The management of response operations in case of natural disaster : from litterature to reality

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THE MANAGEMENT OF RESPONSE OPERATIONS IN CASE OF NATURAL DISASTER: FROM LITERATURE TO REALITY

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SUMMARY

PREFACE

As I was gathering data concerning my Master's thesis to be, happened the 2015 earthquake in Nepal. This tragic event led me to consider the impact of natural disasters in the logistics field as the most interesting topic there could be for a student in supply chain management in its last year of study. It gave me a real motive to learn about and try to understand the many ways in which emergency logistics differs from traditional commercial supply chains.

TABLE OF ABBREVIATIONS

B-FAST	= Belgium First Aid and Support team
BRC	= Belgian Red Cross
DREF	= Disaster Relief Emergency Funds
ERU	= Emergency Response Units
FACT	= Field Assessment Coordination Team
HNS	= Host National Society
IFRC	= International Federation of Red Cross and Red Crescent societies
INSARAG	= International Search And Rescue Advisory Group
LEMA	= Local Emergency Management Agency
MSF	= Medecins Sans Frontières
NGO	= Non-Governmental Organization
NS	= National Society
OSOCC	= On Sight Operations Coordination Centre
RDC	= Reception Departure Center
RC	= Red Cross
USAR	= Urban Search And Rescue teams
VRP	= Vehicle Routing Problem
WASH	= Water Sanitation Hygiene
WFP	= World Food Programme

1. INTRODUCTION

Today, the world is facing more and more disasters, either natural or manmade. The underlying reasons are clear as much as they become the main concerns of our society. The population keeps on growing, the climate keeps on changing, people keep on moving to coast lines and high-density metropolises, poverty keeps on increasing, diseases keep on spreading around the world and industries keep on producing at higher level. All of this creates changes in the equilibrium of our lives. This is illustrated through migrations, changes in demographics, increases of poverty, famines, and diseases. As none of these factors seems to be reversing its current trend, it is likely we will need to respond to and recover from more frequent occurrences of higher-impact disasters.

Looking back into the past, there were 317 natural disasters reported in 2014[1]. Disasters caused by earthquakes and tsunamis, reported at 27 in 2014, were at their fourth highest level for the decade (see appendix 1). There were even more natural disasters in 2015[2] and this number will still increase in the future, given the human behavior of today. In 2015, the largest natural disasters were the massive earthquake in Nepal, the one in Pakistan, the floods in India and the landslide in Guatemala to only name a few (The United Nations Office for Disaster Risk Reduction (UNISDR[3]), 2016). That year, many other disasters occurred such as winter storms, torrential rains, cyclones, tornadoes, landslides but also other kind of catastrophes that require emergency management, for example wars, migrations, terrorist attacks, virus etc. Those catastrophes are handled by the local emergency authorities, involving local relief actors. Whereas, in this paper, I will focus my research on large-scale natural disasters, meaning those that require international help through the involvement of foreign non-governmental organizations (NGOs) as well as governmental ones.

Natural disasters have enormous impacts in terms of deaths[4] and financial losses[5]. They affect life, economy, infrastructure, perceptions and force the population to migrate, start a completely new life all over again far from their habits. Such impacts aren't avoidable, but can be reduced thanks to accurate relief operations. That is why an effective and adequate

[1] According to the World Disasters Report 2015 of the IFRC (http://www.ifrc.org)
[2] 346 natural disasters reported by the United Nations Office for Disaster Risk Reduction (UNISDR)
[3] https://www.unisdr.org/we/inform/publications/47804
[4] 764 427 people were killed by natural disasters between 2005 and 2014 (www.ifrc.org)
[5] 1,595,470 millions of US dollars were estimated as disasters damages between 2005 and 2014 (www.ifrc.org).

management of the humanitarian actions is crucial, that is why a good management of the emergency supply chain is decisive. All the reasons stated above made me deeply involve myself in the research on this topic.

