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Defining Quality of Service in Humanitarian Supply Chains
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Abstract

The objective of this master thesis is to define the quality of service (QoS) in humanitarian supply chains (HSCs). To this end, based on literature reviews, we clarify the concepts related to QoS in HSCs and we propose a conceptual framework. Systematic literature reviews (SLRs) are carried out to identify the relevant QoS attributes in commercial and humanitarian supply chains. We also identify attributes using the Sphere Project handbook. From this process, we have determined a total of 23 QoS attributes: reliability, responsiveness, tangibles, assurance, empathy, timeliness, effectiveness, customer satisfaction, availability, flexibility, transparency, complaining rate, commitment, communication, sustainability, coordination, accessibility, involvement, security & privacy, acceptability, appropriateness, usability, competence. The main contribution of this master thesis is to propose a first framework that defines QoS in HSCs.

Résumé

L'objectif de ce mémoire est de définir la qualité de service (QS) dans les chaînes d'approvisionnement humanitaires (CAH). Pour ce faire, en se basant sur des revues de littératures, nous clarifions les concepts reliés à la qualité de service dans les chaînes humanitaires et nous proposons un cadre conceptuel. Des revues de la littérature systématiques sont ensuite réalisées pour identifier les attributs de qualité de service pertinent aux chaînes commerciales et humanitaires. Nous avons également identifié des attributs à partir du manuel du Projet Sphère. Grâce à ce processus, nous avons détermine 23 attributs de qualité de service: la fiabilité, la réactivité, les évidences physiques, l'assurance, l'empathie, la rapidité, l'efficacité, la satisfaction du client, la disponibilité, la flexibilité, la transparence, le taux de plainte, l'engagement, la communication, la durabilité, la coordination, l'accessibilité, l'implication, la sécurité et la confidentialité, l'acceptabilité, la pertinence, la facilité d'utilisation et la compétence. La principale contribution de ce mémoire est de proposer un premier cadre conceptuel pour définir la qualité de service dans les chaînes d'approvisionnement humanitaires.

Table of Contents

List of Tables

List of Figures

Chapter 1 Introduction

In today's society, no one can live without logistics activities. Food in supermarkets, clothes in shopping malls, and cars in stores are all produced, transported and end up in customer's hands through logistics activities. Normally, logistics consists of supply, materials, and finished products after final distribution (Baker, 2006). We can generally define logistics as functional activities that gets the right goods to the right place and distributes to the right people at the right time.

Along with the globalization of firms and businesses, logistic activities expand in terms of broad landscape as well as types of products. Logistics and operations management were the terms used to describe activities throughout production, distribution, inventory, purchasing, forecasting until supply chain management was first introduced by Oliver and Weber in 1982. The Council of Logistics Management (2003) pointed out that logistics is a part of the supply chains process, which means supply chain management is a broader concept than logistics. A supply chain is a facilities and distribution network performing the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers (Ganeshan and Harrison 1995, cited in Farahani, Asgari & Davarzani. 2009).

There are mainly three kinds of supply chains: commercial supply chains, humanitarian supply chains (HSCs), and military supply chains (Apte, 2009; Farahani, Asgari & Davarzani, 2009). Unlike demand in commercial business that we can forecast, disasters and conflicts in HSCs usually come all of a sudden, just like Nepal's 7.8-magnitude earthquake that happened on April 25th in 2015. More than 8000 people were killed, more than 17,000 were injured, and over a million people became homeless during this terrible earthquake (Strand, 2015). It is obvious that sufficient relief goods and supplies should be delivered to victims as soon as possible. However, emergencies with uncertainties often bring great challenges for organizations to deliver relief goods timely. The geography, the mountainous terrain and poor roads in Nepal became problematic for transportation operations, and the only airport was damaged during Nepal's earthquake. Moreover,

workers didn't have enough heavy equipment to handle large quantities of food and other relief material; the airport was blocked by supplies (Eshkenazi, 2015). This situation called for aids from organizations all over the world. Fortunately, thanks to the lessons learned from earlier disasters, such as the Haiti earthquake and the Southeast Asia tsunami, the United Nation's World Food Program (WFP) made a response plan and brought its own handling equipment to encompass these difficulties (Eshkenazi, 2015). Also, the private sector is increasingly involved in humanitarian relief and recovery. For example, in Nepal's earthquake, Deutsche Post DHL was working together with Air Charter Service (ACS) to deliver relief suppliers and personnel (Woods, 2015).

The Nepal's earthquake emphasised the importance of supply chain management and briefly revealed the relationship between commercial supply chains and HSCs. Revenue-oriented logistics companies in commercial supply chains are not able to overcome all the unexpected problems within a very short time alone, so do the HSCs. There are always collaborations in between. Except for the broad collaborations between the private and humanitarian sectors, there are collaborations among different clusters, which could be the United Nations bodies, local non-governmental organizations (NGOs) and international NGOs (Cozzolino, 2012). Collaborations among different stakeholders require shared quality of service measurements to reduces conflicts.

Nevertheless, compared with commercial supply chains, HSCs are about 15 years behind (Van Wassenhove, 2006). It is urgent for us to understand and develop the HSCs. After knowing the importance of HSCs, we have to target their core elements and find out what their challenges are to better serve the beneficiaries and improve the supply chains. One obvious feature of HSCs, which will be introduced in the second chapter of this thesis, is that it is nonprofit oriented (Apte, 2009). Profits and costs are not the priorities of humanitarian relief and disaster recovery. However, this nonprofit feature of HSCs makes the performance management problematic, since the profit or the revenue is one of the main motivations for performance improvement. Also, as nonprofit orientation, there are other critical elements challenging the performance management of HSCs: limited information technology capacity, human resource problems, chaotic environment, general

reluctance for performance measurement implementation, potentially negative media exposure, etc. (Blecken, Hellingrath, Dangelmeier & Schulz, 2009; Davidson, 2006; Widera & Hellingrath, 2001; Tatham & Hughes, 2011; Jahre & Heigh, 2008; cited in Abidi, 2014). Performance management is important for continuing development (Langley & Holcomb, 1992), so it is vital to investigate and study the performance management in HSCs in order to achieve efficiency in HSCs.

Performance management in HSCs may become tough due to collaborations throughout various decision levels and phases. Humanitarian activities are divided into different decision levels, namely strategic, tactical, and operational level. Moreover, HSCs' management composed of three phases: preparedness, response and recovery (Apte, 2009). In these different phases, local government is responsible for the prepositioning of assets, infrastructure and funding. But in the response and recovery phases, such as terrible disasters like the Nepal earthquake, stakeholders all over the world like the Word Food Programme (WFP), International Federation of Red Crescent Societies (IFRC), and even third-party logistics providers are involved. Therefore, there must be negotiations, collaboration and cooperation between those organizations. It is not a surprise to find conflicts related to trust, authority and priority (Tatham & Kovacs, 2010). Conflicts that occur in collaborations could be mitigated by following general emergency logistics standards which are compatible with all stakeholders in HSCs (Beamon and Kotleba, 2006). QoS can be considered as an indicator to measure weather those standards were met by multiple stakeholders' perspectives, and it is also a significant dimension of performance measurement.

There is a gap for applying service operations management theory to humanitarian operations. Services are intangible and heterogeneous so that it is necessary to find a broader definition than the ones used in the manufacturing context to include all aspects of services (Paquette, Cordeau & Laporte, 2009). This intangible nature of QoS makes it difficult to measure and define QoS. Logistics service quality, which is related to time, speed, trust, information exchange, technological tools, etc., has great influence on

humanitarian supply chain performance and efficiency. Consequently, HSCs would not improve unless the QoS has been defined.

The definition of QoS was first developed by Grönross (1984) as the consequence of the comparison between consumer's expectation of the service and the perception of the service received (Paquette et al., 2011). Some tools were developed in the literature to measure QoS. One of the best-known is the SERVQUAL developed by Parasuraman, Zeithaml, and Berry (1988). Although some attempts have been made, no QoS in HSCs has been defined in the literature.

The importance of humanitarian supply chain management in respect to humanitarian relief, the vital role of performance measurement in continuous development of HSCs, the significant dimension of performance measurement-QoS, and the gap for applying service operations management theory to HSCs all together clarify the necessity to define QoS in humanitarian supply chain management. Considering the huge scope of HSCs, we mainly focus on humanitarian response of sudden-onset natural disasters. The objective of this master thesis is thus to define QoS in disaster response of sudden-onset natural disasters.

In order to comprehensively define QoS within a supply chain, it is essential to have a thorough understanding of the requirements and the incentives of all the stakeholders. There are many different stakeholders, such as donors, governments and NGOs in HSCs, all with different priorities and responsibilities. Moreover, beneficiaries in HSCs are regarded as both customers and stakeholders (Apte, 2009; Abidi, 2014; Cozzolino, 2012), which make it complicated to define the QoS based on stakeholders' needs. The methodology used to define QoS in HSCs is to create a conceptual framework based on literature reviews. General literature reviews on HSCs and QoS propose the research background that illustrates the definitions, particularities, and challenges of HSCs and QoS. Moreover, a systematic literature review on QoS in HSCs is used to extract existing QoS attributes from the literature. In order to make a supplement to the scanty literatures on QoS in HSCs, a systematic review on QoS in commercial supply chains is also made

to identify QoS attributes. Standards and indicators from the Sphere Project handbook and NGOs are regarded as complements to summarize QoS attributes.

The Sphere Project was initiated in 1997 by a group of NGOs, the International Red Cross and Red Crescent Movement. It aims to improve the quality of the actions during disaster response. As shown in Figure1.1, in this handbook, there are principles and core standards including the humanitarian charter and protection principles. The humanitarian charter makes common principles, rights and duties for humanitarian agencies, emphasizing the importance of agency accountability. The protection principles provide guidelines to help humanitarian agencies avoid bringing further harm to affected people. The core standards could improve the efficiency of processes and approaches carried out in HSCs. The Sphere Project gives guidelines for NGOs when they provide services related to water supply, food security and nutrition, shelter and settlement, and other health actions (The Sphere Project, 2011). Other service standards from NGOs like Doctors without Borders, International Committee of the Red Cross (ICRC) and Mercy Corps (MC) will be considered as well. These standards are discussed and linked to QoS attributes identified from literature reviews on HSCs and commercial supply chains.

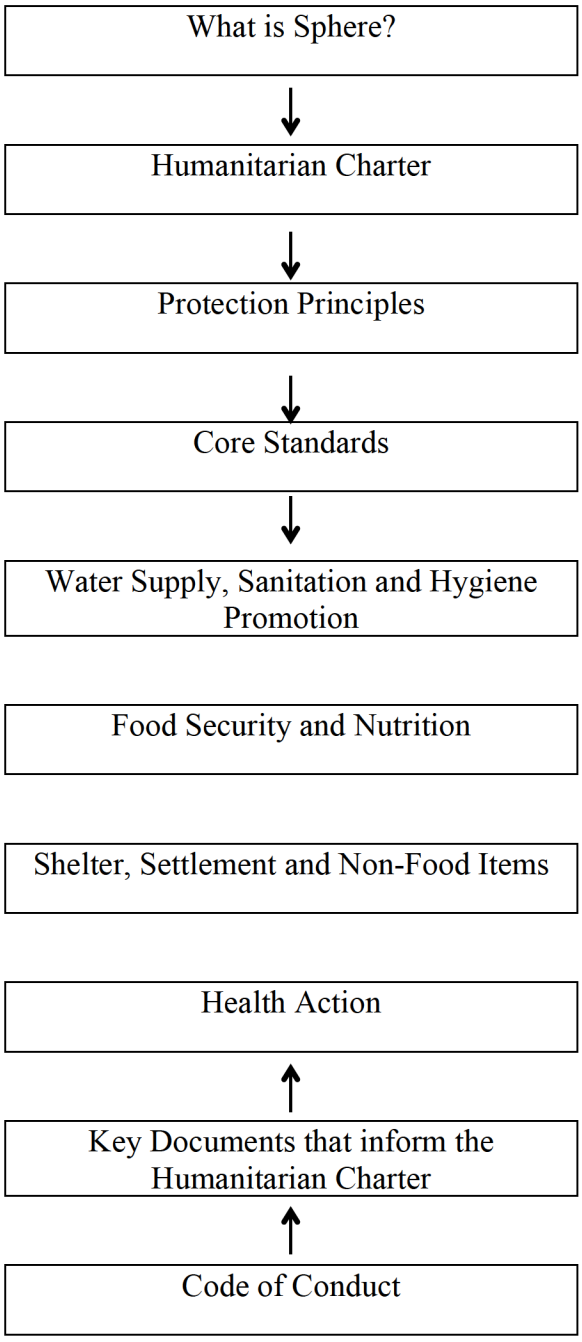

Figure1.1 The structure of the Sphere Project Handbook (Source: The Sphere Project, 2011, p.2)

The main contribution of this master thesis is the conceptual framework created to define QoS in HSCs. First, 23 QoS attributes (*reliability, responsiveness, tangibles, assurance, empathy, timeliness, effectiveness, customer satisfaction, availability, flexibility, transparency, complaining rate, commitment, communication, sustainability, coordination, accessibility, involvement, security & privacy, acceptability, appropriateness, usability, competence*) are defined to measure the quality of services provided by different groups of stakeholders. Second, these attributes are linked to different activities and relations in the HSCs. This conceptual framework fills the gap by applying service operations management theory to HSCs, and helps improve existing QoS measurement tool such as SERVQUAL by considering all stakeholders' perspectives. It provides standards and guidance for humanitarian practitioners to better carry out humanitarian activities.

This master thesis is organized as follows. Chapter 2 introduces the literature reviews on HSCs and QoS to show the necessity to define the QoS in HSCs and to identify the particularities of humanitarian operations. Chapter 3 presents the conceptual framework methodology used to define the QoS in HSCs. Chapter 4 describes the results of systematic literature reviews on QoS in HSCs and commercial supply chains from which QoS attributes have been identified and discussed. Chapter 5 uses standards from the Sphere Project handbook and NGOs to complement previous findings. Chapter 6 discusses the QoS attributes selected and describes the conceptual framework developed for defining QoS in HSCs. Chapter 7 provides the conclusion and contribution of this master thesis; limitations and future research are also included.

Chapter 2 Quality of Service and Humanitarian Supply Chains

This chapter presents a summary of two broad literatures. In section 2.1, a literature review on QoS is presented to give the definition of QoS and to illustrate its importance in performance management of HSCs. Few QoS related models and research gaps are introduced to show the necessity to define QoS in HSCs. In section 2.2, the definition of HSCs is presented. In section 2.3, particularities of HSCs are introduced by comparing HSCs and commercial supply chains, and the main challenges of HSCs are introduced as well. These particularities and challenges of HSCs clarify various critical factors that complicate defining QoS in HSCs. In section 2.4, a classification of disasters is discussed to show the complexity of HSCs and to narrow the research scope. Section 2.5 introduces three decision levels in which the logistics activities are categorized and for which different QoS attributes could associate with. In section 2.6, the most important particularity of HSCs, which is the presence of multiple stakeholders, is further introduced, and the relationships among them are explained. The coordination and collaboration level among stakeholders influence the HSCs' efficiency. It is thus important to take it into consideration when measuring the performance and QoS. The last section of this chapter illustrates the role of information in HSCs, and presents the possibility to apply performance management, especially QoS measurement, to HSCs.

2.1 Literature Review on QoS

Service quality, customer satisfaction and value are three distinct elements that firms in supply chains provide to their customers. However, service quality, customer satisfaction and value were often used interchangeably in the literature and many practitioners failed to distinguish the differences between these concepts (Caruana et al., 2000). In order to better understand QoS, it is necessary to distinguish QoS from other concepts. Customer satisfaction or dissatisfaction come from the experience of a service encounter, and from the comparison between that encounter and what was expected (Oliver, 1980). Thus, if the service offered is of quality, the experience of the customer should be high and should equal or exceed its expectations thus resulting in its satisfaction. Satisfaction is thus

correlated to QoS. Perceived value refers to the customer's overall assessment of the utility of a product (Zeithaml, 1988).

The specific definition of quality in the service context was first developed by Grönross (1984) as the outcome of the comparison between consumer's expectation of the service and the perception of the service received (Paquette et al., 2011). Services are intangible in nature (Roslan et al., 2015), which makes it difficult to measure and define QoS. Some tools were developed in the literature to measure QoS, the SERVQUAL scale developed by Parasuraman et al. (1985) is the most used scale to measure QoS (Ladhari, 2009; cited in Parmata et al., 2016). Parmata et al. (2016) defined QoS through the gap between customers' perception and expectation of company's QoS performance. It is composed of five determinants including tangible, reliability, responsiveness, assurance, and empathy (Lim et al., 1999).

Although the importance of services is recognized by more and more organizations and some tools related to QoS are available, it is still difficult to measure and control QoS. There are also challenges to define QoS in supply chains. Seth et al. (2006 c) presented three factors that impeded the development of QoS measurement. The first factor relates to the intangible nature of services. Additionally, different individuals have their own perceptions of QoS, which makes it hard to obtain a universal definition of QoS across the supply chain. Secondly, there were several criticisms about the general application of the SERVQUAL tool, which implies that QoS need to be further developed or adapted to a specific context. The last factor was that where the relationship between buyers and suppliers was well explored, the applicability of QoS on the supplier side was underdeveloped (Seth et al., 2006 c).

Meanwhile, Seth et al. (2006 b) illustrated that there were various interface and QoS gaps at different levels in the supply chains. Likewise, there is a gap in addressing the effectiveness of HSCs through improved beneficiary satisfaction (Oloruntoba & Gray, 2009; cited in Heaslip, 2013). The reality that 55% of humanitarian relief organizations (HRO) do not monitor and report any QoS attributes, 25% only use few indicators and

only 20% measure QoS consistently (Blecken, 2010; cited in Abidi, Leeuw & Klumpp, 2014) shows that currently HROs have problems to develop QoS attributes.

Overall, it is believed that performance management is crucial for supply chains' efficiency and defining QoS in supply chains is necessary for organizations to be successful. However, the humanitarian sector is lagging behind in terms of obtaining benefits from measuring performance in the supply chain (Abidi et al., 2014). In this master thesis, the main focus will be on QoS in HSCs, which is an underdeveloped topic in the literature.

2.2 Definition of HSCs

Definition of HSCs reveals the important role of HSCs in humanitarian relief operations, and briefly describes how HSCs manage humanitarian activities in an efficient manner. Giving the definition of HSCs is the very first step to introduce the HSCs context where to define the QoS.

Timely relief efforts rely heavily on the logistics infrastructure (Knemeyer, Zinn & Eroglu, 2009). Supply chain management might be the only way to achieve efficiency in humanitarian operations because of the large percentage (80%) of logistics services provided during disaster-relief efforts (Van Wassenhove, 2006). The importance of logistics in humanitarian operations makes it essential to develop a thorough understanding of the humanitarian logistics concept.

We can generally define "logistics" as functional activities that gets the right goods to the right place and distributes to the right people at the right time. But when we discuss "logistics" in the humanitarian context, a more specific definition should be given to "humanitarian logistics". Thomas and Kopczak (2005, p.2) described humanitarian logistics as a set of activities of "planning, implementing and controlling the efficient, cost-effective flow of and storage of goods and materials as well as related information, from point of origin to point of consumption for the purpose of alleviating the suffering of vulnerable people". Van Wassenhove (2006) defined humanitarian logistics as the

processes and systems that are involved in mobilizing people, resources, skills and knowledge to help vulnerable population affected by a disaster. Apte (2009) regarded humanitarian logistics as the special branch of logistics that manages response supply chain of critical supplies and services under multiple challenges such as demand surges, uncertain supplies and critical time windows. The most recent description of humanitarian logistics is that "humanitarian logistics is the logistic component of preparing for and responding to natural disasters and complex emergencies, a broad field that encompasses the management of the entire supply network" (Tatham and Spens, 2016, p.1).

Like commercial companies, the humanitarian organizations have to look beyond basic logistics and use supply chain management methods to coordinate different players involved in humanitarian operations (Tomasini and Wassenhove, 2009a). However, it is not easy to manage HSCs' efficiently with their complexities. Factors resulting in HSCs' complexities, which make it hard to define QoS in the chain, will be introduced as their particularities in next section.

2.3 Particularities and Challenges of HSCs

In order to have a further understanding of HSCs, it is necessary to discuss their particularities and challenges. Particularities including uncertainties, crisis driven mechanism, multiple stakeholders, short response time, poor technical support, etc. require support from special service providers and specific service measurement that are different in commercial supply chains. These particularities and challenges of HSCs compose the complexities when defining QoS in HSCs. Meanwhile, they should be taken into consideration when defining QoS in HSCs.

