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Preface

This thesis is our final assignment of the 2-year Master of Science in Logistics at Molde University College.

The purpose of this Master thesis is to explore the possibilities for a supplier to place their inventory strategically to better suit the needs of humanitarian organizations, and to gain competitive advantage.

This we have done by extensively mapping the humanitarian marketplace, its beneficiaries, and supported theory.

We would like to thank all that has contributed to our work. Most of all we want to thank our supervisor, Berit Irene Helgheim for her persistence in driving us forward. We also want to thank Berner Martin Olsen and Alfred Øverland at ROFI Industrier AS for giving us insight into the supplier's point of view. Acknowledge is also given to the school's library personnel in the search for relevant literature and Muhammad Hassan for advising us in the process of analyzing correlations.

Molde 25.05.2009

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Abstract

The world of humanitarian aid has some unique attributes; it is a highly volatile and unpredictable marketplace, where demand can change form one hour to the next. The research done within this field is limited, but gradually generating more interest. In this thesis we are looking into the humanitarian marketplace from the viewpoint of the supplier, and how the supplier can place its inventory strategically to acquire competitive advantage, and there through serving the needs of the humanitarian organizations at a higher level. We have located areas, and countries of special interest, and we argue that locating inventory close, or inside these countries will comply with the needs of the humanitarian world, and give the supplier a competitive advantage.

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1 Introduction

The purpose of this thesis is to get a deeper understanding of humanitarian logistics in context to disaster relief operations and to look into the possibilities available for a supplier to the humanitarian organizations to place its inventory strategically, to suit the needs of the humanitarian organizations. The world of humanitarian aid is an interesting field of research, though not well researched. We have used a supplier to the humanitarian organizations as a case to get an approach for parts of the research.

Inventory, distribution, conventional and humanitarian logistics, planning and management and coordination, cooperation and information sharing are those fields that have achieved most interest among researchers. Most of the researchers have used quantitative approaches in their work, while those researchers that have used qualitative approaches have mainly put their efforts in describing the field and drawing parallels between the private sector and the humanitarian sector.

The originality of this thesis is based on the fact that no researchers have tried to look at the field of inventory through a supplier's point of view. Where other researchers have focus on the issue of inventory with quantitatively approaches, this thesis takes it further by introducing the issue of strategically positioning of inventory through a qualitative approach.

The objective of this thesis is to look into the world of humanitarian aid, and investigate how a supplier to humanitarian organizations can place its inventory strategically, and therein gaining a competitive advantage.

We have conduced one primary research question followed by four secondary research questions.

Primary research question:

Where should a supplier locate its inventory in order to qualify for the humanitarian market environments and be order winner?

To answer this question we have explored the available information regarding humanitarian logistics, we have collected primary data by conducting a survey and we have collected secondary data regarding natural disasters and their impacts.

In our quest to answer the primary research question we have define four secondary research questions:

1. *What is humanitarian logistics in context of disaster relief operations?*

2. *What are humanitarian organizations preferences in regards to sourcing of humanitarian supplies?*
3. *Which areas and countries are the most affected due to natural disasters?*
4. *In which countries should a supplier position inventory?*

The first question aims to give us a basic and fundamental understanding of what humanitarian logistics is in context to disasters relief logistics.
The second is based on the recognition of what preferences humanitarian organizations have related to how suppliers be qualified for the market and gain orders.
The third question aims to point out areas and countries that are of highest interest for suppliers to locate supplies in.
The fourth question aims to propose which countries that a supplier should position inventory in.

Structure of the Thesis

This thesis is structured as follows; chapter two gives a literature review aiming to present the reader an overview over available research done by researchers before. Chapter three aims to give definitions of natural disasters. Chapter four and five seeks to describe what humanitarian logistics is in context of disaster relief operations in order to give the reader a better understanding of this field. Chapter 6 seeks to give the reader a definition of pre-positioning and implements examples to give the reader further understandings of the concepts. Chapter seven discusses the theory applied in this thesis, while chapter eight explains the chosen methodology. Our case, ROFI Industrier AS is presented in chapter nine. The empirical work in this thesis is presented in chapter ten and eleven, while summary and conclusion is presented in chapter twelve. Limitation of this study and future research is discusses in the end of the thesis.

2 Literature review

This section aims to give a review over existing literature with regards to the field of humanitarian aid logistics and disaster relief. Limitation to relevant literature is set to be only research papers.

The literature review has discovered four main areas of interest among researchers. *Inventory control, distribution* and *management planning* have received significant interest, but the search for a common framework by looking into similarities between private sector, military sector and humanitarian logistics and how these sectors can achieve benefits from each other has been the main focus. The aspects of Coordination, cooperation and information sharing has also received interest from researched, but not to the same extent.

2.1 Inventory

This part aims to give a review over existing literature regarding the aspect of inventory.

The increasing complexity and magnitude of global emergency relief operations create a critical need for effective and efficient humanitarian supply chain management processes(Beamon and Kotleba 2006). Unusual constraints and unpredictable demand in large-scale emergencies gives physical supply chains a challenge. Current emergency approaches are frequently surpassed by the non-governmental organizations need for logistics. This work states that there is limited of research done within this field and have therefore, with this limitation addressed a stochastic inventory control model. This model deters optimal order quantities and reorder points for long-term emergency relief response.

(Beamon and Kotleba 2006) developed and tested three different inventory management strategies which were applied into the crisis of Sudan. By using quantitative modeling, simulation and statistics they identified critical system factors that contributed significantly to inventory system performance. Critical system factors discovered were; response time, annual costs and maximum proportion of emergency order cycles. The models seemed to be more robust and flexible than the current solutions.

(Whybark 2007) work was concerned with the inventories held for disaster relief. He presents the nature of disaster relief and describes the characteristics of management and

acquisition through storage and distribution. According to the author, there are significant differences between disaster relief inventories and enterprise inventories and this is not well understood. He points out acquisition, storage and distribution as fields with highest differences. This opens opportunities to expanding the scope of inventory research. Better theory, systems, and management guidelines are fields that are pinpointed.

2.2 Distribution

This part aims to present what researchers have contributed to in respect of distribution.

(Özdamar, Ekinci, and Küçükyazici 2004) claims that logistics planning in emergency situations involves dispatching commodities (e.g., medical materials and personnel, specialized rescue equipment and rescue teams, food, etc,) to distribution centers in affected areas. He also claims that this has to be done as soon as possible so that relief operations are accelerated. Their research proposed a dynamic time-dependent transportation problem. The planning model was to be integrated into a natural disaster logistics decision support system that indicated the optimal mixed pickup and delivery schedules for vehicles within the considered planning time horizon.

(Yi and Özdamar 2007) work is related to of evacuation and transfer of wounded people to emergency units. An integrated location-routing model is proposed for coordinating logistics support and evacuation operations in response to emergencies and natural disasters. Their aim is to maximize response service lever by enabling fast relief access to affected areas and locating temporary emergency units in appropriate sites.

According to (Sheu 2007) quick response to the urgent relief needs right after natural disaster through efficient emergency logistics distribution is vital to the alleviation of disaster impact in the affected areas. He states that this is a challenging field of logistics, related to potential study areas. His paper present a hybrid fussy clustering-optimization approach to the operation of emergency logistics co-distribution responding to the urgent relief demands in the crucial rescue-period. He proposes a three-layer emergency logistics co-distribution conceptual framework. His methodology involves two recursive mechanisms: disaster-affected area grouping and relief co-distribution and where the aim

is fast response to the urgent relief demands of the affected areas. The work narrows the focus to a tree days crucial rescue period.

Disaster prevention, protection and reconstruction are the major areas of focus to reduce human suffering and damage from disaster. A key point is the ability to enhance the distribution of relief materials effectively (Tzeng, Cheng, and Huang 2007). This research used fussy multi-objective programming to introduce a method to design relief delivery systems and to create an emergency relief model as reference for the decision maker. The model was applied into a real case, the fatale earthquake in Taiwan in 1999. Although the model aimed to serve three different objectives; minimizing total cost, minimizing the total travel time and maximizing the minimal satisfaction during the planning period, the research has some critical limitation based on the assumption that government has the authority to expropriate enough military or civilian vehicles to help with the distribution of relief and to control traffic during the period of relief distribution.

(Akkihal 2006) examines the impact of inventory pre-positioning on humanitarian operations. The research identifies, by using mixed-integer linear programs, optimal locations for warehousing non-consumable inventories required for initial deployment aid, by using mean annual homeless resulting from hazards (Hazards are referred as natural disasters like atmospheric disruptions, floods waves, landslides, seismic disruptions, volcanoes and wildfires) as an indirect estimation of demand for infrastructure inventory.

(Balcik and Beamon 2008) describes facility location problem for humanitarian relief chains and developed an analytical approach that would enable relief practitioners to make efficient and effective facility location and stock pre-positioning decisions. This analytical approach aimes to meet the needs of people affected by the disaster By using a maximal-covering, locations of the distribution centre in the relief network and the amount of relief supplies to be stocked at each distribution centre could be determined. This research is limited to the extent that disasters do not occur simultaneously and that the distribution centers holds enough inventory to satisfy the demand of any scenario to which it is assigned.

Last mile distribution is the final stage of a humanitarian relief chain; it refers to delivery of relief supplies from local distribution centers (LDCs) to beneficiaries affected by

disasters (Balcik, Beamon, and Smilovitz 2008). This research presents a mixed integer programming model in order to increase the efficiency for the vehicle-based last mile distribution system, in which an LDC stores and distributes relief supplies to a number of demand locations. The model finds delivery schedules for vehicles and equitably allocates resources, based on supply, vehicle capacity, and delivery time restrictions. The objective for the model is to minimizing transportation costs and maximizing the benefits to aid recipients. The research also identifies opportunities for the use of intelligent transportation system in the last mile distribution.

2.3 Conventional and humanitarian logistics

This part aims to give an overview of which researchers that have drawn parallels between private sector and humanitarian logistics.

(van Wassenhove 2006) states that private sector can and should be applied to improve the performance of disaster logistics, by using several of cases within disaster relief operations. Private sector has much to contribute to the field of disaster logistics, but they need to understand the core capabilities of humanitarian logistics. The paper describes the complexity of managing a humanitarian supply chain, and points out the cross learning potential for both private sectors and the humanitarian sector in emergency relief operations. This author pinpoints the possibilities of getting involved through corporate social responsibility and draw outlines for better preparedness by pinpointing the importance of the supply chains to be agile, adaptable and aligned. To create better and more effective supply chains, be it in the private sector or relieving the affected in a disaster, there is a case for closer collaboration between the private, business and academic sector.

(Davidson 2006) examines the underlying principles of logistics performance measurements systems from the military and private sector and relate these principles to disaster relief operations, four indicators were found to measure the logistic performance in terms of trade-offs of speed ,cost and assessment accuracy. The author developed a “scorecard” for practitioners to gauge performance both during and after a relief operation.

(Kovács and Karen M. Spens 2007) states that the humanitarian logistics needs to learn from business logistics. Their research aimed for further understanding in planning and

carrying out logistics operations in disaster relief, drawing parallels between business logistics and humanitarian logistics in terms of their unique characteristics. This research creates a framework in order to distinguish between actors, phases and logistical processes of disaster relief.

(Beamon and Balcik 2008) created new performance metrics for the humanitarian relief chain and a performance measurement framework for the relief chain by making a comparison of performance measurement in the humanitarian relief chain with the performance measurement in the commercial supply chain. This research discovered new performance metrics for the humanitarian relief chain, and a performance measurement framework for the relief chain.

2.4 Planning and management

Planning and management within humanitarian logistics is one of the less explored field among academics.

(Perry 2007) claims that the natural disaster response activity needs to be viewed holistically in the context of a disaster management planning continuum that ideally start well before the response action is required and of which locally-led inclusiveness is a crucial component. Based on a field study, this research discusses the response activity concerning the 2004 tsunami. His work discusses the disaster in terms of what should have occurred in order to present a comprehensive hindsight-analysis case. The work places natural disaster response activity clearly to the context of local-nation-led holistic disaster planning.

Disaster relief operations and industrial environments have many common features and requirements for decision making (Smirnov et al. 2007). By using an ontology-driven knowledge sharing and application of well-developed tasks from the area of production network management, they enabled the use of existing problem-solving methods. This work presents an approach to decision making in disaster response operations application that makes it possible to use decision-making tasks from production network management.

2.5 Coordination, cooperation and information sharing

This parts aims to show what researchers ahve done towards coordination, cooperation and information sharing in humanitarian logistics contexts.

(Long and Wood 1995) discussed many of the different logistical aspects of famine relief efforts and discovered that a major opportunity for improving the logistical support of disaster operation lies in the information systems that used by the major relief agencies. Their work emphasizes information about supplies availability, supplies localization and transport mode is vital information for the relief practitioners, whether they are on disaster site or in headquarters.

(Schulz 2008) goes into the depth of investigating what synergies and potential types of benefit a horizontal cooperation between humanitarian organizations could produce, and what impediments to their realization exists. She concludes that the same potential synergies exist in both humanitarian and private sector, but not all of the potential benefits have yet been realized. Impediments that hamper the cooperation willingness between organizations are: the perception of logistics as one of the organization's own core competence, cultural differences and mutual mistrust, the lack of transparency, and inadequate relief capacities.

(Ahrens and Rudolph 2006) identify institutional failure as root cause for underdevelopment and susceptibility to disasters. To enhance a governance structure that fosters development and supports risk reduction, accountability, participation, predictability and transparency are concluded as key features.

2.6 Summary

The literature review is summarized in the table below.

Author	Subject Area	Methodology	Findings
Beamon and Kotleba	Inventory	Stochastic inventory control model	Deters optimal order quantities and reorder points for long-term emergency relief response
Beamon and Kotleba	Inventory	Quantitative modelling	Critical system factors discovered were; response time, annual costs and *maximum proportion of emergency order cycles*
Whybark, 2007	Inventory	Presentation of the nature of disaster relief and its characteristics	Points out acquisition, storage and distribution as fields with highest differences
Özdamar et al., 2004	Distribution	Dynamic time-dependent transportation problem	Indicates the optimal mixed pickup and delivery schedules for vehicles within a considered planning time horizon
Yi and Özdamar, 2007	Distribution	Integrated location-routing model	Maximize response service lever by enabling fast relief access to affected areas and locating temporary emergency units in appropriate sites
Sheu, 2007	Distribution	Hybrid fussy clustering-optimization approach	Narrows the focus to a tree days crucial rescue period
Tzeng et al., 2007)	Distribution	Fussy multi-objective programming	An emergency relief model
Akkihal, 2006	Distribution	Mixed-integer linear programs	Identifies optimal locations for warehousing non-consumable inventories required for initial deployment aid
Balcik and Beamon, 2008	Distribution	Facility location problem	Enable relief practitioners to make efficient and effective facility location and stock pre-positioning decisions
Balcik et al., 2008	Distribution	Mixed integer programming model	Minimizes transportation costs and maximizing the benefits to aid recipients
Van Wassenhove, 2006	Conventional and humanitarian logistics	Case study	States that private sector and humanitarian logistics have much to learn from each other
Davidson, 2006	Conventional and humanitarian logistics	examination	A “scorecard” for practitioners to gauge performance both during and after a relief operation

Kovács and Spens, 2007	Conventional and humanitarian logistics	Draws parallels between business logistics and humanitarian logistics in terms of their unique characteristic	Creates a framework in order to distinguish between actors, phases and logistical processes of disaster relief
Balcik and Beamon, 2008	Conventional and humanitarian logistics	Comparison of performance measurement in the humanitarian relief chain with the performance measurement in the commercial supply chain	Discovered new performance metrics for the humanitarian relief chain, and a performance measurement framework for the relief chain
Perry, 2007	Planning and management	Field study: a comprehensive hindsight-analysis case	The work places natural disaster response activity clearly to the context of local-nation-led holistic disaster planning
Smirnov et al., 2007	Planning and management	Applies decision-making tasks used in production network management into disaster response operations application	An approach to decision making in disaster response operations application that makes it possible to use decision-making tasks from production network management
Long and Wood, 1995	Coordination, cooperation and information sharing	Discussion of different logistical aspects of famine relief efforts	Major opportunity for improving the logistical support of disaster operation lies in the information systems
Schulz, 2008	Coordination, cooperation and information sharing	Investigating of what synergies and potential types of benefit in horizontal cooperation between humanitarian organizations could produce, and what impediments to their realization exists	Potential synergies exist in both humanitarian and private sector

Table 2-1: Figure: summary of literature review

3 Disasters

This chapter aims to give an understanding of what a natural disaster is by defining natural disasters in term of their characteristics. It aims to explain why there has been an increase of the frequency of natural disaster during the last century and how natural disasters impacts the human civilization. Types of different disasters and factors that influences the impact natural disasters have on the human civilization are described.

3.1 Definitions of natural disasters

This section seeks to define the term "natural disasters" by drawing parallels between researchers and professionals.

(Schulz 2008) defines a disaster as "an occurrence of widespread severe damage, injury or loss of life or property with which a community cannot cope and during which the society undergoes severe disruption.(Schulz 2008). The Emergency Database (EM-DAT), maintained by The Center of Research on the Epidemiology (EM-DAT) defines a disaster as:

> *"A situation or event which overwhelms local capacity, necessitating a request to the national or international level for external assistance, or is recognized as such by a multilateral agency or by at least two sources, such as national, regional or international assistance groups and the media"(EM-DAT)*

(van Wassenhove 2006) defines a disaster as "*a disruption that physically affects a system as a whole and threatens its priorities and goals"* (van Wassenhove 2006) and (Akkihal 2006) states that:

> *"When the magnitude and frequency of fluctuation in the geological and climate systems at a specific time and place exceeds the capacity of the civilization at a locality to absorb geological and climate shock , a hazard is born"*. (Akkihal 2006)

A disaster is not redeemed before fluctuation of the nature interferes with human civilizations and creates deaths, damages and economic losses. The term "natural disaster" for disasters triggered by natural phenomena can be misleading. It implies that the disaster results solely from natural hazards, while in fact human behavior and settlement practices (e.g. poor farming, grazing or excessive exploitation of natural resources) are major contributing factors in its creation (Schulz 2008)

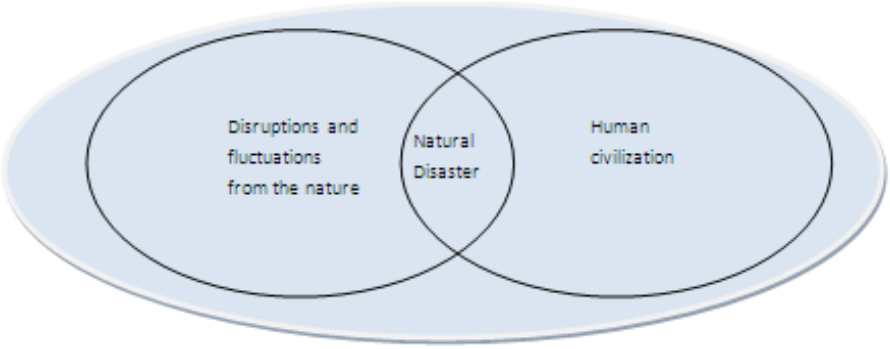


Figure 3-1: The figure shows hoe Nature Intersection with Human Civilization creates natural disasters

Though the researchers has slightly different ways of defining the extent of a disaster there is no doubt that a disaster is an occurrence of an event that affects people and creates relief victims, in need of aid. (EM-DAT) defines affected as:

> *"People requiring immediate assistance during a period of emergency that is requiring basic survival needs such as food, water, shelter, sanitation and immediate medical assistance"*. (EM-DAT)

3.2 Disaster types

A disaster can be categorized according to their causes (natural versus technological or man-made) and speed of occurrence (sudden onset versus slow-onset)(van Wassenhove 2006). (van Wassenhove 2006) defined four categories to explain the different types of disasters.

	Natural	Man-made
Sudden-onset	Earthquake Hurricane Tornadoes	Terrorist Attack Coup d'Etat Chemical leak
Slow-onset	Famine Drought Poverty	Political Crisis Refugee Crisis

Table 3-1*: Disaster categories (van Wassenhove 2006)*

(van Wassenhove 2006) distinguishes between natural and man-made disaster. A natural disaster is a disaster caused by nature itself while a man-made disaster is a disaster caused by human beings. Sudden-onset disasters are referred to disaster that occurs immediate without or with less information in advance (e.g. earthquakes, tornadoes, hurricanes, terrorist attacks, chemical leaks, and coup d' état), while Slow-onset disasters are disaster

that are developing and evolving over time (e.g. famine, drought, poverty, political crisis and refugee crisis). Wars are not included in man-made disasters since these are in categories of their own, and since humanitarian organizations do not get involved while the fighting continues(van Wassenhove 2006).

United Nations international strategy for disaster reduction (UNISDR 2006) has used data from (EM-DAT) to present 3 categories of natural disasters, hydrometrical disasters (drought, extreme temperatures, floods, wild fire, wind storm), geological disasters (slide, earthquake, volcano, mass movements) and biological disasters (epidemic, insect infestations)(UNISDR 2006). (EM-DAT) has also defined a category containing technological disasters. Technological disasters are describe as industrial accidents (e.g. chemical spills, collapse of industrial infrastructure, poisoning and radiation), transport accidents (e.g. during transportation by air, rail, road or water) and miscellaneous accidents (collapse of domestic/non-industrial structures, explosion and fires).

Hydrometrical disasters:	**Geological disasters:**	**Biological disasters:**	**Man-made disasters (technological):**
Drought	Earthquake	Epidemic	Industrial accidents
Extreme temperatures	Volcano	Insect infestations	Miscellaneous accidents
Floods	Mass movements		Transport accidents
Wild fire			
Wind storm			

Table 3-2: ***Categories of Disasters***

In our thesis our research focus will deal with natural disasters and not man-made disasters. This is done make limitations and to narrow our research focus.

3.2.1.1 Natural disasters defined in respect of disaster types

The disasters are defined in respect of (van Wassenhove 2006) disaster categories described in previous section. The disasters types are defined by (EM-DAT) and according to their causes and speed of occurrence.

	Sudden-onset	Slow-onset
Disaster type:		
Complex Disasters	x	x
Drought		x
Earthquake (seismic activity)	x	
Epidemic	x	
Extreme temperaturs	x	
Flood	x	x
Insect infestation	x	
Mass movement dry	x	
Mass movement wet	x	
Storm	x	
Volcano	x	
Wildfire	x	

Table 3-3: Definition of disasters in respect of the disaster categories (EM-DAT ; van Wassenhove 2006)

Complex disasters are disasters that are complex in that senses that they are a compounded by several of factors summarized making an impact on a specific area. This type of disaster does not receive much attention in this thesis due to the small registered number of impacts in our secondary data.

Drought can be described as a slow-onset disaster due to the fact that droughts do not happen suddenly but evolves over time.

Earthquakes are a type of disaster that can be described as sudden-onset because it usually happens without warnings. *Insect infestations, mass movements, storms, volcanoes* and *wild fires* can also be described in terms of sudden-onset disasters.

Epidemics can be described as sudden-onset because an outbreak does not evolve over time but often happens quickly. However, it can be discussed whether epidemics should be describes as slow-onset as well as sudden-onset due to the fact that there are a lot of environmental factors playing a role. High density of people, bad hygienic surroundings and the lack of medical expertise can be factors that could help to predict these kinds of disasters before they happen.

Extreme temperatures are defined as sudden-onset disasters because they often appear unannounced. Though extreme temperatures are defined as sudden-onset disasters it can be discussed whether it could be defined as slow-onset as well. Due to the fact that extreme temperature can, to a certain extent, be predicted in advance due to seasonal fluctuations, it can be define in terms of slow-onset disasters.

Floods can be describes in terms of both sudden and slow onset disasters. Floods can evolve over times because of e.g. longer periods of rain, or it can happen suddenly without warnings because of e.g. heavy rain falls over short time.

3.3 Occurrence and impact of natural disasters

This section aims to explain why natural disasters have shown an increase in frequency during the last century. It also aims to explain how a country's vulnerability effects the impacts of natural disasters.

Occurrence of natural disasters

(UNISDR 2006) has used data from (EM-DAT) in the period of 1900 to 2005 to analyze the disaster occurrence in the last century, in respect of biological, geological and hydrometeorological disasters. The data that have been analyzed and shows stable tends of occurrence of these natural disasters until middle of the century. From 1950 to 1985 the number of registered hydrometeorological disasters rises from 25 to almost 200 per year. From 1985 to 2005 the number has doubled. The occurrences of biological and geological disasters have been stable until 1975. After 1975 we can see a tendency of increased frequency from both types. Biological disasters have shown the highest growth in frequency with a peak in 1999 with over 100 registered natural disasters.

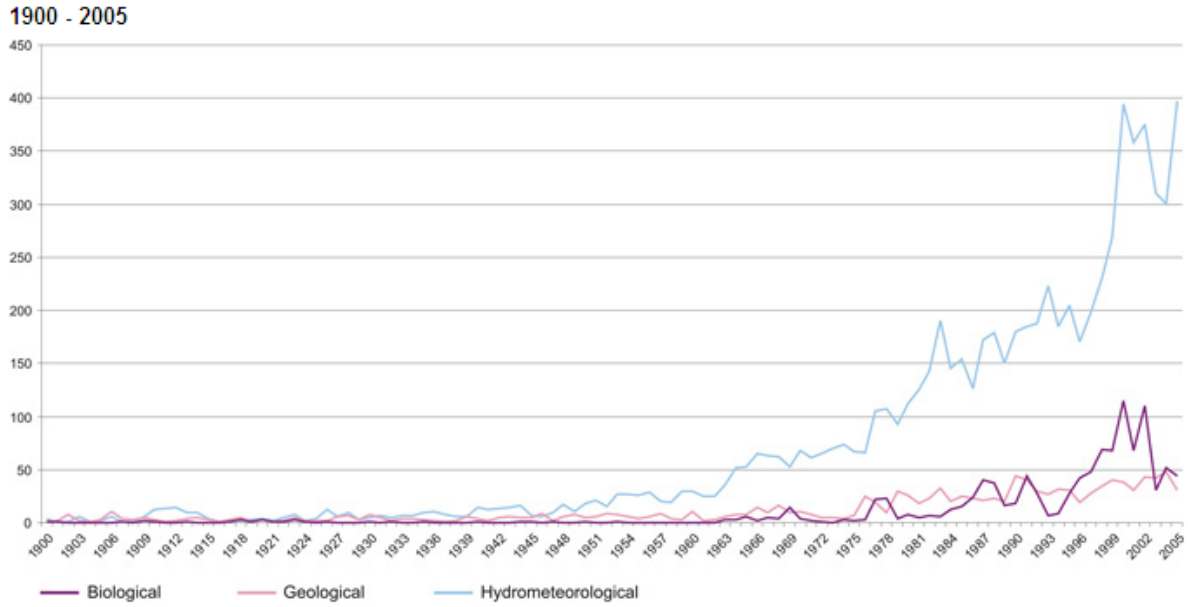


Figure 3-2: The trend of natural disaster occurrence, in respect of biological, geological and hydrometeorological disasters (UNISDR 2006)

There may be several of reasons why the total numbers of registered disaster have increased. It can be discussed whether the rapid growth of natural disasters is a result of increased frequency of disruption and fluctuation in the nature, or as a result of population

growth and increased urbanization. The higher the growth is in the population, and the higher the density of population is, the more interference there will be between the human civilization and the disruptions and fluctuation from the nature. Increased urbanization has also resulted in higher emissions and has scientifically been prove as to cause a higher global temperature. Higher global temperature has made the earth generating more natural disruptions and fluctuations than before. Improved reporting techniques of reporting organizations such as the general press and specialized organizations have also played a role to map natural disasters and to put focus into it.

The impact from natural disasters

There are two factors that influences the impact from natural disasters, the hazard factor (based on meteorological, geological or ecological characteristics) and the vulnerability factor (expressed by the number of people at risk of being harmed by a hazard's occurrence)(Guha-Sapir, Hargitt, and Hoyois 2004).

The size of the population as well as the size of the territory affects the threat to and the vulnerability of a region. The most vulnerable continents are Africa and Asia. Approximately 88% of the people reported killed and approximately 96% of the people reported affected comes from these areas. Due to the relation between natural disasters and density of population it can be noted that Asia make 30% of the world landmass while containing 60% of the world's population. Most people affected pr 100 000 inhabitants comes from South and East Asia and the central regions of Africa(Schulz 2008). Al the countries from these regions have based most of their livelihoods on agricultural and have high density of population (e.g. in river basins). The figure below shows how the different natural disasters related to mortality risk affects areas of the world.

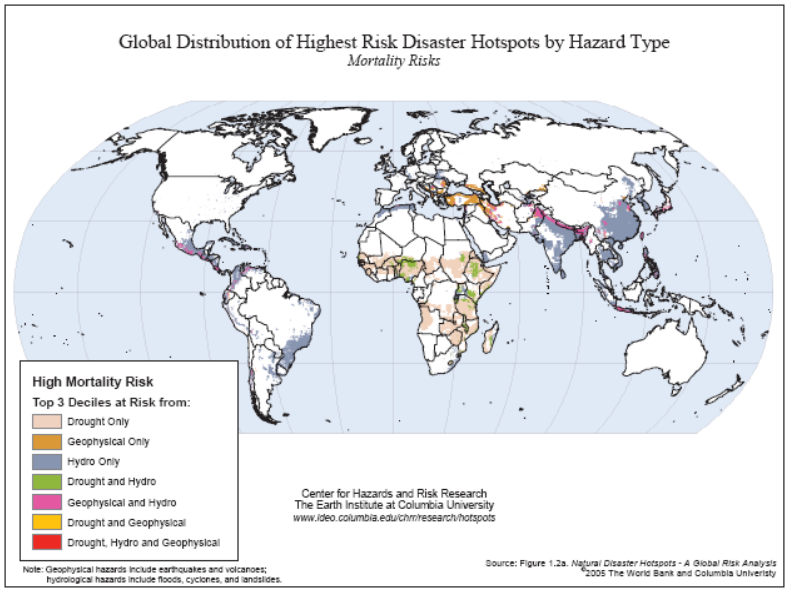


Figure 3-3: Different natural disasters related to mortality risk affects areas of the world *(Dilley et al. 2005)*

3.3.1.1 The hazard factor

Due to the hazard factor (Guha-Sapir, Hargitt, and Hoyois 2004) describes five main disasters types over the last 30 years. This can be used in order to explain how varying types of disasters also results in varying levels of mortality, injury and damage to livelihoods and infrastructure.

Earthquakes is the disaster that has usually has the highest mortality rate and structural destruction, they are the least predictable. Main risk factors are the density of population, structural fragility and the degree of seismic activity. On the other hand, this kind of disaster normally hardly affects standing crops. This can be described as a sudden-onset disaster.

Droughts and famines affect wide areas and have usually a huge effect on the local agriculture because of heavy losses of crops and livestock. Famines are often more complex and can be generated by incidents such as droughts, crop failures or disasters such as floods or armed conflicts. Droughts usually develop over time and are more predictable than other disaster types. Both disaster types can in generally be described as slow-onset disasters.

Floods can cover immense areas and are often invasive and omnipresent. Floods generally affects more people than they kill because they usually only affects infrastructure and crops. They can slow-onset and be easy to predict or they can be sudden-onset.

Volcanic eruptions can affect populations by several of ways such as lava flows, projectiles, lahars (mudflows with volcanic fragments), and ash fallouts.

Ash emission in particular can have severe indirect consequences such as chronic respiratory diseases and the destruction of crops and the basis for livestock husbandry. Volcano eruptions can affect a lot of people but the mortality rate is usually low. Volcano eruptions are in general sudden-onset disasters, but since volcanoes are usually under surveillance, people are often warned before an outbreak.

Windstorms are considered as one of the most destructive disaster types because they are covering wide areas when occurs. They can result in significant numbers of fatalities, injuries and property or agricultural losses. Windstorms are often sudden-onset, but not to the same extent as earthquakes due to the ability for weather forecasts and weather surveillance.

3.3.1.2 The vulnerable factor

Due to the vulnerable factor, The populations vulnerability has four main categories(Schulz 2008):

- Physical aspects of vulnerability (how exposed people are to a potential hazard).
- Social vulnerability (e.g. growth of the population, urbanization, the existent of social safety nets and the existents of conflict or unstable political environments).
- Economic vulnerability (e.g. the population's dependency on agriculture, access to basic infrastructure, diversity of the country's economy).
- Environmental vulnerability (challenges such as soil erosion, pollution, deforestation and water availability).

All the four categories are linked to each other and create the conditions that foster the emergence and establishment of poverty.
Disasters have more impact over poor countries. With respect to the numbers of victims per 100 000 inhabitants per year over the last 30 years, the ten richest countries in the world had a range between 0 to 200 while the poorest countries exhibit ratios from 1 000 to 8 759 (in Malawi)(Guha-Sapir, Hargitt, and Hoyois 2004).
"*The interaction of poverty and vulnerability is a vicious cycle that can only be broken through appropriate sustainable development mechanisms.*"(Guha-Sapir, Hargitt, and Hoyois 2004). When disasters strike poor countries the impact for the population will have larger consequence than for well developed countries. Poor and under-developed countries

do not have the same ability to prevent and militate against disaster occurrences. Disaster relief operations have a tendency focuses on reaction and damage reduction, not how they can prevent it. This often results in alleviation for the relief victims straight after the impact of a disaster, but it doesn’t help to prevent and prepare for next.

Later in this study we will demonstrate how developed countries are more vulnerable than high developed countries, by using Gross Domestic Product as an indicator of how developed and wealthy a country is.

4 Disaster relief operations

This chapter aims to give the reader an understanding of disaster relief operations by disaster relief operation in terms of phases. It also points out important actors involved.

4.1 Definitions of disaster relief operations

Disaster relief can be defined as a *"foreign intervention into a society with the intention of helping the local citizens"*(Long and Wood 1995). (Schulz 2008) defines *"disaster management"* by referring to the Disaster Management Centre of the University of Wisconsin. (Schulz 2008)defines it as

> *"The range of activities of activities designed to maintain control over disaster and emergency situations and to provide a framework for helping at-risk persons to avoid or recover from the impact of the disaster. Disaster management deals with situations before, during and after a disaster"(Schulz 2008).*

The objective with disaster management can be described with respect to three points:

1. To reduce or avoid the human, physical, and economic losses suffered by individuals, by the society, and by the country at large
2. To reduce personal suffering
3. To speed recovery

(Kovács and Karen M. Spens 2007) states that the focus of disaster relief operations is to:

> *"design the transportation of first aid material, food, equipment, and rescue personnel from supply points to a large number of destination nodes geographically scattered over the disaster region and the evacuation and transfer of people affected by the disaster to the health care centers safely and very rapidly"(Kovács and Karen M. Spens 2007).*

Thus different researcher have different ways of defining what a disaster relief operation is, the overall goal for all of them is to alleviate relief victims as soon as possible with the right supplies and services.

4.2 Phases of disaster relief

Both researchers and practitioners have discussed how disaster relief should be divided into processes and even to the extent of how it should be defined. (Kovács and Karen M. Spens 2007) defines disaster relief operations as three phases; (1) preparation, (2) immediate response and (3) reconstruction.

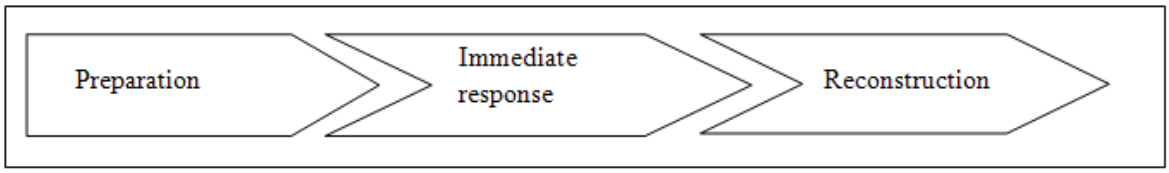


Figure 4-1: ***The phases of disaster relief (Kovács and Karen M. Spens 2007)***

Most researchers agree on that disaster relief consist of three main phases that has to be managed, but some of them have defined to a deeper extent.
(Tufinkgi 2006) developed a more detailed three-phase model from a disaster management perspective based on process descriptions drawn up by the Disaster Management Centre of the University of Wisconsin (Tufinkgi 2006). He differentiates between three phases of pre-disaster (comprising prevention, mitigation, and preparedness); response (consisting of warning, impact and emergency response); and post-disaster recovery (transition/rehabilitation and reconstruction and development).

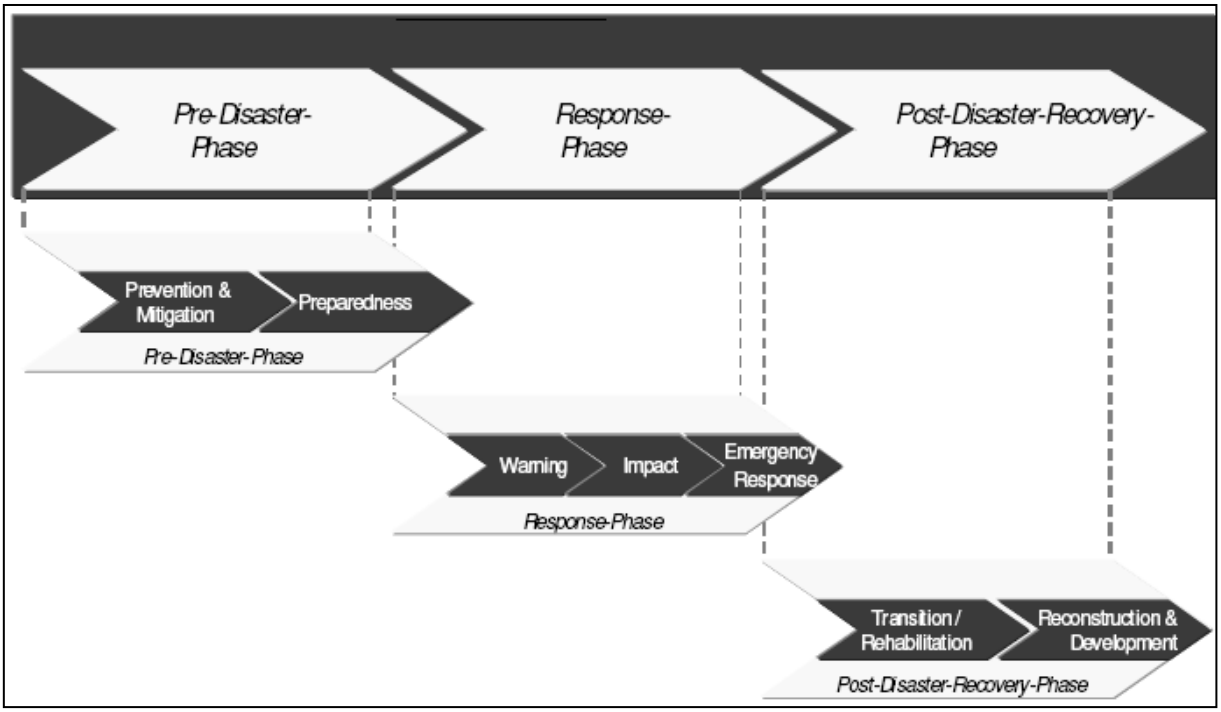


Figure 4-2: ***Tufinkgi's three-phase model (Tufinkgi 2006)***

Schultz presents the emergency response cycle of humanitarian organizations based on IFRC Disaster Response Cycle. This takes the emergency response phase (immediate response) and explains it furthermore by illustrating different steps from identification of beneficiaries to resource distribution and evaluation of impact.

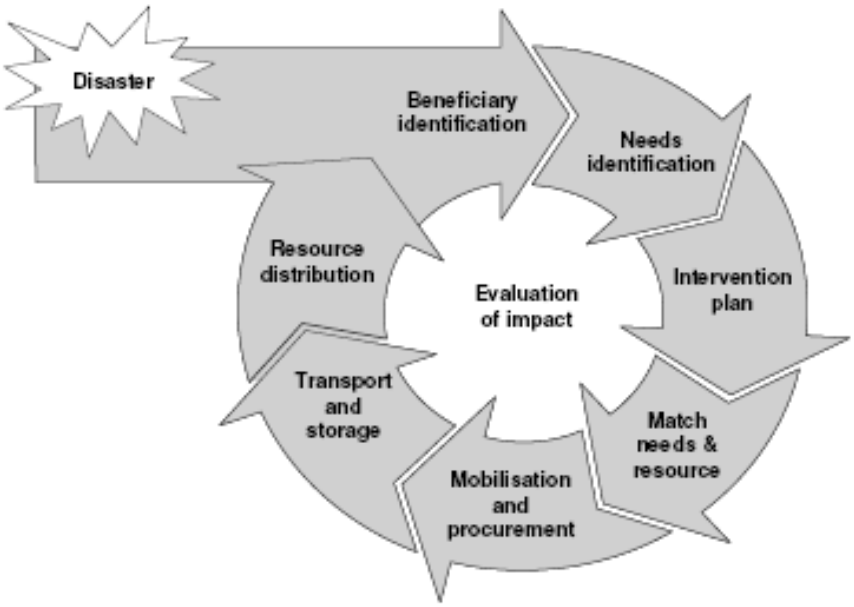


Figure 4-3: ***Emergency response cycle of humanitarian organizations (based on the IFRC Disaster Response Cycle)(Schulz 2008)***

"Once a disaster occurs, demand for large amounts of a large variety of supplies occurs suddenly in massive amounts" (Balcik and Beamon 2008). Their work introduces the Relief mission cycle model identified by (Thomas 2003) and (Beamon 2004) and modified it to describe the general flow of resources to the affected areas. The model consists of four phases. First phase (assessment) is assessment of resource after a disaster has occurred. In the second phase (deployment) supplies are deployed to disaster areas to reach relief victims. In the third phase (sustainment) operations are sustained for a period of time and in the fourth phase (reconfiguration) operations are reduced and in the end terminated.

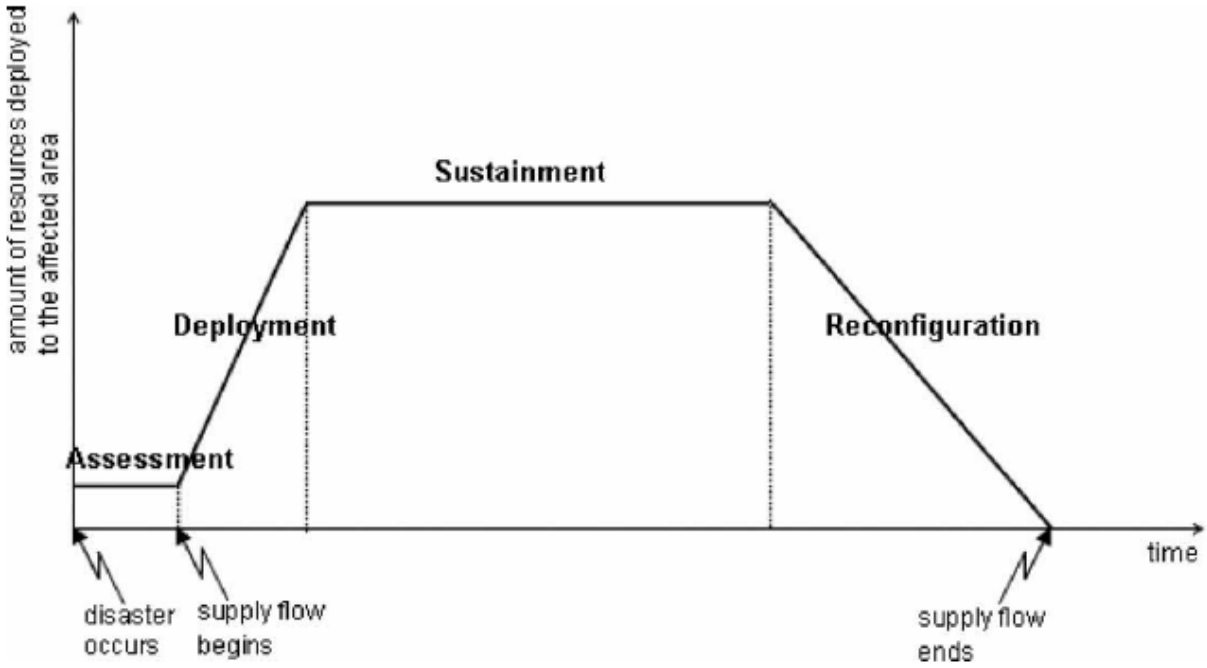


Figure 4-4: *Relief mission life cycle (Balcik and Beamon 2008)*

The length and importance of each phase varies depending on the characteristics of the disaster and the characteristics of the affected areas. (Beamon and Balcik 2008) states that the speed of relief operations during the first days of the disaster significantly affects the lives of many people, threatened by the disaster. The ability of a relief organization to mobilize its resources during assessment and deployment phases is critical to the success of disaster response.

A link can also be drawn to (Beamon and Balcik 2008) relief mission life cycle by introducing the definitions of (van Wassenhove 2006) of how coordination can and should be applied into a disaster relief operation. The coordination forms are linked to the different phases with respect of their characteristics and the different phases' requirements and needs.

	Ramp Up	Maturity	Ramp Down
Command			
Consensus			
Default			

Figure 4-5: *Coordination types and disaster lifecycle phase (van Wassenhove 2006)*

Coordination by **command** has a central coordination and agrees on responsibilities and objectives, common territorial and areas of responsibility.

Coordination by **consensus** emerges when organizations have access to compatible or shared communications equipment, liaison and interagency meetings and pre-mission assessments.

Coordination by **default** is routine contact between desk officers and civil military operations centers.

Coordination by command is appropriate in the ram-up phase which in context to *Relief mission life cycle by (Beamon and Balcik 2008)* can related to the deployment phase. The consensus way of coordinating a disaster relief operation is most appropriate when the operation is mature or according to (Beamon and Balcik 2008)is sustained. Coordination by default is appropriate in the ramp-down phase which can be related to the reconstruction phase described by (Beamon and Balcik 2008).

(Balcik, Beamon, and Smilovitz 2008) describe the last part in the emergency response phase (immediate response) as “the last mile distribution problem”. This is the final stage of the relief chain and refers to delivery of relief supplies from local distribution centers (LDCs) to people in the affected areas. They describes the logistical problem related to this as limitations related to transportations resources and emergency suppliers, difficulties due to damaged transportation infrastructure and lack of coordination among relief actors.

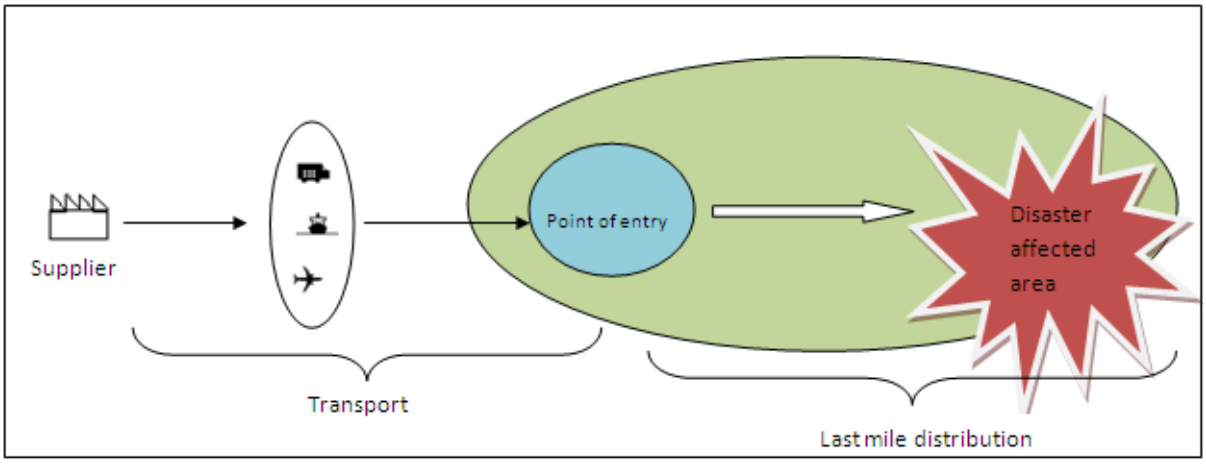


Figure 4-6: *Last mile distribution*

4.3 Actors and parties concerned

When a natural disaster occurs, the size and impact of the disaster defines who should handle the relief operations. If the disaster is of minor art, specialized national or local agencies, sometimes in cooperation with international organizations, handle the disaster. The Pan American Health Organizations (PAHO) and World Health Organization (WHO) claims that if there is a major disaster, it is usual to call for the international community for help The following section gives a brief overview and divides the actors in four main groups:

1. Beneficiaries
2. Operational actors
3. Donors
4. Media

Beneficiaries

Beneficiaries can be described as those who receive some kind of aid from another part. In this context we are talking about a part receiving aid from another part as a result of a disaster. We divide the beneficiaries into two groups: the local population of the affected area and the local government. The local populations are the addresses of the help provided by the international community. The local government is the body that requests

international help and generally coordinate the overall operation(Pan American Health Organization and World Health Organization 2001; Tufinkgi 2006).

Operational actors

In the world of humanitarian aid logistics and relief operations there are several of actors that make their contributions. The different actor has different roles but all are working towards the objectives of humanitarian relief and alleviation. Operational actors serve as a connection between donors and relief victims but work in different ways. Some are focusing on distribution of supplies, services and knowledge while other agencies are focusing on effective coordination and collaboration and how to enhance this. Operational actors can be divided into four main groups, (1) multilateral, intergovernmental organizations (IGOs), (2) Nongovernmental organizations (NGOs), (3) International coordination agencies (own definition) and (4) others (Pan American Health Organization and World Health Organization 2001).

Multilateral, intergovernmental organizations (IGOs): generally, these give support by providing technical assistance related to their special field of expertise, by delegating consultants and experts, or by supporting the allocation of resources to other NGOs or local organizations, or directly to the beneficiaries (Pan American Health Organization and World Health Organization 2001). The body UN agencies are one of the most important representatives to this group. In addition to the UN agencies there exist several of other agencies that has a mandate to support member states during all or certain phases of the disaster cycle (Pan American Health Organization and World Health Organization 2001).

Name	Description	Web site
United Nations Development Program (UNDP)	Is the UN's global development network. It is an organization that works as advocate for change and connecting countries to knowledge, experience and resources. Their goal is to help people to work independently wit own solutions for national and local development.	http://www.UNDP.org
United Nations Office for the Coordination of Humanitarian Affairs (OCHA)	OCHA has a mandate to work with coordination of humanitarian response, policy development and humanitarian advocacy. Its mission, in collaboration with other national and international actors, is to mobilize and coordinate effective humanitarian actions aimed at relieving human suffering in disasters and emergencies.	http://www.reliefweb.int/ocha_ol
World Food Program (WFP)	The world food program works to provide and coordinate food assistance and contributes to logistics coordination during large-scale emergencies. Their aim is to work for a world without hunger and need for food aid.	http://www.wfp.org
United Nations High Commissioner for Refugees (UNHCR)	The United Nations High Commissioner for Refugees works to protect refugees and search for sustainable solutions to their problems. It has the mandate to coordinates all assistance to refugees.	http://www.unhcr.ch
United Nations Children's Fund (UNICEF)	The focus of UNICEF is children and how they can overcome obstacles like poverty, violence, disease and discrimination. It works to cover their needs during emergencies, including food, water, sanitation, health care, and social services.	http://www.UNICEF.org
World Health Organization (WHO)	Has the authority to direct and coordinate the aspects of health within the UN system. It is responsible for instance for shaping the health and research agenda, setting norms and standards and assessing health trends,	http://www.who.org

Table 4-1: ***Multilateral, intergovernmental organizations (IGOs): UN agencies (Schulz 2008)***

Name	Description	Web site
European Community Humanitarian Office (ECHO)	Collaborate with nongovernmental organizations, UN agencies and other international organizations in order to provide food and other kinds of emergency assistance and to help displaced populations. It invests in disaster prevention projects in high-risk regions.	http://www.europa.eu.int/comm/echo/
Organization of American States (OAS)	A regional body that supports member states by assessing their vulnerability to natural hazards and implementing measures to mitigate the impact of disasters. It manages the Inter-American Fund for Assistance in Emergency Situations (FONDEM). It also provides development planning, technical assistance and training in the design of projects,	http://www.oas.org
Caribbean Disaster and Emergency Response Agency (CDERA)	A regional organization established by the Caribbean Community. It has 16 member states, and has coordination of response to any disaster affecting member as core function.	http://www.cdera.org
Coordination Center for the Prevention of Natural Disasters in Central America (CEPREDENAC)	Is an official organization within the Central American Integration System (SICA). It works to build local capacity for vulnerability reduction and collaborates with national scientific and operations agencies. Its objective is to exchange experiences, technology and information to promote disaster reduction in Central America.	http://www.cepredenac.org

Table 4-2: ***Multilateral, intergovernmental organizations (IGOs): other agencies (Schulz 2008; Pan American Health Organization and World Health Organization 2001)***

Nongovernmental organizations (NGOs): are a wide group of organizations, national and international. This organization varies in size and networks as well as their operational approaches. Some of the international NGOs are specialized in disaster relief operations and can therefore offer tailored skills and equipment to the relief victims. There are hundreds of NGOs worldwide that has different agendas motivated socially or religiously, and they have different capabilities, experience and resources. Less than a dozen of the NGOs receive over 90% of the reported funds of the NGOs community(Ferris 2007).

Name	Description	Web site
The International Federation of Red Cross and Red Crescent Societies (IFRC)	The IFRC is an international humanitarian organization bringing together national bodies from 175 countries. It coordinates international humanitarian assistance and is based in Geneva. It works to coordinates international humanitarian assistance and intervenes in affected countries through its national societies or, should no national office exist, with the Federation's own staff. Because of its great experience and flexibility, and its considerable resources, IFRC is one of the most useful nongovernmental sources of cooperation and support for the health sector.	http://www.ifrc.org
Médecins sans Frontières (MSF)	Is a European organization comprised of several independent national bodies (MSF Spain, MSF France, MSF Holland, etc.) Its focusing on medical assistance, and has great experience and capacity in logistics, water purification, sanitation, and the provision of temporary shelter.	http://www.msf.org
Doctors of the World	Is a humanitarian *medical* NGO that works with emergencies. It carries out medium- and long-term development projects.	http://www.doctorsoftheworld.org/
Cooperative for Assistance and Relief Everywhere (CARE)	Is a confederation of 10 national agencies from North America, Europe, Japan and Australia. Its Headquartered in Belgium and manages development and aid projects in 62 countries in Africa, Asia, Latin America and Eastern Europe. CARE USA, based in Atlanta, oversees CARE projects in Latin America and provides emergency assistance to communities affected by disasters.	http://www.care.org
World Vision International	Is a Christian organization that intervenes in aid activities during disasters. It has a focus on children, families and to overcome poverty and injustice. It also provides development aid.	http://www.wvi.org
Caritas Internationalis	Is a Roman Catholic international confederation of 146 agencies working in 194 countries and territories. It works to promote, coordinate and support emergency aid and long-term rehabilitation.	http://www.caritas.org
OXFAM	Is a network of 11 humanitarian groups from Australia, Belgium, Canada, Hong Kong, Ireland, the Netherlands, New Zealand, Spain, the United Kingdom and the United States. It works to provides funds and technical assistance for immediate and long-term aid in disaster situations.	http://www.oxfam.org
Action Against Hunger	Is a European organization that works for food security and distribution. It also works to rehabilitate agriculture and food production that has been suffering from disasters.	http://www.aah-uk.org
The Salvation Army	It intervenes in more than 100 countries working to provide social, medical, educational and other types of community assistance. In disaster situations, national affiliates provide health assistance and emergency supplies.	http://www.salvationarmy.org
World Council of Churches	Is a coordinating body representing over 330 Christian and Orthodox denominations from 120 countries and territories worldwide. It works to support disaster relief efforts in various countries.	http://www.wcc-coe.org/wcc/english.html
Save the Children	Save the Children intervenes in long-term development projects. In emergency situations, it provides humanitarian supplies and rehabilitation and reconstruction assistance and fights for	http://www.savethechildren.org/home.html

	children's rights and strives to deliver immediate and lasting improvements for children's lives.	
International Red Cross Committee (ICRC)	Is a humanitarian Swiss organization that is based in Geneva. It is strictly private and neutral and works to protects and helps the victims of armed conflicts or civil disturbances. It also monitors the application of international humanitarian law	http://www.icrc.org/eng

Table 4-3: ***Nongovernmental organizations (NGOS) (Pan American Health Organization and World Health Organization 2001; Schulz 2008)***

International coordination agencies consists of several of NGOs associations that works for coordination and advocacy reasons. During disaster relief operation it is often normal that both NGOs and IGOs are present in order to help the relief victims. NGOs are often regarded as more flexible and directly responsive to beneficiaries needs than for example large UN agencies. Unfortunately a lot of NGOs have a lower understating and a lack of expertise when entering a disaster arena. This often causes in occupying resources urgently needed by other organizations. There is therefore a high risk formally or informally established "ad hoc agencies" my block supply chains with unsolicited and unusable donations instead of contributing to the progress of overall operations(Pan American Health Organization and World Health Organization 2001). These are some of the main reasons why NGOs have gone into associations in order to enhance coordination and avoid waste of efforts and coordination, and to maximize donations.

Name	Description	Web site
Voluntary Organizations in Cooperation in Emergencies (VOICE)	Is a network of European nongovernmental organizations that provide emergency and rehabilitation assistance. It contributes to disaster preparedness and conflict prevention. Web	http://www.oneworld.org/voice
International Council of Voluntary Agencies (ICVA)	Brings together NGO's working with humanitarian and human rights as an advocacy alliance for humanitarian action. Focuses on humanitarian and refugee policy issues. It is based in Geneva and consists of 70 member agencies + 5 observers/affiliates around the world working in the fields of humanitarian relief, human rights, and development.	http://www.icva.ch/
InterAction	Strives to set minimum standards and promote best practices in humanitarian assistance it is based I Washington and consists of a Consortium of NGOs in the United States.	www.interaction.org/
Steering Committee for Humanitarian Response (SCHR)	Is a long-standing and influential working party based in Geneva. Members consist of IFRC, CARE international, Caritas Internationals, Catholic Relief Services, Lutheran World Federation, MSF International, OXFAM and World Council of Churches.	http://www.humanitarianinfo.org/IASC/pageloader.aspx?page=content-about-schr

Table 4-4: International coordination agencies (Schulz 2008; Pan American Health Organization and World Health Organization 2001)

Other important operational actors related to humanitarian logistics and disaster relief operations can be:

- Specialized institutions with support to overall relief operation by providing valuable technical assistance.
- The private sector with funds, services, goods or equipment.
- Military institutions with their contributions of equipment, human resources and operational procedures.

Donors

Donors are the source of funding for all kinds of humanitarian work. Most of the humanitarian organizations do not deal with commercial, profit making activities and are dependent on donors to sustain their activities. Donors can be divided into three main groups: (Schulz 2008)(1) neighboring regions or governments, (2) foreign governments and (3) the general public and private corporations.

Neighboring regions or governments are those frequently offering support in the form of donations or volunteers very quickly and un-bureaucratically when a disaster strikes their

nearest neighbor. (Pan American Health Organization and World Health Organization 2001)

Foreign governments with their embassies and bilateral cooperation agencies are the interfaces through which foreign governments can offer assistance(Pan American Health Organization and World Health Organization 2001). (Schulz 2008) describes four of the most important bilateral or multilateral agencies, with their own budgets and programs as following:

1. Office of U.S. Foreign Disaster Assistance of the U.S. Agency for International Development (OFDA/USAID)
2. Office of International Humanitarian Affairs of the Canadian International Development Agency (IHA/CIDA)
3. United Kingdom Department for International Development (DFID)
4. European Commission Humanitarian Office (ECHO)

She explains that: "*these governmental agencies are, among others, members of the Development Assistance Committee (DAC) the DAC is the main body through which the OECD and its member countries deal with issues related to co-operation with developing countries. Emergency relief aid is part of their total official development assistance*"(Schulz 2008)

The *general public and private corporations* is a group comprising individual donations from private persons or private corporations. This is donations that are not registered and are donated to a wide range of organizations. " *A rough estimate ventured by interviewers is that this sector accounts for up to 20% of the total emergency relief aid*"(Schulz 2008).

Media

Media is often the first to cover a disaster and is the first to provide information to the living world. Media has great power since it is it often provides information direct to potential donators. If a humanitarian crisis is covered by the press, it is easier for the donors to relater their willingness to donate to the actual disaster. History shows that the disasters that have received most attention from media are the ones that have received most funds, independent of the government. Sudden-onset disasters are the disasters that receive most interest from media. Media is often driven by the preferences of their viewers and must be on the cutting edge to keep up the numbers. Slow-onset disasters are usually not that interesting for the viewers since this becomes “old news” in the long run. This results in high attention and high fund raising for sudden-onset disasters and less attention and funds for the slow-onset disasters. In the end this often affects underdeveloped countries with higher frequencies of slow-onset disasters such as droughts and famines. Attention by donors towards the immediate relief response to sudden-onset disaster is a good thing, but more attention to should point towards the preparation phase. (Jahre and Heigh 2008) have investigated existing funding patterns and pointed out that investing more in the permanent supply chain structures would significantly reduce the funds needed to set up temporary supply chains during disasters (Jahre and Heigh 2008).

5 Disasters relief logistics

This section aim is to explain and define what disaster relief logistics is by putting it into context with commercial logistics and humanitarian logistics. A briefly description of the characteristics of commercial logistics and humanitarian logistics is given and major similarities and differences between the two areas are pinpointed. The field of military logistics could be included to get a complete elaboration, but have been excluded for simplification.

5.1 Definitions and characteristics of commercial logistics

The term logistics originally comes from the army and can be dated back to the area of Napoleon. Napoleon saw the importance of organizing the camp facilities for his army during wars. M*arcèl de logis* was the officer with responsibility of organizing the camp facilities for his troops(van Wassenhove 2006).

Operation management researchers within this field have different ways of defining commercial logistics and use different interpretations like e.g. business logistics, logistics management and supply chain management. For example (van Wassenhove 2006) uses the term business logistics and defines it as:

> *"a planning framework for the management of material, service, information, and capital flows and includes the increasingly complex information, material, communication and control systems required in today's business environment"(van Wassenhove 2006).*

(Simchi-Levi, Kaminsky, and Simchi-Levi 2000)do not distinguish between the terms *logistics management* and *supply chain management*. They use the term supply chain management and describe it as:

> "a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses and stores, so that merchandise is produced and distributed in the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service lever requirements." (Simchi-Levi, Kaminsky, and Simchi-Levi 2000)

In the next chapter we will seek to draw parallels between commercial logistics and aim to give the reader a definition of disaster relief logistics.

5.2 History and development of commercial logistics

In the 1970s companies focused on optimizations of differentiated units by looking at logistics in the classical and simple way with production as core activities. Transport and storage linked procurement and sales to production with focus on turnover of raw materials and finished goods. In the 1980s companies started to focus on optimizing the cross-functional workflows in order to manage the logistics as an interdisciplinary function and look at the marked as "clients" more than just sales. In the 1990s logistics came into focus as an area to achieve competitive advantage. Functions were integrated into process chains and companies down and upstream in the supply chain were included into value-adding chains. A company was not considered as a solitary actor in the marked but rather as an element in a competitive chain of contributing parts seeking for maximal value for the customers. After the 2000s, designing and optimizing of global networks have been in focus, linking local value chains into global networks. In the figure below a detailed description is made by (Baumgarten 2001).

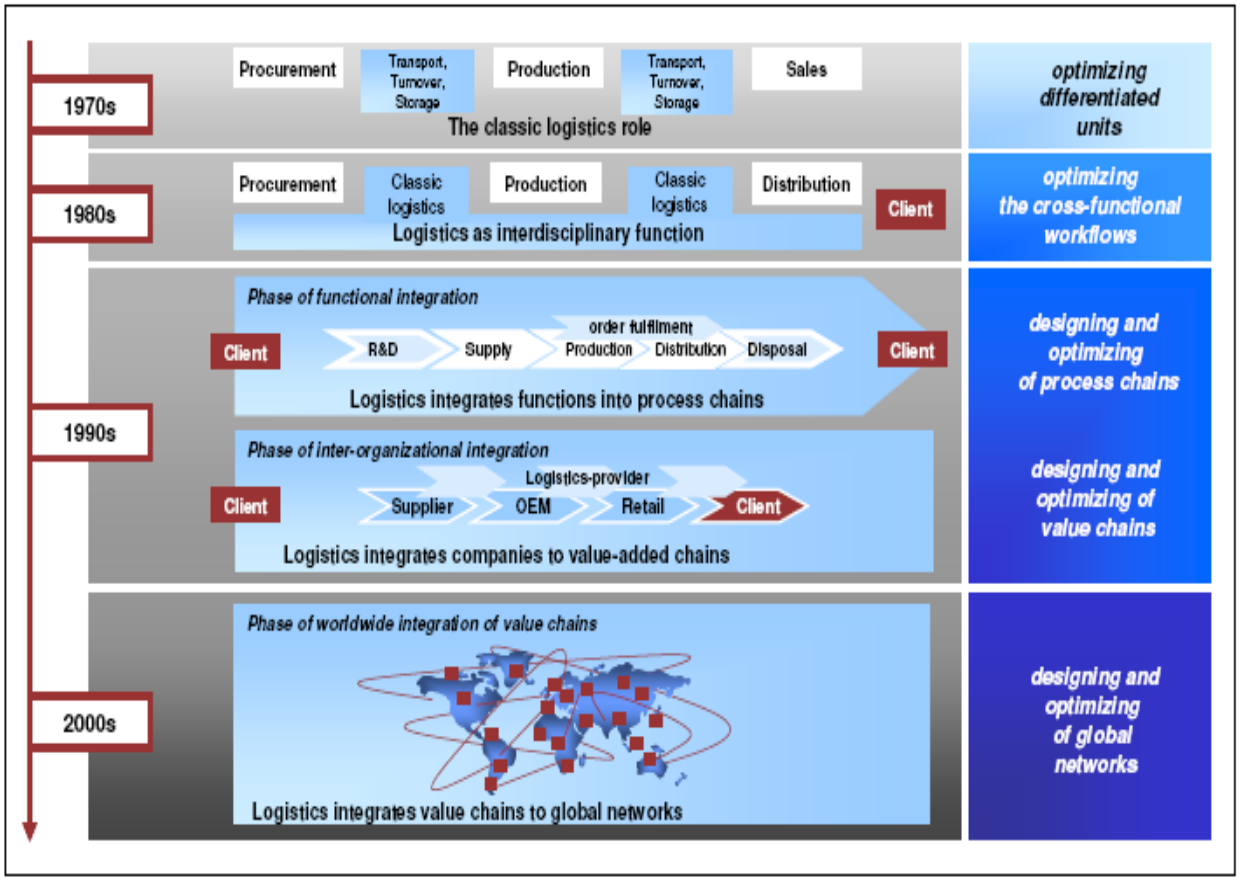


Figure 5-1: The development of logistics (Baumgarten 2001) Translated by the Logistics Department of the Technical University of Berlin and retrieved from (Schulz 2008)

Many companies within the private sector have understood how important logistics is and impact it has on the competitive advantage in the market. In the beginning logistics created competitive advantage. By looking at the extent of the use of logistics in business, we can state that logistics is not only a tool for creating competitive advantage, but rather a necessity to sustain in the market. Third-party logistics (3PL) and four-party logistics (4PL) (Also referred to as ”lead logistics”) have made entrance to the marked, providing professional services to that company that wants to concentrate on their core competence.

5.3 Definitions and characteristics of humanitarian logistics

In the humanitarian world several of terms are used. Humanitarian logistic and disaster relief logistics are often used interchangeably (Kovács and Karen M. Spens 2007) defines “disaster relief” and “continuous aid work” as sub-categories of “humanitarian logistics”. Fritz Institute tried to address a common definition as:

> *"the process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from point of origin to point of consumption, for the purpose of meeting the end beneficiary's requirements"*(Thomas and Mizushima 2005).

The definition, in context with the definitions of (Kovács and Karen M. Spens 2007) mentioned above, puts focus on beneficiaries and gives an end-to-end supply chain management approach in line with the definitions provided for the commercial logistics.

(Jahre and Heigh 2008) distinguish between three types of humanitarian supply chains. (1) The emergency supply chains, (2) the project supply chains and (3) the permanent supply chain infrastructure. The permanent supply chain infrastructure consists of all permanent or long-term facilities and equipment, staff, systems and a standardized process which secures and prepares the responsiveness to any disaster relief operations or ongoing projects the emergency supply chains are related to the immediate response phase and is set up during the first weeks after the impact of a disaster. The emergency supply chain is unpredictable and has a relatively unstable demand and nature. Project supply chains are related to the reconstruction phase and are more predictable and stable. However, both emergency supply chains and project supply chains have a tendency to overlap each other and to identify pure emergency or project supply chains can be difficult. The figure below shows the different types of humanitarian supply chains, described by (Jahre and Heigh

2008) in context with (Kovács and Karen M. Spens 2007) definitions of the disaster logistics phases.

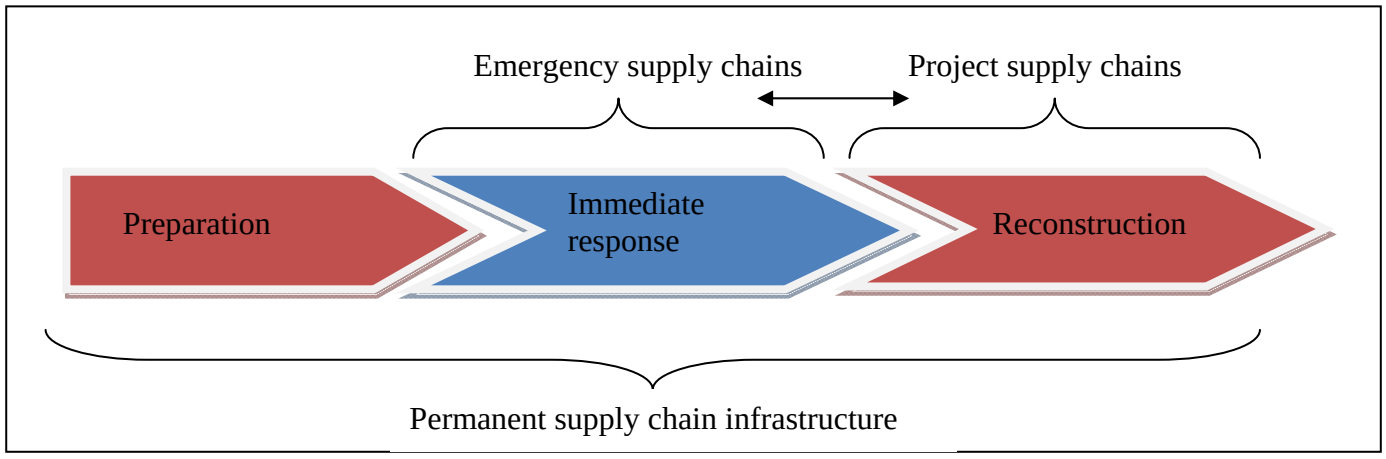


Figure 5-2: ***The phases of disaster relief and supply chains (Kovács and Karen M. Spens 2007; Jahre and Heigh 2008)***

5.4 *Differences and similarities between commercial and humanitarian logistics*

(van Wassenhove 2006) states that humanitarian organizations are about 15 years behind their private sector counterparts. The commercial sector have for a long time realized the importance of logistics and the benefits of effective supply chains. While commercial logistics have exploited the opportunities by going global, humanitarian logistics are struggling to get recognition. (van Wassenhove 2006) states that this has been locked into a vicious circle were the humanitarian organizations lacks the understanding for logistics as a core function and suffer from poor planning and budgetary skills, resulting in logistics requirements not being met.

> *"This in turn has led to a ""fire-fighting mentality"". Managers sees logistics struggling and concluded that a review of logistics was not advantageous further fuelling a lack of understanding, and so the cycle begins again"*(van Wassenhove 2006).

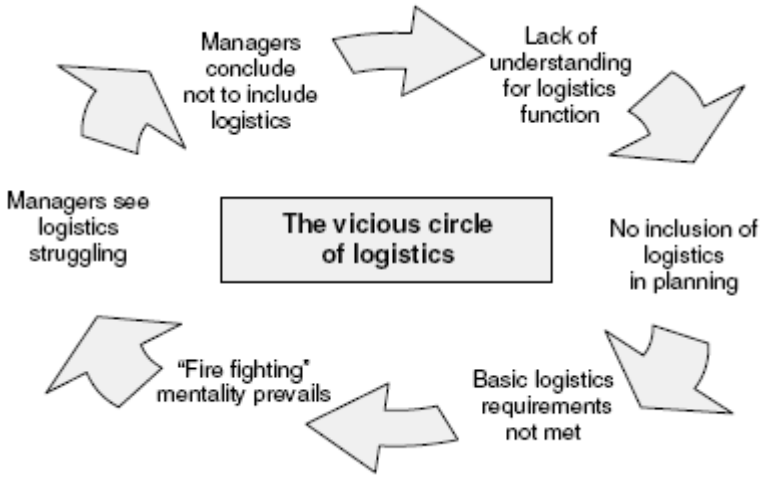


Figure 5-3: ***The vicious circle of logistics (van Wassenhove 2006)***

There are several of characteristics that distinguish private sector from humanitarian logistics and disaster relief logistics.

- (Long and Wood 1995) explains that the customers in disaster relief logistics are not the same as in commercial logistics. The customers in the humanitarian context are referred to as the donors while the beneficiaries are referred to as the consumers.
- Disaster relief operations are characterized with high uncertainty with respect to time, location, demand and extent of the disaster. Private sector and commercial logistics have more settled conditions to deal with.
- Demand for extremely low lead times in disaster relief logistics, affecting the inventory levels, transportation levels distribution management (Beamon 2004).
- Disaster relief often contains high stakes where human lives are depending on the performance of the relief operations. In private sector the stakes are “only money”.
- Disaster relief operations are often operating in difficult environments such as damage to local infrastructure, security issues and other obstacles, while the commercial sector can rely on stable condition guaranteed by local or national community.
- High staff turnover is a frequent problem among humanitarian organizations that deals with disaster relief operations. High pressure and inhuman condition in order to meet the demand of the relief victims can cause fatigue, and make personnel “burn out”(van Wassenhove 2006). In private sector personnel working environments are often protected by civil laws.

Though humanitarian logistics and disaster relief logistics have many differences towards commercial logistics, similarities can also be drawn. Both areas aim to optimize efficiency and effectiveness with basis parameters of time cost and quality. Only the focus is different. Where the commercial sector aims to maximize profit, the humanitarian sector aims to alleviate the suffering from vulnerable people. Logistics is one of the core functions of many commercial companies and is achieving much focus. It should also be core function in disaster relief operations since logistics is estimated to be 80% if the total expenditures for humanitarian organizations (van Wassenhove 2006).

5.5 A reference model of disaster relief logistics

To give a deeper explanation of what disaster relief logistic is, a reference model made by (Tufinkgi 2006) is introduced. This model, referred as the Reference Model of Disaster Relief Logistics or an international disaster relief system (IDRS), explains the different stages and phases from regional clustering to risk analysis to the point of entry and the actual distribution of aid to the beneficiaries. The model is shortly described. Parts in respect to the research focus are highlighted and the work of (Schulz 2008), (Tufinkgi 2006) and (Kovács and Karen M. Spens 2007) are used to describe the model.

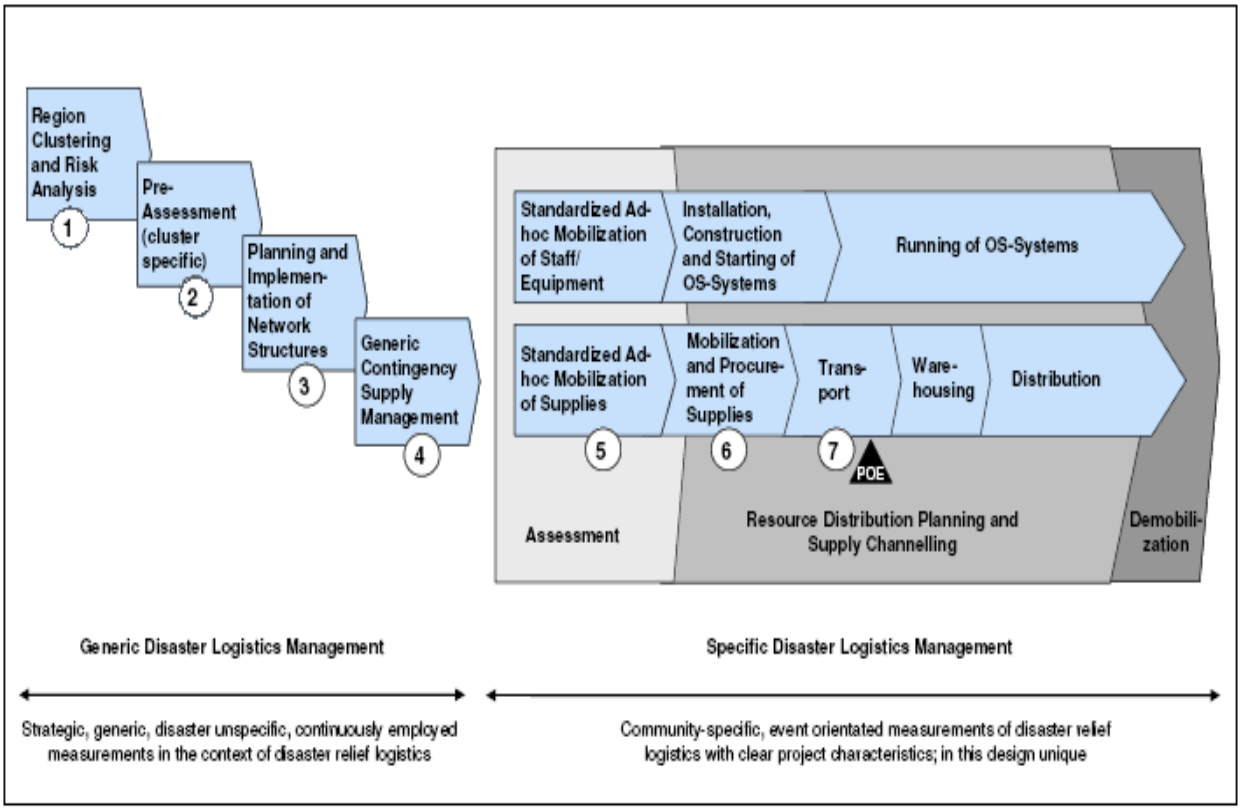


Figure 5-4: ***Reference Model of Disaster Relief Logistics ((Tufinkgi 2006), with minor modifications)*** **(Translated by (Schulz 2008))**

The model consists of seven main steps with two additional steps after the point of entry.

1. **Region clustering and risk analysis** contains tree main tasks. With data and experience from the disasters in the past, the extent of each disaster must be drawn as the first task. Second task aims to identify endangered regions and main treats to in order to make different scenarios with respect to the different types of disasters and the anticipated resource need. The third step creates profiles of resource needs depending on the region as well as the type of disaster using the information gained from the two first tasks. Participants in an IDRS system are identified from local to

international level. Based on appropriate logistics segmentation criteria, different regions that have similar criteria levels will be pooled to form clusters. All the clusters will be defined by their resource needs which form the further assessments and planning efforts.

2. **Cluster-specific pre-assessment** identifies the disaster relief potential for each of the clusters indentified in step one by their structures and resources. The capacity of the IDRS is compared to the potential resource need of the specific cluster in order to identify structural bottlenecks caused by local communities, the cluster or the IDRS itself.
3. **Planning an implementation of network structures** focus on elimination of structural deficits within the IDRS. The objective is to permit a faster ram-up of logistics operations in a disaster relief operation by improving existing, or creating additional structures and logistics systems. Common strategic formulations have to be formulated and physical installations as well as information systems are essential areas to improve.

4. **Generic contingency supply chain management** deals with the anticipation of necessary supplies during a disaster and the executions of generic procurement procedures.

5. **Standardized ad-hoc mobilizations of supplies**. Pre-assessment of the standardized and pre-positioned suppliers are mobilized and the most effective transport alternatives are selected. The objective is to save as much time as possible in the process of reaching the relief victims.

6. **Mobilization and procurement of supplies** deals with establishment of cost-efficient pipelines for procurements of mass products. This switches the delivery of supplies from a push to a pull system.

7. **Transportation of supplies to needed areas** with the additional steps of **warehousing and distribution** as the last steps in an IDRS. These steps can be described by referring to “the last mile distribution phase” as described in previous sections.

An IDRS disaster relief operation is always determinate after a demobilization phase.

By placing this model in context to (Tufinkgi 2006) and (Kovács and Karen M. Spens 2007) definitions of disaster relief phases we can state that the model as a whole is only embraced by the first two phases, the preparation (pre-disaster phase) and the immediate response (the response phase). The first four steps are comprised in the preparation phase while the next three steps can described with respect to the immediate response phase.

In context to the Relief mission life cycle (Balcik and Beamon 2008) we can state that step five and six can be related to the assessment phase while step seven and the additional steps are related to deployment and sustainment. Both models describe a ramp-down phase respectively with the terms reconfiguration and demobilization.

The Emergency response cycle of humanitarian organizations (based on the IFRC Disaster Response Cycle)(Schulz 2008) can also be drawn into this comparison by relating it to step six, step seven and the additional step.

6 Pre-positioning

The first part of this section serves to give you an introduction of the term "pre-positioning" with respect to humanitarian logistics and disaster relief operations. Definitions and approaches among researchers and practitioners are described in order to give a conceptual understanding. The second part of this section gives three main examples of supply chains from the humanitarian world. They are used in order to explain what the term pre-positioning means within the humanitarian context. The first examples regards a humanitarian supply chains with absence of pre-positioning while the last two elaborate of which extent humanitarian organizations use pre-positioned supplies.

6.1 Definition

Pre-positioning of supplies has been a common practice both in commercial and military logistics for decades. Humanitarian logistics have recently started to adopted elements from the commercial and military field, in order to meet their beneficiaries in a better way. Humanitarians have started to understand the importance of acting ex ante a disaster (before disasters strikes) rather than acting ex post a disaster (when the disaster is present). To be prepared with supplies ex ante a disaster has proved a significantly role in disaster relief operation and the ability of alleviating the relief victims. Lead time is crucial due to the death toll that is raising proportional with time.

(Pan American Health Organization and World Health Organization 2001) and (Thomas and Mizushima 2005) defined pre-positioning as *"the storage of inventory at or near the location at which it will be used"* (Thomas 2003; Pan American Health Organization and World Health Organization 2001)Logistics is often-cited as an area that might improve this effort, and inventory pre-positioning has been specifically suggested as a logistical strategy towards a more rapid response(Akkihal 2006). (Oloruntoba and Gray 2006) claims that *"pre-positioning aims to position supplies or other resources at or near places where they are likely to be required"*(Oloruntoba and Gray 2006).

The ability of a relief organization to mobilize its resources during assessment and deployment phases is critical to the success of disaster response. Discussed later in this thesis, (Beamon and Balcik 2008) states that the speed of relief operations during the first days of the disaster significantly affects the lives of many people threatened by the disaster. It is a crucial facts that the performance of a disaster relief operation is much dependent on the level of preparedness (Jahre and Heigh 2008).

Schultz states that:

> *"a simulation model created by the Massachusetts Institute of Technology indicates that relatively small spending on disaster preparedness can already significantly decrease the time and cost of logistics response."* (Schulz 2008)

6.2 Categories and examples of humanitarian supply chains in disaster logistics

In the humanitarian world there are different ways and practices of how to reach relief victims with necessary supplies in case of a disaster. The overall objective for humanitarian organizations is to get supplies to beneficiaries as fast as possible. Some humanitarian does not relate their work to logistics activities, other organizations are following the ad-hoc principle by assigning disaster relief operations as they appear while some humanitarian organization consider logistics as one of their core activities. A focal issue in order to differentiate between different humanitarian supply chains is how humanitarian organizations pre-position their supplies before a disaster strikes. Some humanitarian organizations are not positioning supplies at all; others have centralized warehouses with supplies ready to be shipped to affected areas while some have an extensive network of small or medium size stocks with pre-positioned supplies, positioned in areas with high risk of disasters occurrence.

Based on the discussion in the first section, we can divide the different humanitarian organizations in three main categories, (1) humanitarian organizations that does not consider pre-position of supplies, (2) humanitarian organizations that have one or several of warehouse with pre-positioned supplies and (3) humanitarian organizations that have a network with regional or local warehouse with pre-positioned supplies.

1. Humanitarian organizations that doesn't consider pre-position of supplies are organizations that does not get involved in disaster relief operations on a regularly basis but involve themselves in large-scale disaster in ad-hoc set-ups. Their supply chains and procurement activities usually starts after their appearance and involves sourcing locally, national and internationally. It is common practice to seek for local procurement since this is strengthening for the local community. A lot of humanitarian organizations can be placed in this category, like the German organizations Malteser and Johanitter or "Leger Uten Grenser (the Norwegian fraction of "Doctors without borders")" from Norway. Examples can also be national branches and offices of international networks like Caritas, certain national societies of the Red Cross and Red Crescent Movement. The common

characteristic among the organizations in this category is that their focus is small and often connected to limited access to resources and every organization has its own mission, internal guidelines, and handles things differently.

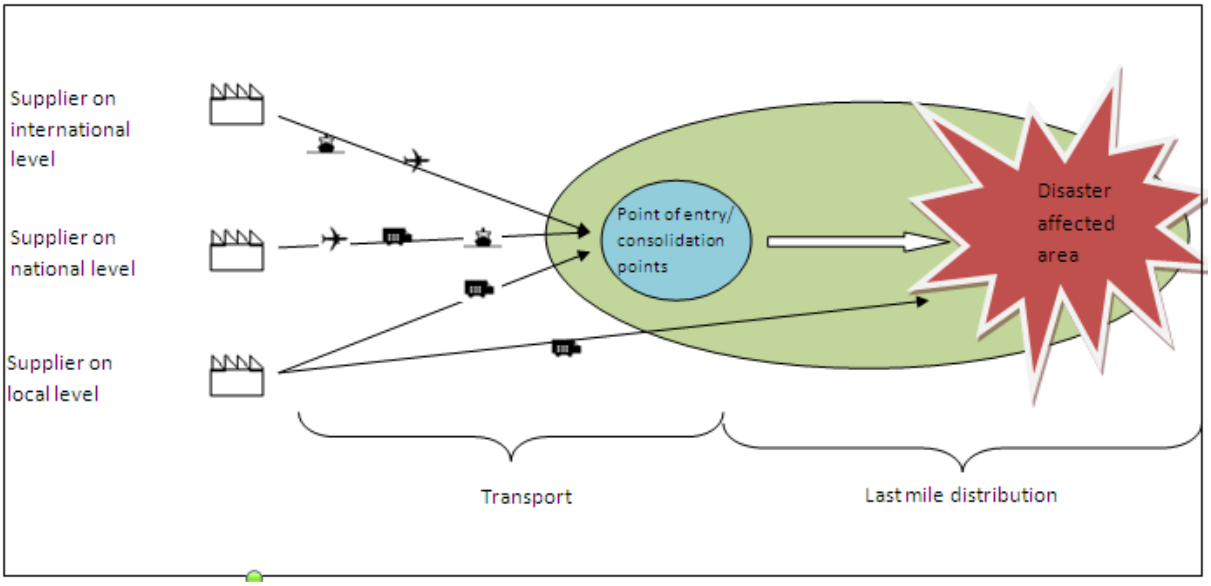


Figure 6-1: Illustration of supply chains of humanitarian organizations in category 1.

2. Humanitarian organizations that have one or several of warehouses with pre-positioned supplies are those that have standardized supplies in central warehouses. These organizations differ from the organizations in category 1 because of their ability to respond immediately to a disaster. Usually these humanitarian organizations are operating with one or two central warehouse, often close to their headquarters or within their home country(Schulz 2008). When a disasters strikes, supplies is sent for immediate disaster response operation through point of entries or consolidations points, within a short limit of time. Short limit of time is considered to be within 12 or 24 hours, dependent on the different organizations[1]. In most of the cases shipping is done with airfreight. This is a highly expensive way of transport but necessary due to the quick response time. In the sustainment phase (Balcik and Beamon 2008), additional supplies are order from supplier well-known from previous engagements and sometimes tied by framework agreements (e-g long term agreements) (Schulz 2008) Examples of humanitarian organizations within this category are UNICEF, OXFAM GB, different national societies of the Red Cross and Red Crescent Movement and Kirkens Nødhjelp (The Norwegian Churc Aid). Below an illustration of Kirkens Nødhjelp's supply chain is given

[1] Based on a telephone interview with CEO Berner Olsen, Rofi Inudstrier, and Harald Glesvold, Logistics advisor Kirkens Nødhjelp

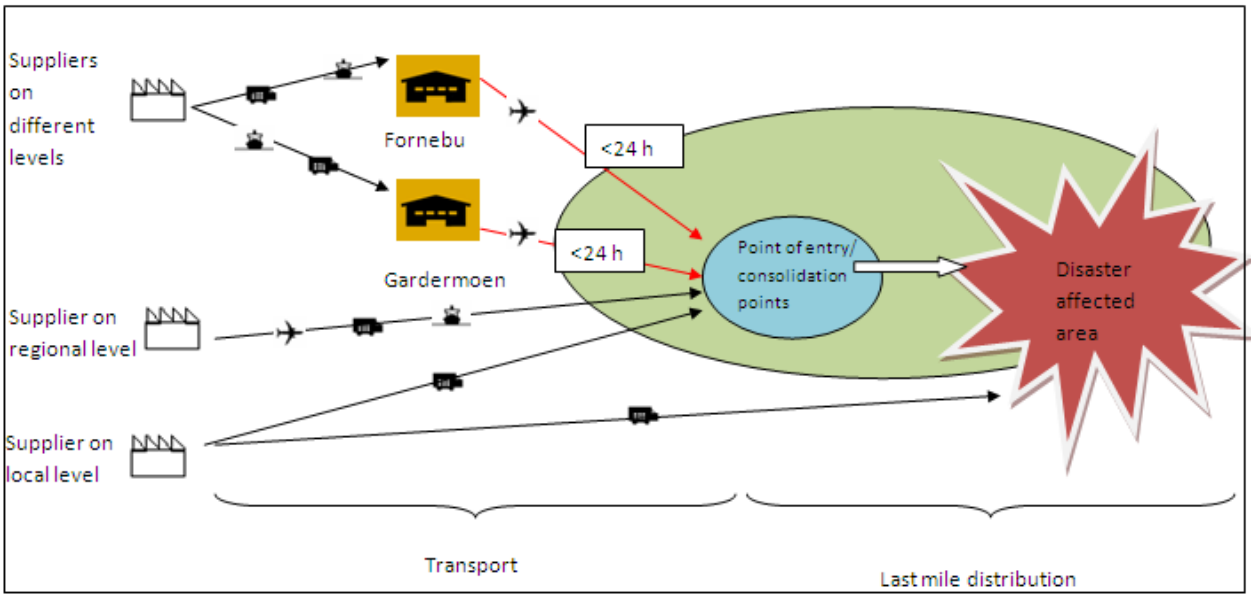


Figure 6-2: ***The supply chain of Kirkens Nødhjelp***[2]

Kirkens Nødhjelp is a Norwegian Non-governmental humanitarian organization that aims to help and protect people affected by disasters. Kirkens Nødhjelp's supply chain is designed to deliver supplies to affected areas within 24 hours. It consists of two central warehouses located in Gardermoen and Fornebu airports outside of Oslo, the capitol in Norway. Kirkens Nødhjelp has specialized its supply to cover goods within water and sanitations and each of the warehouses has capacity of relieving ten thousands relief victims.

3. Humanitarian organizations that have a network with regional/local warehouse with pre-positioned supplies aims to reduce response time to any sudden-onset disaster. They also aim to reduce the use of air freight, since this is an expensive transport method and because of its limitations due to access of suitable airports. They have a large network of know and employed international and regional suppliers, which in general are larger than in categories 1 and 2, and framework agreements (e.g. long term agreements) are used extensively as a tool assuring the procurement pipeline. There are not many humanitarian organizations within this category. The two major organizations are the World Food Program (WFP) with its Humanitarian Response Depot (UNHRD) and the IFRC with its Regional Logistics Units (RLU). The following section aims to give two illustrations of humanitarian organizations within category 3. The UNHRD network of WFP and the IFRC with its Regional Logistics Units (RLUs) are presented. Sources are the organizations respective internet pages, internet itself and two cases written by (Schulz

[2] Based on telephone interview with Harald Glesvold, Logistics advisor Kirkens Nødhjelp

2008).To fully describe the two organizations extent would be exaggerating in respect to the scope of the thesis. Therefore a briefly and simplified description in context to the research focus is the aim for this presentation.

The UNHRD network of WFP

UNHRD is an organization under the United Nation (UN) that was established in order to support emergency response efforts of UN, International, Governmental and Non-Governmental organizations. It has its coordination office in Brindisi, Italy. UNHRD's main mandate and purpose is to support WFP and its corporate goals of being prepared to respond to 3 large-scale emergencies, with 1 million beneficiaries each, at any given time within 12 or 24 hours (depending on location of disaster affected area). UNHRD has established and started construction of five main stocks globally, divided into regions in order to meet these requirements. One in Europe (Brindisi, Italy), one in Middle East (Dubai), one in South East Asia (Malaysia), one in Latin-America (Panama) and one are planned in Africa (Ghana).

Figure 6-3: ***Depot locations of UNHRD network*** **(UNHRD 2009)**

The locations were selected with criteria's based on:

- The possibility of responding to any disaster within 48 hours.
- The availability for already existing warehouses run by WFP or other partners.
- Disaster safety and political risk.
- Costs regarding fuel, warehousing and costs associated to airports.
- Support from the hosting government

Within the UNHRD network WFP serves as a service provider for the humanitarian organization on a non-profit basis. UNHRD are operating with extensive use of long term agreements (LTA) with suppliers in order to ensure that all products and services are on stock to any time, and to ensure deliverances in disaster relief operations. When disaster strikes flow of supplies are sent from a Humanitarian Response Depot (HRD) and LTA

suppliers to the disaster affected area. The figure below illustrates a simplification of the supply chain of the UNHRD network.

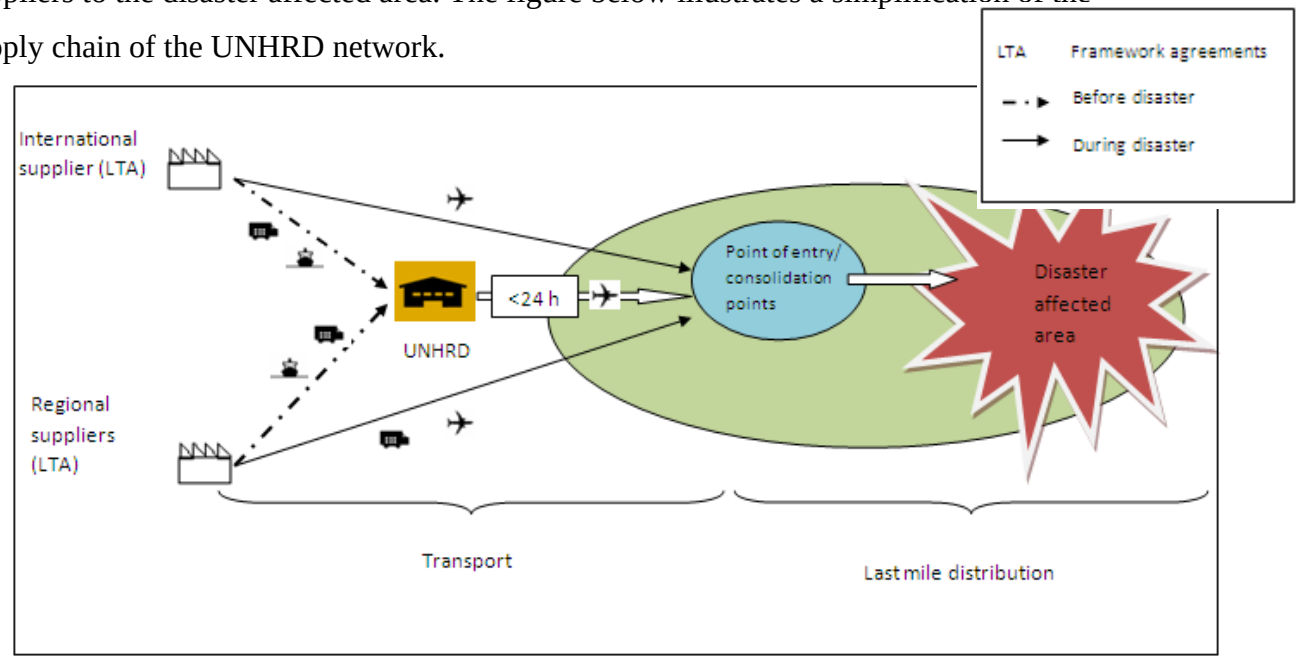


Figure 6-4: The *UNHRD supply chain*

Humanitarian organizations and UN agencies can register themselves as users in the UNHRD system and can then access a wide range of products and services by committing themselves to technical agreements (TA) and standard operating procedures. The system can offer the users timeliness, free storage with related services, real -time stock visibility with information systems, cost effectiveness, procurement, coordination, training facilities and fast response. A list over the different users is shown in the table below.

UN Agencies	Governmental Organizations	Non-governmental Organizations
World Health Organization (WHO)	Irish Aid	Mercy Corps USA
Office for the Coordination of Humanitarian Affairs (OCHA)	Italian Cooperation	Catholic Relief Services
World Food Programme (WFP)	Swedish Rescue Services Agency	Islamic Relief World-wide
UN Joint Logistics Centre (UNJLC)	ECHO	GOAL Ireland
UN Development Programme (UNDP)		World Vision International
Food and Agriculture Organization (FAO)		International Rescue Committee
		InterSOS
		Solidarity
		Norwegian Church Aid
		Care International

Table 6-1: ***Registered users of the UNHRD system (UNHRD 2009)***

The stocks are providing different kinds of *services* and *stored products* for the users. The different kinds of services contain *standard services* and *specific services*, while the stored products contain *program support stocks* and *operation support equipment*. The table below shows the different products groups and the different service provided by the UNHRD network.

Group of products	Services	Specific services
Demining	Inspections of stocks	Procurement
Drugs and medical equipment	Storage	Outbound transportation
Electrical devices	Identification of suitable packaging	Repairs, palletizing, kitting, re-packaging, and labeling
Food items	storage and shipping	Refurbishment of second hand equipment
Individual kit and safety items	Ordinary maintenance	Disposal of stocks
Office and living accommodation	In and outbound custom clearances	Stock insurance
Radio and telecommunication	Issuing of stock reports	Provide training centre facilities
Sanitation and hygiene	Receipt of stock	Rapid response teams
Shelter and housing	Handling within UNHRD network premises	
Tools	Issuing of stock reports	
Transport (e.g. cars, small boats)	Access to common services	
Warehousing equipment and handling equipment	Facilitate the provision of supplies and/or equipment as authorized by the users	
Water supply systems		

Table 6-2: Product groups and services offered by the UNHRD Network (UNHRD 2009)

IFRC and its Regional Logistics Units

The International Federation of Red Cross and Red Crescent Societies (IFRC) is part of the Red Cross and Red Crescent Movement, and serves as an umbrella organization for the National Societies. It is a humanitarian organization that considers logistics as one of its core competences and disaster preparedness and response is one of its main components of work. The organization looks at itself with obligation to meet the needs of the beneficiaries and cannot afford to depend on the reliability of others in this context. The IFRC Logistics and Resource Department (LRMD) developed a logistics strategy in 2005 (Schulz 2008), in order to ensure its independency:

> *"To support National Societies in ensuring that there is sufficient logistics capacity in terms of personnel and resources to deliver services in support of disaster preparedness activities. To achieve a response level of delivering an agreed set of standard relief items for a maximum of 5,000 families in 48 hours and a further 15,000 families in 14 days anywhere globally."(Schulz and Heigh 2006)*

In order to meet this strategy IFRC decided to establish three pre-positioned stocks globally, the Regional Logistics Units (RLU). The locations of the RLUs were located based on following aspects:

- The network of RLUs must be design in order to meet the requirement of response within 48 hours.
- Aspects of economic and logistical advantages.
- Available infrastructure belonging to IFRC or National Societies.
- The possibilities of using third-party logistics
- The administrative boundaries should be in relation to geographical boundaries.

The three different stocks were placed in the Middle East (Dubai), one in South East Asia (Kuala Lumpur) and one in Latin-America (Panama). In addition there is a warehouse related to the headquarter in Europe (Geneva).
The figure below shows the IFRC regions and its RLUs locations:

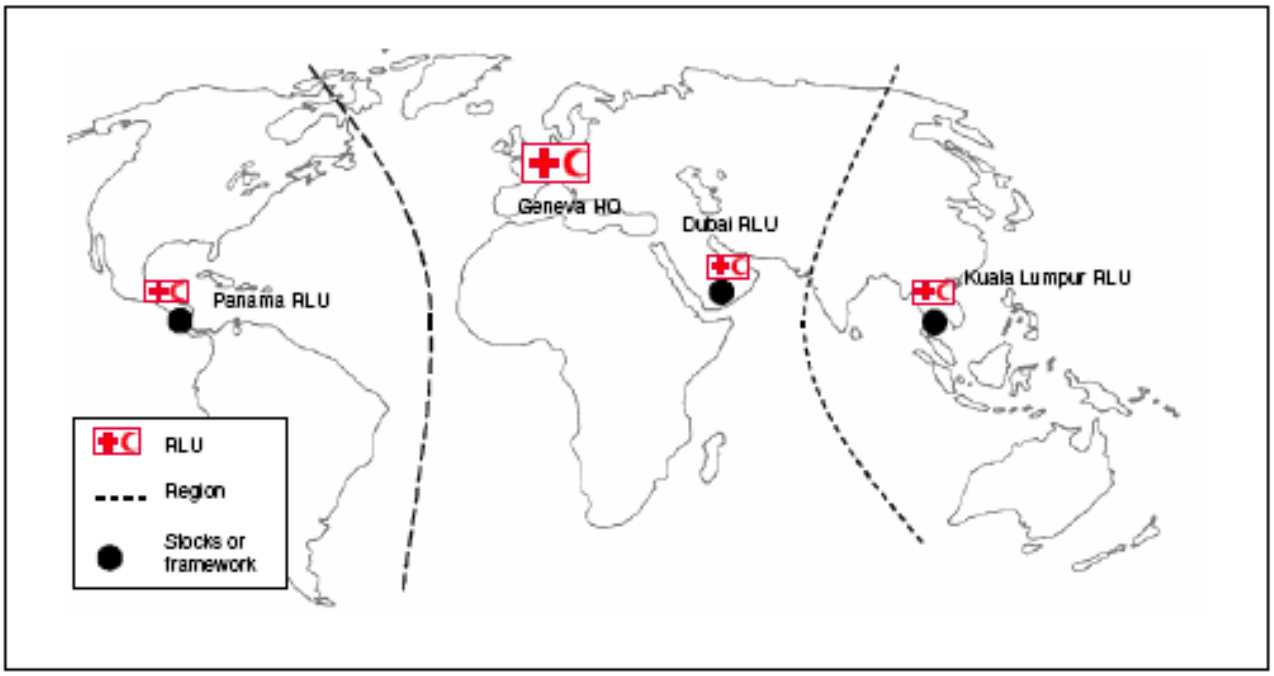


Figure 6-5: IFRC regions and its RLUs locations (Taken from an IFRC presentation given by Ian Heigh at the Humanitarian Logistics Summer School 31.08.-04.09.2006 in Lugano, Switzerland.)

The RLUs have different ways of running their stocks. Two of the RLUs are renting their warehouse space while the third RLU run and manage the warehouse itself. The different RLUs are obligated to keep agreed items and certain services available on stock to any time. This is done by procurement and extensive framework agreements (e.g. long term agreements) with suppliers on different levels, local, regional and international Though all

of the RLUs are managed independently, all reports and information flow is sent to headquarter in Geneva, which have the superior coordination.
The RLUs aimed to offer products and three different kinds of services to their National Societies (NS) and other potential “customers”. The table below shows an overview of the customers registered in April 2008 (Schulz 2008)

Customer	Internal or external customer
American Red Cross	Internal
Australian Red Cross	Internal
British Red Cross	Internal
Canadian Red Cross	Internal
Japanese Red Cross	Internal
Luxembourg Red Cross	Internal
New Zealand Red Cross	Internal
Swiss Red Cross	Internal

Table 6-3: List of customers as of April 2008 (Schulz 2008)

The products that are offered are mainly *family emergency* kits and other *standardized relief items* while *services are within logistics, procurement and logistics technical support*. The products and services are firstly offered to the national societies, who are regarded as "internal" customers, and secondly to other humanitarian organizations. When a disaster strikes a Field assessment and Coordination Team (FACT) is sent to disaster affected area within 24 hours. It registers the situation and indentifies the most urgent needs. Based on this information, appeals are sent to donors and the supplies are deployed from RLUs. Family kits are sent and, Emergency Response Units (ERU) consisting of trained teams of specialists with pre-packed sets of standardized equipment is ready for immediate use, to provide water, sanitation and health services and to support major relief operations with IT, telecommunications and logistics. When the information becomes more precise and the very first needs are served, the supply chain changes from push to pull and the field staff report their supply requirements to the regional RLU, which is in charge of procurement and transportation management. The figure below shows a simplification of the IFRC supply design.

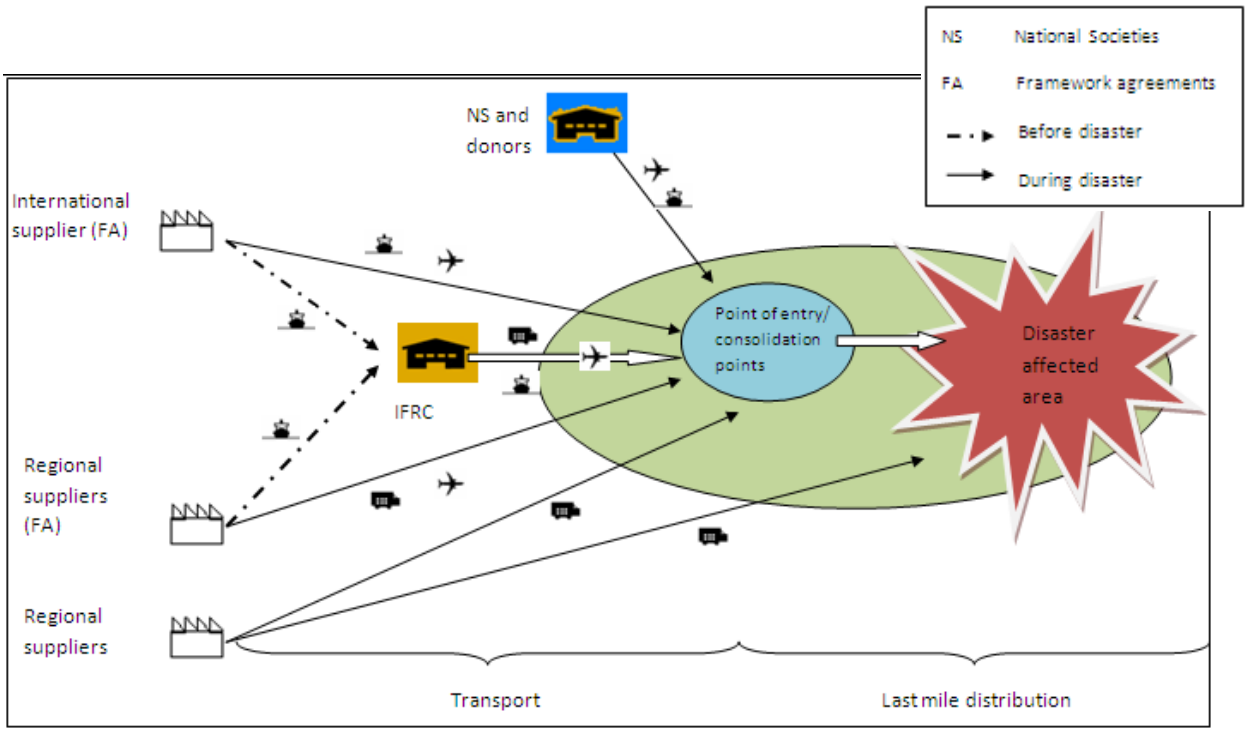


Figure 6-6: IFRC and its RLUs supply chains

7 Theoretical Framework

Here we will look into the theories we will apply in our thesis. This thesis is based on the case of ROFI Industrier AS. Their main operations area is to provide tents and tent equipment to the humanitarian organizations, through the humanitarian marketplace. The humanitarian organizations use these tents for humanitarian operations. Tents can be delivered to the organizations in several ways.

Firstly some of the organizations have their own stock; some of these are managed by the supplier, or partly managed by the supplier. Secondly orders are delivered to the organization for direct shipment or consignment to a specific operation, and lastly the gods are delivered directly from the supplier to the operation.

There are several competing firms competing with generic or differentiated products for the business of the humanitarian organizations. The humanitarian marketplace is highly volatile and unpredictable, where demand can change from one day to the next, and when demand occurs it is often imminent.

We will now look into the prospects for a supplier to the humanitarian organizations, in placing its inventory strategically compared to their competitors, and with special emphasis on the aspect of having centralized or de-centralized inventory.

7.1 Competitive Advantage

The competitive strategy of a firm is often the search for a favorable competitive position within an industry (Porter 1985). The goal of this strategy is to acquire an advantage towards the competitors, and sustaining this advantage over time. According to (Porter 1985), there are two ways of acquiring a competitive advantage, which is either through cost leadership or through differentiation. Cost leadership is when a firm sets out to become the low-cost producer within its industry. The source of cost advantage are many, this could be the pursuit of economics of scale, proprietary technology, preferential access to raw materials, or other factors. Differentiation on the other hand is when a firm seeks to be unique in its industry along some dimensions that are widely valued by buyers. This is done by selecting one or several attributes that many buyers within an industry perceive as important, in order to place its position uniquely to meet those needs. The reward for being unique is a premium price for its products. (Porter 1985)

The value of what the company produces are created by the value chain.

The primary activities of the value chain are inbound logistics, operations, outbound logistics, marketing and sales, and service. Supporting the primary activities are the firm

infrastructure, human resource management, technology development and procurement. The value for the end customer is created in the primary activities; the supporting activities are there only to underpin the actual value creation.

The figure below illustrates the value chain, and shows that the margin, which is what the firm lives off, this is the difference between total cost of all activities within the firm and the price it gets for its products.

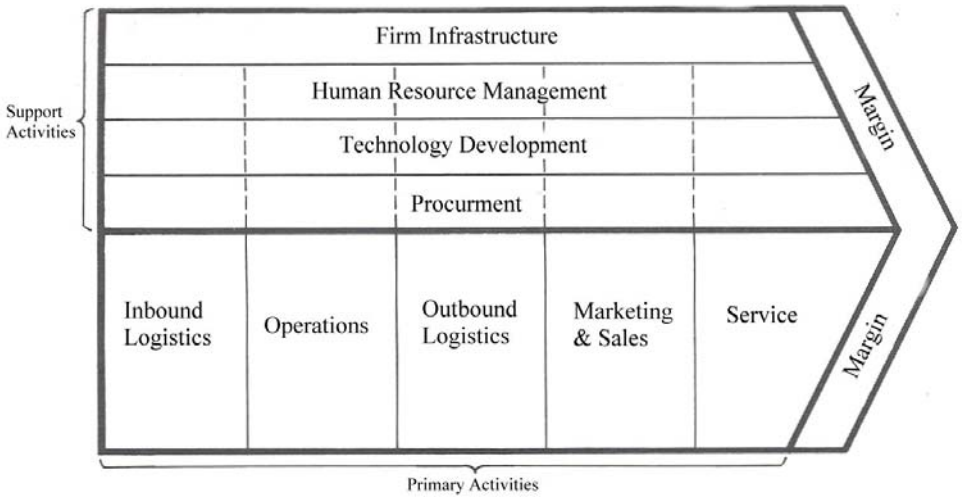


Figure 7-1: The Generic Value Chain (Porter 1985)

7.2 Push and Pull

Generally there are two systems for controlling materials and production, one is the push system, where products are produced and distributed whenever resources are available (Harrison and van Hoek 2005), and in accordance with forecasts and estimated demand in the market place (Hinkelman and Shippey 2002). To accomplish scheduled production in nonstop flows, often recognized by predesigned and relatively fixed assembly lines, and dedicated single purpose machines with high output capabilities (Adam and Ebert 1992). Often used in centralized supply chains, based on historical data, and not data observed in the marketplace (Hinkelman and Shippey 2002).

Pull on the other hand represents a strategy based on specific customer demand. In a pure pull strategy only goods demanded from a customer is produced and shipped. Thereby there is no inventory of finished goods (Hinkelman and Shippey 2002). Pull systems emphasize flexibility and simplicity, often implemented with the use of cheaper, smaller, adaptable machines and close work stations for stockless production, thereby eliminating in-process inventory, and controlling staff (Adam and Ebert 1992).

The Pull strategy is often adopted as the Just-in-time philosophy.

7.3 Just-in-Time

> *"JIT embodies a philosophy of excellence to establish demand-pulled inventory practices that produce to design specifications at a rapid but smoothed delivery rate with zero idle inventories, zero unnecessary leadtimes, and increased employee involvement in the process." (Fogarty, Hoffmann, and Stonebraker 1989) p.680*

Large parts of the Just in time (JIT) philosophy are accredited Toyota, and the Toyota Production System (TPS). Where JIT is an intricate part of the supply chain. As the name insinuates this philosophy is about doing things Just-in-time, not too early and not too late. As the west saw the advantages of this philosophy it lead to the term lean production, described as radically different way of running the business compared to traditional mass production. With lean production lower stocks, higher productivity and superior product quality was achieved. (Harrison and van Hoek 2005)

Although JIT and supporting techniques mostly were developed in Japan, a lot of the concepts are not specifically Japanese. Though JIT is mostly applied to manufacturing, it is not exclusive to this area of operations, and can also be applied to non-manufacturing parts of the operation, in the same fashion as for manufacturing processes. The three main reasons, which makes JIT different from other approaches are, a number of core techniques used to reduce waste, everyone participates and this is done on a continuous basis (Harrison 1992).

7.4 Lean Thinking

This term was developed to make a distance between the more Japanese Just-in-time production method, and the mass production methods more common among the western manufacturers. Here Lean thinking refers to the elimination of waste in all aspects of the business, which is an endless cycle seeking perfection by eliminating waste, and there through increase the value in the perspective of the end customer. Whom should not be the bearer of the cost, time and quality penalties of wasteful processes in the supply network (Harrison and van Hoek 2005).

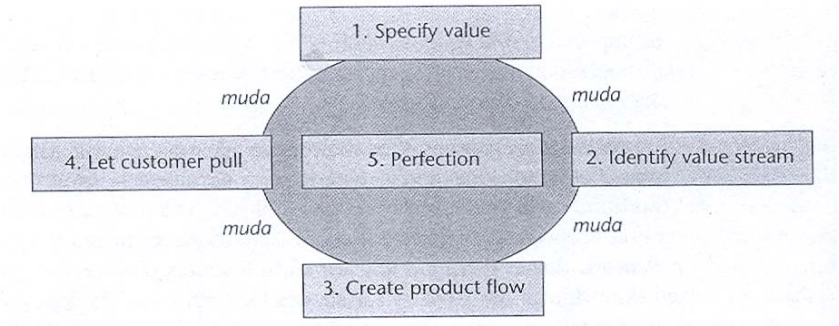


Figure 7-2: Principles of lean thinking (muda is the Japanese word for waste)(Womack and Jones 1996)

In seeking perfection there are four principles. First is specifying value, where value of a product is specified by the end customer and the value is created along the supply chain, resulting in the finished product reaching the end customer. Second is identifying the value stream, where all processes along the supply network are identified. Thirdly is to make value flow, by minimizing delays, inventories, defects and downtime, thereby supporting the flow of value in the supply network. Forth is to use pull scheduling which only responds to actual demand.

In lean thinking there are seven types of waste, these are; the waste of overproduction, the waste of waiting, the waste of transporting, the waste of inappropriate processing, the waste of unnecessary motions, the waste of defects. All unnecessary contributions of these are waste. (Harrison and van Hoek 2005)

Just-in-time Purchasing

This requires the suppliers to deliver components to the purchaser as they are required in the production, either delivered to receiving docking, or directly to the production line. This is a widely used technique in Japan. Suppliers are often located near or sometimes have storage on the purchaser's property. This relationship is often regulated with a long-term contract, and reduces the purchaser's work in process (Fogarty, Hoffmann, and Stonebraker 1989). Resulting in the elimination of waste in the purchasing activities, and inventory holding costs, an increase in customer service and improving overall profits. Vendor managed inventory is one way of implementing this.

Vendor-managed inventory (VMI)

Historically the firms have maintained arm's-length relationship with suppliers. The selection of suppliers has often been chosen on the basis of price only, rather than their responsiveness. A major opportunity for reducing inbound lead times exists in working closer with key suppliers. One powerful way of implementing close collaboration with

suppliers is Vendor Managed Inventory (VMI) (Christopher 2005). Here the supplier takes control of the inventory and order fulfillment, by managing and replenishing the inventory. The supplier assumes reasonability for monitoring sales and inventory, and uses this information to trigger replenishment. (Harrison and van Hoek 2005)

In the humanitarian supply chain a huge problem is that the humanitarian organizations often stands without any funding until the crisis is a fact, and no preposition or sourcing can be done before the crisis is a fact. With vendor managed inventory the inventory is the property of the producer until the humanitarian organization actually needs the merchandise. This moves the decoupling point down the chain, but at the same time makes this business the order winner, and therein gaining a competitive advantage. The financial cost of holding the inventory falls on the vendor.

7.5 Agile supply chain

> *"Agility means using market knowledge and a virtual corporation to exploit profitable opportunities in a volatile market place. Leanness means developing a value stream to eliminate all waste, including time, and to enable a level schedule." (Mason-Jones, Naylor, and Towill 2000)*

Just-in-time works well in a marketplace where demand is certain, variety is low, and consequently he stock keeping units (SKU) are high, but if the market is of the opposite variety we need a different variety of response from the supply chain. Efficiency might be desirable, but is has to take second place to effectiveness in the supply chain. In this context effectiveness is meant as the supply chains ability to respond rapidly to meet the precise need of an often fragmented marketplace. (Christopher 2005)

In a marketplace where demand is uncertain, the levels of variety is high and the number of SKU's are low, we need an agile supply chain which can produce variants for much smaller market segments in response to known demand.(Christopher 2005)

In the real world it is of high probability that within a firm there might be the need for both lean and agile supply chain solutions. This due to that some products might have predictable demand, whilst others have more volatile demand.

To differentiate the product portfolio of the organization the products can be organized I accordance with their supply and demand characteristics. (Christopher 2005)

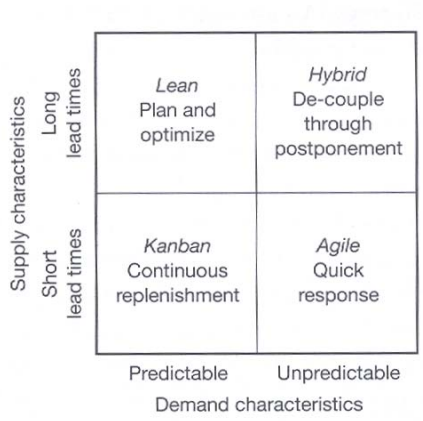


Figure 7-3: Generic Supply Chain Strategies (Christopher 2005)

The figure above suggests four broad generic supply chains strategies dependent on the combinations of supply and demand conditions for the product.(Christopher 2005)
In many supply chains a major problem is the limited visibility of real demand. This is usually derived from the fact that the supply chains tend to be extended with multiple levels of inventory between the point of production and the final marketplace, and production is forecast driven rather than demand driven.
The decupling point *"separates the part of the organization oriented towards customer orders from the part of the organization based on planning."(Argelo et al. 1992)p. 6*
In the figure below the de-coupling point separates the forecast driven part of the supply chain form the demand driven and this is where strategic inventory is placed to be able to respond to actual demand.

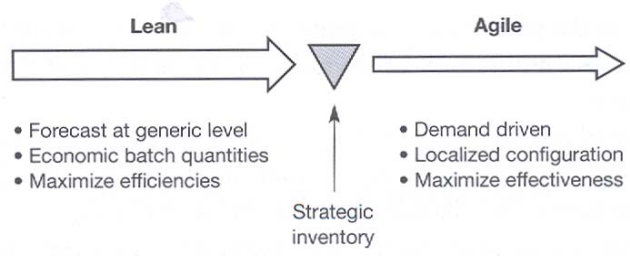


Figure 7-4: The de-coupling point (Christopher 2005)

The term decoupling point represents the point where real demand penetrates upstream in a supply chain. The issue normally is not how far the order has penetrated, but how far the real demand is made visible. Order are often delayed or distorted, due to the actions or decisions of intermediaries, though demand in reality reflects ongoing requirements as close to real-time demand in the final marketplace. (Christopher 2000)

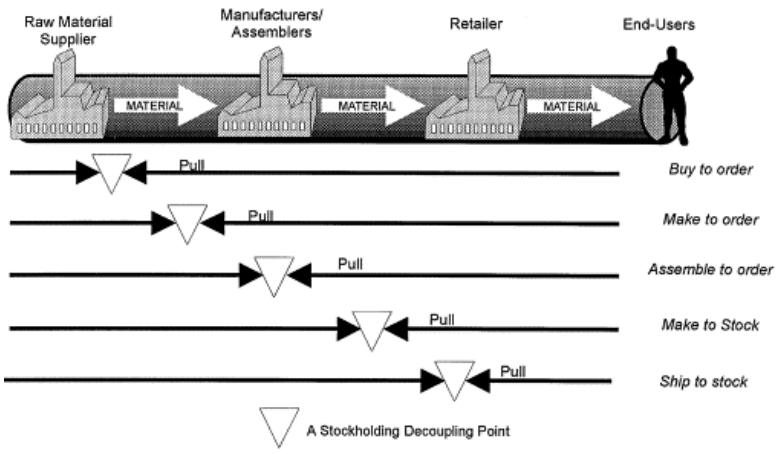


Figure 7-5: Supply chain strategies (Argelo et al. 1992)

The figure above shows examples of simplified supply chains structures with decoupling point marked as the stock holding point. (Argelo et al. 1992; Harrison 1997)

Depending on how fare up the supply chain real demand is known, the decoupling point can be in:

Point 1: Purchase and make to order. No stocks are kept; purchasing is conducted in accordions with the specific need.

Point 2: Make to order: Only raw materials and components are held in stock, each order is a specific project.

Point 3: Assemble to order. Final assembly of the product is only done after a specific customer order. Only system elements and subsystems are held in stock.

Point 4: Make to stock. Finished products are held in stock at the end of the production process, and form there shipped directly to the customer.

Point 5: Make and ship to stock. Products are manufactured, and shipped to locations closer to the customer.

To locate the decoupling point is a balancing process between the delivery time requested by the customer and the throughput time in the purchasing, production and distribution process. (Argelo et al. 1992)

The decoupling point should dictate where and in which form the inventory should be held. The goal for an agile supply chain is to carry inventory in a generic form as far up the stream as possible, this is also called postponement. (Christopher 2000) Up to the decoupling point the flow of products may well be forecast driven, but after the decoupling point it should be demand driven (Christopher and Towill 2000).

7.6 The Leagile supply chain

Based on (Naylor, Naim, and Berry 1999), leagile has been defined as:

> Leagile is "the combination of the lean and agile paradigms within a total supply chain strategy by positioning the decoupling point so as to best suit the need for responding to a volatile demand downstream yet providing level scheduling upstream from the marketplace"(Naylor, Naim, and Berry 1999).

According to (Harrison and van Hoek 2005) there is no reason there should be an "either-or" approach to logistics strategy. The supply chain can adopt a lean strategy up to a given downstream process, and thereafter adopt an agile strategy. This will enable high-productivity, low-cost processes in the start, and responsive processes for customization thereafter. This strategy is referred to as "leagility" because it combines the capabilities of both supply chain strategies. (Harrison and van Hoek 2005)

A study of personal computer supply chain over 15-year done by (Christopher and Towill 2000), shows a development of order winners from quality and cost to availability and lead time. (Christopher and Towill 2000)

7.7 Market Qualifiers and order winners

The concept of order qualifiers and order winners is developed by (Hill 1993), against which it is advocated that manufacturing strategy should be determined. These labels suggests that it is important for every business to understand what the baseline is for entering into a competitive area, these are the order qualifiers. Actually getting the business requires a specific set of capabilities, and these have Hill termed order winners. This definition logically leads to the specification of the appropriate manufacturing strategy. (Christopher and Towill 2000)

According to (Harrison and van Hoek 2005) there are four ways of competing through logistics quality, time, cost and dependability. To win orders demands that performance of the focal firm has to be superior on one or more of these.(Harrison and van Hoek 2005)

Based on the concept of order qualifiers and winners (Christopher and Towill 2000) have developed a wider supply chain concept of market qualifiers and market winners. The notion is that to be truly competitive not just require the right manufacturing strategy, but also an appropriate supply chain strategy.

The connection between the idea of qualifiers and winners, and lean and agile is critical. In its simplest form the lean strategy is most powerful winning contracts on the basis of cost. On the other hand if service and customer value enhancement are prime requirements for

market winning, the likelihood is that agility will be the crucial dimension. (Christopher and Towill 2000)

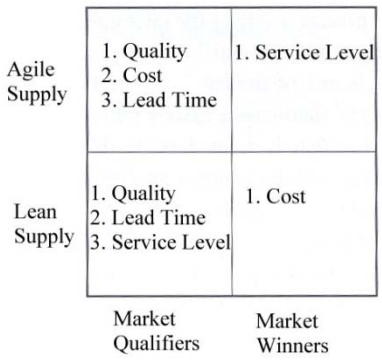


Figure 7-6: Market qualifiers and winners matrix (Mason-Jones, Naylor, and Towill 2000)

The figure above illustrates the differences between the focus in the lean and the agile supply chain, dependent on the market qualifiers and market winners, based on the work of (Mason-Jones, Naylor, and Towill 2000). (Christopher and Towill 2000)

Postponement is the principle of seeking to design products using common platforms, components or modules until the final customization when the customer requirements are known. The advantages of this strategy are several. First of all the inventory can be held in a generic form until primal assembly, resulting in fewer SKU's, and less total inventory. Secondly, generic inventory gives the business larger flexibility, when the same components can be utilized for multiple end products. Thirdly, forecasting is easier, and lastly it gives the company a large possibility of a higher level of product variety to offer the end customer at a lower total cost. (Christopher 2000)

First of all, an agile supply chain is market-sensitive. By this is meant that the supply chain is capable of reading, and respond to real demand. The use of information technology to share data across the supply chain is, in effect, creating a virtual supply chain. Virtual supply chains are based on information rather than based on inventory. Supply chain partners can only take full use of shared information through possess alignment. Lastly to be agile one organization needs to be part of a network, where the supply chain partners are linked together, competing with other supply chains. How this fits together making the supply chain turly agile is shown in the figure below. (Christopher 2005)

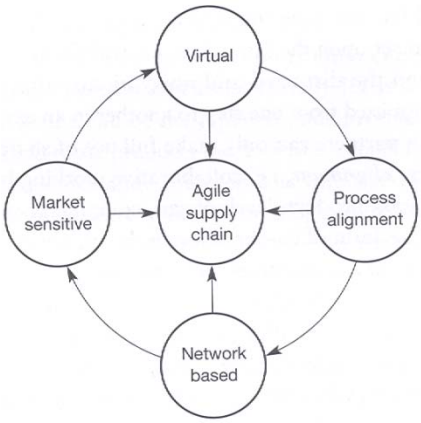


Figure 7-7: The Agile supply Chain (Harrison, Christopher, and van Hoek 1999)

For a supply chain to be really agile it has to be able to read and respond to real demand. To facilitate this use of information technology (IT) is vital. IT together with information sharing across the supply chain will facilitate decisions made on the basis of information, about where and how much inventory is available, and about who is transporting what, and where. In the humanitarian supply chain information sharing can give large benefits, in avoiding overlapping inventory, overlapping transportation, and eliminating of unnecessary operations and transportation.

7.8 Demand Characteristics

(Harrison and van Hoek 2005), has defined D-time "as the time that the customer is prepared to wait to have their orders fulfilled"(Harrison and van Hoek 2005)p. 135. The D-time might be measured in months, days or minutes. This sets the time objectives for the supply chain, and if D-time is minutes there is no time to process materials or process them. Therefore inventories of finished goods have to be held.

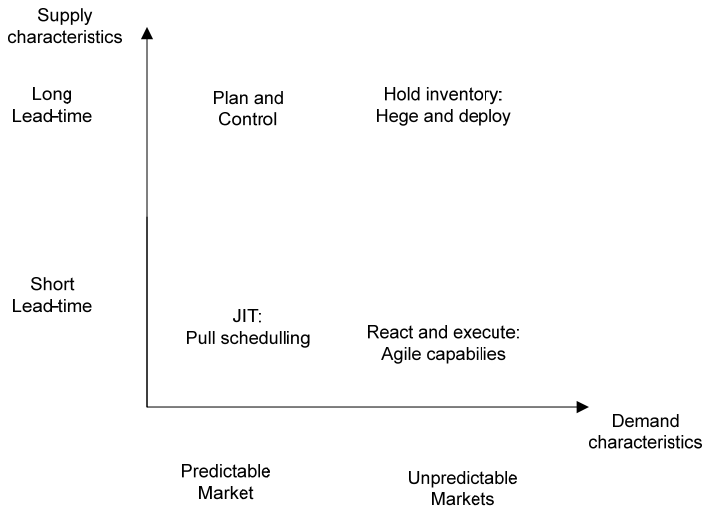


Figure 7-8: Lean and agile under different demand and supply conditions (Christopher and Towill 2000)

The figure above shows the relation between lead-time and the predictability of the market. If a market has a short lead-time and is highly unpredictable we have to hold inventory.

Distinguishing attributes	Lean supply chain	Agile supply chain	Leagile supply chain
Market demand	Predictable	Volatile	Volatile and unpredictable
Product variety	Low	High	Medium
Product life cycle	Long	Short	Short
Customer drivers	Cost	Lead-time and availability	Service level
Profit margin	Low	High	Moderate
Dominant costs	Physical costs	Marketability costs	Both
Stock out penalties	Long term contractual	Immediate and volatile	No place for stock out
Purchasing policy	Buy goods	Assign capacity	Vendor managed inventory
Information enrichment	Highly desirable	Obligatory	Essential
Forecast mechanism	Algorithmic	Consultative	Both/either
Typical products	Commodities	Fashion goods	Product as per customer demand
Lead time compression	Essential	Essential	Desirable
Eliminate muda	Essential	Desirable	Arbitrary
Rapid reconfiguration	Desirable	Essential	Essential
Robustness	Arbitrary	Essential	Desirable
Quality	Market qualifier	Market qualifier	Market qualifier
Cost	Market winner	Market qualifier	Market winner
Lead-time	Market qualifier	Market qualifier	Market qualifier
Service level	Market qualifier	Market winner	Market winner

Table 7-1: Comparison of lean, agile, and leagile supply chains (Naylor, Naim, and Berry 1999), (Mason-Jones, Naylor, and Towill 2000), (Olhager 2003), (Bruce, Daly, and Towers 2004)

The table above describes the two different supply chain theories lean and agile, and the combination of these leagile, and how these correspond to the market.

As you can see the leagile marketplace is volatile and unpredictable, eliminating of waste (muda) is arbitrary, robustness is desirable, and market winner is cost and service level.

7.9 Applied theory

Earlier in this thesis we have described the humanitarian marketplace, comprised of organizations, with different purchasing strategy, warehouse strategy and needs. Their need depend highly on the needs of the beneficiaries, and the need of the beneficiaries depend on a catastrophe, and the art and scope of the catastrophe. Therefore the demand for products needed for the humanitarian operations are highly fluctuating this due to the high unpredictability of humanitarian catastrophes.

The location, art and scope of the demand is uncertain until the catastrophe is a fact. When the catastrophe is a fact, the demand for products related to a sudden catastrophe is imminent. Day's, hours even minutes counts. The right equipment where it is needed can save life, the result being a short lead time (D-time).

For a slow onset catastrophe there might be more time available to prepare, depending on the catastrophe. But as stated earlier in this thesis, the humanitarian organizations have limited buying power, before funding is provided to them by donors, and limited leeway before they are invited by the government of the country affected. In some cases the humanitarian organizations are not invited, and cannot do anything to help. Therefore it can be difficult to know the scope, and actual demand before the crisis is a fact, and then an operation cannot start before the country has asked for help, and the funding is made available to the humanitarian organizations.

The humanitarian organizations are often dependent on donor funding, before they can do any sourcing. Therefore some of them have no inventory, or the inventory is limited. Therefore they have to utilize Just-in-time purchasing, when the funding is available they purchase the products, meaning that the suppliers have to own the stock until the need is a fact.

When funding and invitation is present, a humanitarian operation can start. Often has a huge amount of equipment to be sourced and moved into the affected area within a short time. From the supplier's perspective, this means that they have no time to produce the products when the humanitarian organizations start sourcing for the operation and that if the product is not in inventory the sale is lost.

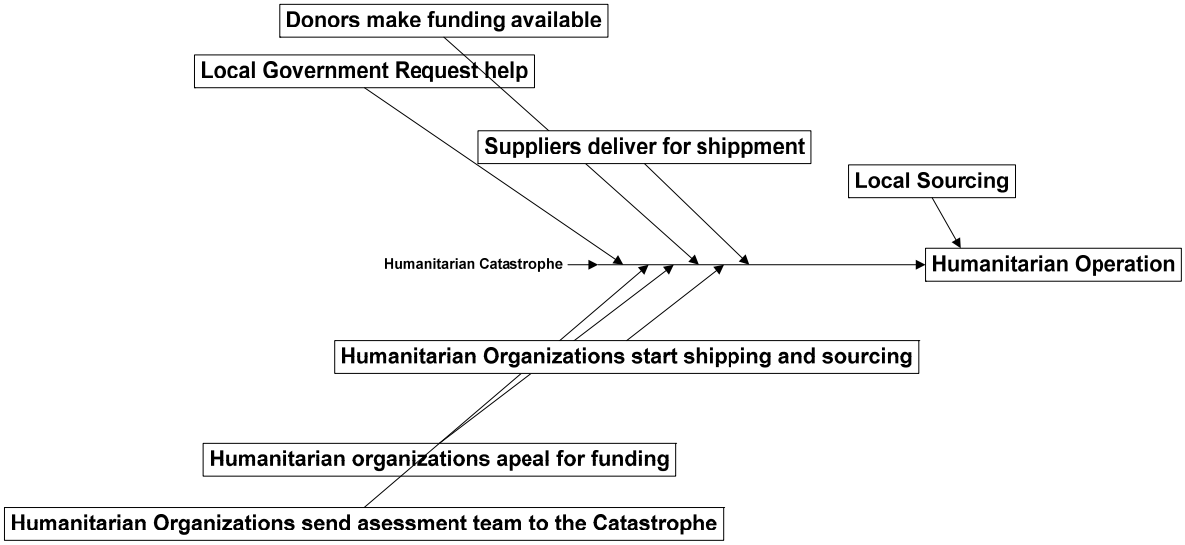


Figure 7-9: Time line before a humanitarian operation starts

The figure above shows the course of events in the initial phase of a humanitarian operation.

For a sudden onset disaster neither the supplier nor the humanitarian organizations has the chance of knowing when, where or how much, and cannot prepare in another way than to have inventory. For a slow onset disaster the supplier can on the other hand prepare and build up inventory in anticipation of the disaster.

We can therefore argue that when a humanitarian operation starts the needed equipment has to be in inventory. The supplier can implement different production scheduling up to the point of inventory, depending on demand forecasting.

To accommodate the Just-in-time purchasing needs of the humanitarian organizations. The international suppliers tend to locate parts of their inventory close to the centralized warehouses, or sign long term agreements with the humanitarian organizations, where the stock is held in the centralized warehouse, but owned by the supplier until the humanitarian organization needs the products. This is also called vendor managed inventory, and the supplier can within the limits of the agreement control the inventory. If an humanitarian catastrophe is a fact, the supplier with long-term contract has a higher probability of being chosen as a supplier.

When the catastrophe is a fact, the needed merchandise is either delivered from the centralized warehouse, where the organization either owns the inventory, has vendor managed inventory, or gets it delivered for consignments, the supplier ships it directly from own warehouse to the catastrophe, or the needed merchandise is sourced locally. The

last method is often preferred due to the low transport cost, impacts on the local economy, and its immediate availability. Sourcing locally is often limited by the merchandise available, depending on the equipment needed, the development level of the country, and the damages of the catastrophe.

To qualify for the humanitarian market, the right product with the right quality has to be available with the right lead-time (D-time). The market winner will be the one that can offer the right service level, here represented having the merchandise available and being punctual with deliveries, to the lowest price.

We can therefore argue that it is favorable to locate the inventory close to the humanitarian organizations to accommodate the short D-time.

In the process of delivering necessary products to a humanitarian catastrophe a large part of the costs is transportation. It has to be done fast, often over large distances, at a time there is a spike in demand, due to that all humanitarian organizations has the need for transportation within the same time window. This is done by air freight, which adds a substantial amount to the total cost of the products.

Outbound logistics is a part of the value chain, by offering lower logistics cost the company will gain a cost advantage, and by being located closer to the market gaining a differentiation advantage compared to its competitors, giving them a competitive advantage. The humanitarian organizations are dependent on donations, and the donors, want their money to be utilized to its maximum.

We will therefore argue that if the products were positioned closer to the catastrophe the transportation cost will be lower, and there will be elimination of waste, the transport does not add any value till the product, and lower transport costs will increasing the value for the end customer.

Shown in the figure below time to market and transport cost, for the different production and transport modes.

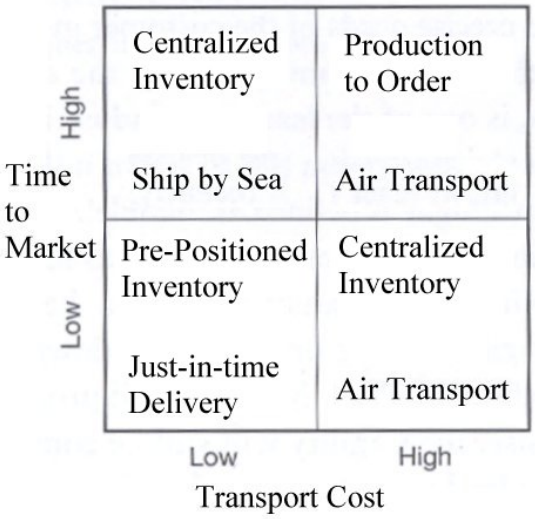


Figure 7-10: Different production and transport modes time to market and their costs

As the figure above shows, when the merchandise is pre-positioned the delivery to the end customer can be done Just-in-time, and with low transport cost, due to the proximity of the inventory. If the stock was shipped by sea the lead time would be high, also if it should be produced before shipped by air. On the other hand if the stock was in inventory but far from the need air transport would secure low lead time, but a high transport cost.

For phase 1 and phase 3 there can be a bit more time and the products can be produced, or they can be shipped with a slower transport mode, if order is known well in advanced. The problem with this is for phase 1 that the time between emergencies, when the humanitarian organizations have emptied their inventory, and build up new inventory, is unknown. They do not know when they will need the new stock, and therefore they would like it in good time. If a new disaster happens, and the stock is on its way on a container ship from China, it will not help the organization until it arrives, and that might be too late. For phase 3 the need for emergency equipment is low, due to the nature of the phase, which is rebuilding of the disaster area.

In short the stock needed for an operation has to be available within a short time window. For a slow onset disaster the supplier has the option to build up inventory, and place it strategic in accordance with location of the disaster, and its development.

We presume that merchandise has to be in inventory to get the sale, and that inventory holding cost is the same or lower for the prepositioned inventory. If the total cost of holding the inventory prepositioned is higher than the cost of holding the merchandise in a centralized warehouse, and to transport it to the beneficiaries, it can be argued that the humanitarian organizations are willing to pay extra for shorter lead-time, increased

flexibility and punctuality, and that the supplier will have a competitive advantage of having the stock pre-positioned.

	Supplier Inventory	Humanitarian Organization Centralized Inventory	Vendor Managed Inventory	Supplier Prepositioned inventory
Quality	Market qualifier	Market qualifier	Market qualifier	Market qualifier
Lead-time	Market winner	Market qualifier	Market qualifier	Market winner
Cost	Market winner	Market winner	Market winner	Market winner
Service Level	Market qualifier	Market winner	Market winner	Market qualifier
Purchasing	JIT Purchasing	Purchasing at reorder point	JIT Purchasing	JIT Purchasing
Flexibility	Yes	No	Yes	Yes
Lead-time	High	Medium	Medium	Low
Punctuality	Medium	High	High	High
Cost	High	Medium	Medium	Low
Transport Cost	High	High	High	Low
Distance	High	Medium/High	Medium/High	Low
Competitive advantage	No	No	Yes	Yes

Table 7-2: Attributes of the different inventory strategies for the humanitarian organizations

From the table above we can see that pre-position stock will be market winner, the humanitarian organizations can practice JIT purchasing, at the same time as they receive more flexibility, lower lead-time, higher punctuality and lower cost.

Preposition stock will therefore comply with the humanitarian organization at a greater level then the other solutions.

Attribute	Result	Humanitarian Organization	The Supplier
Cost	Lower	Increased value for money	Cost advantage
Lead-time	Lower	Faster delivery	Differentiation advantage
Service level	Higher	Better service	Differentiation advantage
Flexibility	Higher	Can postpone purchasing decision	Differentiation advantage
Punctuality	Higher	Shorter distance to the emergency	Differentiation advantage

Table 7-3: Results for the involved parts in prepositioning

(Porter 1985)claims that the firm can utilize its value chain to get competitive advantages. This could be either cost advantage or differentiation advantage, or the company could try a combination of these two.

The table above shows that by better complying with the preferences of the humanitarian organizations the supplier will gain both the cost advantage and the differentiation advantage, and thereby gaining a competitive advantage compared to its competitors.

We can therefore argue that placing a pre-positioned inventory closer to the market, the supplier will gain a competitive advantage towards its competitors, and be able to serve the needs of the humanitarian organizations, the donors, and their beneficiaries better.

When a catastrophe is a fact, there is no time for production, all products has to be in inventory, and ready to be shipped to the affected area. If the supplier is not capable of delivering the products within a short time window he will not be allegeable for the order. To satisfy the need of the beneficiaries of immediate delivery only transport mode actable of delivering within short time is air transport, which is an expensive mode of transport. To cut transport time, and lead-time we propose to put the inventory closer to the affected area, derby eliminating the need for air transport and shorten the time of delivery.
The supplier will comply with the needs of the humanitarian organizations on a higher level than its competitors.

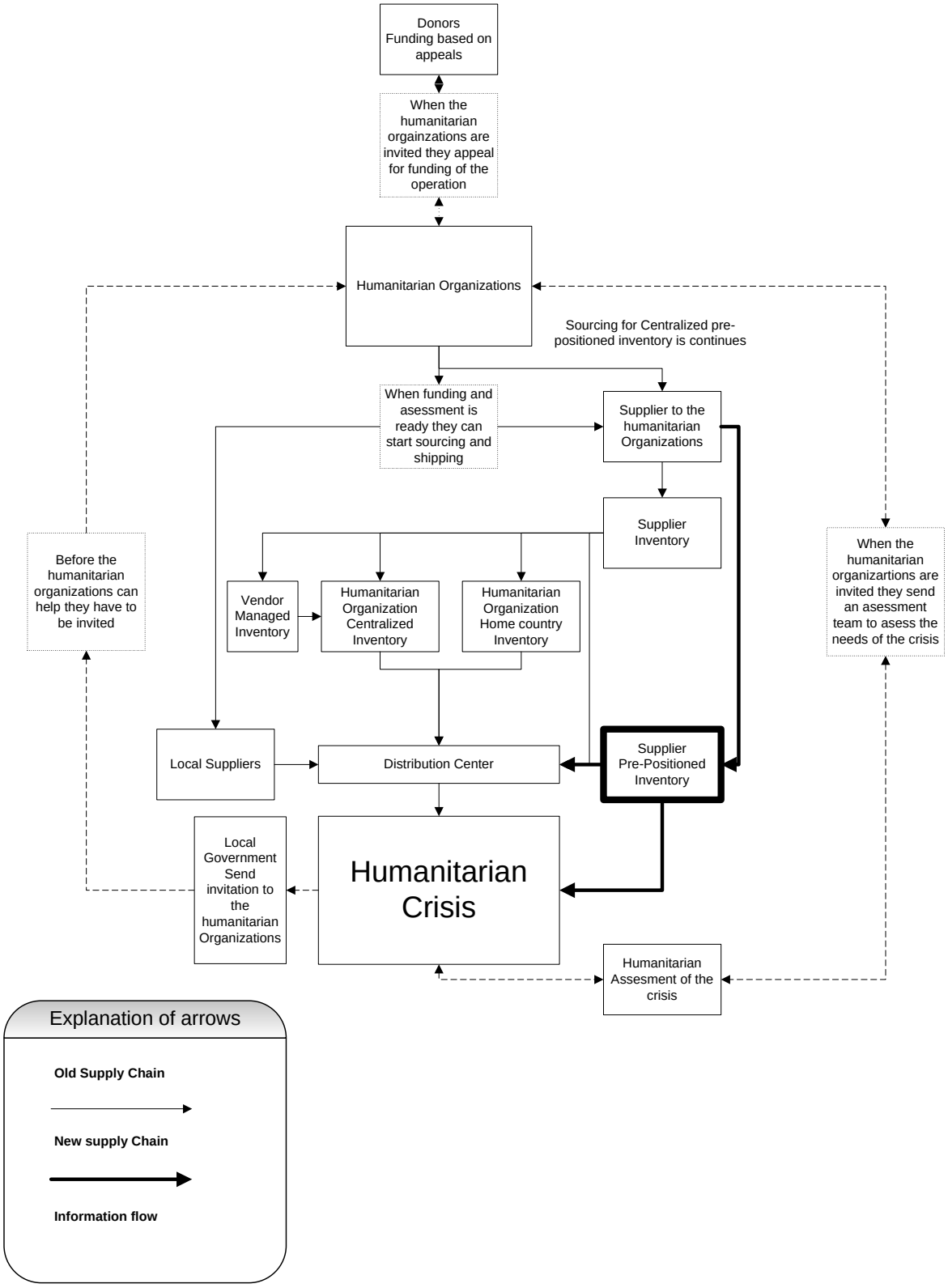


Figure 7-11: Illustration of the Humanitarian Supply Chain

The figure above shows the old, and the new supply chain with pre-positioned inventory close to the humanitarian crisis.

8 Methodology

8.1 Research design

The aim for this chapter is to give the reader a basic theoretical discussion of important issues due to the methodology by given a emphasis on research design. A brief discussion of the data used in this thesis is presented and a discussion of weaknesses and strengths of the methodology is given in the end.

According to (Bryman and Bell 2003) there are three different ways of doing research design; explorative, descriptive and casual.

An explorative design is usually used when the area of study is unknown and not familiar for the researcher. Explorative studies often leads to theories and/or hypothesis because they are inductive. They are often used in the beginning of a research to give the researcher an understanding of the subject.

A descriptive design is used when the research area is known for the researcher and when the researcher knows what to look for. This often leads to a deductive approach where previous formulated theories are tested and possibly generalized. We can to a certain extent say that both explorative design and descriptive design complement each other since explorative studies are often followed by a descriptive one.

A casual design is used to find relationships two factors. It is often used when the researchers wants to test if there is a relationship between two variables.

This study can to a great extent be described within the terms of an explorative design. There is much that is unfamiliar to us regarding the humanitarian logistics context and there is little research done from other researchers. This study has also descriptive elements, since we are describing humanitarian logistics and disaster relief operations in terms of existing theory. Since we are seeking to support the theory with empirical work, we can characterize the descriptive part of this study as deductive. ROFI Industrier AS is a supplier within the humanitarian market and is used in a part of this study to understand more about humanitarian logistics. According to (Yin 2003) case studies can be categorized as single or multiple case studies based on the variety of the cases analyzed in the research (Yin 2003). We can therefore state that ROFI Industrier AS is a single-case. Based on the fact that this study is based on an explorative design, we can define the part with ROFI Industrier AS a single-explorative case study.

8.2 Data classification

There are two ways of separating and categorizing data(Bryman and Bell 2003).We can distinguish between primary and secondary data and we can distinguish between qualitative and quantitative data.

Primary data concerns data that is collected for the given study while the secondary data can be collected for other purposes, usually from others. The primary data is usually better due to the study because it is often collected by the researcher with direct purpose to its study. It is often time and cost consuming to collect only primary data for the study. Secondary data is often used as a tool to reduce time consumption and costs related to the process of collecting data. There is often validity problem attached to secondary data, and the researcher should be aware of this and consider reasonable balance between cost and time spent on the study and the degenerations of the results, if secondary data which is not suitable is used.

Data can also be categorized within the terms of qualitative and quantitative data. Qualitative data can be defined as data that cannot be quantified while quantitative data can be defined as data that can be quantified. Qualitative data is usually used in explorative design because qualitative data are statements that have to be interpreting qualitatively while quantitative data is used with a descriptive design. A descriptive research follows the exploratory as the qualitative findings or observations need to be quantified and statistically tested to possibly be generalized. We can therefore state that there is a closely link between qualitative data and explorative design, quantitative data and descriptive design.

8.3 Validity

"Validity is concerned with the integrity of the conclusion that is generated from a piece of research" (Bryman and Bell 2003)p. 41.

The term validity can be divided into three levels; predicted, content and construct validity (Churchill and Brown 2004)

Predicted validity regards whether the study is able to measure some characteristics or specific behavior.

Content validity regards the ability of the study to cover the important aspects of the study area that are being measured.

Construct validity regards the issue of whether the measuring is measured in the way it is suppose to be and if there are some underlying characteristics that are influencing the outcome.

8.4 Reliability

"Reliability is concerned with the questions of whether the results of a study are repeatable" (Bryman and Bell 2003)p. 40.

"Reliability is the ability of a measure to obtain similar scores for the same object, trait or construct across time, across different evaluators, or across the items forming the measure" (Lindegaard 2008)p. 10.

Our study is supposed to be repeatable in the sense that the study is described in detail. It can be discussed if the study is repeatable across time, since natural disasters characteristics have shown a tendency to change their nature due to e.g. climatic changes. It can also be discussed if the study is repeatable due to national borders and supplies needed for the different natural disasters. It is likely to believe that national borders will endure for longer terms, but due to different kinds of supplies it is more likely to believe that e.g. technological change and innovation will contribute to new products.

8.5 Data used

The major part of the secondary data used in this study where found in articles, books and web-pages. Secondary data were also found and used from The Emergency Database (EM-DAT) and concerns historical data regarding countries related to disasters. In addition a survey was done related to the case study. The purpose of the survey was to collect primary data concerning humanitarian organizations preferences.

The survey

The survey was made available on the internet, and the invitation letter to participate in the survey was sent to 82 persons in total including all known Heads of logistics, if not known the main e-mail address, or known people in the organization. Organizations ranging from small private NOG's to large multi-national NGO's including IFRC and organizations within UN. 24 organizations responded to the questioner, where 12 completed the entire survey. In the further analysis we have only included the complete responses.

The questioner was divided into two parts, each representing different aspect of our research.

Part one looks into the preferences of the humanitarian organizations when it respect to lead time, punctuality, flexibility and customized products, and their preferences when it comes to long term contracts (LTA) and the extension of such contracts.

Part two reveals the different organizations preferences regarding sourcing and pre-positioning, in respect to ROFI Industrier AS and their product spectrum.

Quantitative data

The data from the (EM-DAT) concerns countries affected from different types natural disasters during the period of 1999-2009. The data for each year were aggregated in order to define which countries have represented the biggest "markets" during the last decade. The data represented the different countries in terms of the different impacts made from natural disasters.

The data were run through a process resulting in a group of countries that could be sorted out to be "target countries" and a group of disasters that could be defined as more dominant than others.

The target countries and the dominant disasters were in the end used in order to propose where supplies should position their supplies to qualify for the humanitarian market and to be order winners.

9 ROFI Industrier AS

The information about ROFI Industrier AS was conducting with regular contact with Berner Olsen, the CEO of ROFI Industrier AS.

The mother company was founded in 1914. ROFI Industrier AS was demerged in 1985 while intensifying our internationalization and export orientation and became a part of ROFI Gruppen AS. In the beginning ROFI Industrier AS was producing fishing tools and oil sumps. Now, ROFI Industrier AS have moved away from these products and moved towards a specialization in highly advanced production of heavy textiles. ROFI Industrier AS core activities are their capability in design, development, production and distribution of soft shelters and protection systems and they have production facilities located in Molde (Norway), China and Latvia. Most of the production is done in china while the most customized products are produced in Molde. Latvia does some production but not in the same extent as Molde and China.

9.1 Products

The main product lines comprise tents in sizes from 25 sqm up to 90 sqm as stand-alone units, and the larger tents are inter-connectable to both other tents and to containers. The tents come in both frame-based types and inflatable. Body amours and helmets, deminer vests, aprons, ballistic blanket kits and wheel arch panels constitute the protective line. In addition ROFI Industrier AS provides maintenance and deployment services. The products that are of interest in respect of our focus in this thesis are within the range of tents. These products are those that are of most interest for humanitarian organizations. The table below shows which types of tents that will be used further in this thesis.

Tents:
Accommodation
Command post
Dining
Family
Field camps
Field hospitals
Kitchen
Multi purpose
Office
Relief
School tents
Tent Equipment

Table 9-1: ROFI Industrier AS products of interest (ROFI Industrier AS 2009)

Figure 9-1: Family tents from ROFI Industrier AS (ROFI Industrier AS 2009)

9.2 Customers

The National defense of Norway was and still is an important customer for ROFI Industrier AS. Due to the intensifying of internationalization ROFI Industrier AS extended their group of customers to contain both national and international defense, UN organizations, other humanitarian organizations, civil defenses and emergency services. For decades they have been contracted under Long Term Agreements with UN agencies, NGO's and governmental bodies, making their export share vary between 80 and 90% of their added value.

9.3 The supply chain

ROFI Industrier AS have different kinds of customers. In this thesis it is the humanitarian organizations that are of interest. Characteristics of these organizations will be described in later sections of this thesis. We can describe ROFI Industrier AS

supply chain in terms of two types of customers; humanitarian organization working to alleviate relief victims that are suffering from impacts from natural disasters and other customers. Other customers are sourcing products from ROFI Industrier AS from their production facilities in Molde, China and Latvia. Humanitarian organizations are to a certain extent sourcing products in the same way, but because of special characteristics due to disaster relief demands, there is a need for other solutions. As described later in this thesis, humanitarian organizations are providing services to relief victims under special circumstances. Natural disasters strikes often without warnings and creates sudden demands that requires minimum of response time. To meet these requirements, ROFI Industrier AS is providing service of shipment to any airport in the world within 24 hours.

Figure 9-2: ROFI Industrier AS: Ready deliver supplies within 24 hours (ROFI Industrier AS 2009)

ROFI Industrier AS has strategically placed some of its inventory close to the humanitarian organizations centralized warehouses located on several continents and their technicians and supervisors are also ready to go within 24 hours, if required. ROFI Industrier AS is involved with pre-packed supplies located strategically in 4 main locations, to different extents in respect of the demand characteristics. One of the stocks is placed at ROFI Industrier AS headquarter in Molde, on is placed near Oslo (the capitol of Norway) and three stocks are placed in Dubai. The stock in Molde is fully owned by ROFI Industrier AS and the stock located near Oslo is owned by ROFI Industrier AS, but the warehouse costs are beard the Norwegian emergency response system (NOREPS), which is financed by the Royal Norwegian Ministry of foreign affairs. The first stock in Dubai is fully owned and managed by ROFI Industrier AS. The second one is owned by ROFI Industrier AS, managed by Kirkens Nødhjelp, and running costs are financed through NOREPS. Thirdly ROFI Industrier

AS has a long-term agreement (LTA)with the World Food Program (WFP), where the inventory is owned by ROFI Industrier AS until WFP decides to use it, but stored on the property of the WFP. The LTA with WFP is mentioned as a digression since this stock only contains products related to demining equipment which is not a part of the focus of this thesis. The figure below illustrated the supply chain of ROFI Industrier AS

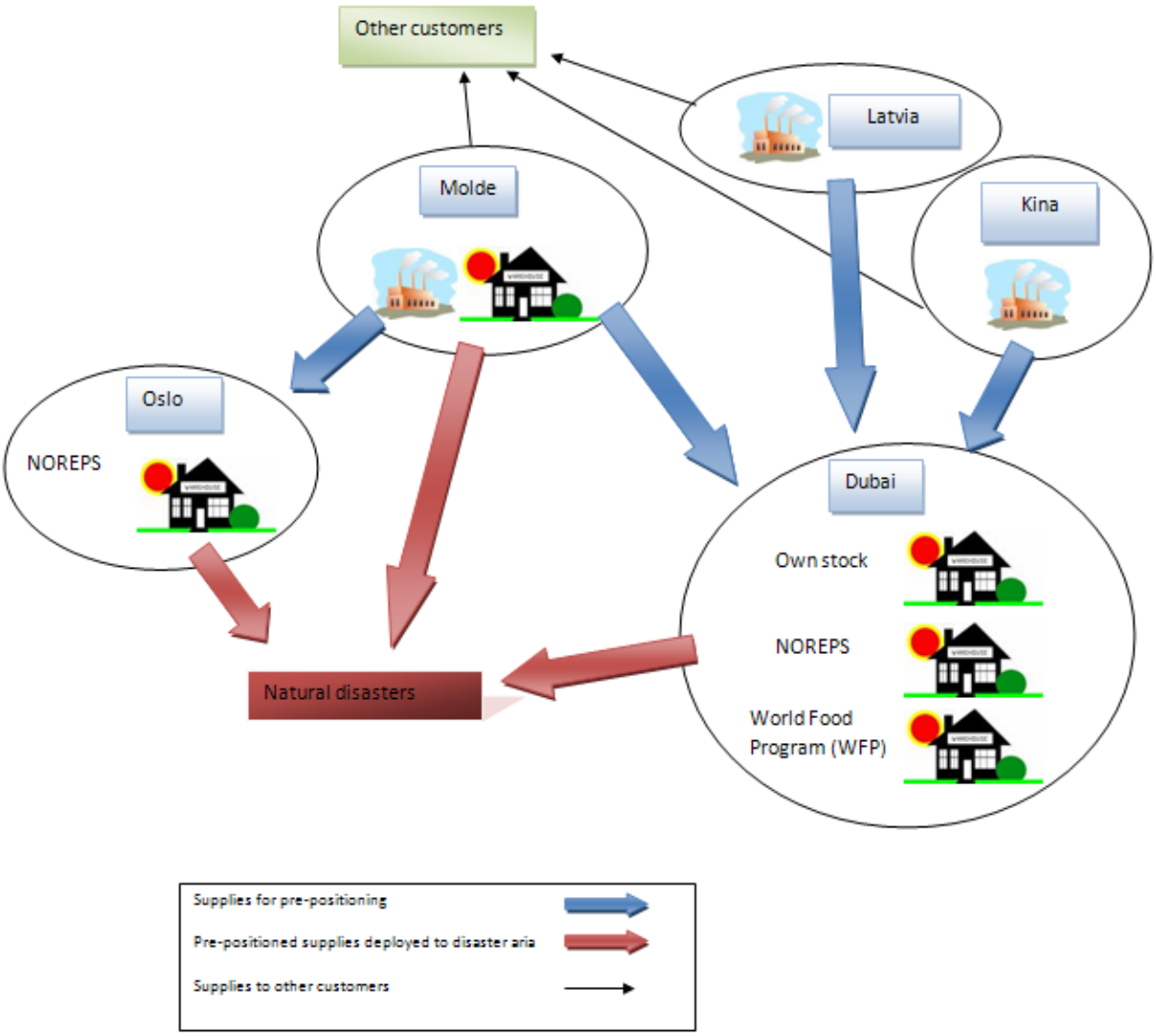


Figure 9-3: The supply chain of ROFI Industrier AS

10 The Preferences of the Humanitarian Organizations

In our case study we are looking at the world of humanitarian logistics from the point of view of a supplier, ROFI Industrier AS. As a part of our qualitative research a questioner was formed to discover more about the preferences of the humanitarian organizations in choosing their suppliers, their overall sourcing strategy, and to get a better understanding of how humanitarian logistics work.

The questioner was made available on internet, and the invitation letter to participate in the survey was sent to 82 persons in total including all known Heads of logistics, if not known the main e-mail address, or known people in the organization. Organizations ranging from small private NGO's to large multi-national NGO's including IFRC and organizations within UN. 24 organizations responded to the questioner, where 12 completed the entire survey. In our analysis we have only included the complete responses.

Reference sample of the questioner can be found in the appendix.

10.1 Results of the questioner

The questioner was divided into three parts, each representing different aspect of our research.

Part one looks into the preferences of the humanitarian organizations in respect to lead time, punctuality, flexibility, customized products, long-term contracts (LTA) and the extension of long-term agreements.

The goal of this questioner is to find the preferences of the humanitarian organizations, and relate it to the theory. We wish to discover witch kind of relation they have to their suppliers, and what kind of attributes do they value from their suppliers. Do they value long-term relations, or only sourcing from the cheapest every time? Do they value punctuality and flexibility? If so this would be an indicator that a supplier placed with inventory closer to the beneficiaries would be a preferred supplier for a humanitarian catastrophe.

Part two deals with ROFI Industirer As and their product spectrum, and from the different organizations point of view, how these products relate to the different kinds of natural disasters.

These answers were inconclusive, and therefore scraped.

Part three reveals the different organizations preferences regarding sourcing and pre-positioning, also in respect to ROFI Industrier AS and their product spectrum.

Here we only found the answers form the question regarding sourcing conclusive and all other results where scraped.

Before the respondents started on the questioner we gave them the opportunity to claim anonymity for the information they provided. 58% (7 out of 12) of the respondents choose this option. In respect of this, no organization are mentioned with name in relation to the questioner.

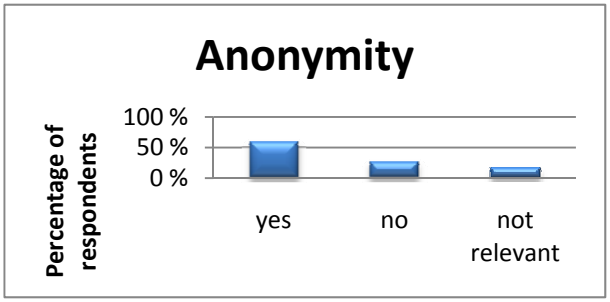


Figure 10-1: Percentage of Participants wanting to be anonymous

10.2 Questioner part one

The participants were asked about their willingness to change supplier, enter long-term agreements, and their preferences regarding options to extend long term agreements, in order to get reduction in lead time, increase in punctuality and increased flexibility. This was set in context to the three different phases of disaster relief logistics, described earlier in this thesis.

Importance of lead-time

The participants were asked about their preferences in regard to lead time. We refer to lead time as "the time between the supplies are ordered to they arrive at the wanted location". The participants were asked to define the importance of lead time by giving the term a value from 1 to 7, where 1 is of no importance and 7 is of high importance. The result shows that 83% of the respondents defined lead time with a value of 6 and 7, while 18% defined the importance of lead time with the value of 4 and 5.

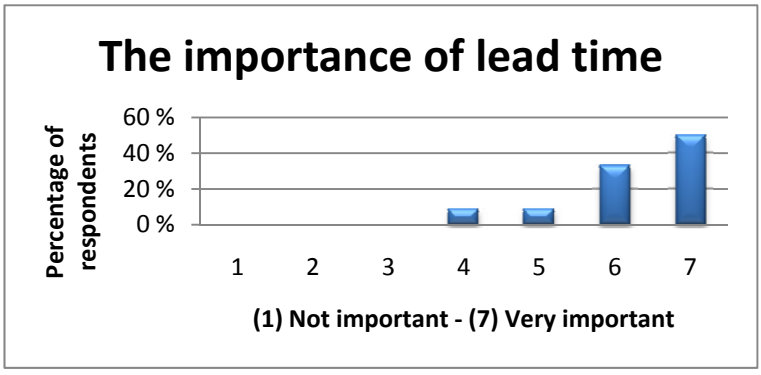


Figure 10-2: Importance of Lead time

As you can see from the answers, lead-time is an important factor when the humanitarian organizations choose suppliers. This underpins our theory, where lead-time is important both within just-in-time, and agile supply chain theory. When a service is produced it is important that the products arrive Just-in-time, as they are needed, otherwise the production stops, and without certain products the humanitarian worker cannot do their jobs.

Change supplier to reduce lead-time

For phase 1 67% said yes, 17% said no, and 17% said this was not relevant.

For phase 2 67% said yes, 17% said no, and 17% said this was not relevant.

For phase 3 67% said yes, 0% said no, and 33% said this was not relevant.

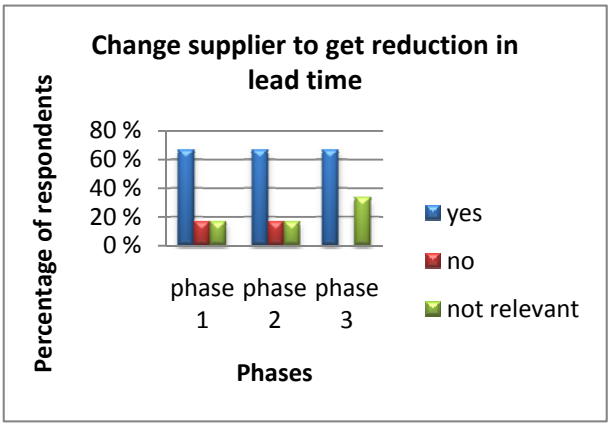


Figure 10-3: Change supplier to get reduction in lead time

From this we might draw the conclusion that the humanitarian organizations in a high degree would change supplier for the different phases if they could acquire a shorter lead-time. This support what we wrote in the theory, where the suppliers complying with the needs of the humanitarian organizations will be chosen.

Enter a long term agreement to reduce lead-time

Here we were interested to learn if the humanitarian organizations were interested in entering long-term agreements to reduce lead time. The results were as follows.

For phase 1 83% said yes, 8% said no, and 8% said this was not relevant.

For phase 2 67% said yes, 17% said no, and 17% said this was not relevant.

For phase 3 67% said yes, 8% said no, and 25% said this was not relevant.

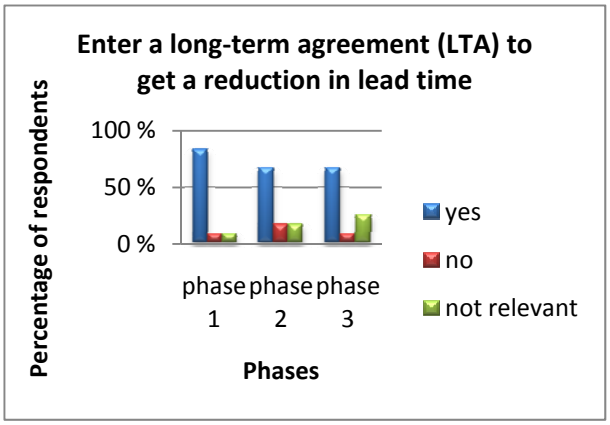


Figure 10-4: Enter a long-term agreement to get reduction in lead time

Long-term agreements seem to be very attractive to the humanitarian organizations, and huge majority of the answering said they would enter a long term agreement if this would lead to shorter lead-time. This corresponds with the theory, where the supplier and the customer ties closer ties, and the supplier has the inventory until the customer needs the merchandise.

Enter a onetime contract to reduce lead-time

For phase 1 58% said yes, 25% said no, and 17% said it was not relevant, for phase 2 the numbers where 75% yes, 8% no and 17% not relevant and for phase 3 33% yes, 25% no and 42% not relevant.

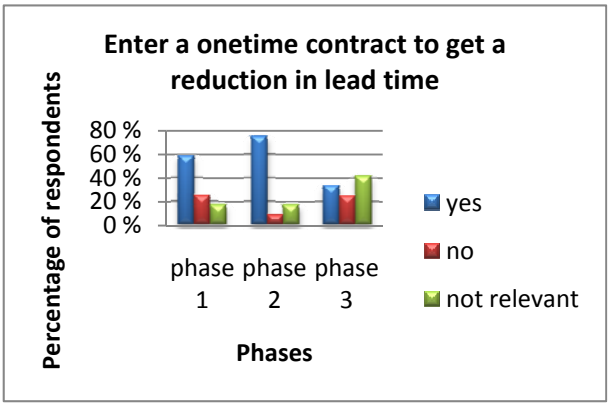


Figure 10-5: Enter a onetime contract to get a reduction in lead-time

Here the wish for shorter lead-time continues, except for phase 3 where most said not relevant. This could have to do with the fact that not all organizations are involved in the rebuilding of a disaster area. But clearly there is a need for short lead-time for phase 1 and 2, phase 1 is between the catastrophes, when the inventory is built up in advance of a new disaster. To have the merchandise in stock when the next crisis is a fact is essential, for phase 2 we have previously stated that if the merchandise is not available when it is needed it might be no need for it.

Option to make new contracts with the same supplier to reduce lead-time

For phase 1 50% said yes to the question, 33% said no, and 17% said not relevant.

For phase 2 50% said yes, 33% said no, and 17% said not relevant.

For phase 3 33% said yes, 42% said no, and 25% said not relevant.

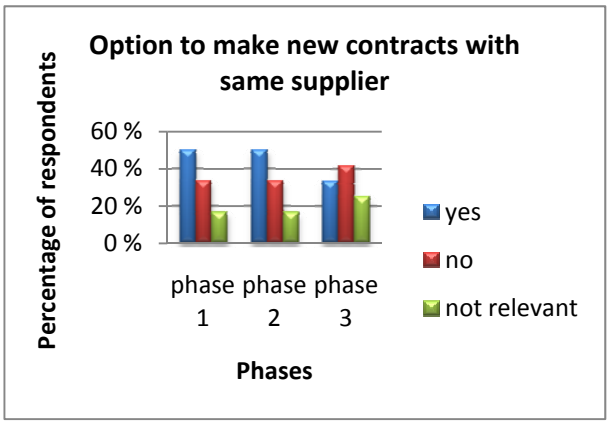


Figure 10-6: Option to make new contract with same supplier

Here 50% said yes for phase 1 and 2, as said earlier the lower number for phase 3 could be explained form the number of organizations participating in this phase. But still a high number of the participants would make a new contract with the same supplier to get a shorter lead-time. This underpins our earlier statements about lead-time.

Importance of punctuality

Here the participants were asked about their preferences when it comes to punctuality, and how important this is for them, on a scale from 1 to 7, where 1 is of no importance, and 7 of high importance. Here we refer to punctuality as the ability for a supplier to deliver at expected time.

100% of the participants said that punctuality was of importance 5 or higher, 92% of 6 or 7, and 67% said it was the highest importance.

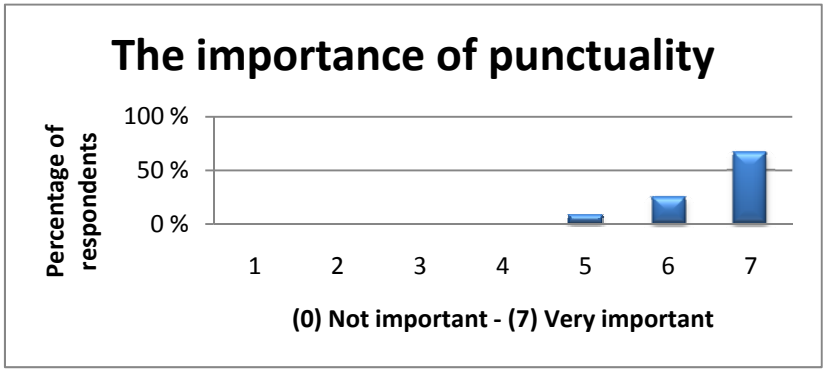


Figure 10-7: Importance of punctuality

All the participants value punctuality of a high degree. This corresponds with our initial thesis, that if products are not arriving at the right time, they are obsolete for an operation,

also if they arrive late for the preparations before an operation, they might arrive when the operation is finished. Therefore it might be of high importance to the humanitarian organizations that the products ordered arrive just-in-time, when they need them for a specific task.

Change supplier to increase punctuality

If changing supplier would increase punctuality, 75% said they would do so in phase 1, 83% in phase 2 and 58% in phase 3. 17% said no in phase 1, 0% for phase 2 and 8% for phase 3. 8% said it was not relevant in phase 1, 17% in phase 2 and 33% in phase 3.

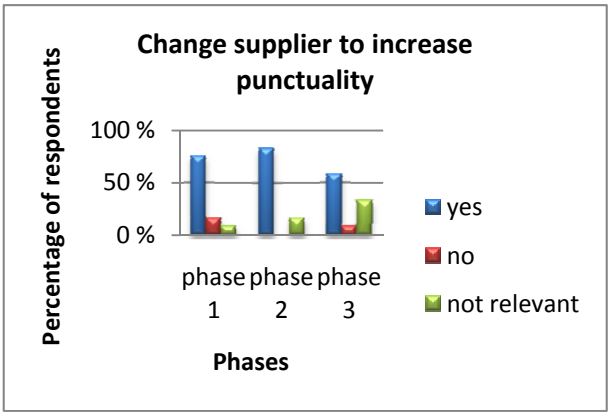


Figure 10-8: Change supplier to increase punctuality

A high degree of the participating organizations would change supplier if this would lead to a higher punctuality. This might be due to the fact that if a supplier cannot be trusted to deliver the merchandise at promised time, if makes it difficult for the organizations to deal with, when they need their supplies just-in-time for an operation.

Enter a Long-Term Agreement to increase punctuality

If entering a long-term contract would increase the punctuality for the different phases of emergency aid 75% said yes for phase 1, 67% for phase 2 and 58% for phase 3. Only 8% would not for all phases, and 17% in phase 1, 25% in phase 2 and 33% in phase 3 found this option not to be relevant.

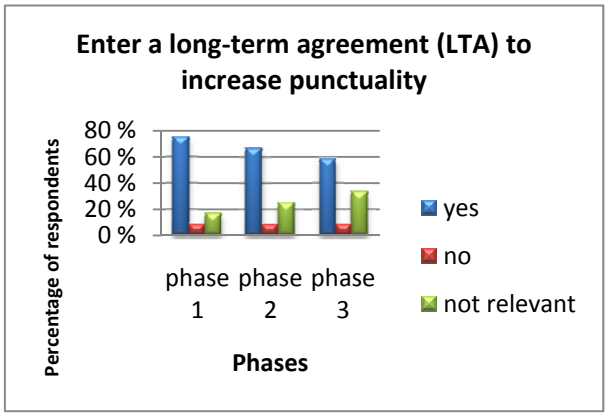


Figure 10-9: Enter a long-term contract to increase punctuality

Also entering a long term contract seems attractive if the result is a higher punctuality, normally a long-term contract takes the form of vendor managed inventory. Implementing VMI moves the ownership of inventory to the supplier, at the same time as the supplies are available to the organizations just-in-time.

Enter a onetime contract to increase punctuality

If entering a onetime contract would increase punctuality 50% would enter one for phase 1, 67% for phase 2 and 58% for phase 3. 17% would not for phase 1 and 8% for phase 1 and 2. 33% found this not to be relevant to phase 1, 25% for phase 2 and 33% for phase3.

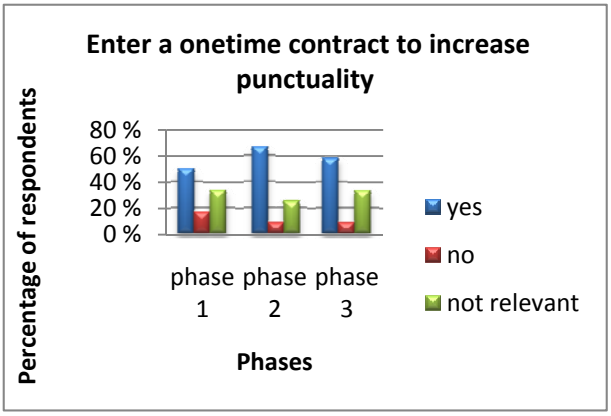


Figure 10-10: Enter a onetime contract to increase punctuality

Half or more of the participants would enter a onetime contract to increase punctuality for all phases. This enhances the fact that punctuality is of high importance to the humanitarian organizations.

Option to make a new contract with the same supplier

If entering a new contract with the same supplier would increase the punctuality for phase 1 25% would do so, for phase 2 42% and for phase 3 17%. For phase 1 25% would not, for phase 2 8% and for phase 3 25%. 50% in phase 1 and 2 and 58% in phase 3 found this not to be relevant.

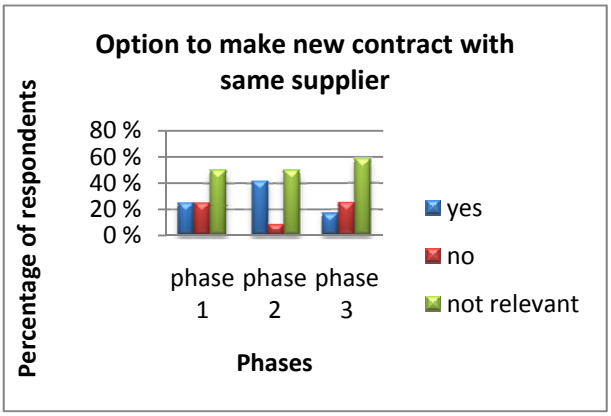


Figure 10-11: Option to make new contract with the same supplier

A high degree the participant's fond a onetime contract not to be relevant for all phases, but for phase 2 42% would enter a onetime contract to increase the punctuality of the deliveries to the phase, which is the phase of the catastrophe where time can save life.

Importance of flexibility

In this question we look for the humanitarian organizations preferences when it comes to flexibility, where "Flexibility is referred to as the possibility to take out goods from pre-positioned stock when it is needed."

On a scale from 1 to 7, where 1 is of low importance and 7 of high importance, 100% said it was of 5 or higher, 82% of 5 or 6 and 42% said 7 of highest importance.

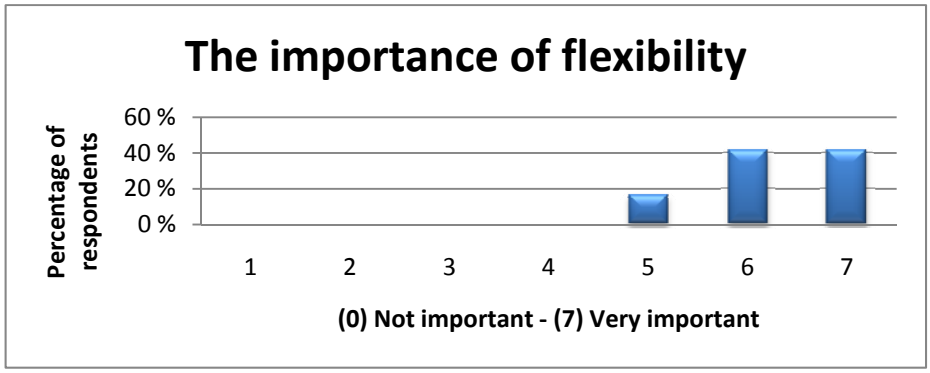


Figure 10-12: The importance of flexibility

For the humanitarian organizations the importance of flexibility is of importance of 5 or higher on a scale from 1 to 7, this might be an indicator that flexibility is a highly desired capability with the suppliers. This is also supported in the high interest the organizations have shown for long-term agreements, which also gives them increased flexibility. Flexibility would help the organizations to do postponement of decision of purchasing, and help them in implementing just-in-time purchasing.

Change supplier to improve flexibility

Here we are interested to know if increased flexibility would be grounds for changing of supplier.

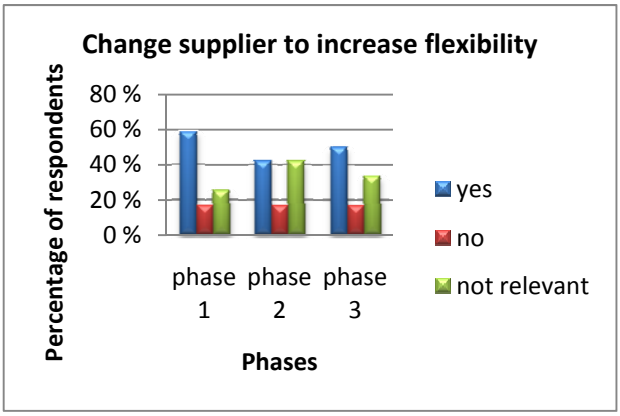


Figure 10-13: Change supplier to increase punctuality

For deliveries to phase 1 58% said yes, for phase 2 42% and phase 3 50%. 17% said no in all phases, and 25% for phase 1, 42% for phase 2 and 33% for phase 3 found this not relevant.

Here we can see that the interest in flexibility continues, but for phase 2 the same amount of respondents found this not to be relevant for the phase as the ones whom said yes. This might be due to the nature of phase 2; merchandise has to be there within a short lead-time, and on time. If these requirements are met there may be little need for flexibility.

Enter a long-term contract to improve flexibility

If entering a long-term contract would increase the flexibility, 58% of the respondents said yes for *phase 1*, *phase 2* and *phase 3*. 8% said no for *phase 1*, 0% for *phase 2* and *phase 3*. For *phase 1* 33% said not relevant, *phase 2* and *phase 3* 42%.

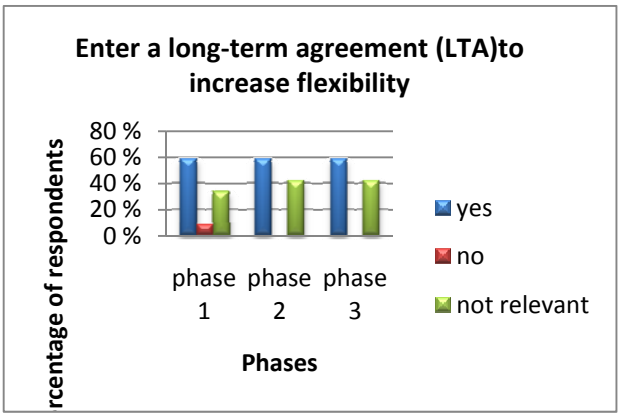


Figure 10-14: Enter a long-term agreement to increase flexibility

A high degree of the respondents said that they would enter a long-term agreement to generate improved flexibility. No one said no, the rest said not relevant, the reason for this

might be that these where organization with no inventory, and therefore no use of a LTA. This corresponds with our previous assumptions, that a LTA gives the organizations increased flexibility, and for the supplier to have a long-term agreement can be a strategic advantage for the supplier.

Enter a onetime contract to improve flexibility

Here 42% said yes for *phase 1* and *phase 2*, 33% for *phase 3*. 17% said no for *phase 1*, *phase 2* and *phase 3*. 42% said not relevant for *phase 1* and *phase 2* and 50% for *phase 3*.

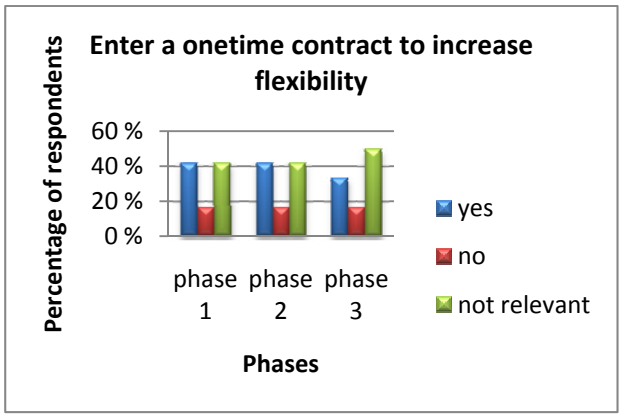


Figure 10-15: Enter a onetime contract to increase flexibility

Here the answers are split between yes, and not relevant, as said earlier the reason for this might be that the not relevant answers could be the organizations with different needs, for sourcing. Some of the organizations only get involved in some of the humanitarian crisis, others only source directly when a crisis is a fact, and some only source when they have funding.

Enter a new contract with the same supplier to increase flexibility

Here 42% said yes for *phase 1*, 33% for *phase 2* and 25% for *phase 3*. 17% said no for *phase 1*, *phase 2* and *phase 3*. 42% said not relevant for *phase 1*, 50% for *phase 2* and 58% for *phase3*.

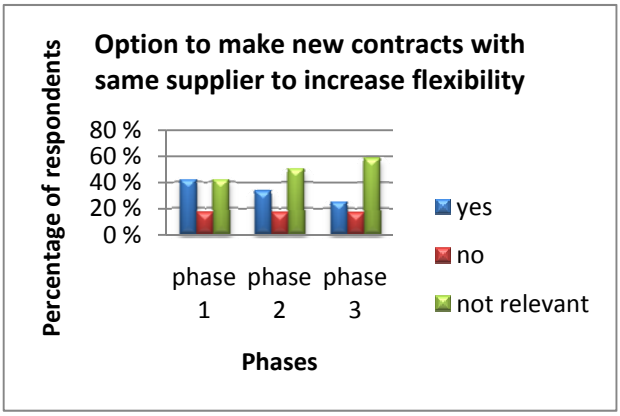


Figure 10-16: Option to make new contract with the same supplier to increase flexibility

Here there is a spilt in phase 1 between yes, and not relevant, for phase 2 and phase 3 the majority said not relevant, but the majority of the participants finding it relevant would do so, supporting previously statements in regard to flexibility. The reason for the large not relevant result might be due to the different attributes and needs of the humanitarian organizations.

Possibility of buying customized goods

Here we asked the participants how important it is for their organization that the suppliers are offering the possibility to customize the products to their specifications.

Here the answers where quite scattered, on a scale from 1 to 7, with the option of not relevant, 8% said 2, 25% said 3, 25% said 4, 17% said 5, 17% said 7 and 8% said not relevant.

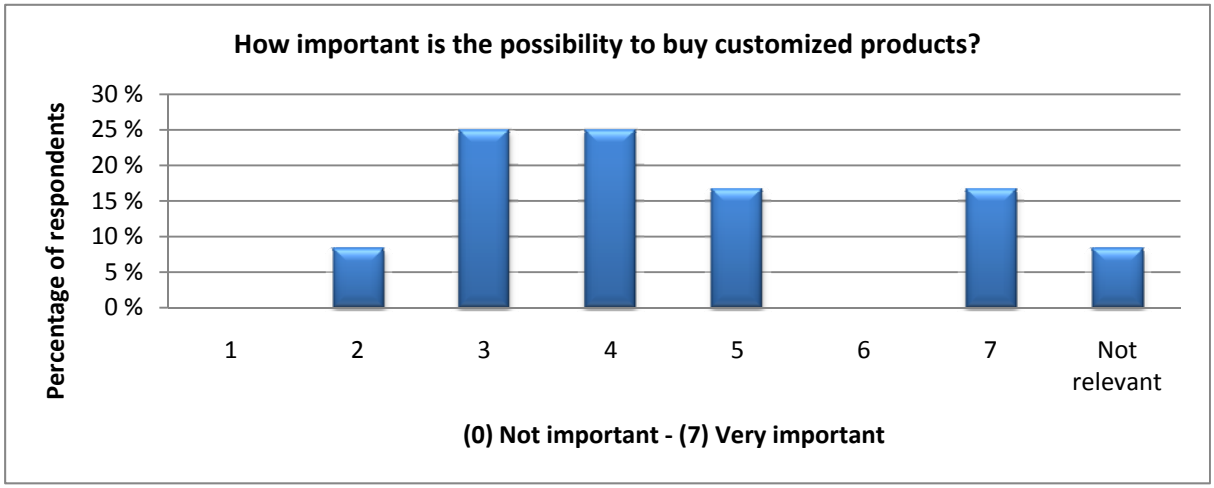


Figure 10-17: How important is the possibility to boy customized products

The need for customized goods seems to be different for the different organizations; this underpins our picture of the humanitarian marketplace, as a diverse place, where the organizations has different needs. We can say that the need for customization is there, but it is not a uniform need for humanitarian organizations.

For how long should a long-term agreement last

Here we are interested in knowing for how long a long-term agreement would last, I respect to the three different phases of a humanitarian crisis. According to sources in ROFI Industrier AS, a normal LTA lasts for 2 years. Therefore we choose to use the scale from 1 to 5 years, and not relevant for those cases it is not.

For ***phase 1*** 17% said a LTA would last 1 year, 33% said it would last 2 years, 17% said it would last 3 years, and 33% said it was not relevant.

For ***phase 2*** 17% said 1 year, 33% said 2 years, 17% said 3 years, and 33% said not relevant.

For ***phase 3*** 17% said 1 year, 25% said 2 years, 17% said 3 years, 8% said 5 years and 33% said not relevant.

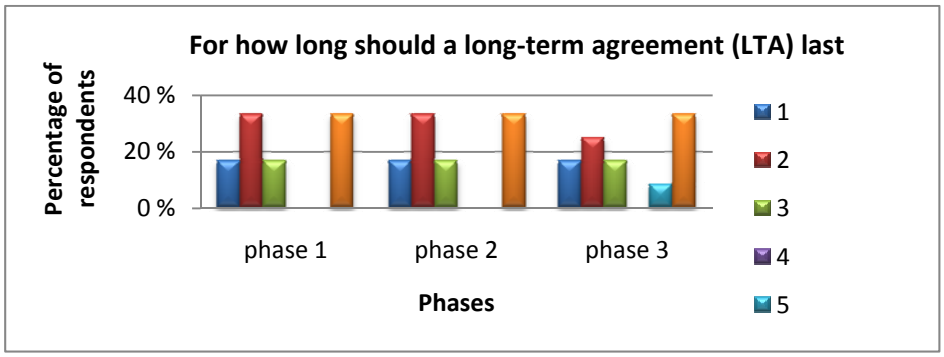


Figure 10-18: How long should a long-term agreement last

Here 33% of our respondents said long-term contracts were not relevant to their organizations or for the phase. The others said that a LTA would last from 1 to 3 years.

Option to extend a long-term agreement

Then we asked the respondents if there is a long-term agreement, are there an option to extend this agreement. The respondents, whom had answered not relevant on all phases in the previous question, would not get this question, when an LTA was not relevant for them.

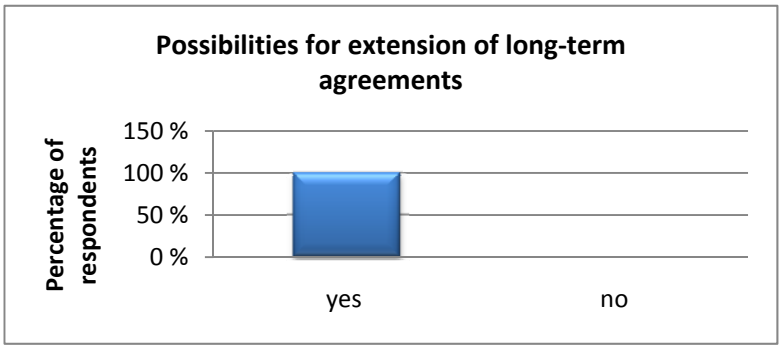


Figure 10-19: Possibility for extension of a long-term agreement

100% of the respondents said yes. This means that if the organizations have a LTA, and they are pleased with their supplier, the contract can be extended.

How long would an extension of a long-term agreement be?

Here the respondents answering yes to the previous question were asked, for how long an extension of a long-term agreement would last.

For ***phase 1*** 60% said 1 year, 30% said 2 years, and 10% said not relevant.

For ***phase 2*** 60% said 1 year, 20% said 2 years, and 20% said not relevant.

For ***phase 3*** 50% said 1 year, 20% said 2 years, 10% said 3 years and 20% said not relevant.

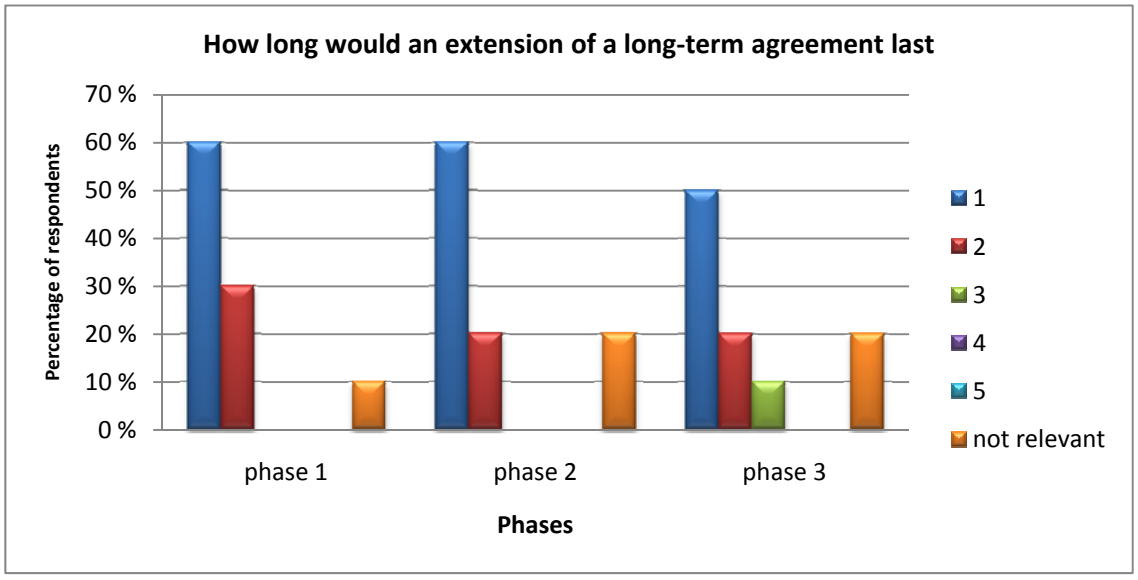


Figure 10-20: How long would an extension of a long-term agreement last

Here we can see that an extension of an LTA would last one or two years for ***phase 1***, and ***phase 2***, and in ***phase 3*** they would last 1-3 years. There are also some of the respondents answering nor relevant, the reason for this might be due to the fact that not all the organizations are necessarily involved in the same phases.

10.3 Questioner part three

Preferred sourcing strategy

Here we are looking for the preferred sourcing strategy of products for the different phases of the crisis.

For phase 1 42% said single sourcing, 8% double sourcing, and 42% multiple sourcing, and 8% said this was not relevant.

For phase 2 25% said single sourcing, 25% said double sourcing, 33% said multiple sourcing, and 17% said this was not relevant.

For phase 3 17% single sourcing, 8% double sourcing, 42% multiple sourcing, and 33% not relevant.

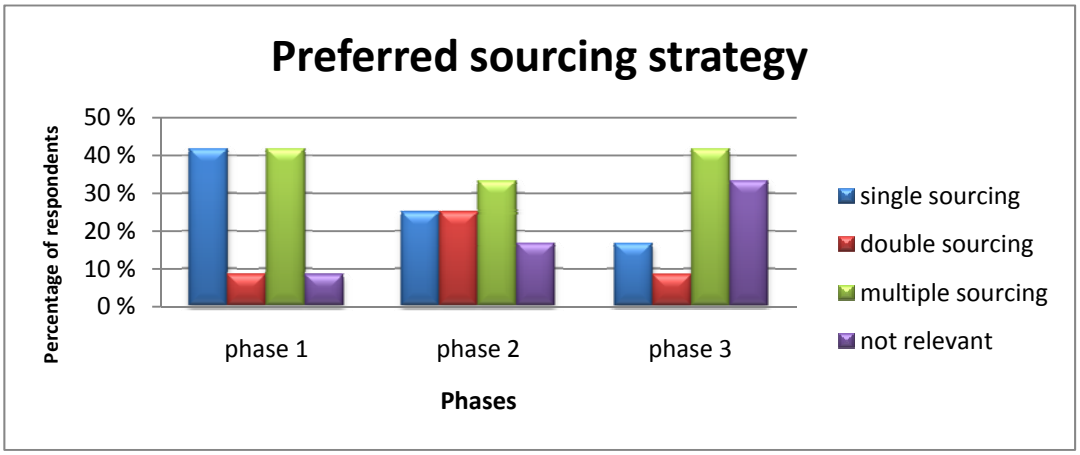


Figure 10-21: Preferred sourcing strategy

From this we might draw the conclusion that there is not one unique sourcing strategy for the different phases and for the different organizations. The different organizations have different sourcing strategy in accordance with their needs, which we earlier in this thesis have presented. But we might conclude that the higher presence of single sourcing for phase 1 could be a result of long-term agreements. The different organizations have different goals and areas of engagement, and they have different inventory needs; some have inventory, some have strategically placed inventory, some have long-term agreements, and some has no inventory at all. For phase 2 we might conduce that a small organization with only one need might do single sourcing, a bigger one might do double sourcing, and the large organizations might do multiple sourcing.

These answers correspond in accordance with our description of the humanitarian marketplace.

11 Priority countries and priority supplies

In previous section of this thesis we have discussed humanitarian logistics in terms of disaster relief logistics, and the theory related to it. We have also introduced the first part of a survey in order to support the theory. This chapter is divided in three parts where the *first part* seeks to prove how a country's vulnerability affects the impacts created from the natures disruptions and fluctuations with the human civilization. This part is important because it will be used as an argument to sort out high developed countries from our further calculations and considerations as well as support the discussion in previous sections. *The second part* aims to discuss and suggest regions and countries that humanitarian organizations, working to alleviate relief victims hit by natural disasters, should put their focus on. These regions are defines as "target regions" and the countries are defined as "target countries". *The third part* is aiming to point out what types of natural disasters that have been dominantly affecting each of the target regions during the last decade in order to propose which countries that suppliers should strategically position inventory in.

11.1 Part one: The relation between human civilizations vulnerability and the impacts of natural disasters

The vulnerability factor is described in previous sections and explains how e.g. population density and the degree of how developed countries plays a role. This is an issue of importance in this section since this defines and explains which countries that is not interesting for humanitarian organizations to put focus on.

To prove this we have chose Gross Domestic Product (GDP) as an indicator of a countries level of development and "average inhabitants' pr square kilometer within a country" as an indicator for population density for each country (Population Reference Bureau 2008). It can be discussed weather GDP is an appropriate indicator to use for this purpose. We chose this value because we mean that this is a value that can reflect how well developed a country is. It can also be discussed weather "average inhabitants' pr square kilometer within a country" is a proper indicator for population. An alternative method could be to use degrees of latitude and longitude in order to point out "windows", and calculate the density of people within these "windows". This is a method use by e.g. (Akkihal 2006)

work to divide the world into squares windows rather than countries. We have chosen to use “average inhabitants’ pr square kilometers within each country” in our thesis. To handle countries instead of “windows” was more convenient because it was easier to align to the rest of the data sets. The data that we chose to use was the different impacts (in terms of total dead, injured, homeless and affected) from multiple disasters and GDP and population density. All data was set in context to countries and run through a correlation analysis to find correlations. The different impacts were set as dependent variables while GDP and population density were set as the dependent variables. The results showed that there was a negative correlation between GDP and the different impact types and a positive correlation between population density and the different impact types. It has to be mentioned that the correlation between the population density and the impact factor “injured” did not correspond within the signification limit and has to be considered as faulting. There can be many reasons for this derogation. The most possible reason would be the appearance of “noise” in the dataset. By “noise” in this context we are talking about countries that have inadequate data in terms of values that are far from the mean. However, we were not able to detect an error in the dataset. Based on these results we can, with exception of the faulting correlation between population density and injured, state that the higher the GDP and the degree of development is within a country, the lower the impact of the nature’s fluctuation and disruption will be on human civilization. We can also state that the higher the population density is in an aria of natural disruptions and fluctuations, the higher the impacts will be.

Correlations

			Death	Density	GDP	Injured	Homeless	Affected
Spearman's rho	Death	Correlation Coefficient	1,000	,082	-,263**	,614**	,648**	,642**
		Sig. (2-tailed)	.	,282	,000	,000	,000	,000
		N	178	175	177	178	178	178
	Density	Correlation Coefficient	,082	1,000	,089	,126	-,021	,001
		Sig. (2-tailed)	,282	.	,242	,098	,786	,993
		N	175	175	175	175	175	175
	GNP	Correlation Coefficient	-,263**	,089	1,000	-,073	-,408**	-,494**
		Sig. (2-tailed)	,000	,242	.	,338	,000	,000
		N	177	175	177	177	177	177
	Injured	Correlation Coefficient	,614**	,126	-,073	1,000	,602**	,517**
		Sig. (2-tailed)	,000	,098	,338	.	,000	,000
		N	178	175	177	178	178	178
	Homeless	Correlation Coefficient	,648**	-,021	-,408**	,602**	1,000	,709**
		Sig. (2-tailed)	,000	,786	,000	,000	.	,000
		N	178	175	177	178	178	178
	Affected	Correlation Coefficient	,642**	,001	-,494**	,517**	,709**	1,000
		Sig. (2-tailed)	,000	,993	,000	,000	,000	.
		N	178	175	177	178	178	178

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 11-1 result from the analyses of the correlations

11.2 Part two: target regions and target countries

The regions and countries that are proposed in this part are that we define as target regions and target countries. These are regions and countries that characterize themselves from the rest of the world because of its high frequency of natural disaster occurrences. These arias and countries are so affected of natural disasters that should be on the top of every humanitarian organization priority list.

Figure 11-2: Target regions. (Adopted from (Google Maps 2009))

We have defined affected countries in terms of 4 different impacts. The four different impacts are defined and taken from (EM-DAT) and concerns the number of total dead, the number of affected, the number of homeless and the number of injured related to natural disasters. The different types of natural disasters are Hydrometrical, Geological and

Biological disasters and are defined in previous sections. Data regarding the frequency of natural disasters are taken from (EM-DAT), where the different *impacts* from the different *disasters* are given in terms of total *numbers of people* and related to *countries*.

We started to adopt the data through a process in order to make the data more aligned for its purpose. We started with a list with 203 countries from the (EM-DAT) database.

1. First we retrieved a comprehensive amount of data from (EM-DAT) where countries, number of people affected in terms of the different impacts and disaster types were represented.
2. A set of countries were sorted out because of obsolete data. Countries that were sorted out could be countries with absence of necessary information.
3. As described in part one, we aligned the data from (EM-DAT) with the data from (Population Reference Bureau 2008) in other to analyse the correlations between the different impacts and population density and GDP. This process created a new list over countries that were excluded. The qualifying reason for excluding countries was their absence of data registered in the (EM-DAT) database.

   After this process we had excluded 71 countries. A list over the excluded countries can be seen in the APPENDIX 2.

After adopting the data to align the datasets we started the process to sort out countries of less significant importance.

1. Based on the statements made in part 1, we conclude that high developed countries do not need the same efforts made by humanitarian organizations as the less developed countries do. If we look into the fact that high developed countries are often funding the bodies (e.g. the United Nation organizations) for humanitarian aid, we can exclude high developed countries. To define high developed countries we used the Human Development Indices (UNDP 2008) from the United Nations Development Program (UNDP).

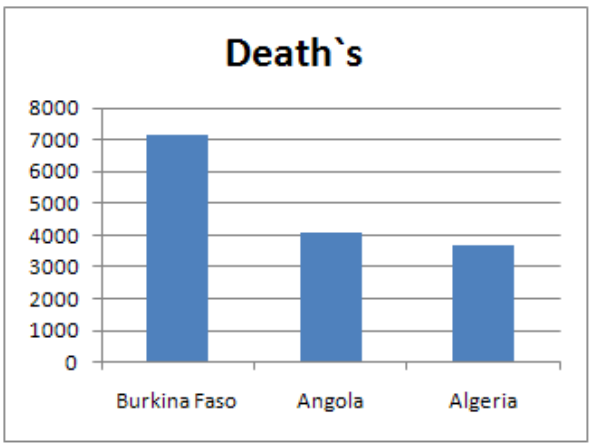
   The excluded countries were in total 75. This gave us a total list of 56 countries for further analysis. A list over excluded countries can be seen in the APPENDIX 3.

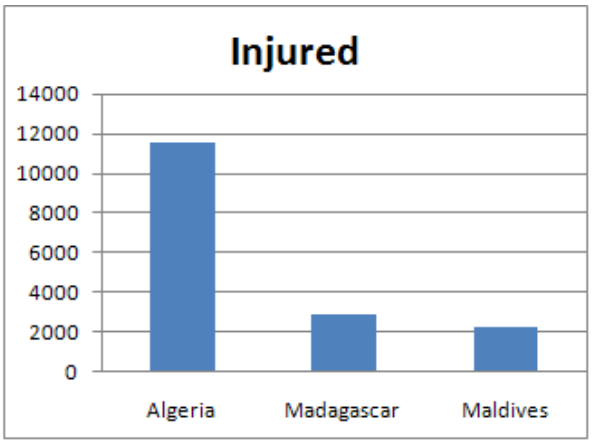
2. After removing the high developed countries we sorted the countries into regions based on continents. Continents were defined by Africa, Asia, Europe, South America,

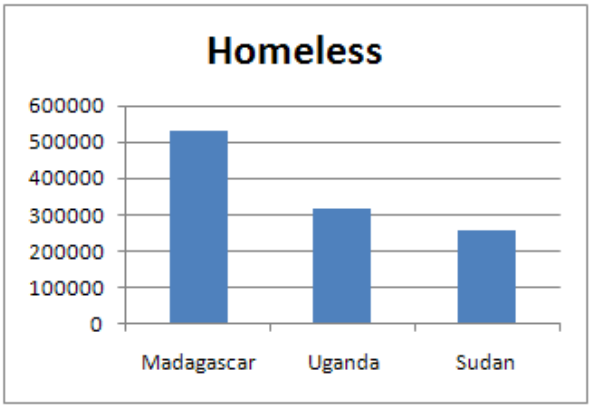
North America and Oceania. The countries within each continent were sorted by total number of people affected by all disasters in respect of the different impacts. The sorting was done arranging the countries with highest impact rate, related to the different types of disasters, to lowest. This resulted in four different lists based on the four different impact types within each of the continents. By this method we were able to pick out those countries that characterized themselves from the others. The top three countries from the four different impacts and the different continents were picked out. It has to be mentioned that the countries are compared within each of the continents, not across continental borders. This can lead to the fact that a country ranked as the top country within one continent will get a lower rank compared to a country in another continent. Although, this ranking can be useful to pinpoint which country in need for bigger attention than others within its respective continent.

The following part will show how the analysis was done within each of the continents, which countries that are more frequented of natural disasters than others and which countries that are pointed out to be target countries.

Africa







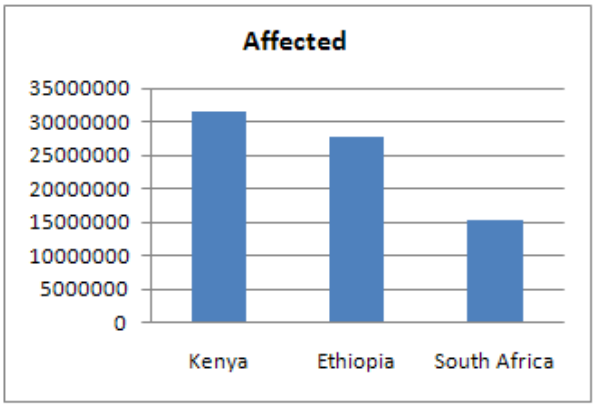


Table 11-1: The impacts of death's, injured, homeless and affected, related to the top three countries

Burkina Faso, Algeria, Sudan, Ethiopia, Angola, Uganda, Kenya, Madagascar and the Maldives are countries that we have picked out in respect of their high frequencies within the different impacts types. It has to be mentioned that Africa is the continent that has the lowest variance within its continent, compared to other continents. By explaining it furthermore we can say state that the mentioned countries are representing the most frequent countries but more countries could be mentioned as potential arias to pinpoint as priority arias for humanitarian organizations.

Figure 11-3: Algeria, Burkina Faso, Sudan and Ethiopia. (Adopted from (Google Maps 2009))

Figure 11-4: Angola, South Africa, Uganda, Kenya and Madagascar. (Adopted from (Google Maps 2009))

Figure 11-5: The Maldives. (Adopted from (Google Maps 2009))

North America

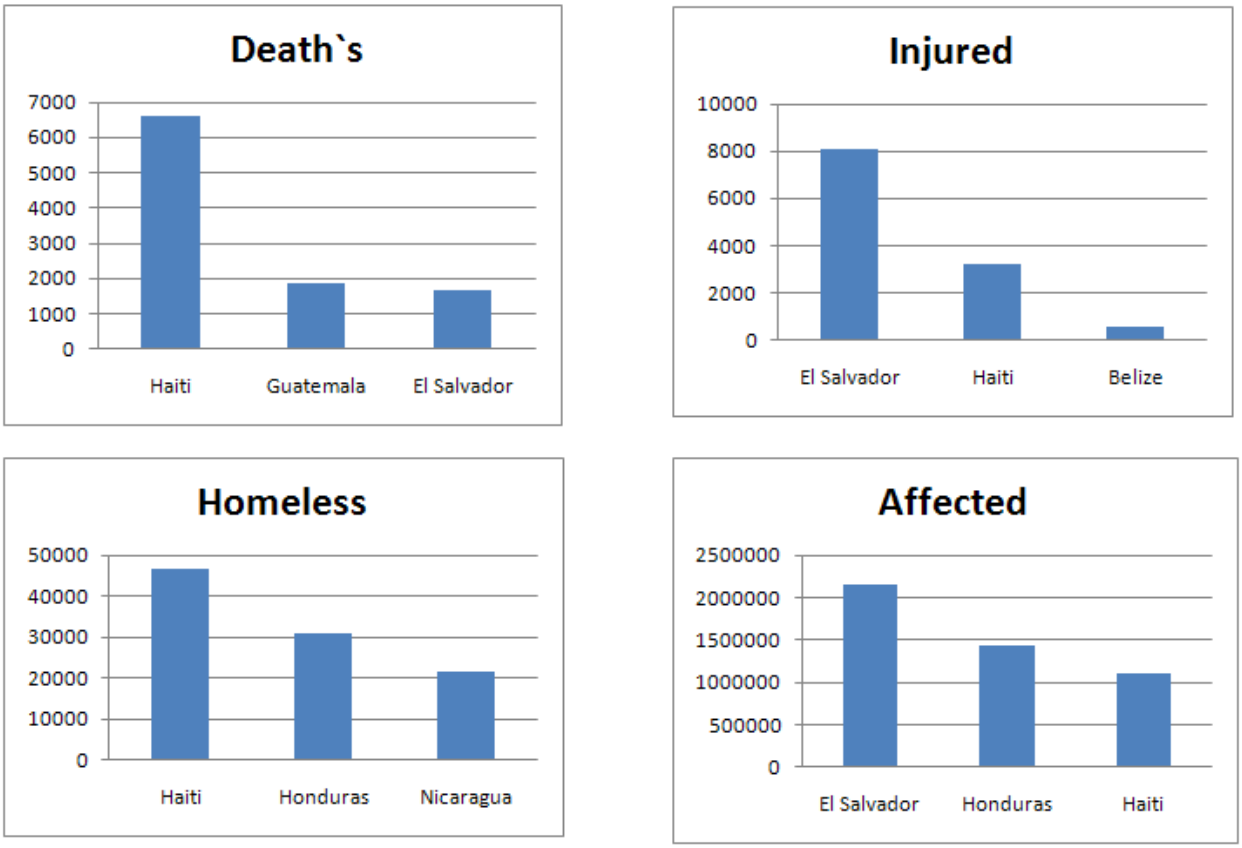


Table 11-2: The impacts of death's, injured, homeless and affected, related to the top three countries

In North America we have picked the top four countries from the ranking to be pointed out to be target countries, based on the ranking in the table above. Haiti, Guatemala, Honduras, El Salvador, Nicaragua and Belize are pinpointed because they are all represented in respect to the frequencies of the different impacts and are more characterizing from the other countries.

Figure 11-6: Haiti. (Adopted from (Google Maps 2009))

Figure 11-7: Guatemala, Honduras, El Salvador Nicaragua and Belize. (Adopted from (Google Maps 2009))

South America

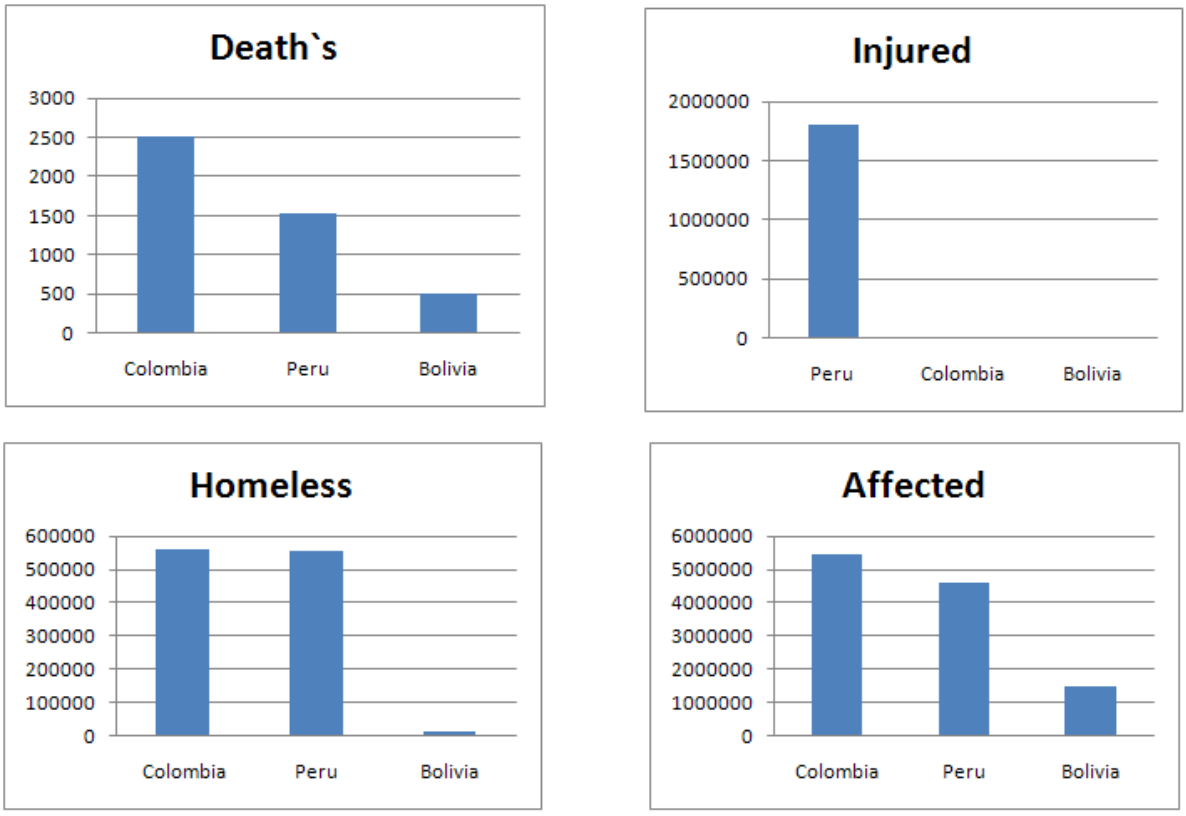
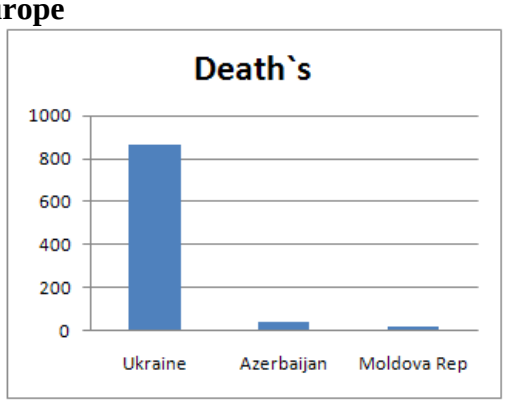


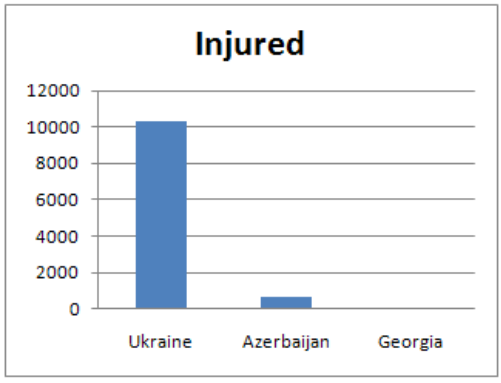
Table 11-3: The impacts of death's, injured, homeless and affected, related to the top three countries

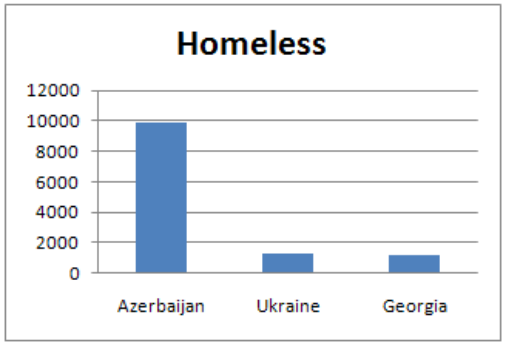
In South America the same countries were ranked as top three according to the different impacts. Colombia, Peru and Bolivia are countries with high frequencies in respect of the different impacts, compared to the other countries, and are therefore pinpointed to be target countries in this aria.

Figure 11-8: Colombia, Peru and Bolivia. (Adopted from (Google Maps 2009))

Europe







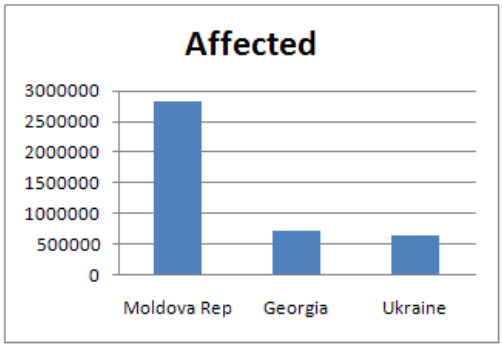


Table 11-4: The impacts of death's, injured, homeless and affected, related to the top three countries

In Europe there are only six countries that are defined as medium or low developed (UNDP 2008). All countries appears on among the top three countries from the different rankings. The countries are represented by Ukraine, Azerbaijan, Georgia, Moldova Republic, Armenia and Lebanon. All these countries can be defined as target countries in this aria but Lebanon is the least frequent country among these. It can be discussed whether it should be pinpointed or not. Based on the relative small numbers related to it, our recommendation is to leave it out of list of target countries for this aria. It can also be discussed whether it is related to the Europe continent or the Asia continent. In this thesis we have considered it to be a part of the Europe continent.

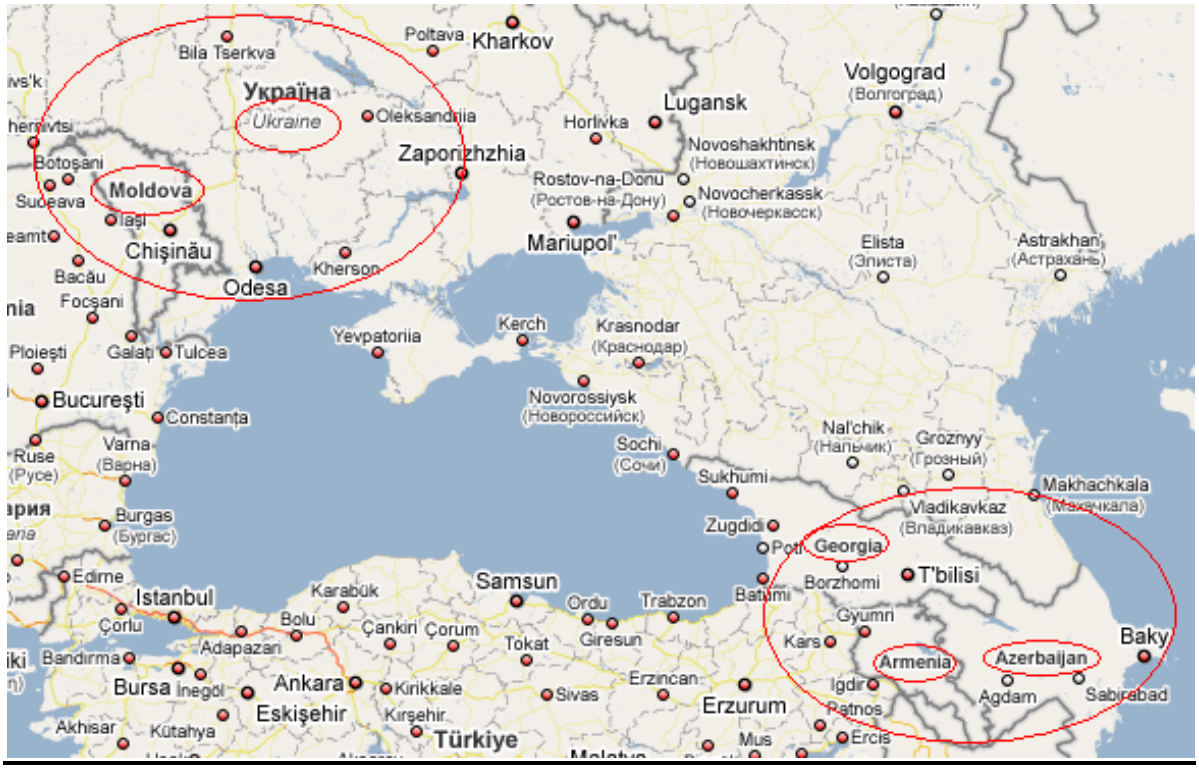


Figure 11-9: Ukraine, Moldova Republic, Georgia, Armenia and Azerbaijan. (Adopted from (Google Maps 2009))

Asia

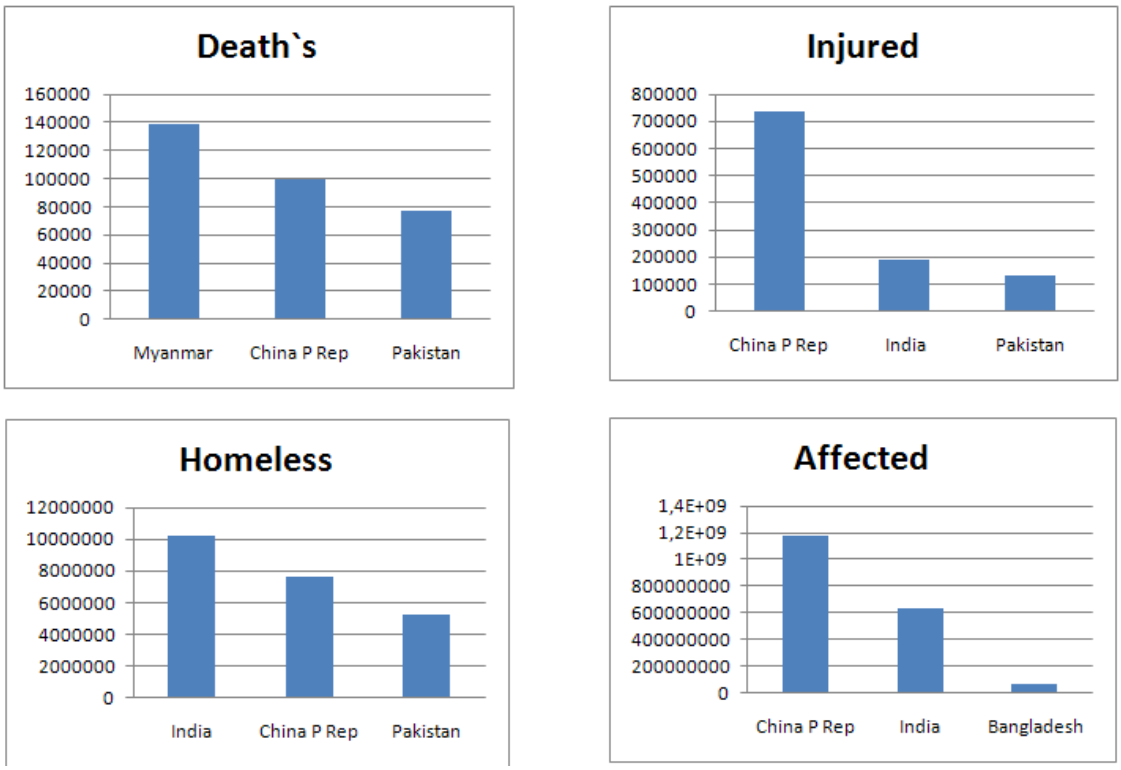
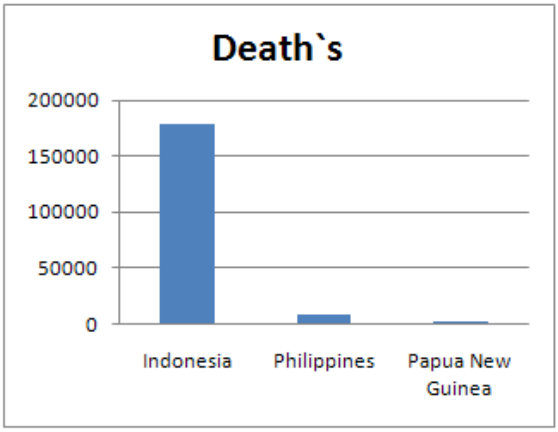


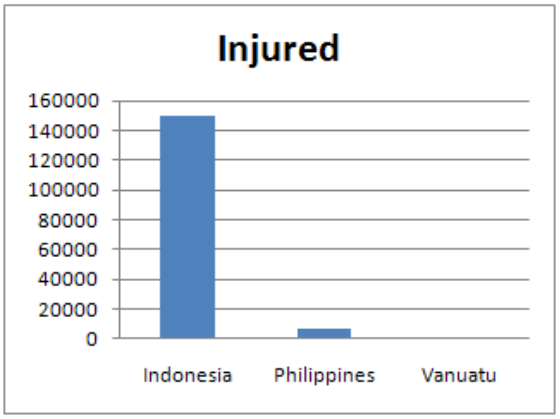
Table 11-5: The impacts of death's, injured, homeless and affected, related to the top three countries

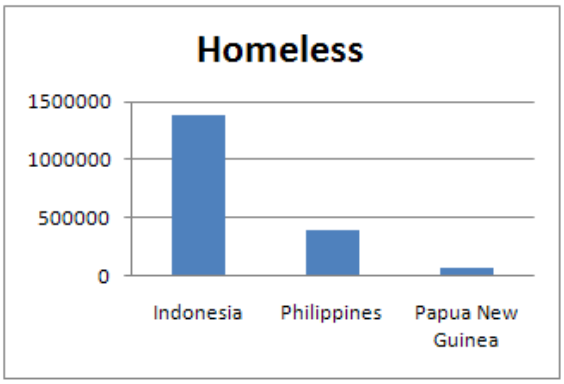
The three top countries in respect of the different impacts were: Pakistan, India, China and Myanmar (former Burundi) and Bangladesh are countries that have an exceptional high frequency of the different impacts, compared to the rest. These countries should be pinpointed for priority arias for humanitarian organizations.

Figure 11-10: Pakistan, India, China, Myanmar and Bangladesh. (Adopted from(Google Maps 2009))

Oceania







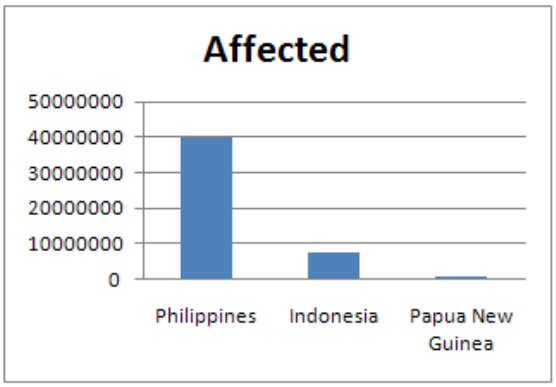


Table 11-6: The impacts of death's, injured, homeless and affected, related to the top three countries

We can clearly see two countries that characterize themselves from the rest of the region. The Philippines and Indonesia are the most frequented countries in respect of the different impacts. Other countries that are pointed out are: Vanuatu and Papua New Guinea. These two countries should also be pinpointed as target countries for this region, according to the top three countries within the different rankings but have not been affected to the same extent as the others.

Figure 11-11: The Philippines, Indonesia and Papua New Guinea. (Adopted from(Google Maps 2009))

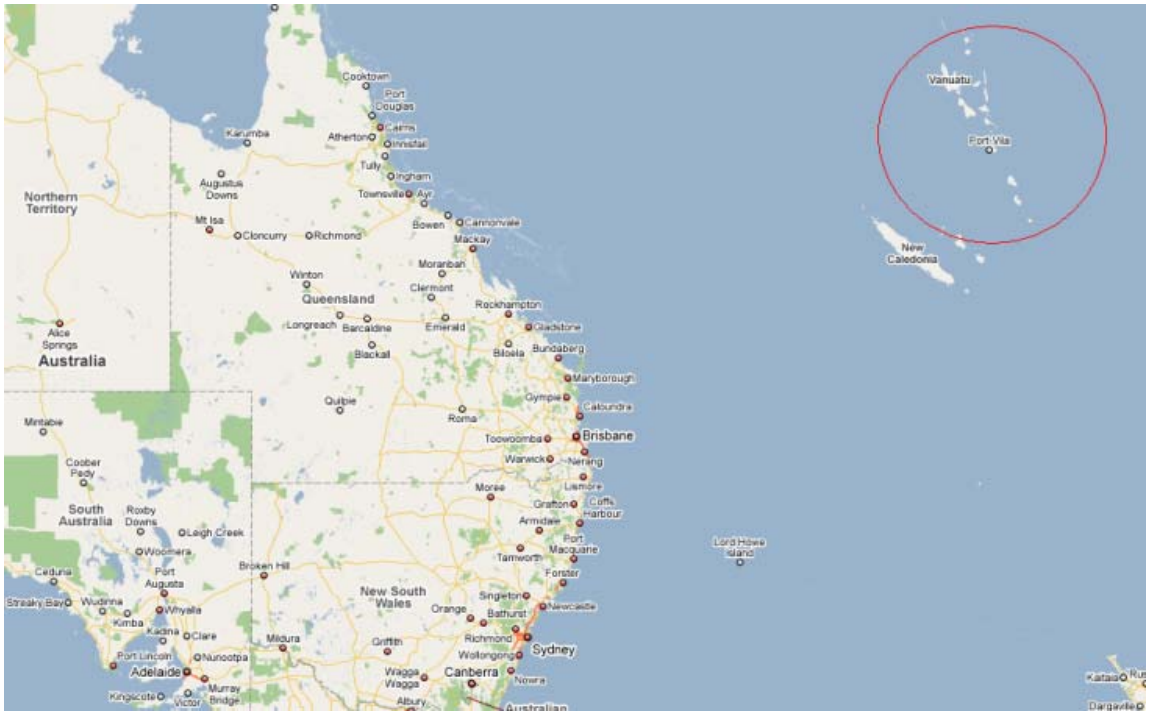


Figure 11-12: Vanuatu. (Adopted from (Google Maps 2009))

11.3 Part three: Target countries and strategic positioning of inventory

The previous part of this chapter has put a focus on which regions and countries that should be prioritized by humanitarian organizations. This part aims to propose which countries that a supplier should position inventory in.

This section seeks to find which types of natural disasters that have been dominating the different continents during the last decade. The analysis points out the different types of disasters that have in a dominating way affected the related regions and countries during the last decade. We have analyzed the different types of impacts and to some extent discuss whether there are certain countries that characterizes themselves from the other countries. We have previous defined disasters in term of the categories and definitions of (van Wassenhove 2006) regarding slow and sudden-onset disasters. The categories and definitions are used in order to distinguish between predictable and unpredictable disasters. We have previous discussed that sudden-onset disasters differ from slow-onset disasters because they don't evolve over time, and therefore needs supplies on inventory close to their appearance

The regions, the countries, the different types of disasters and the different types of impacts are defined in the same way as previous in this chapter.

In the end of this part, the result is summarized by given an overview over the target countries in respect of the dominant natural disasters related to it. The table gives the foundation for proposing which countries that inventory should be positioned in.

Africa

The impact of deaths in Africa is according to the analysis generally caused by epidemics. Some of the deaths can also be related to earthquakes and floods, but epidemics are the major cause of deaths in Africa. This impact does not affect one country particular but is an impact that general affect the region as a whole.

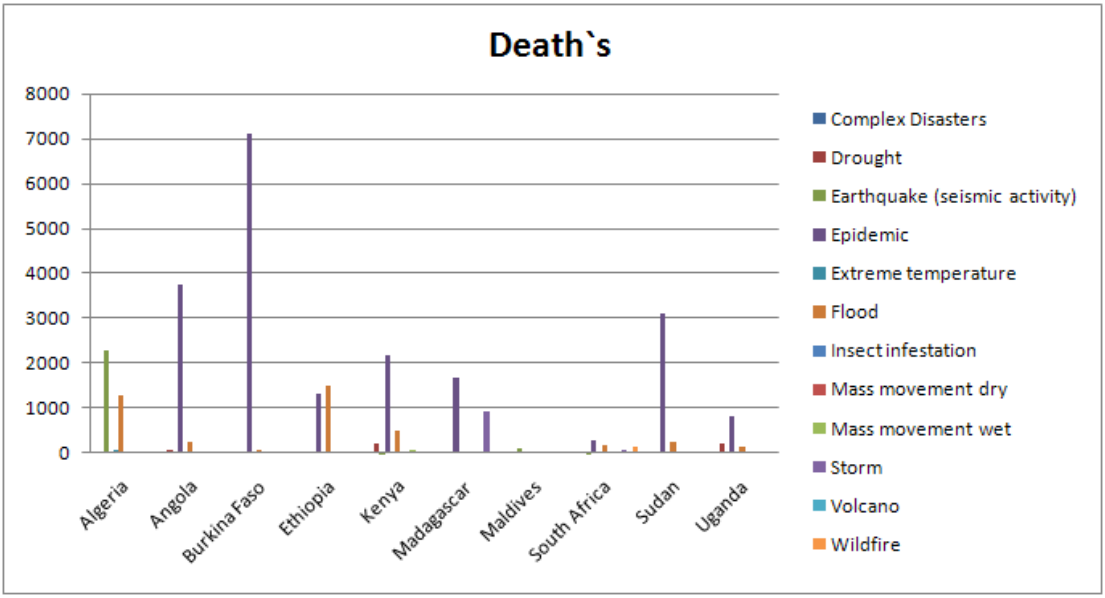


Figure 11-13: Number of deaths related to country and disaster

Due to the numbers of injured it can be stated; based on the results, that earthquakes is the major cause to inured in this region. We can also state that storms are a cause for injured but not in the same extent as earthquakes. Algeria is, according to the results the country most experienced country due to earthquakes.

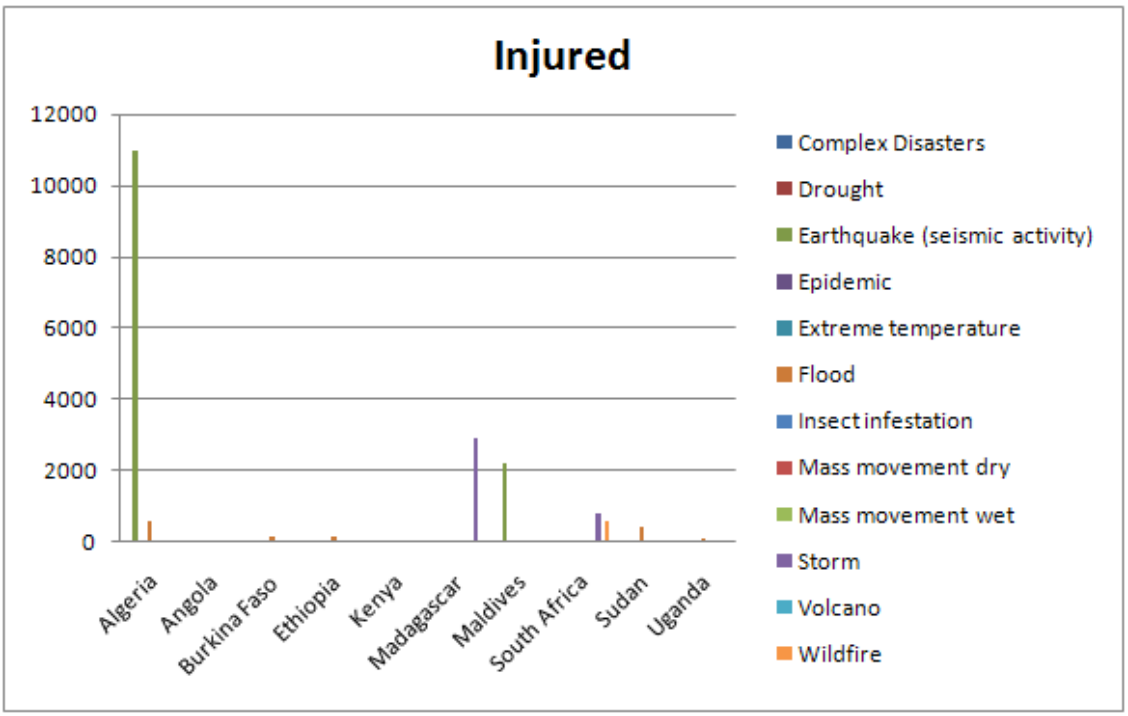


Figure 11-14: Number of injured related to country and disaster

Drought is the major cause when it comes to affected in this region. According to the results we can state that Ethiopia, Kenya, South Africa and to some extent Sudan and Uganda are countries that are heavily affected by draughts.

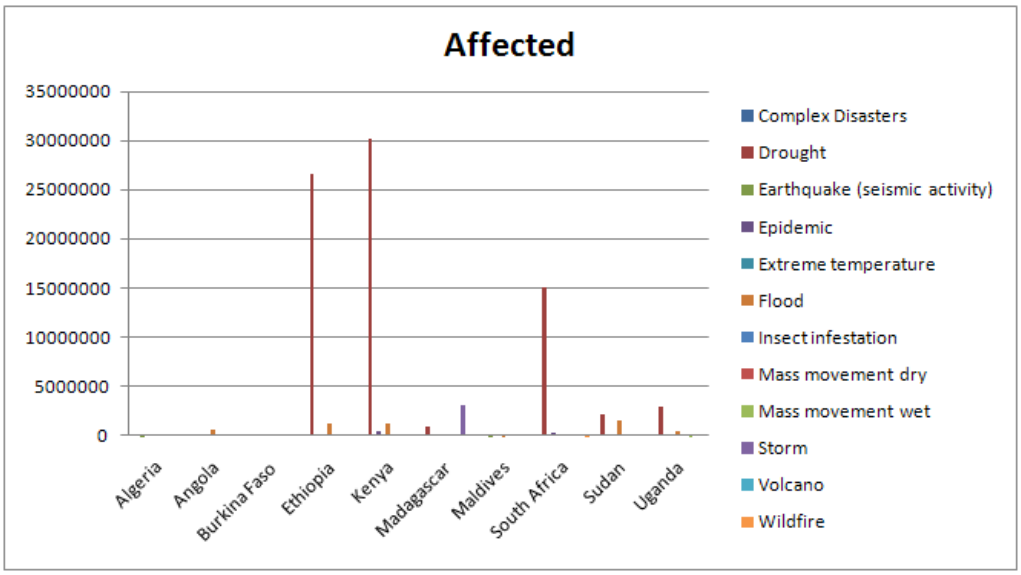


Figure 11-15: Number of affected related to country and disaster

Homeless people are usually caused by storms, floods and earthquakes. Algeria is the country with highest numbers of homeless during the last decade, due to earthquakes, while Madagascar is the country that has the highest number of affected by storms. Angola, Burkina Faso, Ethiopia, Sudan and Uganda are countries have experienced high numbers of affected by floods.

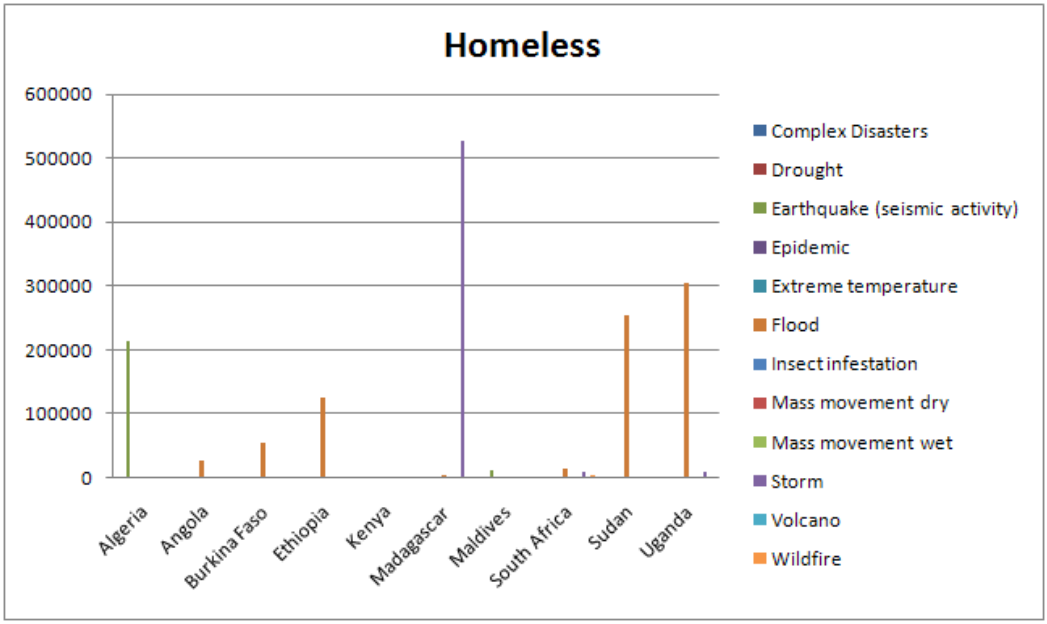


Figure 11-16: Number of homeless related to country and disaster

North America

Several of disaster types have caused the high number of deaths in this region. Storms, earthquakes and floods are disasters that have been most frequented. Haiti is the country with the highest experienced number of deaths due to storms and floods. Guatemala is the

country with highest deaths related to storms while El Salvador is a country highest experienced with deaths due to earthquakes.

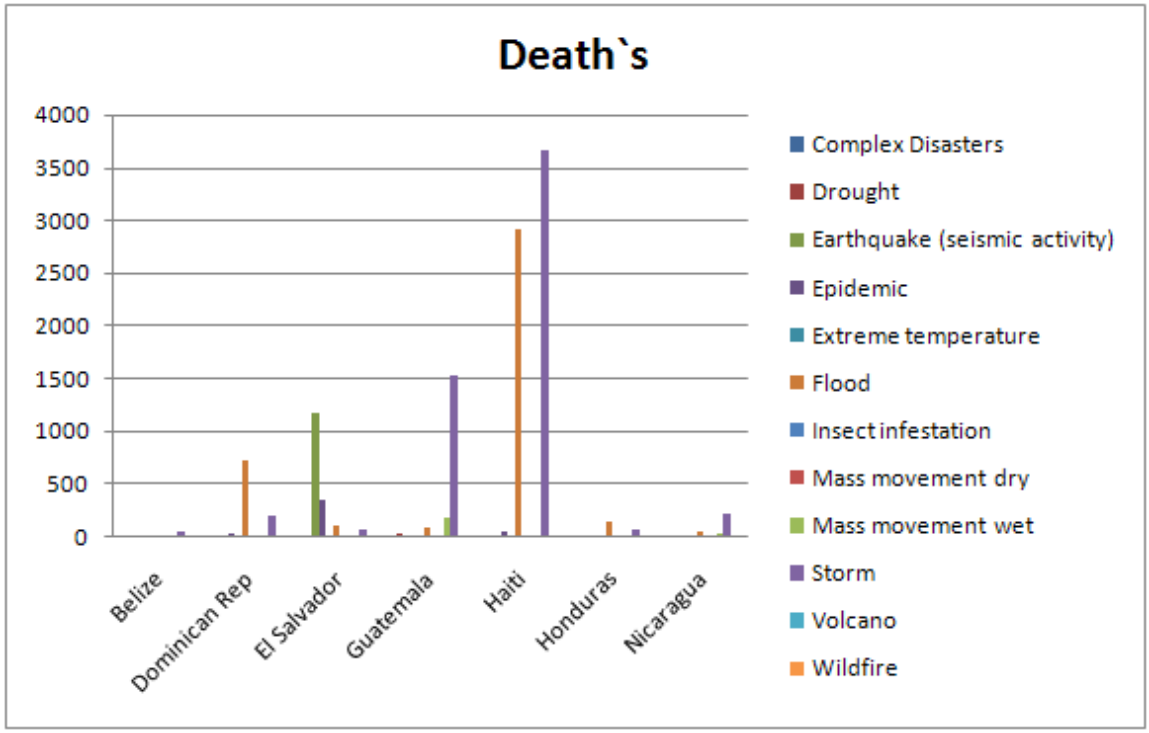


Figure 11-17: Number of deaths related to country and disaster

Due to the total number of injured, there are two types of natural disasters that in general points themselves out within this region. El Salvador is the country with highest number injured due to earthquakes while Haiti and Belize is the country with higehst number of injure due to storms.

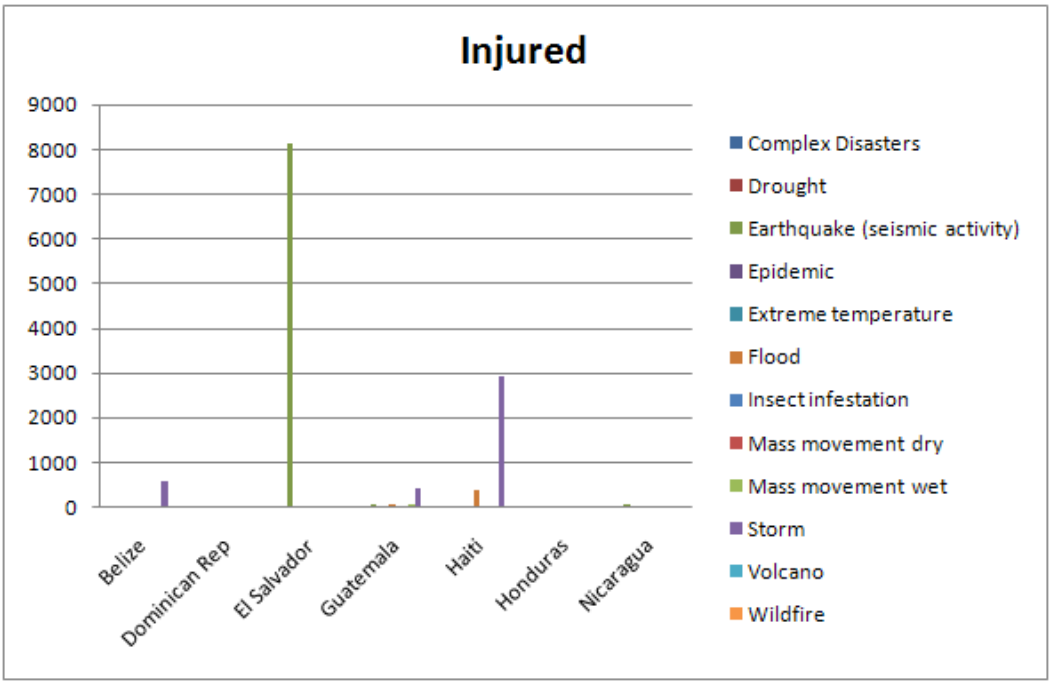


Figure 11-18: Number of injured related to country and disaster

The number of affected people in this region is caused by four major types of disasters. Earthquakes, floods, storm and drought are disasters that have affected this region frequently in the last decade. El Salvador is the country with most affected people due to earthquakes while Belize, the Dominican Republic, Guatemala, Haiti, Honduras, and Nicaragua are countries frequently hit by floods and storms.

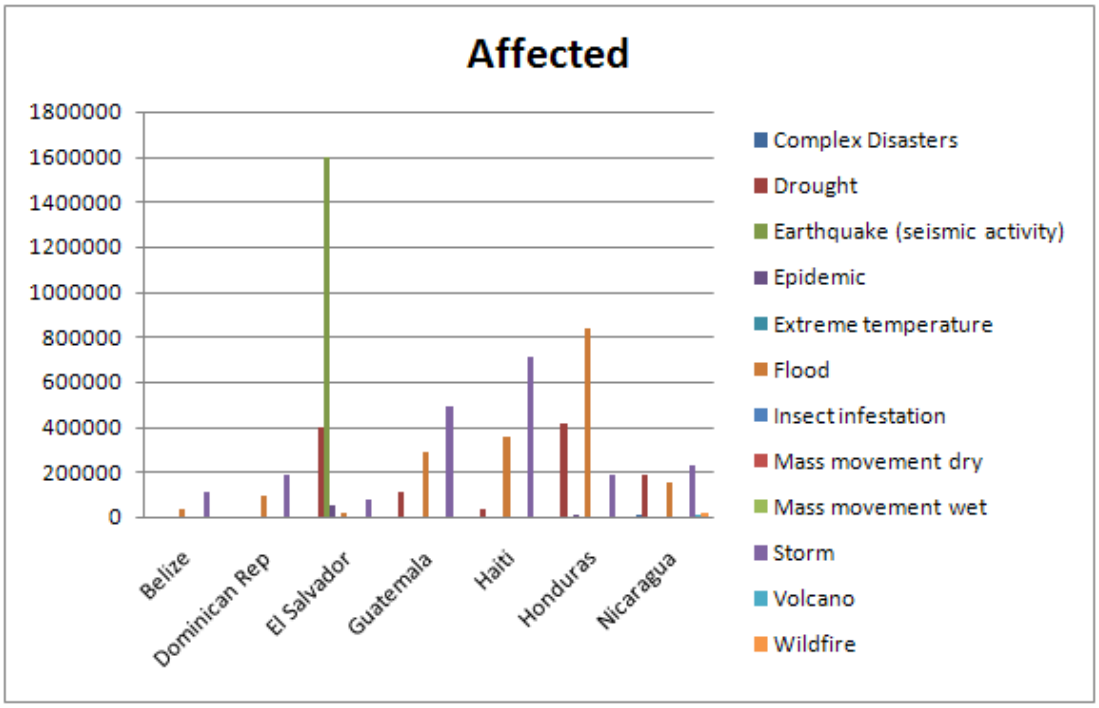


Figure 11-19: Number of affected related to country and disaster

The total numbers of homeless people in this region are in general generated from floods and storms. Haiti, Honduras and Nicaragua are countries that have experienced high numbers of homeless due to both floods and storms.

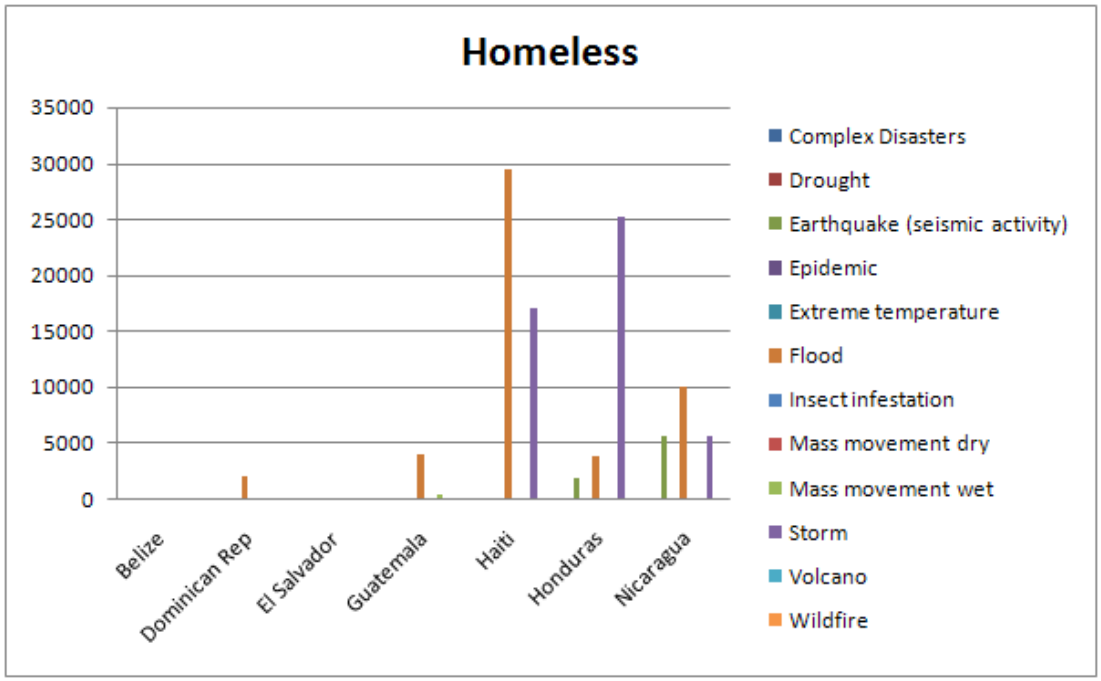


Figure 11-20: Number of homeless related to country and disaster

South America

Earthquakes, floods, mass movements and extreme temperatures are disasters that have created most death's in this region. Bolivia Colombia and Peru are all countries that have experienced earthquakes and floods. Colombia is the country that has experienced the highest rate of death due to mass movements while Peru is the country with the highest death rate related to extreme temperatures during the decade.

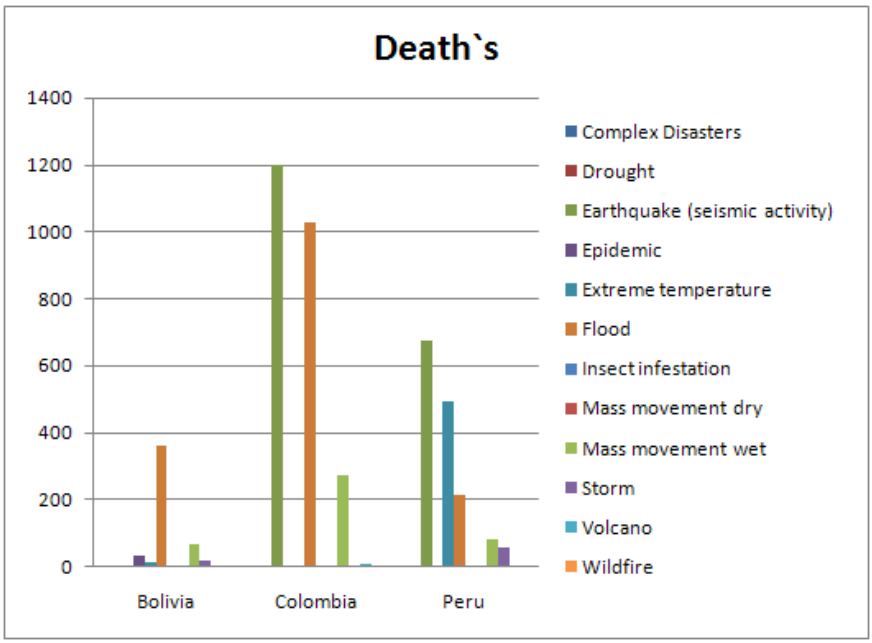


Figure 11-21: Number of deaths related to country and disaster

Injured people in this region are mostly caused by extreme temperatures. According to the results we can state that Peru is the decidedly highest number of deaths due to extreme temperatures.

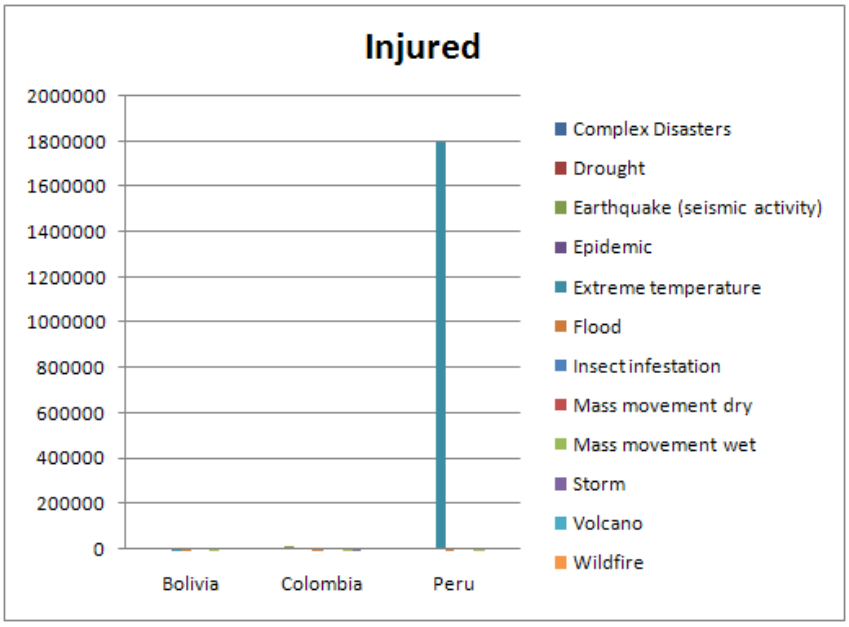


Figure 11-22: Number of injured related to country and disaster

The number of affected people in this region is related to floods, earthquakes and extreme temperatures. Bolivia and Colombia are the countries that have experienced the highest number of affected due to floods, while Colombia and Peru are the countries that have experienced the highest number of affected due to earthquakes. The highest number of affected people due extreme temperatures is represented by Peru.

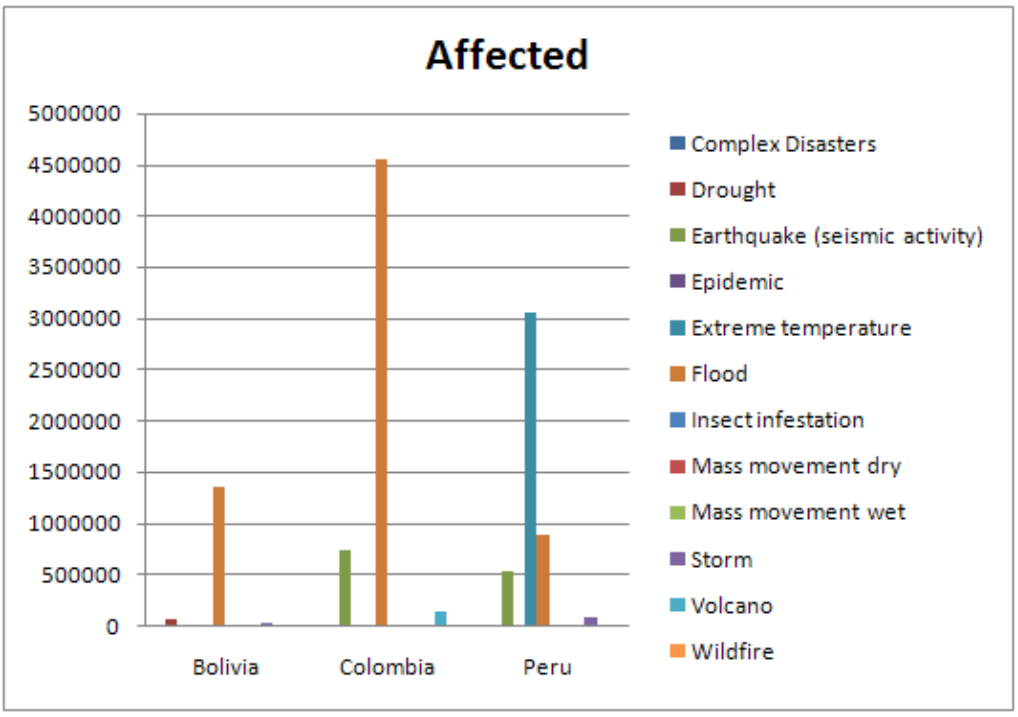


Figure 11-23: Number of affected related to country and disaster

The number of homeless people in this region is in general caused by earthquakes and floods. The countries that are hit by these types of disasters are Colombia and Peru. Peru has experienced relatively equal numbers of homeless from both disasters while Colombia has experienced more homeless people due to earthquakes during the last decade.

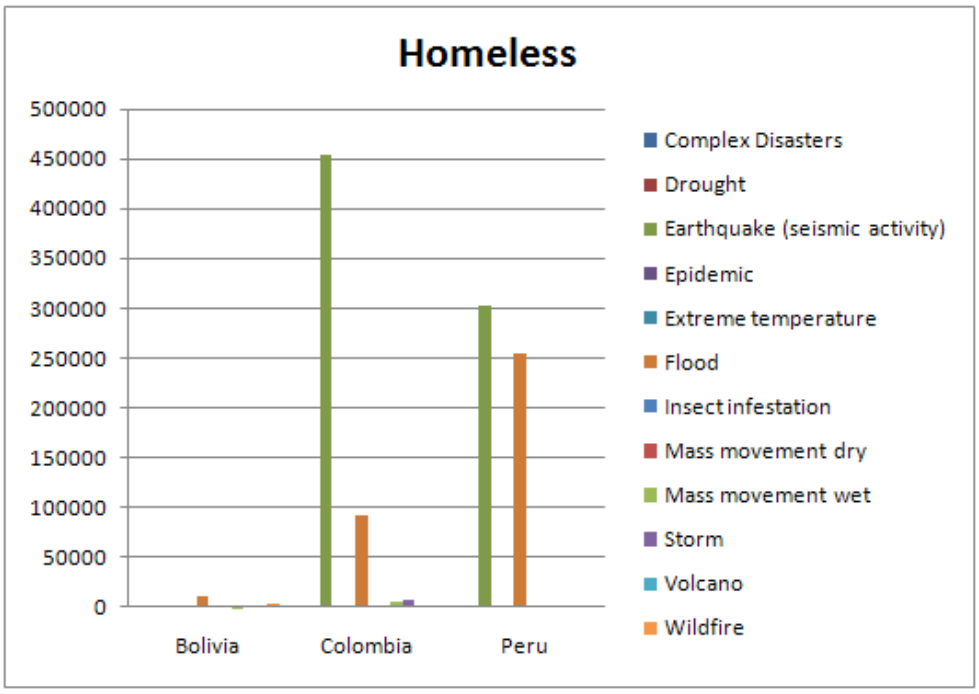


Figure 11-24: Number of homeless related to country and disaster

Europe

Most of the death's in Europe are related to extremes temperatures. Ukraine is the country that has experienced most deaths during the last decade.

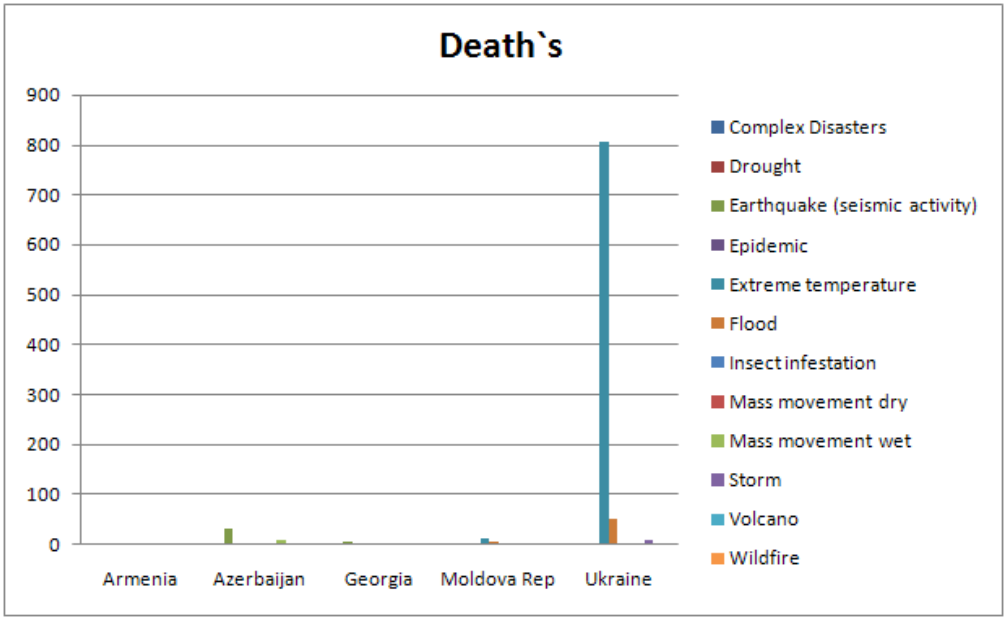


Figure 11-25: Number of deaths related to country and disaster

Ukraine is also on the top regarding the numbers of injures. Extreme temperatures are also the reason for the high number of this impact.

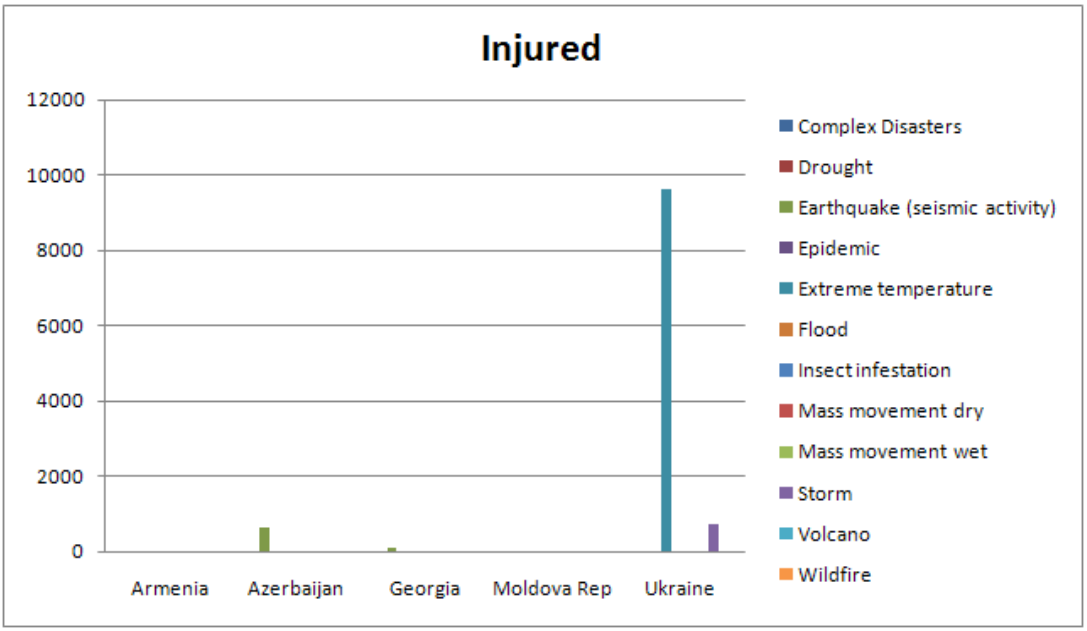


Figure 11-26: Number of injured related to country and disaster

The number of affected in Europe the last decade is related to storms, droughts and floods. Moldova Republic is the country that has experienced most affected people, due to storms. Due to droughts, Moldova Republic, Armenia and Georgia are the countries that have been hit most frequently by this type of disaster. Ukraine is the country most hit by floods.

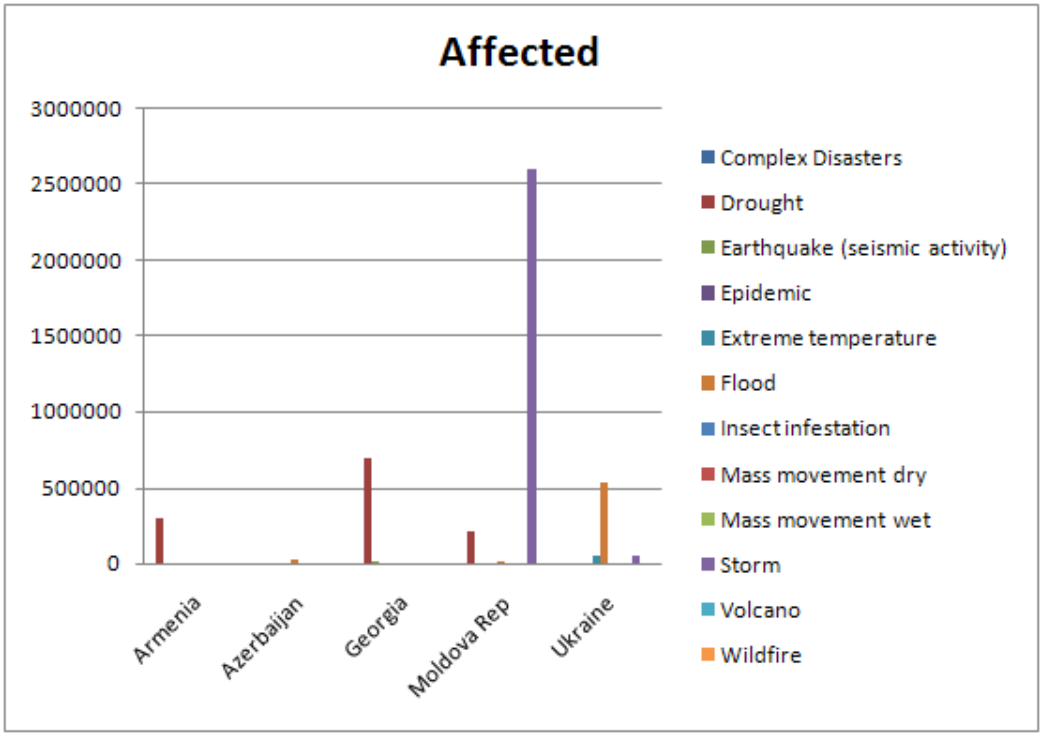


Figure 11-27: Number of affected related to country and disaster

Azerbaijan is the country with highest experienced number of homeless due to earthquakes. It has also experienced homeless people due to floods, but not in the same extent as earthquakes. Earthquakes, floods and storms have caused homeless people in Georgia, Moldova Republic and Ukraine to, but the numbers are relatively small.

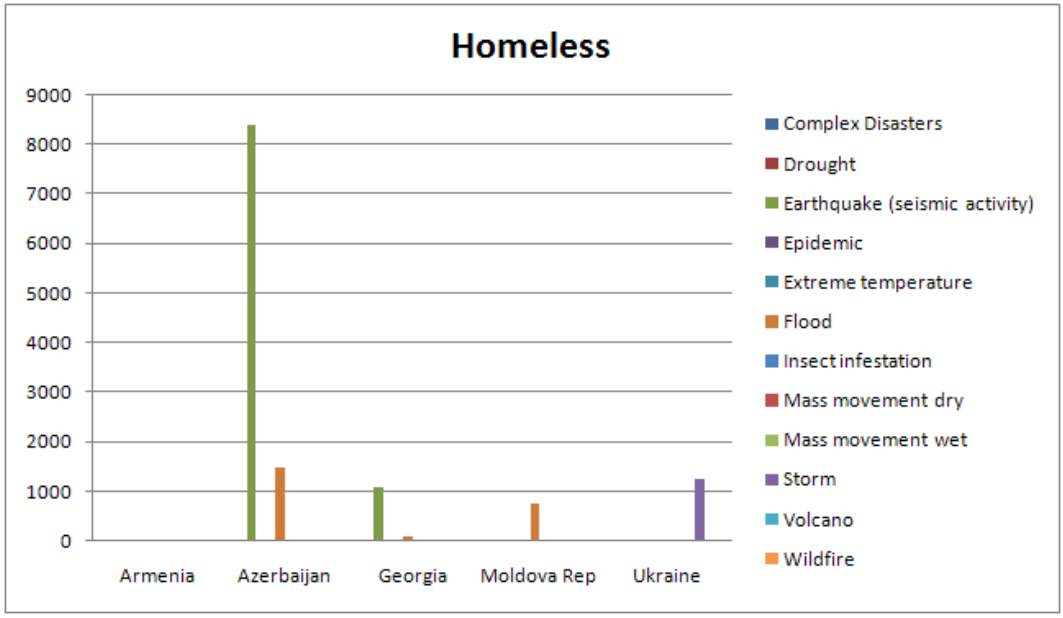


Figure 11-28: Number of homeless related to country and disaster

Asia

In the Asia region deaths are usually caused by floods and storms. China, India and Pakistan are the countries that have experienced the highest death rate during the last

decade, while Myanmar is the country with highest experienced number of deaths related to storms.

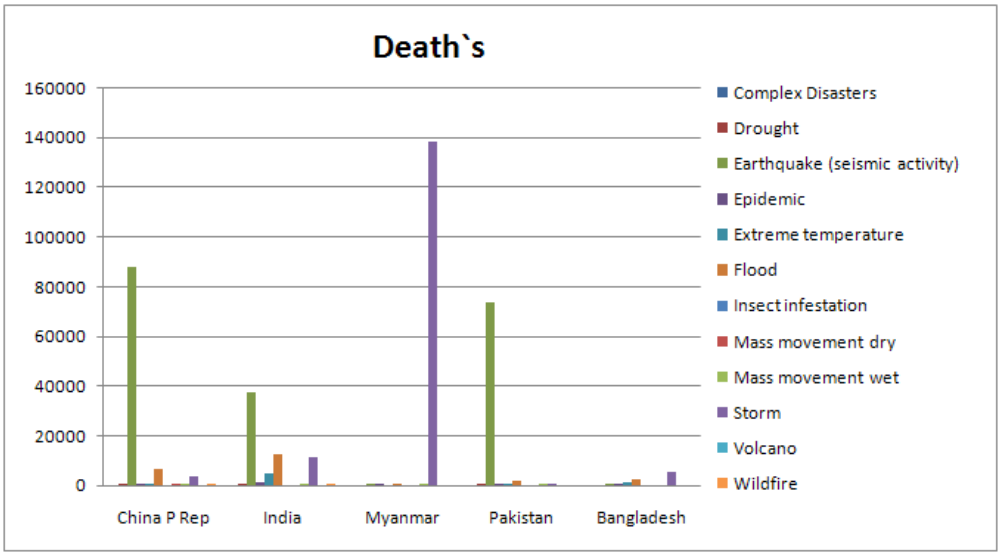


Figure 11-29: Number of deaths related to country and disaster

China, India and Pakistan are the countries that have the highest experienced rate of injured people due to earthquakes. China and Bangladesh have in addition experience high numbers of injured people due to floods and storms.

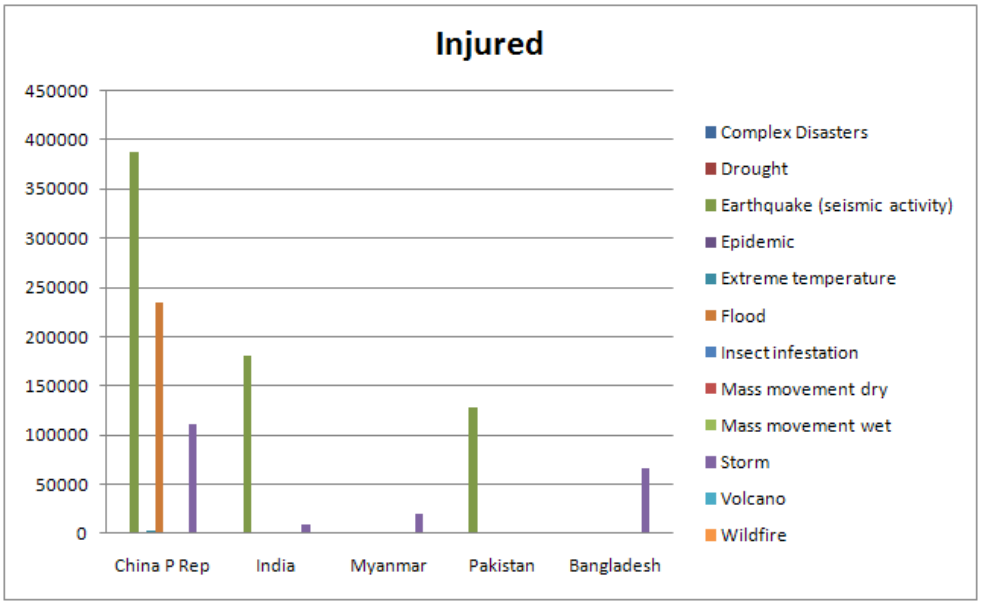


Figure 11-30: Number of injured related to country and disaster

An affected person in this region mostly comes from floods, droughts and storms. The Chinese population has been frequently hit by all these disaster while India has experienced high number of affected people due to droughts and floods. Bangladesh can also be mentioned.

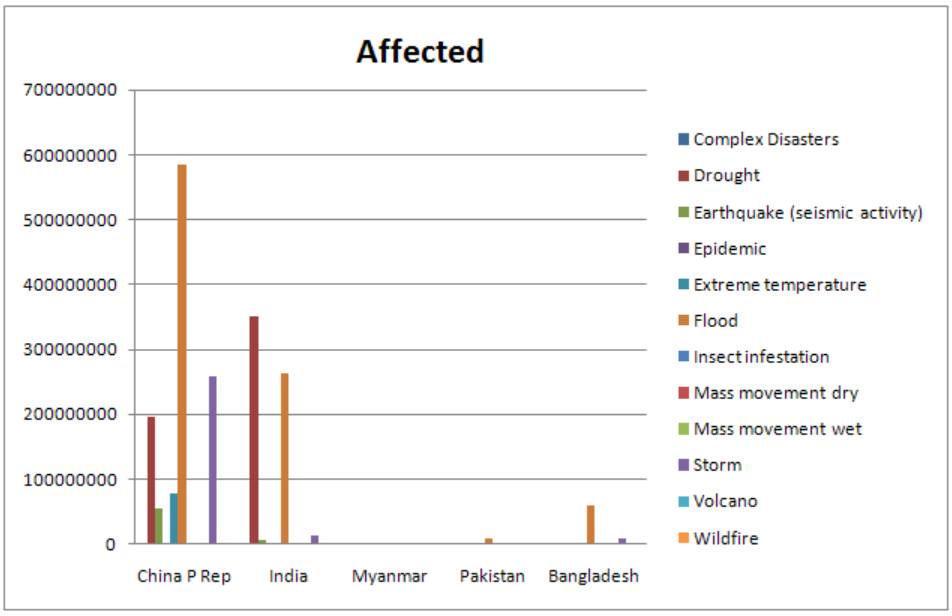


Figure 11-31: Number of affected related to country and disaster

Homeless people in this region are usually as results from earthquakes and floods and to some extent storms. China and India are the countries that have experienced most homeless people due to floods and earthquakes, while Pakistan has experienced homeless people due to earthquakes.

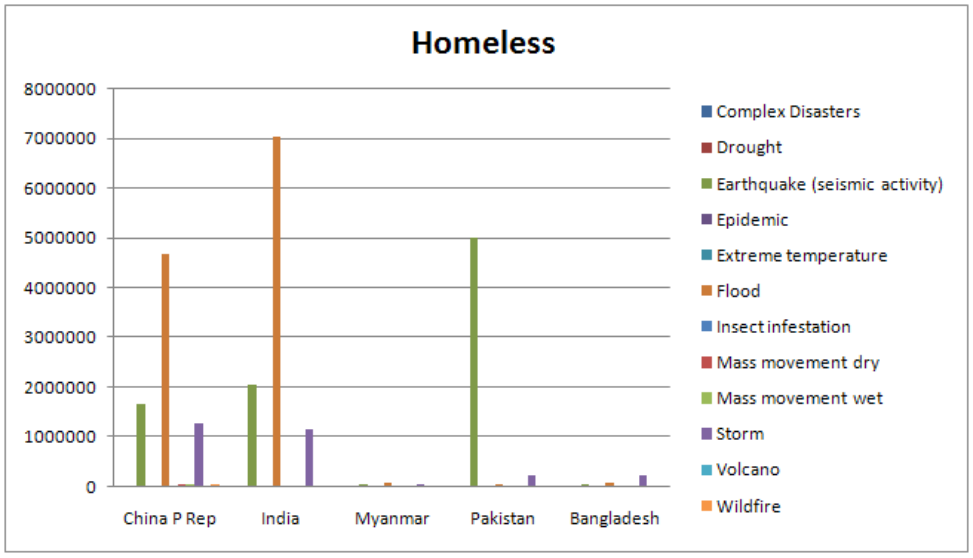


Figure 11-32: Number of homeless related to country and disaster

Oceania

Indonesia is the country in Oceania that through the last decade have experience the highest number of dead people due to a natural disaster. The numbers of deaths are related to earthquakes

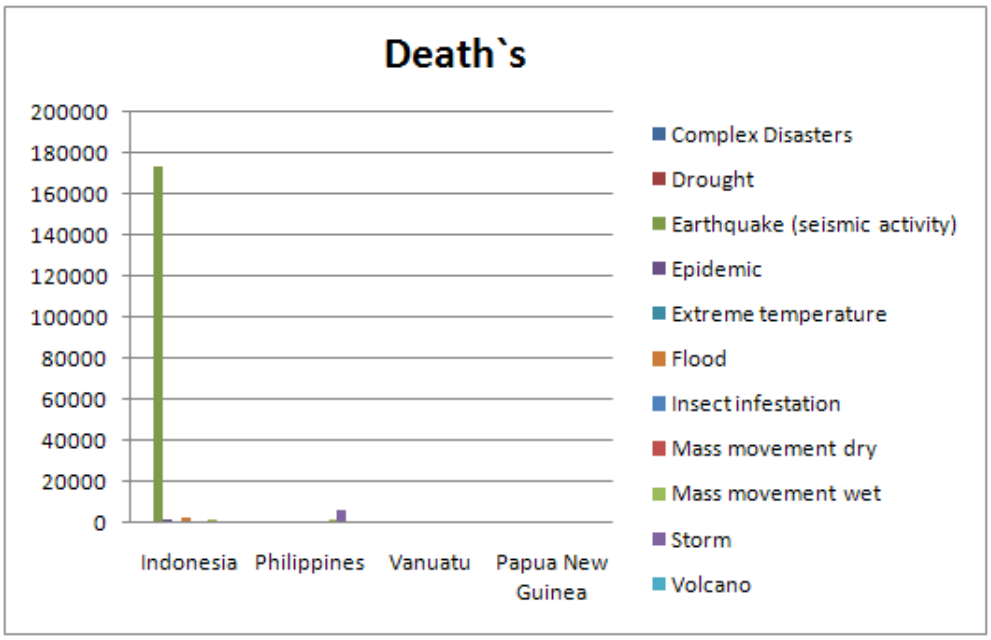


Figure 11-33: Number of deaths related to country and disaster

Indonesia is also the country with highest frequency of injured people the last decade due to earthquakes.

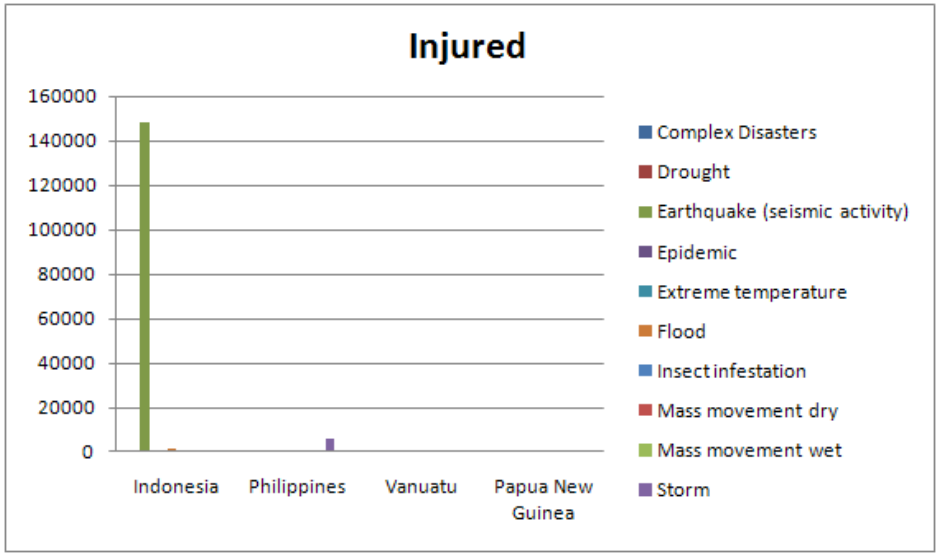


Figure 11-34: Number of injured related to country and disaster

The number of affected people in this region is highest in the Philippines. Affected people in this country are caused by frequent numbers of storms.

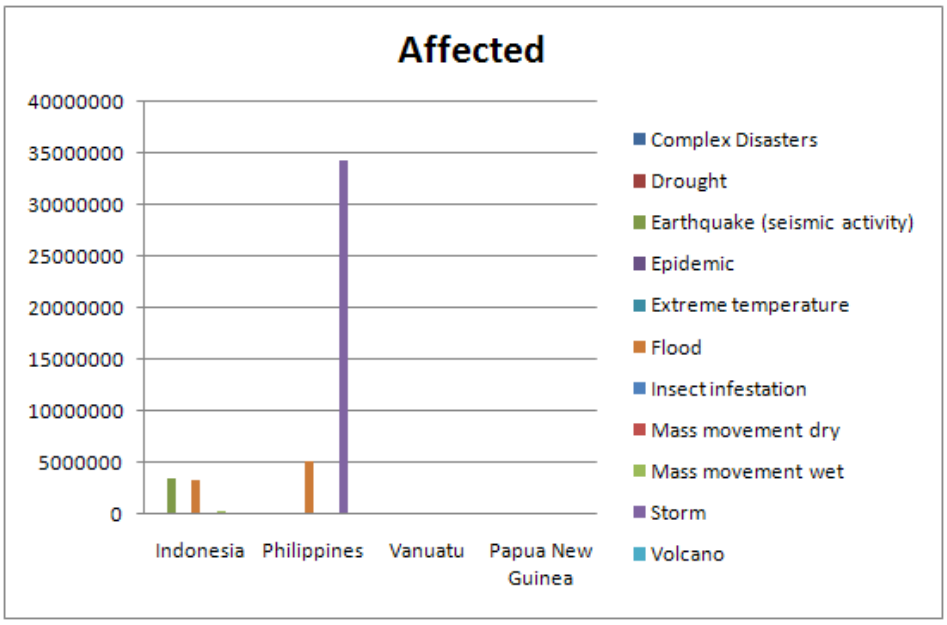


Figure 11-35: Number of affected related to country and disaster

Indonesia is the countries in these regions that have experienced most homeless people. The number of homeless people is related to earthquakes.

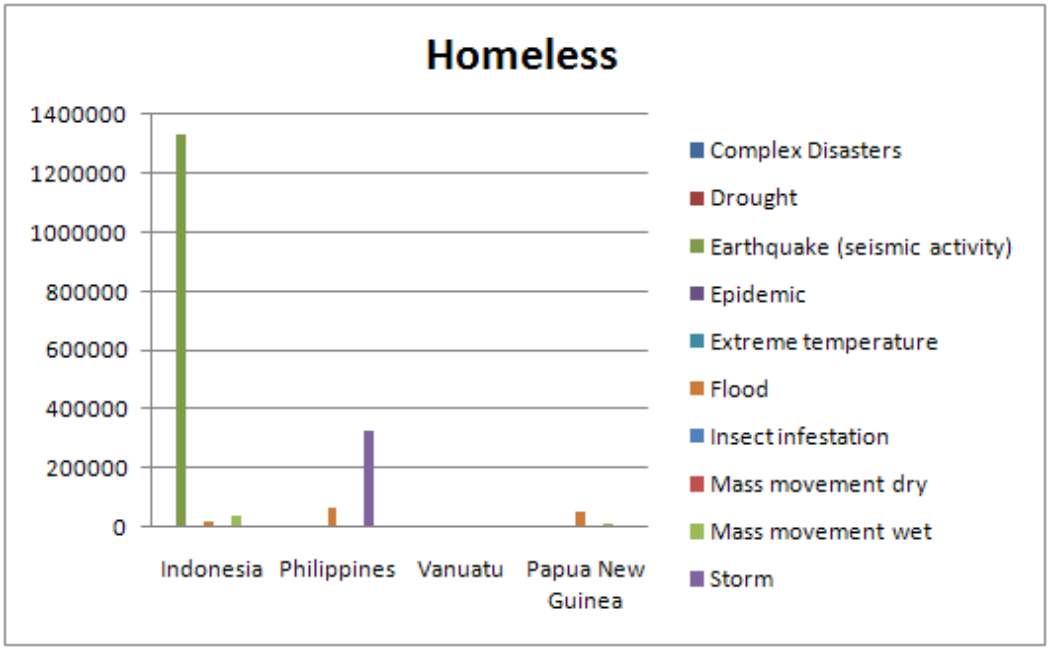


Figure 11-36: Number of homeless related to country and disaster

11.4 Summary

The table below summarizes which disasters that have been dominating in the different regions and countries during the last decade.

		Slow-onset	Sudden and slow onset			Sudden-onset						
Africa	**Disaster:** Complex	Drought	Epidemic	Extreme	Flood	Earthqua	Insect	Mass	Mass	Storm	Volcano	Wildfire
Country:												
Algeria					x	x						
Angola			x		x							
Burkina faso			x		x							
Ethiopia		x	x		x							
Kenya		x	x		x							
Madagascar			x							x		
Maldives						x						
South africa		x	x		x							
Sudan		x	x		x							
Uganda		x	x		x							

		Slow-onset	Sudden and slow onset			Sudden-onset						
Asia	**Disaster:** Complex	Drought	Epidemic	Extreme	Flood	Earthqua	Insect	Mass	Mass	Storm	Volcano	Wildfire
Country:												
Bangladesh					x					x		
China P Rep		x		x	x	x				x		
India		x		x	x	x				x		
Myanmar										x		
Pakistan						x						

		Slow-onset	Sudden and slow onset			Sudden-onset						
North America	**Disaster:** Complex	Drought	Epidemic	Extreme	Flood	Earthqua	Insect	Mass	Mass	Storm	Volcano	Wildfire
Country:												
Belize					x					x		
El Salvador		x				x						
Guatemala		x			x					x		
Haiti					x					x		
Honduras		x			x	x				x		
Nicaragua		x			x	x				x		

		Slow-onset	Sudden and slow onset			Sudden-onset						
South America	**Disaster:** Complex	Drought	Epidemic	Extreme	Flood	Earthqua	Insect	Mass	Mass	Storm	Volcano	Wildfire
Country:												
Bolivia					x	x						
Colombia					x	x			x			
Peru				x	x	x			x	x		

		Slow-onset	Sudden and slow onset			Sudden-onset						
Europe	**Disaster:** Complex	Drought	Epidemic	Extreme	Flood	Earthqua	Insect	Mass	Mass	Storm	Volcano	Wildfire
Country:												
Armenia		x										
Azerbaijan					x	x						
Georgia		x				x						
Moldova Rep		x			x					x		
Ukraine				x	x					x		

		Slow-onset	Sudden and slow onset			Sudden-onset						
Oceania	**Disaster:** Complex	Drought	Epidemic	Extreme	Flood	Earthqua	Insect	Mass	Mass	Storm	Volcano	Wildfire
Country:												
Indonesia					x	x						
Papa New Guinea					x							
Philippines					x					x		
Vanuatu												

Table 11-7: Dominant disasters within its related country

According to the analysis we can conclude that all of the target countries have been affected by sudden-onset disasters during the last decade. In addition some countries have also been affected by slow-onset disasters. In Europe, Armenia is the only country has been affected from only slow-onset disasters (droughts). It has to be mentioned that in Asia, Vanuatu has been included only because it is among the top three countries regarding the total numbers of injured. Compared to the other target countries in Oceania, Vanuatu has a number of totals injured that is so low that it has to be considered as not relevant for a supplier to position inventory in.

Our proposition will be that all the countries, with exceptions from Armenia and Vanuatu, are countries that a supplier should consider to position supplies in. These are countries that have been affected by sudden-onset disasters to different extents during the last decade.

12 Summary

In our study we search for a fundamental understanding of what humanitarian logistics is in context to disasters relief logistics. By exploring the field we found that natural disasters have certain characteristics. The disasters can mainly be characterized as slow or sudden-onset disasters. We also discovered that disaster relief operations can be categorized by 3 main phases where there is a critical need for inventory to be positioned in the first phase in order to respond successfully in the second phase. Further our study discovered different important actors within humanitarian logistics and disaster relief operations. The most important actors discovered were the humanitarian organizations, donors and the beneficiaries. In this study we have described how the different humanitarian organizations organize themselves on different levels in order to be prepared for humanitarian crisis with positioning of inventory. We found that humanitarian organizations do strategically position inventory themselves, but to a small extent. When a disaster occurs, the local government asks for help and humanitarian organizations appeal to donors for funding. When funding is available, humanitarian organizations start sourcing supplies, they do not already have in inventory. Donations could have the form of money, or gifts.

We have discovered that there are many similarities between private logistics and humanitarian logistics. Both are operating after same logistics principles but have different objectives. Were the private sector seeks to maximize profit, humanitarian logistics seeks to maximize the relief to those affected by disasters. The market for a supplier is not actually the humanitarian organizations but their beneficiaries. The one whom pays for the products is not the humanitarian organizations, but the donors. This makes the situation a bit different than the normal supply chain. The frequencies of humanitarian crisis are increasing, and their impact on the population is increasing. This puts an increasing constraint on the humanitarian organizations, and their network. Drawing on the knowledge and resources of the commercial sector, which focuses on optimization and effectiveness on the basis of the parameters time, cost and quality, which is as important for the humanitarian organizations as for the companies.

The theory explains that it is essential to have products on inventory before there is a catastrophe. We have discussed that a supplier must have its supplies ready to be shipped due to short time windows in order to allegeable for orders. The inventory should be close to affected areas in order to reduce lead time and save transportation costs, derby reducing or eliminating the need for air transport, which is an expensive mode of transport. We

argued that by placing inventory closer to affected areas, where there is a high frequency of natural disasters, the supplier can qualify for the market, be an order winner and get long-term agreements. Theoretical we have argued that the supplier will gain a competitive advantage towards its competitors if it locates its inventory strategically closer to the beneficiaries. This will be to an advantage for the humanitarian organizations, and to the beneficiaries.

Our empirical work support this theory by discovering that humanitarian organizations prefer shorter lead times, better punctuality and better flexibility. We have assumed that reducing costs is important for humanitarian organizations due to budgetary constraints. The empirical work also shows that humanitarian organizations are interesting in long-term contracts with suppliers, if they can meet their preferences.
We have argued that inventory should be placed as close to the actual need as possible. It is not always possible to predict accurate where the need will be, but through reasonable deduction we have predicted areas, and countries that have a high probability of having grate needs for help in the future. From our empirical work we have pointed out areas and countries that have been more affected from natural disasters than other during the last decade. We have also proposed a list of countries that a supplier should consider to position inventory, due to the fact that these countries are in general frequently affected by sudden-onset disasters.

13 Conclusion

There are many areas where there is room for improvements within the area of humanitarian relief. Little is done, and more has to be done in the future. The organizations lack understanding of logistics and its importance as a core function, and therefore suffer due to poor planning and budgetary skills, resulting in the logistics requirements not being meet. As we have described in this thesis, things are starting to happen, and we are taking a step further by looking into a small part of the world of humanitarian logistics from the viewpoint of a supplier. Where we have tried to find a method where the supplier can use its inventory to strategically place its selves in a better position to serve the humanitarian organizations.

There are areas, and countries that stand out from the rest of the countries on earth, as they have a higher potential for a natural disaster, their population level is high, and they are at a development level that makes them more prone for huge losses and damages.

In this thesis we have located these countries, and we argue that from the viewpoint of a supplier to the humanitarian organizations it will be of an advantage for the suppler, the humanitarian organizations, the donors, and the beneficiaries that the inventory needed is pre-positioned. The pre-positioned inventory will be able to respond faster, and will therein save time, costs, and as the end goal save life’s.

14 Limitations of this study and Future research

Limitations

There are some limitations and weaknesses that can be described and related to this study. The first limitation and weakness can be addressed to the explorative and descriptive part. There might be aspects of humanitarian logistics and disaster relief operations for this thesis that we have not covered or included properly. There may also be some relevant theory that we could have used to describe the field better. This thesis is looking into the prospect of locating the inventory of suppliers to the humanitarian organizations. This area is little researched, which makes it an interesting area to explore, but is also more difficult to navigate through.

Our deductive description of the theory in respect of the empirical part might also be a limitation due to that there could be better ways of searching for the humanitarian organizations preferences. It could also be described as a limitation the small numbers of respondents. 12 respondents may not be enough to get a representative result due to the fact that there are hundreds of humanitarian organizations.

The empirical part of this thesis that concerns the process of pointing out the target regions and the target countries has several of limitations that could be mentioned. Our analysis of disaster hotspots, and therein our location recommendations, is based on historical data. There is no guaranty that a natural disaster will occur in the same place twice, but the nature of natural disasters, makes it of high probability. The statistics tall nothing about what is done to prevent new disasters to do the same damage in the future. What we can take into account is economic situation in the country and their development level. Pore countries have little or no resources to prepare for the next disaster.

Some of the limitations regarding the empirical work might be:

- The process of pointing out the target regions and the target countries might have been done differently. To sort out the top three countries in respect of the different impacts of death's, injured, affected and homeless , may not be the most proper way of defining the most affected regions and countries.
- A larger sample, like e.g. top ten, could have been taking in order to get a larger and better view over affected countries.

- There might be other ways of doing the empirical analysis than basing it on the different impacts. E.g. economics losses could have been an alternative variable to use in the analysis.
- Our research do not take into consideration that there are large differences regarding the territorial sizes of the countries. Other methods that could be used are degrees of latitude and longitude in order to create “windows” instead of countries as unit for analysis. (Akkihal 2006) used this method successfully and with modification this could be applied to this study as well.
- It doesn’t take into consideration other factors such as each country capabilities of handling natural disasters. Though we have argued that low developed countries are not capable to handle impacts from natural disasters in the same extent as higher developed countries, there are in fact low developed countries that posses some kinds of emergency response systems.

Strengths

Strengths related to this study can be addressed to the data and the theory used in this thesis. The data comes from renowned sources, which makes them reliable, and our theory is well known and tried out.

Future research

Future research for this thesis may be addressed in three important areas:

We have not taken into consideration what types of products that are relevant to position in respect of the different countries and the different types of natural disasters. Countries are different due to e.g. their geographical location, culture and vulnerability and different needs. The different types of natural disaster have individual characteristics and create such needs. Future research into this area could be of great advantage to the humanitarian world. This can be addressed to investigate the specific needs in terms of different types of supplies.

We have proposed which areas and countries that are relevant to position inventory but we have not considered optimal locations due to the fact that one or several of the countries can be served with the same inventory. There are several mathematical models that could be researched and modified in order to decide where to position inventory, in respect to

both optimal location and within each country. Future research could find suitable location models in order to decide where such inventory should be placed.

We have not considered position of inventory within countries. To be able to calculate and decide such location, much extensive information has to be retrieved. Further research may be able to capture such information and use this with modeling tools to propose more accurate location for inventory within actual countries.

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Appendix 1

Questionnaire to Non Governmental Organizations

Introduction

This questionnaire is a part of our master thesis where we are seeking to find strategic solutions for pre-positioning of stocks. The purpose is to get a better understanding of how humanitarian logistic works, from a supplier's point of view. The thesis is focusing on how a supplier can meet the humanitarian organizations preferences with respect to pre-position of goods.

We hope that you will use a few minutes to answer this questionnaire.
The result can be valuable information for humanitarian organizations in the future.

Start

Questionnaire to Non Governmental Organizations

Questions about you preferences. In the humanitarian aid there are 3 main phases when it comes to relief actions. Phase 1 is preparedness, phase 2 immediate response and phase 3 is recovery.

1. Information about you, and your organization:

Name of Organization*		
Your Name		
E-Mail address		
	No	Yes
Anonymous	○	○

* Required information

A pre-positioned stock aims to position supplies near places where they are likely to be required. Lead time is the time supplies takes to reach beneficiaries from stock.

2. How important do you find lead time?

	1	2	3	4	5	6	7		
Not Important	○	○	○	○	○	○	○	Very Important	Not Relevant ○

Comments:

3. If you could get a reduction in lead time in the different phases, would you:

	Phase 1			Phase 2			Phase 3		
	Yes	No	Not Relevant	Yes	No	Not Relevant	Yes	No	Not Relevant
Change supplier?	○	○	○	○	○	○	○	○	○
Enter a Long-term agreement (LTA)?	○	○	○	○	○	○	○	○	○
Enter a One time contract	○	○	○	○	○	○	○	○	○
Option to make new contracts with the same supplier	○	○	○	○	○	○	○	○	○

Comments:

17%

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Questionnaire to Non Governmental Organizations

When you are ordering supplies from pre-positioned stock, there will always be a risk attached to that the supplies will not arrive at the expected time. We refer the ability for a supplier to deliver at expected time as punctuality.

4. How important do you find punctuality?

	1	2	3	4	5	6	7		
Not Important	○	○	○	○	○	○	○	Very Important	Not Relevant ○

Comments:

5. If you could get higher punctuality and increase the possibilities for the supplies to be delivered when you expect it, would you:

	Phase 1			Phase 2			Phase 3		
	Yes	No	Not Relevant	Yes	No	Not Relevant	Yes	No	Not Relevant
Change supplier?	○	○	○	○	○	○	○	○	○
Enter a Long-term agreement (LTA)?	○	○	○	○	○	○	○	○	○
Enter a One time contract	○	○	○	○	○	○	○	○	○
Option to make new contracts with the same supplier	○	○	○	○	○	○	○	○	○

Comments:

29%

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Questionnaire to Non Governmental Organizations

Flexibility is referred to as the possibility to take out goods from pre-positioned stock when it is needed.

6. How important to you find flexibility?

	1	2	3	4	5	6	7		
Not Important	○	○	○	○	○	○	○	Very Important	Not Relevant ○

Comments:

7. If you could achieve better flexibility by doing the options listed, would you:

	Phase 1			Phase 2			Phase 3		
	Yes	No	Not Relevant	Yes	No	Not Relevant	Yes	No	Not Relevant
Change supplier?	○	○	○	○	○	○	○	○	○
Enter a Long-term agreement (LTA)?	○	○	○	○	○	○	○	○	○
Enter a One time contract	○	○	○	○	○	○	○	○	○
Option to make new contracts with the same supplier	○	○	○	○	○	○	○	○	○

Comments:

When choosing a supplier:

8. How important is the possibility to buy customized products?

	1	2	3	4	5	6	7	Not Relevant
Tents	○	○	○	○	○	○	○	○

Comments:

47%

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Questionnaire to Non Governmental Organizations

Long-Term Contracts

When entering a Long-Term Contract:

9. For how long would a Long-term agreement (LTA) last?

Long-term agreement						
Years	1	2	3	4	5	Not Relevant
Phase 1	○	○	○	○	○	○
Phase 2	○	○	○	○	○	○
Phase 3	○	○	○	○	○	○

Comments:

In cases of Long-term Contracts are there:

10. Option to extend the Long-Term Contracts?

○ Yes ○ No

Comments:

11. For how long would an Extension of a Long-term agreement (LTA) be?

Extension Long-term agreement (LTA)						
Years	1	2	3	4	5	Not Relevant
Phase 1	○	○	○	○	○	○
Phase 2	○	○	○	○	○	○
Phase 3	○	○	○	○	○	○

Comments:

64%

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Questionnaire to Non Governmental Organizations

Sourcing Strategy

12. What would be your preferred sourcing strategy, according to the different phases and products?

		Single sourcing(one supplier):	Double sourcing (two suppliers):	Multiple sourcing(several of suppliers)	Not Relevant for this Phase
Phase 1	Tents	○	○	○	○
Phase 2	Tents	○	○	○	○
Phase 3	Tents	○	○	○	○

Comments:

70%

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Questionnaire to Non Governmental Organizations

Which of the product do you use for each of the phases?

13. Hydrometrical disasters(droucht, extreme temperatures,floods, wild fire, wind storm)

Tents	Phase 1	Phase 2	Phase 3	Not Relevant
Accommodation	☐	☐	☐	☐
Command post	☐	☐	☐	☐
Dining	☐	☐	☐	☐
Family	☐	☐	☐	☐
Field camps	☐	☐	☐	☐
Field hospitals	☐	☐	☐	☐
Kitchen	☐	☐	☐	☐
Multi purpose	☐	☐	☐	☐
Office	☐	☐	☐	☐
Relief	☐	☐	☐	☐
Schools tents	☐	☐	☐	☐
Tent Equipment	☐	☐	☐	☐

Comments:

14. Geological disaster (slide, earthquake, volcano, mass movements)

Tents	Phase 1	Phase 2	Phase 3	Not Relevant
Accommodation	☐	☐	☐	☐
Command post	☐	☐	☐	☐
Dining	☐	☐	☐	☐
Familiy	☐	☐	☐	☐
Field camps	☐	☐	☐	☐
Field hospitals	☐	☐	☐	☐
Kitchen	☐	☐	☐	☐
Multi purpose	☐	☐	☐	☐
Office	☐	☐	☐	☐
Relief	☐	☐	☐	☐
Schools tents	☐	☐	☐	☐
Tent Equipment	☐	☐	☐	☐

Comments:

15. Biological disaster (epidemic, insect infestations)

Tents	Phase 1	Phase 2	Phase 3	Not Relevant
Accommodation	☐	☐	☐	☐
Command post	☐	☐	☐	☐
Dining	☐	☐	☐	☐
Familiy	☐	☐	☐	☐
Field camps	☐	☐	☐	☐
Field hospitals	☐	☐	☐	☐
Kitchen	☐	☐	☐	☐
Multi purpose	☐	☐	☐	☐
Office	☐	☐	☐	☐
Relief	☐	☐	☐	☐
Schools tents	☐	☐	☐	☐
Tent Equipment	☐	☐	☐	☐

Comments:

88%

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Questionnaire to Non Governmental Organizations

Questions related to sourcing

16. "A Centralized Stock aims to position supplies so they can be distributed direct to beneficiaries or to a pre-positioned stock"

"A Pre-Positioned stock aims to position supplies at or near places where they are likely to be required."

Please state where you get the different products from and which of the products that would be interesting to have pre-positioned.

	This product we get directly from manufacturer (please put a mark if it is relevant)	This product we get from a centralized stock(please put a mark if it is relevant)	This product we get from a pre-positioned stock(please put a mark if it is relevant)	This product would be interesting to have pre-positioned (Please put a mark if it is relevant)
Tents				
Accommodation	☐	☐	☐	☐
Command post	☐	☐	☐	☐
Dining	☐	☐	☐	☐
Familiy	☐	☐	☐	☐
Field camps	☐	☐	☐	☐
Field hospitals	☐	☐	☐	☐
Kitchen	☐	☐	☐	☐
Multi purpose	☐	☐	☐	☐
Office	☐	☐	☐	☐
Relief	☐	☐	☐	☐
Schools tents	☐	☐	☐	☐
Tent equipment	☐	☐	☐	☐

Comments:

94%

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Appendix 2

Excluded countries due to inadequate date in alignment between GDP, population density and EM-DAT countries

American Samoa
Andorra
Anguilla
Aruba
Bahrain
Bermuda
Bouvet Island
British Indian Ocean Territory
British Virgin Islands
Brunei Darussalam
Canary Is
Cayman Islands
Christmas Island
Cocos (Keeling Islands)
Congo (Dem. Republic of)
Cook Islands
East Timor
Faeroe Islands
Falkland Islands (Malvinas)
French Guiana
French Polynesia
French Southern Territories and Antarctic Lands
Gibraltar
Greenland
Guadeloupe
Heard Island and McDonald Islands
Johnston Atoll
Libyan Arab Jamahiriya
Liechtenstein
Macau
Macedonia (The former Yugoslav Republic of)
Macedonia FRY
Malta
Martinique
Mayotte
Midway
Monaco
Montserrat
Nauru
Netherlands Antilles
Niue
Norfolk Island
Northern Mariana Is
Northern Mariana Islands
Palau
Palestine (West Bank)
Pitcairn Island
Qatar
Reunion
Saint Helena
Saint Kitts and Nevis
Saint Lucia
Saint Vincent and the Grenadines
San Marino
Sao Tome and Principe
St Helena
St Kitts and Nevis
St Lucia
St Vincent and The Grenadines
Svalbard and Jan Mayen Islands
Taiwan (China)
Tajikistan
Tokelau
Turks and Caicos Island
Tuvalu
United Arab Emirates
Virgin Islands (U.S.)
Wake Island
Wallis and Futuna Islands
West Bank and Gaza
Western Sahara
Zaire/Congo Dem Rep

Appendix 3

High income countries, defined by Human Development (Report 2008)

Albania
Antigua and Barbuda
Argentina
Australia
Austria
Bahamas
Bahrain
Barbados
Belarus
Belgium
Bosnia and Herzegovina
Brazil
Brunei Darussalam
Bulgaria
Canada
Chile
Costa Rica
Croatia
Cuba
Cyprus
Czech Republic
Denmark
Ecuador
Estonia
Finland
France
Germany
Greece
Hong Kong, China (SAR)
Hungary
Iceland
Ireland
Israel
Italy
Japan
Kazakhstan
Korea (Republic of)
Kuwait
Latvia
Libyan Arab Jamahiriya
Lithuania
Luxembourg
Macedonia (TFYR)
Malaysia
Malta
Mauritius
Mexico
Montenegro
Netherlands
New Zealand
Norway
Oman
Panama
Poland
Portugal
Qatar
Romania
Russian Federation
Saint Kitts and Nevis
Saint Lucia
Saudi Arabia
Serbia
Seychelles
Singapore
Slovakia
Slovenia
Spain
Sweden
Switzerland
Trinidad and Tobago
United Arab Emirates
United Kingdom
United States
Uruguay
Venezuela (Bolivarian Republic of)

Appendix 4

AFRICA

Death`s

Algeria	Angola	Benin	Bhutan	Botswana	Burkina Faso	Cameroon	Cape Verde Is	Central	Chad
3660	4077	856	200	473	7160	259	0	843	1815

Arranged

Burkina Faso	Angola	Algeria	Nigeria	Sudan	Kenya	Ethiopia	Madagascar	Malawi	Chad
7160	4077	3660	3469	3401	2929	2813	2655	2053	1815

Death`s

Comoros	Congo	Cote d'Ivoire	Djibouti	Egypt	Equatorial	Eritrea	Ethiopia	Gabon	Gambia The
44	316	435	55	49	15	0	2813	51	80

Arranged

Niger	Mozambique	Uganda	Guinea Bissau	Zambia	Benin	Central	Morocco	South Africa	Senegal
1803	1583	1154	1030	874	856	843	821	638	577

Death`s

Ghana	Guinea Bissau	Kenya	Lesotho	Liberia	Madagascar	Malawi	Maldives	Mali	Mauritania
200	1030	2929	57	82	2655	2053	102	231	100

Arranged

Tanzania Uni	Botswana	Sierra Leone	Cote d'Ivoire	Rwanda	Togo	Congo	Cameroon	Mali	Bhutan
474	473	462	435	424	417	316	259	231	200

Death`s

Morocco	Mozambique	Namibia	Niger	Nigeria	Rwanda	Senegal	Sierra Leone	South Africa	Sudan
821	1583	197	1803	3469	424	577	462	638	3401

Arranged

Ghana	Namibia	Maldives	Mauritania	Liberia	Gambia The	Lesotho	Djibouti	Gabon	Egypt
200	197	102	100	82	80	57	55	51	49

Death`s

Swaziland	Tanzania Uni	Togo	Tunisia	Uganda	Zambia
35	474	417	28	1154	874

Arranged

Comoros	Swaziland	Tunisia	Equatorial	Cape Verde Is	Eritrea
44	35	28	15	0	0

Affected

Algeria	Angola	Benin	Bhutan	Botswana	Burkina Faso	Cameroon	Cape Verde Is	Central	Chad
195460	675638	234909	0	134000	171462	32107	30000	31237	1310055

Arranged

Kenya	Ethiopia	South Africa	Mozambique	Malawi	Niger	Tanzania Uni	Madagascar	Eritrea	Zambia
31705296	27806625	15315650	9934397	9656295	6821068	5186029	4068105	4007000	3625815

Affected

Comoros	Congo	Cote d'Ivoire	Djibouti	Egypt	Equatorial	Eritrea	Ethiopia	Gabon	Gambia The
287912	68688	7302	731669	1193	946	4007000	27806625	18010	41991

Arranged

Sudan	Uganda	Rwanda	Swaziland	Chad	Mali	Mauritania	Lesotho	Ghana	Djibouti
3592601	3334952	1939003	1664874	1310055	1097498	1095505	984196	827958	731669

Affected

Ghana	Guinea Bissau	Kenya	Lesotho	Liberia	Madagascar	Malawi	Maldives	Mali	Mauritania
827958	173483	31705296	984196	37865	4068105	9656295	13649	1097498	1095505

Arranged

Angola	Senegal	Nigeria	Namibia	Morocco	Comoros	Togo	Benin	Algeria	Guinea Bissau
675638	622299	499472	471753	323350	287912	242466	234909	195460	173483

Affected

Morocco	Mozambique	Namibia	Niger	Nigeria	Rwanda	Senegal	Sierra Leone	South Africa	Sudan
323350	9934397	471753	6821068	499472	1939003	622299	25200	15315650	3592601

Arranged

Burkina Faso	Botswana	Congo	Gambia The	Liberia	Tunisia	Cameroon	Central	Cape Verde Is	Sierra Leone
171462	134000	68688	41991	37865	33500	32107	31237	30000	25200

Affected

Swaziland	Tanzania Uni	Togo	Tunisia	Uganda	Zambia
1664874	5186029	242466	33500	3334952	3625815

Arranged

Gabon	Maldives	Cote d'Ivoire	Egypt	Equatorial	Bhutan
18010	13649	7302	1193	946	0

Appendix 4

AFRICA, cont`d

Homeless

Algeria	Angola	Benin	Bhutan	Botswana	Burkina Faso	Cameroon	Cape Verde Is	Central	Chad
217700	27750	11353	1000	32000	55172	14389	0	69012	51450

Arranged

Madagascar	Uganda	Sudan	Algeria	Ethiopia	Mozambique	Central	Malawi	Congo	Nigeria
530674	314975	255780	217700	125975	77490	69012	64159	63500	62302

Homeless

Comoros	Congo	Cote d'Ivoire	Djibouti	Egypt	Equatorial	Eritrea	Ethiopia	Gabon	Gambia The
300	63500	0	1500	0	0	0	125975	0	5400

Arranged

Mali	Niger	Burkina Faso	Mauritania	Chad	Ghana	Senegal	Botswana	South Africa	Tanzania Uni
61722	59261	55172	54760	51450	38000	37492	32000	31250	28327

Homeless

Ghana	Guinea Bissau	Kenya	Lesotho	Liberia	Madagascar	Malawi	Maldives	Mali	Mauritania
38000	1750	0	1000	3840	530674	64159	13000	61722	54760

Arranged

Angola	Cameroon	Togo	Maldives	Morocco	Benin	Zambia	Rwanda	Gambia The	Liberia
27750	14389	13374	13000	12539	11353	11000	7000	5400	3840

Homeless

Morocco	Mozambique	Namibia	Niger	Nigeria	Rwanda	Senegal	Sierra Leone	South Africa	Sudan
12539	77490	0	59261	62302	7000	37492	0	31250	255780

Arranged

Guinea Bissau	Djibouti	Bhutan	Lesotho	Comoros	Swaziland	Cape Verde Is	Cote d'Ivoire	Egypt	Equatorial
1750	1500	1000	1000	300	260	0	0	0	0

Homeless

Swaziland	Tanzania Uni	Togo	Tunisia	Uganda	Zambia
260	28327	13374	0	314975	11000

Arranged

Eritrea	Gabon	Kenya	Namibia	Sierra Leone	Tunisia
0	0	0	0	0	0

Injured

Algeria	Angola	Benin	Bhutan	Botswana	Burkina Faso	Cameroon	Cape Verde Is	Central	Chad
11550	16	0	0	0	91	17	0	7	145

Arranged

Algeria	Madagascar	Maldives	South Africa	Morocco	Rwanda	Nigeria	Sudan	Egypt	Mozambique
11550	2887	2214	1362	943	818	654	391	217	188

Comoros	Congo	Cote d'Ivoire	Djibouti	Egypt	Equatorial	Eritrea	Ethiopia	Gabon	Gambia The
0	108	0	0	217	0	13	136	0	131

Togo	Chad	Ethiopia	Gambia The	Congo	Burkina Faso	Tanzania Uni	Uganda	Ghana	Mauritania
156	145	136	131	108	91	73	55	54	36

Injured

Ghana	Guinea Bissau	Kenya	Lesotho	Liberia	Madagascar	Malawi	Maldives	Mali	Mauritania
54	0	35	1	0	2887	8	2214	34	36

Arranged

Kenya	Mali	Cameroon	Angola	Niger	Eritrea	Zambia	Malawi	Central	Sierra Leone
35	34	17	16	16	13	13	8	7	3

Morocco	Mozambique	Namibia	Niger	Nigeria	Rwanda	Senegal	Sierra Leone	South Africa	Sudan
943	188	0	16	654	818	0	3	1362	391

Lesotho	Benin	Bhutan	Botswana	Cape Verde Is	Comoros	Cote d'Ivoire	Djibouti	Equatorial	Gabon
1	0	0	0	0	0	0	0	0	0

Injured

Swaziland	Tanzania Uni	Togo	Tunisia	Uganda	Zambia
0	73	156	0	55	13

Arranged

Guinea Bissau	Liberia	Namibia	Senegal	Swaziland	Tunisia
0	0	0	0	0	0

Appendix 4

ASIA

Death`s	Bangladesh	Burundi	Cambodia	China P Rep	India	Iran Islam Rep	Jordan	Kyrgyzstan	Lao P Dem	Mongolia	Myanmar
	9558	646	707	99815	68772	28742	14	179	69	109	138878

Arranged	Myanmar	China P Rep	Pakistan	India	Sri Lanka	Iran Islam Rep	Turkey	Bangladesh	Thailand	Viet Nam	Nepal
	138878	99815	77483	68772	35767	28742	18554	9558	9488	3976	2558

Death`s	Nepal	Pakistan	Sri Lanka	Syrian Arab	Thailand	Timor-Leste	Turkey	Turkmenistan	Uzbekistan	Viet Nam	Yemen
	2558	77483	35767	118	9488	1	18554	11	24	3976	469

Arranged	Cambodia	Burundi	Yemen	Kyrgyzstan	Syrian Arab	Mongolia	Lao P Dem	Uzbekistan	Jordan	Turkmenistan	Timor-Leste
	707	646	469	179	118	109	69	24	14	11	1

Affected	Bangladesh	Burundi	Cambodia	China P Rep	India	Iran Islam Rep	Jordan	Kyrgyzstan	Lao P Dem	Mongolia	Myanmar
	68367319	6283693	8850998	1172715587	631260848	39272257	330000	25556	1286875	2369660	2694892

Arranged	China P Rep	India	Bangladesh	Iran Islam Rep	Thailand	Viet Nam	Pakistan	Cambodia	Burundi	Sri Lanka	Myanmar
	1172715587	631260848	68367319	39272257	34243580	23747652	14809116	8850998	6283693	5364222	2694892

Affected	Nepal	Pakistan	Sri Lanka	Syrian Arab	Thailand	Timor-Leste	Turkey	Turkmenistan	Uzbekistan	Viet Nam	Yemen
	2322210	14809116	5364222	1329000	34243580	947	1489560	0	601500	23747652	40793

Arranged	Mongolia	Nepal	Turkey	Syrian Arab	Lao P Dem	Uzbekistan	Jordan	Yemen	Kyrgyzstan	Timor-Leste	Turkmenistan
	2369660	2322210	1489560	1329000	1286875	601500	330000	40793	25556	947	0

Homeless	Bangladesh	Burundi	Cambodia	China P Rep	India	Iran Islam Rep	Jordan	Kyrgyzstan	Lao P Dem	Mongolia	Myanmar
	299263	63425	25805	7602932	10210045	87450	0	3810	0	150	86187

Arranged	India	China P Rep	Pakistan	Sri Lanka	Turkey	Viet Nam	Bangladesh	Nepal	Iran Islam Rep	Myanmar	Burundi
	10210045	7602932	5241510	855160	780686	628465	299263	99575	87450	86187	63425

Homeless	Nepal	Pakistan	Sri Lanka	Syrian Arab	Thailand	Timor-Leste	Turkey	Turkmenistan	Uzbekistan	Viet Nam	Yemen
	99575	5241510	855160	0	42084	0	780686	0	0	628465	10740

Arranged	Thailand	Cambodia	Yemen	Kyrgyzstan	Mongolia	Jordan	Lao P Dem	Syrian Arab	Timor-Leste	Turkmenistan	Uzbekistan
	42084	25805	10740	3810	150	0	0	0	0	0	0

Injured	Bangladesh	Burundi	Cambodia	China P Rep	India	Iran Islam Rep	Jordan	Kyrgyzstan	Lao P Dem	Mongolia	Myanmar
	69798	116	53	736538	190798	28422	237	162	0	0	20157

Arranged	China P Rep	India	Pakistan	Bangladesh	Turkey	Iran Islam Rep	Sri Lanka	Myanmar	Thailand	Viet Nam	Nepal
	736538	190798	131354	69798	51852	28422	23178	20157	9378	3632	793

Injured	Nepal	Pakistan	Sri Lanka	Syrian Arab	Thailand	Timor-Leste	Turkey	Turkmenistan	Uzbekistan	Viet Nam	Yemen
	793	131354	23178	375	9378	0	51852	0	0	3632	134

Arranged	Syrian Arab	Jordan	Kyrgyzstan	Yemen	Burundi	Cambodia	Lao P Dem	Mongolia	Timor-Leste	Turkmenistan	Uzbekistan
	375	237	162	134	116	53	0	0	0	0	0

NORTH AMERICA

Death`s	Belize	Dominica	Dominican	El Salvador	Guatemala	Haiti	Honduras	Jamaica	Nicaragua
	55	5	946	1657	1863	6605	223	58	302

Arranged	Haiti	Guatemala	El Salvador	Dominican	Nicaragua	Honduras	Jamaica	Belize	Dominica
	6605	1863	1657	946	302	223	58	55	5

Affected	Belize	Dominica	Dominican	El Salvador	Guatemala	Haiti	Honduras	Jamaica	Nicaragua
	150000	8175	283583	2142581	893950	1094279	1440570	428296	609833

Arranged	El Salvador	Honduras	Haiti	Guatemala	Nicaragua	Jamaica	Dominican	Belize	Dominica
	2142581	1440570	1094279	893950	609833	428296	283583	150000	8175

Homeless	Belize	Dominica	Dominican	El Salvador	Guatemala	Haiti	Honduras	Jamaica	Nicaragua
	0	315	2092	0	4485	46592	31079	1388	21522

Arranged	Haiti	Honduras	Nicaragua	Guatemala	Dominican	Jamaica	Dominica	Belize	El Salvador
	46592	31079	21522	4485	2092	1388	315	0	0

Injured	Belize	Dominica	Dominican	El Salvador	Guatemala	Haiti	Honduras	Jamaica	Nicaragua
	570	30	29	8123	529	3250	31	6	60

Arranged	El Salvador	Haiti	Belize	Guatemala	Nicaragua	Honduras	Dominica	Dominican	Jamaica
	8123	3250	570	529	60	31	30	29	6

Appendix 4

SOUTH AMERICA

Deaths

Bolivia	Colombia	Grenada	Guyana	Paraguay	Peru	Suriname
502	2516	40	44	53	1526	5

Arranged

Colombia	Peru	Bolivia	Paraguay	Guyana	Grenada	Suriname
2516	1526	502	53	44	40	5

Affected

Bolivia	Colombia	Grenada	Guyana	Paraguay	Peru	Suriname
1495502	5452754	61860	409774	402763	4610431	31548

Arranged

Colombia	Peru	Bolivia	Guyana	Paraguay	Grenada	Suriname
5452754	4610431	1495502	409774	402763	61860	31548

Homeless

Bolivia	Colombia	Grenada	Guyana	Paraguay	Peru	Suriname
13700	559680	0	0	12500	557730	0

Arranged

Colombia	Peru	Bolivia	Paraguay	Grenada	Guyana	Suriname
559680	557730	13700	12500	0	0	0

Injured

Bolivia	Colombia	Grenada	Guyana	Paraguay	Peru	Suriname
251	9982	0	0	0	1805503	0

Arranged

Peru	Colombia	Bolivia	Grenada	Guyana	Paraguay	Suriname
1805503	9982	251	0	0	0	0

EUROPE

Death`s

Armenia	Azerbaijan	Georgia	Lebanon	Moldova Rep	Ukraine
1	43	7	1	19	865

Arranged

Ukraine	Azerbaijan	Moldova Rep	Georgia	Armenia	Lebanon
865	43	19	7	1	1

Affected

Armenia	Azerbaijan	Georgia	Lebanon	Moldova Rep	Ukraine
297000	33444	718000	17500	2824001	642333

Arranged

Moldova Rep	Georgia	Ukraine	Armenia	Azerbaijan	Lebanon
2824001	718000	642333	297000	33444	17500

Homeless

Armenia	Azerbaijan	Georgia	Lebanon	Moldova Rep	Ukraine
0	9900	1176	0	753	1267

Arranged

Azerbaijan	Ukraine	Georgia	Moldova Rep	Armenia	Lebanon
9900	1267	1176	753	0	0

Injured

Armenia	Azerbaijan	Georgia	Lebanon	Moldova Rep	Ukraine
0	620	70	50	0	10327

Arranged

Ukraine	Azerbaijan	Georgia	Lebanon	Armenia	Moldova Rep
10327	620	70	50	0	0

OCEANIA

Death`s

Fiji	Guinea	Indonesia	Papua New	Philippines	Samoa	Solomon Is	Tonga	Vanuatu
68	665	178634	389	8581	10	52	0	48

Arranged

Indonesia	Philippines	Guinea	Papua New	Fiji	Solomon Is	Vanuatu	Samoa	Tonga
178634	8581	665	389	68	52	48	10	0

Homeless

Fiji	Guinea	Indonesia	Papua New	Philippines	Samoa	Solomon Is	Tonga	Vanuatu
1772	777	1384443	66400	384579	0	1250	0	2295

Arranged

Indonesia	Philippines	Papua New	Vanuatu	Fiji	Solomon Is	Guinea	Samoa	Tonga
1384443	384579	66400	2295	1772	1250	777	0	0

Affected

Fiji	Guinea	Indonesia	Papua New	Philippines	Samoa	Solomon Is	Tonga	Vanuatu
36961	252523	7375287	300305	39901115	0	2650	16500	80005

Arranged

Philippines	Indonesia	Papua New	Guinea	Vanuatu	Fiji	Tonga	Solomon Is	Samoa
39901115	7375287	300305	252523	80005	36961	16500	2650	0

Injured

Fiji	Guinea	Indonesia	Papua New	Philippines	Samoa	Solomon Is	Tonga	Vanuatu
0	0	150212	103	6506	0	19	0	112

Arranged

Indonesia	Philippines	Vanuatu	Papua New	Solomon Is	Fiji	Guinea	Samoa	Tonga
150212	6506	112	103	19	0	0	0	0

Appendix 5

AFRICA

deaths

	Algeria	**Angola**	**Burkina Faso**	**Ethiopia**	**Kenya**	**Madagascar**	**Maldives**	**South Africa**	**Sudan**	**Uganda**
Complex	0	0	0	0	0	0	0	0	0	0
Drought	12	58	0	0	196	0	0	0	0	194
Earthquake	2301	0	0	0	1	0	102	2	0	0
Epidemic	0	3740	7096	1317	2191	1672	0	282	3108	821
Extreme	40	0	0	0	0	0	0	22	0	0
Flood	1272	266	64	1487	495	52	0	165	260	128
Insect	0	0	0	0	0	0	0	0	0	0
Mass	0	0	0	0	0	0	0	0	0	0
Mass	0	13	0	4	46	0	0	0	0	11
Storm	27	0	0	0	0	931	0	69	33	0
Volcano	0	0	0	5	0	0	0	0	0	0
Wildfire	8	0	0	0	0	0	0	98	0	0
Total	3660	4077	7160	2813	2929	2655	102	638	3401	1154

affected

	Algeria	Angola	Burkina Faso	Ethiopia	Kenya	Madagascar	Maldives	South Africa	Sudan	Uganda
Complex	0	0	0	0	0	0	0	0	0	0
Drought	0	25000	0	26500000	30200000	845290	0	15000000	2000000	2831000
Earthquake	160	0	0	0	0	0	12000	0	0	0
Epidemic	0	87310	61522	52421	333408	40723	0	100384	59969	14886
Extreme	0	0	0	0	0	0	0	0	0	0
Flood	195300	563328	109940	1243204	1171888	111488	1649	100116	1532632	485710
Insect	0	0	0	0	0	0	0	0	0	0
Mass	0	0	0	0	0	0	0	0	0	0
Mass	0	0	0	0	0	0	0	0	0	3356
Storm	0	0	0	0	0	3070604	0	114150	0	0
Volcano	0	0	0	11000	0	0	0	0	0	0
Wildfire	0	0	0	0	0	0	0	1000	0	0
Total	195460	675638	171462	27806625	31705296	4068105	13649	15315650	3592601	3334952

homeless

	Algeria	Angola	Burkina Faso	Ethiopia	Kenya	Madagascar	Maldives	South Africa	Sudan	Uganda
Complex	0	0	0	0	0	0	0	0	0	0
Drought	0	0	0	0	0	0	0	0	0	0
Earthquake	215150	0	0	0	0	0	13000	0	0	0
Epidemic	0	0	0	0	0	0	0	0	0	0
Extreme	0	0	0	0	0	0	0	0	0	0
Flood	2550	27750	55172	125810	0	4482	0	15200	255780	304875
Insect	0	0	0	0	0	0	0	0	0	0
Mass	0	0	0	0	0	0	0	0	0	0
Mass	0	0	0	165	0	0	0	0	0	0
Storm	0	0	0	0	0	526192	0	10200	0	10100
Volcano	0	0	0	0	0	0	0	0	0	0
Wildfire	0	0	0	0	0	0	0	5850	0	0
Total	217700	27750	55172	125975	0	530674	13000	31250	255780	314975

injured

	Algeria	Angola	Burkina Faso	Ethiopia	Kenya	Madagascar	Maldives	South Africa	Sudan	Uganda
Complex	0	0	0	0	0	0	0	0	0	0
Drought	0	0	0	0	0	0	0	0	0	0
Earthquake	10960	0	0	0	0	0	2214	58	0	0
Epidemic	0	0	0	0	0	0	0	0	0	0
Extreme	0	0	0	0	0	0	0	0	0	0
Flood	575	16	91	131	9	17	0	12	391	40
Insect	0	0	0	0	0	0	0	0	0	0
Mass	0	0	0	0	0	0	0	0	0	0
Mass	0	0	0	0	26	0	0	0	0	10
Storm	15	0	0	0	0	2870	0	762	0	5
Volcano	0	0	0	0	0	0	0	0	0	0
Wildfire	0	0	0	5	0	0	0	530	0	0
Total	11550	16	91	136	35	2887	2214	1362	391	55

Appendix 5

ASIA

deaths

	China P Rep	India	Myanmar	Pakistan	Bangladesh
Complex	0	0	0	0	0
Drought	134	20	0	143	0
Earthquake	87946	37805	71	73576	10
Epidemic	423	1498	30	163	245
Extreme	191	4946	0	538	1200
Flood	6757	12720	124	2197	2584
Insect	0	0	0	0	0
Mass	55	0	0	0	0
Mass	779	609	17	239	0
Storm	3507	11168	138636	627	5519
Volcano	0	0	0	0	0
Wildfire	23	6	0	0	0
Total	99815	68772	138878	77483	9558

affected

	China P Rep	India	Myanmar	Pakistan	Bangladesh
Complex	0	0	0	0	128400
Drought	196664000	350000000	0	2200000	0
Earthquake	55738628	5384599	12500	1151699	3500
Epidemic	6829	303395	0	5283	361082
Extreme	77000000	0	0	0	151000
Flood	585340382	262024253	222317	9487092	58573043
Insect	0	0	0	0	0
Mass	0	0	0	0	0
Mass	10100	12000	0	2	0
Storm	257955648	13536601	2460075	1965040	9150294
Volcano	0	0	0	0	0
Wildfire	0	0	0	0	0
Total	1172715587	631260848	2694892	14809116	68367319

homeless

	China P Rep	India	Myanmar	Pakistan	Bangladesh
Complex	0	0	0	0	0
Drought	0	0	0	0	0
Earthquake	1652136	2045700	3200	5006320	15000
Epidemic	0	0	0	0	0
Extreme	0	0	0	0	0
Flood	4674229	7018000	57987	11100	71638
Insect	0	0	0	0	0
Mass	340	0	0	0	0
Mass	13620	0	0	0	0
Storm	1262307	1146345	25000	224090	212625
Volcano	0	0	0	0	0
Wildfire	300	0	0	0	0
Total	7602932	10210045	86187	5241510	299263

injured

	China P Rep	India	Myanmar	Pakistan	Bangladesh
Complex	0	0	0	0	0
Drought	0	0	0	0	0
Earthquake	387500	180741	0	128588	225
Epidemic	0	0	0	211	0
Extreme	3700	25	0	324	2200
Flood	234229	408	110	1921	492
Insect	0	0	0	0	0
Mass	18	0	0	0	0
Mass	132	58	16	20	0
Storm	110959	9566	20031	290	66881
Volcano	0	0	0	0	0
Wildfire	0	0	0	0	0
Total	736538	190798	20157	131354	69798

Appendix 5

NORTH AMERICA

deaths

	Belize	**Dominican**	**El Salvador**	**Guatemala**	**Haiti**	**Honduras**	**Nicaragua**
Complex	0	0	0	0	0	0	0
Drought	0	0	0	41	0	0	0
Earthquake	0	3	1160	8	0	0	7
Epidemic	0	16	334	1	40	8	0
Extreme	0	0	1	6	0	0	0
Flood	1	716	90	80	2902	140	38
Insect	0	0	0	0	0	0	0
Mass	0	0	0	0	0	0	0
Mass	0	0	0	187	0	0	29
Storm	54	211	70	1540	3663	75	228
Volcano	0	0	2	0	0	0	0
Wildfire	0	0	0	0	0	0	0
Total	55	946	1657	1863	6605	223	302

affected

	Belize	Dominican	El Salvador	Guatemala	Haiti	Honduras	Nicaragua
Complex	0	0	0	0	0	0	12500
Drought	0	0	400000	113596	35000	415625	188000
Earthquake	0	2000	1599648	355	0	1720	1785
Epidemic	0	0	52610	2042	200	4530	0
Extreme	0	0	0	1850	0	0	0
Flood	38000	96400	12782	285819	352323	834275	154230
Insect	0	0	0	0	0	0	0
Mass	0	0	0	0	0	0	0
Mass	0	0	0	2720	0	0	5751
Storm	112000	185183	75541	486768	706756	184420	225872
Volcano	0	0	2000	800	0	0	5695
Wildfire	0	0	0	0	0	0	16000
Total	150000	283583	2142581	893950	1094279	1440570	609833

homeless

	Belize	Dominican	El Salvador	Guatemala	Haiti	Honduras	Nicaragua
Complex	0	0	0	0	0	0	0
Drought	0	0	0	0	0	0	0
Earthquake	0	0	0	35	0	1865	5650
Epidemic	0	0	0	0	0	0	0
Extreme	0	0	0	0	0	0	0
Flood	0	2092	0	3990	29419	3944	10109
Insect	0	0	0	0	0	0	0
Mass	0	0	0	0	0	0	0
Mass	0	0	0	460	0	0	0
Storm	0	0	0	0	17173	25270	5763
Volcano	0	0	0	0	0	0	0
Wildfire	0	0	0	0	0	0	0
Total	0	2092	0	4485	46592	31079	21522

injured

	Belize	Dominican	El Salvador	Guatemala	Haiti	Honduras	Nicaragua
Complex	0	0	0	0	0	0	0
Drought	0	0	0	0	0	0	0
Earthquake	0	15	8123	42	0	18	42
Epidemic	0	0	0	0	0	0	0
Extreme	0	0	0	0	0	0	0
Flood	0	3	0	36	345	13	0
Insect	0	0	0	0	0	0	0
Mass	0	0	0	0	0	0	0
Mass	0	0	0	54	0	0	18
Storm	570	11	0	397	2905	0	0
Volcano	0	0	0	0	0	0	0
Wildfire	0	0	0	0	0	0	0
Total	570	29	8123	529	3250	31	60

Appendix 5

SOUTH AMERICA

deaths

	Bolivia	**Colombia**	**Peru**
Complex	0	0	0
Drought	0	0	0
Earthquake	0	1200	676
Epidemic	34	0	0
Extreme	15	0	496
Flood	361	1027	213
Insect	0	0	0
Mass	0	0	0
Mass	69	273	82
Storm	20	7	59
Volcano	0	9	0
Wildfire	3	0	0
Total	502	2516	1526

affected

	Bolivia	Colombia	Peru
Complex	0	0	0
Drought	75000	0	21500
Earthquake	0	753616	538465
Epidemic	500	0	0
Extreme	25277	0	3061927
Flood	1368795	4556813	898857
Insect	0	0	0
Mass	0	0	0
Mass	690	900	0
Storm	18740	3074	86682
Volcano	0	138351	3000
Wildfire	6500	0	0
Total	1495502	5452754	4610431

homeless

	Bolivia	Colombia	Peru
Complex	0	0	0
Drought	0	0	0
Earthquake	0	454570	301985
Epidemic	0	0	0
Extreme	0	0	0
Flood	10600	92350	254325
Insect	0	0	0
Mass	0	0	0
Mass	300	5260	1420
Storm	0	7500	0
Volcano	0	0	0
Wildfire	2800	0	0
Total	13700	559680	557730

injured

	Bolivia	Colombia	Peru
Complex	0	0	0
Drought	0	0	0
Earthquake	0	8644	4238
Epidemic	0	0	0
Extreme	5	0	1800000
Flood	235	1071	1259
Insect	0	0	0
Mass	0	0	0
Mass	11	67	6
Storm	0	200	0
Volcano	0	0	0
Wildfire	0	0	0
Total	251	9982	1805503

Appendix 5

EUROPE

deaths

	Armenia	**Azerbaijan**	**Georgia**	**Moldova Rep**	**Ukraine**
Complex	0	0	0	0	0
Drought	0	0	0	2	0
Earthquake	0	32	6	0	0
Epidemic	0	0	0	0	0
Extreme	0	0	0	13	806
Flood	1	0	1	4	49
Insect	0	0	0	0	0
Mass	0	0	0	0	0
Mass	0	11	0	0	0
Storm	0	0	0	0	10
Volcano	0	0	0	0	0
Wildfire	0	0	0	0	0
Total	1	43	7	19	865

affected

	Armenia	Azerbaijan	Georgia	Moldova Rep	Ukraine
Complex	0	0	0	0	0
Drought	297000	0	696000	210394	0
Earthquake	0	3444	18000	0	0
Epidemic	0	0	0	1647	0
Extreme	0	0	0	0	50000
Flood	0	30000	3100	11960	538665
Insect	0	0	0	0	0
Mass	0	0	0	0	0
Mass	0	0	0	0	0
Storm	0	0	900	2600000	53668
Volcano	0	0	0	0	0
Wildfire	0	0	0	0	0
Total	297000	33444	718000	2824001	642333

homeless

	Armenia	Azerbaijan	Georgia	Moldova Rep	Ukraine
Complex	0	0	0	0	0
Drought	0	0	0	0	0
Earthquake	0	8400	1086	0	0
Epidemic	0	0	0	0	0
Extreme	0	0	0	0	0
Flood	0	1500	90	753	0
Insect	0	0	0	0	0
Mass	0	0	0	0	0
Mass	0	0	0	0	0
Storm	0	0	0	0	1267
Volcano	0	0	0	0	0
Wildfire	0	0	0	0	0
Total	0	9900	1176	753	1267

injured

	Armenia	Azerbaijan	Georgia	Moldova Rep	Ukraine
Complex	0	0	0	0	0
Drought	0	0	0	0	0
Earthquake	0	620	70	0	0
Epidemic	0	0	0	0	0
Extreme	0	0	0	0	9600
Flood	0	0	0	0	0
Insect	0	0	0	0	0
Mass	0	0	0	0	0
Mass	0	0	0	0	0
Storm	0	0	0	0	727
Volcano	0	0	0	0	0
Wildfire	0	0	0	0	0
Total	0	620	70	0	10327

Appendix 5

OCEANIA

deaths

	Indonesia	Philippines	Vanuatu	Papua New Guinea
Complex	0	0	0	0
Drought	0	0	0	0
Earthquake	173596	21	12	7
Epidemic	1246	45	0	142
Extreme	0	0	0	0
Flood	2700	598	0	4
Insect	0	0	0	0
Mass	0	11	0	0
Mass	1086	1817	0	64
Storm	4	6089	36	172
Volcano	2	0	0	0
Wildfire	0	0	0	0
Total	178634	8581	48	389

affected

	Indonesia	Philippines	Vanuatu	Papua New Guinea
Complex	0	0	0	0
Drought	15000	0	0	0
Earthquake	3462111	73501	13000	4400
Epidemic	100985	1176	0	3610
Extreme	0	0	0	0
Flood	3379055	5096287	3000	88193
Insect	0	0	0	0
Mass	0	0	0	0
Mass	297081	240341	0	1063
Storm	3715	34280278	54505	162140
Volcano	117340	209532	9500	40899
Wildfire	0	0	0	0
Total	7375287	39901115	80005	300305

homeless

	Indonesia	Philippines	Vanuatu	Papua New Guinea
Complex	0	0	0	0
Drought	0	0	0	0
Earthquake	1330433	0	2000	6400
Epidemic	0	0	0	0
Extreme	0	0	0	0
Flood	19155	61405	0	50000
Insect	0	0	0	0
Mass	0	0	0	0
Mass	34855	35	0	10000
Storm	0	323139	295	0
Volcano	0	0	0	0
Wildfire	0	0	0	0
Total	1384443	384579	2295	66400

injured

	Indonesia	Philippines	Vanuatu	Papua New Guinea
Complex	0	0	0	0
Drought	0	0	0	0
Earthquake	148023	140	103	71
Epidemic	0	0	0	0
Extreme	0	0	0	0
Flood	1295	219	1	0
Insect	0	0	0	0
Mass	0	0	0	0
Mass	389	180	0	32
Storm	0	5967	8	0
Volcano	105	0	0	0
Wildfire	400	0	0	0
Total	150212	6506	112	103