However, one must recognize that having an increasing number of natural disasters today has brought some positive effects from a certain point of view. Undoubtedly, the increasing number of NGOs that provide relief, the use of information and communication technologies and the lessons learned related to each disaster have brought significant improvements in humanitarian organizations (HOs)' coordination and information sharing. Moreover, globalization has also played a role in these positive effects. Indeed, it is bringing countries, people and cultures even more closer. Thanks to all of this, humanitarian organizations have developed better responsive strategies to face natural disasters. They are better prepared, thus able to provide faster relief.

This research aims at identifying the factors that we must take into account so as to efficiently manage humanitarian logistics operations. In comparison with the characteristics of emergency logistics present in the literature, this paper's objective is to detect and understand the real features, the specificities of humanitarian supply chains. For that purpose, I have conducted interviews of humanitarian organizations in order to understand the reality and be able to provide conclusions.

This paper is to be divided into five parts. To begin with, so that to provide the reader with a clear understanding, I will give an overview of the disaster management cycle by defining the different parts that are involved into it. I will then focus on the response operations conducted in the aftermath of a disaster; especially on the challenges and characteristics linked respectively to the transportation of relief items and to the communication and coordination between the humanitarian teams. After that, on the basis of interviews I have conducted, I will explain the intervention processes of four humanitarian organizations when responding to disasters. I will illustrate this part by providing a concrete example of the management of response operations through the interview of one volunteer back from a relief mission conducted regarding the recent quake that hit Ecuador in April 2016. Finally, I will compare the reality based on the different interviews and on a concrete example, with the literature in order to identify the true characteristics and challenges of emergency logistics.

OVERVIEW OF THE MAIN NOTIONS RELATED TO HUMANITARIAN LOGISTICS

The underlying concept of this research is the disaster management. Disaster management can be defined as "the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies in particular preparedness, response and recovery in order to lessen the impact of disasters" (The International Federation of Red Cross and Red Crescent Societies [IFRC], s.d.)[6]. The main goals of disaster management are to minimize loss via more effective preparedness and response and to create more effective and durable recovery (The disaster management manual, 2008).

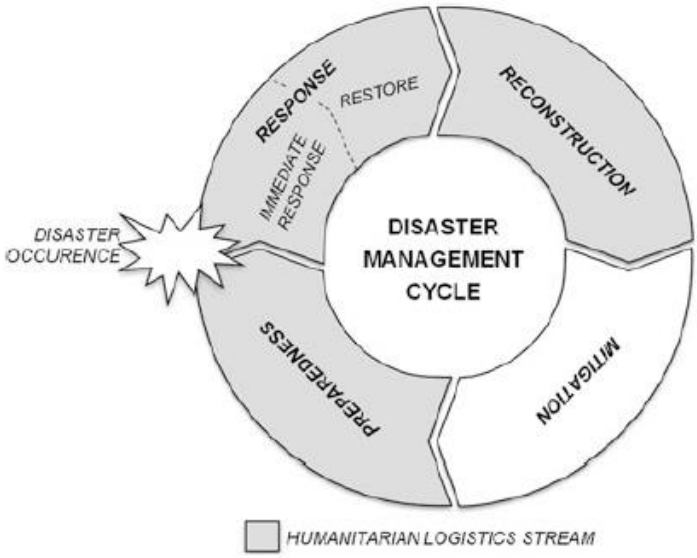
Now that the context is set, I would like to define emergency logistics and highlight its importance. Indeed, logistics is the most important element in any disaster relief effort, and it is the one that makes the difference between a successful and a failed operation. But it is also the most expensive part of any disaster relief. It has been estimated that logistics accounts for about 80 % of the total costs in disaster relief according to Van Wassenhove (2006) (mentioned by Balcik, Beamon, Krejci, Muramatsu, & Ramirez (2009)) and Rottkemper, Fischer, Blecken, and Danne (2011). Emergency logistics, also referred to as humanitarian logistics in the literature, is the process of planning, managing and controlling the flows of relief items from the origin points to the destination points in order to meet the urgent needs of affected people (Caunhye, Nie, & Pokharel, 2011; Jiuh-Biing Sheu, 2007 (mentioned by Ji & Zhu, 2012)). In the aftermath of a disaster, providing relief in the shortest possible time to affected areas is a critical objective (Guojun and Caihong, 2012).