Supply chain activities including inventory management, demand forecasting, and coordination have been studied extensively in the literature (Cachon, 2003). However, the attention paid to HSCs with their particularities is scanty (Chakravarty 2014). Van Wassenhove (2006) stated that the humanitarian sector is about 15 years behind the private sector. Moreover, there are too many uncertainties in their activities, which are

carried out in an unstable environment. Agility, alignment and adaptability (Triple-A) are particularly critical for the humanitarian supply chains (Tomasini and Wassenhove, 2009a). From all of the aspects related to supply, inventory, distribution network, flows, lead-time, information system, customer, demand and objective, we can notice that HSCs are not as mature as commercial supply chains (see Table 2.1).

Table 2.1 Comparison between commercial supply chains and HSCs

Main factors	Commercial supply chain	Humanitarian supply chain
supply/supplier	known	unknown
inventory	manageable	complicated
distribution network	available	challengeable
flows	efficient	unsmooth
lead-time	shorter	longer
information system	integrated software tools	manual
customer	buyers	donors and beneficiaries
demand	known and predictable	estimated
objective	maximize profits	minimize loss of life
agility	stable	essential
adaptability	to the market	to the disasters
alignment	insignificance	important
performance measures	developing	underdeveloped

According to Apte (2009), supply, inventory, distribution network, flows, lead-time, information system, customer, and demand are the factors common to both commercial supply chains and HSCs. An organization's objective, performance measures, agility, adaptability, and alignment are also the important elements that could further define the supply chain. The factors in the first column in Table 2.1 list all the areas where it is possible to make comparisons between commercial supply chains and HSCs. The second and third columns give corresponding particularities of commercial supply chains and HSCs.

In terms of supply, the types of products are clear and most of the demands are usually known in commercial supply chains. On the contrary, the quantities of diverse products are hard to confirm because of multiple stakeholders involved and limited information shared in HSCs (Apte, 2009). The inventory management of commercial supply chains is manageable since demands are predictable and inventory is visible. However, except for the predictability and uncertainty problem, types of disasters and shelf life of supplies also complicate the inventory management systems in HSCs (Apte, 2009). For example, grains should be held for long periods during famine while vaccines should be held for short periods due to their relative short shelf life. Distribution networks in commercial supply chains are usually routed and planned for available vehicles. Nevertheless, in HSCs' distribution networks, especially in the last mile distribution, unexpected geographies in affected areas (e.g. dangerous mountain paths and destroyed transportation systems) challenge the HSCs' distribution abilities. Well-managed supply, inventory, and distribution network in commercial supply chains make the flows of products efficiency in every phase. Uncertain supplies under unavailable distribution networks make it impossible to obtain smooth flows of products in HSCs.

Apte (2009) also pointed out that some commercial organizations (e.g. Wal-Mart and Waffle-house) were able to respond to disasters in the United States in a very short time frame compared with humanitarian organizations. HSCs have to learn from the practices of commercial supply chains to shorten their lead-time when responding to different disasters. According to Apte (2009), information systems are integrated with commercial supply chains. Varma and Khan (2014) listed many information technologies in supply chain management such as bar code and scanner, Radio Frequency Identification (RFID), Electronic Data Interchange (EDI), and Enterprise Resource Planning (ERP) systems. However, most of those information technologies are absent from HSCs due to limited internet access, non-existing software, and undertrained staff (Apte, 2009). Customer differentiations are quite different in commercial supply chains and HSCs. Customer is a relative clear concept in commercial supply chains that usually refers to the groups who pay for and make use of the end products. In HSCs, donors who pay for products and

beneficiaries who use products are both regarded as customers in HSCs. This multi-stakeholder particularity of HSCs will be further discussed in Section 2. Similar to the supply, demand is more predictable in commercial supply chains than in HSCs. The priorities in commercial supply chains and HSCs differ from each other. Commercial supply chains aim to maximize profits and improve customer satisfaction, while HSCs attempt to minimize loss of life. Although costs still matter in HSCs, tradeoffs between budget and suffering could be made to obtain the overall objective (Apte, 2009).

Table 2.1 also presents agility, alignment and adaptability (Triple-A), which are proposed by Tomasini and Wassenhove (2009a), as main factors in supply chain management. Agility is vital for both commercial supply chains and HSCs. It plays an essential role in HSCs to obtain rapid deployment of supplies and services, but it has a relatively stable status in commercial supply chains (Apte, 2009). Adaptability is defined as the ability to "adjust the supply chain's design to meet structural shifts in markets and modify the supply network to reflect changes in strategies, technologies, and products" (Lee, 2004, p.105). Commercial supply chains adapt their structures and strategies to the market in order to obtain competitive advantages, and HSCs have to change their structures and strategies based on the real needs and situation in different disasters. In terms of alignment, it is more important in HSCs than that in commercial supply chains (Apte, 2009). In a business world, commercial organizations usually compete with each other to expend their market share, so alignment seems to be conflict to this competition. Although organizations and governments of HSCs have different specific goals and incentives, their ultimate objective is the same: to deliver relief to affected population, so alignment is essential for different specialists working together to solve problems quickly and efficiently in HSCs.

The last main comparing factor of commercial supply chains and HSCs is the performance measurement. Gunasekaran, Patel & Tirtiroglu (2001) found that not many efforts had been made on performance evaluation of commercial supply chains, measures and metrics of supply chains should be made at basic links like plan, source, assemble, and deliver. Beamon (1999) delivered another message that costs and combination of

costs and customer responsiveness were the two main performance measures of commercial supply chains (cited in Apte, 2009). Although no universal performance measure of supply chains has been developed, the performance measurement of commercial supply chains is improving in its scope and importance (Gunasekaran et al., 2001). However, HSCs lack of attentions from researchers in literature, so performance measures of HSCs is still in its infancy. QoS is the main dimension of performance measures of supply chains; so well defined QoS would improve performance measures in both commercial supply chains and HSCs.

From the comparison between commercial supply chains and HSCs above, we can observe some specific particularities of HSCs. Most of these particularities of HSCs shown in Table 2.1 are caused by uncertainties. For example, uncertainties in supplies complicate inventory management, and uncertainties in information exchange lengthen the lead-time. Based on these detailed particularities above, some general particularities (i.e., uncertainties, crisis driven mechanism…) are presented below, and their challenges on measuring QoS are also discussed.

- Uncertainties,
- Crisis driven mechanism,
- Multiple stakeholders,
- Short response time,
- Poor technical support and undertrained employees,
- Hardly formed trust,
- Unfunctional performance measurement, and
- Collaboration and QoS in need.

Uncertainties

In HSCs, there are uncertainties in the supply, inventory, and demand. Although there are also uncertainties in commercial supply chains, these uncertainties can be better controlled based on historical data and marketing research. However, HSCs do not know when, where, what, how much, where from and how many times the logistics activities

will be needed. They are unable to control the basic factors like demand and supply in order to set up an efficient supply chain. Since governments and several NGOs are involved in worldwide HSCs, uncertainties related to operating in a politically volatile climate are also unavoidable (Wassenhove, 2006). Uncertainties in HSCs sometimes make certain services absent due to unexpected shortage and delay that requires NGOs and governments to work in an agile manner. When measuring QoS, adaptability and agility capabilities should be considered in response to uncertainties in the chain.

Crisis driven mechanism

Unlike commercial supply chains that are motivated by profits, HSCs' priority is effective humanitarian aid. Although HSCs are motivated by crisis rather than profits, costs still matter in their performance management. For example, the annual cost is considered as one of the three indicators that are used in the mathematical modeling of inventory in a humanitarian operation (Abidi et al., 2014). Supplies and resources from donors are usually limited, so NGOs would compete for donors' donations by showing their abilities for managing budget, providing relief and improving efficiency. Obviously, there are tradeoffs between costs and suffering in order to obtain the overall objective (Apte, 2009). Nevertheless, great improvements of QoS in HSCs could be achieved at relatively small additional cost (Gupta et al., 2000), so costs and profit are not the main focus in HSCs. However, this crisis driven mechanism in HSCs lacks motivation for QoS measurement (Abidi, et al., 2014), which slows down the pace to develop QoS measurement in the humanitarian sector.

Multiple stakeholders

In commercial supply chains, customer means the people who pay for and receive the goods. But in HSCs, donors along with beneficiaries can be considered as customers in the humanitarian field (Apte, 2009). HSCs' customer definition could be the most different part from commercial supply chains' that will be explained in detail in section 2.6. Stakeholders with different responsibilities and preferences will collaborate with each other to achieve efficient humanitarian response. Services provided throughout collaboration vary from NGOs to 3PL service providers, and QoS is expected differently

from various stakeholders' perspectives. So it is hard to develop a universal QoS measurement that satisfies all stakeholders in HSCs.

Short response time

The fact that humans can survive only a short time without supplies provides a short window of opportunity to rush the supplies to the affected areas, which means the survival time must be incorporated in decision making. This makes the rapid response become a very important factor in humanitarian relief (Chakravarty, 2014) for sudden-onset disasters. Balcik and Beamon (2008) mentioned that the large amounts of demand usually occur in sudden with short lead-time for a range of supplies in HSCs, and there are high risks with the timeliness of deliveries. So timeliness should be considered when measuring QoS.

Poor technical support and undertrained employees

There is insufficient investment in technology, lasted methods, and techniques in mathematical modeling in HSCs (Gustavsson, 2003; Beamon and Kotleba, 2006). As a result of lacking technology support, most supply chains' processes are manual. Moreover, because of high turnover of employees and the presence of temporary volunteers, these persons could not be equipped with enough professional skill to provide effective humanitarian aid to beneficiaries. Besides, employees and volunteers are unable to capture data while working under great time pressure (Abidi et al., 2014). Unlike commercial supply chains that get to know their customers' needs through surveys, questionnaires and reports, HSCs can only have limited data and feedbacks from beneficiaries, which could provide insufficient resources when defining QoS in HSCs.

Hardly formed trust

It is crucial for hastily formed networks to achieve a trusting inter-personal relationship in a very short time frame (Tatham and Kovacs, 2010). Weick (1998) pointed out that on-call staff like volunteers only spend two to four weeks on humanitarian activities in the repeatedly re-formed and re-developed humanitarian supply network, which means the high turnover of staff members weakens the inter-personal trust and depletes institutional

memory. Moreover, different stakeholders with different goals and priorities make it hard to form firm trust between players in humanitarian supply chains (Tatham and Kovacs, 2010). Quality of trust related services, which involving beneficiaries' privacy and confidential information, should be measured carefully.

Unfunctional performance measurement

Measuring and managing performance are crucial for efficient and effective HSCs. The ability to respond swiftly to external disruptions and undertake dynamic operations reflects the operational performance of HSCs (L'Hermitte et al., 2015). However, unlike commercial supply chains whose performance is rewarded by market and internal incentive, HSCs have a lack of incentive to use the lessons learned from disasters in order to improve performance. Moreover, donors will monitor not only the input and output but also the whole operation, which requires humanitarian organizations to be more accountable and more transparent (Wassenhove, 2006). The underdeveloped performance measurement makes it hard for HSCs to obtain continuous developments. QoS is one of the most important dimensions of performance measurement system of HSCs, well-defined QoS would make great contribution to improving performance measurement systems in HSCs.

Collaboration and QoS in need

As mentioned above, QoS is important in terms of measuring performance of HSCs. Just like commercial organizations, NGOs are also competing for suppliers and funding from donors. However, to form a successful collaboration among NGOs enables each organization to perform similar procedures, thus to reduce redundancy and improve efficiency. There is a need for general emergency logistics standards that could be applied to all organizations considering the conflicts arising from the growing trend of specific logistics of different organizations (Beamon and Kotleba, 2006). The Sphere Project has developed those general emergency logistics standards by describing how the approaches and processes taken during effective humanitarian response, and some key indicators are used as signals to know whether the standards are achieved (The Sphere

Project, 2011). QoS can be regarded as those indicators to guide NGOs to achieve efficient collaborations throughout standard procedures in humanitarian response.

2.4 Disasters Classifications and Two Main Humanitarian Aid Phases

In this section, disasters are classified into four types according to their causes and occurrence time. Based on the disasters classifications, two different humanitarian logistics operations are introduced: disaster response and humanitarian relief. In order to propose an adequate framework of QoS in the context of HSC, we will explain why our research scope is narrowed to disaster response to sudden-onset natural disasters.

2.4.1 Disasters Classifications

Humanitarian logistics are involved in various areas related to crisis, such as Celik et al. (2012) mentioned, areas with natural disaster (e.g., earthquakes, tsunamis, floods), poverty, food insecurity, terrorist attacks, and infectious diseases (e.g., AIDS and Zika). On the one hand, disasters can be divided into natural disasters (e.g., earthquake) and human-made disasters (e.g., terrorist attack and chemical leak) based on the cause. On the other hand, they can also be divided into sudden-onset disasters (e.g., hurriane) and slow-onset disasters (e.g., poverty and famine) based on the speed of happening.

There are overlaps of the two kinds of categories (Van Wassenhove, 2006). The overlaps of the categories (e.g., earthquake can be both sudden-onset and natural), which Van Wassenhove (2006) had raised, make it hard to measure the level of difficulty for humanitarian operation in different disasters. Apte (2009) used a graded axis to illustrate levels of difficulty of different disasters (Figure 2.1). We can see that the level of difficulty gets higher from localized to dispersed disasters, from slow-onset to sudden-onset disasters. The level of difficulty in localized and slow-onset disasters is relatively lower because slow-onset characteristic offers sufficient time for preparation, and localized geography makes locating affected area easy. Dispersed and sudden-onset disasters bring the greatest level of difficulty since they have much more uncertainties (Apte, 2009)

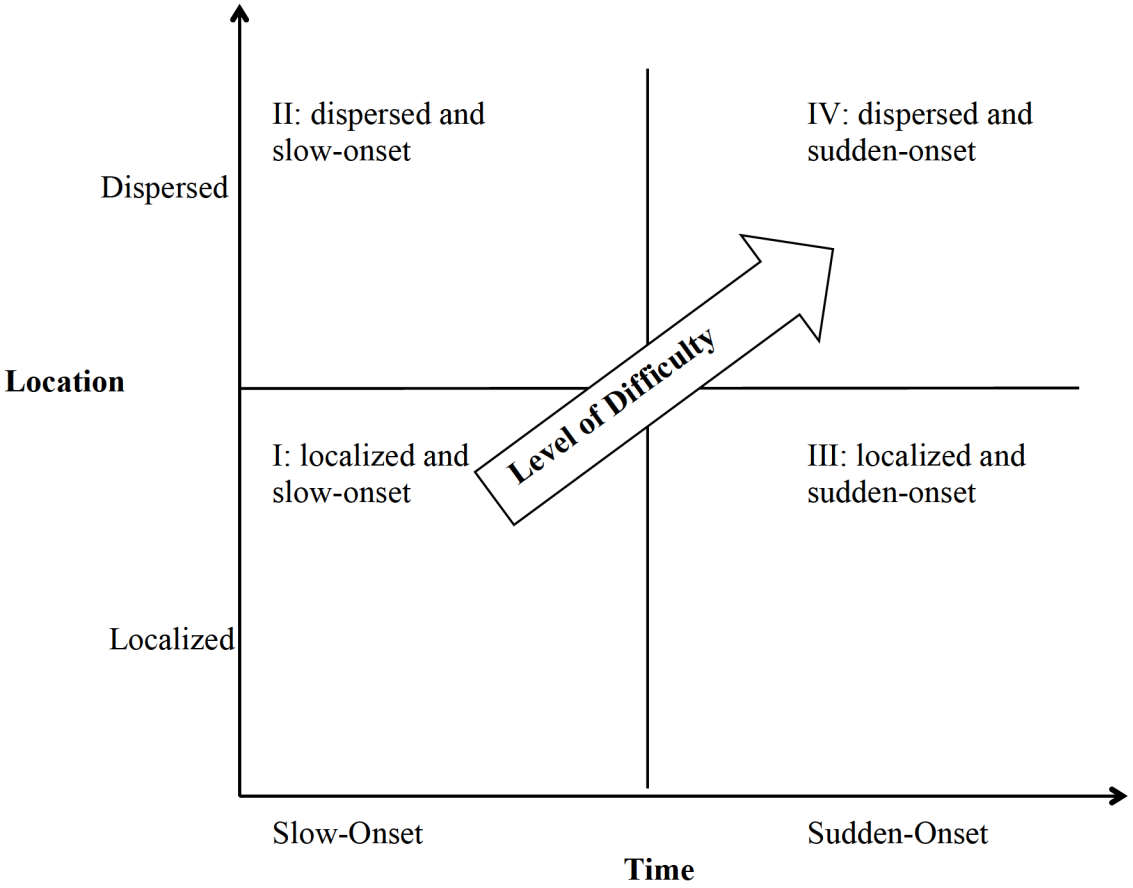

Figure 2.1 Classification of disasters (source: Apte, 2009, p.14)

Cozzolino (2012) extended Van Wassenhove's and Apte's classifications of disasters by taking into consideration the relevant logistics effort. This classification of disasters connects the disasters directly to logistics issues. The four types of disasters (see Table 2.2) can be identified as: calamities, destructive actions, plagues, and crises. Calamities are featured by natural causes and sudden-onset occurrences that need highest logistics effort compared with others. Destructive actions are human-made disasters with high speed of occurrence, and they require much logistics effort. Plagues and crisis are both slow-onset disasters caused by nature and human respectively, so they do not have much logistics effort relevance compared with calamities and destructive actions.

Table 2.2 Types of disasters (source: Cozzolino, 2012, P.7)

Disaster categories		Calamities	Destructive actions	Plagues	Crises
Disaster attributes	cause of the disaster	natural	human-made	natural	human-made
	predictability and speed of the disaster occurrence	sudden-onset	sudden-onset	slow-onset	slow-onset
Relevance of logistics effort	high +	→			low -

Sudden-onset disasters only have short time windows for humanitarian activities without sufficient preparation, and natural disasters usually destroy roads and electricity, which bring more challenges to transportation and communication. We may say that calamities need more logistics effort than other disasters, since calamities put HSCs under more pressures and challenges. However, it is not proper to compare the relevance of logistics effort among different types of disasters since every disaster has the same logistics effort relevance no matter how small the disaster is. So the relevance of logistics effort here can be considered as the complexity of logistics activities.

Natural disasters can be the initiating event for human-made disasters (Ragheb, 2011). For example, flood can lead to dam failure. When we look into the EMDAT/CRED database (www.emdat.be), there are 101 severe natural disasters including animal accidents, droughts, earthquakes, epidemics, extreme temperatures, floods that happened between 2000 and 2016 all over the world. On the other hand, there are 30 technological disasters, which can be regarded as human-made disasters, damage totaling as 16,709,000 USD (Figure 2.2). This damage is not even comparable to the 2010 Somalia's drought alone, whose damage is around 20,000,000 USD. Obviously, whether we look from disaster counts or from the total disaster damage, natural disasters' impact is much bigger than human-made disasters. Because each type of disaster has their particularities (e.g., conflict zones have major security and political concerns), it is important to narrow the scope of the research in order to propose an adequate framework of QoS in the context of HSCs. This master thesis focuses on sudden-onset disasters as they present the highest complexity in terms of logistics activities and are the ones that have the biggest impact.

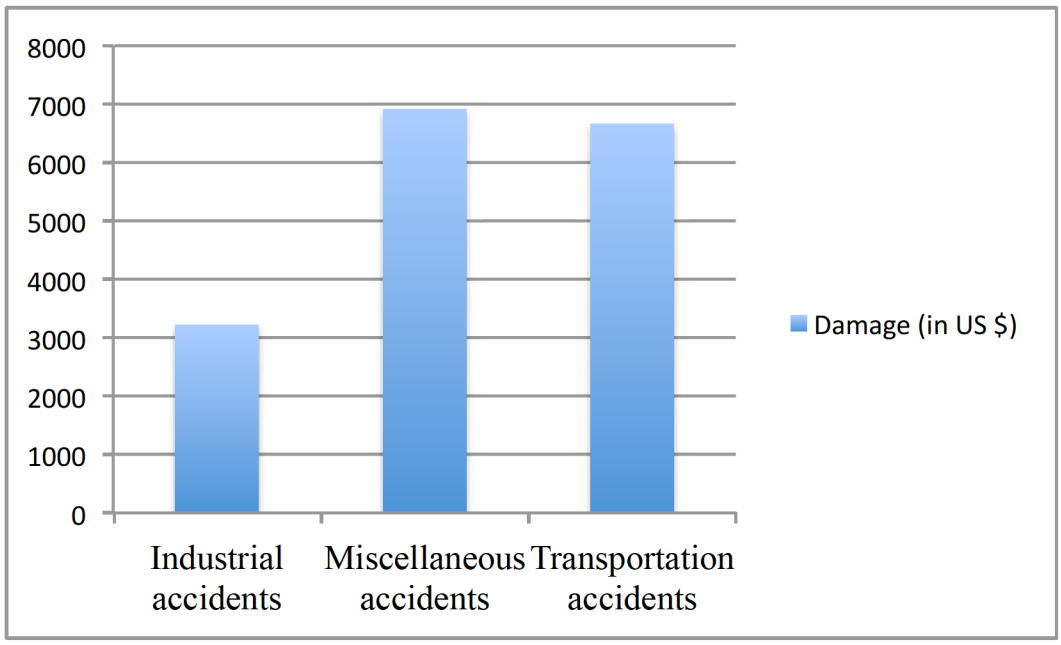

Figure 2.2 Human-made disaster damage from 2010 to 2016 (source: EMDAT/CRED database)

2.4.2 Two Main Humanitarian Aid Phases

Many articles just regard the terms “disaster response” or “humanitarian relief” as the HSC regardless of the different disasters. Different humanitarian logistics operations should be applied to different disasters. Kovacs and Spens (2007) specified two broad aspects for organized humanitarian efforts. One is disaster relief, and another is continuous aid work. In the same lines, Apte (2009) proposed two different humanitarian operation aspects as well: disaster response and humanitarian relief.

During disaster response, humanitarian aids should be delivered to affected populations right after the disasters occurred. Uncertainties in the demand of supplies and donation resources are high due to limited information. However, disaster response attracts more media attention than humanitarian relief does because of its urgency and sudden-onset impacts. More media attraction leads to more donors’ attention, thus creates more potentially financial support. Moreover, disaster response often takes place in concentrated area as sudden-onset disasters usually happen in centralized places. On the contrary, humanitarian relief is a long-term process that has preparation time and needs related information (Apte, 2009). Whereas media cannot follow up all the news in such a long-term process, humanitarian relief cannot attract enough media attention to find a way for sufficient financial support. Long (1997) claimed that disaster response mostly deals with calamities, destructive actions, and plagues. Humanitarian relief mainly works on plagues and crises (Cozzolino, 2012). As mentioned previously, because the great logistics effort required and huge impact that comes along, we will focus on disaster response to sudden-onset natural disaster in this master thesis.

2.5 Life Cycle of Disasters

There are various activities involved within the disasters management cycle. QoS cannot be defined unless its subject - services are targeted. We clarify the main services that are provided throughout the chain by introducing the life cycle of disasters and decision levels in HSC management.

The life cycle of disasters have different impacts on humanitarian operations management. The disaster management cycle includes two phases: relief and development, and four activities: preparedness, response, rehabilitation, and mitigation (Goldschmidt and Kumar, 2016). As the four activities come in a loop, they can also be arranged as mitigation, preparedness, response, and rehabilitation (Tomasini and Wassenhove, 2009a). The relief phase includes response and rehabilitation activities, while the development phase include preparedness and mitigation activities (Goldschmidt and Kumar, 2016).

In mitigation phase, activities like analyzing the potential for hazards and locating service facilities are usually carried out before disasters occur (Celik et al., 2012). It helps prevent the onset of a disaster and lighten the impacts of future disasters (Altay and Green, 2006). The mitigation phase can be regarded as the start of disaster management lifecycle, and as the end of disaster management lifecycle as well, since land use practices and building construction practices are the most common actions taken in this phase (Lindell, 2013). Local government and organizations are mostly involved in reconstruction activities. During the preparedness phase, actions like prepositioning of assets, allocating resources, and planning transportation, are often taken in advance to reduce the risk and vulnerability of communities to disasters. One important step here is to identify the geographic areas and population segments (Berke et al., 2010), which could be done by local emergency management agencies and local household (Lindell, 2013). Response includes evacuating affected population from the disaster. It is the phase that handles the most uncertainties and challenges. The first 72 hours after the disaster occured, as known as the initial response, is vital in order to save as many lives as possible. Following the initial response is the sustained response period, which usually lasts for 90-100 days (Goldschmidt and Kumar, 2016). The response time is quite short but is crucial for saving lives. Usually, international humanitarian organizations, governments, and worldwide commercial companies will be collaborating to save lives within an intensive time window under high uncertainties. Recovery comes after the response, and it lasts for a longer period. Recovery helps affected population to recover from the disaster, and help them rebuild their community in the long term. It is necessary

to build a better community with better resilience against future disasters (Tomasini and Wassenhove, 2009b).

Activities in the disaster management cycle consist of the flows as concluded by Tomasini and Wassenhove (2009b). There are five types of flows in supply chain: material, information, financial, people, knowledge and skills. These flows include not only material and relief products, but also intangible and inseparable services. For example, the first 12 hours are crucial and called the standard relief time (SRT). The speed of transporting relief goods to demand points within this time window is required to offer good transportation service. Geographical information system (GIS) can help to acquire real-time data on transportation network failure (Ahmadi et al., 2015), which provides service for information exchange. These services in different disaster management cycle provided by various stakeholders need to obtain considerable quality to meet different stakeholders' perspectives.

2.6 Stakeholders Involved in Humanitarian Supply Chains

Humanitarian aid providers (e.g., NGOs, governments, donors, etc.) are usually independent and they all have their specific goals regarding to their different responsibilities and prospections. As Balcik et al. (2010) mentioned, actors in humanitarian relief share the same general goal, but their missions, motives, and operating constraints may be different from each other's. This section will focus on stakeholders in HSCs.

The disaster management cycle and decision levels have shown a variety of activities involved in humanitarian operations. The responsibilities of those activities are shared among different stakeholders. Thus, knowing the role of stakeholders is necessary for better coordination and to achieve better service. Based on the literature, there are various key stakeholders involved in HSCs: governments, beneficiaries, donors, the military, NGOs, private sector companies, and even the media (Apte 2009; Kovacs and Spens 2007; Kaatrud er al. 2003; Thomas 2003). After giving definitions to stakeholders in HSCs, collaboration among stakeholders is introduced in subsection 2.6.2 to show the

connections between services and stakeholders as QoS can be improved throughout efficient coordination among stakeholders.

2.6.1 Definition of Stakeholders

Stakeholders can be defined as groups or individuals that affect or are affected by the business (Freeman, 1984). In HSCs, stakeholders could be groups or individuals that affect or are affected by disasters and humanitarian aid activities. Main stakeholders involved in HSC can be described as follow.

Governments. Local governments, neighbouring country governments, and other country governments may be involved in humanitarian aid. Local governments are usually the authorities who lead humanitarian activities (Cozzolino, 2012), and they take the primarily responsibilities on aid provision in response to disasters (Fritz Institute, 2012).

Beneficiaries. Beneficiaries are the affected people who receive humanitarian supplies and services. Different kinds of supplies and services should be targeted to different genders, ages, and cultures of beneficiaries (The Sphere Project, 2011).

Donors. Donors can be foundations, individuals, governments and companies who provide funding for major humanitarian activities.

Military. Military owns anchored distribution networks, so humanitarian logistics can benefit from the underlying reliable structure of military logistics (Apte, 2009). Military is a developed player having the capacity to act in security functions, communications, transport and logistics, construction, command, control, healthcare, and some specialized activities of disaster response (Pettit and Beresford, 2005).

NGOs. Non-governmental organizations include global humanitarian agencies (e.g., WFP, IFRC, CARE) and temporary aid organizations that help organize and assist humanitarian activities.

Private sector. The private sector includes commercial companies, third-party logistics providers (3PLs) or even fourth-party logistics providers (4PLs). Outsourcing logistics services help promote cooperation and adapt solutions to a specific industry or client. The benefits or risks can mostly be shared in a fair manner between partners by outsourcing (Abidi et al., 2015).

Media. Media is an important tool for information delivery. It can help humanitarian organizations attract potential donors and also have a supervisory function on tracking relief performance. As a result, media is a functional tool in humanitarian aid in terms of getting donations, fundraising, communication about local security situation, and some level of stakeholders' coordination (Fritz Institute, 2012).

Fontainha et al. (2015) developed a stakeholder model called the Social-Public-Private Partnership (S3P) model of humanitarian operations (see Figure 2.3). The S3P model classifies stakeholders into three categories: society (international aid network, donor and local aid network), public (military, government and regulatory agency), and private (private sector, direct supplier and media). Local aid network includes NGOs and aid agencies, and international aid network includes governments, governmental organizations, aid agencies, coordinating entities, human rights organizations, and the Red Cross and Crescent Societies. In the private sector, there could be suppliers, universities and other providers of training and education, and regional organizations (Cozzolino, 2012; Thomas 2003 cited in Fontainha et al., 2015).

The S3P model shown in Figure 2.3 was produced to reveal three important messages. The most important one is that beneficiaries are at the center of the stakeholders' relationship networks, the needs of beneficiaries are almost considered in every single action. Secondly, the dashed lines (see Figure 2.3) represents relationships among different stakeholders that are fragile and need to be strengthened. Thirdly, connections among stakeholders are multiple. For example, donors can collaborate with both local

and international aid networks, or can interact with beneficiaries directly (Fontainha et al., 2015).

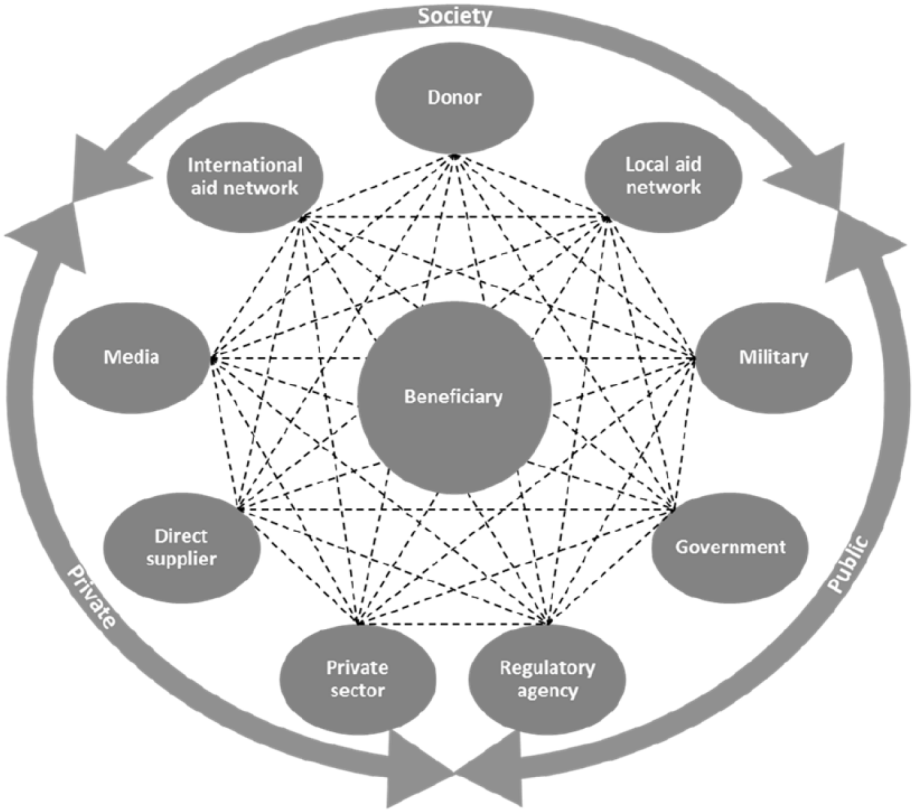

Figure 2.3 S3P integration model of stakeholders in humanitarian operations (source: Fontainha et al., 2015, p.8)

In order to better understand the process of managing disaster responses and the roles of various stakeholders, a case study made by Kabra and Ramesh (2015) about the 2013 Uttarakhand floods will be used as an example. Local administration was responsible for the disaster management under the direction of the State Government and supported by the Government of India. Local administration made emergency planes and carried out relief operations right after the disaster occurred without delay. Based on experience and limited information coming from the disaster site, aid agencies assessed the amount of relief goods to help local and international actors to raise funds. Donations from donors

then came after the request, and sometimes even arrived before the assessment. At the same time, volunteers, the local army, Border Security Force, humanitarian relief organizations, and social media worked together to provide humanitarian service to the affected population (see Figure 2.4). As shown in Figure 2.4, stakeholder groups include district collector, disaster mitigation and management center Government of Uttarakhand, Government of India, NGOs, Government Organizations, and Armed forces composed the relief committee by coordinating with each other.

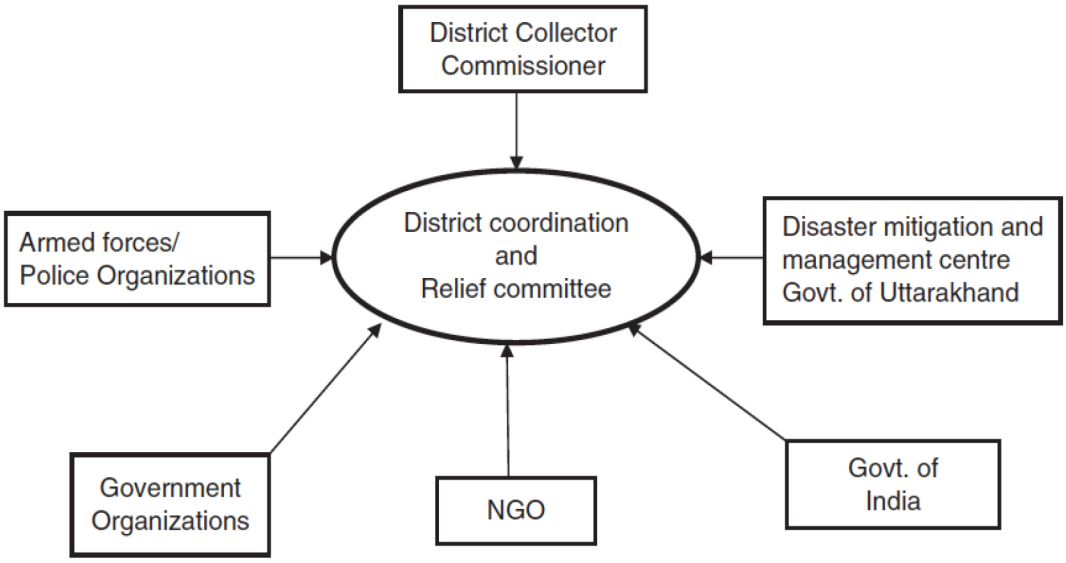

Figure 2.4 Disaster management in Uttarakhand at district level (source: Kabra and Ramesh, 2015, p.35)

2.6.2 Collaboration

As shown in the Uttarakhand case above, coordination and collaboration can be defined as the relationships and interactions among different actors involved in the humanitarian operations (Balcik et al., 2010). There is an increased need for collaboration among humanitarian organizations operating in the same disasters or regions in order to reduce duplication of effort (Thomas, 2003). Coordination among the chain members has been shown to decrease inventory costs, lengthen delivery times, and compromise customer

service (Simatupang et al., 2002). Since logistics accounts for 80% relief of operations (Van wassenhove, 2006), relief chain coordination is the key to improve relief chain performance. Furthermore, studying supply chain coordination helps evaluate the adaptability of conventional supply chain coordination mechanisms to the unique humanitarian environment, and evaluate to what extent humanitarian supply chains can benefit from commercial practices (Balcik et al., 2010).

There are two ways of collaboration and coordination: vertical and horizontal. Vertical collaboration means organization coordinates with upstream or downstream activities. For example, when an NGO coordinates with a logistics provider, the logistics provider has to follow and assist the NGO's guidance and actions. In horizontal coordination, organizations coordinate at the same level and act independently. For example, the United Nations Children's Fund (UNICEF) provides clean water while the United Nations High Commissioner for Refugees (UNHCR) provides temporary shelters for affected population (Balcik et al., 2010).

Collaboration and coordination are the two crucial factors of HSCs. The United Nations Office of the Coordination for Humanitarian Affairs (OCHA) (2010) claimed that coordination of assistance is essential. Collaboration with businesses and local communities can make a difference in delivering the goods, developing capabilities and reducing vulnerabilities (Tomasini & Wassenhove, 2009b). McLachlin and Larson (2011) mentioned that, actually, HSCs share unique drivers, such as increasing awareness, gaining more rapid access to accurate information about what is needed, being better prepared for the next disaster, and providing higher security. As a result, if two humanitarian organizations can be driven together, they can collaborate and coordinate smoothly and efficiently.

However, the complexity of HSCs makes it difficult for organizations to recognize the benefits gained from these interactions and to find working interfaces leading to mutual benefits (Austin, 2000). HSCs include international relief organizations, host governments, the military, local and regional relief organizations, and private sector

companies, each of which have different interests, mandates, capacities, and logistics expertise (Balcik et al., 2010). These players usually have little intention to collaborate and coordinate. It is the disaster that puts them under sudden pressure to coordinate rather than their own intention (McLachlin & Larson, 2011). The humanitarian assistance community, which includes the affected population, NGOs, the United Nations (UN), governments, military units and donors, is defined to be a complex, open, and adaptive system by Seybolt (2009), and poor coordination among these organizations may lead to poor performance and poor QoS.

Fortunately, the importance of coordination is well recognized within humanitarian agencies of the UN. There are different agencies and programs with different tasks within the UN system. For example, the World Food Programme (WFP) mainly focuses on food security problems and UNICEF cares for children (Cozzolino, 2012). The Humanitarian Response Review (HRR) introduced the Cluster Approach (CA) to assign each service area to a specific cluster lead within the UN system (Cozzolino, 2012). CA is regarded as an ideal solution to collaboration and coordination because of its diverse functions in sheltering, logistics, water and sanitation (Jahre & Jensen, 2010).

A cluster is a group of organizations working together on specific topics to help improve humanitarian response performance. The list of the clusters and their respective lead organizations is provided in Table 2.3, which shows the main areas that different clusters work on. For example, WFP is the cluster lead for logistics agencies to coordinate and manage the logistics capabilities of humanitarian relief organizations (HRO), but much of the WFP's achievements come from the strength of its partnerships with other UN agencies, the private sector, and governments (Cozzolino, 2012).

Table 2.3 List of clusters and their respective lead organizations (source: Cozzolino, 2012, p.20)

Cluster (Sector or area of activity)	Cluster lead
Technical areas:	
1. Nutrition	UNICEF (United Nations Children's Fund)
2. Health	WHO (World Health Organization)
3. Water/sanitation	UNICEF
4. Emergency shelter	UNHCR (United Nations High Commissioner for Refugees)
Cross-cutting areas:	
5: Camp coordination/management	UNHCR/IOM (International Organization for Migrations)
6. Protection	UNHCR
7: Early recovery	UNHCR/OHCHR (Office of the High Commissioner for Human Rights)/UNICEF
Common service areas:	
8. Logistics	WFP (World Food Programme)
9: Emergency telecommunications	OCHA (Office for the Coordination of Humanitarian Affairs)/UNICEF/WFP

Clusters include NGOs among other stakeholders. When governments, military, private sectors, and other stakeholders are involved, a complete HSC coordination system is formed. Although types of disaster and relief actors involved may decide on the operational methods they will use, there are usually four common coordination related humanitarian relief activities: procurement coordination, warehousing or inventory coordination, transportation coordination, and collaboration through a system-based 3PL or 4PL (Balcik et al., 2010). Coordination in those stages is inter-connected and cannot be separated.

Vertical coordination aims to synchronise different activities at different levels to obtain overall efficiency and improve customer service, but the clusters have less focus on

vertical coordination (Jahre and Jensen, 2010). Coordination largely happens between the providers of services at the same level in HSCs. For example, coordination between providers of water and sanitation support (Jahre and Jensen, 2010). Balcik et al. (2010) also claimed that coordination among NGOs usually comes in a horizontal way. These clusters make decisions together and share resources and information.

Some recommendations have been made in the literature for clusters and humanitarian agencies to improve collaboration and coordination. Lambert and Knemeyer (2004) put forward four factors that can improve partnership growth: compatibility of corporate cultures, compatibility of management philosophy and techniques, strong sense of mutuality, and symmetry between the parties. Besides, McLachlin & Larson (2011) added that trust is also a necessary and critical element for a long-term and successful relationship.

However, there are challenges of coordination within clusters. One of the challenges is that this kind of coordination might impede coordination across clusters, focusing on functional operations rather than total beneficiary needs. Also, coordination on a global level and on a local level may have conflict between each other because the permanent cluster defines some standards, but the local cluster lead is responsible to a particular response. These challenges highlight the fact that each of the clusters involved in HSCs may define different needs and bring different funding sources, which makes it hard to synchronise the HSCs (Jahre and Jensen, 2010). These challenges and conflicts in coordination demand a call for a framework of QoS to guide clusters to work in the same direction in order to make the HSCs more efficient.

Overall, coordination and collaboration is a manner for stakeholders to work together to ensure that humanitarian flows work efficiently. However, flows in HSCs (materials, products, information, professional skills and donations) still need to be put under specific supervision, control, and measurement to ensure their validities and quality throughout humanitarian response operations. For example, service aspects such as

reliability of donors, responsiveness of suppliers and speed of transportation should be handled carefully.

2.7 The Role of Information Technology

The increasing number of natural disasters and the resulting humanitarian emergencies put humanitarian organizations under great pressure to deliver humanitarian aid in an appropriate and cost-effective way (Thomas and Kopczak, 2005). From the particularities of HSCs in section 2.3, we may agree with Kovacs and Spens (2011) that the humanitarian aid sector is old-fashioned. Although the actual challenges of HSCs depend on the type of the disasters as well as the region (Kovacs and Spens, 2009), the main and unique challenge is the collaboration and coordination (Celick et al., 2012).

Collaboration among different stakeholders raises the needs for the adoption of advanced information technology (IT) systems in the humanitarian management process (Kabra and Ramesh, 2016). Using IT can improve the efficiency of relief activities (Tomasini and Van Wassenhove, 2009b). For example, IT can enhance sharing of information, funds and products, so that the staff in the field can communicate about real-time road conditions effectively (Kabra and Ramesh, 2015). The Internet and the mobile phones also made "citizen journalism" possible (Benthall, 2008). For instance, in the 2008 Sichuan earthquake, Sina Webo (Chinese popular social media) users updated information related to affected population and local road situation even faster than mainstream media. Although rumours cannot be totally avoided in this "citizen journalism", social media plays a great role in information exchange and attracts people's attention in disaster response. For example, social media helps humanitarian organizations to share capacity levels and resource availability to improve coordination among stakeholders (Sarcevic et al., 2012).

Clearly, IT and the media have a great influence on HSCs' performance. Rapid information diffusion is important for humanitarian organization to be familiar with conditions in affected communities (Oloruntoba and Gray, 2006). Humanitarian organizations have aggregated real-time and first-hand data on social media to create

maps of affected location by showing landmarks and geographic characteristics to facilitate logistics and transportation activities (Meier, 2012).

Benefiting from the efforts that the whole humanitarian community made, HSCs will be integrated better in the future, and one of the most obvious future trends in HSCs is the standards and modularity facilitated by IT. Standards create homogeneity in different organizations and can play a role as a coordination mechanism. Modularity can be functioned as an approach to reduce supply chain risks and achieve flexibility (Kleindorfer and Saad, 2005; Squire et al., 2009). QoS could thus be increased by the presence of IT in HSCs.

To conclude this chapter, it is important to emphasize that it is urgent for all industrialised nations to raise productivity for the service sector (Heaslip, 2013). Meanwhile, the humanitarian sector should also pay attention to the service productivity because customer service is a necessary attribute for efficient humanitarian supply chains (Oloruntoba and Gray, 2009). Recently, international humanitarian organizations have started to develop services into humanitarian activities. For instance, WFP provides transportation, customs clearance, and inventory services to logistics clusters (Heaslip, 2015). It is thus vital to study the integration between service operations management and HSCs. Considering service has a great impact on HSCs' productivities and performance, the most inevitable trend is to apply service operations management concept to humanitarian supply chain by defining QoS in HSCs.

Chapter 3 Methodology

This chapter introduces the methodology that will be used in this thesis to answer the research question. As the main contribution, a conceptual framework based on the literature will be developed to define QoS in HSCs.

3.1 Research Question

In this thesis, the central research question is "How to define QoS in the humanitarian supply chain? ". In order to answer this central research question, some sub-questions should be answered to narrow the focus of the study such as "what is QoS?", "what is humanitarian supply chain?", "what are the services provided in HSCs?", "what research has been conducted on QoS in HSCs?". The goal of this master thesis is to find a way to define the QoS in HSCs, which meets all stakeholders' perspectives in the chain. In order to achieve this goal, a conceptual framework should be made to integrate many concepts (QoS, HSCs, stakeholders, etc.) into the humanitarian context.

3.2 Conceptual Framework Methodology

Jabareen (2009, p. 51) described a conceptual framework as "a network, or a plane, of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena". The author also gave some particularities of conceptual frameworks showing that a conceptual framework is not only a set of concepts but also a construct where each concept plays an integrated role. A conceptual framework is also a "translator" to interpret the social reality in order to provide understanding rather than a theoretical explanation. Besides, a conceptual framework does not help to predict a result because of its indeterminism nature (Jabareen, 2009). A conceptual framework for defining QoS in HSCs should provide a better understanding on what are the different attributes of QoS in the specific context of HSCs.

3.3 Literature Reviews

Designing a conceptual framework based on a literature review suits the research background and environment. Since the particularities of HSCs require research to be carried out based on existing factors and experience, learning from published literature on HSCs and QoS is a good approach for creating a framework specific for the humanitarian context. Also, high turnover of employees and volunteers, intensive time phase and the absence of support tools lead to insufficient data and unsystematic records in today's HSCs (Apte, 2009). That is why it is preferable to create a framework based on a literature review than to do a quantitative research on this topic.

Jaccard and Jacoby (2010) also mentioned that the most commonly recommended strategy for gaining perspective on a phenomenon or question is to refer to the published scientific literature in the field. A comprehensive literature review can provide a useful source of ideas and is an essential prerequisite for a scientific research. Journal papers can provide validated knowledge and are likely to have the highest impact on the field (Ordanini et al., 2008). Indeed, established influential journals tend to shape the theoretical and empirical work in a field by setting new horizons for inquiry within their frame of reference (Furrer et al, 2008, p.22).

Literature reviews are vital in management and organization field. Systematic literature reviews (SLRs) are used when collecting QoS attributes from the literature. Theories would be isolated from each other and bodies of empirical research would be just a list of findings without the literature reviews (Benson et al., 1992). However, traditional literature reviews are often affected by selection bias because only major studies in a particular area are included (Easterbrook et al., 1991). Writers may pick and select the papers that support their own point of views, which also causes selection bias in traditional literature reviews (White and Schmidt, 2005). Similarly, narrative reviews are subjective and therefore can lead to bias and error (Columb and Lalkhen, 2005). On the contrary, SLR is an overview of primary studies using defined methods and criteria (Columb and Lalkhen, 2005). SLR aims to identify all the studies addressing a specific question and its methodology is developed to minimize selection bias, publication bias,

and observer bias (Nightingale, 2009). It follows a list of steps to ensure that relevant studies regarding to a specific topic are obtained (Denyer and Tranfield, 2009). Bias can be avoided by deciding in advance what evidence to use, which makes the decision-making uninfluenced by the evidence (White and Schmdit, 2005). There are other specific strengths of SLR, such as its efficient research design, information combination of several primary or individual studies, increased internal validity, etc. (Manterola et al., 2013).

The first use of SLR was in 1992 about thrombolytic therapy in the medical field (Nightingale, 2009). Applications of SLR in medical science led the way to the most advanced thinking (Denyer and Tranfiedl, 2009). Now SLR is also used in many other fields such as nursing and allied health professions, psychology, educational research, and business and management (Adolphus, 2013). In order to minimize the selection bias, a protocol should be developed to clearly define the aims and objectives of the review, the inclusion and exclusion criteria for the studies, the way in which studies will be identified, and the plan of analysis (Nightingale, 2009). There are five main steps to carry out a SLR (White and Schmidt, 2005): framing the research question and choosing a protocol, identifying relevant studies, extracting relevant data, summarizing the evidence, and interpreting the evidence. These steps will be followed carefully.

3.4 Methodology Applied in This Master Thesis

The goal of this master thesis is to define QoS in HSCs and develop a conceptual framework to illustrate this complete construct. To summarize, in this thesis, we mainly use the most recent literature related to the areas of the humanitarian sector, supply chain management in general and QoS in supply chains to help provide an overall view. The Sphere Project will also be introduced as a benchmark for the QoS in the humanitarian sector as it is commonly used by practitioners on the field. However, a literature review may sometimes restrict our mindset, so it is important to use literature review wisely. The norm is to look into the extant literature in depth before building a framework as suggested by Jaccard and Jacoby (2010).

Note that humanitarian logistics, which is in a smaller scope compared with the HSCs, is also considered and discussed in this thesis since humanitarian logistics and HSCs are not distinguished in some literatures. In order to create the conceptual framework, a general literature review was performed on QoS and HSCs to clarify the basic concepts. Besides, SLRs on QoS in HSCs and QoS in commercial supply chains are also performed as described to identify the QoS attributes proposed in the literature. A parallel between what was found in the literature and what is used by practitioners is also made to refine the findings. A framework is then built based on the relationships among important concepts to illustrate the QoS in HSCs

Chapter 4 Systematic Literature Review

In this chapter, a systematic literature review on QoS related to logistics and supply chain in the humanitarian field is conducted first to better define the concept. However, not much attempts in the literature have been made to define QoS in the HSCs. Thus, a SLR on QoS in commercial supply chain is also conducted to provide additional information on QoS attributes. QoS attributes extracted from the SLRs will be summarized and consolidated, and then adapted to the humanitarian context.

This chapter details the systematic literature review process for identifying QoS attributes in supply chains. Research questions are made in order to give the direction when doing the systematic literature review. The evidence is interpreted based on the relevant data, which are extracted from identified studies in five search databases, and research questions are answered as well. The systematic literature review on QoS attributes in supply chains identifies existing QoS attributes in the literature. These existing QoS attributes identified in humanitarian supply chains and commercial supply chains will be further analyzed and selected in chapter 6 in order to better define the QoS in humanitarian supply chains.

4.1 A Systematic Literature Review on the Quality of Service in Humanitarian Supply Chains

As mentioned in the methodology section, there are five main steps to carry out a SLR (White and Schmidt, 2005): 1) frame the research question and choose a protocol; 2) identify relevant studies; 3) extract relevant data; 4) Summarize the evidence; and 5) interpret the evidence. In the following sub-sections, we describe in more details these five steps. A protocol describes how the decision will be made to include studies, how the quality of included studies is assessed, and how the results are summarized and interpret (White and Schmidt, 2005). The protocol designed to define and guide the systematic literature review process here includes five steps: 1) searching the databases; 2) identifying relevant publications; 3) extracting relevant data; 4) summarizing and interpreting the evidence.

4.1.1 Research Questions

Since our aim is to define the QoS in supply chain and logistics in the humanitarian context, we can define the main research question as " What research has been conducted on QoS in HSCs? ". In order to answer the main research question, three sub-questions are proposed as follow:

- How QoS was defined in the HSC literature?
- How QoS was measured in the HSC literature?
- How QoS influence the HSCs' performance?

4.1.2 The Search Process in the Systematic Literature Review

In order to have an overall coverage of studies, the systematic literature review should use an overall search rather than a specific search. Using different search terms and combination of keywords are helpful to find the most targeted studies (White and Schmidt, 2005). Based on the research questions above, keywords can be defined as shown in Table 4.1.

Table 4.1 Keywords to search

Keywords for QoS	**Keywords for HSC**
service + customer satisfaction	humanitarian supply chain
quality of service	humanitarian relief operation
service quality	disaster response
	disaster relief
	emergency response
	humanitarian logistics
	emergency operations
	emergency logistics

There are three keywords for QoS (see Table 4.1). Because the term "quality of service" has low relatively frequency in the literature, so using "service" along with "customer

satisfaction" may result in broader search findings. The term "service quality" and "quality of service" are interchangeable, so both of them can be considered as the keywords for QoS. Considering the complexity of the humanitarian supply chain, terms that are related to logistics, disaster, relief, and emergency are all considered as keywords, which can be humanitarian relief operation, disaster response, emergency response, etc.

Because Oliver and Weber first introduced supply chain management in 1982 (Oliver and Webber, 1982; cited in Christopher, 1992), the period of publications we searched is from 1982 to 2016. We excluded some types of publications such as papers from a conference, technical papers and reviews due to their limited quality and the possibility that they would be duplicates of other published papers. Thus the types of publications we searched were books, journals, thesis, case studies, country reports, government documents, etc. Each keyword for QoS was combined with each keyword for HSC when searching in five databases by using the advanced search method: ABI/Inform Collection, Business Source Complete (EBSCO), Emerald (MCB University Press), Journal Storage, and ScienceDirect (JSTOR, Elsevier).

The number of publications identified by this process is shown in Table 4.2. Because the search options of these five databases differ from each other, the search scope and publication type selection may be slightly different. Eleven publications were identified in ABI database. The search scope included all the elements but the full text, and the source types were limited within books, scholarly journals, dissertations and thesis. There were also eleven publications found in EBSCO database by searching for title or abstract or keywords. The publication types were limited to academic journal, case study, dissertation, book, country report, and government documents in the EBSCO database. There was one, one, and nine publications found respectively in database Emerald, JSTOR, and ScienceDirect by using the same search scope.

Table 4.2 Number of publications identified in five databases

Database	**Scope of the search**	**Number of publications**
ABI	Anywhere except full text	11
EBSCO	Title or abstract or keywords	11
Emerald	Title or abstract or keywords	1
JSTOR	Title or abstract or caption	1
ScienceDirect	Title or abstract or keywords	9

4.1.3 Identify Relevant Publications

In this section, we identified relevant publications by following two steps. First, we excluded nine duplicates from the 33 searching results. After excluding duplicates, we had 24 searching results in total. We then selected relevant publications based on the content in the titles, keywords, and abstracts. As a result, nine publications were selected while 15 publications were excluded because they did not fall into the HSC field or were not about sudden-onset disasters. For example, Capon et al. (2001) made a case study applying the SERVQUAL, which is an instrument to measure service quality performance, to the British Sussex Police Force to discuss the reliability and effectiveness of the SERVQUAL in terms of its influence on the police service performance. This paper was excluded since the context is not related to HSC, and it does not target at sudden-onset disasters either.

4.1.4 Extract Relevant Data

Then, for each of the nine publications, the complete content was read and analyzed since the title and abstract can sometimes be misleading.

We now summarize the nine studies obtained from the search screen process. In order to evaluate performance of nonprofit social service organizations, Medina-Borja and Triantis (2007) made a conceptual framework that includes four main dimensions of performance: revenue generation, capacity creation, customer satisfaction, and outcome achievement. Service quality was regarded as one dimension of the performance concept.

The SERVQUAL was used to measure QoS in Medina-Borja and Triantis's integrated performance measurement system for nonprofit service. Some of the measurements from the SERVQUAL such as timeliness, empathy, reliability and assurance were included in the data envelopment analysis (DEA), which were used to formulate and analyze related data to determinate measurement results.

The implementation of DEA was further introduced by Medina-Borja et al. (2007). They presented one of the first published large-scale implementations of DEA as part of a performance management system for organizations in the nonprofit sector. The DEA performance management implementation cycle included seven parts: variable identification, DEA formulation development, system requirements specification, conceptual performance model development, information portrayal, software support, and integrated performance management system with DEA engine. Medina-Borja et al. (2007) pointed out that most social service effectiveness and service quality data can be included in a DEA evaluation; still, four QoS attributes were directly introduced: timeliness, empathy, reliability, and assurance. They also introduced the advantages and features of the DEA and developed a conceptual model to evaluate nonprofit social service performance.

Oloruntoba and Gray (2009) demonstrated the importance of a customer service analysis to improve the efficiency of humanitarian supply chain. They introduced a very general concept of customer service in emergency relief chains. However, this literature-based conceptual framework did not provide any information about quality and service quality in humanitarian supply chain. It was thus excluded.

Dhaini and Pin-Han (2011) introduced MC-FiWiBAN, which is a new emergency-aware fiber-wireless (FiWi) access network supporting communication in the case of a disaster and providing mission-critical service support. It shows the advanced technology in the communication field. The authors explained the MC-FiWiBAN mechanism in detail and also mentioned the QoS requirements in the VPN service level agreement. Although Dhaini and Pin-Han (2011) regarded security level, custom network control, fast network

access, a fine degree of QoS assurance, and bandwith guarantees as QoS determinate attributes of MC-FiWiBAN, the topic of the study was about telecommunication rather than the HSCs. This paper focusing on Mc-FiWiBAN was excluded.

Rawls and Turnquist (2011) regarded QoS as constraints to a two-stage stochastic programming model in disaster preparedness planning. They extended a two stage stochastic programming model by including specific quality constraints to the uncertain demands when carrying out facility location and resource location activities. These QoS constrains were response time, delivery time and confidence level of demand. The authors also used a quantitative model and a case study to conclude that service quality constrains could increase operational cost.

McLay et al. (2012) used regression to analyze the volume and nature in emergency medical 911 calls during two types of severe weather events: blizzards and hurricane. They focused on the performance of emergency medical service (EMS) in emergency preparedness. There were multiple linear regression models, which used real world data in a case study, for modeling response and service time to estimate the changes in travel and treatment times, but the response time and service time themselves were not discussed extensively.

He et al. (2013) developed a systematic optimization method to improve the performance of emergency good transportation networks in metropolitan areas. This optimization method was a queuing modeling that helped to select emergency logistics centers and optimize vehicle routing in order to minimize response time. Here, the response time, which included transportation time, queue waiting time, and service time of relief goods, was the only element related to QoS.

Similarly, Hu et al. (2013) proposed a two-stage stochastic location model to analyze the impact of the transportation cost and time in peace and disaster time. They studied the location problem with uncertain demand in peace time and uncertain road conditions in disaster time. After introducing two stochastic integer linear programming models in

peace and disaster time, they used a case study to simulate and validate their work. Although they proposed an interesting model to serve as a useful tool for locating suppliers in peace and disaster time and to improve the HSC performance, they did not consider the QoS attributes. This paper was excluded.

Verma and Gaukler (2015) made a comparison between two location models that include and internalize the assumption of distance-dependent damages of disaster response facilities and population centers in a case study. One was a deterministic model used as a basic benchmark to represent the performance of deterministic large-scale emergency models. Another one was a two-stage stochastic programming model taking into consideration the damage caused by a disaster to facilities and population centers as stochastic. They analyzed their models' performance by changing the density of facilities and penalty for second-tier sourcing. However, they did not consider QoS aspects. Overall, this paper focused on a location selection problem and aimed to improve the HSC performance in terms of costs. It was thus excluded because no QoS attributes were discussed.

4.1.5 Summarize and Interpret the Evidence

We can see that a few QoS attributes were mentioned throughout these studies. By reading the complete article, it happens that only five of the studies addressed the QoS by considering specific attributes. Rawls and Turnquist (2011) identified delivery time, response time, and confidence level of demand as QoS attributes in facility location and resource allocation activities. He et al. (2013) and McLay et al. (2012) both used delivery time to measure the QoS in humanitarian transportation system and emergency preparedness in blizzards and hurricane weather respectively. Timeliness, empathy, reliability, and assurance were used to measure the QoS by DEA (Media-Borja and Triantis, 2007; Media-Borja et al., 2007). Collectively, timeliness including delivery time and response time, empathy, reliability, and assurance are the four QoS determinants that we identified from the SLR on QoS in HSCs. Table 4.3 gives a classification matrix for the five remaining papers. These papers were classified based on the three research

questions we proposed in Subsection 4.1.1 in order to understand how QoS was defined, how QoS was measured, and how QoS improved HSC performance.

Table 4.3 Paper classification matrix

	QoS attributes	**Measure**	**Improve**
Conceptual	-Medina-Borja and Triantis (2007) -Medina-Borja et al. (2007)	-Medina-Borja et al. (2007)	-Oloruntoba and Gray (2009)
Empirical	-McLay et al. (2012)		
OR	-He et al. (2013) -Rawls and Turnquist (2011)		-Verma and Gaukler (2015) -Hu et al. (2013) -Dhaini and Pin-Han (2011)

Considering that the four QoS attributes determined above are not enough to define an overall QoS in HSCs, we will expand our search scope by considering the QoS attributes used in the supply chain literature. A systematic literature review on QoS in the supply chain could help us learn about the experience in a more general domain and borrow applicable attributes to define QoS in HSCs.

4.2 A Systematic Literature Review on the Quality of Service in Supply Chains

In this section, a SLR on the QoS in supply chain will be made to discover more QoS attributes in order to define an overall QoS in the HSC context. The research questions and search process will be slightly different from what we used in the SLR of HSCs. They will be described in the next sections.

4.2.1 Research Questions

Based on the research questions developed in Subsection 4.1.1, the main research question here is "What research has been conducted on QoS in supply chains in the literature? ". In order to answer this main research question, three sub-questions are proposed as follow:

- How QoS was defined in the supply chain literature?
- How QoS was measured in the supply chain literature?
- How QoS influence supply chains' performance?

As for QoS in HSCs, four steps are followed to carry out the SLR: identify relevant studies, extract relevant data, summarize the evidence, and interpret the evidence (White and Schmidt, 2005). These steps are detailed in the following.

4.2.2 The Search Process in the Systematic Literature Review

Before deciding the search keywords for supply chain management in general, an attempt was made to see how feasible this search process would be. We searched by keywords "supply chain", "transportation", "warehousing", and "purchasing" to see how many studies would be shown in the five selected databases. More than 2,000 results were found by using the combination of keywords for "transportation" and "quality of service" in the database ABI alone. In order to narrow down the search scope, we use a general concept "supply chain" as the keyword to search in combination with keywords for QoS (see Table 4.4).

Table 4.4 Keywords to search

Keywords for QoS	**Keywords for supply chain**
service + customer satisfaction	supply chain
quality of service	
service quality	

The databases search period and types of publications were the same as those of HSC's search process. The number of publications identified by this search process is shown in Table 4.5. In total, 294 books, scholarly journals, dissertation and thesis were identified using ABI. There were also a large number of publications found in EBSCO (171 results). In the databases Emerald and JSTOR, only three results and one result were found, respectively. 76 results were found in ScienceDirect. Thus, we obtained a considerable number of publications (545) to conduct a SLR on QoS in the supply chain.

Table 4.5 Number of publications identified in the five databases

Database	**Scope of the search**	**Number of publications**
ABI	Anywhere except full text	294
EBSCO	Title or abstract or keywords	171
Emerald	Title or abstract or keywords	3
JSTOR	Title or abstract or caption	1
ScienceDirect	Title or abstract or keywords	76
	Total number of publications	545

4.2.3 Identify Relevant Publications

Considering the number of papers identified in the five databases, we first excluded 194 duplicates and then conducted the first screening based on titles and abstracts. The main consideration when screening the studies was whether QoS was defined in the articles. The definition of QoS was the general selection criteria, and most studies were excluded because of one of the following reasons: 1) QoS was mentioned but not analyzed or explained; 2) QoS was not the target; 3) service was introduced without quality; 4) studies focused on the relationship between one specific QoS aspect and another element; 5) studies were more related to performance management.

The first exclusion reason is that QoS was mentioned but not analyzed or explained. In most studies, QoS was regarded as an element or additional constraint of a testing model, which aimed at improving supply chain performance or selecting suppliers. For example,

Govindan, Khodaverdi & Vafadarnikjoo (2016) concluded that service quality, human resource policies, customer service, time delivery performance, technological capability, and financial stability were the most important criteria for 3PL provider selection without defining the QoS aspect. Hojung Shin, Collier & Wilson (2000) studied the influence of supply management orientation (SMO) on suppliers' operational performance and buyers' competitive priorities, QoS was just one component of the buyers' competitive priorities. Thus, such studies do not provide a clear definition of QoS.

The second exclusion reason is that QoS was not the target. Many excluded studies' topics were about the introduction of new technologies or models that could bring improvements to supply chains' performance. Thus, the resulting improved QoS would be mentioned in the conclusion part to show the advancement of that technology or model. For instance, Lai, Li, Wang & Zhao (2008) tested that IT capability affected competitive advantage of 3PL, because customized services were provided and service quality was improved under such positive influence from IT capability. In this study, QoS was not defined nor introduced either.

The third exclusion reason is that service was introduced without quality. Since our thesis focuses on QoS, only mentioning service was insufficient. For example, Sautter, Maltz & Boberg (1999) developed a course regarding customer service, but quality of customer service was not mentioned.

The fourth exclusion reason is that studies focused on the relationship between one specific QoS aspect and another elements. Some studies mainly explored the relationship between one specific QoS aspect and other supply chain factors such as profits, strategies, and product types. As a result, under such condition, authors often regarded QoS as a general idea and did not analyze and determine what is QoS. For example, Saura, Servera Francés, Berenguer Contrí & Blasco (2008) explored the relationships among service quality, customer satisfaction and loyalty in the supply chain in terms of information and communication technologies (ICT). The result emphasized the intensity of these relations rather than define service quality.

The last exclusion reason is that studies were more related to performance management, some were not even related to QoS. For example, Chahal, Dangwal & Raina (2014) examined the domain of green marketing construct in the context of small and medium companies operating in developing countries without mentioning any QoS concepts.

Based on the five exclusion reasons above, 485 papers including duplicates were excluded and 60 papers were ultimately kept for further analysis. The second screening was carried out based on the contents of those 60 papers since sometimes titles and abstracts can be misleading. After reading the full content, 24 papers were further excluded based on the same excluding reasons in mentioned above. Five papers focusing on internal QoS were also excluded. Since internal QoS is about internal supplier and internal customers such as departments and employees within an organization (Umamaheswari, 2014), the internal QoS is more about human resource rather than supply chain management. As a result, 31 papers were considered for further analysis.

4.2.4 Extract Relevant Data and Summarize the Evidence

These 31 papers were classified based on their methodologies and purposes. Table 4.6 shows the classification matrix of these papers. Summaries will be given based on the groups of papers of this classification matrix.

Table 4.6 Paper classification matrix

	QoS attributes	Measure	Improve
Conceptual	**Group 1**	**Group 4**	**Group 7**
	-Langley and Holcomb (1992) -Gunasekaran et al. (2001) -Bottani and Rizzi (2006) -Grimaldi and Rafele (2007) -Alvarez-Rodríguez et al. (2014) -Hawkins et al.	-Bottani and Rizzi (2006) -Alvarez-Rodríguez et al. (2014)	-Angeliki and Loukas (2003) -Sánchez-Rodríguez et al. (2004) -Yang et al. (2006)
Empirical	**Group 2**	**Group 5**	**Group 8**
	-Seth et al. (2006a) -Seth et al. (2006b) -Seth et al. (2006c) -Yuen (2006) -Acharyulu and Shekhar (2012) -ÇErri (2012) -Azizi et al. (2014) -Nathavat and Siri-on (2014) -Parmata et al.	-Seth et al. (2006a) -Seth et al. (2006b) -Seth et al. (2006c) -Garver et al. (2010) -Acharyulu and Shekhar (2012) -Azizi et al. (2014) -Nathavat and Siri-on (2014) -Parmata et al. (2016)	-Yuen (2006) -Öztayşi et al. (2009) -Zhang et al. (2013)
OR	**Group 3**	**Group 6**	**Group 9**
	-Ren and Zhou (2008) -Huang et al. (2013) -Agrawal et al. (2015)	-Chen et al. (2002) -Chen et al. (2004) -Agrawal et al. (2015) -Merkert and Assaf	-Gupta et al. (2000) -Huang et al. (2013) -Liu et al. (2013)

Group 1

Group 1 includes papers that built conceptual frameworks based on literature reviews and defined QoS in supply chains. Langley and Holcomb (1992) presented three pathways for logistics to create customer value while introducing four attributes of QoS: customization, flexibility, innovation, and responsiveness. Gunasekaran et al. (2001) developed a framework to measure supply chain performance on a strategic, tactical and operational level separately. Based on a literature review, a list of key performance metrics is

presented, such as cash flow time, customer query time, and truthfulness of demand. Bottani and Rizzi (2006) developed a model based on quality function deployment (QFD), which is used in the Toyota Production System, and fuzzy model to manage customer service. The developed model could be used to select the most efficient and effective logistics leverage to achieve customer satisfaction. An ordered framework for logistics indicators, named LogistQual, was developed by Grimaldi and Rafele (2007) based on the SERVQUAL model, which includes five dimensions of QoS: tangibles, reliability, responsiveness, assurance, and empathy (Parasuraman et al., 1988). QoS attributes in supply chain were divided into three parts in LogistQual, which are tangible components, ways of fulfilment, and informative actions. Alvarez-Rodríguez, Labra-Gayo & de Pablos (2014) defined the common characteristics of cloud services by the Cloud Service Measurement Index Consortium (CSMIC) and attempted to create an e-Procurement index to measure the QoS of procurement systems based on the last version of CSMIC. Hawkins et al. (2015) provided a conceptual framework and proposed hypotheses about the relationship among QoS and its determinants. Five determinants related to QoS were developed, including sufficiency of requirement definition, communication, sufficiency of lead-time, internal customer commitment, and monitoring. Lin et al. (2016) proposed a two-dimensional service quality framework based on a triadic view. This conceptual framework of QoS for online shopping was made in the context of e-retailing supply chain that reflected the two dimension: e-service and logistics in the QoS framework. Nine elements related to QoS were mentioned: personnel contact quality, order release quantities, information quality, ordering procedures, order accuracy, order condition, order quality, order discrepancy handling, and timeliness.

Group 2

Papers in the second group were empirical research using surveys and questionnaires. These papers also provide QoS attributes. Seth et al. (2006a) presented a conceptual framework model of QoS in supply chains based on gap analysis while introducing various dimensions of QoS reported in literature. The authors used dimensions of QoS based on an exhaustive literature review and 14 in-depth open-ended interviews to understand the importance of QoS in supply chain and identify different factors that

affect QoS in the supply chain. Similarly, Seth et al. (2006b) proposed a model for assessing the QoS at various interfaces of supply chain using 3PL. This model was based on concepts proposed in the literature, which were the dimensions of QoS proposed by Parasuraman et al. (1985) and a related framework proposed by Gunasekaran and Ngai (2003). The results were combined with information of different interviews. Seth et al. (2006c) also studied the QoS of suppliers in the supply chain. Literature reviews and interviews were used to help reveal seven factors for measuring QoS of suppliers. These factors included service reliability, credibility, service competence, intra-organizational communication, service flexibility, financial trust and pleasant environment. The authors claimed that these factors were different from the most popular QoS measurement tool for service sectors, i.e., the SERVQUAL. Yuen (2006) studied the relationship among QoS of 3PL, organizational effectiveness, and relationship management with service partners by collecting and analyzing data from surveys. QoS attributes of 3PL used in this work were the five dimensions coming from the SERVQUAL (Parasuraman et al., 1988).

Also included in Group 2, Acharyulu and Shekhar (2012) focused on the hospital value chain in India whose clinical and non-clinical operations must be linked by designing a customer centric supply chain. A survey was conducted based on the internal metrics collected from hospital supply chain operations by selecting eight parameters which were reliability, responsiveness, assets, cost, revenue, customer satisfaction, sustainability, and safety. After measuring the importance of each parameter, it was suggested that hospitals should emphasize more on responsiveness, reliability, and safety (Acharyulu and Shekhar, 2012). Çerri (2012) proposed five hypotheses related to the relationships among logistics service quality, commitment, and customer loyalty, and tested these hypotheses through questionnaires and structural equation modeling. The QoS determinants were determined in accordance with existing literatures (Stank et al., 2003; Stank et al., 1999; Mentzer et al., 2001) that could be concluded as date, quantity, accuracy, communication, efficiency, and responsiveness. After testing all the hypotheses of the relationships, the results indicated that the role of logistics service quality was crucial in the loyal-commitment-performance chain of relations (Çerri, 2012). Azizi et al. (2014) used in-depth interviews with 16 Iranian retailers to identify ten key factors of physical

distribution service quality (PDSQ), which were date, time, communicate, quantity, undamaged, brand, respect, complain, billing, and punctuality. A test was used to rank PDSQ factors to show their importance and satisfaction level, and the result showed that the delivery of undamaged order was known as the most important factor. Nathavat and Siri-on (2014) developed a supplier performance evaluation model for a company to find the most important criteria when selecting a supplier. The evaluation criteria were determined by interviews and surveys that included four main criteria and several sub-criteria. The result of the analytical hierarchy process model showed that quality is the most important criteria when selecting suppliers for piping materials. Parmata et al. (2016) revalidated the SERVQUAL scale to measure distributor perceived QoS in pharmaceutical supply chain.

Group 3

There are four papers using operations research method and giving QoS attributes in Group 3. Ren and Zhou (2008) introduced four types of contracts between call centers and customers to study call-center outsourcing. The QoS of call center was defined as "the probability of a customer's inquiry call being successfully resolved" (Ren and Zhou, 2008, p.372). Huang, Xi, Sun & Fan (2013) proposed a stochastic programming model for service selection problem, a model that could improve the optimal execution of service supply chain efficiency. Four QoS attributes were used in that model: execution time, execution cost, availability, and reliability. Agrawal et al. (2015) used a multi-criteria decision-making technique to conduct numerical evaluations for QoS attributes of transport alternatives. The SERVQUAL were used to develop a questionnaire regarding QoS provided by Delhi Transport Corporation. Xue et al. (2016) proposed a collaboration model in cluster supply chains to help medium sized enterprises benefit from collaboration. QoS dimensions were divided into three categories, namely service dimension, product dimension, and enterprise dimension.

Group 4, 5 and 6

Papers in Group 4 to 6 discussed how QoS was measured by different methodologies, which included conceptual framework, empirical evidence, and operations research. Note

that some papers are overlapped in the classification matrix, so those in Groups 1,2 and 3 that have been already introduced above will not be introduced again. Both papers of Group 4 have been described. In Group 5, only one new paper is using empirical method to measure QoS. Maximum difference (MD) scaling was used by Garver et al. (2010) to measure the importance of QoS attributes of truck driver satisfaction. According to the authors, MD is a useful tool that can examine a wide variety of concepts including QoS, strengths and weakness, and so on. In order to propose a supplier performance rating model, qualitative aspects of QoS were translated into mathematic equations to measure quality (Chen et al, 2002; 2004). Merkert and Assaf (2015) used two-stage data envelopment analysis (DEA) models to investigate the efficiency of airports in combination with QoS. This efficiency measure includes common airport outputs such as passenger numbers, cargo weight lifted and air traffic movements.

Group 7, 8 and 9

Including Yuen (2006)'s and Huang et al. (2013) discussed previously, there are nine papers illustrating how QoS impact the supply chain performance in Groups 7, 8 and 9. In the group using a conceptual methodology, Angeliki and Loukas (2003) imported quality management ideas into e-commercial field, and presented the necessity to develop QoS standards and practices in e-commerce to improve the performance of e-commerce industry. Sánchez-Rodríguez et al. (2004) used QoS management, personnel management, cross-functional coordination, quality information, management commitment, and benchmarking to define the implementation of quality management practices in purchasing. Then, a structural equation model was used to test the impact of this implementation. The result showed that quality management could increase the level of purchasing's operational performance and internal customer satisfaction significantly. Yang et al. (2006) externalized business quality dimensions to better understand the buyer's expected service, and to improve business service quality itself in the e-commerce industry. A hypothetical case study was used by Öztayşi et al. (2009) to investigate the possibility of implementing radio frequency identification (RFID) as a QoS improving tool in hospitality industry. Dimensions of the SERVQUAL and an additional six determinants from the literature were used as the QoS attributes. The

analysis of the case study showed that RFID implementation could support the QoS tested.

There is an additional paper, using empirical methodology to demonstrate the influence of QoS on supply chain performance in Group 8 that was not previously described. A social network and collaborative filtering techniques were combined to enhance the effectiveness of personalized QoS-aware manufacturing service recommendation (Zhang, et al., 2013). Although the implementation of personalized service recommendation systems in e-manufacturing is still in the early stage, it had already showed its great value in terms of cross-enterprise collaboration (Zhang, et al., 2013).

Group 9 includes the paper by Gupta et al. (2000) that proposed a two-stage model for optimizing supply chain planning under demand uncertainties. The results showed that there was a trade-off between the service levels and cost. However, significant improvements of guaranteed service levels only requires relatively small additional cost, which means supply chain performance could still be improved under such circumstance. Liu et al. (2013) measured logistics service quality in logistics service chain quality game model, which benefited decision-makers under multi-period-oriented conditions. The methods presented help make logistics more visible and review potential QoS problems, thus, can improve logistics service quality and improve revenue for the logistics service supply chain.

4.2.5 Interpret the Evidence

Papers that provided QoS attributes are listed in the Table 4.7, 4.8, 4.9, 4.10. These attributes of QoS are divided into three groups, namely, business-to-customer (B2C) attributes, overlapped attributes, and business-to-business (B2B) attributes. B2C attributes presented in Table 4.7 are specific to the end customer context and exist in the activities between distributors and end customers. B2B attributes presented in Table 4.8 are more specific to the activities between manufacturers and distributors. Overlapping attributes presented in Table 4.9 and 4.10 mean that these attributes could be applied in both B2B and B2C contexts.

There are 37 QoS attributes summarized and consolidated from 20 papers. QoS attributes with relatively high frequencies in the literature are introduced below.

Reliability. Over half of these papers regarded *reliability* as the determinant of QoS. *Reliability* refers to the ability to perform the promised service dependably and accurately (Parasuraman et al., 1988), and the capability to deliver orders within the due date (Franceschini and Rafele, 2000; cited in Bottani and Rizzi, 2006). Accuracy proposed by Çerri (2012), reliability proposed by Öztayşi et al. (2009), and accountability proposed by Alvarez-Rodríguez et al. (2014) are all consolidated as *reliability*.

Time. *Time* here includes all the QoS determinants related to time, such as time period elapsing from customer's order until receipt (Franceschini and Rafele, 2000; cited in Bottani and Rizzi, 2006), total cash flow time, total cycle time, customer query time (Gunasekaran et al., 2001), and execution time (Huang et al., 2013).

Responsiveness. *Responsiveness* was defined in SERVQUAL as the willingness to help customers and provide prompt service (Parasuraman et al., 1988).

Flexibility. Franceschini and Rafele (2000) defined *flexibility* as the capability to modify orders in terms of due date and quantity when required (cited in Bottani and Rizzi, 2006). Agility proposed by (Alvarez-Rodríguez et al., 2014) is consolidated here.

Communication. *Communication* was defined as the ease of contact and calling delivery agent (Azizi et al., 2014). One of the measure scales for logistics service quality mentioned by Çerri (2012) was "this supplier proactively communicate supply issues that may delay our order" (Çerri, 2012; p. 83). Hawkins et al. (2015) proposed a hypothesis that the greater post-award communication between the buyer and supplier leaded to the greater B2B QoS. Some informative actions like information sharing (Nathavat and Siri-on, 2014) are also included.

Cost. *Cost* here is related to supply chain finance performance including cost associated with assets and return on investment, total inventory cost (Gunasekaran et al., 2001), execution cost (Huang et al., 2013), and reasonable cost (Mersha and Adlakha, 1992; cited in Seth et al., 2006a). Some other financial attributes like revenue for the providers are also included.

Assurance. *Assurance* is another dimension in SERVQUAL, defined as knowledge and courtesy of employees and their ability to motivate trust and confidence (Parasuraman et al., 1988). According to this definition, attributes related to employees, which include good respect of distribution company employees (Azizi et al., 2014), courtesy (Seth et al., 2006a), and trustworthiness (Öztayşi et al., 2009) are consolidated into assurance.

Empathy. Empathy referred to the individualized attention that the firm provided to its customers (Parasuraman et al., 1988).

Tangibles. *Tangibles* is another attribute in SERVQUAL defined as the physical facilities, equipment, and appearance of personnel (Parasuraman et al., 1988).

Quantity. *Quantity* means delivery in ordered amount (Azizi et al., 2014).

Reputation. *Reputation* includes image, brand, and credibility (Gronroos, 1998; cited in Öztayşi et al., 2009) of a company or supplier. Azizi et al. (2104) also proposed a dimension related to brand as "delivery of right ordered brands" (Azizi et al., 2014; P 136).

Correctness. *Correctness* is the avoidance of mistakes in orders delivered (Franceschini and Rafele, 2000; cited in Bottani and Rizzi, 2006), and also refers to the accuracy of delivery (Nathavat and Siri-on, 2014).

Availability. *Availability* is considered as inventory availability (Nathavat and Siri-on, 2014; Langley and Holcomb, 1992).

Predictability. *Predictability* refers to the forecasting methods and ability of suppliers (Gunasekaran et al. (2001).

Competence. Professionalism and skills (Öztayşi et al., 2009) are consolidated into *competence.*

Security & privacy. According to Alvarez-Rodríguez et al. (2014), *security & privacy* included eight sub-indicators: access control & privilege management, data geographic/political, data integrity, data privacy & data loss, physical & environment security, proactive threat & vulnerability management, retention/disposition, and security management, this attributes was developed for e-procurement systems.

Regularity. *Regularity* means that the dispersion around the mean value of the delivered lead-time (Franceschini and Rafele, 2000; cited in Bottani and Rizzi, 2006)

Usability. *Usability* proposed by Alvarez-Rodríguez et al. (2014) was targeted to e-procurement system. Schvaneveldt et al. (1991) gave a better explanation that *usability* referred to the ease of use of product/services from the point of view of customers (cited in Seth et al., 2006a).

Harmlessness. *Harmlessness* is the avoidance of damages in orders delivered (Franceschini and Rafele, 2000; cited in Bottani and Rizzi, 2006)

Productivity. *Productivity* can be measured by the number of items produced in a given time period (Franceschini and Rafele, 2000; cited in Bottani and Rizzi, 2006)

Commitment. Internal customer commitment may increase the sufficiency of the requirement definition (Hawkins et al., 2015). Although this attribute is related to internal QoS, it may give some indications for the relationship among volunteers in HSC.

Except for the dimensions above, there are other dimensions showing in relatively low frequencies in the literature such as *complaining rate* that is the possibility of complain tracking of distribution agents (Azizi et al., 2014), *date* that is order delivery in standard and determined date (Azizi et al., 2014). Besides, *Sustainability* emphasizes that relief items provided could not do harm to the environment in affected area. Moreover, *sustainability* can also refer to the sustainable development of economy, and sustainable recovery of affected population, which means *sustainability* includes *harmlessness* mentioned earlier. *Partnership level* can be considered as the measurement for coordination efficiency among players in the chain and can be consolidated into *coordination*. For example, high partnership level between a supplier and a 3PL logistics provider would improve the efficiency of the chain, since the supplier and the 3PL provider are both experts in their own field: production and transportation. A supply chain can benefit from this division of labour instead of letting one player doing all the activities in the chain. *Customization* refers to the abilities of companies to customize the services or products according to customers' specific requirements.

Among all the QoS attributes listed in Table 4.7, 4.8, 4.9, and 4.10, *reliability*, *responsiveness*, *assurance*, *empathy*, and *tangibles*, which composed the SERVQUAL, are the five dimensions with relatively high frequencies in the literature. It is reasonable to agree with Seth et al. (2006c) that SERVQUAL is the most acceptable QoS measurement, and many researchers use it for a variety of applications. Most of the QoS determinants were developed based on the SERVQUAL, and some QoS determinants were developed by surveys, questionnaires, and case studies.

In Subsection 4.2.4, we have introduced the classification matrix of included papers. From the papers that measured QoS, we can conclude that some measuring scales were developed to measure QoS. For example, Likert's 5-point scale was used by Acharyulu and Shekhar (2012) to measure the importance of performance outcomes of hospital value chains. Other tools like QFD and fuzzy logic were also used to measure QoS in supply chains.

In terms of the relationship between QoS and supply chain performance, most authors believed that improved QoS would help improve the performance of supply chains. For example, the implication of quality management practice in purchasing could lead to the achievement of increasing levels of purchasing's operational performance (Sánchez-Rodríguez et al., 2004). Although there is a trade off between the QoS and cost, great improvements of QoS could be achieved at relatively small additional cost (Gupta et al., 2000). The service performance is thus improved while the financial performance stays stable by increasing the QoS.

Commercial QoS attributes listed in Table 4.7, 4.8, 4.9, and 4.10 would be further discussed and consolidated with those identified in Chapter 5. That is to say, QoS attributes in commercial supply chains can be applied to the HSCs context as long as they correspond to HSCs particularities.

Table 4.7 B2C QoS attributes identified in the literature

	B2C attributes		
Paper	After sale	Accessibilit	Reliability
-Acharyulu and Shekhar (2012)			✓
-Agrawal et al. (2015)			✓
-Alvarez-Rodríguez et al. (2014)			✓
-Azizi et al. (2014)			
-Bottani and Rizzi (2006)			✓
-ÇErri (2012)			
-Grimaldi and Rafele (2007)	✓		✓
-Gunasekaran et al. (2001)			
-Hawkins et al. (2015)			
-Huang et al. (2013)			✓
-Langley and Holcomb (1992)			
-Lin et al. (2016)			
-Nathavat and Siri-on (2014)			
-Öztayşi et al. (2009)		✓	✓
-Parmata et al. (2016)			✓
-Ren and Zhou (2008)			
-Seth et al. (2006a)		✓	✓
-Seth et al. (2006b)			
-Seth et al. (2006c)			✓
-Xue et al. (2016)			✓
-Yuen (2006)			✓

Table 4.8 B2B attributes identified in the literature

	B2B attributes												
Paper	Sustainability	Productivity	Security & Privacy	Availability	Partnership level	Predictability	Commitment	Customization	Innovation	Negotiability	Competence	Environment	Completeness
-Acharyulu and Shekhar (2012)	✓												
-Agrawal et al. (2015)													
-Alvarez-Rodríguez et al. (2014)			✓										
-Azizi et al. (2014)													
-Bottani and Rizzi (2006)		✓											✓
-ÇErri (2012)													
-Grimaldi and Rafele (2007)				✓		✓							
-Gunasekaran et al. (2001)					✓	✓							
-Hawkins et al. (2015)							✓						
-Huang et al. (2013)				✓									
-Langley and Holcomb (1992)								✓	✓				
-Lin et al. (2016)													
-Nathavat and Siri-on (2014)				✓				✓		✓			
-Öztayşi et al. (2009)													
-Parmata et al. (2016)													
-Ren and Zhou (2008)													✓
-Seth et al. (2006a)			✓			✓					✓	✓	✓
-Seth et al. (2006b)													
-Seth et al. (2006c)											✓	✓	
-Xue et al. (2016)		✓											
-Yuen (2006)													

Table 4.9 Overlapped QoS attributes identified in the literature

	Overlapped QoS attributes										
Paper	Responsiveness	cost	Customer satisfaction	Tangibles	Assurance	Empathy	Flexibility	Usability	Time	Communication	Quantity
-Acharyulu and Shekhar (2012)	✓	✓	✓								
-Agrawal et al. (2015)	✓			✓	✓	✓					
-Alvarez-Rodríguez et al.		✓			✓		✓	✓			
-Azizi et al. (2014)									✓	✓	✓
-Bottani and Rizzi (2006)							✓		✓		
-ÇErri (2012)	✓								✓	✓	✓
-Grimaldi and Rafele (2007)	✓			✓	✓	✓	✓		✓	✓	
-Gunasekaran et al. (2001)		✓					✓		✓		
-Hawkins et al. (2015)									✓	✓	
-Huang et al. (2013)		✓							✓		
-Langley and Holcomb (1992)	✓						✓				
-Lin et al. (2016)									✓	✓	✓
-Nathavat and Siri-on (2014)	✓					✓				✓	
-Öztayşi et al. (2009)	✓			✓	✓		✓				
-Parmata et al. (2016)	✓				✓		✓			✓	
-Ren and Zhou (2008)											
-Seth et al. (2006a)	✓	✓			✓	✓	✓	✓	✓	✓	
-Seth et al. (2006b)		✓	✓				✓		✓		✓
-Seth et al. (2006c)										✓	
-Xue et al. (2016)		✓	✓						✓		
-Yuen (2006)	✓			✓	✓	✓					

Table 4.10 Overlapped QoS identified in the literature

	Overlapped QoS attributes									
Paper	Harmlessnes	Reputation	Complain	Billing	Punctuality	Regularity	Correctness	Personnel	Assets	Revenue
-Acharyulu and Shekhar (2012)									✓	✓
-Agrawal et al. (2015)										
-Alvarez-Rodríguez et al. (2014)										✓
-Azizi et al. (2014)	✓	✓	✓	✓	✓					
-Bottani and Rizzi (2006)	✓					✓	✓			
-ÇErri (2012)										
-Grimaldi and Rafele (2007)								✓	✓	
-Gunasekaran et al. (2001)										✓
-Hawkins et al. (2015)										
-Huang et al. (2013)										
-Langley and Holcomb (1992)										
-Lin et al. (2016)								✓		
-Nathavat and Siri-on (2014)				✓	✓		✓	✓		
-Öztayşi et al. (2009)		✓								
-Parmata et al. (2016)										
-Ren and Zhou (2008)										
-Seth et al. (2006a)		✓					✓			
-Seth et al. (2006b)										✓
-Seth et al. (2006c)										
-Xue et al. (2016)		✓								
-Yuen (2006)										

Chapter 5 KPI and Standards Used by Humanitarian Operations

KPI are considered as an appropriate tool for organizational decision making, system control and performance assessment (Reichmann, 2001; Gladen, 2005; Parmenter, 2010; cited in Prause and Schroder, 2015). It helps evaluate the performance or the success of structures or specific activities (Prause and Schroder, 2015). In this chapter, we present KPIs and standards used by humanitarian relief organizations (HROs) as a basis for defining QoS and add on references to our previous findings.

This chapter is divided into two parts. The first part focuses on standards in humanitarian response mentioned in the Sphere Project handbook. Standards in the Sphere Project handbook are composed of four elements, which are minimum standards, key actions, key indicators, and guidance notes. In order to better present the information related to QoS, four tables listing humanitarian activities, standards, indicators, stakeholders, KPIs, and QoS attributes are presented to highlight the QoS attributes indicated in the Sphere Project. Note that some terminologies used in the Sphere Project handbook are different from those defined in the operations management literature. The introduction sections of the Sphere Project handbook refer to standards as being different services offered by humanitarian organizations and to indicators as practices to follow in order to provide these services. However, in terms of operations management, we consider that what is referred as standards is the levels of service to be attained in humanitarian response and to indicators as being signals showing whether a standard has been attained or not. In the second part of this chapter, we present some information related to QoS attributes that was identified through a superficial review of important humanitarian organizations' websites.

5.1 KPI and Standards Developed by the Sphere Project

The Sphere Project was found by a group of NGOs and the International Red Cross and Red Crescent Movement, whose aim is to improve the quality of actions during disaster response. The Sphere Project and its handbook introduce considerations of quality and accountability to humanitarian response. It is designed to support planning, implementing,

monitoring and evaluate during humanitarian responses, and it can be used by donors, government and local authorities, the military or the private sector. There are evidence-based minimum standards covering four areas, namely, 1) water supply, sanitation and hygiene promotion; 2) food security and nutrition; 3) shelter, settlement and non-food items; and 4) health action (The Sphere Project, 2011).

According to the guidance notes in the Sphere Project handbook, some of the minimum standards of the Sphere Project handbook are quantitative requirements and specify the minimum level to be reached in humanitarian response. Key indicators are related to these standards, providing a way of measuring and communicating the processes and results of key actions (The Sphere Project, 2011). Considering the evidenced-based feature of the minimum standards, appropriate users, and the broad coverage of humanitarian response in the Sphere Project handbook, it can be used as the main reference when defining QoS determinants in HSC.

In the following subsections, information related to QoS will be listed in four tables focusing on four different humanitarian aid areas mentioned in the Sphere Project handbook. Minimum standards and key indicators will be introduced for each of the four areas. As mentioned earlier, most of these standards and indicators represent services and practices rather than levels of service to be attained and signals to be measured. Nevertheless, in the guidance notes and appendices of the Sphere Project handbook, specific KPIs are sometimes provided. A KPI shows the quantitative requirements for the services provided by humanitarian organizations, governments, and 3PL providers. These standards, indicators, and KPIs will be linked to different humanitarian activities in each table. Besides, the main stakeholders involved in each activity will be mentioned. Then, base on all these elements listed in the tables, the QoS attributes are identified.

5.1.1 Quality of Service Attributes in Water Supply, Sanitation and Hygiene Promotion

Table 5.1 lists the main humanitarian response activities in water supply, sanitation and hygiene, followed by standards and indicators in the Sphere Project handbook. The KPI column in this table shows whether there are specific quantitative measurements for the

services or not. Main stakeholders involved are proposed based on these activities and indicators in the Sphere Project handbook. Note that some stakeholders involved in these humanitarian activities are mentioned in the Sphere Project handbook, and some stakeholders are added in Table 5.1 based on the types of activities provided to give broader perspectives for the QoS attributes we want to develop. The QoS attributes are summarized from indicators considering all the stakeholders' perspectives. For example, the minimum standards of water supply, sanitation and hygiene promotion (WASH) programme require involving all the affected population into the design, management and maintenance of the facilities, and three main indicators reflect this standard in a specific way. The first indicator is that all groups with the population have safe and equitable access to WASH resources and facilities, so the QoS attributes could be summarized as the accessibility, safety and empathy.

Among all the QoS attributes summarized in Table 5.1, there are some unique QoS attributes in HSCs with high frequencies that are not common in the commercial supply chains. Indicators like disposing children's faeces safely, minimizing fly and mosquito breeding, handling vector control chemicals appropriately, and disposing all medical waste separately reveal that protecting the environment is a priority in humanitarian supply chain, as well *safety,* which is consolidated into *sustainability,* an important QoS attribute in HSCs. *Privacy* is also important in respect to protect beneficiaries' dignity, since one core belief of the Sphere Project is to ensure " those affected by disasters have a right to live with dignity" (The Sphere Project, 2009, p.4). Actions such as providing minimum washing basin for a certain number of individuals and private laundering and bathing areas for women are all the measures to protect privacy. *Competence* means that both individuals, such as employees and volunteers, and organizations, such as humanitarian organizations and commercial companies, have the ability to provide professional services for the affected population. *Coordination* among HROs and other agencies is also important in terms of improving the efficiency. *Involvement* of the beneficiaries shows their cooperation and intention to devote themselves into the reestablishment of their affected community. Additionally, *coordination* and *involvement* can also be considered as means to obtain the QoS, which are the assets that each

stakeholder should aim for. Moreover, the QoS attribute *communication*, which includes all informative actions such as information exchange between HROs and the private sector, is also an asset to achieve the QoS in HSCs.

Table 5.1 QoS attributes in water supply, sanitation and hygiene (WASH)

Activities	Standards	Indicators	KPIs	Stakeholders	QoS attributes
WASH	WASH programme design and implementation	safe and equitable access	No	all groups within the population	accessibility; safety; empathy
		clear and respectful communication	No	HROs, governments, the private sector, military	communication
Hygiene promotion	Hygiene promotion implementation	appropriate description and demonstration	No	HROs, governments, the private sector, military	communication
		cleaning after defecation	No	the private sector, military, HROs, beneficiaries	safety
		motivating different groups to take action	No	beneficiaries	involvement
		safe disposal of children's faeces	No	the private sector, military, HROs, beneficiaries	safety; sustainability
	Identification and use of hygiene items	timely distribution of hygiene items	Yes	all groups within the population	timeliness; coordination
		post-distribution monitoring	No	the private sector, military; HROs; beneficiaries	appropriateness
		investigation of the use of alternatives	No	governments; donors, the private sector; HROs	flexibility
Water supply	Access and water quality	average water use is at least 15 liters per person per day	Yes	governments, donors, HROs, beneficiaries	availability; sustainability
		the maximum distance from the water point is 500 meters	Yes	the private sector, military, HROs, beneficiaries	accessibility
		queuing time at a water source is no more than 30 minutes	Yes	governments, donors, the private sector, HROs	availability
	Water quality	no faecal coliforms per 100ml of water	Yes	the private sector, military, HROs, beneficiaries	sustainability; safety
		appropriate training and monitoring of water treatment	No	the private sector, military, HROs, beneficiaries	sustainability
		preference to a protected or treated source	No	the private sector, military, HROs, beneficiaries	safety
	Water facilities	at least two clean water collecting containers per household	Yes	governments, donors, the private sector, beneficiaries	availability
		at least one washing basin per 100 person	Yes	the private sector, governments, HROs,	privacy
		water free from contamination	No	the private sector, governments, HROs,	safety
Excreta disposal	Environment free from human faeces	safe excreta disposal	No	the private sector, governments, HROs,	safety; sustainability
	Appropriate and adequate toilet facilities	toilets being used safely	No	governments; HROs, beneficiaries	safety
		minimizing security threats to users throughout the day and the night	No	governments; HROs, beneficiaries	safety; privacy
		minimizing fly and mosquito breeding	No	governments; HROs, beneficiaries	safety; sustainability
Vector control	Individual and family protection	providing vector control measures	No	governments; HROs; the private sector	responsiveness
		understanding the transmission modes and protecting themselves	No	the private sector; HROs	competence
		using insecticide-treated mosquito nets effectively	No	the private sector; HROs	competence
	Physical, environmental and chemical protection measures	setting the displaced population appropriately to avoid the exposure	No	the private sector, governments, HROs	competence; safety
		providing working referral mechanisms	No	governments; donors; the private sector; HROs	competence; availability
	Chemical control	handling vector control chemicals appropriately	No	the private sector, governments, HROs,	safety; sustainability
		following national and international protocols	No	all groups within the population	accountability; responsiveness
Solid waste management	Collection and disposal	removing waste on a daily basis	No	all groups within the population	timeliness
		timely and controlled safe disposal of solid waste	No	all groups within the population	timeliness; safety
		all medical waste being isolated and disposed separately	No	government; HROs; beneficiaries	sustainability; safety
Drainage	Drainage work	water point drainage being well planed, built and maintained	No	governments; HROs; beneficiaries	accessibility
		no pollution of surface water	No	governments; HROs; beneficiaries	safety

5.1.2 Quality of Service Attributes in Food Security and Nutrition

The second area of humanitarian response in the Sphere Project handbook is the food security and nutrition. *Sustainability* still has very high frequencies as a QoS attribute here. There are four activities, namely food security, access to available goods and services, primary production, and access to markets, which require sustainability to ensure service quality (as shown in Table 5.2). Promoting livelihood strategies about food security to the affected population gives the possibility for the affected population to live healthy lives. HROs, governments, and other agencies work together to support local economy and restart primary production in order to create jobs and boost the economy of the local community. Also, governments design interventions to create a healthy economic environment for markets recovery. Overall, *sustainability* enables the affected population and community to recover and develop in the long run, which means stakeholders should have sustainable perspectives when providing humanitarian services.

There are also four unique QoS determinants shown in Table 5.2. *Appropriateness* and *acceptability* are the two unique QoS attributes in food transfers. In order to be used efficiently and effectively at the household level, the food items provided should be appropriate and acceptable to recipients. *Appropriateness* here means the access to water; cooking fuel and food processing equipment should be taken into consideration when designing the food transfer program. *Acceptability* shows that all targeted people should accept the program decision after taking participation in the feedback process.

Transparency is especially important to the multi-stakeholders relationship in HSCs. Donors have the rights to know whether the donations are used efficiently so that it is necessary to develop monitoring and beneficiary accountability mechanisms to track the preference of the stakeholders on distribution methods and information provided to beneficiaries (The Sphere Project, 2011).

Considering the importance of knowledge transfer inside the HROs and between the HROs and the beneficiaries, *skilled employees and volunteers* is another unique QoS attribute in HSCs, which can be consolidated into *competence* mentioned in Table 5.1,

representing the ability of HROs, governments, and the private sector to provide professional services. Considering the high turnover rate of volunteers working in a hastily built HSC, having them trained and equipped with skills is the premise to provide basic humanitarian service. Moreover, *competence* is not only a QoS attribute but also an asset that each stakeholder should have to obtain the QoS.

Table 5.2 QoS attributes in food security and nutrition

Activities	Standards	Indicators	KPIs	Stakeholders	QoS attributes
Food security and nutrition assessment	Food security	response including both immediate food needs and promotion of livelihood	No	all groups within the population	availability; sustainability
	Nutrition	recommending actions targeting the most vulnerable individuals and groups	No	HROs; the private sector; governments	empathy
Infant and young child feeding (IYCF)	Policy guidance and coordination	a national or agency policy is in place addressing IYCF	No	the private sector; governments; HROs	accessibility
		a lead coordination body on IYCF	No	HROs; the private sector; governments	coordination
	Basic and skilled support	having access to timely, appropriate, nutritionally foods and to skilled	No	all groups within the population	accessibility; competence
Management of acure malnutrition and micronutrient deficiencies	Moderate acute malnutrition	coverage is large than 50 per cent in rural areas	Yes	governments; HROs; the private sector	accessibility
		the portion of discharges from targeted program who have died is< 3 per cent	Yes	governments; HROs; the private sector	safety
	Severe acute malnutrition	less than one day's return walk of the program site for more than 90% people	Yes	HROs; governmets	accessibility
	Micronutrient deficiencies	treating micronutrient deficiencies according to current best clinic practice	No	HROs; governments; the private sector	competence
		accompany with public health interventions	No	governments	coordination
	General food security	all the disaster-affected people in need can receive relative assistance	No	all groups within the population	empathy; availability
	General nutrition requirements	adequate access to range of foods	Yes	the private sector; governments; HROs	accessibility
	Appropriateness and acceptability	involving all targeted people in program decision-making	No	all groups within the population	appropriateness; acceptability
	Food quality and safety	providing food without health-risking	No	HROs; government; the private sector	safety
		tracking all the beneficiaries' complaints by monitoring	No	all groups within the population	reliability; transparency
	Supply chain management	food reaching intended distribution points	No	the private sector; HROs; beneficiaries	availability
		using tracking systems, inventory accounting and reporting systems	No	HROs; the private sector	competence
	Targeting and distribution	targeting criteria based on thorough analysis of vulnerability	No	all groups within the population	responsiveness
		targeting mechanisms agreed among the disaster-affected population	No	all groups within the population	acceptability
		existence of relevant alternative distribution models	No	HROs; governments; donors	flexibility
		monitoring mechanism related to stakeholders' preference	No	all groups within the population	transparency
	Food use	raising beneficiaries' awareness of good food hygiene	No	all groups within the population	safety
		training relevant staff on food handling and hazards form improper practices	No	HROs; governments; the private sector	safety; competence
	Access to available goods and services	preferring cash and vouchers as the form of transfer for all targeted people	No	all groups within the population	appropriateness
		supporting local economy to recover from the disaster	No	all groups within the population	sustainability
	Primary production	accessing to the necessary inputs to protect and restart primary production	No	all groups within the population	sustainability; accessibility
	Income and employment	providing employment opportunities for both women and men equally	No	HROs; governments	empathy
	Access to markets	designing interventions to support the recovery of markets	No	governments	responsiveness; sustainability

5.1.3 Quality of Service Attributes in Shelter, Settlement and Non-food Items

When conducting strategic planning and settlement planning for shelter and settlement, HROs should coordinate with all the beneficiaries in order to fully understand their needs and then provide acceptable response. The QoS attributes listed in Table 5.3 are all

introduced earlier in Chapter 4 or Section 5.1.1 and 5.1.2. Overall, these QoS attributes show that HROs should take the responsibilities to provide basic services to keep affected population safe and live with dignity. At the same time, skilled employees and volunteers of HROs should encourage all the affected population to educate themselves to obtain sustainability and help their community to recover for the long run.

Table 5.3 QoS attributes in shelter, settlement and non-food items

Activities	Standards	Indicators	KPIs	Stakeholders	QoS attributes
Shelter and settlement	Strategic planning	solutions meeting the essential needs of all the disaster-affected population are agreed with the population in coordination with all responding agencies	No	all groups within the population	acceptability; coordination
	Settlement planning	planning processes are agreed by all shelter-assisted populations	No	all groups within the population	acceptability; coordination
		all settlements plans demonstrating the risks and vulnerabilities in the use of shelters	No	HROs; governments; the private sector	responsiveness; transparency
	Covered living space	an initial minimum covered floor area of 3.5 square meters per person for all affected individuals	Yes	governments; HROs; beneficiaries	privacy; safety
	Construction	demonstrating the involvement of the affected population and the maximizing of local livelihood opportunities	No	governments; HROs; the private sector	coordination
	Environmental impact	minimizing the adverse impact on the natural environment	No	all groups within the population	sustainability
Non-food items: clothing, bedding and household items	Individual, general household and shelter support items	meeting the entire disaster-affected population needs when assessing non-food item needs	No	governments; HROs; the private sector	accessibility
	Clothing and bedding	all beneficiaries have at least two full sets of clothing in the correct size that are appropriate to the culture, season and climate	Yes	governments; donors; HROs	privacy; availability; empathy
	Cooking and eating utensils	all disaster-affected people have access to a dished plate, a spoon or other eating utensils and a mug or drinking vessel	No	governments; donors; HROs	empathy; privacy
	Stoves, fuel and lighting	no harm to people in the routine use of stoves	No	HROs; governments; the private sector	safety
		providing artificial lighting in a safe and sustainable way	No	HROs; donors; governments	safety
	Tools and fixings	providing tools and equipment to all households and also providing training related to safe use	No	donors; HROs; governments;	empathy; availability

5.1.4 Quality of Service Attributes in Health Action

Except for the QoS attributes proposed in the three areas above, there are three additional QoS attributes in health action (see Table 5.4). HROs, local governments, and donors have to work together to ensure that primary healthcare services are free for all the beneficiaries. The *free-of-charge* attribute means that essential humanitarian services should be free according to the nonprofit feature of HSC. It is the compulsory QoS attribute in HSC to ensure that all the beneficiaries have access to humanitarian services whatever they need. Because *free-of-charge* attribute enables every individual to have equal access to humanitarian aid, it can be considered as one aspect of *accessibility*.

Table 5.4 QoS attributes in health action

Activities	Standards	Indicators	KPIs	Stakeholders	QoS attributes
Health systems	Health service delivery	an adequate number of heath facilities to meet the essential health needs	Yes	the private sector; donors; HROs; governments	accessibility
	Human resource	at least 20 qualified health workers per 10,000 population	Yes	HROs; governments; the private sector	competence
	Drugs and medical supplies	no health facility is out of stock of selected essential medicines for more than one week	No	HROs; governments; the private sector; donors	availability
	Health financing	primary healthcare service are free of charge	No	donors; governments; HROs	free-of-charge
	Health information management	providing a report regularly within 48 hours of the end of the reporting to the lead agency	Yes	HROs; the private sector; donors; governments	timeliness; responsiveness; communication
	Leadership and coordination	developing a health sector response strategy at the onset of emergency response	No	HROs; the private sector; governments	coordination; timeliness
Control of communicable diseases	Communicable disease prevention	keeping incidence of major communicable diseases stable	No	HROs; the private sector; governments	responsiveness; safety
	Communicable disease diagnosis and	using standardized case management protocols for the diagnosis and treatment of common infectious disease readily	No	HROs; the private sector; governments	competence; reliability
	Outbreak detection and response	reporting suspected outbreaks to the next appropriate level within the health system within 24 hours of detection	Yes	HROs; the private sector; governments	timeliness
Child health	Management of newborn and childhood	all children under 5 years of age presenting with pneumonia having received appropriate antibiotics	Yes	HROs; the private sector; governments; donors	responsiveness
Sexual and reproductive health	Reproductive health	at least one health facility with CEmOC and newborn care for 500,000 population	Yes	HROs; the private sector; governments; donors	availability
Injury	Injury center	having trained staff and systems for the management of multiple casualties	No	HROs; the private sector; governments; donors	competence
Mental health	Mental health	having trained staff and systems for the management of mental health problems	No	HROs; the private sector; governments; donors	competence
Non-communicable diseases	Non-communicable diseases	having clear standards operating procedures for referrals of patients	No	HROs; the private sector; governments	competence; responsiveness

5.2 Standards used by other HROs

Standards used by HROs can be regarded as supplementary when defining QoS in HSC. We investigated 26 relief organizations which are Action Against Hunger (AAH), CARE, Caritas Internationalis, Catholic Relief Services (CRS- USCC), Doctors Without Borders, Emergency Nutrition Network (ENN), Food For The Hungry International (FHI), Hunger Plus, Inc., International Committee of the Cross (ICRC), International Federation of Red Cross and Red Crescent Societies (IFRC), International Organization for Migration

(IOM), International Rescue Committee (IRC), Lutheran World Federation, Mennonite Central Committee (MCC), Mercy Corps (MC), Overseas Development Institute (ODI), Oxfam, Refugees International, Relief International, Save the Children, The Office of U.S. Foreign Disaster Assistance (OFDA), United Nations Children's Fund (UNICEF), United Nations High Commissioner for Refugees (UNHCR), United Nations Office for the Coordination of Humanitarian Affairs (OCHA), US Committee for Refugees (USCR), and World Vision International based on the information on their websites. We tried to find out what are these organizations' services provide, services standards, visions, missions, and core values by looking at the main links on their websites. For example, on the website of IFRC, we went through the categories including "who we are", "what we do", "where we work", "get involved", "news and media", "appeals", and "publications". Note that we did not conduct an in-depth review of the reports published by these organizations.

At first glance, we noticed that CRS and ICRC give fundamental principles to unite the components of the movement. ENN and Caritas Internationalis provide standards and guidance for management and operation. However, considering these principles and guidance work in the strategic level of HROs, it is not realistic to use them as indicators of QoS. Doctors Without Borders, IFRC, MC and World Vision International all emphasize the *accountability* throughout the humanitarian activities. Hunger Plus Inc. mentioned the Sphere Project in its humanitarian policy. No new QoS attribute is found from these HROs, but it seems that *accountability* is the basic and important attribute for HROs performance.

The Sphere Project handbook and 26 HROs websites help us to explore the evidence-based QoS attributes in HSC. In chapter 6, those unique QoS attributes found in HSCs will be analyzed with those found in commercial supply chains, which will provide the basics to develop a framework for defining the QoS in HSC.

Chapter 6 Defining the Quality of Service in Humanitarian Supply Chains: The Proposed Framework

The QoS attributes identified in Chapter 4 will be discussed and adapted into the humanitarian context. The QoS attributes identified in Chapter 5 will also be discussed. Then based on the combination of these QoS attributes, a framework will be developed to define the QoS based on multiple stakeholders' perceptions in HSCs.

6.1 Classification of the Quality of Service Attributes Identified in the Commercial Supply Chains Literature

In this section, we discuss the QoS attributes in supply chains identified in Chapter 4. These QoS attributes are divided into three main groups. The first group includes the QoS attributes that are important for commercial supply chains but are not applicable to HSCs. The second group contains QoS attributes that are applicable to both contexts. The last group includes QoS attributes that can also be applied to HSCs, but that they are considered differently in these two contexts.

The first column of Table 6.1 shows two QoS attributes identified in the commercial supply chain literature that are not directly applicable for HSCs. *Billing* is one of the behavioral features of distribution agents, and it refers to the patience and carefulness of distribution agents in account settlement (Azizi et al., 2014). Billing is important for the transactions between organizations but not for the beneficiaries. Indeed, HROs have the responsibilities to manage their budgets and keep their financial status transparent to their donors. Another QoS attributes excluded from the HSCs is *after sale*. The service recipient of after sale is the customer who has paid for their services or products and wants to continuously use the service or products. There is a contract for after sale between the service providers and customers. However, in the HSC context, final customers usually refer to beneficiaries who do not have to pay for the services and products they received. There may be after sale activities among donors, the private sector, and HROs in case of facilities failure, but it is uncommon to have contracts for safer sale between beneficiaries and other service providers in the short-term

humanitarian response. It can be believed that good after sale is a competitive advantage for companies in the commercial world, but it is not a dominant QoS attribute in HSCs. Therefore, *billing* and *after sale* are the two QoS attributes used in commercial supply chains and are not applicable for the beneficiaries within HSCs.

The second column in Table 6.1 lists 18 QoS attributes that are identified in commercial supply chain literature and are applicable to HSCs. When selecting QoS attributes that are applicable to the HSC context, the five QoS attributes from SERVQUAL (*reliability*, *responsiveness*, *tangibles*, *assurance*, *empathy*) can be considered as general QoS attributes in HSCs. *Harmlessness* in commercial supply chains means the avoidance of damages in orders delivered. When we apply *harmlessness* in HSCs, its meaning could be extended as the avoidance of damages in humanitarian supplies delivered, and doing no additional harm to the affected population and local environment when delivering humanitarian services and products. Because this *harmlessness* attribute protects the affected population and local environment from most infectious disease and pollution, so it provides the opportunity for the affected population and local environment to recovery and develop after the disaster. Considering the similar meaning of *harmlessness* compared with *sustainability*, *harmlessness* can be consolidated into *sustainability*, which has a broader meaning includes safety, continuous development, and so on. Low *complainting rate* means that stakeholders, especially donors and suppliers in HSCs are satisfied with the service provided by HROs and NGOs, so it is necessary to keep relative low *complainting rate* when conducting humanitarian response. *Punctuality* and *regularity* are consolidated into *timeliness*. Considering the importance of *timeliness* in humanitarian response, both *punctuality* and *regularity* should be applied in HSCs. *Commitment* can be regarded as another general QoS determinant like the five QoS attributes in SERVQUAL. The remaining QoS attributes identified in commercial supply chains (*accessibility*, *flexibility, usability, communication, security & privacy, availability, coordination,* and *competence*) are repetitive to those indicated by the Sphere Project in Chapter 5, which will be further discussed in the next section.

QoS attributes in the third column in Table 6.1 have been identified in the commercial supply chain literature, but have a different meaning in HSCs mainly because the "customer" in HSCs becomes the "beneficiary". In commercial supply chains, customers are those who pay for the final products or services. However, multiple stakeholders including donors, governments, HROs, the private sector, military, and beneficiaries can all be seen as customers in HSCs. The *customer satisfaction* in HSCs is not only about the satisfaction of beneficiaries, but about the satisfaction of donors and governments. Satisfying the interests of other stakeholders should be considered when carrying out humanitarian activities. *Negotiability* is usually bilateral in commercial supply chains; it happens when suppliers negotiate the materials and price with manufactures or when manufactures negotiate the price and service with buyers. However, in HSCs, humanitarian organizations will have to negotiate on more aspects than prices and quality standards, and this with multiple different types of stakeholders. For example, they will have to negotiate with donors for funding and with governments or groups to securely access the affected populations. The existence of negotiation somehow reflects that there is coordination among stakeholders, so *negotiability* can be considered into *coordination*.

Reputation in HSCs is related to the HROs, as they have to manage their images in order to attract the general population's and the donors' attentions and trusts. *Reputation* can be considered as one dimension of *reliability* since a good reputation contributes to the reliability of the HROs. In commercial supply chains, *customization* helps companies tailor their products and services to customer needs. Similarly, *customization* means that HROs adapt their services to the beneficiaries by communicating with them, which enables HROs to deliver services appropriately, satisfy beneficiaries' needs, and protect their dignity and privacy. Therefore, the *customization* attribute can be considered within *communication*, *appropriateness* and *acceptability*, which will be introduced in the next section. *Innovation* is essential to a company's competitive advantage. It brings the new technologies and methods to allow companies to reach higher profits and to better adjust to the market evolution. In HSCs, *innovation* is often related to new medical treatments and better processes to deliver service, and it aims to bring efficiency rather than reaching higher profits. *Innovation* in HSCs depends on scientific and management progresses.

This can increase efficiency and allow a sustainable way to improve HSCs continuously. Thus, *innovation* can be regarded as one dimension of *sustainability*. *Cost* is the financial aspect of HSCs. As we know, one particularity of HSCs is that it is non-profit. Although cost is not the priority in HSCs, it still has great influences on the performance of humanitarian response. In commercial supply chains, the ultimate goal of most companies is to reduce costs and improve profits. However, cost is considered as a constrain rather than a goal in HSCs. HROs raise funding from donors, they have to respect their limited budgets and be responsible to their donors. The cost attribute requires stakeholders to provide good services with relative low resources, which can be extended as *effectiveness*.

Table 6.1 Classification of QoS attributes identified in the commercial supply chain literature

Identified in commercial supply chain literature but not applicable to HSCs	Identified in commercial supply chain literature and applicable to HSCs	Identified in commercial supply chain literature but mean different to HSCs
Billing	Reliability	Customer satisfaction
After sale	Responsiveness	Negotiability (Coordination)
	Tangibles	Reputation (Reliability)
	Assurance	Customization (appropriateness, acceptability)
	Empathy	Innovation
	Sustainability (Harmlessness, Safety)	Cost (Effectiveness)
	Complaining rate	
	Timeliness (Punctuality, Regularity)	
	Commitment	
	Accessibility (Free-of-charge)	
	Flexibility	
	Usability	
	Communication (Informative actions)	
	Security & Privacy	
	Availability	
	Coordination	
	Competence (skilled employees and volunteers)	

6.2 Quality of Service Attributes Identified in Humanitarian Supply Chains

Additional QoS attributes described in the Sphere Project must be added to the previous QoS attributes. There are four additional QoS attributes described in Chapter 5 that are not mentioned in the commercial supply chain literature (see Table 6.2).

Appropriateness and *acceptability* require humanitarian staff to offer services to beneficiaries in an appropriate way and provide proper relief items accepted by all beneficiaries according to their culture, religion, and customs. The culturally practices must be identified for a given humanitarian response by policy makers and managers of HROs (Rodon, Maria Serrani & Giménez, 2012). Rodon et al. (2012) described the outbreak of cholera in Mozambique in 2008 as an example of delivering services appropriately, showing that volunteers accompanied by a cultural mediator analyzed the local community reaction to the humanitarian aid in order to minimized potential cultural tensions. Volunteers presented water treatment as a service offered to the population instead of adding chlorine directly to the collected water in order to minimize the distrust from people who preferred to use rainwater. *Involvement* is similar to coordination, but it comes before coordination. *Involvement* aims to motivate different groups to take actions in humanitarian response, and it encourages the affected population to rebuild their community by relying on their own efforts. *Transparency* ensures every stakeholder in HSCs to have the equal access to the information related to cost, funding, and other factors in HSCs' procedure. Moreover, *transparency* is especially important to donors and suppliers in terms of monitoring humanitarian activities.

Table 6.2 lists 23 QoS attributes identified in HSCs, which will be integrated into a framework for defining QoS in HSCs in the next section. Stakeholders' perceptions, main activities and services in HSCs, and relationships among stakeholders will be considered when creating the framework for defining QoS in HSCs.

Table 6.2 QoS attributes

QoS described in the commercial supply chain literature and applicable to HSCs	QoS attributes described in the Sphere Project handbook
Reliability (Reputation)	Acceptability
Responsiveness	Appropriateness (Customization)
Tangibles	Involvement
Assurance	Transparency
Empathy	
Sustainability (Harmlessness, Safety, Innovation)	
Complaining rate	
Timeliness (Punctuality, regularity)	
Commitment	
Accessibility (Free-of-charge)	
Flexibility	
Usability	
Communication (Informative actions)	
Security & Privacy	
Availability	
Coordination (Negotiability)	
Competence (Skilled employees and volunteers)	
Customer satisfaction	
Effectiveness (cost)	

6.3 Conceptual Framework for Defining Quality of Service in Humanitarian Supply Chains

In order to create a theoretical framework for defining QoS in HSC, stakeholders, humanitarian services, and QoS attributes will be integrated into the relationship network of different stakeholders. The stakeholders' relationship network will be first created to

define the structure of the framework, and HSCs services and QoS attributes will then be assigned to different links in this network to complete the framework.

6.3.1 Stakeholders Relationships Network

In order to discuss the QoS offered by the stakeholders with similar goals and motivations, the S3P integration model of stakeholders in HSCs (Fontainha et al., 2015) introduced in Section 2.5.1 has been simplified to help create the relationships network of different stakeholders (Figure 6.3). Stakeholders from the S3P model are grouped into four categories (see Table 6.3), namely donors and suppliers, beneficiary organizations, donor organizations, and beneficiaries.

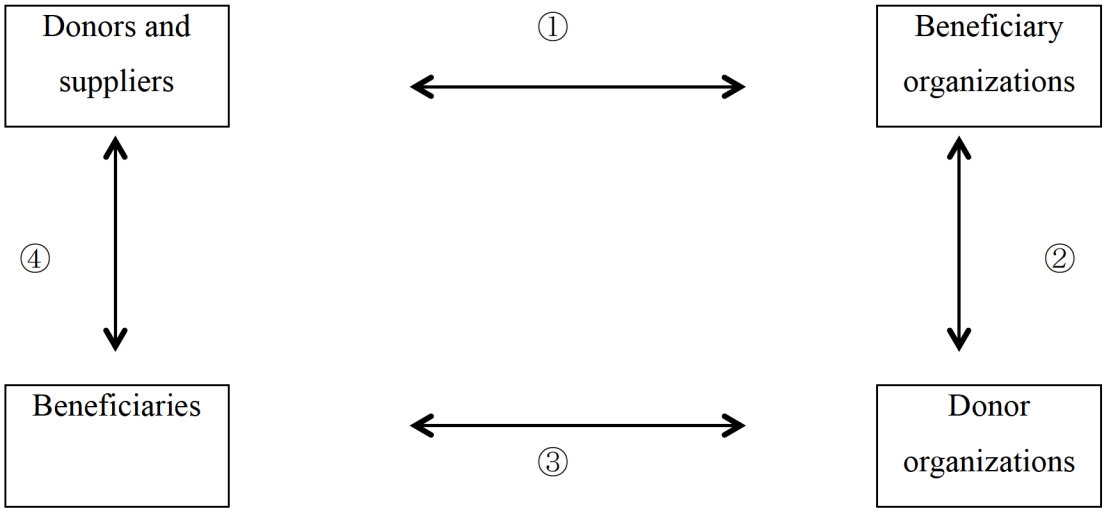

Figure 6.1 Stakeholders' relationships network

Donors and suppliers include private companies and governments who provide donations or supplies for the humanitarian response. These donations and supplies are sent directly to beneficiary organizations. Beneficiary organizations include international aid network, which are governmental organizations, aid agencies, coordinating entities, human rights organizations and Red Cross and Red Crescent societies (Fontainha et al., 2015), governments, and regulatory agency. Normally beneficiary organizations are "*cluster leads*", such as UNICEF, UNHCR, WFP, and OCHA, and they do not have contacts with the beneficiaries directly. "*Cluster leads*" build collaboration and coordination among other entities (Cozzolino, 2012). Beneficiary organizations send donations and suppliers

to designed clusters, who can be considered as donor organizations. Private companies who are hired by the beneficiary organizations to delivery relief goods to the beneficiaries directly, and the military are all considered as donor organizations. Moreover, local aid network, which is composed of local NGOs and local governmental agencies, also belongs to the donor organization category when they have direct contacts with the beneficiaries. The last category of stakeholders is beneficiaries referring to affected people who need humanitarian aids.

Table 6.3 Groups of stakeholders (adapted from Fontainha et al., 2015)

Category	**Donors and suppliers**	**Beneficiary organizations**	**Donor organizations**	**Beneficiaries**
Stakeholders	donors	international aid network	private sector	affected population
	the private sector	governments	military	
	governments	regulatory agency	local aid network	

There are four types of relationships between the four stakeholders' categories (see Table 6.2). The first relationship is between donors & suppliers and beneficiary organizations. Because this donors-to-organizations relation is similar to B2B relation in commercial supply chains, so this relationship can be related as D2O (donors-to-organizations). The second relationship is between beneficiary organizations and donor organizations, which can be related as O2O (organizations-to-organizations) because it is also similar to B2B relation in commercial supply chains. The third relationship is between donor organization and beneficiaries, which can be considered as O2B because it is similar to B2C in the commercial supply chain. These interactions, information flows, and service deliveries between these groups happen in a loop, as there are feedbacks from beneficiaries to donors and suppliers, this is the fourth type of relationship named as B2D. Moreover, there are feedbacks in every relationship, so each group of stakeholders are interdependent. The efficiency of this feedback loop requires coordination, communication, and transparency of activities and services in HSCs. The next section will introduce the main activities and services associated to each link in the chain.

6.3.2 Main Services and Quality of Service Provided by Stakeholders in HSCs

As mentioned in Section 6.3.1, there are four types of relationships among stakeholders. Table 6.4 shows services provided and the QoS attributes required by stakeholders in each type of relationship.

The first stakeholders' relationship is between donors & suppliers and beneficiary organizations (see Table 6.4). In order to understand the beneficiaries' needs, HROs conduct assessment on the situation of a disaster and forecast demand. Based on these assessments and forecasts, organizations within the international aid network raise funds and supplies from donors, governments, and the private sector. According to the kinds and amount of relief goods that donors and suppliers provided, beneficiary organizations have to make plans to manage the inventory before they get distributed. The five QoS attributes from the SERVQUAL (*reliability, responsiveness, tangibles, assurances,* and *empathy*) can be considered as the general and basic QoS attributes of the services provided in the first relationship of stakeholders. *Effectiveness* and *customer satisfaction* are considered as general QoS attributes throughout all humanitarian services. *Timeliness* emphasizes the short response time in HSCs. Thus the assessment on the situation of a disaster and forecasting of relief items should be made quickly by beneficiary organizations. Since donors do not have the obligation to fulfill all the relief items needed, beneficiary organizations should make efforts to raise funding and suppliers to make sufficient relief items available, which shows that *availability* is an important QoS attribute related to inventory management. Sudden-onset natural disasters usually occur under multiple uncertainties, so *flexibility* is required when providing humanitarian services. For example, information about the local suffering situation is hard to collect; so fund raising can be done without prior assessment in order to save time. Making procedures in HSCs transparent is vital to improve efficiency in the chain such that different stakeholders can have access to the information they need and reduce information transfer time. Moreover, *transparency* enables donors to monitor beneficiary organizations' actions and humanitarian aid performance so as to control the QoS in HSCs. As a result, beneficiary organizations may improve their performance under donors' monitoring and keep donors' complaining rate relatively low in return.

Commitment from both donors & suppliers and beneficiary organizations help to build trust in their relationship. QoS attributes in this phase are usually defined in a D2O context, and donors' and suppliers' perceptions are the main focus.

The second stakeholders' relationship is between beneficiary organizations and donor organizations (see Table 6.4). Usually, the local aid network will be responsible for evacuations because local governments and military are familiar with the environment and the population situation. Still, the five QoS attributes in SERVQUAL, effectiveness, and customer satisfaction can be regarded as the general and basic QoS attributes in this phase. *Timeliness* requires the evacuation process to take place quickly and orderly considering that there will be an aftershock following a severe earthquake. Local aid network has to communicate with beneficiary organizations and seek their help in most severe disasters considering their limited abilities and resources (*communication)*. Beneficiary organizations distribute relief items up to the warehouses in affected areas, and they have to make sure that relief items are delivered in the right quantities, and stored in the right containers (*competence*). Some specific services will be outsourced to the private sector. For example, DHL can provide fast delivery services, since it has professional facilities and technologies, and can contribution to the last mile distributions. Various beneficiary organizations and donor organizations are involved in warehousing, distribution, and outsourcing activities. They have to communicate and coordinate with each other to achieve optimal solutions. Thus *coordination* is an important QoS attribute to evaluate their effectiveness, which has an impact on the QoS they provided. QoS attributes defined in the relationships between beneficiary organizations and donor organizations are related to a O2O context because there is no direct contact with beneficiaries.

The third stakeholders' relationship is between donor organizations and beneficiaries (see Table 6.4). Activities in the field, such as resource gathering, transportation, and deployment, occur within this relationship. QoS attributes identified in this type of relationship are different from those in the first and second types of relationship because they are put into a O2B context, where services are directly provided to beneficiaries.

Except for *reliability, responsiveness, tangibles, assurance, empathy, effectiveness, customer satisfaction* and *timeliness* mentioned earlier, there are seven QoS attributes typically related to people's physical and psychological situations. Sufficient medical care, shelters, and other relief goods should be provided near beneficiaries (*accessibility*). Clearly, beneficiaries' perceptions are the main focus in this phase, and more beneficiaries' involvement in humanitarian activities will lead to better aid performance (*involvement*). Beneficiaries' *security and privacy* must be protected when providing various services. For example, proving personal bathing spot and keeping sensitive information on beneficiaries confidential are associated with services of good quality. Local culture and customs should be respected in order to provide appropriate and acceptable services to beneficiaries (*acceptability* and *appropriateness*). Useful products, facilities, and supply services that are provided to beneficiaries should be understood and operated easily for beneficiaries (*usability*).

The last stakeholders' relationship is between beneficiaries and donors & suppliers. Feedbacks from beneficiaries can provide information on HROs' humanitarian aid performance to monitor the relief process, which shows *transparency* of the HSC. Besides, beneficiaries' feedbacks on services that provided by HROs and governments could be regarded as historical data. These feedbacks provide information on beneficiaries' preference on types of supplies, geographic strategies, and potential culture conflicts (*acceptability* and *appropriateness*), which can be used as references in future humanitarian response. This direct connection between beneficiaries and donors & suppliers shows that *involvement* for beneficiaries themselves is important in terms of service providing in HSCs. QoS attributes required in this stakeholders' relationship are considered as B2O-D attributes.

Overall, the five QoS attributes in the SERVQUAL along with *effectiveness* and *customer satisfaction* can be considered as the general and basic QoS attributes in HSCs since they are applicable to almost every services in the chain. *Timeliness* is the crucial QoS attribute that reflects the short time window to react in case of a disaster. All the QoS

attributes are assigned to different stakeholders' relationships, and they are put under B2B and B2C contexts to show their distinct functions.

Table 6.4 Activities, services, stakeholders' relationships, and QoS attributes in HSCs

Relationships of stakeholders	①	②	③	④
Stakeholders involved	donors & suppliers and beneficiary organizations D2O -donors -private sector -governments -international aid network -regulatory agency	beneficiary organizations and donor organizations O2O -international aid network -governments -regulatory agency -local aid network -private sector -military	donor organizations and beneficiaries O2B -the affected population -private sector -military -local aid network	beneficiaries and donors & suppliers B2O-D -donors -private sector -governments -the affected population
Services	-assessment -forecasting -fund and supply raising -inventory management	-warehousing -distribution -outsourcing	-delivery and transportation -communication	-assessment -forecasting -precaution
QoS attributes	-reliability -responsiveness -tangibles -assurance -empathy -timeliness -effectiveness -customer satisfaction -availability -flexibility -transparency --complaining rate -commitment	-reliability -responsiveness -tangibles -assurance -empathy -timeliness -effectiveness -customer satisfaction -communication -coordination -competence	-reliability -responsiveness -tangibles -assurance -empathy -timeliness -effectiveness -customer satisfaction -sustainability -accessibility -involvement -security and privacy -acceptability -appropriateness -usability	-transparency -involvement -acceptability -appropriateness

6.3.3 Develop a Conceptual Framework for Defining QoS in HSCs

Figure 6.2 shows the theoretical framework for defining QoS in HSCs. The stakeholders' relationships network forms the basis of the framework, and it introduces stakeholders in

groups and illustrates the connections of the different groups of stakeholders. Services provided by different groups of stakeholders are also presented. Discussion of Section 6.3.2 explains that *reliability*, *responsiveness*, *tangibles*, *assurances*, *empathy, effectiveness, customer satisfaction* are the seven basic QoS attributes in HSCs. *Timeliness*, which includes punctuality and regularity, is an essential QoS attributes required for all the services provided in HSCs. The other QoS attributes identified, which are similar to those of the commercial supply chain literature and the Sphere Project handbook, are grouped according to the services of the different stakeholders' relationships. QoS attributes in the framework are also put under B2B or B2C context to show their applicable situations.

This framework fills the gap for applying service operations management theory to HSCs, and improves existing QoS measurement model such as the SERVQUAL by considering all stakeholders' perspectives. Moreover, QoS attributes in this framework provide standards and guidance for humanitarian practitioners to better carry out humanitarian activities.

Among all the 23 QoS attributes identified in Table 6.2, the four QoS attributes (*coordination*, *competence*, *involvement*, and *communication)* are also a mean to achieve the QoS. That is to say, if coordination among stakeholders, competence of humanitarian service providers, involvement of beneficiaries, and communication among stakeholders exist in the humanitarian aid process, then the QoS can be achieved more easily.

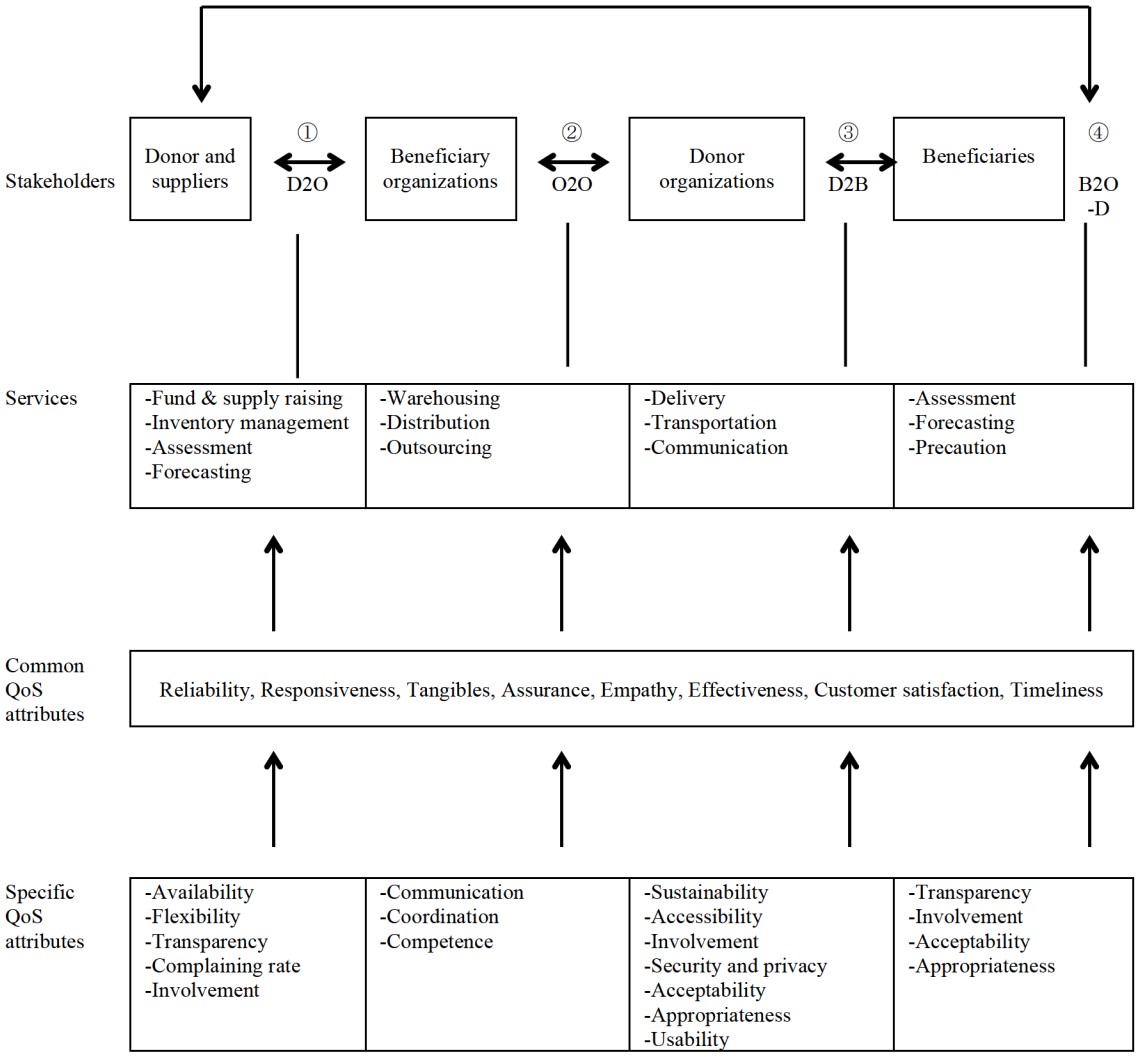

Figure 6.2 A conceptual framework for defining QoS in HSCs

Chapter 7 Conclusion

Supply chain management can provide a competitive advantage for companies. For example, it supports the division of work of global firms, and this allows companies to reduce their costs and keep a certain quality level through outsourcing services to specialists. Motivated by this cost reduction advantage, global commercial supply chains have developed rapidly in the last decades. However, HSCs has not evolved at the same rhythm as commercial supply chains since they are not deployed in an environment that compete over profits. HSCs face multiple challenges when planning and conducting humanitarian responses, including uncertainties, coordination issues between multiple stakeholders, short lead-time requirements, poor technical support and undertrained employees, hardly formed trust, and undefined performance measurement. Clearly defined performance measurement process is essential to control service quality and enable HSCs to develop continuously. There is a gap in the literature on methods adapted for applying service operations management principles to HSCs. This master thesis aims to bridge this gap and to create a conceptual framework to define QoS in HSCs, which could be used as a basis to complement existing performance measurement tools in HSCs.

The framework for defining QoS in HSC was developed based on different literature reviews: QoS literature review, HSCs literature review, QoS in the HSC systematic literature review, QoS in supply chains systematic literature review. The main findings of the literature review on QoS allow to synthetize the definitions and dimensions of service quality in supply chains, whereas those of the literature review on HSCs highlight their particularities, stakeholders, and the different types of disasters types to provide an overview of the context in which they are deployed. The literature review on HSCs presents the notions behind the proposed conceptual framework, and it also creates the basis for the discussion on the QoS attribute selection.

A systematic literature review on QoS in HSC was then conducted to identify QoS attributes. Limited scope of articles (books, journals, thesis, case studies, country reports,

and government documents) are read and screened in order to find out the existing QoS attributes identified by researchers. However, only a few papers have been published on this topic. Thus, the number of articles was too small to develop a comprehensive group of QoS attributes. A SLR on QoS in commercial supply chains was then performed to identify supplementary QoS attributes from which some are applicable to the HSC context. In order to complete our list of attributes, we also reviewed the standards and indicators proposed in the Sphere Project handbook, one of the most important reference for humanitarian services in HSCs. Moreover, we superficially surveyed important humanitarian organisations' websites to find out whether they have presented other QoS attributes or not.

QoS attributes identified in systematic literature reviews and summarized from the Sphere Project handbook are then discussed and consolidated when some QoS attributes have the similar meaning. Finally 23 QoS attributes were selected and integrated into a HSC network to create the framework for defining QoS in HSCs.

7.1 Conceptual Framework Designed

The S3P model (Fontainha et al., 2015), which was present in Section 2.6.1, was simplified into a stakeholders' relationships network demonstrating the relationships and interactions between the different stakeholders in the humanitarian context. Based on these relationships among stakeholders, services carried out by the different stakeholders are grouped into three main relationships or phases. Considering the multiple roles of stakeholders in HSCs and services they provided, 21 QoS attributes identified in commercial and humanitarian supply chains literatures were assigned to different services, to different contexts, and to different stakeholders.

This master thesis is one of the first researches to apply service operations management theory to HSCs, and it shows the possibility and necessity for researchers to enhance the performance of humanitarian supply chains by improving the quality of service. QoS attributes in the proposed conceptual framework are identified in D2O, O2O, O2B and B20-D types of relationships. Our work contributes to the humanitarian supply chain

literature by proposing a conceptual framework of quality of service considering all stakeholders' perspectives.

7.2 Limitations and Future Research

This master thesis is based on literature reviews. However, the concepts of humanitarian response, humanitarian relief, humanitarian logistics, and humanitarian supply chains are not distinguished in many literatures. Since we wanted to focus on sudden on-set natural disasters, it was sometimes difficult to assess if a paper was in fact relevant or not for our study because of a blurry definition of HSCs used by many authors.

When conducting the systematic literature reviews on QoS attributes, many factors related to QoS were taken into consideration. We looked for terms such as "performance attributes", "performance outcomes", "performance parameters", "key factors of quality of service", and "logistics quality attributes" within the articles. However, different terminologies may cause some bias, and some articles or factors might have been left aside.

The aim of this thesis is to define QoS in HSCs. We achieve this by introducing QoS attributes in HSCs, but we did not provide a list of indicators that could be used to measure them. This is a limitation of this master thesis. To fill this gap, specific KPIs should be determined and clearly defined (measure, unit of measurement, and targeted objectives). For example, Kaplan and Norton (1996) introduced the concept of balanced scorecard (BSC) as a top-down approach. It provides a language and a framework to translate a company's mission and strategy into objectives and measurements at every level in the company. The BSC uses four different perspectives, which are financial perspective, customer perspective, internal business process perspectives, learning and growth perspective, to translate missions and strategies into objectives and measures. This multi-perspective consideration of BSC is similar to the multi-perspective of stakeholders in HSCs, thus BSC can be used as a basic framework for defining QoS measures in HSCs. This is left for future research.

Although KPI and standards from the Sphere Project are evidence-based, the developed conceptual framework has not been validated by practitioners. The validation process is left for future research. Defining QoS is the first step to improve the HSCs' performance. In order to improve the efficiency of HSCs, the importance of each QoS attributes has to be measured to better inform stakeholders and help them take better decisions.

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