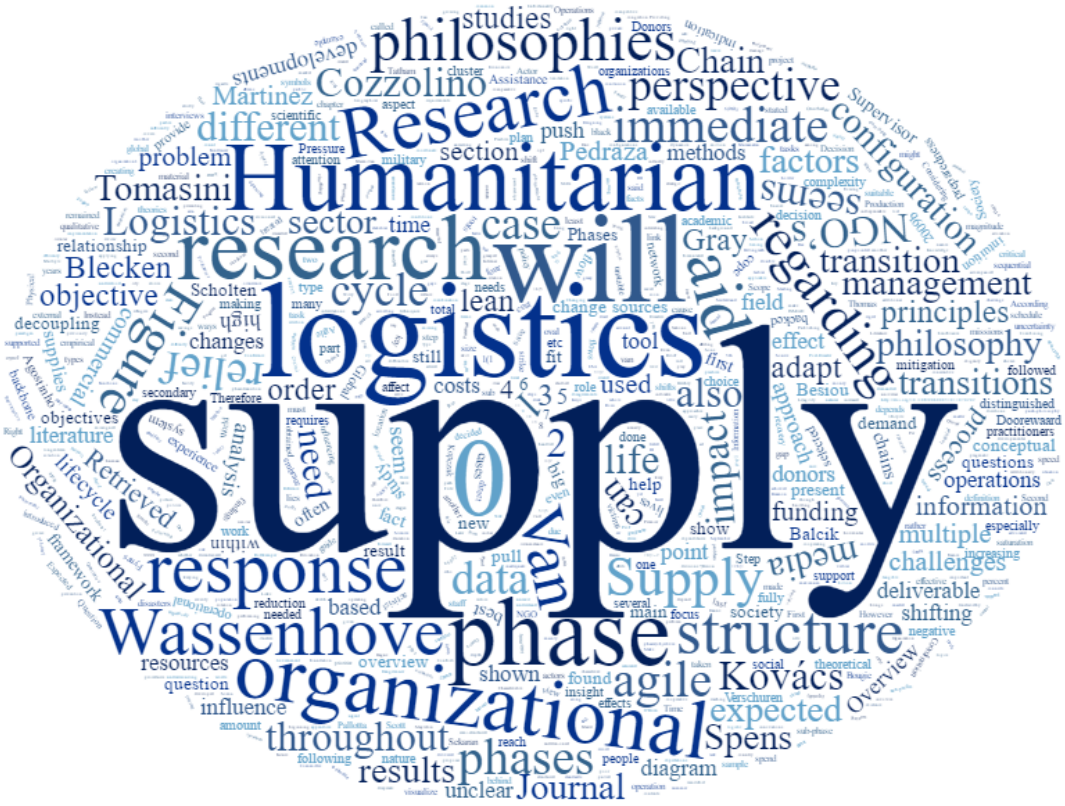
An exploratory study on the (re)configuration of humanitarian supply chains throughout the disaster life cycle



Key words: Disaster response, Humanitarian supply chain, Supply chain configuration, disaster life cycle

Soma Ahmad

4005716

argus I

TU Delft Delft University of Technology

An exploratory study on the (re)configuration of humanitarian supply chains throughout the disaster life cycle

Master thesis submitted to Delft University of Technology

in partial fulfilment of the requirements for

the degree of

MASTER OF SCIENCE

in

Management of Technology

Faculty of Technology, Policy and Management

by

Soma Ahmad

Student number: 4005716

To be defended in public on August 25, 2017

Graduation committee

Chairperson	: Prof. dr. B.A. van de Walle,	Multi Actor Systems
First Supervisor	: Ir. M. Ludema,	Transport and Logistics' Organization
Second Supervisor	: Dr. S. Cunningham,	Multi Actor Systems

PREFACE

Dear reader,
You are on the point of reading my thesis, called: *An exploratory study on the (re)configuration of humanitarian supply chains throughout the disaster life cycle*. It is written according the graduation requirements of the faculty Technology Policy and Management of Delft University of Technology.

This journey has exceeded my expectations in the most extraordinary way. I got the chance to interview people from all sorts of organizations and places : US, Nepal, France, Germany, Norway and of course the Netherlands. All these perspectives allowed me to create a holistic view and made me even more passionate to succeed. My research was not easy, but through perseverance and the great support from my environment I was able to deliver a high-quality report. I would therefore like to take the time to thank some of the many people that helped me throughout my research.

First and foremost, my gratitude goes out to my graduation committee. Marcel Ludema, thank you for your energy and daily supervision. Your guidance and pragmatic view on the matter was indispensable. Scott Cunningham, thank you for your fresh and critical view on the matter, you have challenged me to excel even more. Bartel van der Walle, thank you for sharing your experience, contacts and guidance. Your dedication to the humanitarian cause is inspiring. I truly believe that you will succeed in creating a TU Delft department regarding, humanitarian studies.

Notably, Lieke van Amelsfort and Bas Groothedde, thank you for giving me the opportunity to represent Argusi Aid during my thesis. As my external mentors and colleague's, you've welcomed me in Breda and supported me throughout the experience. Your ambition, excellent network and experience was essential. With your vision, passion and leadership, I believe that Argusi Aid is destined for crucial changes.

In addition, I am grateful for all the professionals who invested their precious time for an interview with me. Your knowledge and experience was the key to my research and insights. I humbly hope that my research will be contribution to the butterfly effect that is awaited by the humanitarian sector.

Finally, I feel incredibly blessed with the love and support of my family and friends. You've helped me to keep believing in myself, even when I forgot how. Especially my fiancé, Willem.

I hope you will enjoy reading and above all I hope you will get as intrigued by humanitarian aid as I am.

Best wishes,
Soma Ahmad

July 01, 2017
Delft, Netherlands

SUMMARY

With the increasing need for help and the severe funding gaps present in the humanitarian sector, working as pragmatic as possible is a matter of lives. The humanitarian context is a dynamic environment which means; turbulent challenges, minimal resources, diverse actors and different objectives throughout the disaster life cycle. This influences the humanitarian supply chain, which seems to go through multiple transitions throughout the disaster lifecycle. The example central for this thesis, is the supply chain transition from push to pull. Right after a disaster occurs, the "No regret policy" is enacted. "This policy affirms that it is better to err on the side of over-resourcing the critical functions rather than risk failure by under-resourcing." (World Health Organization, 2013). This result in a push of supplies which are often misaligned with the real needs of the beneficiaries; supplies are sent regardless of the costs, causing congestion of the system (Oloruntoba & Gray, 2006). Later in the disaster life-cycle, when more knowledge of the needs is obtained, the supplies are pulled. In the commercial setting the supply chain configuration is aligned with the product and the product life cycle. This study shows that not only the products need to be taken into account in the humanitarian supply chain, but also the disaster life cycle. The changes throughout the disaster life cycle have impact on the demand and supply, this is also shown in Figure 1. The main objective is therefore, to provide insight for NGO's on adapting their supply chain configuration, regarding the shifting supply chain objectives throughout the disaster life cycle. This is supported by the underlying design objective which is to create a conceptual knowledge based framework that will indicate the most important aspects to keep the supply chain configuration aligned with the disaster life cycle. It is also shown how such a data base of best practices and barriers could allow for guidelines / standard operating procedures to align the supply chain configuration to the disaster lifecycle.

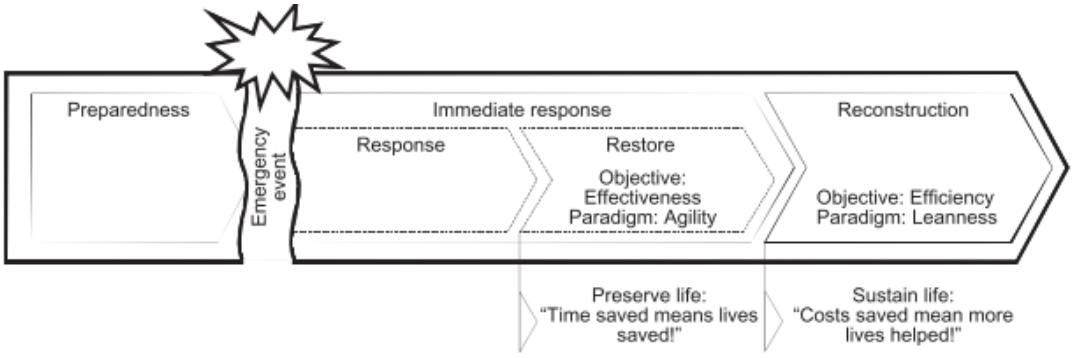


Figure 1 Humanitarian logistics processes throughout the disaster life cycle (Cozzolino, et al., 2012)

In order to achieve the research and design objectives, this exploratory research has the following main question: How can humanitarian supply chains, in a sudden on-set nature disaster, be (re)configured to adapt to changes over the disaster life cycle? Three sub questions are formulated to guide the research towards answering the main question. The methods for gathering information were a literature study and semi-structured interviews, with five humanitarian organization related experts and three established academics in the humanitarian context. It is chosen to focus on natural sudden onset disasters, this is among others based on the literature review of Leiras et al. (2014). They argued that it is probably because of the high complexity of man-made disasters that only 18% of all the papers they reviewed covered them (Leiras et al., 2014). Furthermore with the current growing climate change problem, sudden onset nature disasters are more likely to occur.

The first sub question was chosen to be: What is the current state of humanitarian aid? This question is answered from multiple perspectives in order to enable a holistic view. Firstly the humanitarian environment is investigated. It is found that the humanitarian environment is shaped by: the type of disaster, the actors and the stability of the situation. These change throughout the disaster lifecycle which thus influences the situation. Therefore the most essential concepts considering the humanitarian aid network and the disaster life cycle are described. Literature regarding shifting supply chain objectives throughout the disaster life cycle is available but in a preliminary stage. How the disaster life cycle affects the aid programmes requires further research. The humanitarian aid network was found to be a network with a large diversity of actors. Each of these actors have different drivers and available resources. This is found to be a complicating factor especially as this results in an unclear understanding of who the customer is for a humanitarian organization. For a humanitarian organization to have a donor-focused or a beneficiary-focused supply chain is not always the same. Secondly, it was explained how disaster response normally goes. It was found that a few weeks are needed before the coordination in the disaster aftermath is completely functioning. Thirdly, trends and developments in the humanitarian logistics from the last decades where described. It can be said that the humanitarian aid industry has professionalized extensively the last decades but is still in need of much more developments. Last but not least, the barriers in humanitarian logistics that affect the HSC were summarized. Some of the barriers cannot be predicted and are caused by the nature of the disaster. The barriers that can be dealt with are the organizational and technical challenges. Solving these would be preparedness activities which are needed to be invested in.

The second sub question is chosen to be: How do the changes throughout the disaster life cycle affect the humanitarian supply & demand? Before being able to answer this question it is important to understand which changes throughout the disaster life cycle affect the supply & demand. The humanitarian demand is formed by the needs, these are firstly for safety, security and basic needs which evolve into the need for a self-reliant, independent, sustainable community. How the humanitarian supply is shaped can be categorized with two factors: organization specific and disaster context specific factors. The organization specific factor is set up by the certainty of funding and the supply network. Certainty of funding can for example be influenced by media attention. How the fast track procedures are put up also plays a big role. The supply network enables the supply, each of the links in this chain is needed. The disaster context specific factors are the ones the humanitarian organization needs to deal with. This results in bottlenecks in the supply network and the urgency & uncertainty of the situation. Bottlenecks might be: congestion of warehouses due to unsolicited donations, destroyed infrastructure and damaged entry ports (harbours, airports, etc.). The urgency of the situation also influences the supply, as time is lives saved. Uncertainty of impact, magnitude location and timing also influences the supply. Because the nature of the humanitarian context changes throughout the disaster life cycle, it affects the demand uncertainty, this causes ineffective demand and supply matches. Having this said, the most important characteristics to describe the humanitarian demand are: urgency, uncertainty, volume and variety. For supply it is urgency and uncertainty. The obtained knowledge allows a holistic overview of all the demand & supply characteristics and how they globally change through the disaster life. These findings are based on the interviews and literature.

The third sub question is: Which crucial characteristics need to be monitored for an aligned supply chain configuration throughout the disaster life cycle? Answering this sub question was done by developing a knowledge based framework that enables deeper understanding of the possible humanitarian supply

chain configurations. The main categories of this knowledge based framework are: context (provides the aspects that need to be dealt with), strategy (the approach that is chosen to deal with the context), structure (the way the realizing the approach is facilitated) and process (the steps that need to be taken). Each of these categories are followed by aspects that shape these categories.

The structure category is for example followed by the following aspects: supply network, organizational & financial. Where the supply network is divided in generic upstream and downstream supply chains, visualizing the different possible decoupling points. These decoupling points are useful to control the push to pull barrier. The complete overview of the categories with all the aspects and sub aspects form the skeleton of the conceptual knowledge based framework. This knowledge based framework is to be filled with new barriers and best practices that are encountered by the humanitarian community. This will eventually create an ever-growing database with best practices and barriers for the humanitarian sector to learn from. Such a database could be shared online for the complete humanitarian community. A summarized version would also be useful in the field pocket book of humanitarian practitioners. The more best practices and barriers are filled in this database, the clearer the relation of the supply chain configuration and the disaster life cycle becomes. The goal is that the matured framework eventually could be used as input for developing standard operating procedures or guidelines for aligning the supply chain configuration with the disaster life cycle. For understanding how this would look like the main take outs from the semi structured interviews are implemented and this allowed developing useful guidelines regarding the sourcing processes throughout the disaster life cycle. The guidelines are presented in the form of an if-then-else diagram, eventually suggesting which (previously presented) supply network decoupling structure is the best fit for the situation. The if then else diagram, will also be useful in the field pocket book of humanitarian practitioners, as these do not discuss how processes and operation should be adjusted throughout the disaster life cycle. The more the first part of the knowledge based framework is enhanced by new best practices and barriers, the more if-then-else diagram can be made covering other decision processes. Supply chain processes can be organization specific and need to be therefore tailormade in future studies.

By creating the first deliverable, the conceptual knowledge based framework, the crucial characteristics of a humanitarian supply chain configuration are identified. But these are not yet clearly separated per process (assessment, procurement, transport, warehousing, evaluation). The second deliverable, the sourcing guidelines, show exactly which crucial characteristics need to be monitored for an aligned sourcing process throughout the disaster life cycle. This is the first step towards an aligned supply chain configuration. Further research is required to develop guidelines for the other processes. When fully developed these might even be transformed into decision support tools, where the circumstances are filled in and the best decisions are advised.

Now the three main questions have been answered, it is time to answer the main question: How can humanitarian supply chains, in a sudden on-set nature disaster, be (re)configured to adapt to changes over the disaster life cycle? This can be done by creating full understanding of what a supply chain configuration is and what affects its performance. This means: full understanding of the changes throughout the disaster life cycle are needed, full understanding of the supply & demand characteristics and understanding which factors are supply chain design factors and which are situational. It was found that the answer to the main question depends on the process and product category. The if then else diagram answers the main question exactly for the process of sourcing. Decision support tools for the

other processes, disaster types and organization types will be the next step. The two concepts that are suggested in this thesis provide valuable insights in the form of a comprehensive high level overview. The eventual tools need more research to increase generalizability, they need to mature over time.

One of the most important findings in this thesis is that push is not necessarily a bad thing and it cannot be completely eliminated. It was found that uncertainty and urgency in the direct aftermath of disaster is very high. The need for acting quickly is enormous, even though the required information is not yet obtained. Therefore, supplies are indeed pushed in the first few weeks after the disaster, this is based on the disaster specifications and the knowledge of the country. As was found push of supplies can result in oversupply of certain goods which can cause congestion of the system. This caused the initial thought to be that pushing supplies without knowing the exact needs is something that needs to be stopped. But in fact, due to the minimal available information and the urgency, it can be said that push is not necessarily bad as long as it is minimized and the unused products can be used in later stages. By adapting the initial Fritz Institute matrix (original is left, adapted is right, Figure 2), it was found that by elongating the response time and minimizing the level of uncertainty the push stage can be minimized.

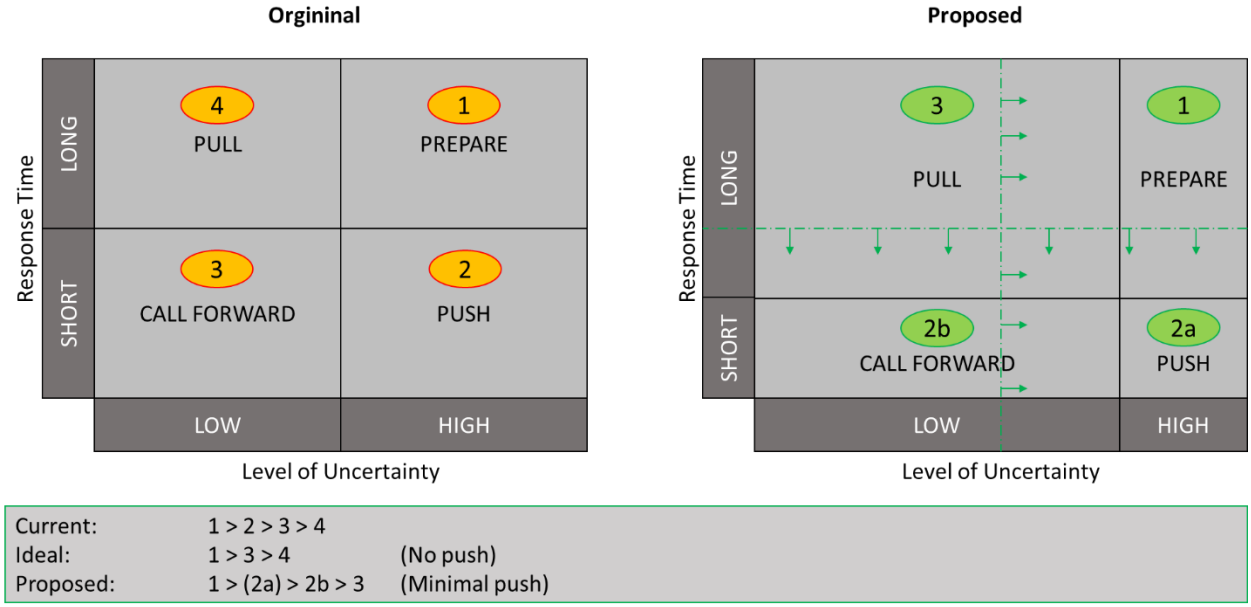


Figure 2 Fritz Institute matrix

Another important finding is the that products and services change throughout the disaster life cycle. This is investigated regarding the WASH and Shelter category but the exact transitions require future studies. Especially when considering that the transitions throughout the disaster life cycle are a dynamic sliding scale which can move in two directions. The immediate response phase can be followed by the reconstruction phase, but in case of an aftershock or a landslide that is followed up by a flood, the emergency state can be reenacted. Therefore, milestones need to be indicated in future studies to obtain more understanding of transitions through the disaster life cycle. Nevertheless, three major shifts in from project and service characteristics are indicated throughout the shift from immediate response to reconstruction. Firstly, the transition from standardized to tailormade solutions. Secondly, the transition from Functional and easy to use products to complex systems that require education and or installers. Thirdly of course the start of the short term solutions which eventually turn into long-term solutions which are more sustainable.

TABLE OF CONTENTS

1 INTRODUCTION

The global humanitarian aid sector had a 26% funding gap during the summer of 2015, while 78.9 million people were in desperate need of assistance (O'Brien, 2015). This is a big problem especially when considering the increasing need for humanitarian aid. With the increasing need for help and the funding gaps present in the humanitarian sector, working as pragmatic as possible is a matter of lives. Considering the fact that 60 to 80 percent of the total humanitarian aid costs are logistics and supply chain costs (Blecken et al., 2010; Van Wassenhove, 2006), it can be understood that developments in this field could result in savings. Uncertainty of demand and limited resources are mentioned as some of the challenges faced by humanitarian logistics (Kovács & Spens, 2012). Many other factors play a role, turning humanitarian logistics into a wicked problem (Tatham & Houghton, 2011).

The humanitarian context is a dynamic environment which results in changing challenges, resources, actors and objectives throughout the disaster life cycle. This influences the humanitarian supply chain, which seems to go through multiple transitions throughout the disaster lifecycle. One example is the supply chain transition from push to pull. Right after a disaster occurs, the "No regret policy" is enacted. "This policy affirms that it is better to err on the side of over-resourcing the critical functions rather than risk failure by under-resourcing." (World Health Organization, 2013). This result in a push of supplies which are often misaligned with the real needs of the beneficiaries, supplies are sent regardless of the costs, causing congestion of the system (Oloruntoba & Gray, 2006). Later in the disaster life-cycle, when more knowledge of the needs is obtained, the supplies are pulled. It is found that "the unpredictable, dynamic and chaotic environment in which relief chains operate is unique." (Beamon & Balcik, 2008).

From effective to efficient, from push to pull, from agile to lean, these changes in supply chain objectives and philosophies seem to be influencing the fit of the supply chain structure. But when and how to cope with these changes still seems to be unclear. Instead of facts and factors, these decisions are often based on intuition and experience (Besiou, et al., 2011). Therefore, the thesis objective is to provide insight for humanitarian organizations on when and how to adapt their supply chain configuration, regarding the shifting supply chain objectives. This is supported by the underlying design objective which is to create a conceptual knowledge based framework that will give an overview of all the important dimensions and aspects that need to be monitored.

To achieve the objective, understanding of the supply chain performance and changes through time is needed. It is said that: "Effective performance measurement systems would assist relief chain practitioners in their decisions, help improve the effectiveness and efficiency of relief operations, and demonstrate the performance of the relief chain, thereby increasing the transparency and accountability of disaster response."(Beamon & Balcik, 2008). Therefore, a knowledge based framework set up and filled up with best practices and barriers for humanitarian practitioners to understand the importance of all the aspects of the supply chain configuration and how this needs to change through time. This allows insights for developing standard operating procedures (S.O.P's) or guidelines for processes in the humanitarian supply chain. In fact, from the best practices and barriers that were filled in, guidelines are set up for sourcing throughout the disaster life cycle. This is visualized in the form of an if then else diagram. Future studies are required to further develop the concepts to be used as a support tool which can be used to keep the supply chain configuration aligned with the disaster life cycle.

It is found that the phases of the disaster life cycle, described in theory and reality, are different. The phases are fuzzy and overlapping while the academic world speaks of clear distinction between the phases (even though a single set of phases has not been agreed upon). Therefore, the phases, when discussed in this thesis, are not defined by a specific time but by their characteristics.

Because of the climate change and its serious effect on our planet the scope of this thesis is chosen to focus on natural sudden onset disasters (hurricanes, earthquakes, floods, etc.).

Two humanitarian organizations (Anonymized Organization A & B) and one logistics service provider in the humanitarian context (Anonymized Organization C) were interviewed regarding their supply chain configuration's barriers and best practices in a semi structured interview setting. They are asked to discuss their supply chain configuration and activities throughout the disaster life cycle regarding cases that fit with the selected scope. These interviews and the interviews with academics allow for setting up the deliverables and the input regarding barriers and best practices.

To share the complete process and findings thoroughly and just, this report is structured as followed. Chapter 2 will present the research methodology and design objective. Chapter 3 and 4 lay the foundation of the academic and empirical input for this thesis. This entails the literature study, desk research and input from the exploratory interviews to create full understanding of the field of this thesis. Chapter 3 will provide a multi perspective view of humanitarian aid and all its complications relevant to the study. Chapter 4 will discuss the relief chain and all it's important characteristics. this also entails learnings from commercial supply chain strategies. Chapter 5 will combine the knowledge of chapter 3 and 4 in order to develop the conceptual design objective, the knowledge based framework and the guidelines for sourcing. Following from the analysis and deliverables, the findings will be discussed in chapter 6. The conclusion, discussion and recommendations will be presented in chapter 7. Finally, the bibliography and the appendix are added for further details and back ground information of the research.

2 THESIS METHODOLOGY

This chapter discusses how the research is set up and which methods are used. Firstly, the problem statement is given. This is followed by the research objective and description of the deliverables. Furthermore, the research questions and chosen research methods are discussed. Finally, a short description of the expected limitations and thesis execution is given.

2.1 THE PROBLEM STATEMENT

Because of the climate change problem, sudden onset nature disasters will keep increasing. "The increased frequency and scale of disasters, scarce resources, funding competition, and the need for accountability require more efficient, effective and transparent relief operations" (Beamon & Balcik, 2008, p. 8). The number of humanitarian organizations has also increased. However, the resource allocation is often found a problem. The reconstruction activities are typically overfunded while the disaster relief projects experience a late and high peak of funding. This result in a push of supplies which are often misaligned with the real needs of the beneficiaries, supplies are sent regardless of the costs, causing congestion of the system (Oloruntoba & Gray, 2006). "Wastage rates of up to 30 percent in aid delivery have been identified in some post-crisis situations" (Pettit & Beresford, 2009). Later in the disaster life-cycle, when more knowledge of the needs is obtained, the supplies are pulled.

Humanitarian aid is complex. There are many changes throughout the disaster lifecycle: demand, product characteristics, challenges, resources. But the humanitarian supply chain throughout the disaster lifecycle does not change along. When looking into the phases of the disaster life cycle, there seem to be disagreements in literature considering the exact phases within the humanitarian process. From the literature study, it seems that uncertainties in this field will have big effects throughout the whole process. The shift from speed to cost reduction indicates the phase-transition but how and when is unclear. "In terms of operational performance the interesting part about the transition between the stages is the shift in focus from speed to cost reduction" (Tomasini & Wassenhove, 2009a, p. 550).

The supply chain configuration is found to be related to the phases but the link between the immediate response and reconstruction phase seems to be inadequate (Oloruntoba & Gray, 2006). Cozzolino et al (2012) stated that there is a relationship between the phases within humanitarian logistics and the required logistics techniques. Because the immediate response phase requires an agile approach and the reconstruction phase should be handled per lean principles (Cozzolino et al., 2012). However, these principles can also be combined throughout the supply chain with a decoupling point (Scholten et al., 2010). "Although several previous studies introduced the agile principle as suitable for disaster relief, when and how to embrace the agile and the lean principles remained unclear" (Cozzolino et al., 2012, p. 28).

From effective to efficient, from push to pull and from agile to lean, these changes in supply chain objectives and philosophies seem to be influencing the fit of the supply chain configuration. But when and how to cope with these changes still seems to be unclear. Instead of facts and factors, these decisions are often based on intuition and experience (Besiou, et al., 2011). Knowledge on how to align the supply chain configuration to the changes of the disaster life cycle is paramount. This exploratory study will contribute to that.

2.1.1 Definitions used

In order to avoid any misunderstanding this section gives a short overview of the multi-interpretable jargon that is used in this thesis.

- **Supply chain configuration:** "A configurations is defined as a commonly occurring cluster of strategy, structure, process and context." (Neher, 2013).
- **Supply chain management**: encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across companies (CSCMP, 2009).
- **Logistics (management)**: that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption in order to meet customers' requirements (CSCMP, 2009).
- **Humanitarian logistics**: "The process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials as well as related information, from the point of origin to the point of consumption for the purpose of meeting the end beneficiary's requirements." (Thomas & Mizushima, 2005, p. 60).
    - The tasks that belong to this concept are the following: "preparedness, planning, procurement, transport, warehousing, tracking and tracing and customer clearance." (Thomas & Mizushima, 2005, p.60).

2.2 RESEARCH OBJECTIVE & DELIVERABLES

The main objective is to provide insight for NGO's on adapting their supply chain configuration, regarding the shifting supply chain objectives throughout the disaster life cycle. This is supported by the underlying design objective which is to create a knowledge based framework that will indicate the most important aspects to keep the supply chain configuration aligned with the disaster life cycle.

The deliverable is set up in two parts, the base of an ever-growing knowledge based framework and if then else scheme. The knowledge based framework (section 0 & 5.3) will be filled up with best practices and barriers for humanitarian practitioners to understand the importance of all the aspects of the supply chain configuration and how this needs to change through time. The framework can be complemented with other best practices in order to increase the learnings. It will work as guidance for humanitarian supply chain officers to understand which aspects belong to the supply chain configuration and need to be aligned with the disaster life cycle. This creates insights on which dimensions to monitor in order to have more effective and efficient aid. The final knowledge framework can be stored on an online open-access database such as humanitarianresponse.info or reliefweb.com. This would allow other humanitarian practitioners to add their own experienced best practices and barriers. These online knowledge sharing platforms will be further discussed in section 3.3.

The second part of the deliverable (section 5.4) is an example of guidelines that can follow from the learnings of the first part. It will be a useful decision making support tool regarding the sourcing process. Guidelines for other processes are left for future studies. It is visualized in an if then else diagram. It could be useful in the field pocket book of humanitarian practitioners. The tool will follow from the first application of best practises and findings in section 5.3. It will be created as an if-then-else diagram. The more the first part of the knowledge based framework is enhanced by new best practices and barriers, the more if-then-else diagram can be made to support the decisions of humanitarian practitioners. The purpose of these two deliverables is increasing awareness and understanding regarding an aligned supply chain configuration throughout the disaster life cycle. Therefore, the main requirement of the two deliverables if providing insight in relation regarding the supply chain configuration and the disaster life cycle.

Following the five-stage prescriptive model (Dym et al., 2014), the problem definition and conceptual design are realized for both deliverables. Therefore, the level of detail of both parts is conceptual, visualizing the factors schematically in a static matter. Further research is needed to further develop the deliverables to be ready for application. Clarification of the choice of methods will follow in chapter 3.

2.3 RESEARCH QUESTIONS

The main question (MQ) is decided to be:

How can humanitarian supply chains, in a sudden on-set nature disaster, be (re)configured to adapt to changes over the disaster life cycle?

In order to guide the process of answering the main question, four sub-questions (SQ) are formulated. Each of them is listed below, including a short list of "answer directions". These represent the expected type of answer in the broadest sense of the word.

1. What is the current state of humanitarian aid?
2. How do the changes throughout the disaster life cycle affect the humanitarian supply & demand?
3. Which crucial characteristics need to be monitored for an aligned supply chain configuration throughout the disaster life cycle?

2.4 METHODOLOGY THROUGH THESIS OUTLINE

The thesis exists of three main phases: problem exploration, design process and discussion. The first phase is mainly research based, the obtained information will than supports the design objective in the second phase. The research questions, as described in the previous section, are crucial to achieving the main and design objective. In order to achieve the goal of this thesis the research questions need to be answered and the design objective needs to be met. The three main phases are respectively: problem exploration (chapter 3 & 4), design process (chapter 5) and discussion (chapter 6 & 7). Following Verschuren & Doorewaard (2010) the methods with best fit are selected as a combination of a desk research and empirical study through qualitative methods. Tabel 1 provides an overview of methods per research question per assigned chapter.

Due to the complexity of the situations which are dealt with in the humanitarian sector, the variety of multiple actors and the varying types of NGOs, it is deliberately chosen to opt for a broad exploratory perspective. Because of this choice, mainly qualitative data is used for these results no specific statistical data analysis tools were required.

Tabel 1 Overview of methods per research question per assigned chapter

Questions	Methods	Chapters
How can humanitarian supply chains, in a sudden on-set nature disaster, be (re)configured to adapt to changes over the disaster life cycle?	Desk research, semi-structured interview (exploratory & non-exploratory)	Chapter 6 & 7
1. What is the current state of humanitarian aid?	Desk research & exploratory semi structured interviews	Chapter 3
2. How do the changes throughout the disaster life cycle affect the humanitarian supply & demand?	Desk research & exploratory semi-structured interviews	Chapter 4
3. Which crucial characteristics need to be monitored for an aligned supply chain configuration throughout the disaster life cycle?	Desk research; exploratory & non-exploratory semi-structured interviews	Chapter 5

2.4.1 Phase one

Information for the problem exploration phase is obtained through desk research and semi structured interviews (Verschuren & Doorewaard, 2010). The desk research is performed with existing academic literature and online secondary data sources such as reports and statistics of humanitarian organizations. The semi-structured interviews are executed in a sequential order, allowing the findings of the first interview to be used in the second. The interviewees are selected from multiple fields in order to acquire broad understanding of the problem. Some examples of these fields are: academic professionals, commercial supply chain experts, humanitarian practitioners, etc. It is deliberately opted to ensure a divers variety of interviewees in order to scope out biased opinions. This also means considering the difference of people in different organizational levels. How this is achieved is further explained in section 2.4.4. These methods provide the information for chapter 3 & 4. As shown in, this answers the first two sub questions. This is the input for the following phase the design process.

It is chosen to focus on natural sudden onset disasters, this is among others based on the literature review of Leiras et al. (2014). They argued that it is probably because of the high complexity of man-made disasters that only 18% of all the papers they reviewed covered them (Leiras et al., 2014). Furthermore, with the climate change sudden onset nature disasters are more likely to occur. Other decisions on the scope are made in the problem exploration phase (chapter 3), these are regarding the following aspects:

- Type of disaster: Natural & sudden-onset
- Geographical perspective: Nepal, Haïti
- Disaster lifecycle stage: (preparedness), response, (recovery)
- Decision level strategic / tactical (Logistics management HQ, Regional director and country director / director of operations)
- Stake holder perspective: INGO
- Coordination perspective: Centralized - decentralized
- Type of aid: WASH & Shelter

2.4.2 Phase two

The learnings from chapter 3 & 4 form the starting point for the second phase of this research where the design process of the deliverables is central. Following the five-stage prescriptive model (Dym et al., 2014), the problem definition and conceptual design are realized. Therefore, the level of detail of both parts is conceptual, visualizing the factors schematically in a static matter. Further research is needed to further develop the deliverables to be ready for application. The methods for developing the two deliverables, as described in section 2.2, are non-exploratory semi structured interviews and desk research. In this phase the desk research is mostly supplementary to the findings from the interviewees.

The first deliverable is the base of a conceptual knowledge based framework that can be filled up with best practices and barriers for humanitarian practitioners to understand the importance of all the aspects of the supply chain configuration and how this needs to change through time. The skeleton of the conceptual knowledge based framework is visualized in the form of a tree diagram which is based on the definition of a supply chain configuration by Neher (2013). Neher (2013) defines a supply chain configuration as a combination of the context, strategy, structure and processes. Through the input of chapter 3 & 4 the aspects of these categories are defined in section 0.

These semi structured interviews allow understanding on their supply chain configuration. The non-exploratory interviews are organization related. The aim of the organization related interviews is to describe their organizations supply chain regarding the relevant aspects of the supply chain configuration are represented, in order to eventually use it to validate the findings from chapter 4 and allowing to create the skeleton of the conceptual knowledge based framework in section 0.

Each of the interviewees are also asked to talk through a specific sudden onset nature disaster in order to give examples from previous experiences. From these experiences, best practices and barriers can be found to fill in the first knowledge based framework in section 5.3.

The conceptual knowledge based framework is supposed to become an ever-growing database allowing other humanitarian practitioners to add their own barriers and best practices. This means that it requires more cases to fully mature. Extra cases means that more situations can be described, thus the quantity can excel the quality and generalizability. The knowledge based framework leads to understanding of the importance of all the aspects of the supply chain configuration and how this needs to change through time. In order to show how further understanding supports insights on alignment of the supply chain configuration to the disaster life cycle the second deliverable is an if then else diagram which focuses on guidelines for sourcing (section 5.4). This diagram is developed with arrows and gateways which are adopted from the BPMN-method (Business Process Model Notation). This method is chosen because it allows a clear and concise representation of the if then else diagram.

It is aimed to analyze 1 to 3 organizations, depending on the available time, contacts and data. If, due to one of these constraints, the study is limited to only one organization related analysis, validation is performed through extra interviews to verify the findings. The organization selection will depend on the frequency of occurrence of the natural disaster and the available contacts / data.

2.4.3 Phase three

The final phase of this thesis is the discussion, this entails chapter 6 & 7. Chapter 6 entails an overview of the findings of this research and a discussion of these findings. Chapter 7 covers the conclusion, recommendation and reflection on the complete thesis process.

2.4.4 Semi structured interviews, contacts & data analysis

As already discussed in the previous section it is deliberately opted to find interviewees of a broad spectrum of specializations. This is needed to ensure saturation of the findings and prevent basing findings on biased expressions.

The interviewees are approached from the network of Argusi Aid and Prof. dr. B.A. van de Walle (Head of the graduation committee). This allowed for 7 full semi structured interviews, as well as many advisory meetings in order to reflect on the findings. These advisory meetings enabled the verification of the findings in an implicit way. The interviewees are experts from the humanitarian sector covering both the academic and operational field. They were contacted because of their experience and knowledge of the field. Tabel 2 gives an overview of all the interviewees and their background.

The semi structured interviews are set up with a personal interview protocol in order to provide learnings for each of the chapters in a different way. The duration of the interviews was aimed to be an hour, by respecting the interviewees busy schedule. Interviews are performed face2face or by a skype call. Semi-structured interviews leave space for the interviewee to ask further in case of interesting insights. This might lead to less time to treat all topics. This is consciously considered therefore the interviewees are asked multiple times to check the available time throughout the interview. The topics that are planned to treat are ordered by priority, this allows ensuring useful information when the interviewer runs out of time. An overview of the guiding questions that were chosen for the semi structured interviews is shown in Appendix A.

According to the interview protocol all the communications are recorded and fully transcribed. These transcriptions are fully analyzed in order to select main take outs. Data analysis and confirmation is done inductive and unconstrained to allow findings to emerge freely. Once immersed in the wealth of data, the most promising lines of findings are followed taken out as main take outs from the interviews. Appendix B provides an overview of the main take outs that are used per interview or communication. The main take outs of the organization related interviewees are left out due to privacy agreements. These interviewees are therefore also anonymized. By means of relevance it is chosen to only add the main take outs in the appendix. The complete collection of transcriptions entails over 50 pages, and can be requested for those who are interested. By performing multiple manual data clustering's, the main take outs formed the input for the thesis. The clustering's allowed for useful and established findings. The ones in scope are used in chapter 3, 4, 5. The insight's obtained from the clustering's which were not in scope are recommended for future studies in chapter 7.

Tabel 2 Overview of interviewees and their background

Category	name	function	organization	contact	date
Humanitarian organization	Anonymized Interviewee A.1	Logistics Manager, Emergency and Humanitarian Assistance	A	semi-structured interview	17/01/2017
Humanitarian organization	Anonymized Interviewee A.2	Logistics officer Nepal	A	semi-structured interview	22/02/2017
Humanitarian organization	Anonymized Interviewee B.1	WASH Expert, Logistics, coordination	B	semi-structured interview	04/01/2017
Ex-humanitarian organization/ commercial SC	Anonymized Interviewee B.2	Shelter Expert, Logistics, entrepreneur	B	semi-structured interview	09/02/2017
Supplier (first tier company)	Anonymized Interviewee C.1,2,3	Logistics managers & procurement officers	C	semi-structured interview	26/01/2017
Academics (humanitarian)	Kenny Meesters	PhD Humanitarian Aid	TU Delft	advisory conversations & semi-structured interview	27/12/2016
Academics (humanitarian)	Tina Comes	Professor Centre for Integrated Emergency Management (CIEM)	University of Agder & TU Delft	advisory conversations & semi-structured interview	1/02/2017
Academic & commercial supply chain expert	Bas Groothedde	Co-founder of Argusi	Argusi	advisory conversation	Multiple times during the project
Academic & Ex-humanitarian organization/ commercial SC	Martin Ohlsen	Professor & emergency coordinator	WFP	advisory conversation	25/01/2017

2.4.5 Reflection

The choices regarding the methodology that are discussed in this chapter are consciously chosen to ensure a generalizability and robustness. To what extent this is achieved and how this could be done better in future studies is discussed in chapter 7.

3 A MULTI PERSPECTIVE VIEW OF HUMANITARIAN AID

This goal of this chapter is to answer the first sub question: What is the current state of humanitarian aid? This questions was deliberately set up broadly in order to allow for a clear understanding of the situation. In order to answer this sub question this chapter has been divided into three subchapters and a chapter conclusion. Subchapter 3.1 will provide a multi perspective view of humanitarian aid. Basic principles and definitions are presented. The disaster life cycle and types of aid are presented. As well as the humanitarian aid network and how it is related to the disaster life cycle. This is followed by Subchapter 3.2, which will give insight on the activities and events throughout the disaster life cycle as well as a deeper understanding of the demand in the humanitarian setting. Following with subchapter 3.3 which will summarize the trends and development in humanitarian logistics from the last decades. Thereafter, subchapter 3.4 will give an overview of the challenges in humanitarian logistics. Finally, the chapter conclusion will be presented in subchapter 3.5; here the answer to the first sub question will be given. This answer will be combined with the knowledge of chapter four and used as input for chapter 5.

3.1 HUMANITARIAN ENVIRONMENT

The goal of humanitarian operations is defined as followed: "A successful humanitarian operation mitigates the urgent needs of a population with a sustainable reduction of their vulnerability in the shortest amount of time and with the least amount of resources" (Tomasini, et al., 2004, p. 1).

This is easier said than done. Operating in humanitarian aid is often described as having a client form hell. It is unclear: when they need your services, what they need, how much they need, and where they want to receive it. (Kovács & Spens, 2007). It is characterized by: "ambiguous objectives, limited human and capital resources, high levels of urgency and uncertainty, and a politicized environment" (Tomasini and Van Wassenhove, 2009).

This report will maintain the following definition for humanitarian Logistics: "The process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials as well as related information, from the point of origin to the point of consumption for the purpose of meeting the end beneficiary's requirements" (Thomas & Mizushima, 2005, p. 60). The tasks that belong to this concept are the following: "preparedness, planning, procurement, transport, warehousing, tracking and tracing and customer clearance" (Thomas & Mizushima, 2005, p.60).

3.1.1 Types of disasters

A disaster is "a disruption that physically affects a system as a whole and threatens its priorities and goals"(Van Wassenhove, 2006, p. 476). In order to understand more of disasters and the consequences they bring with their occurrence it is of importance to understand the types of disasters. Figure 3 shows the classification of disaster types, based on disaster attributes and categories (Cozzolino, 2012).

Starting with the disaster attributes, this can be subdivided in cause of disasters and predictability and speed of the disaster occurrence. The cause of the disaster can either be natural or man-made. Predictability and speed of the disaster occurrence is sectioned as sudden-onset and slow-onset (L N Van Wassenhove, 2006). In the case of a natural disaster sudden-onset could be a typhoon and slow-onset a drought.

When considering a man-made disaster, sudden-onset could be a terrorist attack and slow-onset could be a political crises. One might argue that the rising sea-level, which will drown multiple Caribbean islands, is a slow-onset disaster which has a man-made and natural cause.

The disaster categories are grouped as: calamities, destructive actions, plagues and crises. Examples for these would respectively be: earthquake, coup d'état, famine and refugee crises. One might wonder why people speak of an Ebola crisis even though it can be argued that it is not man-made.

Figure 3 shows that this type of labelling of disasters also allows relating the relevance of logistical effort to the disaster category. Calamities and destructive actions seem to have a greater impact on the level of destruction of the area. Therefore more knowledge is needed and the costs are often higher. (Cozzolino, 2012)

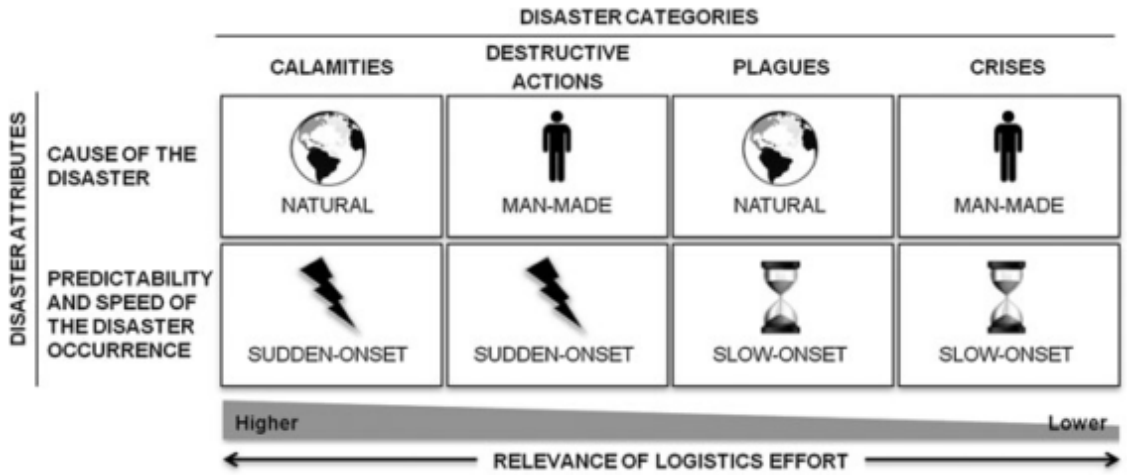


Figure 3 Types of disasters (Cozzolino, 2012)

3.1.2 The disaster life cycle and the aid programs

Disaster life cycle definitions found in literature

From the studied literature, it was found that multiple authors used different names and time frames for the phases of the, disaster life cycle, total process. The post-disaster sub-phase mentioned by Blecken et al (2010), covers for example the response and rehabilitation phase of Tomasini & Van Wassenhove (2009b).

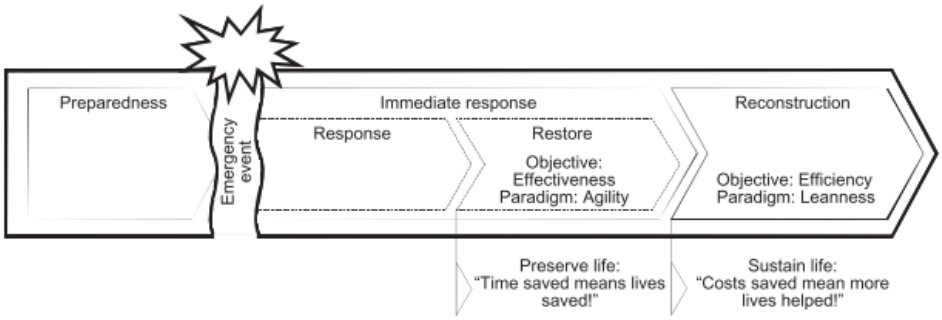


Figure 4 Humanitarian logistics process (Cozzolino, et al., 2012)

This rehabilitation phase is called the Reconstruction phase by Cozzolino et al (2012). In Figure 4 the phases distinguished by Cozzolino et al (2012) are shown. While Tomasini & Van Wassenhove (2009b) describes a more circular process with a mitigation phase which connects the first and last phase. The UN with their cluster approach have distinguished 7 phases; prevention, mitigation, preparedness, disaster, response, recovery and reconstruction (Appendix 109D).

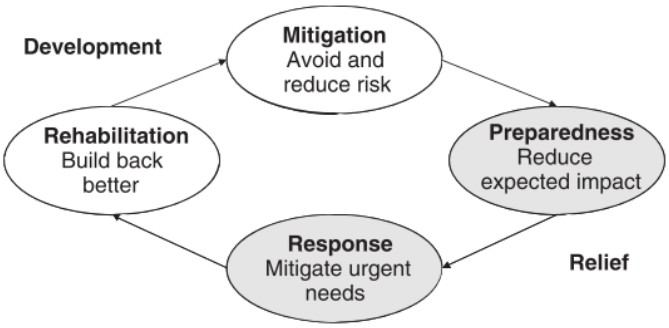


Figure 5 Disaster management life cycle (Tomasini & Van Wassenhove, 2009b)

A more theoretical overview is shown in Figure 6. Here the phases are categorized by the intensity of the task and coordination. This results in a ramp up, sustain and ramp down phase. (Tomasini & Wassenhove, 2009)

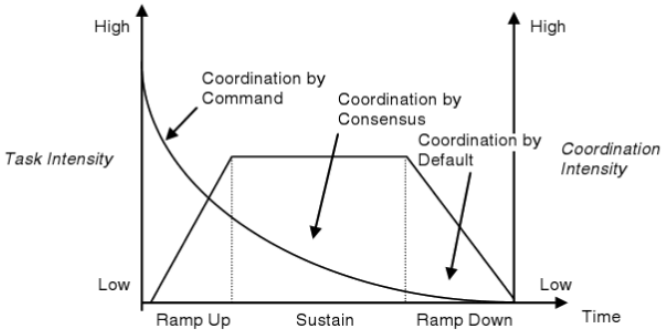


Figure 6 Coordination life cycle (Tomasini & Wassenhove, 2009)

Next to the disagreement on the phases, the duration of these phases also seems to be unclear. Has mentioned the immediate response phase to be 1 – 3 days, while Besiou et al (2011) mentioned 6 months. The reconstruction phase is found to last 1 to 10 years (Besiou et al., 2011). From theory it seems that the phases throughout the disaster life cycle are all separate, but the terminology differs. When looking at the humanitarian aid programs, the terminology still differs but the distinction becomes clearer.

The disaster life cycle per aid programs

Aid programs are roughly divided into two types of programs related to time: the first one is catering to the emergency needs right after the disaster and the second aims on rebuilding the affected society's basic needs up to the Sphere standards[1] (The Sphere Project, 2011). These two programs seem clear but even here, multiple types of definitions are circulating. Some of these are listed in Tabel 3.

Tabel 3 phases of aid programs

	First phase	**Second phase**
(Beamon & Balcik, 2008)	Relief activities: relief for victims of large-scale emergencies. These short-term activities focus on providing goods and services to minimize immediate risks to human health and survival.	Development activities: longer-term aid, focusing on community self-sufficiency and sustainability. These activities include establishing permanent and reliable transportation, healthcare, housing, and food.
(Cozzolino, 2012)	Disaster relief	continuous aid work
(Meesters, 2016)	Response: Rescue (3 days) & relief (food / tents)	Recovery: early recovery (tent camps) & late recovery
(Kovács & Spens, 2012)	Disaster relief	Development aid

From the interviews it is found that the distinction in the aid projects and the phase categorization is not as black and white as may seem from literature. These phases are overlapping and the exact point of transitions seems to be unclear. This finding confirms that the decisions considering the transitions are based on intuition and experience, instead of facts and figures. (Anonymized Interviewee B.2, 2017) (Anonymized Interviewees C.1, 2017) (Anonymized Interviewee B.1 , 2017) (Meesters, 2016)

Let us take step back in order to recap why it is important to understand these transitions. This chapter is answering the first sub question. It is will show how the changes throughout the disaster life cycle effect the demand. Now the phases of the disaster life cycle have been described. But before being able to start describing all the changes throughout the disaster life cycle, the humanitarian network needs comprehension.

3.1.3 Humanitarian Aid Network

By following the three categories of Beamon & Balcik (2008), the humanitarian aid network can be divided into three categories: UN-related, international government related organizations (IFRC) and non-governmental organizations (NGO's) (Beamon & Balcik, 2008). Military forces could be considered as governmental entities or separately. An overview of all the stakeholders and organizations in the humanitarian aid network is shown in appendix E.

[1] Sphere standards are the minimal quality standards that are universally agreed upon and documented in the sphere handbook.

Organizations active in the disaster relief operations have a big role in the first few days and break down their participation in the later stages. Organizations mostly active in the reconstruction phase, play small roles in the first phase but are there any way in order to claim their contribution in the later stages. This can also be done by using contacts in their network. (Meesters, 2016)

UN related

From the interviews it was found that the UN often operates with an umbrella function (Ohlsen, 2017). An overview of the UN cluster approach is shown in appendix D. “Clusters are groups of humanitarian organizations, both UN and non-UN, in each of the main sectors of humanitarian action, e.g. water, health and logistics.” (OCHA, 2017)

Each cluster has a (few) UN-organization(s) responsible for that cluster. World Food Program (WFP) is for example responsible for the logistics cluster. This means that they often serve as a third-party logistics service provider for other humanitarian organizations. In the case of the Nepal Earthquake in 2015 for example, WFP helped Anonymized Organization A with their logistics (Anonymized Interviewee A.2, 2017). The Nepali case of 2015 was mentioned by some of the interviewees. Barriers and best practices from this disaster will therefore be discussed in section 5.3. WFP is active in all phases of the disaster life cycle.

Another UN-organizations that was often mentioned during the interviews was the UN Humanitarian Response Depots (UNHRD). The UNHRD provides supply chain solution in for emergency preparedness and response. They have six depots located across Europe, Africa, Middle East, Southeast Asia, and Latin America, visualized in Figure 7. This allows them to be able mobilize all requested relief items within 24 to 48 hours.

Figure 7 UNHRD overview global depots (Source: ppt Martin Ohlsen)

Government related

Governmental organizations are country related. The international red cross & red crescent movement (IFRC) has departments in each country that are government related. Military forces that provide aid during humanitarian aid are also government related. These are often used in the immediate response phase to transport great quantities of products and people. The Dutch ministry of external affairs (BuZa) offers, for example, in case of big humanitarian disasters the services of their military cargo airplanes KDC-10 (Anonymized Interviewee B.1 , 2017), or the big military cargo ship, Karel Doorman. In the aftermath of the Haiti 2010 earthquake the American Army coordinated the main harbor of Port au Prince (Anonymized Interviewee B.1 , 2017).

Non-governmental

There are all sorts of Non-Governmental Organizations (NGO's), they are defined as followed: "NGOs are voluntary associations independent of government control that seek to provide humanitarian assistance according to need (Byman et al., 2000, p. 64).". They can operate on national or international level. The bigger international NGO's have an international overarching department that sets the rules for the country members. Save the Children for example has their head offices in the UK, also all their supply chain division is located there. The country member knows the country characteristics and can all immediately react in case of a disaster. The country members in stable countries, that have marginal risk to disasters, are functioning as a marketing and financing department. Oxfam (and Unicef UN-based) also operate(s) this way. Anonymized Organization A also operate in this way but Anonymized Organization A is a more decentralized organization, how they work and what affect it has on their supply chain will be discussed in section 5.2.3.

Keep in mind that there are also many non-humanitarian organizations that work in the humanitarian sector, these are also non-governmental and above all commercial. These are the suppliers of products and services. Anonymized Organization C, is such an actor, they provide supply, procurement, consultancy, and emergency response services. Such organizations can provide their portfolio to humanitarian organizations as well as governments, as long as they comply to their requirements.

Stakeholders of a nonprofit organization

For humanitarian organizations to reach their goal it is important to know which stakeholders are involved. Stakeholders are defined as "any group or individual who can affect or is affected by the achievement of an organization's objectives" (Freeman, 1984, p. 46). When positioning all the stakeholders in a power versus interest grid it allows understanding of the relation between all the actors in the humanitarian context. How these stakeholders can be approached and motivated towards reaching the same goal can be learned from this. Such a power vs interest grid will be provided in chapter 5, in order to provide implementation strategies of the delivered framework of this thesis. This section is merely giving an overview of the type of stakeholders that are present in the humanitarian context.

Stakeholders of a humanitarian organization are: donors, beneficiaries, staff and volunteers (Beamon & Balcik, 2008). From the interviews it is found that media should also be considered as a stakeholder (Comes, 2017). The amount of coverage and attention they give to a certain disaster can affect the quantity and magnitude of the donations, which can thus the achievement of a humanitarian organization's objectives. This so-called media-effect is often experiences as a challenge and will therefore be further elaborated upon in section 3.4. Some of the critical processes between various stakeholders are shown in Figure 8.

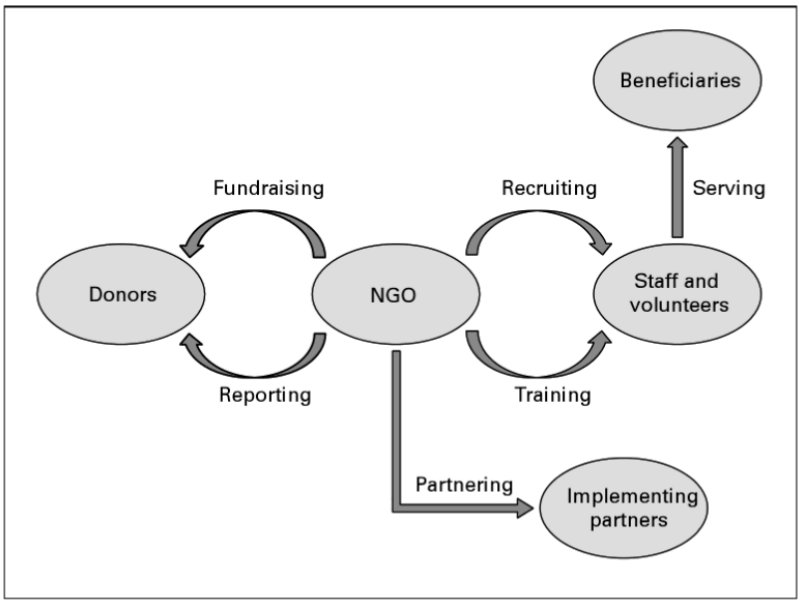


Figure 8 overview of humanitarian relief processes and stakeholders (Tatham & Christopher, 2014)

Who is the customer?

Commercial supply chains are customer centered. The customer is "king", this is the same person who pays and receives the product / service. He has two types of power: communication and financial. Their ability to communicate enables them to share their needs and provide feedback on their experiences. When bad experiences are communicated, this results in negative media coverage and could averse future businesses.

In the humanitarian context, the aid recipients are not the paying entity. They also have little / no communication power. Right after the disaster they cannot communicate their needs and further throughout the disaster life cycle, feedback loops are mostly labeled as inadequate (Monaghan & Lycett, 2013). The donors are the ones paying and communicating their wishes. A sustainable relation with the donors is therefore very important. From this perspective one could say that unsatisfied donors would have more impact on the humanitarian organization than unsatisfied aid recipients (to a certain extent). Therefore, there has been some discussion on whether the donor or the aid recipient is the customer. Either way, the humanitarian organization must cater to all their stakeholders, just focusing on the customer is not enough.

The thoughts of my interviewee's on this matter mostly matched my thoughts: humanitarian aid should be beneficiary focused. This would have to be translated to the humanitarian supply chain. When configuring the humanitarian supply chain, the end-point is the aid worker who does the last mile distribution. It is therefore the aid workers' responsibility to be the voice of the beneficiaries while working for the humanitarian organization. This difficulty was also found in literature. "Managing tradeoffs may be more complicated in nonprofit organizations due to the conflicting interests of revenue sources (donors), benefit providers, and recipients."(Beamon & Balcik, 2008)

3.2 DISASTER RESPONSE

Immediate response phase: response

As soon as a sudden onset nature disaster happens all the organizations in the humanitarian context start a **capacity assessment** in order to know what they could contribute if demanded. Such a capacity assessment means checking inventory, vendor managed inventory and calling suppliers to check their available inventory and fastest delivery possibilities. Based on this information the decision to response can be made. For each organization, the **decisions to respond** to the requested aid are different. These can depend on the size of the disaster or the fact that there is or is no country office in the disaster stricken country. Of course, the match of the need and the field of expertise of the humanitarian organization also play a role. These are all preparing activities, they cannot immediately react since the national government of the stricken country first needs to make an official statement where they communicate that the foreign help is needed. Such an **official governmental aid request from the stricken country** allows international organizations to enter. As soon as this is done, humanitarian organizations will reserve some of their available disaster relief budgets. They will also **apply for fast track funding** possibilities with (Inter-)governmental institutions.

The organizations send a team of disaster relief experts with some suitcases of emergency supply to the location to make a **first needs assessment**. This is often a military airplane which is made available by the donor country. The disaster relief experts also take a small quantity of disaster relief items with them to hand out while assessing. Often aid workers are already on the site because they have been working on reconstruction projects when a new disaster strikes. In that case, they can give advice regarding the most needed relief items.

> "You can't arrive empty handed" (Anonymized Interviewee B.2, 2017)

For the local needs assessments many procedures are available which might differ per organization. The most known rapid assessment tool is the MIRA: "The Multi-Cluster/Sector Initial Rapid Assessment (MIRA) is a joint needs assessment tool that can be used in sudden onset emergencies" (Committee Inter-Agency Standing, 2015). It can be used by a MIRA assessment team or by other using the same instrument. This quick needs assessment is requires many estimations based on experience of the aid worker. These estimations contain many uncertainties, therefore the **"no regrets policy"** is being used. These **supplies are pushed** based on an estimation, which would rather contain to many than too little material.

The first 24-72 hours are very crucial for the severely injured victims who are in a life-threatening situation. It often shows that the international aid-organizations can only arrive and provide some pushed supplies in the end of this crucial period. The quickest to arrive on the site are often the **local organizations** (neighbouring firefighters, hospitals, volunteers, etc.). Most communities and their neighbouring ecosystem seem to be **self-reliant** in the first few days (Meesters, 2016). According to humanitarian standards local communities are estimated to be self-reliant only for 48h, after which humanitarian organizations must be operational on the ground (Tomasini and Van Wassenhove, 2009). One of the clearest milestones in this phase is the moment that the search for victims is stopped (Meesters, 2016).

In these first few weeks it is **coordination** between the aid workers is difficult, most of the decisions are made in the aid camps between the aid workers in an **informal** matter. UNOCHA tries to take a part in this division of tasks, by documenting all the aid activities. They take up a coordinating task and the Log cluster

provides minutes of all meeting online, as well as all changes of the situation such as: the perturbations of the roads etc. But in this stage the documentation is slower than the informal communication lines between the aid workers. This causes the documentation to often work in hindsight (Meesters, 2016). Humanitarian aid workers are more in a firefighting position than really anticipating the next steps to take (Kovács et al., 2016).

Immediate response phase: restore

It takes up to a rough two weeks until the situation is more or less stabilized and estimations of needs can be more accurately made. In the restore part of the immediate response phase the volume of the supplies disaster relief items are better is slowly increasing as the **knowledge of the situation is increasing**. The **coordination is improving** and taking more shape and the systems starts running. Because of the increasing understanding of the severity of the disaster, now the in-depth sectoral assessments or multi-cluster assessments are to be initiated (Committee Inter-Agency Standing, 2015). The clusters start working and UNOCHA enables the communication between the humanitarian organization per cluster. This allows organizations to be able to exchange certain materials.

The media coverage is by now completely enacted for all sorts of funding campaigns targeting the public. Because of that the **monetary influx reaches an optimum** in this phase.

As the **supplies are increasing** the main port of entry, which can be an airport or a harbour, will receive a higher load than usual. Therefore, an extra group, such as a military unit, will come in to support with the coordination and handling of incoming goods. But the coordination assistance cannot stay for the whole restore phase. Difficulties arrive when the military support leave the scene (Anonymized Interviewee B.1 , 2017).

Restoring the first basic human needs such as food, water, medical support, security and safety, are targeted here. These forms of aid are not necessarily provided with a sustainable long-term perspective, but with a temporarily purpose. This phase is documented to last up to roughly 6 months.

When and how to **transition from disaster relief to reconstruction is** not a clear transition, it's **a sliding scale**. The transition from distributing water bottles to installing a water purification system is not just something that can be done in one day.

Reconstruction

The activities in this phase are all targeted for a sustainable long-term solution. The humanitarian organizations start to have a better **relation with the local communities** of the stricken country. This allows them to fully **understand the local cultural values, power relations, market forces** and the original pipelines of products. The **global supply chains are reduced** for the simple products in order to start **sourcing locally**. The complex products such as medicine or medical equipment are pulled. Furthermore, the original supply lines are rebuilt. Thus, only the unavailable products, services and knowledge is provided, this allows the local community to become empowered and self-reliant again. This Phase can take up to two years. It is **less interesting for the mainstream media**, and therefore often forgotten. These projects are therefore **often underfunded**.

3.3 TRENDS AND DEVELOPMENTS IN HUMANITARIAN LOGISTICS FROM THE LAST DECADES

Throughout all the interviews and literature it was found that the humanitarian sector has gone through many developments, especially in the past decades. These developments are especially important to keep in mind because this allows understanding of the zeitgeist of the older papers.

In 2005 Thomas et al. stated that because of all the uncertainties in the humanitarian context, humanitarian organizations are 15 years behind private sector companies in their supply chain performance (Thomas et al., 2005). But it seems that the situation has been changing since that time. Charles et al. (2010) states that by constantly working in environments with high degree of uncertainty, humanitarian organizations end up becoming specialists in the implementation of agile systems (Charles, Lauras, & Van Wassenhove, 2010). Beamon & Balcik (2008) also stated that commercial parties can learn from the commercial sector. There is still much room for improvement, but it seems that slowly and steadily this attention is increasing. Around 2010, the International Federation if Red Cross and Red Crescent Societies (IFRC) has for example won a prestigious logistics award that was previously only won by well-established commercial companies (Van Wassenhove & Martinez, 2010). Humanitarian organizations are going through a **professionalization trend** (D'Haene et al., 2015). This has to do with the growing need for humanitarian aid.

> *"The last decade has seen a significant increase in the number, magnitude, and impact of both natural and man-made disasters in the world, and these points to a dramatic upward trend"* (Cozzolino, 2012).

The number of humanitarian organizations and studies has also increased in the past decades (global humanitarian studies index). This development is influencing the fund raising and awareness positively.

> *"International humanitarian assistance increased in 2015 for the third consecutive year, reaching a record high of US$28.0 billion"* (Global Humanitarian Assistance, 2016).

As innovation and professionalization lies closely to academic research, the **increased academic attention** towards the humanitarian aid sector is also a trend from the last decades which is worth noticing (global humanitarian studies index). It was only in 2006 that a new journal was founded especially for the humanitarian logisticians. This was called "Journal of Humanitarian Logistics and Supply Chain Management" (Kovács & Spens, 2011a). The number of academic papers covering the topic of humanitarian logistics has augmented since then.

> *"The humanitarian relief supply chain has only recently been given serious consideration as a supply chain management discipline"* (Overstreet et al., 2011).

Furthermore, many **online data sharing initiatives** are being developed. A short overview of the most popular websites is given in Tabel 4. Some of these websites create transparency and document the activities in retrospect. Others have the intention to create transparency of the occurring activities which can be used as a tool for humanitarian practitioners.

Tabel 4 Overview of Online Humanitarian Data Sharing Initiatives

Link
http://dlca.logcluster.org/
http://www.unocha.org/humanity360/
http://www.caipa.co.uk/methodology/
http://reliefweb.int/

Other developments that where found are the increase in Humanitarian organizations acting as logistics service providers, the humanitarian aid is becoming more beneficiary centered. In order to include the beneficiaries' input use of coupons instead of cash is a new trend (Besiou & Van Wassenhove, 2015). These coupons allow for autonomous selection of expenditures for beneficiaries and transparency for humanitarian organization. One of the other big trends that is visible is the transition from global to local sourcing. In order to enable the local economy to stabilize and become independent again.

3.4 CHALLENGING FACTORS OF HUMANITARIAN LOGISTICS FOUND IN LITERATURE

In order to provide an overview of the current challenges of humanitarian logistics, the papers selected throughout the literature study were extensively studied. This resulted in a structure to categorize the challenges. When comparing it to the division of Kabra et al. (2015), who has created 5 categories to group all the barriers in humanitarian logistics, a new category is added. The new division grouped four of the barriers of Kabra et al. (2015) into organizational challenges. It also allows more light to be shed upon: the challenges due to the nature of humanitarian logistics operations and technical challenges. The chosen outline of challenges (Tabel 5) will also be used to structure this section. A summary of this section is provided in the final paragraph of this subchapter.

Tabel 5 Comparison of challenges overview

Overview of challenges in section 0	Classification of barriers in humanitarian logistics **(Kabra et al., 2015)**
Challenges due to the nature of humanitarian logistics operations ➢ **Urgency & Uncertainty** ➢ **Complex environment**	
3.4.2 Organizational challenges ➢ **Intra-organizational perspective** ➢ **Inter-organizational perspective**	➢ Management barriers ➢ Cultural barriers ➢ People barriers ➢ Organizational barriers
3.4.3 Technical challenges ➢ **Different phases need different approaches** ➢ ➢ **Knowledge *sharing*** ➢ **Lack of data**	➢ Technological barriers

3.4.1 Challenges due to the nature of humanitarian logistics operations

Urgency & Uncertainty

The moment that a humanitarian disaster strikes; urgency is key. The quicker actions are taken, the more lives can be saved (Cozzolino et al., 2012). The aim of NGO's is to be able to provide help starting as soon as the first 24-72 hours. This is also the time frame where the European parliament procedures allow taking formal funding decisions and providing demanded funds according to the "fast-track" budgetary procedures (European Parliament Humanitarian aid, 2004).

But the uncertainty features of impact, magnitude, location, and timing, echo in every aspect of each disaster, they have a negative influence on humanitarian logistics (Van Wassenhove & Pedraza Martinez, 2010). This leaves the organizations with burning questions: What is the impact of the disaster? Material damage, lost human lives or both? If both, is the infrastructure still available to reach the victims? etc. What is the magnitude of the disaster? Village, city, country? An increasing size exponentially affects the complexity. Where are the people who need help? Are they safe there? Can they stay there? etc. When a disaster will strike: How many victims/ refugees are there? Where are they located? Is the infrastructure destroyed or unsafe? Is the current temporary shelter save? etc. The ability to predict a disaster could save thousands of lives but also knowing if a second strike will find place. This is also backed up by Balcik et al (2010).

3.4.2 Organizational challenges

Intra-organizational perspective

Looking from a more intra-organizational perspective it is found that one of the negative effects is high rotation of personnel. Therefore, multiple procedures and policies are needed in order to manage and keep track of all the changes in personnel and multiple parties with different objectives. In addition, it contains the barrier of creating and keeping a trustworthy relationship with humanitarian practitioners (Van Wassenhove & Martinez, 2010).

Kovács & Spens (2009) presents yet another personnel problem which is amplified by the high rotation of personnel, the lack of qualified in-country staff, which is caused by "braindrain" (Kovács & Spens, 2009). This phenomenon occurs when the majority of the highly-educated locals leave the country to work abroad.

The organizational perspective shows that the mentality of the humanitarian activist has a great influence on the developments. This philosophy is also backed up by (Agostinho, 2013, p. 210): "It is important to stress that the implementation of the models must be accompanied by a change in the mentality of the organization's staff, especially in regards to directions and levels of exigency, so that new processes are strictly followed."

Inter-organizational perspective

When considering the inter-organizational aspects, Balcik et al (2010) points out that the media plays a critical role. They direct the attention of the public and make sure that the link between funders and those in need of help is made. Even though this is an indispensable role in the view of the funding for humanitarian aid, this also brings along some negative consequences. Especially in the beginning when the stories are all new and "easy to sell".

This can result in an oversupply of relief supplies and information flowing into an emergency area, causing congestion of the system because the logistical resources and the staff are occupied is often a consequence (Balcik et al., 2010). This is supported by Besiou et al (2011), who have created a preliminary causal-loop diagram (Figure 9) visualizing the negative media effect.

Blecken et al (2010), discusses another negative effect regarding the lack of media attention in the post-disaster sub-phase. During the recovery/reconstruction phase after the catastrophe, the media attention fades. This amplified the scarcity of funds and resources in this phase (Blecken et al., 2010). As a result, the competition for funding and visibility among humanitarian organizations grows, especially in cases where the severity of size of the situation is not as popular as the others. This phenomenon increases the power of the media even more and can cause relief agencies to act in inappropriate ways (Balcik et al., 2010).

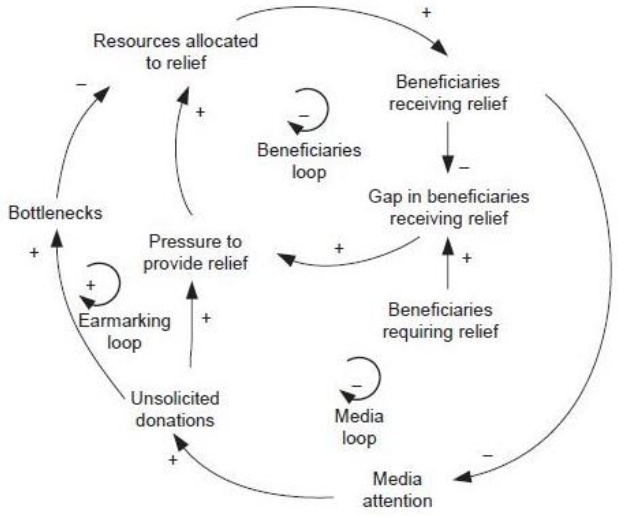


Figure 9 Causal-loop diagram regarding the media-effect (Besiou et al., 2011)

Another complication caused by the inter-relational aspect, provided by Thomas & Kopczak (2005), is the big need of accountability and transparency, which is demanded by the pressure from donors, who no longer accept only general data from the mission. Donors nowadays demand detailed information about the mission's performance and impact (Thomas & Kopczak, 2005); this is also supported by Scholten et al., (2010). This shifts the focus of the NGO´s extremely towards there administration affairs and affects their efficiency. The double standards of the society seem to smother investment opportunities for innovations in humanitarian logistics. This is backed up by activist and fundraiser Dan Pallotta: "Too many non-profits are rewarded for how little they spend, not for what they get done." (Pallotta, 2013).

It is common knowledge that the developments in the academic, commercial and military field of operational research, supply chain and logistics keep growing due to the competitive market. Unfortunately, the humanitarian sector has different ways of working: "donors prefer to spend their money on tangible direct relief materials rather than information systems, or even logistics equipment." (Gray & Oloruntoba, 2006, p. 118). This is supported by (Kovács & Spens, 2007).

3.4.3 Technical challenges

Different phases need different approaches

According to Cozzolino et al (2012) the phases each have different logistic objectives and follow another supply chain paradigm, as shown in Figure 4. Right after the emergency event effectiveness is key; this requires an agile supply chain. But as soon as the threat is gone and the people are saved, the reconstruction phase starts. Here efficiency is key, which requires a lean supply chain. This change could influence the fit of the supply chain configuration throughout the disaster cycle.

> "Although several previous studies introduced the agile principle as suitable for disaster relief, when and how to embrace the agile and the lean principles remained unclear" (Cozzolino et al., 2012, p. 28).

Agile and Lean principles are not only advocated to be used in different phases of the disaster life cycle, but also combined within different parts of the material and information flows. This will be further explained in section 4.1.2 (Figure 13). Combining the two principles throughout the supply chain, creating the right allocation of the inventory and information decoupling point is found to be a possible solution (Scholten, et al., 2010; Gray & Oloruntoba, 2006).

Another aspect that seems to change throughout the disaster lifecycle is, whether a push or pull system is used. Multiple sources state that the immediate response phase is dominated by a push-philosophy and the reconstruction phase by a pull-philosophy (Kovács & Spens, 2007; Van Wassenhove & Pedraza Martinez, 2010).

The different phases distinguished by Kovács & Spens (2007) are visualized in the framework for disaster relief logistics (Figure 10). Per phase different parallels are drawn between several actors' perspectives and topics in humanitarian logistics and business logistics (Kovács & Spens, 2007). This shows how the management focus also dependents on the phases.

Figure 10 Framework for disaster relief logistics (Kovács & Spens, 2007)

Knowledge sharing

Due to the previously discussed uncertainties in the humanitarian sector, the knowledge from the commercial and military field, cannot be one on one translated to the humanitarian operations (Blecken et al., 2010). Because of this humanitarian organizations are 15 years behind private sector companies in their supply chain performance (Thomas et al., 2005). This means that the innovations of the last 15 years within the private sector are not yet applied in the humanitarian sector.

Van Wassenhove (2006) suggests that the knowledge of the academics is the key to optimizing humanitarian logistics e.g. the academic world is a source which is untapped. But it seems that the opposite is true as well, Charles et al. (2010) states that by constantly working in environments with high degree of uncertainty, humanitarian organizations end up becoming specialists in the implementation of agile systems (Charles et al., 2010). Beamon & Balcik (2008) also state that commercial parties can learn from the commercial sector. Furthermore, Van Wassenhove et al (2006) states that past decades significant progress has been made in applying some of supply chain management's best practices to the humanitarian.

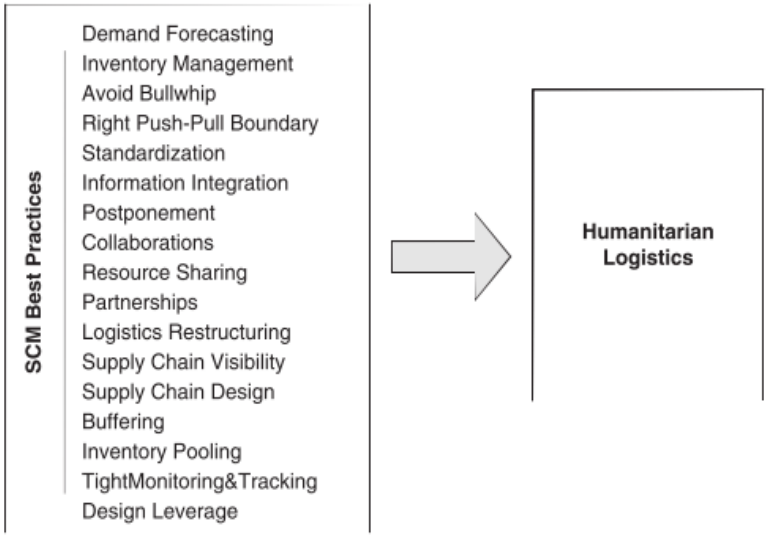


Figure 11 Applicable SCM Best practices (Van Wassenhove & Pedraza Martinez, 2010)

Nevertheless, another reason why the humanitarian logistics is not able to profit from the academic literature, given by Kovács & Spense (2007), is the difference in focus: "Academic literature on humanitarian logistics tends to concentrate on the preparation phase of disaster relief. Donors, on the other hand, focus on the immediate response phase after a disaster." (Kovács & Spens, 2007). This is backed up by Kovács & Spens (2011); they emphasize the need for studies that enrol humanitarian logistics in long-term development programs. "Research is still research. It has not really filtered down into policy, practice, and procedures" (Kovács et al., 2011). This stand is also shared by Besiou & Van Wassenhove (2015), they explain how research is often too generalized or too specific.

Lack of data

Multiple uncertainties in the humanitarian sector have strong impact on the working conditions and possibilities, as already explained in section 0, they are related to; uncertainty of impact, magnitude, location, and timing. This creates high decentralization of people in need (small density of beneficiaries in big areas) and the lack of available data to support a decision making analysis (Van Wassenhove et al., 2010). Lack of available data problem is also supported by Monaghan et al., (2013). They discussed the challenge and need for closing the loop between supply, demand and impact. But also see an opportunity: "the use of big data with its characteristics of volume, velocity, variety, veracity, while not without challenge, offers opportunities to extract great value in the assessment of humanitarian supply networks." (Monaghan et al., 2013), they call it datafication. This phenomenon is backed up by several studies (Turner et al., 2011; Blecken et al., 2010).

Turner et al., (2011) stresses the lack of knowledge on all details and changes in multiple aspects of a community in distress. They suggest that the following aspects are needed; "population density, ethnic makeup and tensions, social attributes, resources availability and desire, crime rates, and the location and makeup of processing and dispensary centres" (Turner et al., 2011).

Blecken et al., (2010), suggest that an inventory relocation management system is needed. This system would keep track of all the inventory requirements. Especially because often confident prediction of the demand for relief items is not possible (Blecken et al., 2010).

Right after a disaster occurs, the "No regret policy" is enacted. "This policy affirms that it is better to err on the side of over-resourcing the critical functions rather than risk failure by under-resourcing." (World Health Organization, 2013). This result in a push of supplies which are often misaligned with the real needs of the beneficiaries, supplies are sent regardless of the costs, causing congestion of the system (Oloruntoba & Gray, 2006). Later in the disaster life-cycle, when more knowledge of the needs is obtained, the supplies are pulled.

3.4.4 Summary of challenging factors

The described challenges show the difficulties that are present in humanitarian logistics. Furthermore, it has been made clear that the circumstance throughout the humanitarian disaster lifecycle change over time. The studied literature has shown that these changes, throughout the disaster cycle, influence the supply chain and its management. Changing the supply chain structure is needed to support the changing circumstances. When and how to adapt the supply chain, regarding to the transitions through time, still seems to be a problem in humanitarian logistics. Tabel 6 shows an overview of the discussed challenges. They all effect the supply chain directly or indirectly. The most important effects on the HSC are also mentioned in the tabel. The final section of this chapter, section 3.3, will summarize which changes and challenges throughout the disaster life cycle effect the demand. It will also answer the first sub question on how the demand is affected.

Tabel 6 Overview of challenging factors in the humanitarian sector

3.1. due to nature of the system		
Sub-cat.	**Challenge**	**effect on HSC?**
Urgency	React as soon as possible	requires prerelease agreements and prepositioned stock
	No regret policy: push of supplies in the immediate response phase	congestion of the system
Uncertainty	Impact, magnitude, location, and timing, have a negative influence on humanitarian logistics, thus demand uncertainty	bullwhip effect in immediate response phase
	Disruption of infrastructure	delays and requires flexibility
	Supply chains in humanitarian logistics have a short and uncertain existence	requires flexibility
	aftershocks or other reoccurrence of disaster	
3.2. Organizational		
Sub-cat.	**Challenge**	**effect on HSC?**
Intra-organizational perspective	Creating and keeping trust from humanitarian practitioners	High rotation of personnel
	difficult demanding working conditions	no time for performance measures
	“braindrain”	lack of qualified in-country staff
	considering the mentality when implementing new models	
Inter-organizational perspective	media effect	oversupply in the immediate response phase
		Insufficient supply/budget in the reconstruction phase
		inappropriate actions for attention, performed by relief agencies
	Pressure of donors for transparency	Decreasing efficiency of NGO’s
	Double standards of society: Judging non-profits on how little they spend, rather than what they get done.	
3.3. Technical		
Sub-cat.	**Challenge**	**effect on HSC?**
Phases	Multiple authors have different definitions for the phases	
	More academic knowledge is needed in the immediate response phase	
	Each phase requires different supply chain structures	
	The transition between the phases is unclear	
Knowledge sharing	Knowledge from military and commercial field can’t be one on one translated	little learning possibilities
	Gap between research and practice	
	Academics focus on the preparation phase while donors focus on the immediate response phase	little R&D
	Research is often not applicable	
Lack of data	Lack of available data to support a decision making analysis	inaccurate / incomplete data
	Rise of social media is not sufficient (yet)	

3.5 CHAPTER CONCLUSION

The purpose of this chapter was to provide an answer to the first sub question: what is the current state of humanitarian aid? This question is answered from multiple perspectives in order to enable a holistic view. Firstly, the humanitarian environment is investigated. It is found that the humanitarian environment is shaped by: the type of disaster, the actors and the stability of the situation. These changes throughout the disaster lifecycle which thus influences the situation. Therefore, the most essential concepts considering the humanitarian aid network and the disaster life cycle are described. Literature regarding shifting supply chain objectives throughout the disaster life cycle is available but in a preliminary stage. How the disaster life cycle affects the aid programmes requires further research. The humanitarian aid network was found to be a network with a diversity of actors. Each of these drivers have different drivers and available resources. This is found to be a complicating factor especially as this results in an unclear understanding of who the customer is for a humanitarian organization. For a humanitarian organization to have a donor-focused or a beneficiary-focused supply chain is not always the same. Secondly, it was explained how disaster response normally goes. It was found that a few weeks are needed before the coordination in the disaster aftermath is completely functioning. Thirdly, trends and developments in the humanitarian logistics from the last decades where described. It can be said that the humanitarian aid industry has professionalized extensively the last decades but is still in need of much more developments. Finally, the barriers in humanitarian logistics that affect the HSC were summarized. Some of the barriers cannot be predicted and are caused by the nature of the disaster. The barriers that can be dealt with are the organizational and technical challenges. Solving these would be preparedness activities which are needed to be invested in.

4 THE HUMANITARIAN SUPPLY CHAIN CONFIGURATION

This chapter will answer sub question two: How do the changes throughout the disaster life cycle affect the humanitarian supply & demand? The chapter will start by discussing humanitarian supply chain strategies from literature. This will be followed by the explanation, on how the changes throughout the disaster life cycle affects the humanitarian supply & demand. These sections will lightly touch upon the crucial characteristics of a humanitarian supply chain configuration. Finally, an overview will be given on theories regarding supply chain alignment.

4.1 HUMANITARIAN SUPPLY CHAIN STRATEGIES

This section will firstly start by describing supply chain attributes from literature, then a selection will be maid of the most important attributes per phase of the disaster life cycle. This will be followed by an overview of the current academic thoughts regarding the supply chain strategies in the humanitarian setting. These will strategies will then also be combined allowing to give the reader an idea on when which strategies matter and how the decoupling point can influence this.

4.1.1 Supply chain attributes

Supply chain strategies are required to enable a certain outcome. When choosing a supply chain strategy this selects the supply chain attributes (characteristics).

According to the SCOR-model the following supply chain attributes are needed: Reliability, responsiveness, agility, costs & assets (Supply chain council, 2010). The definitions of these supply chain attributes according to the Supply chain council (2010) are shown in Tabel 7.
Goh & Souza (2016) have analyzed the SCOR supply chain attributes and created a set of performance measures for each of these attributes. They decided to leave assets management out of the scope because humanitarian organizations are often resource-light. They mostly rely on external resources and capabilities. Therefore, they have only investigated the following key performance attributes: reliability, responsiveness, agility and cost (Appendix G).
When looking through the set of performance measures prescribed by Beamon & Balcik (2008), the main supply chain attributes are named: Resources, output & flexibility (Beamon & Balcik, 2008) (appendix F).

Tabel 7 SCOR Supply Chain Attributes (Supply chain council, 2010)

Supply chain attribute	Definition According to the Supply Chain Council (2010)
Reliability (External attribute)	*"The Reliability attribute addresses the ability to perform tasks as expected. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the reliability attribute include: on-time, the right quantity, the right quality. The SCOR KPI (level 1 metric) is Perfect Order Fulfillment. Reliability is a customer-focused attribute."* (Supply chain council, 2010)
Responsiveness (External attribute)	*"The Responsiveness attribute describes the speed at which tasks are performed. Examples include cycle-time metrics. The SCOR KPI is Order Fulfillment Cycle Time. Responsiveness is a customer-focused attribute."* (Supply chain council, 2010)
Agility (External attribute)	*"The Agility attribute describes the ability to respond to external influences and the ability to change. External influences include: Non-forecasted increases or decreases in demand; suppliers or partners going out of business; natural disasters; acts of (cyber) terrorism; availability of financial tools (the economy); or labor issues. The SCOR KPIs include Flexibility and Adaptability. Agility is a customer-focused attribute."* (Supply chain council, 2010)
Costs (Internal attribute)	*"The Cost attribute describes the cost of operating the process. It includes labor costs, material costs, and transportation costs. The SCOR KPIs include Cost of Goods Sold and Supply Chain Management Cost. These two indicators cover all supply chain spend. Cost is an internally- focused attribute."* (Supply chain council, 2010)
Assets (Internal attribute)	*"The Asset Management Efficiency ("Assets") attribute describes the ability to efficiently utilize assets. Asset management strategies in a supply chain include inventory reduction and in-sourcing vs. outsourcing. Metrics include: inventory days of supply and capacity utilization. The SCOR KPIs include: Cash-to-Cash Cycle Time and Return on Fixed Assets. Asset Management Efficiency is an internally-focused attribute."* (Supply chain council, 2010)

Combining the supply chain attributes and aligning them with the disaster life cycle.

When looking through the Beamon & Balcik (2008) performance measures it is found that the "resources" attribute is comparable to the "costs" attribute from the SCOR model. The "flexibility" attribute is interchangeable with the "agility" attribute from SCOR. And the "Output" attribute covers the "responsiveness" and "reliability" SCOR attributes. Thus all SCOR attributes are represented except for the "Assets" attribute. Because of this, the fact that Goh & Souza kept the "assets" attribute out of scope and the limitations of this study it is decided to refer analyzing this attribute for future studies.

The obtained information thus far, chapter 3 on the disaster life cycle and the previous section regarding supply chain attributes, allows aligning the supply chain attributes with the disaster life cycle. For each phase only two attributes are selected. Selecting more attributes would work against the purpose, which is creating a focus for the strategy. Because donors are less willing to focus on the preparedness phase and most of the funding is disaster based, focusing on the costs is an important attribute for the preparedness phase. The second attribute assigned for the preparedness phase is Agility. It is paramount that the supply chain in the preparedness phase has the ability to answer to changes in the environment and can quickly change into the required form.

Because of the analysis in section 3.2 the immediate response phase is analyzed with the subdivision of response and restore. In the ideal situation the supply chain attributes would be the same as the restore phase: agility and responsiveness. Cost should not be the case and seem to be an attribute when listening to the terms as the "no-regret policy". But the response phase has responsiveness and costs as the attributes which shift to response and agility in the restore phase. The costs are required to include as the funds are often dependent on the donations which follow from the disaster's media attention. The available funds in the first few weeks are depending on the funding structure of the humanitarian organization. This will be further elaborated upon in section 0.
As the funding becomes scarce and the demand becomes certain, eventually the reconstruction phase has to focus on reliability and costs. Tabel 8 provides an overview of the supply chain attributes when aligned with the phases of the disaster life cycle. And as discussed, the "assets" attribute is left out of scope.

Tabel 8 Supply chain attributes aligned with disaster life cycle.

Supply chain attributes	**Preparedness**	**Immediate response (response)**	**Immediate response (restore)**	**Reconstruction**
Reliability				**X**
Responsiveness		**X**	**X**	
Agility	**X**		**X**	
Costs	**X**	**X**		**X**
~~Assets~~	~~---~~	~~----~~	~~---~~	~~---~~

4.1.2 Strategies

The "whatever it takes" approach following from the "no-regrets policy" that has been used in the humanitarian section is not efficient. Especially when all the induces bottlenecks are considered. Therefore, the humanitarian supply chain should be effective and efficient. This requires adoption of clear strategic approaches (Scholten et al., 2010b). The views that were found from academic authors seem to have a similar thought pattern. They are mostly discussing the lean and agile strategies to be best applicable to the humanitarian context. As described in section 3.1.2, Cozzolino (2012) described that the immediate response phase requires a supply chain following the **agile** principles and the reconstruction phase following the **lean** principles (Cozzolino et al., 2012). This was visualized with Figure *12*.

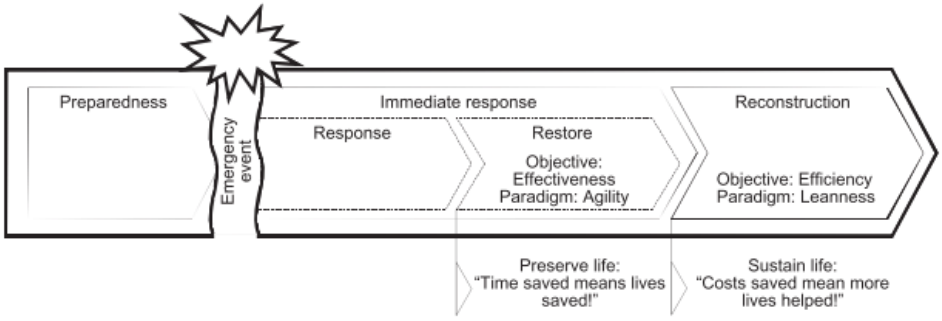


Figure 12 Humanitarian logistics process (Cozzolino, et al., 2012)

Agility is indeed proven to be very applicable to the immediate response phase, but agility is too expensive to maintain through the complete disaster life cycle. Therefore Cozzolino's (2012) idea of shifting from an

agile to lean strategy seems very useful. Authors such as Sholten et al., (2010b) and Oloruntoba & Gray (2006), argue that the lean and agile qualities should not be separated overtime but should be combined in the supply chain by using the decoupling point. Scholten et al., (2010b) calls it **leagile** principles, Oloruntiba & Gray (2006) call it **Hybrid** supply chains. It can be described in once since they both base their theory on the decoupling point. The main idea is positioning the supply stream decision point somewhere between the suppliers and the customers. This can be explained as the point in the supply chain where the demands from the market (pull) meet the upstream supply (push) (Oloruntoba & Gray, 2006). This point is also known as : the Customer Order Decoupling Point (CODP) (Rudberg & Wikner, 2004). The stream between the supplier and the CODP is pushed. From this CODP to the customer the stream is pulled (Hines & Rich, 1997). The previously mentioned authors propose that the proper location of decoupling points for material and information flows can produce a **hybrid (leagile)** supply chain that combines a lean and efficient supply upstream and an agile and effective supply downstream. How this could work is visualized in Figure 13.

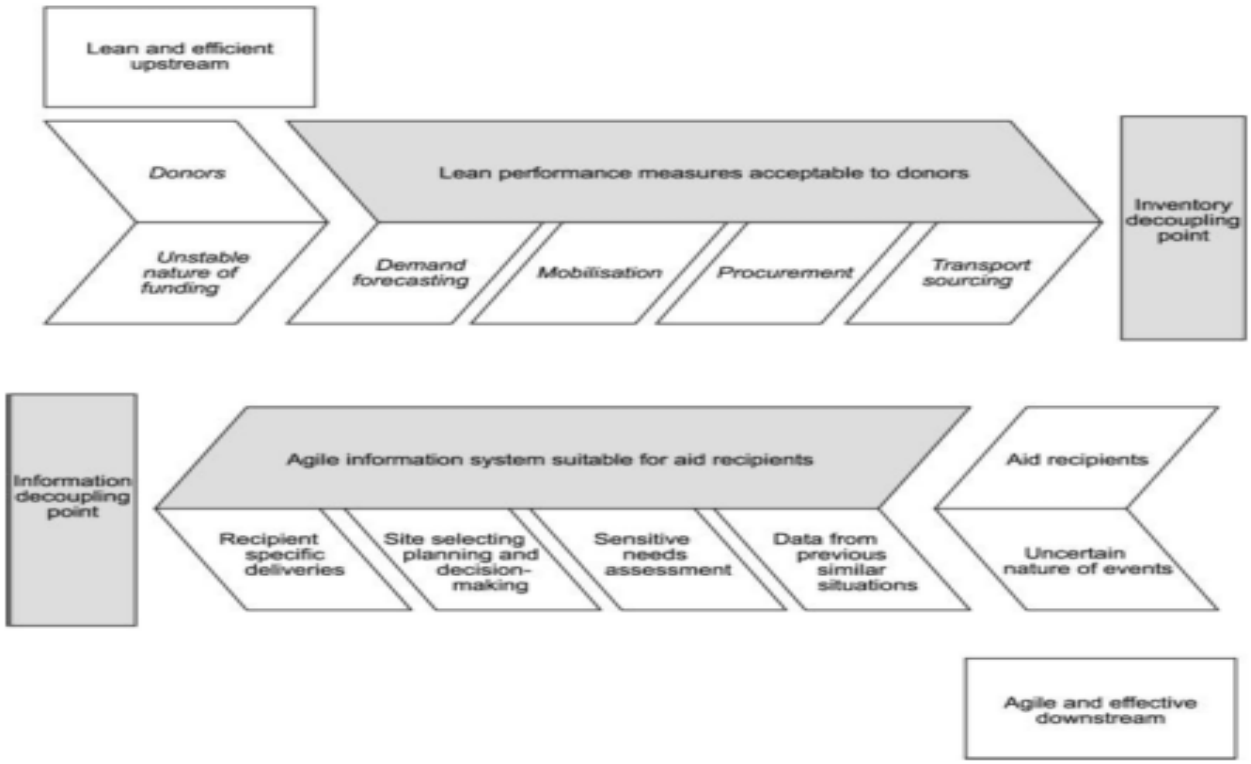


Figure 13 (Oloruntoba & Gray, 2006)

Charles et al., (2010) has developed a framework for defining supply chain agility. And they have developed a model for assessing and improving the capabilities of the HSC in terms of agility based on analysis of humanitarian approaches. This also enabled them explain the difference of Agility and Resilience, Figure 14 (Charles et al., 2010). This is important to understand as the humanitarian supply chain is often challenged by unpredictable bottlenecks. Comes et al., (2013) described the importance of resilience in a supply chain. A Robust supply chain is explained as achieving a good performance in expected circumstances and being able to maintain operations if fundamental changes occur (Comes et al., 2013). This would requir working with high contingency, by being prepared for all sorts of scenario's.

Supply chain ability	Structural properties	Deals with	Aims at
Agility	Flexibility	Volatility and uncertainty	Quick satisfaction of customer
Resilience	Robustness	Identifiable risk of disruption	Business continuity

Figure 14 Agility vs Resilience (Charles et al., 2010)

Combining theories with obtained knowledge

When combining the objective's transition, from effective to efficient, with the leagile philosophy the thought of different decoupling points arises. This allows keeping both strategies (lean and agile) in the supply chain as a sliding scale. During the immediate response phase the agile downstream side should be longer and during the reconstruction phase the upstream should be longer. I believe this would be good solution rather than having different supply chains per phase. How these different decoupling points are positioned in the humanitarian supply chain is visualized in section 5.2.3.

4.2 HUMANITARIAN DEMAND CHARACTERISTICS

This section shines light on the characteristics of humanitarian demand. What the humanitarian needs are and how these evolve throughout the disaster life cycle. What this means for the product and service categories and how the most important characteristics of the humanitarian demand change through time.

4.2.1 Humanitarian Needs

A sudden onset nature disaster can disrupts the complete society and living environment. When considering the humanitarian needs understanding Maslow's hierarchy of human needs (Figure 15), provides a good overview. Maslow describes three levels, with each two sublevels of types of human needs. Each first level is needed before being able to fulfill a higher level.

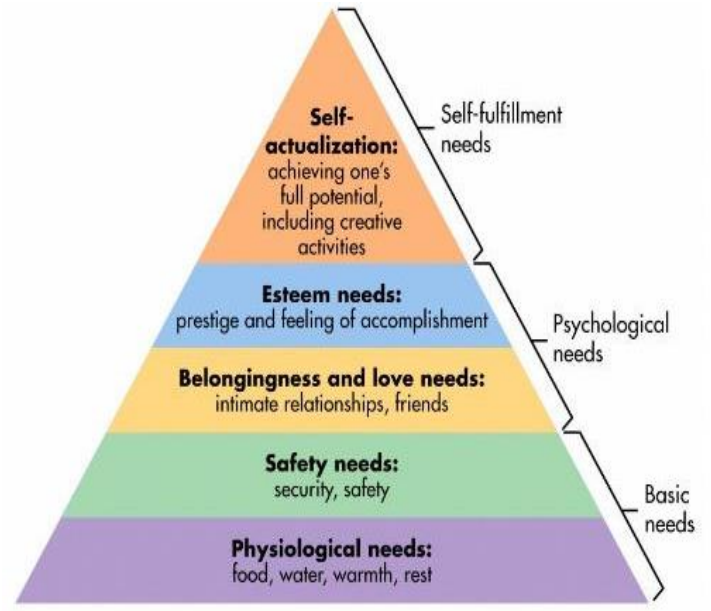


*Figure 15 Maslow's hierarchy of human needs (*McLeod, 2016)

In order to consider an action to be "humanitarian" the following three principles must be present: "humanity, neutrality and impartiality" (Tomasini & Van Wassenhove, 2009, p. 20). The definition of these principles and other concepts, also required for acting "humanitarian", are listed in Tabel 25 (Appendix C). So the needs are answered by following the three humanitarian principles and Maslow's hierarchy of human needs. The basic needs are the first ones to be answered. In order to know what the basic human needs are, the SPERE Handbook is used. It is known as: "the most widely known and recognized set of common principles and universal minimum standards for humanitarian response" (The Sphere Project, 2011). The book covers the minimum standards for the categories: WASH (Water supply, Sanitation & Hygiene); food security & nutrition; shelter, settlement and non-food items (clothing, bedding & household items); health action. Each of these sections contain multiple sub categories with minimum standards, key actions, key indicators and guidance notes. The standards are subjective in nature and indicate the minimum levels to be attained. An example of the minimal needs for water is shown in Figure 16.

Survival needs: water intake (drinking and food)	2.5–3 litres per day	Depends on the climate and individual physiology
Basic hygiene practices	2–6 litres per day	Depends on social and cultural norms
Basic cooking needs	3–6 litres per day	Depends on food type and social and cultural norms
Total basic water needs	7.5–15 litres per day	

Figure 16 Minimal Water needs per person (The Sphere Project, 2011)

The basic human needs are restored in the immediate response phase, when these are accommodated, the psychological needs (second level needs) can be catered to. These psychological needs cannot be solved with some products, these can only be solved when the community is completely self-reliant, independent and sustainable.

4.2.2 Product and service categories through time

Each of these product categories were found to have a different evolution throughout the disaster life cycle. Some examples of how the products / service categories develop through time (found through interviews) can be found in Tabel 9. Relations regarding exact quantities, exact phases and durations are kept out of the scope of the thesis. Therefore, the arrows on the top only indicate the gradient of time. As an example the shelter category will be further explained.

The need for shelter is catered to in the direct aftermath by using emergency shelter kits and tents. In this phase the many uncertainties caused by the disaster do not allow for direct permanent building. Anonymized Interviewee B.2 explained that the Shelter experts are all preferring to use tarpaulin and shelter kits over tents, as tent are far more expensive. Another reason is that the elements in the shelter kit can be reused when building permanently, the tarpaulin can for example be reused for isolating the roof (Anonymized Interviewee B.2, 2017). The T-shelter is only used when building permanently is not yet possible because of the circumstances. These are small wooden cabins that can be lived in until the permanent housing can start. With the permanent housing humanitarian organizations have experiences

that the cultural experiences weigh in heavily. It is therefore very important to build these houses together with the community. The most used method is therefore owner based housing, this allow humanitarian organizations to set up the housing plan in cooperation with the local community. They empower the community by letting them build the house and be in charge again. This way the humanitarian organization does the payment in stages when all the agreements are met and give advice on building in a resilient way when needed.

Tabel 9 preliminary overview of product / service offerings through time (Appendix B)

	>>>>time>>>>>	**>>>>time>>>>>**	**>>>>>time>>>>**	**>>>>time>>>>**
Shelter:	Emergency shelter kits (tarpaulin)	Tents (Camp)	T-shelter (Transitional)	Owner based housing
Water:	Distributing water bottles	Chlorine tablets	Aqua-taps	Installing a water purification system
Medical:	MET: Medical emergency teams	(small field hospitals (tents?))	Reconstructing local hospital	
Food:	Distributing food packages (global sourcing)	Distributing food packages (local sourcing)	Distributing seeds and agricultural equipment	

Even though this cannot be quantified, discussing this evolution through time with the interviewees did allow some overall observations that are worth mentioning. The overall evolution of product and service characteristics throughout the disaster lifecycle, are by means of interviews at least found to be true for the categories: shelter, water and food. Even though the medical evolution is listed in Tabel 9, the absence of medical interviewees does not allow to state that these findings also apply to the medical category. Having said that, the three overall evolutions through time can be stated. Firstly, the transition from standardized to tailormade solutions. Secondly, the transition from Functional and easy to use products to complex systems that require education and or installers. Thirdly of course the start of the short-term solutions which eventually turn into long-term solutions which are more sustainable.

4.2.3 Demand: Urgency, Uncertainty, Volume & Variety

The urgency of the demand implies the importance of the responsiveness. This is not to be confused with the supply velocity, which is an actual supply chain attribute, which will be further elaborated upon in chapter 4. The urgency of demand is high in the immediate response phase, as the immediate response phase requires answering to the most basic human needs (water, food, shelter, medicine, etc.). In the response sub phase, the first few weeks after the disaster the urgency is even higher than in the restore sub phase, when the life-threatening situations are stabilized. In the reconstruction phase the biggest threats are resolved and thus the urgency is much lower. The uncertainty of the demand in the response period of the immediate response phase is found to be high. The demand can be estimated based on the region, severity of the disaster and previous experiences. Only after the first coordination activities have found place and the situation is stabilized, during the restore period, the demand can be understood with a little more certainty. In the immediate response phase there are chances for second strikes of the natural disaster, like aftershocks. New groups of people that were on the hide can be found. These and many other changes might also affect the certainty with which the demand can be estimated. It is not until the

reconstruction phase where the demand is clearly formulated with the local communities. Only then the uncertainty of demand can be considered low.

The volume changes over time are found to be growing throughout the immediate response phase. The more certainty there is the more can be sent. In the reconstruction phase the volumes can be estimated as medium, this has to do with the variety demand aspect which will be discussed next. But first it is important to realize that these findings corresponded with the thoughts on the changes through time by the Fritz Institute, visualized in Figure 17. They also have added some supply chain structures to these phases (preparedness, push, call forwards & pull), these will be further discussed in section 4.4.1.

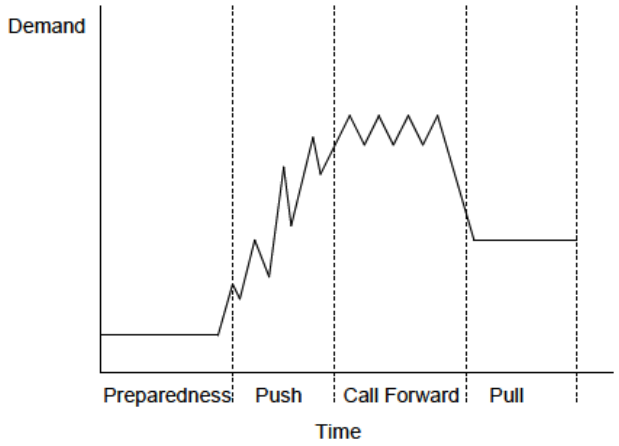


Figure 17 Demand over time (Fritz Institute, 2006)

With variety of the demand, the quantity of different products and services is mentioned. This variety increases, and thus the number of different offered services and products diverges throughout the disaster life cycle. More explanation on the characteristics of the products and services was given in the previous section.

From the understanding that is created about the demand characteristics an overview of all the factors affecting the demand characteristics is Tabel 10 is formed. An overview of the qualitative values of these characteristics is given in chapter 5.

Tabel 10 Overview of factors affecting the demand characteristics

		Immediate response phase		**Reconstruction Phase**
		Response	**Restore**	**Reconstruction**
Demand	**Urgency**	Life-threatening situation + Basic needs	Basic needs (temporarily)	Sustainable solution for independent community
	Uncertainty	Life threatening, dynamic situation	Dynamic situation	Stable situation
	Volume	Affected by uncertainty	Increased by needs	Decreased by need for local sourcing
	Variety	Affected by uncertainty & urgency	Increased by knowledge of needs	Increased by knowledge of needs

4.3 HUMANITARIAN SUPPLY CHARACTERISTICS

Last but not least, this section will elaborate lightly upon the humanitarian supply characteristics and how / why these change through time. Before being able to explain this, the supply channels (Figure 18) in the humanitarian context will be explained. Because this chapter explains more about the humanitarian supply chain configurations this will not be too elaborate.

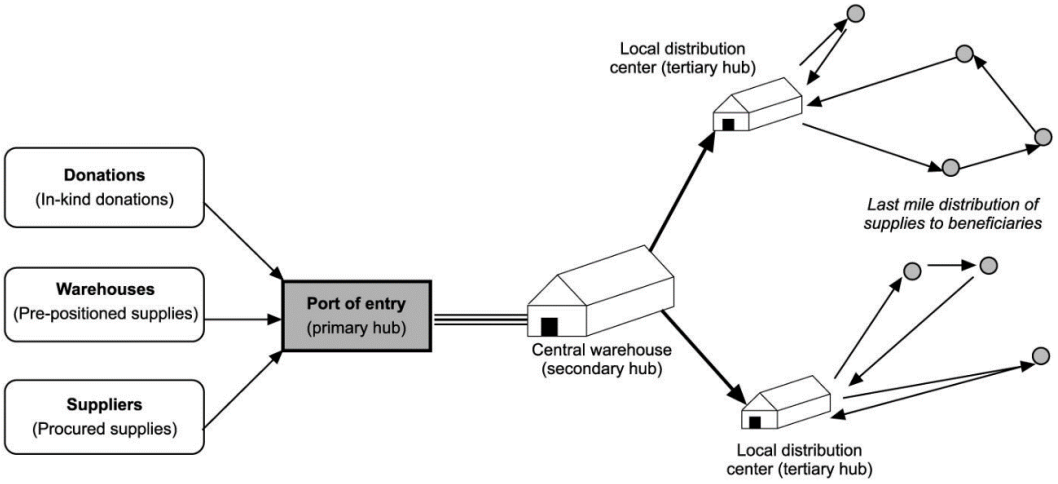


Figure 18 Structure of the relief chain (Beamon & Balcik, 2008)

4.3.1 Supply Channels

Supply channels can be explained as the "pipelines" through which the aid items and services arrive at the port of entry. These supply channels in the humanitarian context can be roughly divided into three categories: Donations, warehouses, suppliers (Beamon & Balcik, 2008). Each of these three categories are shortly explained below.

Donations

During severe nature disasters humanitarian organizations receive extra donations, these donations are either monetary or in-kind and can be solicited or not.

Solicited monetary donations are most useful as these funds can be immediately spent on the needs that are identified. Unsolicited monetary donations can also be useful, but when these do have certain conditions the situation gets more complicated. When for example these funds are only supposed to be spent on disaster relief and thus temporary aid. This can result in extremely overfunded disasters and imbalance in funding with the reconstruction activities and the funding for other aid activities.

Solicited in-kind donations are very useful especially because the transportation of these products is often already done. The challenge of this type of donations is the missing feedback loop. If the need for a certain product is already fulfilled, other donors cannot immediately know that the needs have changed. Therefore, a small risk of oversupply is present. Unsolicited in-kind donations are not always as useful as intended. Many stories of an oversupply of unsolicited in-kind donations causing congestion of the logistics system are known. The UN-OCHA report of 2013 (Boulet-Desbareau, 2013) gives some shocking examples Figure 19. The reason for this problem is mostly the experienced urgency to act that is felt by actors, this results in a "dump of the truck", not realizing the products might not be as appropriate as imagined.

"Inappropriate donations are so common that relief missions now routinely bring incinerators with them to the scene of a disaster to destroy items that may be dangerous or are clogging up the system"(Murray, 2005, p.9).

Figure 19 Unsolicited donations being destroyed (Haiti 2010)
(Boulet-Desbareau, 2013)

An overview of the types of donations is given in Tabel 11. Finally, it was found that donations are higher for sudden-onset nature disasters than other types of disasters (such as drought or civil wars), because people consider communities that are stricken by an earthquake more as victims than people in a civil war (Anonymized Interviewee B.2, 2017). Donations are also higher for countries that are closer to the donor country of countries that function as a holiday destinations. The perceived urgency in the donor country seems to make a big difference.

Tabel 11 Overview of types of donations

	Solicited	**Unsolicited**
Monetary	Always useful	Useful as long as the expenditure requirements do not set up too many restrictions
In-kind	Useful, as long as the required quantities are met	Not always as useful as intended. (too) Often "dump of the truck". Experienced donors donate better quality and quantities.

Keep in mind that this thesis is written from the perspective of humanitarian organizations, the Donations are therefore not the main supply channel that will be focused on. This overview is merely given to create more understanding of all the aspects a humanitarian organization needs to cope with. Nevertheless, in the recommendations the donations channel is also lightly touched upon.

Warehouses

The next supply channel that is distinguished is the products that get sent from the warehouses. This warehouse network has to be set up in the preparation phase in order to be able to call upon the products when needed.

The structure of the warehouse network is found to depend on the humanitarian organization and the radius of impact that they aspire. The organizational structure, the funding structure (budget for preparedness), type of aid specialization, these are all specific for the humanitarian organization. These can be set up **centralized or decentralized**. Centralized would entail one central decision making entity

which would decide who does what. In the humanitarian context, this could be translated as the head quarter being in a leading role. Decentralized would mean that the branches would each decide for themselves what the next steps are. In the humanitarian sector this would mean that the country offices have a high delegated authority and the headquarters would have a supportive role.

It is found that the warehouse network is set up for preparation and after a disaster, temporarily local and regional distribution centers can be located. The boundary between the preparedness network of warehouses and the temporary extension can be defined as the port of entry. This can be considered as the main airport or harbor of a country; a country can of course have multiple ports of entry. All the aspects and possible network structures will be further illustrated in section 0.

As already explained, the UNHRD has a complete depot network with which they also enable other humanitarian organizations to call upon their stock. This network is kept out of the scope of the thesis but it is important to keep in mind that such a network exists and that humanitarian organizations establish exchange agreements for stock among themselves as well.

Suppliers

In essence, the two aforementioned supply channels also source their provisions from suppliers. Nonetheless it is mentioned as a separate supply channel because it represents the goods that are immediately bought in the disaster aftermath. This section will describe: global vs. local sourcing; standard supply agreements and vendor managed inventory (VMI); regular vs emergency procurement and tenders vs. complex procurement.

Procurement can be done **globally, regionally or at country level**. Local sourcing is preferred by humanitarian organizations because this supports the local economy. Unfortunately, this is not always possible. It is found that the possibility of local sourcing depends on two aspects: the maturity / stability of the local market (Anonymized Interviewee A.1, 2017) and the delegated authority in the country office (Ohlsen, 2017). If the market is not stable there will be little to no product availability, plus the suppliers will be more expensive since the demand will be higher than the availability of the local market. If the delegated authority is low, the country offices will not have enough monetary resources to buy for a significant amount of products. So, when these criteria are not met it is better to source globally. When sourcing globally the advantage of economies of scale is plays an indispensable role. When taking this into consideration, it should be also kept in mind that the transportation costs might outweigh the savings when buying large quantities at once.

Knowing your suppliers and communicating the future needs can save time. Therefore, many humanitarian organizations have standard supply agreements in order to enable faster procedures (Ohlsen, 2017). This can also be in the form of VMI, this is the case when the humanitarian organization has already paid for the goods. These agreements can also be put in place in a less definitive way. For example agreeing upon an emergency procurement method, which would mean that certain rules and requirements are simplified.

In case of many products, requirements and constraints, the complexity of the procurement increases. In this case the procurement procedures can take longer than a simple one product purchase. It is also possible that humanitarian organizations put up a tender and assess all the tenders.

4.3.2 Supply characteristics

The supply characteristics can also be discussed regarding: urgency, uncertainty, volume and variety. The supply characteristics depend on the supply chain structure. The upstream part of the supply chain, until the decoupling point depends on the the type of organization and its strategy. The downstream part of the supply chain structure depends on the country and the impact level of the disaster. For this thesis it was chosen to focus on the upstream part. Thus the supply characteristics of this section will be discussed regarding the upstream part.

Just as the demand urgency, the supply urgency in the immediate response phase, depends on the life-threatening situation and the basic needs of the people in need. Furthermore the media effect also plays a role regarding the demand urgency. If the media is covering stories on people who are in severe conditions and not receiving aid, the pressure on humanitarian organizations will increase, and thus the urgency to supply will increase. From the interviews it was also found that another aspect also plays a role, which is the perceived urgency. This is an aspect that can follow from the media effect. For example when the stricken country is a neighbouring country of the base country of the humanitarian organization. In the reconstruction phase the sense of urgency decreases, with the disappearing life threatening situation and decreasing media attention.

Supply uncertainty depends on how dynamic the situation is. As already explained the situation is highly unstable in the beginning of the disaster life cycle, this stabilizes towards the reconstruction phase.

The supply chain structure is another aspect that influences the supply uncertainty. If the supply chain structure has a low response time, the right supply on the right time will be more difficult, especially in a dynamic situation such as the immediate response phase. The responsiveness depends on the connection between all the elements of the supply chain. For example, the better the relationship with the suppliers the faster agreements can be made. The critical paths that the supply chain has is also a factor of the supply chain structure that can influence the supply uncertainty. The supply uncertainty increases with the number of critical paths that can shut down or clog. The more contingency is built in the structure, the better the ability to react to an unexpected situation.

The supply volume is also affected by the uncertainties of the situation, big volumes cannot be sent when the situation is unclear. This doesn't only mean the uncertainty of the needs; the funding uncertainty also plays a role. The first few weeks the volume is also low because the humanitarian organizations need to receive all the funds before spending. The preparedness of the supply chain network also influences the slowly increasing supply volume. In the reconstruction phase the need for local sourcing and sustainable solutions decreases the volume.

The variety of the supplies is low in the immediate response phase because of the urgency and uncertainty. Only some standardized disaster relief items are sent. The more knowledge on the situation and the needs increases, the more the variety can increase. In the reconstruction phase, while the volume is decreasing, the variety reaches its peak. This has to do with the increased knowledge of the customized needs.

The factors influencing the supply characteristics, and the supply characteristics are respectively shown in Tabel 12 and Tabel 13. These are constructed from the learnings from the interviews and literature study.

Tabel 12 Factors influencing supply characteristics.

		Immediate response phase:		Reconstruction phase:
		Response	**Restore**	**Reconstruction**
Supply	**Urgency**	Life-threatening situation + basic needs Media effect	Basic needs + media effect	No media attention, no life-threatening situations
	Uncertainty	Dynamic situation, supply chain structure	Dynamic situation, supply chain structure	Stable situation, supply chain structure
	Volume	Affected by uncertainty and preparedness of supply chain network	Increased by needs and affected by bottlenecks in supply chain	Decreased by need for local sourcing & sustainable solutions
	Variety	Affected by uncertainty & urgency	Increased by knowledge of needs	Increased by knowledge of customized needs

Tabel 13 Supply characteristics

		Immediate response phase:		Reconstruction phase:
		Response	**Restore**	**Reconstruction**
Supply	**Urgency**	high	high	medium
	Uncertainty	high	medium	low
	Volume	small	large	medium
	Variety	small	medium	large

4.4 ALIGNING SUPPLY CHAIN CONFIGURATIONS

It is shown how by describing the context, strategies, structure and processes supply chain configurations are defined. But when, which configuration is needed, depends on the changing dimensions which affect the supply chain configuration. This section will describe relevant theories on how to align the supply chain configuration with the most dominant dimensions. Which dimensions are considered most dominant differs per author. All theories (except the first) are developed for commercial supply chain and not the humanitarian context. Therefore, with each of these theories the applicability to the humanitarian context will be discussed. This is required in order to obtain more understanding regarding which dimensions need to monitored throughout the disaster life cycle for obtaining an aligned supply chain configuration.

4.4.1 Based on response time and level of uncertainty

Fritz institute (Fritz Institute, 2008) has developed a matrix (Figure 20) that uses the dimensions; response time and level of uncertainty, to indicate the supply chain structure in the humanitarian sector. This matrix is specifically designed for the humanitarian context. This creates the following four types of supply chain: prepare, push, call forward, pull. These categorizations are focussed on the coordination mechanism. Where the names all speak for themselves. Call forward is the stepping stone to pull, this occurs when some sort of control is achieved in the push stage. This is when the initial push has completed and there is a possibility to plan further delivery of goods after receiving specific instructions from the programme.

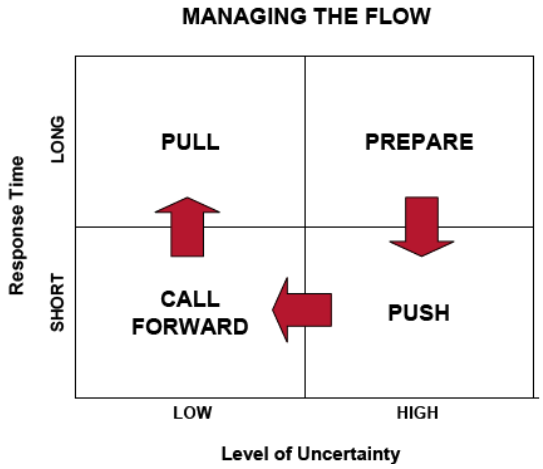


Figure 20 Supply chain types in humanitarian setting (Fritz Institute, 2008)

Applicability to humanitarian context

This alignment matrix is the first and only one of the theories which is actually designed for the humanitarian context. It provides indeed a clear overview of how the coordination mechanisms evolve, but does not provide extra information on what that means for the supply chain structure.

> *"Supplies are "pushed" to the disaster location in the immediate response phase. Pull philosophy applied in reconstruction"* (Kovács & Spens, 2007)

4.4.2 Based on demand and supply uncertainty

One of the examples regarding the choice of supply chain structure can be shown by considering the matrix of Lee (2002), Figure 21. According to Lee (2002) knowledge on the demand uncertainty & supply uncertainty allows to decide which type of supply chain fits best with the situation. With this matrix four supply chain configurations are configured: efficient supply chains, responsive supply chains, risk-hedging supply chains & responsive supply chains.

Figure 21 Matched strategies to Uncertainty framework (L. Lee, 2002)

Applicability to humanitarian context

When translating this to the humanitarian world, there is one important aspect which lacks attention. For the humanitarian world the difference between global and local sourcing has many consequences. Local sourcing is preferred because this supports the local economy. Thus there needs to be a distinction between global and local supply uncertainty. It is found that the possibility of local sourcing depends on

two aspects: the maturity / stability of the local market (Anonymized Interviewee A.1, 2017) and the delegated authority in the country office (Ohlsen, 2017). If the market is destroyed or unstable there will be little to no product availability, plus the suppliers will be more expensive since the demand will be higher than the availability of the local market. If the delegated authority is low, the country offices will not have enough monetary resources to buy for a significant amount of products. So, when in these cases it is better to source globally.

4.4.3 Based on demand and product structure

Corsten & Gabriel (2002) have developed alignment matrix that uses the dimensions: product structure and demand, shown in Figure 22. The four supply chain designs that it created are called: lean, agile, connected & speed.

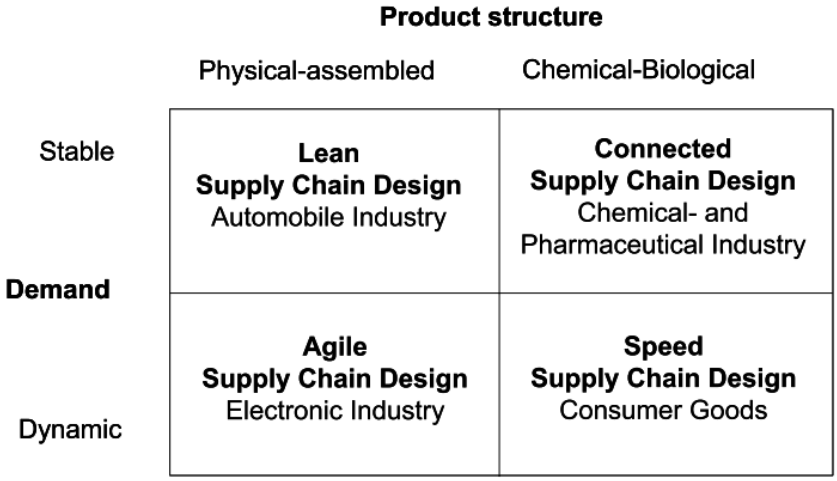


Figure 22 Supply chain configurations based on product structure and demand (source: Corsten & Gabriel)

Applicability to humanitarian context

The demand dimension might be useful to indicate the shift of the demand volatility throughout the disaster life cycle. The product structure would be applicable to the different product categories in the aid programmes, such as: food, shelter, medicine, etc. Because all these product categories each have their own evolution throughout the disaster life cycle, this might not be as useful to indicate the shifts throughout the disaster life cycle. Unless multiple of these matrixes can be made, each specialized per product category.

4.4.4 Based on coordination mechanism and strategic goal

The final alignment matrix that needs to be taken into account is designed by Klaas (2003). It is based on the dimensions of coordination mechanism and strategic goal, visualized in Figure 23. This creates four logistics segments that are called: tight, agile, modular and individual.

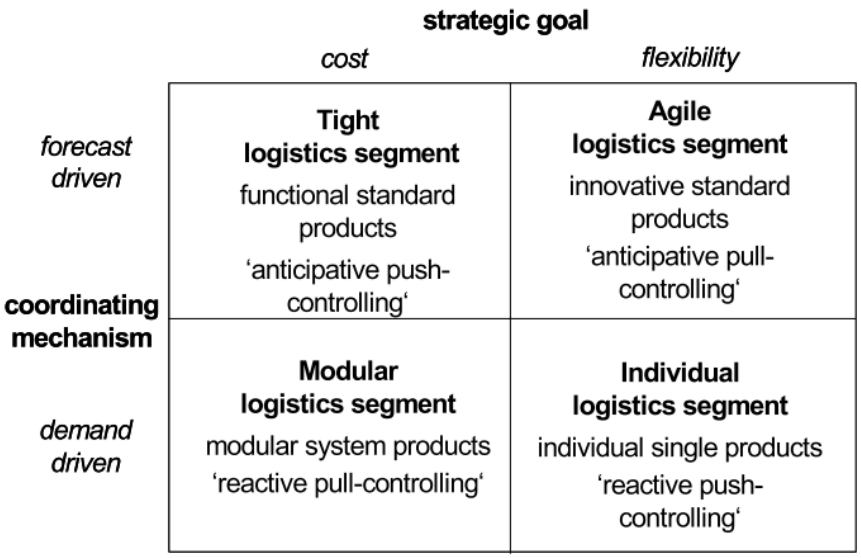


Figure 23 Supply chain configuration based on strategic configuration and coordination mechanism (Source: klaas, 2003)

The four logistics segments that Klaas (2003) has developed are all described in a theoretical manner with the configuration theory. Four dimensions are used with each different aspects, a complete overview of these dimensions and aspects is given in the appendix H.

Applicability to humanitarian context

The coordination mechanism clearly changes throughout the disaster life cycle thus this is definitely an important dimension. Especially because this relates to the Fritz institute changes mentioned in section 4.4.1. When pushing supplies this is done based on forecasts and when pulling this is based on the demand. Strategic goal also seems to change throughout the disaster life cycle as can been read in the following quote:

> *In terms of operational performance the interesting part about the transition between the stages is the shift in focus from speed to cost reduction (Tomasini and Van Wassenhove, 2009b, p. 550).*

So flexibility and costs are indeed important supply chains attributes that can be aspired. One might argue that this seems incomplete, when thinking about speed. More elaboration on the strategies will be given in section 5.2.2.

4.4.5 Overview of supply chain configurations methods

After having discussed the selected aligning theories that seem the most applicable to the humanitarian setting an overview will be given in this section. Tabel 14 provides an overview of all the configurations that were discussed. At this moment at least fort uncertainty dimension it can be said that this is required when looking at the humanitarian context. This applies to the supply and demand uncertainty. This dimensions is especially mentioned as it is integrated in most of the aligning theories. All the other mentioned dimensions will also be incorporated in one way or the other. The theories that mentioned all the configurations all use different nomenclature, but have each some sort of overlapping aspects. Which of these will be selected in the eventual framework of this these will be described in the chapter conclusion, section 4.5.

Tabel 14 Overview of supply chain configuration approaches, adapted from Neher (2003)

Authors	Configurations	Dimensions	Applicability to Humanitarian context
Fritz Institute (2008)	• Prepare • Push • Call forward • Pull	• Level of uncertainty • Response time	• It is the only alignment matrix developed especially for the humanitarian context. • Provides little details on structure.
Lee (2002)	• Efficient supply chain • Rik-hedging supply chain • Responsive supply chain • Agile supply chain	• Demand uncertainty • Supply uncertainty	• Difference between local and global supply is missing. Therefore, supply uncertainty might be a dimension which is too generalized. • Demand uncertainty gradually decreases through the disaster life cycle, this is a significant dimension.
Corsten & Gabriel (2002)	• Lean supply chain • Connected Supply chain • Agile supply chain • speed supply chain	• Demand uncertainty • product structure	• Demand uncertainty again good. • Product structure is indeed an interesting topic but not when divided into physical assembled or chemical biological. Plus might require multiple divisions regarding different product categories with different evolutions through time.
Klaas, (2003)	• Tight logistics segment • Agile logistics segment • Modular Individual logistics segment • Individual logistics segment	• Strategic goal • coordination mechanism	• Coordination mechanisms are very important, these are similar to the supply chains described by the Fritz institute • Strategic goal also seems to be shifting but might need more aspects.

4.5 CHAPTER CONCLUSIONS

The objective of this chapter was to answer the second sub question: How do the changes throughout the disaster life cycle affect the humanitarian supply & demand? Before being able to answer this question, it is important to understand which changes throughout the disaster life cycle affect the supply & demand.

The humanitarian demand is formed by the needs, these are firstly for safety, security and basic needs which evolve into the need for a self-reliant, independent, sustainable community. How the humanitarian supply is shaped can be categorized with two factors: organization specific and disaster context specific factors. The organization specific factor is set up by the certainty of funding and the supply network. Certainty of funding can for example be influenced by media attention. How the fast track procedures are put up also plays a big role. The supply network enables the supply, each of the links in this chain is needed. The disaster context specific factors are the ones the humanitarian organization needs to deal with. This results in bottlenecks in the supply network and the urgency & uncertainty of the situation. Bottlenecks might be: congestion of warehouses due to unsolicited donations, destroyed infrastructure and damaged

entry ports (harbours, airports, etc.). The urgency of the situation also influences the supply, as time is lives saved. Uncertainty of impact, magnitude location and timing also influences the supply.

Because the nature of the humanitarian context changes throughout the disaster life cycle, it affects the demand uncertainty, this causes ineffective demand and supply matches. Having this said the most important characteristics to describe the humanitarian demand are: urgency, uncertainty, volume and variety. For supply it is urgency and uncertainty. The obtained knowledge allows a holistic overview of all the demand & supply characteristics and how they globally change through the disaster life cycle is shown in Tabel 15 & Tabel 16 respectively. These findings are based on the interviews and literature.

Tabel 15 Overview of demand characteristics through time (Source: based on interviews)

		Immediate response phase:		**Reconstruction phase:**
		Response	**Restore**	**Reconstruction**
Demand	**Urgency**	high	high	low
	Uncertainty	high	medium	low
	Volume	small	large	medium
	Variety	small	medium	large

Tabel 16 Overview of supply characteristics through time (Source: based on interviews)

		Immediate response phase:		**Reconstruction phase:**
		Response	**Restore**	**Reconstruction**
Supply	**Urgency**	high	high	medium
	Uncertainty	high	medium	low

5 DEVELOPMENT OF THE KNOWLEDGE BASED FRAMEWORK & ANALYSIS

In this chapter the design deliverables of this thesis is central. With all the important knowledge that is collected up till now the supply chain configuration knowledge based framework can be developed, as well as the if then else diagram which can be used as guidelines for the sourcing processes (Deliverable 1 & 2, respectively).

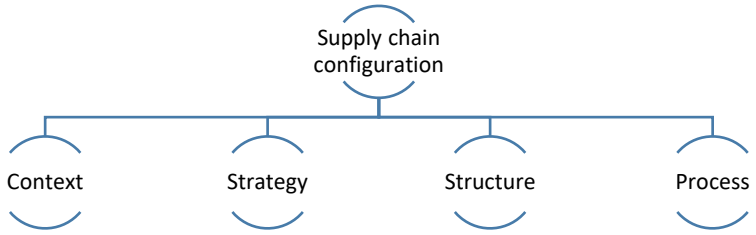


Figure 24 Supply chain configuration definition (Neher, 2013)

The first section of this chapter will start discussing the working principles of the three organizations that where focused on during the non-explorative semi structured interviews. This allows describing the supply chain configuration of these organizations. The second section will use these learnings and the learnings from chapter 3 & 4 to draw up the aspects that fall under the definition of a supply chain configuration (Figure 24). This will create understanding on the most important aspects that need to be taken in to account when (re)configuring the humanitarian supply chain according to the changes throughout the disaster life cycle. The supply network sub branch will be introduced under the structure branch of the supply chain configuration (Figure 24). As learned in section 4.1.2, the decoupling point is a useful tool to control whether supplies are pushed or pulled. Therefore, four upstream and four downstream decoupling points are introduced. This is eventually an important step because this allows relating the product types to these structures.

In order for knowledge based framework to be complete it needs to be filled in with best practices and barriers form sudden onset nature disaster cases. Therefore, the third section then fills in the knowledge based framework with the main take outs from the non-exploratory interviews that cover the best practices and barriers from the mentioned disasters. Even though this is the first version of the knowledge based framework, and further growth is needed for it to reach maturity. Guidelines regarding sourcing throughout the disaster life cycle can be developed in the form of an if then else diagram, this is described in section 5.4. Finally, this chapter will be concluded by summarizing the two designed concepts.

5.1 FRAMEWORK INPUT: WORKING PRINCIPLES OF ANONYMIZED ORGANIZATIONS

In this section, the main take outs from the semi structured interviews are used to create an overview of the basic working principles of Anonymized Organization A, B & C. These are described in a sequential order. Firstly, Anonymized Organization A is described; their high-level strategy, structure and processes. This description will also be provided for Anonymized Organization B & C. Finally, the basic working principles of the organizations will be compared. From this the barriers, commonalities and differences per organization will be derived. This and the disaster cases the interviewees mentioned as examples during the interviews (see main take outs appendix B) will be the input for the knowledge based framework in section 5.3.

5.1.1 Anonymized Organization A

It is a humanitarian organization which has around 100 country offices (members) all over the world. Anonymized Organization A can be considered as a one stop shop as they are active in the immediate response phase and the reconstruction phase. They are very involved with the aid receiving communities. In order to enable this, Anonymized Organization A has a very decentralized structure. Most of the **decision making is done on the country office level**.

Country officers do the procurement, decide on the number of warehouses and locations, etc. So in the case of a big sudden onset disaster, they deploy the supply chain.

They have an **emergency toolkit** (online and as booklet) which serves as guide lines for emergency aid. These contain some **standard operating procedures** (SOP's) as support of deciding whether to provide aid or not. There are no standard operating procedures with respect to how to designing the supply chain, this differs per country office. One of the future goals for Anonymized Organization A is to have more SOP's.

Anonymized Organization A International is positioned in the US when the country offices are overwhelmed during the emergency response Anonymized Organization A-International can send a SURGE team that will support the aid-activities. Anonymized Organization A's international entity has **one warehouse in Dubai** with a small quantity of prepositioned emergency supplies. This stock functions only **as a back-up** in case local procurement is impossible. The country officers can thus ask for **support form Anonymized Organization A-international** or other members.

Anonymized Organization A-international can also support in procurement. "As often as possible we try to procure as locally as possible." Generally, ANONYMIZED ORGANIZATION A does not do a lot of bulk procurement. There is long term planning and some smaller grouped procurement in our development work. Procurement has a **robust system** they work with, it is online and they have the capacity and flexibility to incorporate performance measurement.

Performance measures are therefore also put up on country level and they are more **output based** (Metrics demanded by donors: amount of aid recipients reached, etc.) than on process level. These are not monitored by Anonymized Organization A-international because of a **lack of systems and human resources**.

5.1.2 Anonymized Organization B

Anonymized Organization B is Dutch humanitarian organization that is specialized, and therefore mostly focusses, on reconstruction, this is done in close cooperation with the local communities. Through their contacts in the humanitarian network they can access the area's after a few months. In case of big sudden onset nature disasters Anonymized Organization B joins the joint efforts of the Dutch collaborative aid organizations (Samenwerkende hulp-organizaties, SHO).

Humanitarian organizations have a backup budget for disaster relief, but most of the funding is raised and applied for after the disaster. For example the "Samenwerkende Hulporganizaties" (**SHO**), is a cooperation of Dutch humanitarian organizations, they do the crowdfunding and first transportation activities together in case of large disasters. The participating humanitarian organizations such as Anonymized Organization B cans start procuring a first batch of goods, with their own funds and an estimation of the funds that will be raised.

Anonymized Organization B has a “big sister” that coordinates the network of catholic humanitarian organizations. When in need of extra coordinators, or experienced staff, Anonymized Organization B employees can also be outsourced to support their colleagues in their network.
Because Anonymized Organization B is mostly focusing on reconstruction work their supply chain structure is not their focus. When big logistic efforts are asked of Anonymized Organization B, they often decides to outsource these activities to Anonymized Organization C.

International Aid Transparency Initiative (IATI) is an online open data platform for the aid-sector. Every organization that receives funds for international aid should be IATI-proof, this means reporting in a special format. This allows the Dutch ministry of foreign affairs (Ministerie van Buitenlandse Zaken, BuZa) to compare the activities of all fund receiving organizations.
Anonymized Organization B is currently in transitioning their database to be completely IATI-Proof. This documenting transition solves the problem of double documenting efforts.
Dutch Relief Alliance (DRA) is an alliance of 14 Dutch humanitarian organizations. These all receive funding from BuZa and need to convert their documenting in order to be IATI-proof. Anonymized Organization B is one of the first humanitarian organizations that did this transition, they are therefore helping the others going through the transition.

5.1.3 Anonymized Organization C

Anonymized Organization C is a commercial company which provides services to governments and humanitarian organizations. Their activities can be divided in the following four sections: **Supply services**, **Procurement services**, **Consultancy services** and **Emergency Response**. The headquarter (HQ) is positioned in the Netherlands, and other offices are located in the USA and Uganda.
Anonymized Organization C owns a large network of professionals who can be seconded in order to provide consultancy services. These services can be strategic, tactical or operational. Anonymized Organization C Also has a great network of suppliers.

When a disaster occurs, Anonymized Organization C contacts their suppliers to create a **capacity assessment**. The clients are responsible for the seeds assessment. From experience Anonymized Organization C knows which products and service will be asked for, this allows them to prepare the knowledge on the capacity of their suppliers before asked for.

The **structure** of the supply chain is new per disaster. For Anonymized Organization C the structure depends on the needs of the client. The projects are all clearly framed so sharing resources per project is not possible. Also because the clients are restricted to their own specific procurement rules. Transparency plays a big role.

Clients expect from them that they can **react quickly** and **have the capacity to quickly scale up**. Even though their clients might work on a firefighting base, Anonymized Organization C does not experience it that way. This flexibility means that sometimes the HQ also works in the weekends. They can’t say no to their clients. They have always been able to comply to their client’s needs. They ensure this by having a clear overview of their capabilities as organization. Clear communicating this with the client is very important.

As Anonymized Organization C is specialized in **procurement** they have developed extensive working principals. They have three types of purchasing: Simple purchasing, competitive quotation and competitive tendering. This categorization reflects the complexity of the procurement procedure. For the complex purchasing procedures more time is planned.

The complexity of the procurement is explained to be influenced by the following factors:

- The size and diversity of the order, if an order contains multiple different products the procurement procedures need more time.
- The complexity of the product. Medicine have more constraints, to check when purchasing, than laptops.
- Whether service activities are involved. Services make the procurement extra complex, when for example installers, or engineers are needed.
- Above certain budgets, regulations can also change. The delegated authority of the country officers in contact with Anonymized Organization C might be up to a certain budget. Higher expenses would then need permissions of higher ranks in the organization. These regulations depend on the clients wishes.
- Global vs local sourcing: Medicine for example might have special treatment regulations. When procuring locally it cannot be verified if all these regulations are met. The deliberation regarding local or global sourcing has to be decided per product. This is not a decision that is made per project.

Performance of suppliers is measured and judged based on: **delivery time**, **quality of goods** and product **price**. These are the KPI's for the performance of the suppliers. During emergency response Anonymized Organization C monitors the delivery time as strict as possible. They evaluate this afterwards, and provide feedback to the suppliers. This is Anonymized Organization C's task; this way they ensures that the suppliers in their network indeed comply to their standards. Relations with underperforming suppliers will be stopped.

Anonymized Organization C also measures their own speed in the procurement process. When they get a project, they need a few days to write a tender and publish it. When the Tender deadline is reached, the bids of the competing suppliers need to be evaluated. **The time Anonymized Organization C takes to create an evaluation report for their clients**, is a KPI for their performance. If this takes longer than a week they consider themselves as underperforming. When the client has decided which bid they want, Anonymized Organization C has to write out the contract. **The speed with which they deliver the contract** is also a KPI.

5.1.4 Overview organizations

It is needed to create an understanding of the **commonalities and differences** of the discussed organizations, for a better perspective this is shown in Tabel 17. The most important characteristics that need to be kept in mind are the fact that Anonymized Organization A & Anonymized Organization B are a one stop shop NGO's, while Anonymized Organization C is a commercial service provider that operates in the humanitarian sector. Anonymized Organization C evaluates the performance of their suppliers, to ensure that all suppliers in their network are reliable. This is not done by the two humanitarian organizations. Their reason was lack of resources, but Anonymized Organization C saw this as a matter of resource allocation. When looking further into the Anonymized Organization A & Anonymized Organization B it can be said that Anonymized Organization A is bigger than Anonymized Organization B. Anonymized Organization A has permanent prepositioned stock, Anonymized Organization B not. Plus, Anonymized Organization A International can send in-house SURGE teams, Anonymized Organization B not. Both NGO's have a lager sister organization that acts as an umbrella for their related organizations, creating a worldwide network.

Tabel 17 Commonalties and difference

Anonymized Organization	**A**	**B**	**C**
Context	Mostly reconstruction, occasionally immediate response	Mostly reconstruction, rarely immediate response	All phases of the disaster life cycle
SC-strategy	Decentralized, Country director decides whether to answer to the disaster. Procurement system is robust	Only focus on specialism, that is primarily reconstruction phase. Disaster relief in cooperation with SHO. Mostly outsourcing procurement and transport.	Agile: responsive and flexible British government in Ebola Response took the "Whatever it takes strategy"
SC-structure	Decentralized structure, decision making at country office level. Prepositioned stock in Dubai, acts as back up for when country offices demand it. HQ supports country offices with Surge teams.	Decentralized information structure, no prepositioned stock unless put up for specific program. SC activities often outsourced.	Big network of suppliers + professionals that are at their availability. No prepositioned stock. The headquarter is positioned in the Netherlands, and other offices are in the USA and Uganda
SC-Processes	Needs assessment, procurement, transport, warehousing, distribution	Needs assessment, (Warehousing), (distribution) Rest is outsourced. Vendor managed inventory.	Supply services, Procurement services, Consultancy services and Emergency Response.

5.2 DEVELOPMENT SKELETON KNOWLEDGE BASED FRAMEWORK

5.2.1 Context

This section will provide a collection of aspect from the context that need to be monitored in order to understand the required supply chain configuration in that point of time. For describing the context two subcategories are made: **Humanitarian environment** and **Aid specific characteristics**. These aspects were chosen by combining some of the dimensions to describe logistics segments, used by Klaas (2003), with the knowledge on the humanitarian context in chapter 3 and chapter 4. Figure 25 gives an overview of the sub branches regarding the context of a humanitarian supply chain configuration.

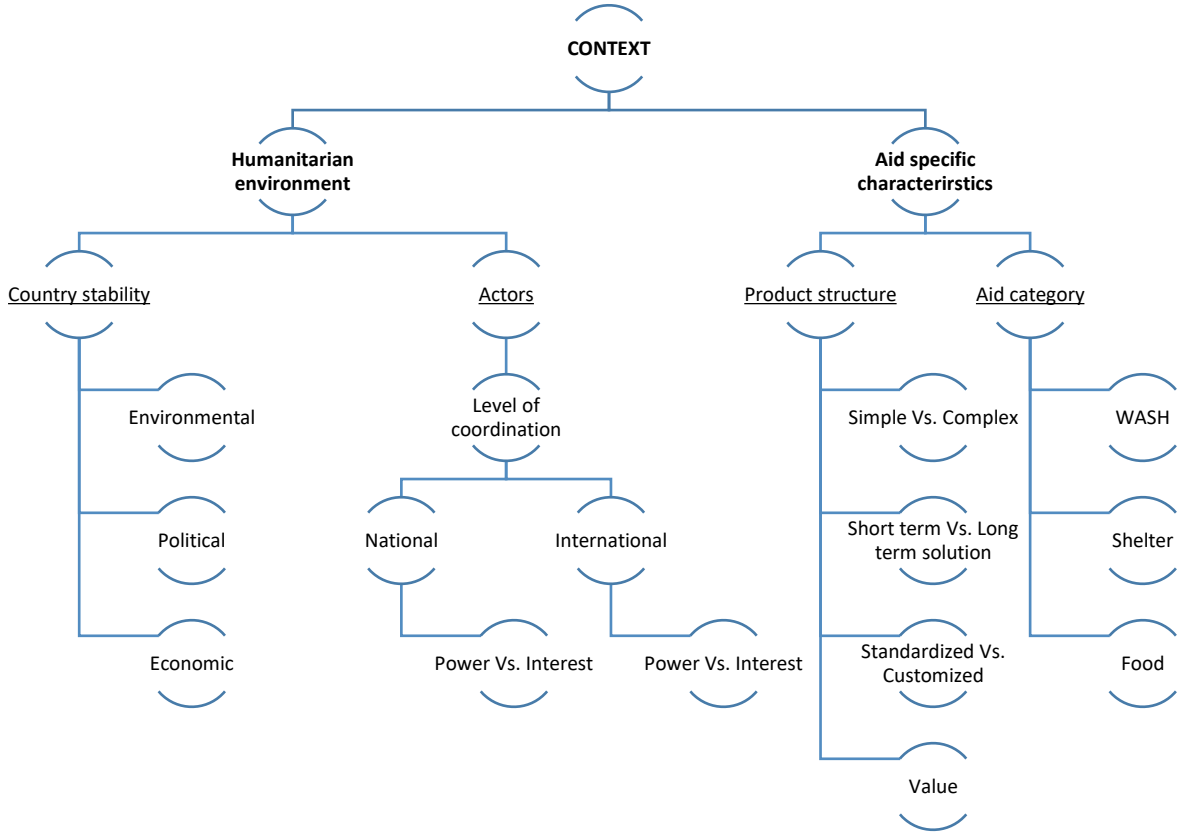


Figure 25 Sub branches regarding the context of a humanitarian supply chain configuration

Humanitarian environment

Starting with the humanitarian environment branch of the context, it depends on two factors: The Country's stability and the Actors. The **country's stability** is a very important factor that influences the humanitarian environment. This can be effected due to environmental, political or economic factors. **Environmental factors** can, in the chosen scope of this thesis (sudden onset nature disasters), be all sorts of effects of the disaster. For example, in the case of an earthquake it could be the chance of an aftershock. These environmental factors can be experienced as a barrier for the supply chain. **Political factors** give meaning to the political stability of the country. The political stability can influence the interest of the government. Government might delay declaring an emergency situation and thus delaying international aid If they are too proud or want to show that they are capable of solving the problem themselves.

This might be the case when new elections are coming up. They political stability is therefore definitely an aspect to keep in mind. The **economic stability** is the final and most important one. The country might have already had an underdeveloped weak economy or it might be affected by the disaster. Certain types of aid can influence the economic stability of the country as well. As already explained in Chapter 3, one of the developments in humanitarian aid is supplying money or coupons in order to support the local economy. Providing in-kind goods or money has indeed a different outcome regarding the local economy. Thus it is very important to keep in mind how the local economy is affected because of the humanitarian aid activities. It is also vital the other way around: How supply aid is affected by the local economy. The type of needs can be affected, as well as the required security. Firstly, explaining the type of need which might be affected. This covers the difference between restoring the water purification and supply systems of the country or setting up these systems from scratch. If a country is economically underdeveloped there might be more (rural) area's which are lacking these systems. Secondly, in an economically unstable area often corruption and criminality and corruption rises. This influences the required safety procedures, also the country's policies need to be better studied to prevent problems at customs.

The active **actors can be either national or international**. And each of these actors have their **own type of power and interest**. Power in this sense might be monetary or legal. Interests can be influenced by the degree of engagement with the victims. One might say that the engagement with the stricken community influence the engagement and thus interest. Section 3.1 has already created a picture of all types of actors that play a role in the humanitarian environment. This showed that the following actors play a role in the humanitarian environment: UN-related, IGO's & NGO's, governments, media and beneficiaries. The relation between these actors and their actions are found to be an important factor influencing the supply chain configuration. Especially because **coordination and cooperation** is very important. This is more urgent in the immediate response phase, than in the reconstruction phase, as sharing the little available resources and information is a matter of saving lives.

Aid specific characteristics

As explained in section 4.2.2 the product structure and aid category change throughout the disaster life cycle. Three overall evolutions through time can be stated. Firstly, the transition from standardized to tailormade solutions. Secondly, the transition from Functional and easy to use products to complex systems that require education and or installers. Thirdly of course the start of the short-term solutions which eventually turn into long-term solutions which are more sustainable. An overview of the discussed aspects shaping the humanitarian context and affecting the right supply chain configuration are listed in Tabel 18.

Tabel 18 Dimensions to monitor

		Preparation phase	Immediate response phase		Reconstruction phase
		Preparedness	**Response**	**Restore**	**Reconstruction**
Actors & events	**Urgency** (Dimension: response time)	Perceived urgency differs per actor	High stakes, time is a matter of saving life		Time is a matter of life quality and economic independence
Demand	**Uncertainty** of situation (this affects demand)	Forecast accuracy	Sliding scale: knowledge of situation increases • impact • magnitude • location • Timing		Uncertainty of funding
Product	Understanding product evolution through time and how these relate to the other aspects. • standardized → customized • functional & simple → complex systems • short term solution → long term solution				

5.2.2 Strategy

For the strategies it was found that the strategy should change through time. Thus the first question to ask is what are the active phases in the disaster life cycle. If the organization is a one issue organization and only provided aid in the form of disaster relief in the immediate response phase it is not necessary for the organization to us multiple different decoupling points. Their strategic goal would stay the same throughout their programmes. In the case of a “one-stop-shop”, providing allrounder aid, it can be seen differently as these programmes are affected to changes throughout the disaster life cycle.

The coordination mechanism decides whether the supply chain acts on demand based information or forecast based. This can also be seen as push or pull. As was described in section 4.4.1.

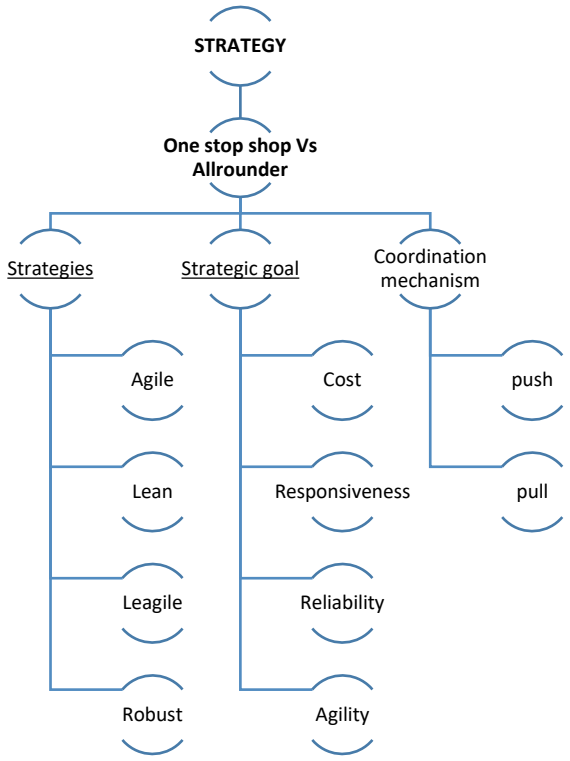


Figure 26 Sub branches regarding the strategy of a humanitarian supply chain configuration

5.2.3 Structure

As discussed in section 4.3.1, a supply chain configuration structure depends on the supply network, organizational structure and the financial structure. Because of the scope the financial structure is not further discussed. The supply network sub branch is the most important in this section. As learned in section 4.1.2, the decoupling point is a useful tool to control whether supplies are pushed or pulled. Therefore, four upstream and four downstream decoupling points are introduced. This is eventually a vital step because this allows relating the product types to these structures. And because as it was found that in section 4.2.2 that the product types change through the disaster life cycle. This section provides the first link regarding an aspect from the supply chain configuration and the disaster life cycle.

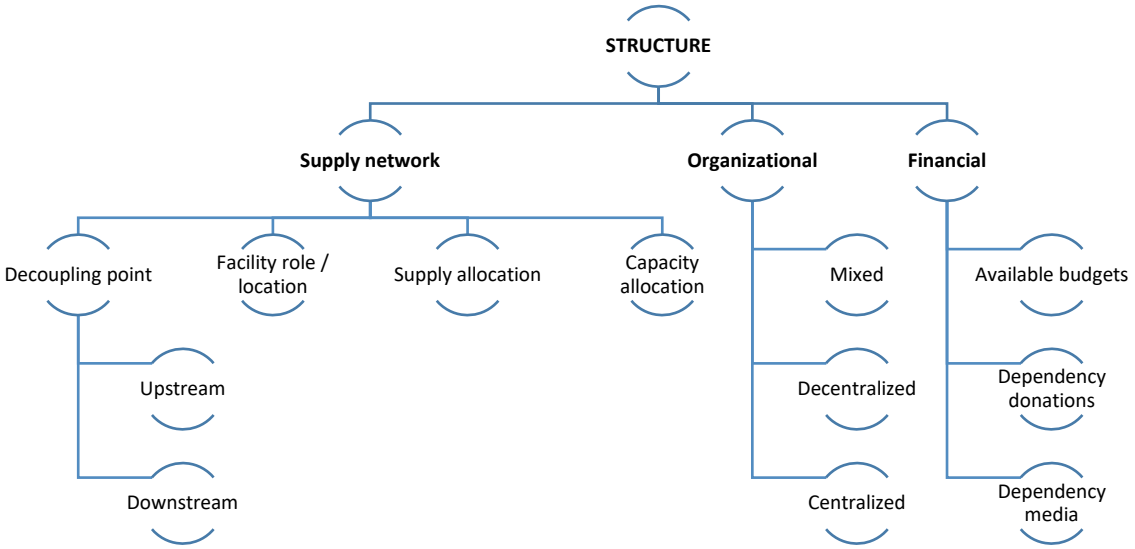


Figure 27 Sub branches regarding the structure of a humanitarian supply chain configuration

The humanitarian supply chain structure: Upstream

The **upstream part of the supply chain structure is** found to be **organization specific**. So before being able to draw out the possible supply chain structures it is important to obtain more understanding of the different organizations. From the desk research and interviews it was possible to make an organizational categorization for the INGO's. These are centralized, mixed and decentralized. These will be shortly described because these are needed in order to explain the supply chain structures. The **centralized organizations** are the ones that have a supply chain division which arranges most the activities. These can also be authorizing activities for other divisions. Examples for this type of INGO's are: Unicef, Save the children and Oxfam. **Mixed organizations** are a combination between centralized & decentralized. These organizations work as a decentralized organization but have a supportive supply chain division that only has a regional distribution centrum as back up. An example of a mixed organization is Anonymized Organization A. **Decentralized organizations** arrange all the supply chain activities regionally. These do not necessarily have prepositioned stock but can work with supply agreements or Vendor Managed Inventory (VMI). An example of a decentralized organization is Anonymized Organization B.

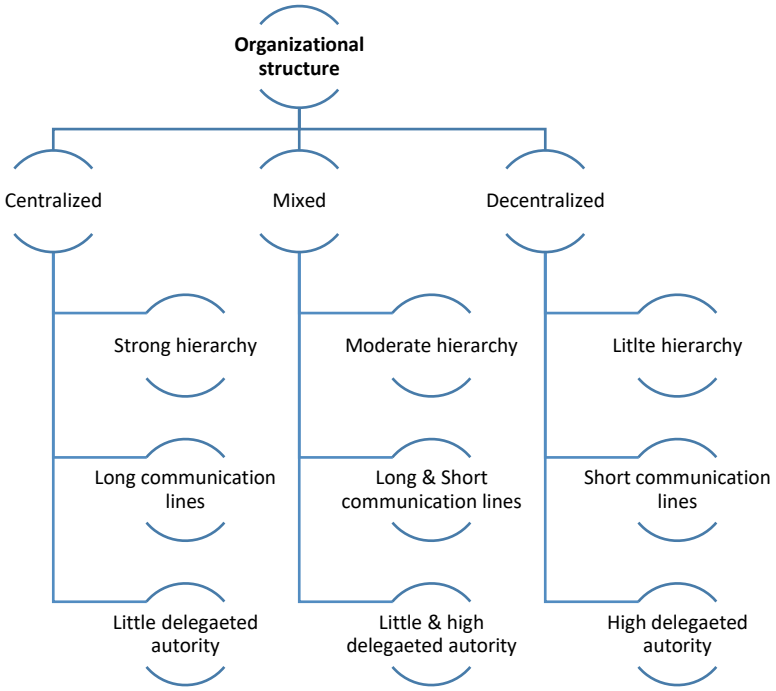


Figure 28 Sub sub branches regarding the organizational structure of a humanitarian supply chain configuration

With this knowledge four upstream supply chain structures (U.4 - U.1) are visualized in Tabel 19 Generic upstream humanitarian supply chain structures. The legend for understanding the elements of these drawings is shown in Figure 29. Behind the drawings are given to show which supply chain structures belong to which organization structure. For example the codes, C4 – C1, show that all a centralized organizational structure has all supply chain structures.

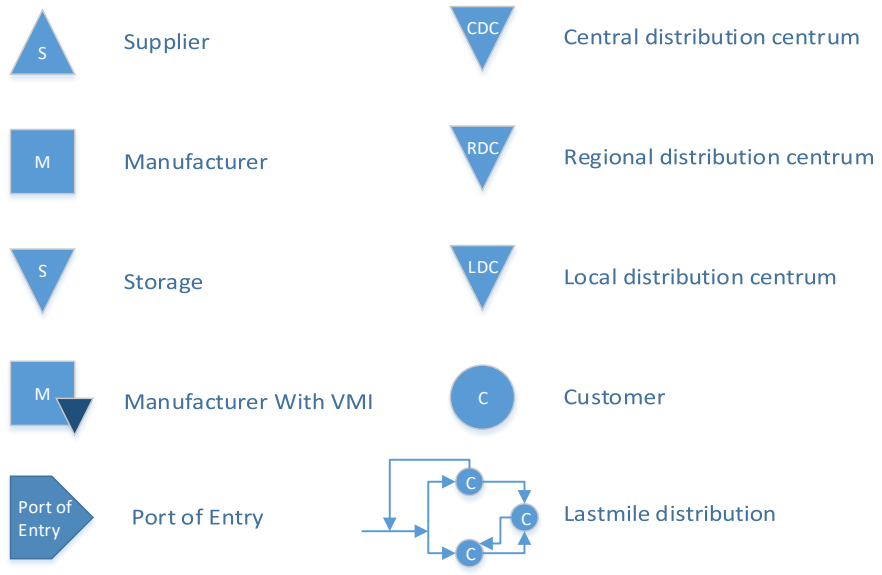
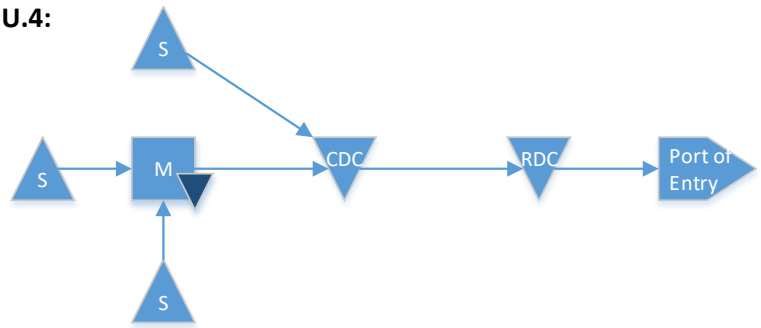
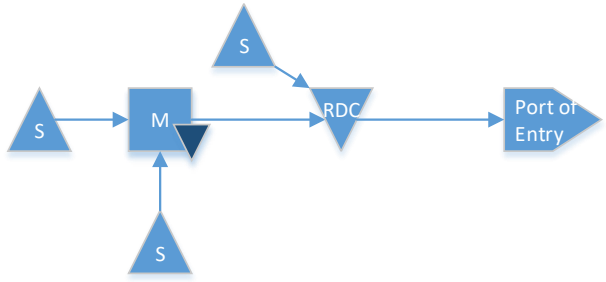
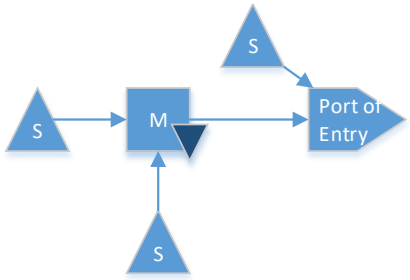
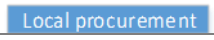


Figure 29 Legend supply chain structures

With some examples these structures will be further explained. **Structure U.4** can represent the Unicef supply chain. Unicef has their supply chain division in Copenhagen (CDC), they have three RDC's in Panama, Dubai & Shanghai. (An example for their specialized product chain (therapeutic foods) is shown in Appendix J.). Save the children and Oxfam both also have a supply chain division in London. Structure U.3 can represent Anonymized Organization A, they have only one RDC in Dubai, with little variety and little volume, Only 150000 USD (Anonymized Interviewee A.1, 2017). This allows them to support the local country offices if needed. Structure U.2 can be Anonymized Organization B who do not own their own prepositioned stock, but can procure regionally. When locally procured U.1 is applicable.

Tabel 19 Generic upstream humanitarian supply chain structures

Generic decoupling structures: UPSTREAM	Centralized	Mixed	Decentralized
U.4: 	C4	-	-
U.3: 	C3	M3	-
U.2: 	C2	M2	D2
U.1: 	C1	M1	D1

When comparing these structures to the product types used per organization, it can be understood that only complex products with high quality restrictions such as medicine or machinery is prepositioned in the CDC. RDC's contain the non-perishable disaster relief items. The variety and volume depends if the organization is a one-issue organization (like MSF) or an allrounder (like STC). More details on these products specifications is showed in Tabel 20.

Tabel 20 Product characteristics per structure

Generic decoupling structures: UPSTREAM	Product specifications

U.4	• C4: Prepositioned products in CDC
	  ○ Complex products with high quality restrictions
	  ○ Complex / big procurement procedures / tenders
	  ○ Unicef: High variety & High volume

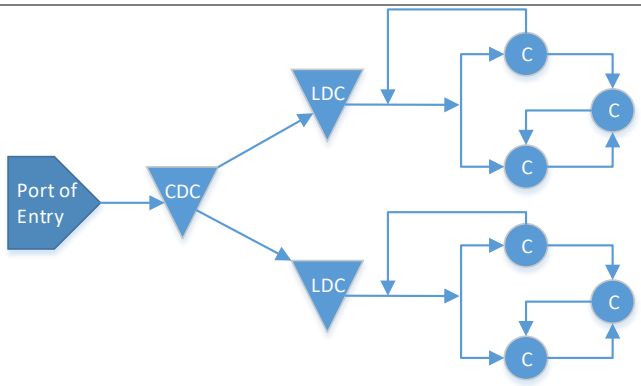
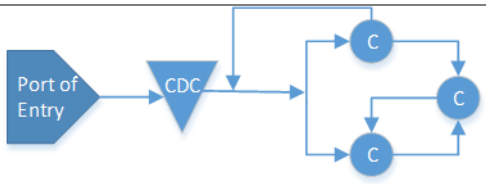
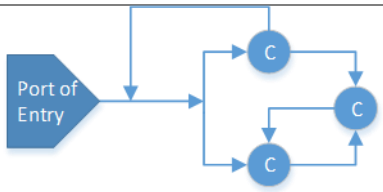
U.3	• C3: Prepositioned relief items
	  ○ Save the children: High variety, Low volume (source: Stan Klinkenberg)
	• M3: Prepositioned relief items in RDC
	  ○ MSF: Low variety, high Volume (Source: Stan Klinkenberg)

U.2	• C2, M2 & D2: Relief items, emergency procurement
U.1	• C1, M1 & D1: Relief items, local emergency procurement

The humanitarian supply chain structure: Downstream

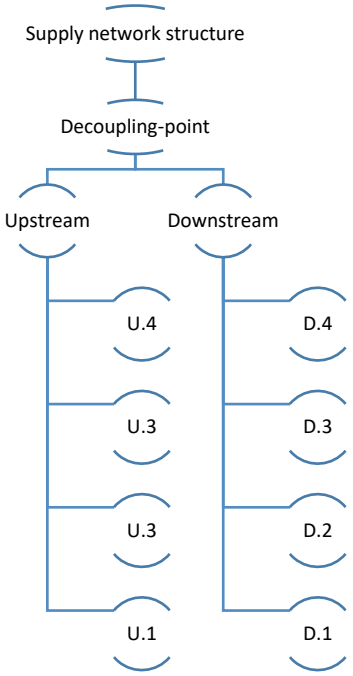
The downstream part of the supply chain structure is found to be country specific, also the impact of the disaster has impact on this part. Some warehouses or offices can already be existent because of the reconstruction activities of the humanitarian organization or these can be of a temporary extent.

Tabel 21 Generic downstream humanitarian supply chain structures

Generic distribution structures: Downstream		Large	Medium	Small
D.4:		L4	-	-
D.3:		L3	M3	-
D.2:		L2	M2	S2
D.1:	Local procurement	L1	M1	S1

The **CDC**'s in the downstream part of the supply chain are often connected to the country office. When the goods cannot be immediately distributed these get stalled here first. For example in the case of usolicited donations and bulk batches. When pick and packing is needed to create the emergency kits for example. The **LDC**'s receive the sorted products in order to be assigned for the **last mile distribution**. The last mile distribution relies heavily on relation with local population (Comes, 2017).

Tabel 22 Sub sub branches regarding the supply network structure of a humanitarian supply chain configuration



5.2.4 Process

Figure 30 gives an overview sub branches regarding the process of a humanitarian supply chain configuration. The processes are important because it allows knowing where what needs to be monitored. The most common supply chain process categorization according to humanitarian organizations was found to be: assessment, procurement, transport, warehousing, distribution, evaluation. In order to prevent elaborating on each of the processes in details, the scope of the thesis is on the sourcing activities. And even the sourcing activities can be elaborated upon in great detail, as multiple scenarios are possible. Therefore, it chosen to focus on the process of sourcing from the perspective of a country officer right in the disaster aftermath. This entails making the decision between procurement or sourcing the prepositioned goods from the warehouses after the assessment. Ideally evaluation would also belong to this topic.

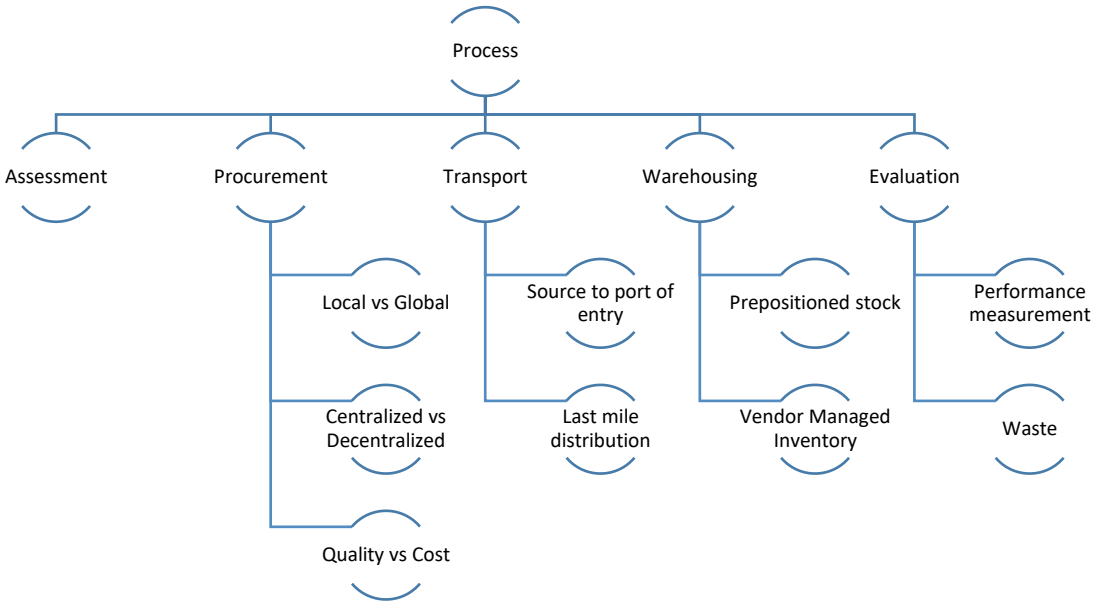


Figure 30 Sub branches regarding the process of a humanitarian supply chain configuration

Global or local procurement

The choice between local or global procurement was found to depend three main factors: **capacity & stability of the local market**, the **delegated authority of the country officer** (Anonymized Interviewee A.1, 2017) (Ohlsen, 2017) and the **product quality restrictions**.

If the **local market** is instable, the local market might be affected by the disaster or could have been underdeveloped from the beginning, it is impossible to procure locally. The local market has to be intact in order to procure locally. The local market might also lack the capacity for answering to the increased demand. Bulk supply is therefore generally not procured locally. As shown in the framework (section0), this falls under the context-aspect of humanitarian supply chain configurations.

The **delegated authority** describes the decision making power a country officer has, in other words his / her budget. If a country officer has low delegated authority, he / she will have a small budget to procure local goods without permission from his / her peer. "*If the country logistics officer has a low delegated authority, they can arrange a few soup kitchens and that's it*." (Ohlsen, 2017). The delegated authority is an organizations specific characteristic. As shown in the framework (section 0), this falls under the structure-aspect of humanitarian supply chain configurations.

The **product quality restrictions** might dictate a certain quality which cannot be verified when procuring locally. An example of this might be certain medicine which only work when kept under a certain temperature. Such medicine require a cold supply chain. When procuring locally it cannot be checked whether these transportation rules have been followed. When procuring globally and keeping control on the transportation the quality restrictions can be obeyed.

Next to the factors that affect the choice between local or global procurement it is also important to understand the **positive and negative consequences of this choice**.

Local procurement was found to be best for the local community, this can be argued from two perspectives: economic and cultural. Firstly, local procurement stimulates the local economy as money is being inserted. Furthermore, the local entrepreneurs get more revenue instead of more competitors which are handing out free goods. Secondly, when procuring locally the goods match with the cultural preferences of the community. This ensures the acceptance and usefulness of the supplied goods.

Global procurement seems to be only preferable for the beneficiaries when certain quality restrictions force selecting certain suppliers. But there is another perspective that needs to be taken into account: the humanitarian organization. Even though economy of scale might make global procurement in bulk cheaper, the transportation costs do not weigh up to the gained discount when buying bulk. Global procurement is therefore more expensive than local procurement. But there is another reason that was found to play a big role for humanitarian organizations: visibility (Anonymized Interviewee B.2, 2017). The visibility of the aid supply has a positive effect on the media coverage, and thus the funding. This can be considered the most significant positive aspect for global procurement.

Global or local prepositioned goods

The choice between global or local prepositioned goods is a characteristic of the supply chain structure, the choice depends on the **organization structure** and **product types**. Prepositioned stock follows from (de)centralization of the organization. The more decentralized the supply chain structure is, the more local warehouses they have, the more responsive they are. It also depends on the product types; simple disaster relief supplies can easily be stored in warehouses. But in case of perishable products or very valuable products storing these might be very expensive. For these products it is generally not chosen to keep them in warehouses. In this description we take out of scope the fact that the sudden onset nature disasters are spikes of load that have to be answered to in a system which is suffering on the heavy baseload (Comes, 2017).

The **consequences** of decentralized supply chain structure can either be argued to be **positive or negative** depending on the perspective. As already discussed a decentralized supply chain structure is responsive, this allows fast aid supply. This is positive for the beneficiaries and the humanitarian organization. But a decentralized structure is expensive, as many products are “waiting” to be used. [Red Cross Haiti case Tina Comes]. This not only results in idle resources which is very expensive, there is another problem as well. This expense has to be done in the preparedness phase, not all funding structures allow for such an expense. This also has to do with the visibility aspect. Most donors are not willing to pay for prepositioned goods, the visibility is minimal with such a structure (Anonymized Interviewee B.2, 2017). Some supply chain structures are thus affected by the funding structure.

5.2.5 The knowledge based framework

By creating the first part of the knowledge based framework, the crucial characteristics of a humanitarian supply chain configuration are identified. The main categories are: context, strategy, structure and process.

- Context: Provides the aspects that need to be dealt with
- Strategy: The approach that is chosen to deal with the context
- Structure: The way the realizing the approach is facilitated
- Process: The steps that need to be taken

The knowledge from chapter 3 & 4 was used to create a first set up. Then with the working principles described for Anonymized Organization A, B & C this first set up was improved. This allowed to assign sub branched to each of these categories (context, strategy, structure & process). The first set up was made sketched manually and continuously improved. This process is not fully described as it grew organically. If this research is repeated other researches might come up with a slightly different setup, as personal approach is also an important factor. But I do believe that the essence will be the same.

When putting all sub branches together the skeleton of the knowledge based framework is created, as shown on the next fold out page. The next step is filling the branches with new barriers and best practices that are encountered by the humanitarian community. This will eventually create a database with best practices and barriers for the humanitarian sector to learn from.

A summarized compact version might even be incorporated in the field handbook or pocketbook. These handbooks are filled with operational guidelines for humanitarian practitioners in the field. These are all operational and do not incorporate the changes throughout the disaster life cycle.

The framework works as a guidance for humanitarian supply chain officers to understand:

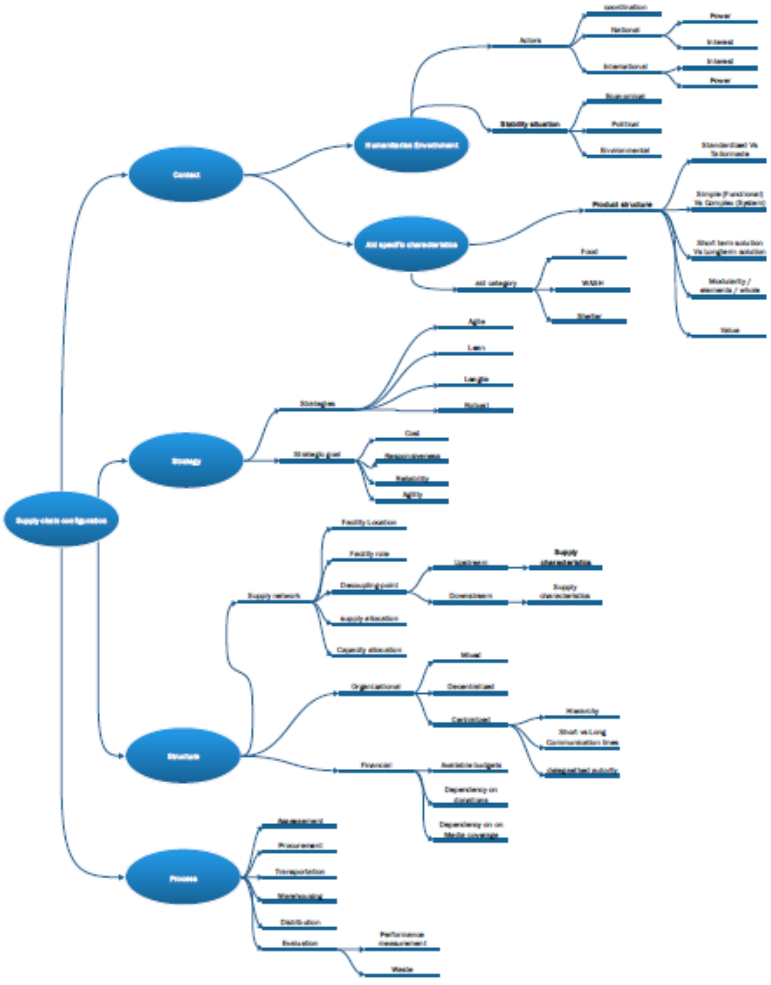
- which aspects belong to the SC configuration and have to be aligned with the disaster life cycle
- which dimensions to monitor and which aspects correlate
- how to go earlier to pull

It will also allow learnings from the best practices and barriers from previous disasters.

The second part of the deliverable (section 5.4) will follow from the first part. It will be a useful decision making support diagram regarding the sourcing process. This will also be useful in the field pocket book of humanitarian practitioners. The diagram will follow from the first application of best practises and findings in section 5.3. It will be created as an if-then-else diagram. The more the first part of the knowledge based framework is enhanced by new best practices and barriers, the more if-then-else diagram can be made to support the decisions of humanitarian practitioners.

This page was intentionally left like this, as the complete skeleton of the knowledge based framework will be inserted as a A3 fold out page manually

Preview



5.3 KNOWLEDGE BASED FRAMEWORK APPLICATION: BARRIERS & BEST PRACTICES

This section gives essential meaning to the knowledge based framework. The best practices and barriers which came up from the non-exploratory interviews are assigned to the branches of the knowledge based framework. This is a useful way for sharing best practices and barriers in order to enable insights on the humanitarian supply chain configuration and the disaster life cycle. Keep in mind that this is an example of how it could look like with best practices and barriers. It might be that a look up table is more clear, developing this further is left for future studies. This framework needs to grow and fully mature by adding more best practices and barriers of different cases. This needs to be an iterative process. The more input the viewer upgrades would be needed regarding the structure. It is possible that some branches are missing from the structure, as only three organization, six interviews are used for the input. When the skeleton is fully matured, the knowledge based framework is eventually to be shared and enable humanitarian practitioners to add their own best practices and barriers. Such a database allows many insight on humanitarian supply chain configurations and the disaster life cycle. An example of an insight and how this could be shared is provided in section 5.4. But first it is time for this section. The sub sub sections are ordered according to the main categories as shown in Figure 31.

*******NOTE THAT DUE TO ANONYMIZATION MANY INPUTS IN THIS SECTION HAD TO BE LEFT OUT*******

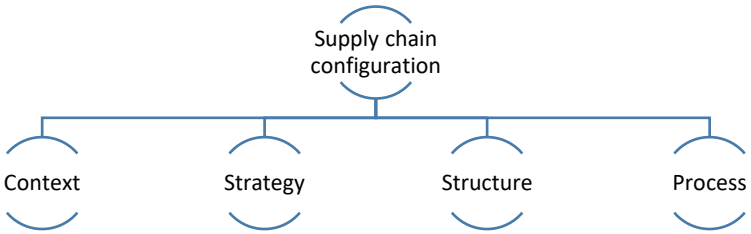


Figure 31 Supply chain configuration definition (Neher, 2013)

5.3.1 Context

Aid specific characteristics

Best practices

- For complex valuable products prepositioning is not advised as these might damage or get stolen. Therefore, Vendor Managed Inventory (VMI) is a good solution.

  Anonymized Organization B has a VMI agreement with Waka Waka: *Waka Waka is a Dutch, social start-up, that develops and sells portable solar lights for commercial purposes. They have a "Buy-one-Give-one" system, this entails that for every sold solar light one is donated for humanitarian aid purposes. Anonymized Organization B has a prerelease agreement with WakaWaka, at any point in time Waka Waka can provide up to 2000 lights for aid purposes. [Appendix B. Anonymized interviewee B.1]*

Humanitarian environment

Bottleneck related best practices

- Geographical challenges can be prepared for by maintaining a strong relationship with local transporters.

Nepal's Geographic challenge: *"Our biggest challenge during the emergency was the geographical challenge. For reaching the very remote area's we had to use mules. Road transport was not possible." [Appendix B. Anonymized Interviewee A.2]*

Bottleneck related barriers

- When lacking contingency plans a lot of money and time can go to waste.

  Huge delay of aid due to fuel shortage due to Indian border block: *"After the emergency phase we got blocked from the government of India. That was a very hard time because, most of the commodities came from India. Even FUEL. There was some political issue that is way they blocked the borders. We were trying to do a lot of work in the reconstruction phase. But we could not do any transport because we did not have fuel. We could not distribute the commodities. We had to pay twice the money. Even one truck was normally 20.000 Nepalese rubies. but during that time we had to pay 36.000 Nepalese Rubies. That situation we will never forget. We did not have fuel, we did have transport services. It was a bad experience. It started from September 2015 to march 2016. During that time we had to work for the office from home. Most of the money went to transport. That is a waste, if we did not get that blockage, that money could have gone to the beneficiary." [Appendix B. Anonymized Interviewee A.2]*

- A pitfall can be underestimating the infrastructure's capacity.

  The road's load-capacity was too weak for the hospital containers: *The case of Ebola, was mentioned as a good bad-example. "there was no good assessment of such a disaster-type, so: everyone sent everything". The Dutch ministry of foreign affairs sent a big ship (Karel Doorman) that was filled with many items which were eventually not used. One of the biggest problems was for example the capacity of the roads. Among the sent goods, hospital containers were sent. These containers were too heavy to be transported by trucks. The roads were not strong enough to facilitate this transport. Therefore, helicopters were needed to transport the hospital containers. Another problem was that the hospital containers had to be used be certified specialized doctors. Only transporting the goods was not enough. [Appendix B. Source: Meeting Stan Klinkenberg (d.4)]*

Actor related barriers:

- Achieving high coordination levels is difficult when the coordinating organizations change

  Coordination: *During the emergency response phase of the Haïti 2010 disaster the American Military was responsible for the coordination of the harbour (port of entry). When they left the chaos started. [Appendix B. Anonymized Interviewee A.1]*

- The country's government might be very proud and therefore be hesitant to accepting international aid. This can result in delayed declaration of emergency situations or very strict customs regulations.

  Control of customs: *In the Case of the Nepal Earthquake of 2015, Anonymized Organization A delivered Waka Waka solar lights. The Challenge in this case was with the Nepalese Customs. Anonymized Organization A is not registered in Nepal as an aid providing organization. They used the Big sister organization's name. The Nepalese customs blocked the import of the lights because another*

sister organization had already imported many lights and they had not yet received the distribution report. The lights had to stay in the customs warehouse until the sister's distribution report was handed in at the customs. These warehouses were not locked / sealed which caused loss of lights. Anonymized Interviewee A.1's explanation for this decision of the Nepalese government was that they wanted to keep control, especially regarding new unknown / unfamiliar technologies. [Appendix B. Anonymized Interviewee A.1]

Governmental control monetary influx: *The government of Nepal accepted international aid (Earthquake, 2015) but demanded that all the monetary influx would go through their account. This rule was set-up because of the excessive corruption problems the country has. By monitoring the monetary influx the government believed they could sustain the corruption. This was a huge problem because humanitarian organizations cannot transfer money to governments. Humanitarian organizations cannot lose the control over their expenses, donors will not accept the resulted lack of transparency. This resulted in great delay of operations for many humanitarian organizations. Luckily Anonymized Organization B had a solution which will be mentioned under the best practices. [Appendix B. Anonymized Interviewee A.2]*

Actor related best practices:

- Engagement with the community creates more knowledge on the needs and customs of a country Having an employee who is native citizen or close cooperation with local organizations is very useful.

Transferring Nepali Employee: *Anonymized Organization B immediately flew in one of their Nepalese employees in order to work in Nepal after the earthquake of 2015. This immediately provided them much information about the stricken country. Having a local employee with knowledge of the country's language, culture and customs is a useful asset. [Appendix B. Anonymized Interviewee A.2]*

Control monetary influx (continued):
Anonymized Organization B is part of the Caritas Network, this is a religious network (Christian). When the Nepali government used their regulations to exert control on the monetary influx, Anonymized Organization B found a solution. Their close relation with the local church gave them enough trust to use their account as "monetary port of entry". This enabled them to dodge the governmental bank account and keep control. [Appendix B. Anonymized Interviewee A.2]

5.3.2 Strategy

Strategies

Barriers all round organization vs one stop shop

- Humanitarian organizations working as allrounders have difficulty balancing with the different load forms:

Balancing between the permanent baseline and peak load is challenging: *"Most humanitarian organization focus on the ongoing conflicts and complex disasters because they are just like their*

permanent baseline. So you will see a lot of the supply networks are actually designed to cover the permanent baseline which is pretty heavy these days, when you look at all the ongoing wars and the refugees that are spread all over the globe. That is basically the global layout of the biggest INGO's networks. And on top of this heavy baseload, which already stretches the system almost to the point that it is breaking, they have to deal with the sudden onset." [Appendix B. Source: Meeting Tina Comes (a.2)]

Barriers push vs pull

- Ebola… Extreme push due to multiple aspects:

The no regrets philosophy strongly followed during Ebola:
The problems with the Ebola Case:

- *WHO had denied for a long time that the Ebola pandemic would be a fact. Therefore, aid was lacking for a long time. When the two cases in the US where discovered, the reaction of all actors was like a sudden onset disaster. "organizations were following a Panic-model."*
- *WHO had forecasted an exponential growth model of the Ebola Virus, but in retrospect we saw a linear growth.*
- *The panic and exponential growth expectation where the reason that all supply chain models where calculated as a worst. This was the case for the calculations of the WHO and Anonymized Organization C*
  - *The tradeoff that had to be made was: how long does it take to scale my supply model up? If that is that takes too much time, it is better to calculate with the worst-case scenario and take the losses for granted. Making the tradeoff was very difficult, especially with the available information.*

[Appendix B. Anonymized interviewee C1,2,3]

Lack of knowledge of such a disaster type: *The case of Ebola, was mentioned as a good bad-example. "there was no good assessment of such a disaster-type, so: everyone sent everything". The Dutch ministry of foreign affairs sent a big ship (Karel Doorman) that was filled with many items which were eventually not used. [Appendix B. Source: Meeting Stan Klinkenberg (d.4)]*

Strategic goal

Best practices

- Having an asset-light organization is useful when the strategic goal is being agile and responsive

The strategic goal of Anonymized Organization C is being Agile and responsive: *It is expected from their clients that they react quickly and have the capacity to quickly scale up. Even though their clients might work on a firefighting base, Anonymized Organization C does not experience it that way. This flexibility means that sometimes the HQ also works in the weekends. They can't say no to their clients. [Appendix B. Anonymized interviewee C1,23]*

Great network of suppliers: *Being able to comply to your client's needs (Client = humanitarian organization or government), means being very flexible. They ensure this by having a clear overview of their capabilities as organization. Clear communication with the client and the network of*

professionals. Last but not least the great network of suppliers. [Appendix B. Anonymized interviewee C1,23]

- A chain is as weak as its weakest link, if your goal is to be fast it is required that your partners are fast too.
  ***Anonymized Organization C's suppliers are judged on delivery time, quality & price**: Performance of suppliers is measured and judged based on: delivery time, quality of goods and product price. These are the KPI's for the performance of the suppliers. [Appendix B. Anonymized interviewee C1,23]*

Barriers

- Balancing between efficiency and effectiveness

  ***Balancing the underfunded reconstruction phase and (over)funded immediate response is a challenge:** "The difficulty is of course that these organizations need to balance efficiency and effectiveness. So most of the ongoing baseload is typically underfunded, Like the conflicts in Africa. The conflict in the middle east (Syria) is getting better funding now. So they push these organizations towards efficiency. Whereas in the response to a natural disaster they will all tell you that everything needs to be in the initial response on effectiveness. Leading then also to a lot of waste that is produced and to a lot of inefficiencies. Just because there is this race for access. just try to get there and to deliver "anything" because anything is needed." [Appendix B. Source: Meeting Tina Comes (a.7)]*

5.3.3 Structure

Supply network

Best practice

- Anonymized Organization A has a Mixed structure with headquarters working as back office support.

  Headquarters as extra support for scaling up: Anonymized Organization A *International is positioned in the US when the country offices are overwhelmed during the emergency response the International office can send a SURGE team that will support the aid-activities.* Anonymized Organization A *international has one warehouse in Dubai with a small quantity of prepositioned emergency supplies. This stock functions only as a back-up in case local procurement is impossible. The country officers can thus ask for support from the international office or other members. [Appendix B. Anonymized Interviewee A.1]*

Barriers

- Balancing a centralized vs decentralized supply chain structure

  ***Prepositioned goods may go to waste:** "the American red cross still has the principle sources to respond to the next Haiti earthquake. They have the ware houses and capacity for that, but of course you also know that there was just one Haiti earthquake, and there were of course also other disasters around but not as big and as extreme. So now they are having the capacity to basically respond for an earthquake that is not happening. So they have idle staff, a lot of goods on their shelves that they have*

to replace every 6 months or so, basically that all goes to waste." [Appendix B. Source: Meeting Tina Comes (a.4)]

Organizational

Best practices

- Humanitarian organizations which have a bigger sister organization use this to their advantage.

Barriers

- When employees have to deal with heavy workloads feedback loops suffer.
  Humanitarian practitioners have heavy workload: *The logisticians on country office level often have a very stretched job, which means they are often over overloaded. This forces them stick to the most important actions and keeps them from reflecting on performances and implementing these findings regarding long term learnings. [Appendix B. Anonymized Interviewee A.1]*

5.3.4 Process

Sourcing

Best practices

- Global sourcing is not supporting the local economy, organization are switching towards local sourcing

  Organization that source globally are being judged*: USAID for example has the slogan: "aid from the American people". They have standard contracts with US-suppliers and distribute these supplies. Even though this is very generous/thoughtful of them, it does not help the local economy. In fact, it makes business for local entrepreneurs even more difficult, because they cannot compete with free distributed supplies. Among other aid workers their slogan is therefore changed into: "for the American people", because their aid-money stimulates the US-economy instead of the aid-needing region. (Source: Kenny Meesters)*

Evaluation

Barriers

- When the workload is high performance measurement is not prioritized

  Anonymized Organization A is not prioritizing learnings from performance measurement due to overloaded employees:
  Anonymized Interviewee A1 stated that the logisticians on country office level often have a very stretched job, which means they are often over overloaded. This forces them stick to the most important actions and keeps them from reflecting on performances and implementing these findings regarding long term learnings. This was backed up by Anonymized Interviewee A.2, who said that they did not have time to measure their performance during the immediate response phase. [Appendix B. Anonymized Interviewee A1 & A2]

  Anonymized Organization A is not prioritizing learnings from performance measurement due to overloaded employees:

"The logistician is usually also procurement and logistics and admin. Or the logistician only does logistics but it is a huge country office and there should actually be three or four. so to put another burden on top of that is hard. I truly understand the importance of performance measurement on process level, but we don't have the systems or the people." [Appendix B. Anonymized Interviewee A1]

Best practices

- Evaluating the performance of the suppliers ensures the quality of your network

  Anonymized Organization C's *suppliers are judged on delivery time, quality & price**: During emergency response* Anonymized Organization C *monitors the delivery time as strict as possible. They evaluate this afterwards, and provide feedback to the suppliers. This is their task; this way* Anonymized Organization C *ensures that the suppliers in their network indeed comply to their standards. Relations with underperforming suppliers will be stopped. [Appendix B. Anonymized Interviewee C 1,2,3]*

- Evaluating your own quality as an organization ensures the quality of your work

  Anonymized Organization C *also measures own performance:* *When* Anonymized Organization C *gets a project they need X days to write a tender. When the Tender deadline is reached, the bids of the competing suppliers need to be evaluated. The Time* Anonymized Organization C *takes to create an evaluation report for their clients, is a KPI for their performance. If this takes longer than a week they are underperforming. When the client has decided which bid they want,* Anonymized Organization C *has to write out the contract. The speed with which they delivers the contract is also a KPI. [Appendix B. Anonymized Interviewee C 1,2,3]*

5.4 FRAMEWORK EXTENSION REGARDING THE SOURCING PROCESSES.

5.4.1 Guidelines for Sourcing throughout the disaster life cycle

The knowledge from this thesis allows creating a preliminary categorization of the upstream and downstream supply chain structures which were created and discussed in section 5.2.3. The downstream part was found to be country specific and the upstream part was found to be organization specific. The downstream part was therefore not further elaborated upon. Selecting which type of upstream supply chain structure is appropriate can also be rephrased as selecting the type of sourcing. The sourcing of goods can be done either locally or globally. Furthermore, these goods are either prepositioned, thus sourced from a warehouse, or procured. Figure 32 summarizes the sourcing categorization that evolved from this insight. Note that in this framework the degree of local or regional is not specified as this would require more details which cannot be verified considering the scope of this research. This conceptual framework is therefore aiming for a high-level description.

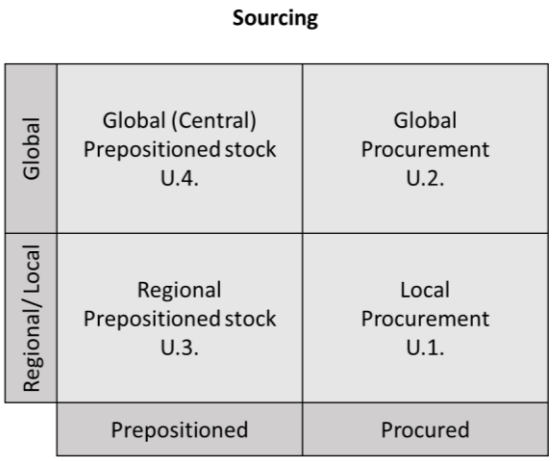


Figure 32 Sourcing categorization

In section 5.2.4 the choices between global and local sourcing and between prepositioned and procured goods was further discussed. Therefore, the main factors will only be shortly mentioned. The choice between local or global procurement was found to depend three main factors: **capacity & stability of the local market**, the **delegated authority of the country officer** (Anonymized Interviewee A.1, 2017) (Ohlsen, 2017) and the **product quality restrictions**. The choice between global or local prepositioned goods is a characteristic of the supply chain structure, the choice depends on the **organization structure** and **product types**.

Guidelines for sourcing

When in the case of a sudden onset nature disaster scenario the sourcing decisions (local vs global, procurement vs stock) need to be made the if then else diagram shown in

Figure *34* can serve as a guideline. Tabel 19 alone is the first categorization to show the different sourcing possibilities. From the best practices and barriers, it was learned that it is important to change the sourcing focus throughout the disaster life cycle. The goal is to procure locally as fast as possible. Therefore, the following frameworks are developed to serve as guidelines for country officers, it helps them to choose which high level sourcing possibility to source from. This overview is made from the supply characteristics of each of these sourcing options and the obtained knowledge on the disaster life cycle. The following section will describe how they work.

Before explaining the framework on a content-level it is important to clarify how the framework should be read. The guidelines are set up as an If-then-else diagram which requires to be read from top to bottom. As shown in the schemes the left-hand part represent the thought process and the right-hand column shows the advised response. The thought process is visualized with blocks which are connected through arrows and gateways. The names of each of the gateways is shown in the legend, **Error! Reference source not found.**. These Gateways are adopted from the Business Process Modell and Notation (BPMN)

methodology. Because this adoption is a high-level visualization only three gateways are selected, which will be described now. Firstly, the flows entering the exclusive gateway exit in minimally two paths which are mutually exclusive. Secondly, the parallel gateway visualizes the paths that continue simultaneously. Thirdly, the inclusive gateway can be best explained as a combination of the previous two gateways. It allows to have only one outgoing flow, but works also in the case of concurrent tasks.

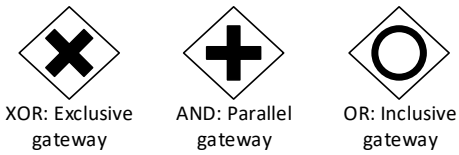


Figure 33 Legend: Gateways

The guidelines for sourcing throughout the disaster life cycle are shown in

Figure *34*. These guidelines are applicable for standardized, functional simple, short term products. For such products think of disaster relief items. These types of products can easily be prepositioned by a humanitarian organziation. In the direct disaster aftermath the fastest solution is needed thus checking the availability of prepositioned goods (U.3) is the first step. If this is not available possibilities for exchanging prepositioned goods and possibilities for procuring locally (U.1) are advised to asses parallel. The if then else scheme indicates the vital steps. Remeber in the direct disaster aftermath speed is paramount. Therefore if both options are possible select the fastest. If time is negligable, or less important as in the later stages of the disaster life cycle, choose local procurement (U.1). As previously explained, local procurement has a positive effect on the beneficiaries. If both are impossible check the following two options parallel: fast track global procurement possibilities and availability of global prepositioned goods (U.4). Follow he if then else scheme for the vital steps. Again when both are possible choose the fastest. If time is negligable, or less important as in the later stages of the disaster life cycle, choose the cheapest. Global sourcing can have large financial consequences. If both options are impossible, the only option of global procurement is left (U.2).

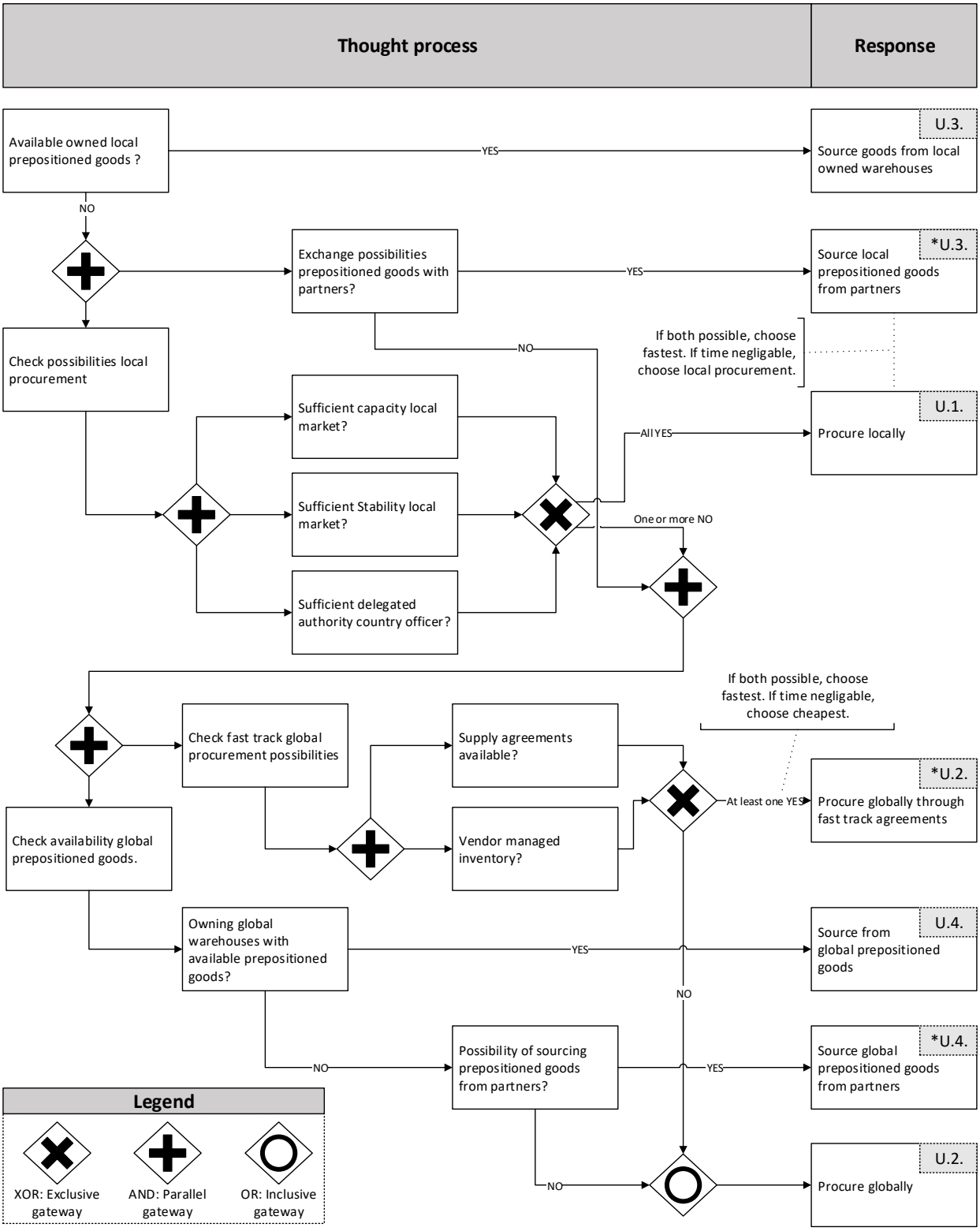


Figure 34 guidelines for sourcing of: Standardized, functional simple, short term products.

Example when applying to the need for Shelter

When applying the guidelines of sourcing to a hypothetical disaster where all houses are detroyed and the local community is in need of shelter as soon as possible, it's functioning could be better understood. When fully developed it can be encorporated in the field pocket book supporting sourcing decisions for the country officer.

As the urgency is high it is important to focus on functionality. As permanent housing would require more investigation in the needs and local infrastructure it is required to start of with standardized, functional simple short term products. In the case of need for shelter this would be tents or shelterkits. Shelterkits are prefered over tents as these are cheaper and all elements can be reused as input when building permanent housing. But this choice can only be made if the luxery of making this choice is present. The if then else diagram with the sourcing guidelines in Figure 32, suggest with starting of checking if local prepositioned goods are available. So if the concerning humanitarian organization has prepositioned tents or shelterkits these need to be sourced from the local owned warehouses (U.3). If these are not prepositioned or the warehouse is destroyed because of the sudden onset nature disaster two other options need to be considered simultaneously. These are the exchange possibilities regarding prepositioned goods of other humanitarian organizations and possibilities for local procurement. If other humanitarian organizations have tents or shelter kits, and are distributing to another region, exchange plans can be made for the concerning humaniatarian organization to distribute in their assigned region. Concurrently the possibility for local procurement has to be investigated. This depends on the stability of the local market, capacitity of the local market, and the delegated authority of the humanitarian practitioner. Now if the delegathed autority is sufficient but the market is destabilized and the capacity is affected, local procurement would not be possible anymore and exchange agreements with other organization need to be made (*U.3). If the required conditions for local procurement (U.1) are also met the duration of sourcing needs to be compared in order to select the fastedt sourcing possibility. If time is negligable local procurement is prefered as this would be benificial for the local economy and the beneficiaries. If both options are impossible it is needed to look for two other options, fast track global procurement possibilities and availability for global prepositioned goods. Fast track procurement can only be done when these agreements have been prepared for, these could be supply agreements of vendor managed inventory (*U.2). Global prepositioned goods can only be sourced if the concerning humanitarian organization has the supply network structure with warehouses (U.4). If not prepositioned goods from partners can be sourced by making exchange agreements (*U.4). The last thing to try is procuring globally (U.2).

As was found in chapter 4, the upstream supply chain structure is organization specific. This can also be seen from this example regarding the sourcing guidelines applied for shelter. If the humanitarian organization does have their own warehouse structure many aspects would fall of. It is therefore advised that future studies create these sourcing guidelines with for different types of humanitarian organizations. Also other product categories are required to further investigated.

5.5 CHAPTER CONCLUSION

The objective of this chapter was to answer the third sub question: Which crucial characteristics need to be monitored for an aligned supply chain configuration throughout the disaster life cycle? This was done by developing a knowledge based framework that enables deeper understanding of the possible humanitarian supply chain configurations. The main categories of this knowledge based framework are: context, strategy, structure and process.

- Context: Provides the aspects that need to be dealt with
- Strategy: The approach that is chosen to deal with the context
- Structure: The way the realizing the approach is facilitated
- Process: The steps that need to be taken

This knowledge based framework is to be filled with new barriers and best practices that are encountered by the humanitarian community. This will eventually create an ever-growing database with best practices and barriers for the humanitarian sector to learn from. Such a database could be shared online for the complete humanitarian community. A summarized version would also be useful in the field pocket book of humanitarian practitioners.

For understanding how this would look like the main take outs from the semi structured interviews are implemented and this allowed developing a useful decision making support tool regarding the sourcing processes throughout the disaster life cycle. This will also be useful in the field pocket book of humanitarian practitioners. The tool is created as an if-then-else diagram. The more the first part of the knowledge based framework is enhanced by new best practices and barriers, the more if-then-else diagram can be made covering other decision processes.

By creating the first part of the knowledge based framework, the crucial characteristics of a humanitarian supply chain configuration are identified. But these are not yet clearly separated per process. The second part of the framework, the decision support tool shows exactly which crucial characteristics need to be monitored for an aligned sourcing process throughout the disaster life cycle. This is the first step towards an aligned supply chain configuration. Further research is required to develop other trustworthy decision support tool.

6 FINDINGS & DISCUSSION

This chapter will discuss the findings of this research. As most of the findings touch upon common themes the findings are categorized as followed. Firstly, the main findings regarding the decision support tool will be discussed. Secondly, the findings regarding the push pull transition are discussed. Those findings are visualized by adapting the Fritz institute diagram discussed in section 4.4.1. Thirdly, additions for the developments and trends, previously discussed in section 3.3, are discussed. Fourthly, additions regarding the barriers and challenges, previously discussed in section 3.4, are discussed. Lastly other findings are discussed. This enumeration entailed an overview of section 6.1. Section 6.2 will provide a discussion of the findings and deliverable.

6.1 FINDINGS

6.1.1 Sourcing

In section 5.4 an if then else diagram was made for decision support regarding the following sourcing decisions: Global vs local and prepositioned vs procurement.

The global vs local decision can be shown by considering the matrix of Lee (2002). According to Lee (2002) knowledge on the demand uncertainty & supply uncertainty allows to decide which type of supply chain fits best with the situation. When translating this to the humanitarian world, there is one important aspect that needs attention. For the humanitarian world the difference between global and local sourcing is big. Local sourcing is preferred because this support the local economy. Thus there needs to be a distinction between global and local supply uncertainty. It is found that the possibility of local sourcing depends on two aspects: the maturity / stability of the local market (Anonymized Interviewee A.1, 2017) and the delegated authority in the country office (Ohlsen, 2017). If the market is not stable there will be little to no product availability, plus the suppliers will be more expensive since the demand will be higher than the availability of the local market. If the delegated authority is low, the country offices will not have enough monetary resources to buy for a significant amount of products. So, when these criteria are not met it is better to source globally. It was also found that as the disaster life cycle progresses the humanitarian supply chains becomes less important. The beneficiary should be central and for them to be prosperous it is needed to use sustainable locally sourced products. The need for products then transitions to knowledge for learning to be self-sustaining again.

6.1.2 Push vs Pull

It was found that uncertainty and urgency in the direct aftermath of disaster is very high. The need for acting quickly is enormous, even though the required information is not yet obtained. Therefore, supplies are indeed pushed in the first few weeks after the disaster, this is based on the disaster specifications and the knowledge of the country.

As was found push of supplies can result in oversupply of certain goods which can cause congestion of the system. This caused the initial thought to be that pushing supplies without knowing the exact needs is something that needs to be stopped. But this research found that push is not necessarily bad. In the Ebola case Anonymized Organization C got a request of the British government to supply certain products and manage their warehouses. The main objective was “no stock out”. This created left many products that

where unused. But the people at Anonymized Organization C stated that this cannot be considered as waste because these products where stocked and used in later stages. What we can learn from this is that excessive push is not necessarily waste, as long as the products can be used in a later stage. Of course it depends on the difference between the needs and the sent goods. If a batch of used teddy bears is sent to a refugee camp where refugees with the average age of 45 live, it is waste (yes this has happened).

As was explained in the previous section the humanitarian supply chain becomes redundant. Therefore, it is important to keep the push as minimal as possible. This is also more resource efficient.

From the Frits Institute matrix it shows that having a longer response time and a lower level of uncertainty allows decreasing the push phase, Figure 35. The left matrix shows the original matrix, and the right matrix is adapted by minimizing the push phase. As minimal push means extra focus on information streams the first thing that is needed is owning a robust information system. Information systems of humanitarian organizations have a much room for improvement (Comes, 2017).

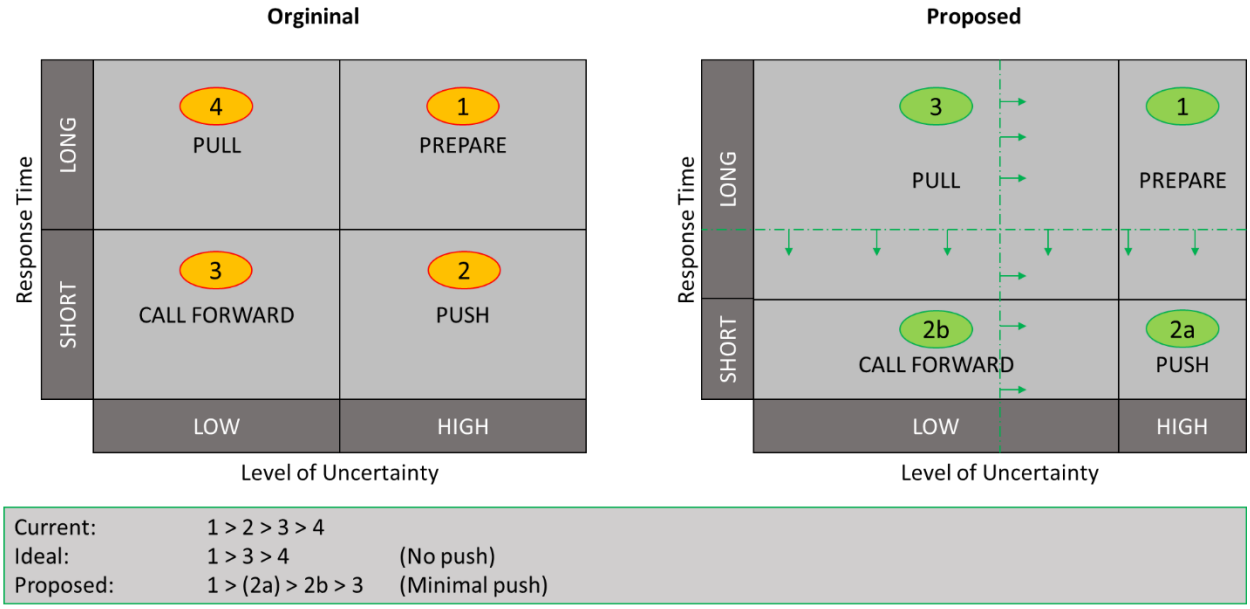


Figure 35 How eventually the flow should go (Adapted from Fritz Institute)

The second requirement is increasing the response time, Figure 36. This can be done by the following measures:

- Increasing preparedness
- Increasing resilience
- Increasing mitigation
- Decreasing supply time
- Increase coordination

Note that these measures are all measures that have to be executed in the preparedness phase. Only the last proposed measure for increasing the response time is something that can be done during disaster relief. This could result in shared shipments or sourcing from partners' prepositioned stock. But even increasing coordination is more effective when done prior to the disaster. So unless the accepted number

of fatalities increases, which is unacceptable and will never happen, **investments in preparedness are needed.**

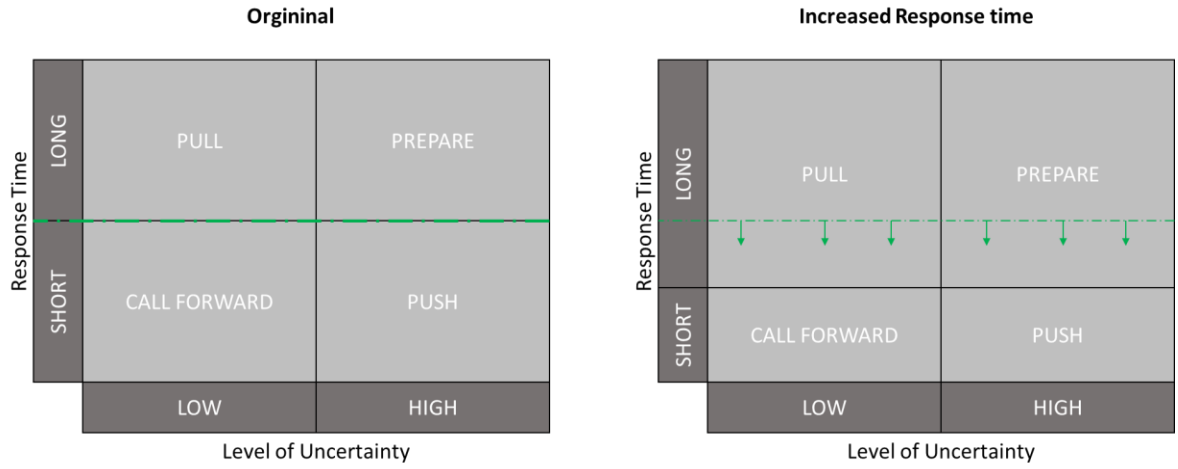


Figure 36 increase response time

The third requirement for decreasing push is decreasing the level of uncertainty Figure 37. During this research it was found that this means decreasing demand AND supply uncertainty.

For decreasing the demand uncertainty:

- By increasing preparedness, creating scenarios of what might happen and creating contingency plans. Preparedness does not necessarily mean prepositioned stock, it can also mean creating pre-supply agreements or vendor managed inventory.
- By increasing/speeding up relation with local community (trend)
- Keep communication lines up to standard in order to receive information of changing events (such as aftershock) asap.

For decreasing the supply uncertainty:

- By increasing preparedness, not necessarily prepositioned stock! (VMI, supply agreements, etc.)
- Creating scenarios of what might happen and creating contingency plans. This enables a robust supply network that can
- Using Standard operating procedures that allow for immediate action
- Increasing preparedness

For decreasing the uncertainty also most of the measures are required to deal with in the preparedness phase. Furthermore, most of these improvements require investments in the systems and procedures of humanitarian organizations. It was found that donors prefer donating to goods that are tangible and visible, rather than investing is system improvements (Van Wassenhove, 2006). Therefore investments in the preparedness phase are minimal even though a recent study of Boston Consulting Group in cooperation with WFP showed that **one dollar spent in preparedness equals three dollars spent in immediate response** (Kovács et al., 2016). Therefore, it is crucial that awareness for the importance of preparedness activities increases, especially among the donors.

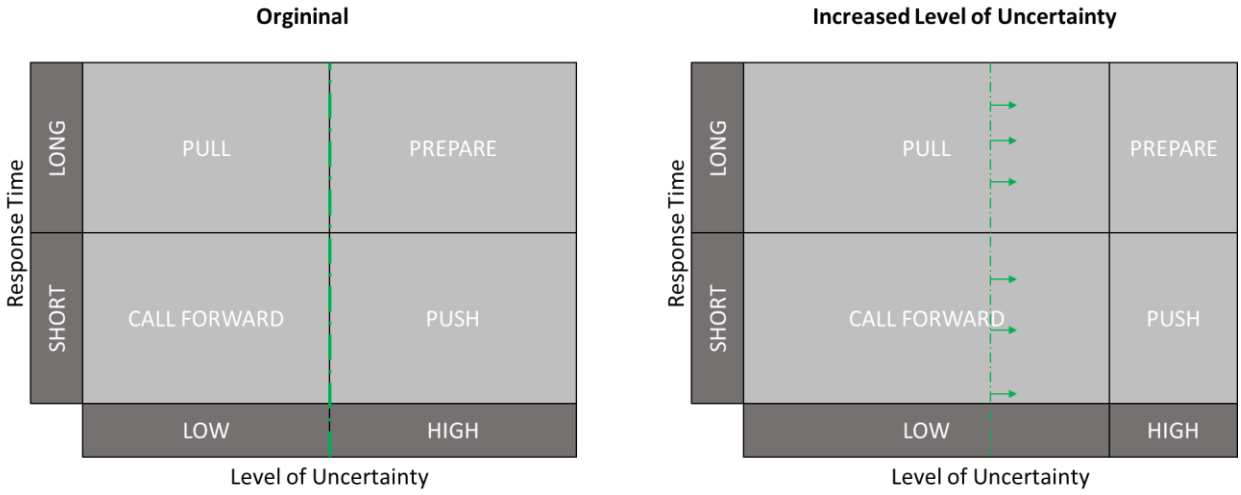


Figure 37 Decrease level of uncertainty

6.1.3 Additional findings regarding Developments & trends

One of the trends that was clearly visible when analysing the interviews was the development towards beneficiary centred aid provision. This means incorporating the local community as soon as possible in order to provide solutions which are in line with the culture and habits of the local community. This allows a more sustainable way of providing aid as the acceptance of the local community is ensured. "Throughout the disaster life cycle there is trend towards sustainable way of providing aid. Therefore, local procurement and beneficiary aid is growing" (Anonymized Interviewee A.1, 2017).

An example of this development is can be shown with Anonymized Organization B owner driven housing projects (Anonymized Interviewee B.1 , 2017). During these projects the development of the houses in the reconstruction phase is done in cooperation with the beneficiaries. The beneficiary becomes responsible for building the house and Anonymized Organization B provides aid with creating the building plan. This way Anonymized Organization B does not have cater the building material, these can be sourced by the beneficiaries and fit the local traditions. Funding is provided phase after phase throughout the building process, as the requirements are met. This process is very useful as the beneficiaries learn more about building earthquake proof.

6.1.4 Additional Findings regarding barriers and challenges

It was found that humanitarian practitioners often have a stretched job which is overburdened. The pressure is very high and the circumstances of these people are hard. With the limited resources to allocate, it is paramount to for them to prioritize, pushing performance measurement into a secondary position.

> "The logistician is usually also procurement and logistics and admin. Or the logistician only does logistics but it is a huge country office and there should actually be three or four. So to put another burden on top of that is hard. I truly understand the importance of performance measurement on process level, but we don't have the systems or the people." (Anonymized Interviewee A.1, 2017)

As was found in section 3.3, the need for a cultural and mentality shift among humanitarian practitioners is confirmed. The aversion towards performance measurement needs to be met by improving the understanding of the opportunities. Some humanitarian practitioners think being efficient is only for commercial companies such as large super market chains. Other researchers had found a large aversion towards performance measurement amongst humanitarian practitioners, "we are not Needle" (Comes,

2017). Furthermore, understanding of the influences of the changes throughout the disaster life cycle need to be learned. The humanitarian practitioners I spoke said the phases of the disaster life cycle are not important for them. They explained it is only important for governments as they link certain values such as weakness and power to certain phases. They explained that they just help where needed, but the understanding that the phases actually do affect the best way they can arrange their processes and operations was missing.

6.1.5 Other findings

It was found that the financing structure influences the preparedness expenditure. When humanitarian organizations have a project based financing structure, the funding arrives in the immediate response phase. Preparedness activities cannot be funded with such a structure unless there is an extra budget for preparedness expenditures, which is often minimal. Another issue with project based financing is that the financing can be done for only the immediate response phase, causing the expenditures to be focussed on short term solutions instead of long term (Anonymized Interviewee B.2, 2017).

It was found that each product category has their own evolution throughout the disaster life cycle, this was discussed in section 4.2.2. How these transitions exactly take place needs to be further investigated in future studies. This cannot be pinpointed exactly, but it is found that at least three transitions through the disaster life cycle take place in general. Firstly, the transition from standardized to tailormade solutions. Secondly, the transition from Functional and easy to use products to complex systems that require education and or installers. Thirdly of course the start of the short-term solutions which eventually turn into long-term solutions which are more sustainable.

Supply chain performance measurement in the humanitarian sector is underdeveloped. There is much room for improvement. Performance measurement and documentation in the procurement phase and the delivery phase are done well because of the transparency requirements of the donors. Thus the documentation and measurement in the beginning and the end of the supply chain is done, only the in-between steps are missing.

6.2 DISCUSSION

6.2.1 Discussion of findings

This thesis has shown that humanitarian sector has a complex and dynamic environment. It is therefore very important to keep in mind that each disaster is different. The diversity of actors in the humanitarian sector also makes that no supply chain configuration is the same. When and how exactly supply chain configuration have to transition regarding the changes throughout the disaster life cycle cannot be said. But the most important aspects affecting these changes are found through this exploratory study. These are very useful as these aspects affecting the transitions can be used to get more insight on the sliding scale. The exact milestones and indicators are to be further developed in future studies. The findings from this thesis are therefore not applicable to each case, but the holistic approach allows for finding commonalities regarding the transitions throughout the disaster life cycle. The findings are based on; desk research; general information regarding the field form experts; best practices & barriers of two humanitarian organizations and one commercial supply chain service provider for the humanitarian sector. This has allowed for general findings regarding supply chain configurations throughout the disaster life cycle.

Keep in mind that the findings regarding the need for preparedness, resilience and better information systems is not necessarily new this has been discussed in literature. The fact that the empirical findings of this study confirm this can be seen as an indication of the urgency of this matter. The unique point of view of this research can be found in the finding that the needs change throughout the disaster life cycle. This means that instead of focussing on the time to get an indication of the transitioning phases. One has to focus on the changing demand for products and services. Furthermore, the supply and demand uncertainty need to be taken into account for the supply chain configuration. When combining this with the strong empirical findings, it is safe to say that this exploratory research has pin pointed crucial points of improvement for humanitarian supply chain configurations.

6.2.2 Expected functionality of deliverables

The knowledge based framework is now filled up with best practices and barriers the contacts from Anonymized Organization A, B & C. This allowed for drawing up sourcing guidelines in the form of an if then else diagram. When the knowledge based framework is fully developed it allows for more detailed guidelines or guidelines for other processes.

Because of the complexity of the humanitarian environment the knowledge based framework needs to grow and mature over time. When fully developed it can work as guidance for humanitarian supply chain officers to understand which aspects belong to the supply chain configuration and need to be aligned with the disaster life cycle. This creates insights on which dimensions to monitor in order to have more effective and efficient aid. The eventual purpose would be to store it on an online open-access database such as humanitarianresponse.info or reliefweb.com. This would allow other humanitarian practitioners to add their own experienced best practices and barriers. Some entity should then become responsible for the updates and awareness. As discussed in section 203.3, knowledge sharing platforms (such as: humanitarianresponse.info or reliefweb.com) are growing these could govern this as a global platform. The final knowledge based framework could also be governed by a University, but since the online humanitarian websites are already known by a broad humanitarian public this might be a logical choice. Especially when considering that right after publishing, the quality of the framework depends on network externalities. This means that the more people join the knowledge framework the better the framework would work as the input would grow fast. This would work up to a saturation point where all the best practices and barriers of all combinations are stored. How the lay-out of the webpage would work is left out of the scope of this thesis. But one could imagine a special search engine with catchwords that will provide the possibility to diverge to the learnings from best practices and barriers applicable to the case at issue.

The more the knowledge based framework is filled the more guidelines can be developed for humanitarian practitioners to align their supply chain configuration with the disaster life cycle. When these guidelines are fully developed, these can be incorporated in the humanitarian field pocket books of humanitarian organizations. These handbooks are up till now not discussing how their processes and operations should transform throughout the disaster life cycle. When country officers do not have support from the international office or these guidelines can be consulted. This is very useful for humanitarian organizations as the semi structured interviews with Anonymized Organization A & B both showed that they do not have SOP’s and they do not take the phases of the disaster life cycle into account. One of the interviewees even said that the phases throughout the disaster life cycle are not that important for them. He explained it was only important for governments and certain organizations which attach certain values

of power and weakness to the phases. This influences them in deciding when to work. What I found is that it actually is important for the humanitarian organizations as well, because it affects the way they should work. My thesis contributes to this understanding by providing guidelines that indicate different set ups of the supply chain configuration. Keep in mind that the phases throughout the disaster life cycle are a sliding scale and not a clear-cut transitioning. Therefore, these guidelines provide indications of transitioning in the form of milestones and points of attention for the humanitarian practitioner.

The if then else diagram that works as guidelines for strategic sourcing throughout the disaster life cycle is for now only developed for standardized, functional simple, short term products. Further development on such guidelines would entail customized, complex, long term products. This could also allow for guidelines and S.O.P's on other processes than sourcing. Further development regarding other levels such as tactical and operational also can be further elaborated upon.

Even though the two presented concepts are to be further developed before being fully functional, in combination with the academic literature review and empirical findings they have created a stepping stone for future studies to excel the humanitarian field.

7 CONCLUSION, REFLECTION & RECOMMENDATIONS

This final chapter of the thesis will provide the conclusion by reflecting on the posed research questions. These will be answered leading to the answer of the main research question: *"How can humanitarian supply chains, in a sudden on-set nature disaster, be (re)configured to adapt to changes over the disaster life cycle?*". Furthermore, the complete process of writing the thesis, including the choices and personal role will be reflected upon. Finally, the recommendations section list the suggestions for future studies. Some recommendations will also be provided for Delft University of technology and Argusi, regarding developments in the humanitarian sector.

7.1 CONCLUSION

This exploratory research is executed to answer the **main question**: How can humanitarian supply chains, in a sudden on-set nature disaster, be (re)configured to adapt to changes over the disaster life cycle? In the beginning of this study three sub questions were asked to guide the research towards answering the main question. By answering the sub questions this section will eventually conclude this research with the answer for the main question.

The **first sub question** is: what is the current state of humanitarian aid? It was found that the humanitarian sector has grown enormously the last decades resulting in professionalization more academic attention. Unfortunately this is still insufficient to solve all the problems, therefore there is still a lot of room for improvement.

The **second sub question** is: How do the changes throughout the disaster life cycle affect the humanitarian supply & demand? The humanitarian demand is formed by the needs, these are firstly for safety, security and basic needs which evolve into the need for a self-reliant, independent, sustainable community. How the humanitarian supply is shaped can be categorized with two factors: organization specific and disaster context specific factors. The organization specific factor is set up by the certainty of funding and the supply network. Certainty of funding can for example be influenced by media attention. How the fast track procedures are put up also plays a big role. The supply network enables the supply, each of the links in this chain is needed. The disaster context specific factors are the ones the humanitarian organization needs to deal with. This results in bottlenecks in the supply network and the urgency & uncertainty of the situation. Bottlenecks might be: congestion of warehouses due to unsolicited donations, destroyed infrastructure and damaged entry ports (harbours, airports, etc.). The urgency of the situation also influences the supply, as time is lives saved. Uncertainty of impact, magnitude location and timing also influences the supply. Because the nature of the humanitarian context changes throughout the disaster life cycle, it affects the demand uncertainty, this causes ineffective demand and supply matches. Having this said the most important characteristics to describe the humanitarian demand are: urgency, uncertainty, volume and variety. For supply it is urgency and uncertainty. The obtained knowledge allows a holistic overview of all the demand & supply characteristics and how they globally change through the disaster life cycle is shown in Tabel 15 & Tabel 16 respectively. These findings are based on the interviews and literature.

The **third sub question** is: Which crucial characteristics need to be monitored for an aligned supply chain configuration throughout the disaster life cycle? Answering this sub question was done by developing a knowledge based framework that enables deeper understanding of the possible humanitarian supply chain configurations. The main categories of this knowledge based framework are: context, strategy, structure and process.

- Context: Provides the aspects that need to be dealt with
- Strategy: The approach that is chosen to deal with the context
- Structure: The way the realizing the approach is facilitated
- Process: The steps that need to be taken

This knowledge based framework is to be filled with new barriers and best practices that are encountered by the humanitarian community. This will eventually create an ever-growing database with best practices and barriers for the humanitarian sector to learn from. Such a database could be shared online for the complete humanitarian community. A summarized version would also be useful in the field pocket book of humanitarian practitioners.

For understanding how this would look like the main take outs from the semi structured interviews are implemented and this allowed developing a useful decision making support tool regarding the sourcing processes throughout the disaster life cycle. This will also be useful in the field pocket book of humanitarian practitioners. The tool is created as an if-then-else diagram. The more the first part of the knowledge based framework is enhanced by new best practices and barriers, the more if-then-else diagram can be made covering other decision processes.

By creating the first part of the knowledge based framework, the crucial characteristics of a humanitarian supply chain configuration are identified. But these are not yet clearly separated per process. The second part of the framework, the decision support tool shows exactly which crucial characteristics need to be monitored for an aligned sourcing process throughout the disaster life cycle. This is the first step towards an aligned supply chain configuration. Further research is required to develop trustworthy decision support tools for the other processes.

Now the three main questions have been answered, it is time to answer the **main question**: How can humanitarian supply chains, in a sudden on-set nature disaster, be (re)configured to adapt to changes over the disaster life cycle? This can be done by creating full understanding of what a supply chain configuration is and what affects its performance. This means: full understanding of the changes throughout the disaster life cycle are needed, full understanding of the supply & demand characteristics and understanding which factors are supply chain design factors and which are situational. It was found that the answer to the main question depends on the process and product category. The decision support tool answers the main question exactly for the process of sourcing. Decision support tools for the other processes will be the next step.

7.2 RESEARCH CONTRIBUTION & ACADEMIC REFLECTION

7.2.1 Contribution

This exploratory research on the transition of supply chain configurations throughout the disaster life cycle has found rich empirical findings as presented in chapter 6. The practical contribution is the applicability to the humanitarian field pocket book. This results in a great social impact because: “Decision making in humanitarian operations is usually based on intuition and experience which are not always sufficient to fully understand the global impact of these decisions.”(Besiou et al., 2011, p. 78). Because 60 to 80 percent of the total humanitarian aid costs are logistics and supply chain costs (Blecken et al., 2010), the knowledge based framework and decisions support tools could have a big impact on the expenditures and reduce the funding gap.

The academic field has not yet fully grasped the supply chain structure and philosophy transitions present in the immediate response phase of humanitarian disaster life cycle. This thesis has provided insight for humanitarian practitioners to understand that the changes throughout the disaster life cycle are import sets of information that need to be used. For the academic field the empirical findings of this thesis could be used as input.

More knowledge on this field will also yield a business impact. In some cases it is proven that the humanitarian sector has gained more experience than the commercial and military field (Charles et al., 2010). This in contrast to the statement on how the developments in the humanitarian sector are lacking in section 1. It can be concluded that is all not that black and white. As stated by many authors (Van Wassenhove, 2006; Charles et al., 2010; Kovács & Spens, 2007), cooperation and knowledge sharing is key. Many coordination and knowledge sharing platforms are being developed. Therefore, this study will eventually also contribute to the commercial field. In the commercial field it is the product life cycle that influences the demand characteristics. The demand is unstable and volatile when a product is recently introduced to the market. This stabilized through time as the product matures. The supply chain objectives are therefore also influenced and need to cope with the changes.

7.2.2 Reflection

This section will provide the opportunity to reflect on the thesis process. The research and methods will be first reflected on. This will be followed by a reflection on the design aspect of the thesis. Finally, a personal reflection will be provided regarding the process.

Research

One of the most notable achievements of this research is the number of interviewed experts. The availability of data and cooperative humanitarian organizations was one of the expected pitfalls but this was not the case at all. The opportunity that was created to interview as many people from all over the world has enriched and completed this thesis in such a way that it can be considered as a very strong point. The interviewees were approached from the network of Argusi Aid and Prof. dr. B.A. van de Walle (Head of the graduation committee). As discussed in section 2.4.4, the **semi structured interviews** were categorized as exploratory and non-exploratory.

The **exploratory** semi structured interviews were the ones with the academics. The academics were: Tina Comes, Kenny Meesters, Martin Ohlsen & Bas Groothedde. An overview of these interviewees is given in Tabel 23. Reflection regarding the usefulness of the interviews is also written in this tabel, where the interviewees are ordered from most valuable insights from to least applicable insights.

Tabel 23 Reflection exploratory interviews

Name	Function	Organization	Reflection	Meeting
Tina Comes	Professor Centre for Integrated Emergency Management (CIEM)	University of Agder & Delft University of Technology	Advisory conversations & semi-structured interview. Approachable and her experience and knowledge was very applicable regarding supply chain configurations and the humanitarian field.	Face2Face & Skype-call
Kenny Meesters	PhD Social media in Humanitarian Aid	Delft University of Technology	Advisory conversations & semi-structured interview. Very helpful for creating understanding of the humanitarian sector (network, demand & coordination). No specific supply chain input.	Face2Face & Skype-call
Bas Groothedde	Co-founder of Argusi & PhD on supply chain partnerships and network design	Argusi	Advisory conversations and useful brainstorming sessions by reflecting through a commercial supply chain perspective.	Face2Face
Martin Ohlsen	Professor & emergency coordinator	World Food Program	Short exploratory conversation where it was found that the applicability of his knowledge was either not applicable or leading to saturation of knowledge in chapter 3.	Skype-call

The **non-exploratory** were with the humanitarian practitioners and service providers, these provide experiences from their organizations and insights regarding their supply chain configuration. These are anonymized due to privacy reasons. The organizations that were covered were called Anonymized Organization A, B & C. Organization A & B are humanitarian organizations and organization C is a commercial company providing supply chain and procurement services in the humanitarian sector. An overview of the interviewees is given in Tabel 24. Reflection regarding the usefulness of the interviews is also written in this tabel, where the interviewees are ordered from most valuable insights from to least applicable insights.

Tabel 24 Reflection non-exploratory related interviews

Name	Function	Organization	Reflection	Meeting
Anonymized Interviewee B.2	Shelter Expert, Commercial Logistics, entrepreneur innovative shelter product	B	Very useful insights as he is very experienced in the humanitarian and commercial supply chain sector.	Face2Face
Anonymized Interviewee B.1	WASH Expert, Logistics, coordination	B	Very useful insights as he is very experienced in the humanitarian sector both in the field and on the headquarters.	Face2Face
Anonymized Interviewee A.1	Logistics Manager, Emergency and Humanitarian Assistance	A	Useful contact providing useful insights regarding organization A. Responsible for the logistics support of many A-members.	Skype-call
Anonymized Interviewees C.1,2,3	Logistics managers & procurement officers	C	Interesting insights were achieved by incorporating the perspective from commercial service & logistics providers in the humanitarian sector. But when staying strict on the scope this could have been left out.	Face2Face
Anonymized Interviewee A.2	Logistics officer Nepal	A	Difficult interview as the connection was not very steady. The operational/ tactical position of this interviewee did not allow for understanding of high conceptual terms.	Skype-call

The conversation with Anonymized Interviewee B.2 covered both exploratory and non-exploratory topics. This was a very valuable interviewee as he has had supply chain experience in the commercial sector (for a large Dutch supermarket), has worked at anonymized organization B as Shelter expert. He also had experience with another large humanitarian organization. This was also the longest interview as it took almost two hours. This is also the reason why in the main take outs only with this contact the design criteria are noted.

As Anonymized Interviewee A.2 has an operational/ tactical role it was found that many questions regarding changes throughout the disaster life cycle and shifting supply chain objectives were difficult to discuss. It was very interesting to compare the contrast between the interview with Anonymized Interviewee A1 & A2. International office versus country office and the level of responsibility was also different. Both contacts gave very interesting insights.

When starting the research, it was kept in mind that head quarter and field insights provide different perspective and are both important. In retrospect, this insight was also needed to be applied when preparing the questions. For future studies it is advised to adapt the questions to the interviewee. It is also strongly advised to opt for face2face meetings as these strongly ad to the quality of the conversation.

The learnings from the interviews allowed for valuable information. Because of the number of interviewees and all interviewees provided overlapping insights it was possible to ensure nonbiased insights. Furthermore, by working systematically with the main take outs it was aimed to come to findings which are nonbiased. Nonetheless it must be kept in mind that personal bias is never zero.

If this research were to be continued it is advised to also interview surge-team members. As previously explained in chapter 5, surge teams are emergency response experts that fly over when a country office is overwhelmed. It is expected that their speed and efficiency provides a wealth of learnings that can be applied. Furthermore, understanding when they decide to leave could also provide more indications of the transition from immediate response to the reconstruction phase. As was discussed in section 6.1, humanitarian organizations do not take the shifts throughout the disaster life cycle very much into account, they seem to see it as: “just another label”. Keep in mind that this is not an attack on them as they do the best they can do in very hard circumstances.
Even though this study has shown that the disaster life cycle does indeed affect the alignment with the supply chain configuration. Including the perspective of surge teams into the next steps of this study would add to the generalizability of the results.
Furthermore, it has to be mentioned that for this research instead of interviews the anthropologist’s perspective would have been a good method as well. Especially because humanitarian practitioners do not have a habit of working with academics. Going native following, and asking why certain decisions are made would. Such a research method would allow a more in depth perspective of one specific case. The anthropological method would take significantly more time. As this research had an exploratory goal the interviews (face to face and via skype) where easier to be able to collect multiple perspectives and examples.

Finally, the transitions throughout the disaster life cycle need to be discussed, because full understanding of this concept is crucial for this thesis. As this concept is not tangible and very complex this thesis has pinpointed the importance and created a stepping stone for future studies to further investigate it. A major contribution to the complexity is caused by the difference between the reality and our framework. The reality in the humanitarian sector is much messier due to the uncertainty, urgency and limited resources. Also, because the transitions throughout the phases of the disaster life cycle are not hard transitions but a sliding scale. The transition from immediate response to reconstruction does not happen from one day to the other. Plus, these transitions are dynamic, the transitions can also go back and forth, it depends on the disaster. Ebola was for example constantly moving back and forth from emergency response to reconstruction. Every time a new patient was identified the disaster relief activities were enacted. The effects from a disaster could also have a piling effect increasing the urgency even more. An example for this could be when floods cause landslides.

Design

This research has an exploratory focus on humanitarian supply chain configurations throughout the disaster life cycle of a sudden onset nature disaster. The research has been principally qualitative to get a first insight of humanitarian supply chains and its field. Therefore, is was chosen that the designed deliverables are in a conceptual state. Additionally, work is important to think of more point by point elaboration and development. When the knowledge based framework is further developed as an accessible database that can be enriched by worldwide barriers and best practices many innovations are expected. The if then else diagram that was developed regarding the guidelines for sourcing throughout the disaster life cycle, is a first preview of the possibilities. Further development could lead to more standard operating procedures resulting in another step towards efficient and effective humanitarian supply chain configurations aligned to the disaster life cycle.

The first set up of the conceptual knowledge based framework was made sketched manually and continuously improved. This process is not fully described as it grew organically. If this research is repeated other researches might come up with a slightly different setup, as personal approach is also an important factor. But I do believe that the essence will be the same.

Research methods

The limitation is created by the scope of project, only analyzing the sudden onset nature disasters leaves out many other disaster types. Furthermore, only material and information flows were considered. Therefore, the financial flows were not studied. From the interviews the financial flows turned out to play a paramount role. They are therefore slightly touched upon and incorporated in the framework. Further development of this aspect is advised for future studies.

Throughout the research the scope has changed quite some times, this is an indication that the scope of the thesis was initially put up too broadly. This mistake has not affected the research quality negatively as it has contributed to a better understanding of the humanitarian context. Even though I strongly advice that future research will be scope properly in order to obey the time limitations of the thesis.

Personal reflection

I have learnt that my curiousness for the topic and the willingness to provide a significant contribution to the humanitarian sector was sometimes acting as a hurdle regarding the timely progress. The more you learn the more you realize how much there is to learn. It was a beautiful learning experience to realize that as a master student you can only do so little. There is so much more to discover and so much more to learn. The process of this thesis was not easy for me, but I am very happy that I am fortunate enough to have had the opportunity to prove myself in this way. Especially because this thesis has made me even more intrigued in the topic of humanitarian supply chains.

7.3 RECOMMENDATIONS FOR FUTURE STUDIES

Because of the holistic view that was aimed, many issues came up the surface which had to be kept out of the scope. Nevertheless, there was enough evidence found in order to believe that further research is paramount in these fields. Therefore, this section will sum up some of the suggestions for future studies. The first part of these ideas is related to elaborations on the content of this thesis. The second part contains some broad suggestions for other areas which seem to be missing attention. On that note, this section ends with some suggestions on how Delft University of Technology and Argusi can contribute to these future studies.

7.3.1 Recommendations on elaboration of current study

This research was qualitative, quantifying the relation of the disaster life cycle with the supply chain configuration might even provide more learnings. Also investigating other cases and expanding the research regarding disaster types other than sudden onset nature disaster can be elaborated upon.

As explained the conceptual knowledge based framework is an ever-growing concept. The more barriers and best practices are added the more, the more the branches of the framework mature to a complete representation of a humanitarian supply chain configuration. When the framework is completely matured, the method of visualization needs to be further elaborated upon. As previously discussed this is expected to be in the form of a lookup table with key terms allowing to find relevant best practices and barriers regarding supply chain configuration aspects. The goal of the matured knowledge framework would be to allow for more understanding regarding the (re)configuration of humanitarian supply chains throughout the disaster life cycle. An example of how this could be, is shown in the if then else diagram that is the second conceptual design of this thesis. It visualizes the found SOP's regarding the sources process for standardized, functional, simple and short term solutions. Future studies are needed to further develop this regarding lower level processes and processes other than sourcing. The version presented in this thesis is the first version which needs to be tested with more cases in order to ensure generalizability.

As was found in chapter 4, the upstream supply chain structure is organization specific. This can also be seen from this example regarding the sourcing guidelines applied for shelter. If the humanitarian organization does have their own warehouse structure many aspects would fall of. It is therefore advised that future studies create these sourcing guidelines with for different types of humanitarian organizations. Also other product categories are required to further investigated.

The SCOR attributes that were assigned to the phases in the disaster life cycle were assigned in a qualitative manner. Further investigation of these concepts is expected to provide a wealth of information. Furthermore the "assets" attribute was kept out of the scope because the supply chain management assets of humanitarian organizations are often setup flexibly. Thus the supply chains are only setup in case of a disaster. Because, the fact that Goh & Souza kept the "assets" attribute out of scope and the limitations of this study it is decided to refer analyzing this attribute for future studies.

It was found that each product category has their own evolution throughout the disaster life cycle, this was discussed in section 4.2.2. How these transitions exactly take place needs to be further investigated in future studies. This cannot be pinpointed exactly, but it is found that at least three transitions through the disaster life cycle take place in general. These transitions are dynamic, can change in multiple directions and act as a sliding scale. Aspects affecting the disaster life cycle transitions can be used to get more insight on the sliding scale. The exact milestones and indicators are advised to be further investigated in future studies.

The humanitarian environment is found to be complex and dynamic. A stakeholder analysis might be useful to regarding the actors of this research. Such an analysis can provide new insights and create more knowledge for further implementation of the findings of this research. Following from this an implementation plan is needed to incorporate the stakeholders when (re)configuring the supply chain structure and their transitions.

In order to overcome the fact that humanitarian practitioners do not have experience working with academics and to constrain the required time for data-collection, serious gaming might be a solution to understand humanitarian practitioners. This means that serious games should be developed to understand how humanitarian practitioners make decisions regarding the supply chain configuration.

7.3.2 Recommendations for studies on other areas in the humanitarian field

Other financing structures: It was found that many humanitarian organizations have a project based financing structure. This restricts humanitarian organizations in their resource allocations, money that is donated for disaster relief cannot be spent on reconstruction or rehabilitation activities. But because of the pre-described media-effect (Besiou & Van Wassenhove, 2015) disaster relief programmes receive more donations than preparedness, rehabilitation, reconstruction or resilience programmes. Researching other financing structures which allow a need based resource allocation is required. This will enable the humanitarian field to make investments and think about long term solutions. Of course quick wins are easy for the donors to understand, but every multinational has a R&D-department and so should humanitarian organizations.

Performance measurement other than output based for donors: During my interviews and research I found that humanitarian organizations often only use output based performance measurement to visualize achievements for the donors. Supply chain performance measurement for improvements is lacking behind. It seems that the underdevelopment of improvement through performance measurement has two main causes. Firstly, humanitarian organizations are biased. They believe that this way of working is a commercial method which is not applicable to the humanitarian field. “We are not Needle” (Comes, 2017) Needle is a German supermarket brand. Secondly, the humanitarian practitioners already have a heavy workload. They often do the work for multiple people. This brings us back to the previous research suggestion: resource allocation. “We simply don’t have the resources for performance measurement” (Anonymized Interviewee A.1, 2017).

Virtual check-inn for the unsolicited pushed supplies: Even though humanitarian organizations prefer monetary donations rather than in-kind, it doesn’t mean that unsolicited in-kind donations are per definition a bad thing. When the supplies are useful and in the right quantity these products can be very useful. For example in the case of the 2015 Earthquake of Nepal, the Indian government sent kitchen sets which were very useful (Anonymized Interviewee A.2, 2017). These where products that where never

asked for, but turned out to be valuable. Unfortunately unsolicited in-kind donations are not always as useful as in the case of the kitchen sets Nepal 2015. As explained in section 4.3.1, unsolicited in-kind donations can cause for congestion of the logistics system. By implementing a preliminary selection possibility to check whether these donations are useful or not, the donations can then be rejected before sent to the location. Some sort of virtual check-inn for the pushed donations could be a solution for the congestion of the logistic bottlenecks.

More focus on resilience and preparedness: From a Boston Consulting Group study on return on investment for emergency preparedness the following was found: "ALL UNICEF and WFP emergency preparedness investments examined in Chad, Madagascar and Pakistan were found to save significant time and/or costs in the event of an emergency. 64% of investments saved both costs and time." (Boston Consulting Group, 2015). Thus, when focussing on sudden onset nature disasters an estimation of the risk prone areas and the probability of occurrence was found to be a good guideline to know which types risks need to be prepared for. When combining these findings to the fact that 1$ spent in preparedness equals $3 spent in disaster response (Kovács et al., 2016, p.11), it is safe to say that investment in preparedness activities is fruitful. Keep in mind that the barrier analysis in chapter three showed that the preparedness activities are underfunded. It is therefore strongly advised that more focus on resilience and preparedness is created in the humanitarian and academic sector.

7.3.3 Recommendations for Delft University of Technology

There are many opportunities for Delft University of Technology (TUD) to contribute to the humanitarian field. It is crucial that the Delft University of Technology starts acknowledging the problems in the humanitarian field by investing in programmes and research dedicated to the field.

Interfaculty studies such as transport infrastructure and logistics (TPM, EEMCS, CEG) and construction management (A & TPM) already exist. By combining the knowledge of the applicable disciplines and adding some electives focussing on the humanitarian field, many new researches and studies can be created contributing to the humanitarian field. The faculties with applicable disciplines are:

- Civil Engineering and Geo science (CEG)
- Technology Policy and Management (TPM)
- Electrical Engineering, Mathematics and Computer Sciences (EEMCS)
- Industrial Design Engineering (IDE)

Interdisciplinary collaboration for the higher cause should not only be limited to the TUD. Interuniversity collaboration has been developed between the Leiden, Delft and Erasmus Universities (Leiden University, Delft University of technology, & Erasmus University, 2017). Studies such as industrial ecology (Leiden University and Delft University of technology) already exist. Leiden university for example has a research group on governance of crises studies. They study the phenomena, dynamics and actors related to crisis governance (Kuipers, 2017). The Leiden University Crisis Research Center (CRC) is part of this Research Group. They also have a master called Crisis and Security Management.

Combining these disciplines to create electives, minors or even a master programme could result in more students willing to apply their knowledge to the humanitarian field. It is best to bring the field of humanitarian sector early under the attention of students. This will prevent students form reinventing the wheel when creating a holistic view of the humanitarian field. The more focus on the sector the better

the collaboration with the humanitarian organizations. This will also enable understanding on the problems humanitarian organizations encounter. Imagine how this could involve prepared thesis subjects and accessibility to the needed data, which would help both institutions in excelling the level of knowledge.

7.3.4 Recommendations for Argusi Aid, the humanitarian branch of Argusi

Argusi is a Dutch supply chain specialist that has specialized in horizontal collaboration and network optimization. The aim of their new branch Argusi Aid is to provide their supply chain knowledge to humanitarian organizations. They have started this branch in 2015 and offered in cooperation with the Kühne Foundation, multiple logistics trainings and workshops.

For Argusi Aid it is of great importance to have clear understanding of which organizations they can help. The network optimization calculations Argusi Aid could offer require a certain level of supply chain maturity. Network optimization for an organization which does not have their own warehouses or supply chain division might not be as effective. It is therefore of importance for Argusi Aid to have a clear overview of which types of humanitarian organizations are operating in-house on their supply chain. No need for investing in organizations that outsource supply chain activities. Organizations such as the WFP & IFRC have invested much of their resources in their supply chain. These are the larger international organizations that focus on the immediate response phase or act with specialized products that are not to be sourced locally, such as medicine. This thesis report has provided an overview of the humanitarian network and explained the differences between the organizations that. This overview will provide support when selecting possible clients.

When investing on network optimization these activities fall under the preparedness activities. Organizations that do not invest (enough) in the preparedness phase might not be willing to allocate their resources in such a way to work towards a better supply chain network. The mentality change which pushes towards more understanding of the importance of preparedness activities are therefore also important for Argusi. This research has created a useful overview of the challenges in the humanitarian sector. It can be used to increase the awareness of the need for investing in preparedness activities.

Another aspect that is important for Argusi is, as provided in this thesis, a holistic view regarding the humanitarian field. After the many interviews that have been conducted it is found that the humanitarian trend of the last decades is to empower to beneficiaries as soon as possible. Connecting to the local suppliers and regular ways of sourcing is the goal in order to destabilize the local economy. Therefore, the global supply chains are mostly important in the immediate response phase. For Argusi it is therefore interesting to look into actors that work in the immediate response phase, or actors that work on a specific aid category which requires specialized products and thus global sourcing pipelines. These specialized products can be medicine or specialized purification equipment.

BIBLIOGRAPHY

Agostinho, C. F. (2013). Humanitarian logistics: How to help even more? *In Management and Control of Production and Logistics*, *6*(PART 1), 206–210. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84885827282&partnerID=40&md5=c6cea155c3c8322e2665ae98c77a41c2

Balcik, B., Beamon, B. M., Krejci, C. C., Muramatsu, K. M., & Ramirez, M. (2010). Coordination in humanitarian relief chains: Practices, challenges and opportunities. *International Journal of Production Economics*, *126*(1), 22–34. http://doi.org/10.1016/j.ijpe.2009.09.008

Beamon, B. M., & Balcik, B. (2008). Performance measurement in humanitarian relief chains. *International Journal of Public Sector Management*, *21*(1), 4–25. http://doi.org/10.1108/09513550810846087

Besiou, M., Stapleton, O., & Wassenhove, L. N. Van. (2011). System dynamics for humanitarian operations. *Journal of Humanitarian Logistics and Supply Chain Management*, *1*(1), 78–103. http://doi.org/10.1108/20426741111122420

Besiou, M., & Van Wassenhove, L. N. (2015). Addressing the Challenge of Modeling for Decision-Making in Socially Responsible Operations. *Production and Operations Management*, *24*(9), 1390–1401. http://doi.org/10.1111/poms.12375

Blecken, A., Danne, C., Dangelmaier, W., Rottkemper, B., & Hellingrath, B. (2010). Optimal Stock Relocation under Uncertainty in Post-Disaster Humanitarian Operations. *2010 43rd Hawaii International Conference on System Sciences*, 1–10. http://doi.org/10.1109/HICSS.2010.296

Boston Consulting Group. (2015). *UNICEF/WFP Return on Investment for Emergency Preparedness Study*. Retrieved from http://www.unicef.org/publications/index_81164.html

Boulet-Desbareau, P. (2013). *Unsolicited in-kind donations & other inappropriate humanitarian goods*.

Charles, A., Lauras, M., & Van Wassenhove, L. (2010). A model to define and assess the agility of supply chains : building on humanitarian experience. *International Journal of Physical Distribution & Logistics Management*. http://doi.org/10.1108/09600031011079355

Comes, T., Schätter, F., & Schultmann, F. (2013). *Building robust supply networks for effective and efficient disaster response*. *ISCRAM 2013 Conference Proceedings - 10th International Conference on Information Systems for Crisis Response and Management*. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84905638551&partnerID=tZOtx3y1

Committee Inter-Agency Standing. (2015). *Multi-sector initial rapid assessment guidance*.

Cozzolino, A. (2012). *Humanitarian Logistics, Cross-Sector Cooperation in Disaster Relief Management*. Roma: Springer. http://doi.org/10.1007/978-3-642-30186-5

Cozzolino, A., Rossi, S., & Conforti, A. (2012). Agile and lean principles in the humanitarian supply chain The case of the United Nations World Food Programme. *Journal of Humanitarian Logistics and Supply Chain Management*, *2*(1), 16–33. http://doi.org/10.1108/20426741211225984

D'Haene, C., Verlinde, S., & Macharis, C. (2015). Measuring while moving (humanitarian supply chain

performance measurement – status of research and current practice). *Journal of Humanitarian Logistics and Supply Chain Management*, *5*(2), 146–161.

Emergency response framework. (2013). Geneva, Switzerland.

Fritz Institute. (2006). *Managing a humanitarian supply chain response*.

Fritz Institute. (2008). *Supply chain structure*.

Global Humanitarian Assistance. (2016). Humanitarian aid network. Retrieved September 27, 2016, from http://www.globalhumanitarianassistance.org/tools/guides/humanitarian-aid-network/

Goh, Q. L. M., & Souza, R. De. (2016). A SCOR framework to measure logistics performance of humanitarian organizations. *Journal of Humanitarian Logistics and Supply Chain Management*, *6*(2), 222–239.

HAP. (2010). *The 2010 HAP Standard in Accountability and Quality Management*. *Humanitarian Accountability Partnership International* (2nd ed.). Geneva, Switzerland: Humanitarian Accountability Partnership International.

Hines, P., & Rich, N. (1997). The seven value stream mapping tools. *International Journal of Operations &Production Management*, *17*(1), 46–64.

International Procurement Agency. (2017). *International Procurement Agency- Company Introduction*.

Kabra, G., Ramesh, a., & Arshinder, K. (2015). Identification and prioritization of coordination barriers in humanitarian supply chain management. *International Journal of Disaster Risk Reduction*, *13*, 128–138. http://doi.org/10.1016/j.ijdrr.2015.01.011

Kovács, G., & Spens, K. (2009). Identifying challenges in humanitarian logistics. *International Journal of Physical Distribution & Logistics Management*, *39*(6), 506–528. http://doi.org/10.1108/09600030910985848

Kovács, G., & Spens, K. (2012). *Relief Supply Chain Management for Disasters : Humanitarian Aid and Emergency Logistics*. Hershey, USA: Premier Reference Source.

Kovács, G., Spens, K., & Haavisto, I. (2016). *Supply Chain Management for Humanitarians, tools for practice*. London, United Kingdom: Kogan Page. Retrieved from http://proquest.safaribooksonline.com.tudelft.idm.oclc.org/book/social-sciences/library-and-information-science/9780749474690/cover/coverimage_xhtml

Kovács, G., & Spens, K. M. (2007). Humanitarian logistics in disaster relief operations. *International Journal of Physical Distribution & Logistics Management*, *37*(2), 99–114. http://doi.org/10.1108/09600030710734820

Kovács, G., & Spens, K. M. (2011a). Humanitarian logistics and supply chain management: the start of a new journal. *Journal of Humanitarian Logistics and Supply Chain Management*, *1*(1), 5–14. http://doi.org/10.1108/20426741111123041

Kovács, G., & Spens, K. M. (2011b). Trends and developments in humanitarian logistics – a gap analysis. *International Journal of Physical Distribution & Logistics Management*, *41*(1), 32–45. http://doi.org/10.1108/09600031111101411

Kuipers, S. (2017). https://www.universiteitleiden.nl/en/research/research-projects/campus-the-

hague/research-group-governance-of-crisis.

L. Lee, H. (2002). Aligning supply chain strategies with product uncertainties. *California Management Review*, *44*(3), 105–119.

Leiden University, Delft University of technology, & Erasmus University. (2017). http://www.leiden-delft-erasmus.nl/en/home.

Leiras, A., Brito, I. de, Peres, J. E. Q., Bertazzo, T. R., Tsugunobu, H., & Yoshizaki, Y. (2014). Literature review of humanitarian logistics research: trends and challenges. *Journal of Humanitarian Logistics and Supply Chain Management Literature*, *4*(1), 95–130. http://doi.org/10.1108/JHLSCM-04-2012-0008

Monaghan, A., & Lycett, M. (2013). Big data and humanitarian supply networks: Can Big Data give voice to the voiceless? *2013 IEEE Global Humanitarian Technology Conference (GHTC)*, 432–437. http://doi.org/10.1109/GHTC.2013.6713725

Murray, S. (2005). How to deliver on the promises: supply chain logistics: humanitarian agencies are learning lessons from business in bringing essential supplies to regions hit by the tsunami. *Financial Times*, *7*(5), 9.

Neher, A. (2013). The Configurational Approach in Supply Chain Management. In *Research Methodologies in Supply Chain Management* (pp. 75–89).

OCHA. (2017). https://www.humanitarianresponse.info/en/about-clusters/what-is-the-cluster-approach.

Oloruntoba, R., & Gray, R. (2006). Humanitarian aid: an agile supply chain? *Supply Chain Management: An International Journal, 11*(2), 115–120. Retrieved from http://www.emeraldinsight.com/doi/pdfplus/10.1108/13598540610652492

Overstreet, R. E., Hall, D., Hanna, J. B., & Rainer, R. K. (2011). Research in humanitarian logistics. *Journal of Humanitarian Logistics and Supply Chain Management*, *1*(2), 114–131. http://doi.org/10.1108/20426741111158421

Pettit, S., & Beresford, A. (2009). Critical success factors in the context of humanitarian aid supply chains. *International Journal of Physical Distribution & Logistics Management*, *39*(6), 450–468. http://doi.org/10.1108/09600030910985811

Rudberg, M., & Wikner, J. (2004). Mass customization in terms of the customer order decoupling point Mass customization in terms of the customer order decoupling point. *Production Planning & Control, The Management of Operations*, *15*(June), 445–458. http://doi.org/10.1080/0953728042000238764

Scholten, K., Scott, P. S., & Fynes, B. (2010a). (Le)agility in humanitarian aid (NGO) supply chains. *International Journal of Physical Distribution & Logistics Management*, *40*(8/9), 623–635. http://doi.org/10.1108/09600031011079292

Scholten, K., Scott, P. S., & Fynes, B. (2010b). (Le)agility in humanitarian aid (NGO) supply chains. *International Journal of Physical Distribution & Logistics Management*, *40*(8/9), 623–635. http://doi.org/10.1108/09600031011079292

Supply chain council. (2010). *Supply Chain Operations Reference (SCOR ®) model*.

Tatham, P., & Christopher, M. (2014). *Humanitarian logistics, meeting the challenge of preparing for and responding to disasters* (2nd ed.). Kogan Page. Retrieved from http://ebookcentral.proquest.com.tudelft.idm.oclc.org/lib/delft/detail.action?docID=1801845

Tatham, P., & Houghton, L. (2011). The wicked problem of humanitarian logistics and disaster relief aid. *Journal of Humanitarian Logistics and Supply Chain Management*, *1*(1), 15–31. http://doi.org/10.1108/20426741111122394

The Sphere Project. (2011). *The Sphere handbook*. *Response* (Third edit, Vol. 1). practical action publishing. http://doi.org/ISBN 978-1-908176-00-4

Thomas, A., & Mizushima, M. (2005). Logistics training : necessity or luxury ? *Forced Migration Review*, (22), 60–61. Retrieved from http://www.fmreview.org/sites/fmr/files/FMRdownloads/en/FMRpdfs/FMR22/FMR22fritz.pdf

Thomas, A. S., & Kopczak, L. R. (2005). From logistics to supply chain management: the path forward in the humanitarian sector. *Fritz Institute*, 1–15. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:From+Logistics+to+Supply+Chain+Management:+the+path+forward+in+the+humanitarian+sector#0

Tomasini, R. M., & Wassenhove, L. N. Van. (2009). From preparedness to partnerships : case study research on humanitarian logistics. *International Transactions in Operational Research*, *16*(5), 549–559. http://doi.org/10.1111/j.1475-3995.2009.00697.x

Tomasini, R., & Van Wassenhove, L. (2009). *Humanitarian Logistics*. Palgrave Macmillan. Retrieved from http://ebookcentral.proquest.com.tudelft.idm.oclc.org/lib/delft/reader.action?docID=435789

Tomasini, R., & Wassenhove, L. Van. (2004). A framework to unravel, prioritize and coordinate vulnerability and complexity factors affecting a humanitarian response operation. *INSEAD. Faculty and Research.*, 1–15. Retrieved from http://www.insead.edu/facultyresearch/research/doc.cfm?did=1363

Van Wassenhove, L. N. (2006). Humanitarian aid logistics: supply chain management in high gear†. *Journal of the Operational Research Society*, *57*(5), 475–489. http://doi.org/10.1057/palgrave.jors.2602125

Van Wassenhove, L. N., & Pedraza Martinez, A. J. (2010). Using OR to adapt supply chain management best practices to humanitarian logistics. *International Transactions in Operational Research*, *19*(1–2), 307–322. http://doi.org/10.1111/j.1475-3995.2010.00792.x

Verschuren, P., & Doorewaard, H. (2010). *Designing a research project* (2nd ed.). The Hague: Eleven International Publishing. http://doi.org/10.1017/CBO9781107415324.004

INTERVIEWS

Anonymized Interviewee A.1. (2017, 01 17). Semi structured interview, Anonymized Organization A, Logistics manager, Emergency and humanitarian assistance. (S. Ahmad, Interviewer)

Anonymized Interviewee A.2. (2017, 02 22). Semi structured interview, Anonymized Organization A, Logistics officer Nepal. (S. Ahmad, Interviewer)

Anonymized Interviewee B.1 . (2017, 01 04). Semi structured interview, Anonymized Organization B, WASH expert. (S. Ahmad, Interviewer)

Anonymized Interviewee B.2. (2017, 02 09). Semi structured interview, Previous Anonymized organization B, Shelter Expert, Logistics, entrepreneur. (S. Ahmad, Interviewer)

Anonymized Interviewees C.1, 2. (2017, 01 26). Semi structured interview, Anonymized Organization C, Logistics managers & procurement officers. (S. Ahmad, Interviewer)

Comes, M. (2017, 02 01). Semi structured interview, TU Delft Professor Information systems humanitarian aid,. (S. Ahmad, Interviewer)

Meesters, K. (2016, 12 27). Semi structured interview, Phd Candidate Social media Humanitarian Aid. (S. Ahmad, Interviewer)

Ohlsen, M. (2017, 01 25). Personal Communication, WFP, Professor & emergency coordinator. (S. Ahmad, Interviewer)

APPENDICES

A. EXAMPLE-QUESTIONS SEMI STRUCTURED INTERVIEW, UNICEF

These sample questions show the questions I want to ask in broad lines. These are therefore not meant to be used as a fixed questionnaire, as further elaboration is needed.

Personal background:

Interviewer: Soma Ahmad

- Master student Management of Technology at Delft University of Technology, Netherlands.
- Performing Master thesis with the humanitarian branch of supply chain specialist Argusi.
- Goal of research: to provide insight for NGO's on when and how to adapt their supply chain configuration, regarding the shifting supply chain philosophies and performance measures (push to pull, agile to lean, effective to efficient).
- Contact: Soma1903@gmail.com, telephone: 0031-614810073

Interviewee: …

1. …

UNICEF logistics department:
During this topic I will verify and complement my online findings

1. Could you tell me about your logistics department?
    a. Which departments does it have?
    b. What activities belong to the logistics department?
    c. How is information shared between these departments?
    d. How are decisions made in the immediate response phase?
    e. How do you decide whether to outsource certain activities or do them in-house?

Performance Measures / Key Performance Indicators

2. Does your logistics department work with Key Performance Indicators (KPI's) or performance measures?
    - If yes:
        a. Which?
        b. Do they change through time/per program (disaster relief/ reconstruction)?
        c. Do they change per product / service category?
            - If yes: How are your products / services categorized?

              Example (Beamon & Balcik, 2008):
                - Tier 1 Supplies: certain items that are especially critical and needed immediately at the earliest stages of all emergencies (e.g. jerry cans, tarps, tents, blankets, hygiene kits).
                - Tier 2 Supplies: other supplies that are less critical, and can be safely supplied during later stages.

- If no:
  d. Why not?

During the interview I might show you a list of performance measures and discuss the possibilities and importance of them throughout the disaster lifecycle.

Product / service segmentation

3. Does your organization differentiate types of products/categories regarding emergency response?

Emergency response Haiti:

4. What was UNICEF's role after Hurricane Matthew?
   What type of aid programs where enacted and why? (education, health, WASH, etc.)

Disaster life cycle:

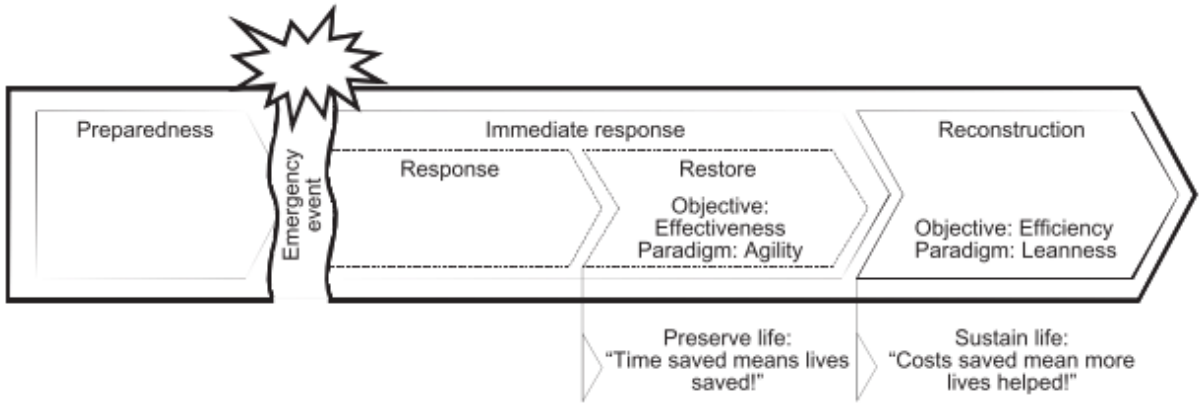


Figure 1 Humanitarian logistics process (Cozzolino, et al., 2012)

5. In which phases of the disaster lifecycle does your organization work?
   (immediate response phase/ reconstruction)

6. What type of phase descriptions of the disaster life cycle do you find most accurate and why?

7. Do you experience shifts in working philosophy throughout the mission?
   (Effective – efficient, agile – lean, etc.)
   a. How does your organization cope with the shift throughout the disaster lifecycle?

B. Main Take Outs Interviews

This appendix provides an overview of the main take outs that are used per interview or communication. All the communications were recorded and fully transcribed, by means of relevance it is chosen to only add the main take outs in the appendix. The complete collection of transcriptions entails over 50 pages, and can be requested for those who are interested. The main take outs of the organization related interviewee are left out due to privacy agreements, as well as those from Kenny Meesters as those contain many references to the anonymized organizations.

Exploratory / advisory communication:

a) Tina Comes
b) Martin Olsen
c) Kenny Meesters

Non-exploratory interviews:

d) Interviewee Anonymized (A.1)
e) Interviewee Anonymized (A.2)
f) Interviewee Anonymized (B.1)
g) Interviewee Anonymized (B.2)
h) Interviewees Anonymized (C.1)

a. Main Take outs Tina Comes (Advisory/ Exploratory)

1. "You will see that a lot of bigger international NGO's and also UN-agencies are in the process of shifting there supply chain strategy from very centralized structures to a bit more regionalization or sub regionalization, so decentralized structures so they are struggling with that. Because they don't have the appropriate information systems set up for that. I have been working on that particularly for the IFRC."
2. "Most humanitarian organization focus on the ongoing conflicts and complex disasters because they are just like their permanent baseline. So you will see a lot of the supply networks are actually designed to cover the permanent baseline which is pretty heavy these days, when you look at all the ongoing wars and the refugees that are spread all over the globe. That is basically the global layout of the biggest INGO's networks. And on top of this heavy baseload, which already stretches the system almost to the point that it is breaking, they have to deal with the sudden onset."
3. "You see normally huge bullwhip effects in humanitarian supply chains. Because of course they want to be able to respond to a disaster. Whenever they are not able to respond to a disaster as quickly as they should, it costs live and they get negative media coverage which means they get less funding."
4. "the American red cross still has the principle sources to respond to the next Haiti earthquake. They have the ware houses and capacity for that, but of course you also know that there was just one Haiti earthquake, and there were of course also other disasters around but not as big and as extreme. So now they are having the capacity to basically respond for an earthquake that is not happening. So they have idle staff, a lot of goods on their shelves that they have to replace every 6 months or so, basically that all goes to waste."
5. "Downstream part, the part that is set up in the response to a disaster relies heavily on establishing partnerships with the large international organizations or governments."
6. "when you look at distribution structures that emerge, it is very often are than in connection with local communities. also just to get additional capacity, like in Nepal they were working a lot with

the local carriers who were able to transport the relief goods into the remote areas that they could reach and there were not enough helicopters around to organize airdrops."

7. "The difficulty is of course that these organizations need to balance efficiency and effectiveness. So most of the ongoing baseload is typically underfunded, Like the conflicts in Africa. The conflict in the middle east (Syria) is getting better funding now. So they push these organizations towards efficiency. Whereas in the response to a natural disaster they will all tell you that everything needs to be in the initial response on effectiveness. Leading then also to a lot of waste that is produced and to a lot of inefficiencies. Just because there is this race for access. just try to get there and to deliver "anything" because anything is needed."
8. "Because I remember from the group of Munster with kpi's and humanitarian organizations. They also met some resistance initially. Because they were basically it is a measurement system as you would find it in the commercial sector. They said like: we are not Needle (German supermarket branche). that's a culture issue. Did you see their work?"
9. "What you need and how that evolves, will also depend on the national and local response. say: in how far does the government provide assistance, what type of assistance, in how far are the people building up things themselves? are they resilient (to use another famous term). So it's very natural that the humanitarian needs will evolve, and ideally you would expect them to go overall down"

b. Martin Ohlsen (Exploratory)

1. The Zatari camp is called the best refugee camp they created stores etc. to give the power to the refugees. They Empower the refugees by letting them use their capabilities. They have for example created a bakery in the refugee camp.
2. UNHRD Have interconnected warehouses
3. It is important to check the deligated authority of the country logistics officer.
   "If the country logistics officer has a low deligated authority, they can arrange a few soup kitchens and that's it"
   What is the office structure? Do they have procurement officers?
4. Some organizations have standing supply agreements
5. Sometimes it is better to just send a jumbojet with supply than bargain seperatly. (economies of scale)
6. Local purchase is only possible if the delegated authority is high and the local market allows it.
7. UNHRD has set agreements to borrow stock and to not hold stock for too long
8. WFP deligated authority is high
9. Nowadays, the logistics officer is also the purchasing officer. It all falls under the supply chain umbrella.

c. Main Take Outs Kenny Meesters (Exploratory)

Main take outs left out due to privacy reasons

d. Interviewee Anonymized (A.1)

Main take outs left out due to privacy reasons

e. INTERVIEWEE ANONYMIZED (A.2)

Main take outs left out due to privacy reasons

f. INTERVIEWEE ANONYMIZED (B.1)

Main take outs left out due to privacy reasons

g. INTERVIEWEE ANONYMIZED (B.2)

Main take outs left out due to privacy reasons

h. INTERVIEWEES ANONYMIZED (C.1,2,3)

Main take outs left out due to privacy reasons

C. THE HAP STANDARD PRINCIPLES

Tabel 25 (HAP, 2010)

HAP Standard Principle:	The HAP definition:
Humanity:	Concern for human welfare and respect for the individual.
Impartiality:	Providing humanitarian assistance in proportion to need, and giving priority to the most urgent needs, without discrimination (including that based upon gender, age, race, disability, ethnic background, nationality or political, religious, cultural or organizational affiliation).
Neutrality:	Aiming only to meet human needs and refraining from taking sides in hostilities or giving material or political support to parties to an armed conflict.
Independence:	Acting only under the authority of the organisation's governing body and in line with the organisation's purpose.
Participation and informed consent:	Listening and responding to feedback from crisis-affected people when planning, implementing, monitoring and evaluating programmes, and making sure that crisis-affected people understand and agree with the proposed humanitarian action and are aware of its implications.
Duty of care:	Meeting recognised minimum standards for the well-being of crisis-affected people, and paying proper attention to their safety and the safety of staff.
Witness:	Reporting when the actions of others have a negative effect on the well-being of people in need of humanitarian assistance or protection.
Offer redress:	Enabling crisis-affected people and staff to raise complaints, and responding with appropriate action.
Transparency:	Being honest and open in communications and sharing relevant information, in an appropriate form, with crisis-affected people and other stakeholders.
Complementarity:	Working as a responsible member of the aid community, co-ordinating with others to promote accountability to, and coherence for, crisis-affected people.

D. UN CLUSTER APPROACH

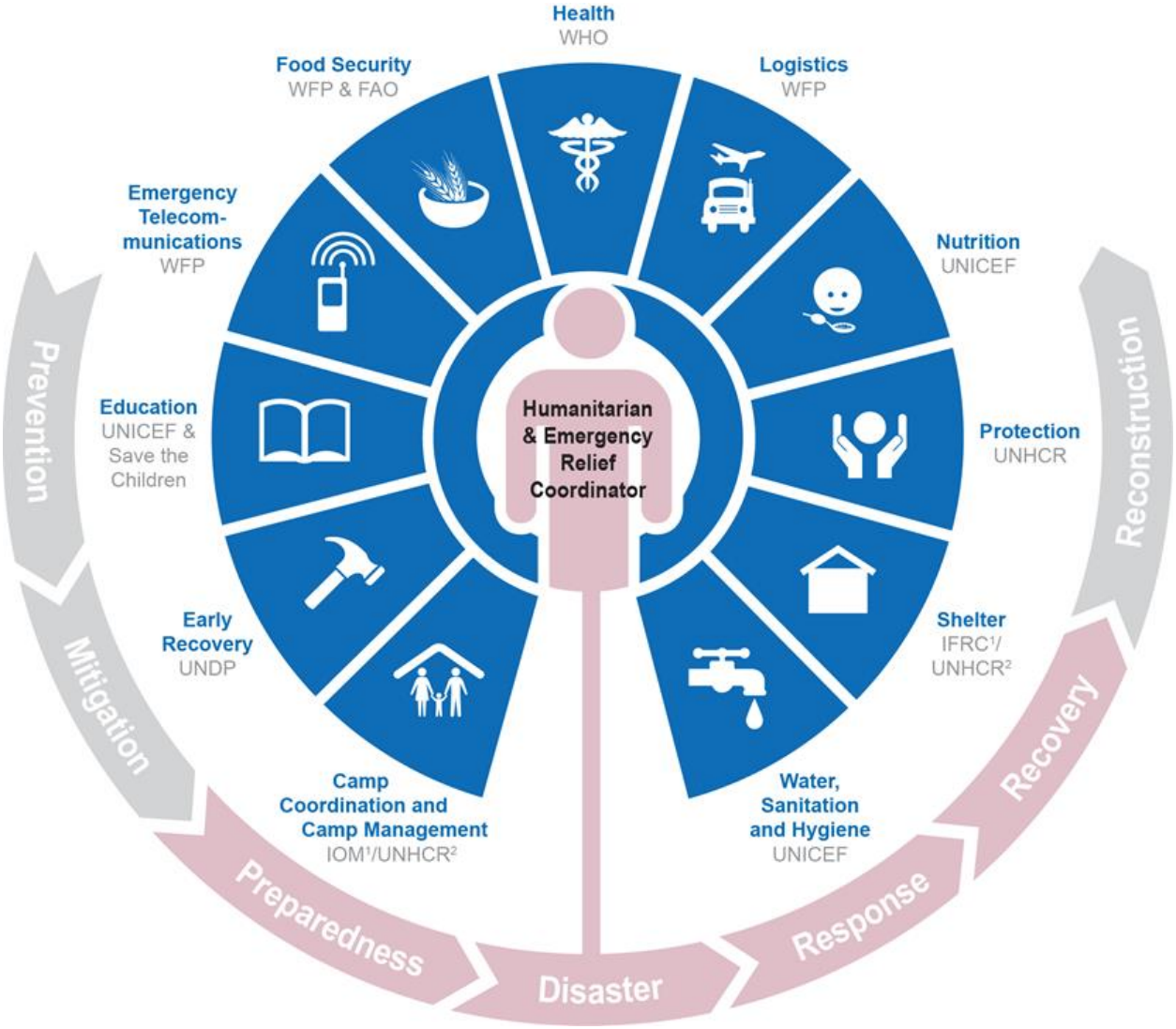


Figure 38 Overview UN cluster approach
https://www.humanitarianresponse.info/en/about-clusters/what-is-the-cluster-approach

E. OVERVIEW OF THE HUMANITARIAN AID NETWORK

Appendix 1 http://www.globalhumanitarianassistance.org/tools/guides/humanitarian-aid-network/

F. SET OF PERFORMANCE METRICS BY (Beamon & Balcik, 2008)

Resources
Total cost (of resources used)
Overhead costs
Total cost of distribution (including transportation and handling cost)
Inventory investment (the investment value of held inventory)
Inventory obsolescence (and spoilage)
Order/setup costs
Inventory holding costs
Cost of supplies
Number of relief workers employed per aid recipient
Number of "value added" hours (the number of direct hours spent on dispensing aid per total number of labor hours)
Dollars spent per aid recipient
Donor dollars received per time period
Output
Total amount of disaster supplies (delivered to aid recipients)
Total amount of disaster supplies of each type (delivered to aid recipients
Total amount of disaster supplies to each region (delivered to aid recipients)
Amount of disaster supplies delivered to each recipient
Target fill rate achievement
Average item fill rate
Stock-out probability
Number of backorders
Number of stock-outs employed
Average backorder level
Average response time (average time between occurrence of the disaster and arrival of supplies)
Minimum response time (minimum time between occurrence of the disaster and first arrival of supplies)
Flexibility
Number of individual units of Tier 1 supplies that an organization can provide in time period Tc
Minimum response time
Mix of different types of supplies that the relief chain can provide in a specified time period
Number of individual units of Tier 1 supplies that an organization can provide in time period Tc

Figure 39 Summary of relief chain performance metrics (Beamon & Balcik, 2008)

G. PROPOSED SCOR-METRICS FOR HUMANITARIAN ORGANIZATIONS (Goh & Souza, 2016)

Metric	SCOR metric	SCOR no.	Performance attribute and process	Formula
A1.1	Perfect order fulfilment	RL 1.1	Reliability and all processes	(Total perfect orders)/(Total number of orders) × 100% Note: an order is perfect if the individual items making up that order are all perfect
A2.1	Percentage of orders delivered in full	RL 2.1	Reliability and delivery process	(Total number of orders delivered in full)/(Total number of orders) × 100%
A2.2	Delivery performance to customer commit date	RL 2.2	Reliability and delivery process	(Total number of orders delivered within scheduled date)/(Total number of orders) × 100%
A2.3	Documentation accuracy	RL 2.3	Reliability and delivery process	(Total number of orders delivered with accurate documentation)/(Total number of orders) × 100%
A2.4	Perfect condition percentage	RL 2.4	Reliability and delivery process	(Total number of orders delivered in perfect condition)/(Total number of orders) × 100%
A3.1	Store documentation accuracy	RL 3.43	Reliability and store process	(Total number of orders delivered with accurate store documentation)/(Total number of orders) × 100%
A3.2	Delivery documentation accuracy	RL 3.50	Reliability and final delivery process	(Total number of orders delivered with accurate delivery documentation)/(Total number of orders) × 100%
A3.3	Risk mitigation plan	RL 3.48	Reliability and all processes	(Total number of items with alternative sources)/(Total number of items) × 100%
B1.1	Order fulfilment cycle time	RS 1.1	Responsiveness and all processes	(Total actual cycle times for all orders delivered)/(Total number of orders delivered)
B2.1	Source cycle time	RS 2.1	Responsiveness and source process	For all supply items ordered, the maximum value of ((The payment date)–(Date of informal sourcing request))
B2.2	Assembly cycle time	RS 2.2	Responsiveness and store process	(Total number of kits in active assembling) (Average daily kits outputs)
B2.3	Delivery fulfilment cycle time	RS 2.3	Responsiveness and delivery process	(Total actual delivery cycle times for all orders delivered)/(Total number of orders delivered)
B3.1	In-stock percentage	RS 3.47	Responsiveness and store process	(Total number of essential items where the stock level falls below its minimum stock level during emergency event)/(Total number of essential items) × 100%
B3.2	External event response	RS 3.31	Responsiveness and all processes	For all items delivered for an emergency events, the average value of ((Date when a specific resource is delivered to victim)–(Onset date of a particular humanitarian event))
C1.1	Upside supply chain flexibility	AG 1.1	Agility and all processes	Total elapsed days between the occurrence of the unplanned event and the achievement of sustained plan, source, make, deliver and return performance

Figure 40 Proposed SCOR metrics Part 1 (Goh & Souza, 2016)

Metric	SCOR metric	SCOR no.	Performance attribute and process	Formula
C2.1	Upside source flexibility	AG 2.1	Agility and source process	For all supply items ordered, the maximum value of ((Receipt date of order in which quantity increases by 100%)–(PO date of order in which quantity increases by 100%))
C2.2	Upside delivery flexibility	AG 2.3	Agility and delivery process	For all delivery items, the maximum value of ((order delivery date in which quantity increases by 100%)–(The date of ordered items ready for delivery in which quantity increases by 100%))
C3.1	Current on-hand inventories	AG 3.39	Agility and store process	The amount of all items currently in warehouses
C3.2	Current purchase order cycle time	AG 3.40	Agility and source process	For all supply items ordered, the maximum value of ((goods receipt date)–(Date of purchase request))
D1.1	Supply chain management cost	CO 1.1	Supply chain and all processes costs	The sum of the costs associated with the Level 2 processes to plan, source, store, and deliver
D2.1	Cost to plan	CO.2.1	Supply chain costs and plan process	The sum of all costs associated with the plan process such as plan to source, and plan to delivery
D2.2	Cost to source	CO.2.2	Supply chain costs and source process	The sum of all costs related to sourcing such as material planning, planning procurement staff, supplier negotiation, bidding, and quotations
D2.3	Cost to manage product inventory	CO.3.82	Supply chain costs and store process	The sum of all costs on activities for store, including warehousing operating cost, rental cost, and manpower cost
D2.4	Cost to deliver	CO.2.4	Supply chain costs and delivery process	The sum of all costs associated with the delivery process such as outbound transportation costs
D2.5	Supply chain risk mitigation cost	CO.2.7	Supply chain costs and all processes	The sum of the costs associated with supply chain risk mitigation activities in plan, source, and deliver processes
D3.1	Cost to manage supply chain performance	CO.3.78	Supply chain costs and all processes	The sum of all costs on activities for supply chain performance management, including both manpower and documentation costs

Figure 41 Proposed SCOR metrics Part 2 (Goh & Souza, 2016)

H. ASPECTS PER LOGISTICS SEGMENT BY KLAAS (2003)

Tabel 26 Aspects per logistics segment by Klaas (2003)

Dimensions to describe logistics segment:	Aspects per dimension:
Mechanisms of coordination	• connection between: supply, production & distribution • push/pull oriented coordination of flow of goods
Logistics processes and infrastructure	• bundling of materials flow • postponement / speculation • centralizing / decentralizing
Formal organizational structure	• specialization • delegation • standardization • etc. (all aspects of formal organization structure)

Logistics context	• demand
	  ○ quantity required
	  ○ required service level
	  ○ predictable / unpredictable
	• product
	  ○ volume
	  ○ weight
	  ○ production technology
	  ▪ economies of scale
	  ▪ flexibility
	  ○ competitive strategy
	  ▪ differentiation
	  ▪ cost leader

I. CLUSTERS OF ALL THE SUPPLY CHAIN CONFIGURATIONS PROVIDED BY NEHER (2013)

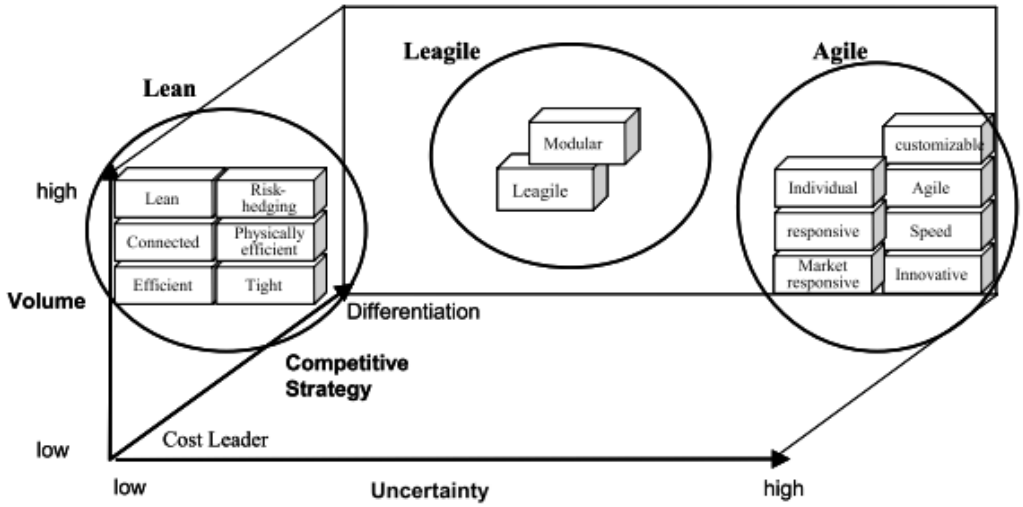


Figure 42 Clusters of configurations (Neher, 2013)

J. UNICEF SUPPLY CHAIN OVERVIEW

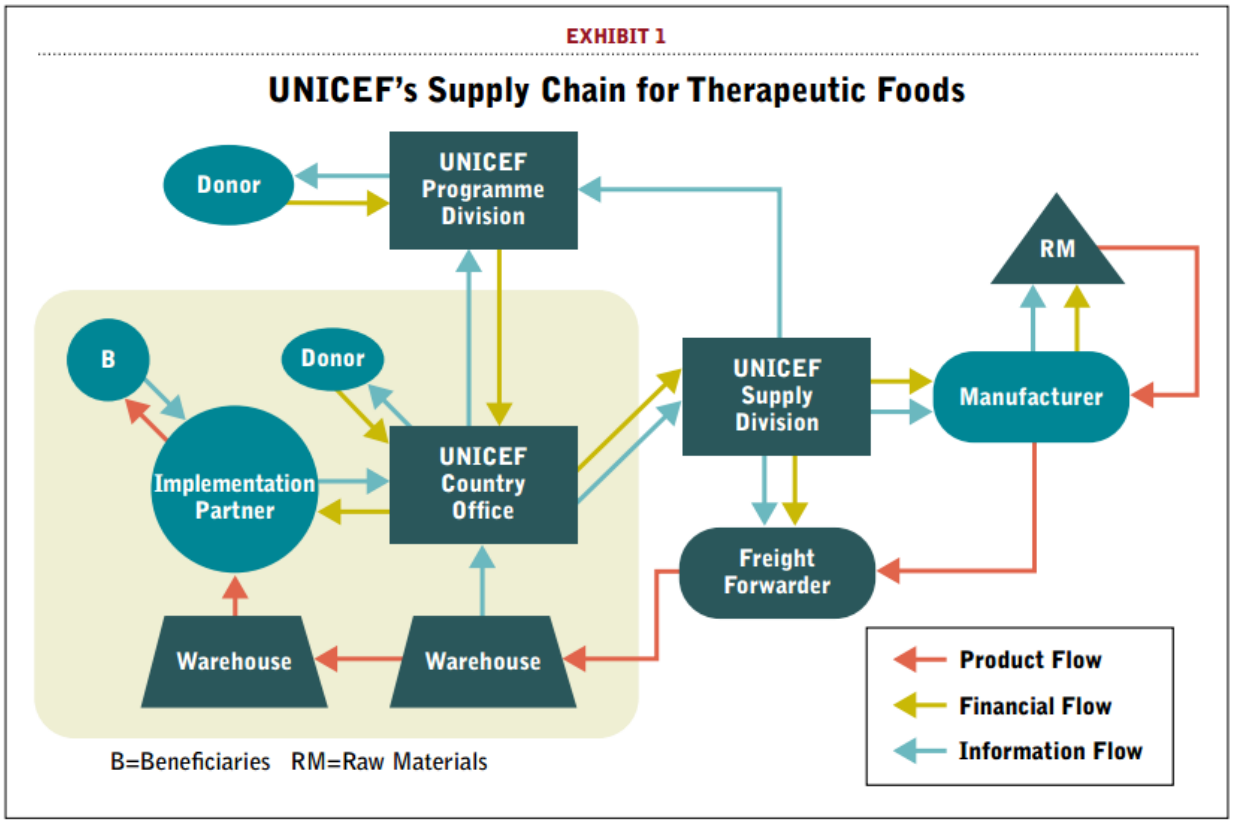


Figure 43 Supply chain Unicef for therapeutic foods (source: Unicef raport)