Therefore, after those definitions and facts, one has to understand that commercial and humanitarian supply chains are quite different on some points. While commercial supply chains are focused on quality and profitability, humanitarian supply chains are more concerned with minimizing losses of life and suffering (Campbell, Vandenbussche, & Hermann, 2008). Indeed, the dominant objective of a relief operation is clearly to save lives no matter the costs. Among the differences between commercial supply chains and humanitarian relief chains, we can find, with regard to humanitarian relief chains, the general uncertainty, the unpredictability of demand (in terms of time, location, quantity, size, occurrence), the high stakes associated with timely and efficiently delivery, the scarcity or

[6] http://www.ifrc.org/en/what-we-do/disaster-management/about-disaster-management/

unavailability of resources (people, vehicles, money), the short-time frame to make decisions and the unreliable information (Balcik & Beamon, 2008).

With a focus on logistics operations and supply chain management, the management of any disaster can be divided into three main phases: preparation, response and recovery (Cozzolino, 2012; Malilay et al., 2014; Tajima, Gore, & Fischer, 2014); together, they constitute the humanitarian logistics stream (Cozzolino, 2012). Without considering and focusing of this logistics aspect, it exists a fourth phase called mitigation, I will come back to it. The four phases together are named the disaster management cycle, which is represented as follows:



Source: Cozzolino (2012).

In order to understand the disaster management cycle, it is necessary to have a closer look at the four phases that constitute this cycle.

1. PREPAREDNESS

In the disaster preparedness phase, specific measures are taken and various operations are conducted before the disaster strikes. The aim of this phase is to prevent or, at least, reduce the consequences of upcoming disasters by involving communities and preparing supplies. It incorporates the strategies put into place in order to implement both successful operational response and recovery processes.

Concerning the response process, it encompasses physical infrastructure activities (e.g., strengthening levies to prevent flooding, constructing shelters), policy efforts (e.g., establishing disaster-resistant building codes), and preparedness activities (e.g., arranging volunteer deployment, training volunteers, pre-positioning stocks, determining evacuation arrangements).

Concerning the recovery process, it generally includes defining objectives to guide the recovery efforts, identifying potential sources of financial assistance and determining sites for certain post-disaster functions such as accommodation.

Therefore, this phase is crucial as it not only enlarges the network design, but also the system of information and communication technologies that builds the core of collaboration.

A wide range of players are active during that phase: governments, NGOs and companies, all with their own roles and interests; that is why all strategies undertaken during this pre-disaster phase involve defining the roles and responsibilities of each party as well as defining a coordinating structure among all the participants (Cozzolino, 2012; Malilay, J. et al., 2014; Tajima et al., 2014; The Disaster Management Manual, 2008).

2. RESPONSE

The next step, following the preparedness phase in time, is the response phase. This post-disaster phase refers to actions taken immediately after the occurrence of a disaster to ensure that the impacts of the disaster are minimized and that people affected are given immediate relief and support. The idea is to restore, in the shortest possible time, the basic services and delivery of goods to the highest possible number of receivers in order to address their immediate and short-term needs. This includes providing food, water, shelter and medical care. During this stage, the focus is on coordination and collaboration among all the actors involved in the humanitarian emergency. The connection between suitable donors, suppliers, NGOs, and other partners that were made in the first phase is activated during this phase, as

the disaster occurred. All the actors involved have to operate as quickly as possible. The time to assess the health status and the needs of the affected community as well as the time to provide relief is determinant, as the first 72 hours are crucial. Indeed, human lives directly depend on the speed of interventions. The speed is also critical because circumstances often change quickly with time, so information becomes quickly outdated and no usable anymore (Cozzolino, 2012; Tajima et al., 2014; The Disaster Management Manual, 2008).

3. RECOVERY

The last phase constituting the disaster management cycle, with a focus on the logistics operations, is called the recovery phase as it refers to the coordinated processes of supporting disaster-affected communities in reconstruction of physical infrastructure and restoration of emotional, social, economic and physical well-being. It aims to address the problem from a long-term view, in contrast to the previous stages. Indeed, the effects of natural disasters can last for long periods of time and have long-term consequences on economy and people's life. This eventually transitions into recovery, where efforts are geared more directly towards the re-establishment of regular living conditions. At last, the recovery phase's purpose is to bring both the environment and supply networks back to a 'normal' state (Balcik and Beamon, 2008; Chou, Zahedi, & Zhao, 2014; Tajima et al., 2014; Day, 2013; Tomasini & Van Wassenhove, 2009).

4. MITIGATION

Without focusing on the logistics operations, as I previously mentioned, a fourth phase constitutes the disaster management cycle: the mitigation phase. During this stage, efforts are focused on reducing social vulnerability (Cozzolino, 2012). This phase intends to minimize the potential damages of disasters in a proactive manner. It involves the utilization of several measures to reduce risks, including, for example, land-use planning, building codes and engineered structures (Mileti, 1999 (mentioned by Tajima, Gore, & Fischer, 2014)) and it belongs to the responsibility of the affected government and thus do not involve the direct participation of logisticians.

At the end of the cycle, humanitarian organizations always learn from their mistakes and provide their lessons that will be useful for the next operations. For example, the ALNAP[7], a network aimed at strengthening humanitarian effect, improves the performance of humanitarian action by making the lessons of previous responses available online. In collaboration with humanitarian organizations, this network is able to provide lessons learned from some disasters such as the one in Nepal.

5. OBJECTIVES

Each stage of the process has a specific objective. With regard to the humanitarian logistics stream and driven by the urgency of the needs, the transition between the different stages involves the shift in focus from speed to cost reduction. Indeed, in the recovery phase, once prioritized commodities have been delivered and urgent needs have been satisfied, there is a better visibility about the process to assist beneficiaries, so cost becomes a driver. At that moment, the relief supply chain starts to resemble a normal business supply chain (Tomasini & Van Wassenhove, 2009).

In this paper, I will base my research on the response operations occurring in the aftermath of a disaster. I would like to understand how relief operations are carried, with a focus on the aspects of humanitarian logistics.

[7] ALNAP= Active Learning Network for Accountability and Performance in Humanitarian Action. It is a unique system-wide network dedicated to improving the performance of humanitarian action through shared learning

2. ANALYSIS OF THE CHALLENGES AND CHARACTERISTICS OF THE RESPONSE PHASE: LITERATURE REVIEW

Now that concepts concerning the topic are set, I would like to focus on the heart of this dissertation, that is to say, the response phase, which was previously defined as happening directly after the occurrence of a disaster. The literature concerning humanitarian logistics is abundant today; indeed, many researches have been done to provide mathematical models aiming at better managing the response operations in emergency situations. The following literature review will provide an overview of the characteristics and challenges linked to humanitarian logistics. What needs to be taken into account in order to organize and plan in an effective way the relief operations? What are the operational challenges on the field that all international actors usually face? Even though every disaster has its inherent features, the process of responding to them and the challenges they represent remain relatively similar in all cases.

As a basis for comprehension, here is a representation of the humanitarian logistics chain:

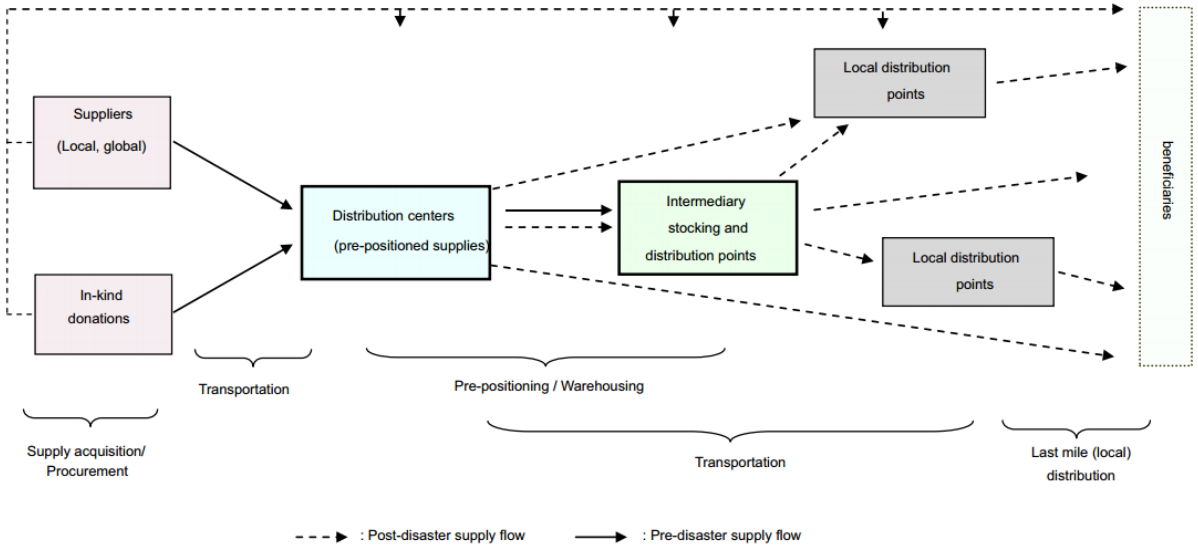


Fig. 1. Relief chain structure.

Source: Balcik et al. (2010).

2.1. MATHEMATICAL MODELS DEFINED IN HUMANITARIAN LOGISTICS

To tackle the emergency logistics problem, numerous mathematical models have been determined in the literature.

2.1.1. DEFINITION OF THE PROBLEM ADDRESSED IN HUMANITARIAN LOGISTICS

Afshar & Haghani (2011) and Haghani & Oh (1996) define the humanitarian logistics problem as sending a number of different relief commodities from various origins to several distribution points using different modes of transportation in a timely and efficiently manner. Tomasini & Wassenhove (2009) determine the goal as the mitigation of the population's urgent needs in the shortest possible time and with the fewest resources.

2.1.2. OVERVIEW OF THE DIFFERENT MATHEMATICAL MODELS USED FOR SOLVING THE LOGISTICS PROBLEMS ARISING IN DISASTER RELIEF ACTIVITIES

The following mathematical models that are available in the literature, address different aspects of the humanitarian logistics in case of disaster management. They are going to be classified according to the problems they want to solve.

2.1.2.1. Scheduling and routing problems

2.1.2.1.1. Deterministic models

Lee, Lei, Pinedo, & Wang (2013) study a scheduling problem with operations that require renewable as well as non-renewable resources. The routing of each team is given, the operations have deadlines and the availability of the renewable resources depends on the sequence of the operations. Li & Tan (2013) propose two-vehicle scheduling schemes using linear multi-objective programming approaches to obtain the maximum commercial profits while satisfying the disaster-relief requirements. Both proposed models feature such objectives as minimizing the total cost, maximizing the minimal satisfaction, and maximizing commercial profits in the scheduling process. Campbell et al. (2008) take the first step toward developing new methodologies for the routing problems. They focus specifically on two

alternative objective functions for the traveling salesman problem and the vehicle routing problem: one that minimizes the maximum arrival time and one that minimizes the average arrival time. Yuan & Wang (2008) focus on the path selection problem in emergency logistics management and build mathematical models to select the best path. The motivation of their research is to consider more actual factors in time of disaster when building models. Two mathematical models are built in this study and algorithms are developed to solve the model.

Barbarosoğlu, Özdamar, & Çevik (2002) develop a mathematical model for scheduling helicopter activities during a disaster relief operation. A two-level hierarchical decomposition is applied to this problem, resulting in two mixed integer mathematical models with conflicting objective functions. The top level mainly involves tactical decisions of determining the helicopter fleet, the total number of tours to be performed by each helicopter. The base level addresses operational decisions such as the vehicle routing of helicopters from the operation base to the emergency area, the delivery schedule and the re-fueling schedule of each helicopter given the solution of the top level. