004b; Pettit and Beresford, 2005). Along the same lines, van der Laan *et al.* (2009) argue that the configuration of humanitarian supply chains differs if organisations are involved in disaster emergencies or in more predictable post-emergency environments where humanitarian needs become more visible and the overall operational environment becomes more stable and predictable. Thus, the focus shifts from speed (i.e. making humanitarian items available within days) in emergency situations to increased efficiencies based on repetitive deliveries in post-emergency environments. However, van der Laan *et al.* (2009) note that even recurrent deliveries conducted in post-emergency contexts are characterised by a certain level of instability and unpredictability. This is due, in particular, to inherent complexities in the contextual environment and to inefficiencies internal to the humanitarian organisations themselves, such as inaccuracies in stock records (van der Laan *et al.*, 2009).

Going one step further, Cozzolino *et al.* (2012) consider the applicability of lean and agile principles to the different phases of disaster relief. In their opinion, whilst agility is essential in emergency operations, lean practices consistent with those used in the

commercial environment may be applicable to protracted operations. Taking a slightly different approach, Hughes (2009) explains that lean and collaborative supply chains are more suitable before a disaster occurs and that agile/fully flexible supply chain management is necessary in the emergency/survival response phase. Subsequently, a combination of collaborative, lean and agile practices is suitable in the rebuilding and restoration phase of a disaster.

In summary, the academic literature on the logistics aspects of protracted operations is limited and the applicability of agility to these operations is not clearly established. Before addressing these points, the next section considers the concept of supply chain agility in greater detail.

3. The concept of supply chain agility

3.1 Supply chain agility in the humanitarian logistics literature

The humanitarian logistics literature repeatedly argues that supply chain agility is an essential requirement in disaster relief operations. For example, Charles *et al.* (2010) contend that flexibility, responsiveness, and effectiveness are essential components of agility and enable humanitarian organisations to respond to the high level of uncertainty existing in relief supply chains. A number of authors go into the specific mechanisms underlying the creation of agility. For instance, Tatham and Kovács (2010, 2012) argue that swift trust supports effective humanitarian responses by enabling highly diverse actors to coordinate their action in a timely fashion. In parallel, Oloruntoba and Gray (2006) consider the concept of postponement as a way to cope with instability in humanitarian operations. More precisely, they argue that humanitarian organisations can be agile by maintaining the relief supplies in a generic form as far downstream in the supply chain as possible until more accurate and reliable information about the needs of beneficiaries is available to convert generic stocks into products specifically meeting those needs. This approach is taken one stage further by Tatham *et al.* (2015) who discuss the use of three dimensional printing in the humanitarian context, and thereby, exemplify the concept of postponement.

According to Kovács and Tatham (2009), humanitarian organisations can prepare for emergencies and create agility by appropriately configuring their resources, and in particular, their physical resources (e.g. pre-positioning inventory) and their human resources (e.g. maintaining rosters of experts). Scholten *et al.* (2010) highlight the critical role of technology in achieving network integration, and ultimately, agility in emergency relief supply chains. Thompson *et al.* (2006) also focus on information technology in humanitarian operations and argue that decision support systems facilitate swift task assignment and resource allocation in rapidly changing decision-making environments. Likewise, Altay and Labonte (2014) contend that information management and information exchange are the keys to successful humanitarian responses because relevant and timely information supports effective flows of goods, inter-organisational coordination, and appropriate decision making. Altay and Pal (2014) consider the cluster approach as an effective way to generate higher quality information and to speed up its diffusion. As a consequence, clusters improve coordination and support prompter humanitarian responses (Altay and Pal, 2014).

Other analyses (Altay, 2008; Dubey *et al.*, 2015; Dubey and Gunasekaran, 2016) do not only focus on the concept of agility but, by drawing on Lee's (2004) work, study the related concepts of adaptability and alignment in response to the uncertainties and changes inherent in humanitarian logistics operations. According to the above-mentioned authors, agility is a response to short-term changes, whereas adaptability relates to more

structural, medium-term changes. Alignment is about coordinating the interests of the various participants to the supply network in order to optimise the overall performance of the supply chain.

Supply chain resilience is another concept related to that of agility. Resilience, that has been widely studied not only in the business literature (Christopher and Peck, 2004; McCann *et al.*, 2009; Ponomarov and Holcomb, 2009), but also in relation to disasters (Zobel, 2009; Scholten *et al.*, 2014), refers to the ability of a system to resist and absorb disruptions and changes. Thus, whilst both concepts are closely related, resilience is about the robustness of a system and its ability to swiftly recover to its original state, whereas agility defines the ability of the same system to respond to short-term turbulence by anticipating disruptions and changes, and by moving quickly in order to avoid, as much as possible, any negative consequences on the humanitarian flows of goods.

The current paper focuses solely on agility and does not study the concepts of adaptability, alignment, and resilience. Beyond the fact that investigating all the above concepts would be beyond the scope of a single study, this paper focuses on sudden and short-term disruptions, uncertainties, and changes encountered in the field, as well as on the need to rapidly draw up suitable responses and adjust logistics operations. These elements reflect the concept of agility rather than those of adaptability, alignment, and resilience.

Although agility is focused on short-term changes and uncertainties, a long-term organisational approach to the concept is certainly needed. Thus, according to Dubey and Gunasekaran (2016), operational reactivity and the effectiveness of short-term relief action are dependent on the development of long-term organisational capacity. In a similar way, Altay and Green (2006) note that, in a disaster environment, timely responses and continuity require the development of a disruption management system designed to deal with a high level of turbulence, to protect routine operations, and to support rapid operational restoration. Although Park *et al.* (2013) do not focus on humanitarian organisations, but on business organisations affected by unexpected and large-scale events causing major supply chain disruptions, the relevance of their work in relation to the current paper lies in the highlighted importance of building inherent capabilities within the organisation itself in order to overcome and recover from severe disruptive events. In particular, robust information systems, coordination and collaboration with key suppliers, and the development of substitution strategies (i.e. supply chain portability) are key elements supporting the restoration process (Park *et al.*, 2013).

A strategic approach to the concept of agility in humanitarian logistics is also taken by Tomasini and Van Wassenhove (2009), Tatham and Christopher (2014), and L'Hermitte *et al.* (2015) who argue that supply chain agility and the ability of humanitarian organisations to organise rapid responses transcend the logistics function and require a business-wide approach as well as the development of deep-rooted capabilities. In the same way, Fawcett and Fawcett (2013) contend that, due to the extreme level of complexities and uncertainties inherent in humanitarian operations, a comprehensive perspective to the design of humanitarian systems is needed. Specifically, Fawcett and Fawcett (2013) suggest a move from temporary supply chains designed to respond to specific disaster situations to more permanent infrastructures based on ongoing planning and coordination. This more comprehensive approach to agility reflects the research conducted in a business context, and in particular, in the field of manufacturing. For example, Vinodh *et al.* (2010) present agility as a complex concept that is reflected in 20 dimensions as diverse as

organisational structure, the nature of management, the involvement of employees, and IT integration. On these grounds, Vinodh *et al.* (2010) argue that agility requires management inputs, workforce contributions, as well as advanced technology.

The above studies provide clear indications that agility enables humanitarian organisations to adapt to uncertainty and to sudden and unanticipated changes that prevent the achievement of a smooth and continuous flow of goods. Ultimately, agility enables humanitarian organisations to swiftly provide life-saving assistance to the people affected by a disaster (Scholten *et al.*, 2010), i.e. to improve the human performance of humanitarian organisations (Dubey *et al.*, 2015). However, in the literature, agility is seen as an essential requirement in the framework of emergency operations. Clearly, humanitarian organisations deal with the highest level of uncertainty and turbulence when an unpredictable, sudden and highly destructive event occurs, as was the case in Nepal in April 2015. In such disaster situations, uncertainties and complexities result from unanticipated and rapidly changing demand patterns, deliveries that are extremely difficult to plan, a large number of heterogeneous partners taking part in the supply chain operations, a widespread level of infrastructure destruction, and a lack of information (Beamon and Balcik, 2008).

Whilst, as explained in Section 2, the level and the pace of turbulence are, obviously, less acute in protracted operations, such operations are not free of uncertainties, complexities, and disruptions. In order to better understand the nature of the constraints and challenges encountered in protracted operations and, therefore, to gain a deeper insight into the logistics environment of these operations, it is necessary to investigate why supply chain agility is actually needed.

3.2 Understanding why supply chain agility is needed

Supply chain agility prevents operational volatility (i.e. multiple changes and unpredictable events along the supply chain) from disrupting the continuity of the logistics and supply chain flows (Prater *et al.*, 2001; Christopher, 2011). Therefore, understanding why supply chain agility is needed requires an insight into the nature of the risks and uncertainties that humanitarian organisations are likely to encounter in field operations.

Whilst the previous section demonstrates that supply chain agility is repeatedly discussed in the humanitarian logistics literature, the volume of research on humanitarian supply chain risk management is limited (Larson, 2011), and in particular, clear categories of risks and uncertainties encountered along the humanitarian supply chains remain to be empirically established and tested (L'Hermitte *et al.*, 2015). In this respect, the broader supply chain literature provides relevant insights as well as a structured understanding of the challenging and constraining factors that can negatively impact on logistics and supply chain operations. Thus, according to Manuj *et al.* (2007), adverse events can be categorised into supply risks, operations (or process) risks, demand risks, and security risks.

Supply risks and uncertainties relate to issues around supplier reliability, capacity, and quality that can result in the disruption or interruption of supply. This includes, for example, the inadequate quality of the goods supplied, late and/or partial deliveries, supplier failure, etc. Operations/process risks and uncertainties are internal to an organisation and prevent it from producing/delivering the goods or services as requested (in terms of time, quantity, quality, and cost). Such risks originate from, among other things, the use of inappropriate technology, inadequate procedures, and an unsuitable level of skills. Demand risks and uncertainties are associated with outbound supply chain operations, i.e. with customers. Sources include variations in demand, i.e. in volume and/or in the range of goods requested, as well as the lack of demand visibility. Security risks and

uncertainties are external threats that negatively impact on supply chain operations. They are as diverse as terrorism or intellectual property violations (Manuj *et al.*, 2007).

Along the same lines, Christopher and Peck (2004) differentiate between the following three risk categories: internal to the organisation, external to the organisation but internal to the supply network, and external to the supply network (i.e. contextual). A similar approach is taken by Pfohl *et al.* (2011) who categorise supply chain risks as those within a given focal company (e.g. in relation to processes and/or inappropriate decisions leading to processing delays), those related to suppliers (e.g. the loss of a key supplier) and customers (such as demand fluctuations), and those outside the supply chain (e.g. natural disasters or terrorist attacks). Wagner and Neshat (2010) also study the sources of supply chain vulnerability related to the supply and demand sides as well as those resulting from the structure of the supply chain itself. In this regard, they note that global supply chains (i.e. across national boundaries, as is often the case of humanitarian supply chains) are more vulnerable and require a higher level of coordination of the flows of goods and information. Figure 1 illustrates the different levels of risk and uncertainty sources as described in the business supply chain literature.

Commercial businesses mainly deal with demand, supply and process risks and uncertainties (Van der Vorst and Beulens, 2002). In this context, Christopher *et al.* (2006) argue that agility is particularly suitable to an environment of unpredictable demand with short response times. Humanitarian organisations typically operate in these conditions given the uncertainty generated by a disaster, e.g. where it will strike and what its magnitude will be. These unknown factors make planning extremely complicated in terms of timing (When will supplies be needed?), location (Where will they be needed? From where should they be shipped?), relief nature (What supplies will be needed?), volume (How much assistance will be needed?), and operating mode (How will aid be delivered?) (Van Wassenhove, 2006).

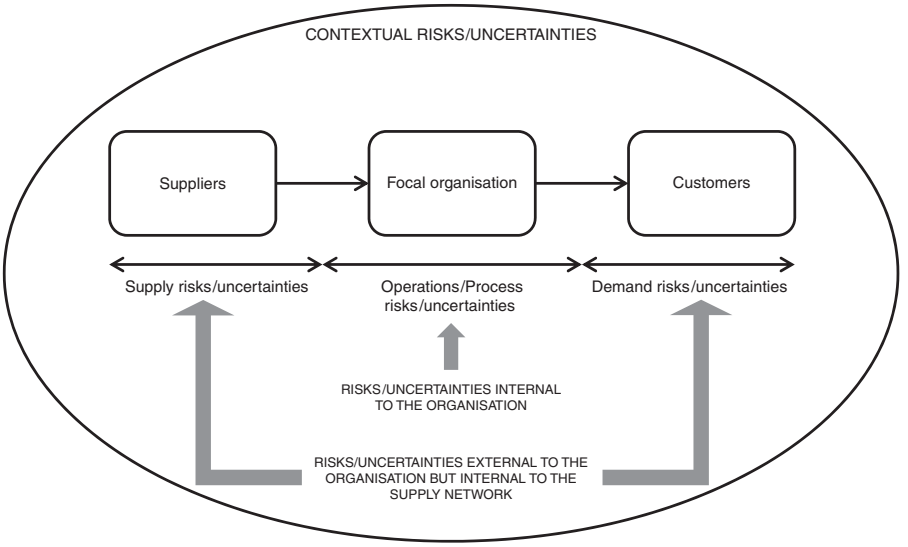

Figure 1.
Risk and uncertainty impacting on supply chain operations

Sources: Adapted from Christopher and Peck (2004), Manuj *et al*. (2007) and Pfohl *et al*. (2011)

Contextual (also called macro-environmental) risks and uncertainties are widely studied in the business supply chain literature but these external risks are frequently categorised as catastrophic and/or isolated events disrupting supply chains (such as the 9/11 terrorist attacks or the 2011 earthquake/tsunami in Japan), rather than external disruptions that occur on an ongoing basis. This approach to externalities can be explained by the fact that, unless they do business in developing countries, commercial organisations do not normally have to manage challenges such as non-existent or damaged transport infrastructure, explosive devices on land delivery routes, insufficient or inadequate logistics expertise or services, underdeveloped information technology, violent political turmoils, corrupt officials, or armed groups practising extortion. However, humanitarian organisations repeatedly experience some or all of the above challenges, and as a result, have to cope with a variety of risks and uncertainties in the macro-environment.

L'Hermitte *et al.* (2014) identify a set of five macro-environmental/contextual factors that may negatively impact on humanitarian logistics operations. These relate to the physical elements in the disaster environment (e.g. weather or topography), the socio-economic setting, governmental decisions, security issues, and infrastructure problems. Altay (2008) also identifies a number of sources of macro-environmental/contextual complexity and uncertainty in humanitarian logistics, including the insecurity prevailing in most humanitarian environments, ethical risks (e.g. corruption), and political risks (such as the lack of understanding and cooperation between humanitarians and the military).

Despite repeatedly considering the above macro-environmental factors, the current humanitarian logistics literature primarily studies agility in response to supply chain-related risks and uncertainties, i.e. in relation to demand, supply, and processes (L'Hermitte *et al.*, 2015). This is mainly because these analyses draw on the business literature on agility, and as mentioned above, contextual risks and uncertainties occur to a lesser extent in the commercial environment.

Whilst unknowns and contingencies are an integral part of any humanitarian operation, the scale and scope of the above-mentioned sources of risk and uncertainty are different if the humanitarian organisation is involved in an emergency operation or in a longer term recovery operation (Blecken, 2010). For example, demand, supply, and process uncertainties are inevitable in the immediate aftermath of a disaster because any new disaster leads to the configuration of a time-specific, ad hoc supply chain (Merminod *et al.*, 2014), and because goods are needed immediately, supply has to be swiftly organised, and new processes need to be set up (Ertem *et al.*, 2010). However, in the post-emergency phase, demand, supply and processes tend to be better articulated and established, making the management of the supply chain more predictable (Maïola, 2007). Thus, the nature of the risks encountered and the resultant design of a particular humanitarian supply chain depend on the disaster stage in which humanitarian organisations operate (Altay, 2008).

The remainder of this paper focuses on gaining a better understanding of the above-mentioned risks and uncertainties in the context of protracted operations. To this end, the conceptual model presented in Figure 1 serves as a guide to identify the challenging and constraining factors and collect risk-related data on protracted operations.

4. Methodology

Kovács and Spens (2011b) argue that researchers should gain a true understanding of the reality of field operations and conduct practice-oriented research in humanitarian logistics. To this end, we collected empirical data on protracted operations and used a

descriptive approach to make sense of these data. As noted by Saunders *et al.* (2009), descriptive research is undertaken when a clearer picture of the studied phenomenon is needed, i.e. a description is necessary for the researcher to be able to assess a situation, as is the case in our study. Indeed, since the literature on humanitarian longer term operations is limited, describing those operations as well as their logistics environment seems to be an appropriate first step. Thus, this research aims to gather information about, and obtain a more accurate picture of, the characteristics of protracted operations. Subsequently, the descriptive data are analysed to assess if agility is needed in these operations. In this sense, the descriptive data are used as a precursor to explanation (Saunders *et al.*, 2009).

To complete this work, case study research is undertaken. This methodology has been selected because it is helpful to conduct research in a real-life context, and by limiting the scope of the study, to identify meaningful characteristics of the studied phenomena (Yin, 2003), i.e. humanitarian protracted operations. In this research, the unit of analysis is the United Nations (UN) World Food Programme (WFP). As the UN agency that specialises in food assistance, WFP (2010) strives to provide the "right food to the right people at the right time" (p. 3). In 2014, WFP delivered 3.2 million metric tons of food to 80 million people in 82 countries (WFP, 2015). In contrast to many humanitarian organisations which distinguish field operations on the basis of disaster relief or development programmes, WFP differentiates between three types of operational environments: emergency operations, protracted operations, and development operations. Emergency operations are designed to provide immediate and urgently needed assistance in the aftermath of a disaster (WFP, 2016b). WFP's development operations go beyond temporary food aid and aim to assist communities in addressing endemic poverty problems and in achieving long-term food security (WFP, 2016a). In order to bridge the gap between immediate disaster relief and long-term development, WFP has developed a third category of operations called Protracted Relief and Recovery Operations (PRROs). PRROs aim to assist the affected communities in re-establishing their livelihoods in disaster recovery settings and/or protracted crises such as a long-term refugee crisis (WFP, 2004a, 2016c). In the remainder of this paper, we will refer to PRROs as protracted operations. Over the course of 2014, WFP was involved in 57 such operations. By comparison, WFP conducted 39 emergency operations and 27 development projects over the same period of time (WFP, 2015).

Thus, WFP was selected because it expressly conducts protracted operations, and this enabled us to focus our data collection and analysis on these particular operations. The key features distinguishing WFP's protracted operations are described in Table II.

In line with Yin's (2003) recommendation regarding data collection in case studies, different sources of evidence (i.e. qualitative and quantitative) were used. Mixed methods are increasingly recognised as complementary and leading to better research outcomes in social sciences. In particular, whilst qualitative research is used to describe the phenomena studied and provide a narrative support, quantitative data add precision and a numerical quantification (Johnson and Onwuegbuzie, 2004). Thus, following Jick's (1979) recommendation, this research capitalises on the respective strengths of qualitative and quantitative research. As a first step, qualitative interview data are collected and used to better understand the logistics and supply chain environment of protracted operations and to provide insights into what may disrupt the deliveries of humanitarian supplies. In a second stage, gathering and analysing quantitative survey data enables us to investigate more precisely the nature of the disruptions and constraints encountered in protracted operations, as well as their logistics consequences.

Operational focus	The operational focus is on self-reliance, the improvement of households' livelihoods, and the recovery of local economies (in contrast, saving lives is emphasised in emergency operations)
Supply	Local procurement and purchases (for food and logistics resources) are emphasised
Food distributions	Beneficiaries of food distributions are better targeted in order to improve nutrition (in contrast, general food distributions are more frequent in emergency operations)
Type of assistance provided	Less direct deliveries of food are needed and are, when possible, replaced by cash/voucher assistance
Local partners	The use of local implemented partners is emphasised
Supply chain integration	Coordination/partnership with other humanitarian organisations is expanded
Budget flexibility	More flexibility exists in the reallocation of protracted operations' budgets, which enables field workers to better plan for contingencies and, ultimately, to deal more appropriately with rapid changes and surges in humanitarian needs

Source: Adapted from WFP (2004a)

Table II.
Key features of WFP's protracted operations

In this research, qualitative data were collected by means of five semi-structured interviews of 30-60 minutes conducted in June 2014 at WFP's Rome headquarters. Since interview participants were selected on the basis of their ability to provide the most relevant research information, the interview sampling was purposive (Saunders *et al.*, 2009). In particular, three logistics officers and two heads of logistics were recruited with the help of WFP's logistics management on the basis of their expertise (logistics officers are in charge of the day-to-day field logistics activities and heads of logistics are responsible for designing, planning, supervising, and leading WFP's logistics operations in their respective country offices), their extensive experience in humanitarian logistics (each individual participant has more than ten years of experience), and their involvement in protracted operations. In particular, the participants work/have worked, among others, in Senegal, Burkina Faso, Congo, and/or Afghanistan, as will be reflected in the interview results presented in the next section. It should, however, be noted that these countries do not constitute units of analysis for the case approach since, as mentioned earlier, the focus of our study is WFP and the data collected reflect WFP logisticians' overall experience in relation to protracted operations.

The interview questions (provided in Table III) were framed in order to explore the level of (in)stability in protracted operations, the nature of the disruptions/constraints encountered in the field, their impacts on logistics operations, as well as the methods

Interview topic covered	Interview questions
General operational environment	How stable/turbulent is the operational environment of protracted operations?
Nature of disruptions/ constraints	What kind of disruptions/constraints do you encounter (have you encountered) in protracted operations?
	What is the degree of predictability of these disruptions/constraints?
Impact on logistics operations	What is the impact of these disruptions/constraints on logistics operations?
Dealing with disruptions/ constraints	How are disruptions/constraints overcome in protracted operations?
	To what extent is agility (responsiveness and flexibility) needed in protracted operations?

Table III.
Interview questions

used to overcome them. A qualitative content analysis of the transcribed interview data were subsequently undertaken based a manual approach that enabled us to identify the relevant excerpts. More specifically, a colour system was used, i.e. different colours were associated with the various topics covered in the interviews. Next, each transcript was carefully reviewed and the relevant units of analysis highlighted in the appropriate colour in order to make them easily identifiable and facilitate the analysis of the data.

In addition to the qualitative interview data, quantitative data were collected through an online survey of WFP's field logisticians currently/previously involved in protracted operations. The survey questionnaire followed the framework of the interview questions (general characteristics of protracted operations, nature of disruptions/constraints, impact on logistics operations, and mitigation practices). The relevant literature (especially, Blecken *et al.*, 2009; Charles *et al.*, 2010; McGuire, 2011; Holguín-Veras *et al.*, 2012; L'Hermitte *et al.*, 2014) as well as the text content of the above-mentioned interviews were used to frame the survey questions. In respect to the disruptions/constraints encountered in protracted operations, data were collected on the two following generic categories:

(1) contextual disruptions/constraints (this category relates to the risks and uncertainties external to the supply network, i.e. the macro-environmental risks and uncertainties presented in Section 3.2); and

(2) supply chain-related disruptions/constraints (this category encompasses the risks and uncertainties internal to the organisation, as well as those external to the organisation but internal to the supply network, as presented in Section 3.2).

The survey involved five questions related to protracted operations (three matrix questions using five-point Likert scales and two multiple choice multiple select questions). These questions formed the fourth (and last) section of a comprehensive survey focusing on the concept of agility in humanitarian logistics. The online questionnaire was sent by WFP's logistics division to some 200 logistics staff members. In order to target the logisticians being/having been involved in protracted operations, we set up a branching logic with a source question (Are you working or have you previously worked in the field in a PRRO?). Respondents answering yes to this question were given access to the fourth section of the questionnaire. A total of 23 respondents completed it from November to December 2014. Respondents were international logistics officers (60 per cent) and national logistics officers (40 per cent). In total, 13 of them had been working for WFP for over ten years, nine for six to ten years, and one for three to five years. The quantitative data collected were subsequently analysed by aggregating the results in Microsoft Excel and presenting them in the form of tables and charts. The survey questions are provided in Table IV.

5. Key findings

5.1 Interview results

The transcribed text contents of the interviews provide an overview of the logistics environment of humanitarian protracted operations. In order to provide a narrative support to the interview raw data, and in turn, increase the validity of our research, we have integrated excerpts of the interviews into the overall discussions conducted below. The numbers attached to the quotations reflect the codes assigned to each interviewee in order to anonymise the data.

5.1.1 Disruptions and constraints encountered in the field. The interview data demonstrate that uncertainties and disruptions are part of the supply chain environment

Survey questions	Associated statements/choices
To what extent do you agree or disagree with the following statements regarding PRROs?	Demand patterns are stable Delivery lead times are regular The network of supply chain participants (suppliers, implementing partners, etc.) is well established Timely and accurate logistics information is available (e.g. inventory levels, physical position of the goods, etc.) Supply chains are demand driven (i.e. supplies are pulled through the supply chain) Order fulfilment processes are well established
Based on your past experience, which of the following contextual disruptions/ constraints are the most frequent in PRROs? Please tick the 3 MOST FREQUENT contextual disruptions/constraints	Physical (e.g. weather, typography, etc.) Security (e.g. conflict, pilferage, etc.) Infrastructure (e.g. roads, ports, communication, etc.) Socioeconomic (e.g. logistics resources, skills, fuel prices, etc.) Government (e.g. inefficient administration, corrupt practices, etc.) Other, please specify
Based on your past experience, which of the following supply chain-related factors are the most constraining/disruptive in PRROs? Please tick the 3 MOST FREQUENT supply chain-related sources of constraints/disruptions	WFP's business processes and standard procedures Functional silos within WFP Funding and in-kind donations Unpredictable demand for humanitarian supplies Suppliers of food and other items Suppliers of logistics services Implementing partners Commercial partners (e.g. TNT, UPS, Maersk, etc.) Other, please specify
Do contextual and supply chain disruptions/constraints have the following impacts on logistics activities in PRROs?	Access restrictions Operational bottlenecks Capacity constraints (warehousing and/or transport) Delayed deliveries Stock-outs Partial or total loss of cargo (e.g. pilferage) Supplies not fit for purpose (e.g. damaged, deteriorated, close to or beyond expiry date) Cost increases beyond anticipated budget Skill shortages Other, please specify
How are operational disruptions/ constraints mitigated/overcome?	By adapting field operations (e.g. changing delivery locations, transport modes, transport routes, etc.) By deviating from the agreed internal business processes and standard procedures By securing support from the regional bureaux By requiring support from other teams/groups within WFP Logistics (e.g. stand-by partners, shipping, etc.) By requesting support from other divisions within WFP (e.g. information technology, procurement, etc.) By cooperating with other organisations (humanitarian, governmental, commercial, and/or military) Other, please specify

Table IV.
Survey questions

of humanitarian protracted operations. Thus, "in protracted operations, we do have situations that can disturb the regular business, such as a local flooding that doesn't create additional beneficiaries but disturbs the operations" (No. 3). Some of these disruptions are contextual (i.e. macro-environmental) and are, therefore, uncontrollable: "the main problems in PRROs are related to insecurity. Everything can move very quickly so that it is sometimes difficult to plan operations in the long term" (No. 1). While remaining uncontrollable, some contextual disruptions are, nevertheless, foreseeable. For example, "in Burkina Faso, there is a problem of infrastructure during the rainy season, we know that. From November to June, during the dry season, there is no access problem. But in July, the rainy season starts and makes roads impassable. So interruptions are mainly due to weather problems and to the lack of infrastructure" (No. 2).

Other constraints and disruptions are supply chain related, i.e. internal to the organisation and/or the supply network. Examples include funding, supply and internal processes: "in Senegal, the problems to manage were mainly the lack of funding, namely funding that is delayed or does not come at all. We also had problems related to supply such as quantity issues. For example, a supplier promises to deliver 5,000 tonnes but only delivers 3,000. There are also problems related to the UN. For example, we are not allowed to make any advance payments to suppliers, be they the suppliers of food or the suppliers of transport services" (No. 4).

To summarise the above interview data, it can be said that a variety of disruptions and constraints are encountered in protracted operations. These relate to issues internal to the organisation itself (e.g. the inability of WFP's logisticians to make advance payments), problems internal to the supply network (e.g. the inability of suppliers to fulfil their commitments as well as funding delays), and contextual factors (e.g. weather problems, lack of infrastructure, and/or security issues). Due to these multiple risks and uncertainties, the fifth interviewee concludes that the environment of protracted operations is not much different from that of emergencies: "many protracted operations are like emergency operations" (No. 5).

5.1.2 Impact on logistics operations. The interview data indicate that the above disruptive factors frequently result in access restrictions such as in Burkina Faso where "sometimes, roads are closed in the north due to security problems" (No. 2). The aforementioned constraints and disruptions along the supply chain can also cause delays and wastage: "in Burkina Faso, allow for two months between the time the food is bought and the time it is delivered. This is the problem of all landlocked countries. It is possible to deal with that with buffer stocks in the ports. But the goods are perishable and, sometimes, the food supplies delivered expire only one or two months after the delivery date. If the food has been bought to cover four months of distribution, it is necessary to speed up the distribution operations and this poses big problems" (No. 2). One further consequence of disruptions is the need to revise budgets: "I cannot remember one PRRO for which we did not have to submit a request for budget revision. This is often to adapt to changes that can destabilise a project and also, sometimes, to update and take into consideration the latest vulnerability analyses or any other factor" (No. 5).

5.1.3 Methods used to overcome disruptions. The above-mentioned negative impacts on logistics and supply chain operations are dealt with "by adjusting field operations on an ongoing basis" (No. 1). According to the fifth interviewee, "in most PRROs in which I have been involved, there were obstacles, some circumstances, political or natural, that resulted in the need to adjust the operation along the way. We may have to open new corridors and use other access roads. Really, this is part of WFP's

operational routine" (No. 5). Adapting operations may also require field staff to find creative solutions. For example, "in Burkina Faso, when there is enough funding, it is possible to preposition supplies before the rainy season. When there is not enough funding, we have to find alternative solutions such as using pirogues, camels, or donkeys" (No. 2).

When solutions cannot be found in the field, WFP's logisticians can request support from other parts of the organisation that are, typically, located in the region: "the first line of support is the regional bureau. They support the field on a number of issues, including in the case of disruptions" (No. 3). The support provided is both administrative and technical, and regional bureaux play an active role in planning and implementing field operations. For example, "they provide assistance when country offices have issues related to excesses of goods, or losses of goods, or damaged goods. They can also help with supplier agreements, with the interpretation or implementation of WFP's policies and procedures, with information sharing, the coordination of operations, or when country offices need logistics staff, etc." (No. 5). The second interviewee confirms that, "in PRROs, we work mostly with the regional logistics officer who is the person who helps us manage our operations. We also have contacts with the country director. But there are not many contacts with the headquarters" (No. 2). According to the first interviewee, "the relationships with Rome are rare in PRROs. This is different in emergency operations where the direct contacts with the headquarters are very common" (No. 1).

Whilst the contacts between headquarters divisions and field logisticians do not seem to occur frequently in protracted operations, the support of WFP's headquarters and the organisational arrangements they implement are essential in order to support agility at the operational level. This concerns, for example, the programming aspects of an operation. "In countries like Afghanistan or Congo, well countries where we work in difficult situations, contingencies such as a new influx of refugees or the occurrence of natural disasters have been integrated into the design of the project. It's already there, risk is recognised from the beginning, hence the ability to be flexible" (No. 5). Organisational arrangements also include the development of tools, such as advance financing mechanisms in order to enhance field responsiveness and flexibility. As explained by the fourth interviewee, "one of the biggest problems in PRROs is the lack of funding. Nothing can be done without funding. A number of tools have been implemented to deal with this. For example, Forward Purchase Financing is a tool that provides agility to operations. It enables us to anticipate food purchases and consignments" (No. 4).

Forward Purchase Financing is a financial instrument established by WFP in order to reduce response times as well as supply lead times and, therefore, improve the timeliness of food deliveries. Other financial tools include "the Working Capital Financing facility that works as an internal loan granted on the basis of anticipated contributions, for example, funding promised by Canada" (No. 2). Delegation of authority is also mentioned as an organisational factor enhancing agile operations: "in PRROs, decision-making is decentralised at the country level and this supports agility. For example, if a village is burning, it is possible to use part of the money that was allocated to road repairs" (No. 4).

Overall, the interview data provide clear indications that the logistics and supply chain environment of protracted operations is not free of disruptions, and that humanitarian organisations must take steps to overcome/mitigate the various contingencies in such operations. As will be further discussed in Section 6, the

interview data also provide evidence that achieving agility requires that a number of organisational mechanisms are in place. This includes, for example, internal cooperation between the programme and the logistics functions, financial innovation, as well as the decentralisation of authority. The above results are confirmed and/or completed by the survey findings presented in the next section.

5.2 Survey results

The survey results are presented in the form of descriptive statistics that are typically used to describe, summarise, and compare the basic characteristics of a data set (Saunders *et al.*, 2009). Descriptive statistics are in line with the descriptive approach selected for this research and presented in Section 4. Thus, we move from the narrative data analysis conducted in the previous section to numeric variables providing quantitative insight into the studied phenomenon, namely, the logistics environment of humanitarian protracted operations. As is frequently the case with descriptive statistics, tables and charts are used in the remainder of this section to present the quantitative information. In particular, frequency counts are reported, i.e. the number of times a particular response option has been selected by respondents (Sue and Ritter, 2007).

The responses presented in Table V show that the survey participants perceive the supply chain environment of protracted operations as somewhat predictable. In other words, supply, demand and process risks and uncertainties are limited (but not non-existent). Thus, 65 per cent of the respondents agree or strongly agree that the conditions are met for the humanitarian supplies to be pulled through the supply chain, i.e. that supply chains in protracted operations are demand driven. More specifically, 52 per cent of the respondents agree that demand patterns are stable and that there is a certain level of continuity in the supply chain environment with logistics information available in a timely and accurate manner (83 per cent of the respondents agree or strongly agree with this statement), a well-established network of supply chain participants (74 per cent of the respondents agree or strongly agree with this statement), stable delivery lead times, and functional order fulfilment processes (52 per cent of the respondents agree with both statements).

Despite this level of predictability, disruptions are encountered both in the supply chain environment and in the macro-environment. In the supply chain environment, the

To what extent do you agree or disagree with the following statements regarding PRROs? ($n = 23$)	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	na
Demand patters are stable	0	12	6	4	1	0
Delivery lead times are regular	0	12	6	4	1	0
The network of supply chain participants (suppliers, implementing partners, etc.) is well established	1	16	6	0	0	0
Timely and accurate logistics information is available (e.g. inventory levels, physical position of the goods, etc.)	4	15	2	2	0	0
Supply chains are demand driven (i.e. supplies are pulled through the supply chain)	1	14	5	2	1	0
Order fulfilment processes are well established	0	12	8	2	1	0

Table V. Supply chain characteristics of protracted operations

sources of disruption are both internal to the organisation and internal to the supply network. The results shown in Figure 2 indicate that funding is the supply chain-related constraint most frequently encountered in protracted operations (it was selected 19 times, i.e. by 83 per cent of the respondents). The other frequently cited sources of disruptions include WFP's internal business processes and standard procedures, the existence of functional silos as well as unpredictability in demand.

Figure 3 illustrates that the most frequent sources of uncertainty in the macro-environment of protracted operations relate to security issues, e.g. conflict and pilferage (selected by 70 per cent of the respondents), transport and communication infrastructures (selected by 70 per cent of the respondents), and government issues, e.g. the inefficiency of the administration and/or corrupt practices (selected by 61 per cent of the respondents).

As shown in Table VI, 91 per cent of the survey participants consider that the above-mentioned supply chain-related and contextual risks and uncertainties result in frequent or occasional bottlenecks in protracted operations. For 87 per cent, the deliveries of humanitarian supplies are also frequently or occasionally delayed. The following frequent or occasional impacts were also mentioned by respondents: access restrictions (78 per cent), stock-outs (74 per cent), capacity constraints for storage and transport (65 per cent), and cost increases beyond anticipated budget (48 per cent).

Finally, Table VII indicates that for 65 per cent of the survey respondents, the above disruptions are most frequently mitigated or overcome by adapting field operations, e.g. by changing the delivery locations, the transport modes, and/or the transport routes. This indicates that disruptions and constraints are mainly dealt with at the field level. However, the support from regional bureaux, from WFP's central logistics department and from other divisions within WFP, as well as cooperation with external organisations are sometimes needed to mitigate/overcome such disruptions.

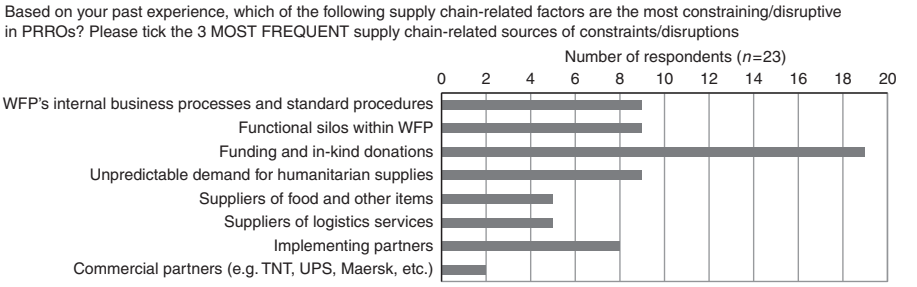

Figure 2.
Supply chain-related disruptions/ constraints in protracted operations

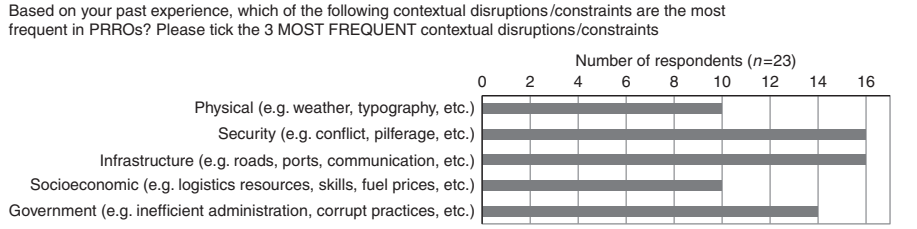

Figure 3.
Contextual disruptions/ constraints encountered in protracted operations

Do contextual and supply chain disruptions/ constraints have the following impacts on logistics activities in PRROs? ($n = 23$)	All the time	Frequently	Sometimes	Seldom	Never	na
Access restrictions	0	5	13	4	1	0
Operational bottlenecks	0	9	12	2	0	0
Capacity constraints (warehousing and/or transport)	0	2	13	8	0	0
Delayed deliveries	0	11	9	3	0	0
Stock-outs	0	6	11	5	1	0
Partial or total loss of cargo (e.g. pilferage)	0	0	5	16	2	0
Supplies not fit for purpose (e.g. damaged, deteriorated, close to or beyond expiry date)	0	0	8	12	3	0
Cost increase beyond anticipated budget	0	3	8	11	1	0
Skill shortages	0	2	7	12	1	1

Table VI.
Logistics impacts of disruptions/ constraints

How are operational disruptions/constraints mitigated/overcome? ($n = 23$)	All the time	Frequently	Sometimes	Seldom	Never	na
By adapting field operations (e.g. changing delivery locations, transport modes, transport routes, etc.)	1	14	7	0	0	1
By deviating from the agreed internal business processes and standard procedures	0	1	6	10	4	2
By securing support from the regional bureaux	0	2	11	6	3	1
By requiring support from other teams/ groups within WFP Logistics (e.g. stand-by partners, shipping, etc.)	0	4	15	2	1	1
By requesting support from other divisions within WFP (e.g. information technology, procurement, etc.)	0	2	18	2	0	1
By cooperating with other organisations (humanitarian, governmental, commercial, and/or military)	0	8	13	1	0	1

Table VII.
Mitigating/ overcoming operational disruptions and constraints

6. Discussion

The literature review on supply chain risks and uncertainties as well as the above findings enable us to answer the three research questions formulated in Section 1. In relation to the first question (*RQ1*), previous research shows that agility is needed in response to a variety of risks and uncertainties that go beyond the internal environment of an organisation and beyond the supply chain-related uncertainties inherent in the supply network. Agility is also needed as a result of contextual disruptions and constraints that relate to the macro-environment of each disaster situation (e.g. weather-related issues, security problems, and/or the lack of infrastructure).

With regard to the second research question (*RQ2*), the interview and survey data provide evidence that protracted operations are reasonably continuous operations and that the logistics environment is, to some extent, predictable. Specifically, supply chain-related risks and uncertainties (i.e. the risks/uncertainties internal to the organisation,

as well as those external to the organisation but internal to the supply network) are limited since supply and demand patterns are relatively stable and delivery processes are fairly structured and functional. This operational environment allows for reasonable planning and preparation horizons, and to some degree, for a repetitive and routine approach to logistics. Protracted operations are, nevertheless, not fully stable and predictable due to a number of constraints and disruptions. These not only relate to risks and uncertainties internal to the organisation (e.g. unadapted processes), as well as to disruptions and constraints in the supply chain environment (e.g. lack of resources, changing demand, and supply issues), but first and foremost to contextual factors, i.e. externalities (e.g. security issues and/or the lack of infrastructure).

The above discussion leads us to the third research question (*RQ3*). Since agility is needed in response to risks and uncertainties internal to the organisation, internal to the supply network, and related to the macro-environment of disaster situations, and since these risks and uncertainties are encountered, to a certain extent, in protracted operations, we contend that supply chain agility is needed in such operations. More specifically, the data clearly indicate that ongoing logistics adjustments are essential in order to respond swiftly to field-level contingencies, and ultimately, prevent disruptions in the flow of humanitarian supplies. To a large extent, this is because humanitarian organisations typically operate in developing countries where a degree of instability, uncertainty and unpredictability almost always prevails, and where there are multiple logistical constraints. Such changes and dynamics in the operational environment can be mitigated, or even overcome, by the use of agile principles.

Going one step further, our research shows that protracted operations require humanitarian organisations to cater simultaneously for a degree of stability and regularity in the flow of goods as well as for multiple contingencies. As such, our research empirically demonstrates that protracted operations are hybrid operations. On one hand, the supply chain environment allows for a certain level of predictability and longer term planning, and in turn, for the achievement of a demand-driven flow of supplies. On the other hand, field complexities and dynamics exist, in particular, as a result of instabilities in the macro-environment, and this requires the development of agile capabilities. From that perspective, it is suggested that a combination of two generic supply chain strategies, i.e. operational optimisation and agile practices may be required in protracted operations. According to Christopher *et al.* (2006), a strategy of operational optimisation (i.e. a lean strategy) is suitable in an environment of predictable demand and long supply lead times. It aims to plan and optimise supply chain activities, and ultimately, achieve efficiencies in the process flows as well as cost reductions. On the other hand, agility is a quick response strategy applied when the demand environment is unpredictable and supply lead times are short. A number of authors have already argued that agile and lean principles are not mutually exclusive (Christopher, 2000; Christopher and Towill, 2001) and have suggested various techniques to achieve them simultaneously, including the Pareto curve approach, distinguishing between base and surge demand patterns, and the decoupling point/postponement strategy (Christopher and Towill, 2001). Since the purpose of this paper is not to examine the applicability of these techniques and/or to develop new approaches more appropriate to the humanitarian logistics context, additional investigations are required in this regard, as will be explained in a later section.

In addition, this research is consistent with prior humanitarian logistics research that takes a strategic approach to agility and highlights the need to build organisational capacity to support responsiveness and flexibility in the field (Tatham and Christopher, 2014; L'Hermitte *et al.*, 2015). In particular, our findings

indicate that built-in agility is critical to respond swiftly and effectively to the complexities and dynamics inherent in protracted operations, and emphasise three organisational factors supporting field-level agility. First, rapid operational adjustments would not be possible without the decentralisation of authority and the empowerment of field workers, i.e. without the ability of front-line logisticians to make decisions, manage resources, and adapt the planned operations as necessary. This supports agility because decisions are taken at the point where action is needed and where the in-depth knowledge and understanding of the local conditions are located.

Second, the development of an appropriate organisational structure, i.e. the effective allocation and delegation of responsibilities to a number of entities (e.g. in the framework of this paper, WFP's regionally based organisational structure), and the facilitation of the relationships and communication between the different parts of the organisation (e.g. between field workers and regional bureaux) critically support agile operations. In the case of WFP, this is because regional bureaux have a better knowledge of local and regional specificities and practices, reinforce the relationships with governments and local/regional partners, contribute to speeding up decisions and actions, and bring authority and decisions closer to field operations. That said, communication between the entities of WFP's three-tier structure (that includes headquarters, regional bureaux, and the field) need to be effective, streamlined, and transparent in order to avoid any overlaps and/or conflict in the guidance and requests (WFP, 2009), and ultimately, to create agility. The data show that internal communication and coordination are also essential between the programme function (in charge of developing a suitable response strategy) and the logistics function (that organises the flows of humanitarian goods). To achieve an agile project design and enable field workers to better manage contingencies, functional silos need to be broken down, i.e. both functions need to have a clear understanding of each other's roles and constraints and work together rather than in parallel. Specifically, agility needs to be integrated into the response strategy and plans based on the logisticians' needs for flexibility.

Finally, innovation is also recognised as an essential organisational factor supporting agility. In particular, this research highlights the role played by innovative financial instruments in the ability of field logisticians to overcome funding constraints. These mechanisms are all the more important as the research data outline funding shortages as one major issue in protracted operations. This is consistent with WFP's report on the evaluation of the PRRO category (WFP, 2004a) which indicates that donors tend to prioritise funding for the emergency phase of a humanitarian crisis over protracted operations. Thus, innovative financial instruments enhance supply chain agility by improving advance planning, by supporting the ability to better anticipate (and, therefore mitigate) disruptions, by reducing delays in purchases and deliveries due to funding issues, and by improving the timeliness of humanitarian deliveries.

To summarise the above discussions, and following Yin's (2003) recommendation regarding the output of case study research, four propositions emerge from the WFP case study. These propositions are:

P1. Protracted operations are hybrid operations characterised simultaneously by a degree of stability, predictability, and regularity in the flow of goods and by field complexities and dynamics.

P2. The level of stability, predictability, and regularity existing in protracted operations enables humanitarian organisations to focus on operational optimisation and cost control.

P3. Humanitarian organisations need to retain a degree of agility in protracted operations in order to deal with the inefficiencies and complexities internal to the organisation and internal to the supply network, and with the volatility and uncertainty in the contextual environment.

P4. Organisational factors are critical to build and maintain agility, and ultimately, to respond quickly and effectively to the short-term complexities and dynamics inherent in protracted operations.

These propositions are testable and open new avenues for academic research, a number of which will be considered in Section 8.

7. Contributions

The contributions of this paper are twofold. First, this study is the first empirical research that focuses exclusively on the logistics features of protracted operations and that contributes a more concrete and complete understanding of these operations. In doing so, this paper adds to an emerging but growing volume of humanitarian logistics literature on the importance of differentiating between operational environments (Howden, 2009; Hughes, 2009; Holguín-Veras *et al.*, 2012; Venkatesh *et al.*, 2013). In particular, this paper emphasises that logistics operations do not stop with the urgent delivery of relief supplies and the rapid deployment of teams of experts in the aftermath of a disaster. Although this may seem obvious, the current humanitarian logistics literature does not appropriately reflect the importance of logistics beyond the emergency phase of a disaster. Thus, this research joins the few previous studies (e.g. Kovács and Spens, 2011a; Kunz and Reiner, 2012) that highlight this deficiency, and contributes to addressing it by exploring the logistics environment of WFP's protracted operations.

Second, this research establishes that humanitarian protracted environments are not fully stable and that unpredictability and disruptions exist. As a consequence, the paper demonstrates that operational optimisation and efficiency strategies are not fully appropriate and need to be completed by the development of agile practices in order to support the continuity of humanitarian deliveries in protracted operations. Mainly, this is because a disaster response, be it in the emergency or in the recovery phase of a disaster, is entrenched in its external, i.e. contextual environment. This environment has a significant impact on logistics operations and creates unique logistics and supply chain conditions (Whybark *et al.*, 2010). Thus, this paper highlights the fact that, in the humanitarian logistics discipline, the concept of agility cannot be studied solely by focusing on supply chain-related risks and uncertainties, i.e. in relation to demand, supply and processes, as has primarily been done in the business literature, and by extension, in this related to humanitarian logistics (L'Hermitte *et al.*, 2015). In addition to these challenges, contextual factors need to be considered and integrated into the analysis. As a consequence, our findings establish that the selection of an appropriate supply chain strategy in the humanitarian context goes beyond applying agile principles in the emergency response and lean principles in the recovery stage of a disaster, as this has been claimed in the current humanitarian logistics literature. In other words, this study builds a case for looking at humanitarian protracted operations through a different lens from that previously found in the literature.

Going one step further, this research emphasises the importance of considering the specificities of the humanitarian environment when applying business strategies to humanitarian operations. As argued by Taylor and Pettit (2009), business principles and strategies can usefully and successfully be transferred to the humanitarian logistics and supply chain context provided the differences between both environments are recognised and taken into account.

8. Limitations and further research

This study takes a descriptive research approach to reflect on, and better delineate, the concept of humanitarian protracted operations. Further investigations should be undertaken in order to confirm/refine our results and to complete our reflection on the logistics environment of humanitarian protracted operations. First, since this research is focused on a single case study (WFP), further research involving other humanitarian actors should be conducted. In particular, it should be determined if other organisations face the same sources of logistics and supply chain disruptions in protracted operations and how they respond.

Second, this research's relatively small number of interviewees and survey respondents does not enable our results to be considered representative of the population, i.e. representative of all WFP logisticians involved in protracted operations. In other words, the statistics presented in Section 5.2 cannot be extended beyond the limited scope of this research. Thus, in addition to broadening investigations beyond the scope of a single organisation, increasing the number of interviews and survey participants is a necessary condition to make research on protracted operations generalisable.

Third, it appears that there is a level of ambiguity in our research regarding the issue of costs and budget. Whilst Table V indicates that cost increases beyond the anticipated budget do not occur frequently, the interview data suggest that budget revisions are commonly required. Additional investigations are needed to clarify this issue.

Fourth, since the nature of this research is descriptive, its purpose is to shed light on the operational environment of protracted operations and to demonstrate that such operations are not conducted in a fully stable and predictable setting. Although a number of organisational mechanisms supporting agility are identified, this paper does not go as far as to provide a plan of action for humanitarian organisations seeking to increase the effectiveness and efficiency of their longer term operations. As a consequence, more research is required in order to extend the knowledge of protracted operations, and to develop adapted analytical models as well as practical and actionable recommendations for practitioners. In particular, since protracted operations have been characterised as hybrid in Section 6, the path forward to optimise these operations and develop efficiencies as well as, simultaneously, retain a certain level of agility in order to cope with turbulence should be further investigated. To this end, researchers could further investigate the role played by the agility-enhancing elements mentioned in Section 3.1. These elements include, among other things, information management and exchange, IT integration, inter-organisational coordination, the cluster approach, and collaboration with suppliers. In doing so, research on protracted operations will inform practice, move from a descriptive to a prescriptive approach, and ultimately, develop a theoretical framework for humanitarian protracted operations.

Finally, as mentioned in Section 3.1, the present study focuses on the concept of agility, i.e. the ability of humanitarian organisations to identify short-term turbulent events along the supply chain and to move quickly in order to avoid, as much as

possible, any disruptions in the flow of goods. Further research could consider the related concepts of supply chain adaptability, alignment, and resilience, as well as the extent to which these properties are also needed in the context of protracted operations.

9. Conclusion

Notwithstanding the limitations discussed above, this paper provides a better understanding of the concept of humanitarian protracted operations from a logistics and supply chain perspective. It demonstrates that the environment of such operations is not fully stable and predictable due to the existence of a number of supply chain-related, and above all, contextual uncertainties and complexities. Thus, this research demonstrates that supply chain agility is an essential operational requirement in humanitarian protracted operations. It also highlights the importance of differentiating between operational environments in the humanitarian context, and of identifying the distinctive features of each of these environments in order to determine the type of supply chain practices and strategies that are best appropriate to them.

References

Alexander, D. (2005), "An interpretation of disaster in terms of changes in culture, society and international relations", in Perry, R.W. and Quarantelli, E.L. (Eds), *What is a Disaster? New Answers to Old Questions*, International Research Committee on Disasters, University of Delaware, Newark, DE, pp. 25-38.

Altay, N. (2008), "Issues in disaster relief logistics", in Gad-El-Hak, M. (Ed.), *Large-Scale Disasters: Prediction, Control and Mitigation*, Cambridge University Press, New York, NY, pp. 120-146.

Altay, N. and Green, W.G. III (2006), "OR/MS research in disaster operations management", *European Journal of Operational Research*, Vol. 175 No. 1, pp. 475-493.

Altay, N. and Labonte, M. (2014), "Challenges in humanitarian information management and exchange: evidence from Haiti", *Disasters*, Vol. 38 No. S1, pp. S50-S72.

Altay, N. and Pal, R. (2014), "Information diffusion among agents: implications for humanitarian operations", *Production and Operations Management*, Vol. 23 No. 6, pp. 1015-1027.

Apte, A. (2010), *Humanitarian Logistics: A New Field of Research and Action*, Now Publishers, Hanover, MA.

Beamon, B.M. and Balcik, B. (2008), "Performance measurement in humanitarian relief chains", *The International Journal of Public Sector Management*, Vol. 21 No. 1, pp. 4-25.

Beresford, A. and Pettit, S. (2012), "Humanitarian aid logistics: the Wenchuan and Haiti earthquakes compared", in Kovács, G. and Spens, K. (Eds), *Relief Supply Chain Management for Disasters*, IGI Global, Hershey, PA, pp. 45-67.

Blecken, A. (2010), "Logistics in the context of humanitarian operations", in Dangelmaier, W., Blecken, A., Delius, R. and Klöpfer, S. (Eds), *8th International Heinz Nixdorf Symposium*, Heinz Nixdorf Institute, Paderborn, 21-22 April, pp. 85-93.

Blecken, A., Hellingrath, B., Dangelmaier, W. and Schulz, S.F. (2009), "A humanitarian supply chain process reference model", *International Journal of Services Technology and Management*, Vol. 12 No. 4, pp. 391-413.

Buatsi, S.N., Oduro, F.T., Annan, J., Turkson, E. and Kwesi-Bour, J. (2007), "The role of logistics in humanitarian aid in disaster relief and continuous aid operations: the case of care international Ghana", in Tatham, P.H. (Ed.), *First International Humanitarian Logistics Symposium*, Cranfield University, Farington.

Charles, A., Lauras, M. and Van Wassenhove, L. (2010), "A model to define and assess the agility of supply chains: building on humanitarian experience", *International Journal of Physical Distribution & Logistics Management*, Vol. 40 Nos 8/9, pp. 722-741.

Christopher, M.G. (2000), "The agile supply chain: competing in volatile markets", *Industrial Marketing Management*, Vol. 29 No. 1, pp. 37-44.

Christopher, M.G. (2011), *Logistics and Supply Chain Management*, Pearson Education, Harlow.

Christopher, M.G. and Peck, H. (2004), "Building the resilient supply chain", *The International Journal of Logistics Management*, Vol. 15 No. 2, pp. 1-14.

Christopher, M.G. and Towill, D.R. (2001), "An integrated model for the design of agile supply chains", *International Journal of Physical Distribution & Logistics Management*, Vol. 31 No. 4, pp. 235-246.

Christopher, M.G., Peck, H. and Towill, D. (2006), "A taxonomy for selecting global supply chain strategies", *International Journal of Logistics Management*, Vol. 17 No. 2, pp. 277-287.

Cozzolino, A., Rossi, S. and Conforti, A. (2012), "Agile and lean principles in the humanitarian supply chain", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 2 No. 1, pp. 16-33.

Dubey, R. and Gunasekaran, A. (2016), "The sustainable humanitarian supply chain design: agility, adaptability and alignment", *International Journal of Logistics: Research and Applications*, Vol. 19 No. 1, pp. 62-82.

Dubey, R., Singh, T. and Gupta, O.K. (2015), "Impact of agility, adaptability and alignment on humanitarian logistics performance: mediating effect of leadership", *Global Business Review*, Vol. 16 No. 5, pp. 812-831.

Ertem, M.A., Buyurgan, N. and Rossetti, M.D. (2010), "Multiple-buyer procurement auctions framework for humanitarian supply chain management", *International Journal of Physical Distribution & Logistics Management*, Vol. 40 No. 3, pp. 202-227.

Everywhere – Humanitarian Response and Logistics Services, Jahre, M. and Navangul, K.A. (2011), "Predicting the unpredictable – demand forecasting in international humanitarian response", *NOFOMA 2011 Conference, Harstad University College, Harstad, June*.

Fawcett, A.M. and Fawcett, S.E. (2013), "Benchmarking the state of humanitarian aid and disaster relief: a systems design perspective and research agenda", *Benchmarking: An International Journal*, Vol. 20 No. 5, pp. 661-692.

Giroux, H., Beaulieu, M. and Cooren, F. (2009), "Gérer les chaînes logistiques humanitaires: l'expérience de Médecins Sans Frontières", *Logistique & Management*, Vol. 17 No. 1, pp. 65-76.

Holguín-Veras, J., Jaller, M., Van Wassenhove, L.N., Pérez, N. and Wachtendorf, T. (2012), "On the unique features of post-disaster humanitarian logistics", *Journal of Operations Management*, Vol. 30 No. 7, pp. 494-506.

Howden, M. (2009), "How humanitarian logistics information systems can improve humanitarian supply chains: a view from the field", in Landgren, J. and Jul, S. (Eds), *6th International ISCRAM Conference*, International Association for Information Systems for Crisis Response and Management, Gothenburg, 10-13 May, available at: www.iscramlive.org/ISCRAM2009/papers/

Hughes, K. (2009), "The evolution of fully flexible supply chains", in Gattorna, J. (Ed.), *Dynamic Supply Chain Alignment*, Gower Publishing Limited, Farnham, pp. 85-95.

Jick, T.D. (1979), "Mixing qualitative and quantitative methods: triangulation in action", *Administrative Science Quarterly*, Vol. 24 No. 4, pp. 602-611.

Johnson, R.B. and Onwuegbuzie, A.J. (2004), "Mixed methods research: a research paradigm whose time has come", *Educational Researcher*, Vol. 33 No. 7, pp. 14-26.

Kovács, G. and Spens, K.M. (2007), "Humanitarian logistics in disaster relief operations", *International Journal of Physical Distribution & Logistics Management*, Vol. 37 No. 2, pp. 99-114.

Kovács, G. and Spens, K.M. (2009), "Identifying challenges in humanitarian logistics", *International Journal of Physical Distribution & Logistics Management*, Vol. 39 No. 6, pp. 506-528.

Kovács, G. and Spens, K.M. (2011a), "Humanitarian logistics and supply chain management: the start of a new journal", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 1 No. 1, pp. 5-14.

Kovács, G. and Spens, K.M. (2011b), "Trends and developments in humanitarian logistics – a gap analysis", *International Journal of Physical Distribution & Logistics Management*, Vol. 41 No. 1, pp. 32-45.

Kovács, G. and Tatham, P.H. (2009), "Responding to disruptions in the supply network – from dormant to action", *Journal of Business Logistics*, Vol. 30 No. 2, pp. 215-229.

Kunz, N. and Reiner, G. (2012), "A meta-analysis of humanitarian logistics research", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 2 No. 2, pp. 116-147.

Larson, P.D. (2011), "Risky business: what humanitarians can learn from business logisticians - and vice versa", in Christopher, M.G. and Tatham, P.H. (Eds), *Humanitarian Logistics*, Kogan Page, London, pp. 15-31.

Lee, H.L. (2004), "The triple-a supply chain", *Harvard Business Review*, Vol. 82 No. 10, pp. 102-112.

L'Hermitte, C., Tatham, P.H. and Bowles, M. (2014), "Classifying logistics-relevant disasters: conceptual model and empirical illustration", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 4 No. 2, pp. 155-178.

L'Hermitte, C., Bowles, M., Tatham, P.H. and Brooks, B. (2015), "An integrated approach to agility in humanitarian logistics", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 5 No. 2, pp. 209-233.

Long, D.C. and Wood, D.F. (1995), "The logistics of famine relief", *Journal of Business Logistics*, Vol. 16 No. 1, pp. 213-229.

McCann, J., Selsky, J. and Lee, J. (2009), "Building agility, resilience and performance in turbulent environments", *People & Strategy*, Vol. 32 No. 3, pp. 44-51.

McGuire, G. (2011), "Handbook of humanitarian healthcare logistics", available at: www.humanitarianhealthcarelogistics.com/handbook.htm (accessed 11 February 2016).

McLachlin, R., Larson, P.D. and Khan, S. (2009), "Not-for-profit supply chains in interrupted environments", *Management Research News*, Vol. 32 No. 11, pp. 1050-1064.

Maïola, A.-L. (2007), "Médecins Sans Frontières et la gestion des catastrophes naturelles: standardisation et limites de la logistique en situation d'urgence", *Mondes en développement*, Vol. 1 No. 137, pp. 81-88.

Manuj, I., Dittmann, J.P. and Gaudenzi, B. (2007), "Risk management", in Mentzer, J.T., Myers, M.B. and Stank, T.P. (Eds), *Handbook of Global Supply Chain Management*, Sage Publications, Thousand Oaks, CA, pp. 319-336.

Merminod, N., Nollet, J. and Pache, G. (2014), "Streamlining humanitarian and peacekeeping supply chains", *Society and Business Review*, Vol. 9 No. 1, pp. 4-22.

Oloruntoba, R. and Gray, R. (2006), "Humanitarian aid: an agile supply chain?", *Supply Chain Management*, Vol. 11 No. 2, pp. 115-120.

Park, Y., Hong, P. and Roh, J.J. (2013), "Supply chain lessons from the catastrophic natural disaster in Japan", *Business Horizons*, Vol. 56 No. 1, pp. 75-85.

Pettit, S. and Beresford, A. (2005), "Emergency relief logistics: an evaluation of military, non-military and composite response models", *International Journal of Logistics: Research and Applications*, Vol. 8 No. 4, pp. 313-331.

Pfohl, H.-C., Gallus, P. and Thomas, D. (2011), "Interpretive structural modeling of supply chain risks", *International Journal of Physical Distribution & Logistics Management*, Vol. 41 No. 9, pp. 839-859.

Ponomarov, S.Y. and Holcomb, M.C. (2009), "Understanding the concept of supply chain resilience", *International Journal of Logistics Management*, Vol. 20 No. 1, pp. 124-143.

Prater, E., Biehl, M. and Smith, M.A. (2001), "International supply chain agility: tradeoffs between flexibility and uncertainty", *International Journal of Operations & Production Management*, Vol. 21 Nos 5/6, pp. 823-839.

Saunders, M., Lewis, P. and Thornhill, A. (2009), *Research Methods for Business Students*, Pearson Education Limited, Harlow.

Scholten, K., Sharkey Scott, P. and Fynes, B. (2010), "(Le)agility in humanitarian aid (NGO) supply chains", *International Journal of Physical Distribution & Logistics Management*, Vol. 40 Nos 8/9, pp. 623-635.

Scholten, K., Sharkey Scott, P. and Fynes, B. (2014), "Mitigation processes – antecedents for building supply chain resilience", *Supply Chain Management: An International Journal*, Vol. 19 No. 2, pp. 211-228.

Stephenson, R.S. (1994), "Disasters and development", United Nations Development Programme, available at: www.pacificdisaster.net/pdnadmin/data/original/dmtp_15_disasters_development_8.pdf (accessed 11 February 2016).

Sue, V.M. and Ritter, L.A. (2007), *Conducting Online Surveys*, Sage Publications, Thousand Oaks, CA.

Tatham, P.H. and Christopher, M.G. (2014), "Introduction", in Tatham, P.H. and Christopher, M.G. (Eds), *Humanitarian Logistics*, Kogan Page, London, pp. 1-18.

Tatham, P.H. and Kovács, G. (2010), "The application of 'swift trust' to humanitarian logistics", *International Journal of Production Economics*, Vol. 126 No. 1, pp. 35-45.

Tatham, P.H. and Kovács, G. (2012), "Developing and maintaining trust in hastily formed relief networks", in Kovács, G. and Spens, K. (Eds), *Relief Supply Chain Management for Disasters*, IGI Global, Hershey, PA, pp. 173-195.

Tatham, P.H. and Pettit, S.J. (2010), "Transforming humanitarian logistics: the journey to supply network management", *International Journal of Physical Distribution & Logistics Management*, Vol. 40 Nos 8/9, pp. 609-622.

Tatham, P.H., Loy, J. and Peretti, U. (2015), "Three dimensional printing – a key tool for the humanitarian logistician?", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 5 No. 2, pp. 188-208.

Taylor, D. and Pettit, S. (2009), "A consideration of the relevance of lean supply chain concepts for humanitarian aid provision", *International Journal of Services Technology and Management*, Vol. 12 No. 4, pp. 430-444.

Thompson, S., Altay, N., Green, W.G. III and Lapetina, J. (2006), "Improving disaster response efforts with decision support systems", *International Journal of Emergency Management*, Vol. 3 No. 4, pp. 250-263.

Tomasini, R. and Van Wassenhove, L. (2009), *Humanitarian Logistics*, Palgrave Macmillan, Basingstoke.

Vaillancourt, A. and Haavisto, I. (2015), "Country logistics performance and disaster impact", *Disasters*, Vol. 40 No. 2, pp. 262-283.

van der Laan, E.A., de Brito, M.P. and Vergunst, D.A. (2009), "Performance measurement in humanitarian supply chains", *International Journal of Risk Assessment and Management*, Vol. 13 No. 1, pp. 22-45.

Van der Vorst, J.G.A.J. and Beulens, A.J.M. (2002), "Identifying sources of uncertainty to generate supply chain redesign strategies", *International Journal of Physical Distribution & Logistics Management*, Vol. 32 No. 6, pp. 409-430.

Van Wassenhove, L.N. (2006), "Humanitarian aid logistics: supply chain management in high gear", *The Journal of the Operational Research Society*, Vol. 57 No. 5, pp. 475-489.

Venkatesh, V.G., Dubey, R. and Sli, S.S. (2013), "Disaster relief operations and continuous aid program in human supply networks: are they congruent?", in Pant, M., Deep, K., Nagar, A. and Bansal, J.C. (Eds), *Third International Conference on Soft Computing for Problem Solving (SocProS 2013)*, Springer, New Dehli, pp. 959-973.

Vinodh, S., Devadasan, S.R., Vasudeva Reddy, B. and Ravichand, K. (2010), "Agility index measurement using multi-grade fuzzy approach integrated in a 20 criteria agile model", *International Journal of Production Research*, Vol. 48 No. 23, pp. 7159-7176.

Wagner, S.M. and Neshat, N. (2010), "Assessing the vulnerability of supply chains using graph theory", *International Journal of Production Economics*, Vol. 126 No. 1, pp. 121-129.

WFP (2004a), "Full report of the thematic evaluation of the protracted relief and recovery operation (PRRO) category", World Food Programme, available at: http://documents.wfp.org/stellent/groups/public/documents/reports/wfp065633.pdf (accessed 11 February 2016).

WFP (2004b), "Summary report of the thematic evaluation of the PRRO category", World Food Programme, available at: http://documents.wfp.org/stellent/groups/public/documents/eb/wfp024420.pdf (accessed 11 February 2016).

WFP (2009), "Review of management and adminstration in the World Food Programme", World Food Programme, available at: www.unjiu.org/en/reports-notes/JIU%20Products/JIU_REP_2009_7_English.pdf (accessed 11 February 2016).

WFP (2010), "Fighting hunger worldwide", World Food Programme, available at: http://documents.wfp.org/stellent/groups/public/documents/communications/wfp220666.pdf (accessed 11 February 2016).

WFP (2015), "WFP in 2014", World Food Programme, available at: www.wfp.org/content/wfp-2014 (accessed 11 February 2016).

WFP (2016a), "Development Operations (DEVs)", World Food Programme, available at: www.wfp.org/operations/development (accessed 11 February 2016).

WFP (2016b), "Emergency Operations (EMOPs)", World Food Programme, available at: www.wfp.org/operations/emergency (accessed 11 February 2016).

WFP (2016c), "Protracted relief and recovery (PRROs)", World Food Programme, available at: www.wfp.org/operations/relief (accessed 11 February 2016).

WFP Logistics (2013), "WFP Logistics in 2012", World Food Programme, available at: http://documents.wfp.org/stellent/groups/public/documents/communications/wfp257680.pdf (accessed 11 February 2016).

Whybark, D.C., Melnyk, S.A., Day, J.M. and Davis, E.W. (2010), "Disaster relief supply chain management: new realities, management challenges, emerging opportunities", *Decision Line*, Vol. 41 No. 3, pp. 4-7.

Wisner, B. and Gaillard, J.C. (2009), "An introduction to neglected disasters", *Jàmbá: Journal of Disaster Risk Studies*, Vol. 2 No. 3, pp. 151-158.

Yin, R.K. (2003), *Case Study Research: Design and Methods*, Sage Publications, Thousand Oaks, CA.

Zobel, C.W. (2009), "Representing perceived tradeoffs in defining disaster resilience", *Decision Support Systems*, Vol. 50 No. 2, pp. 394-403.

Corresponding author
Cécile L'Hermitte can be contacted at: cecile.lhermitte@utas.edu.au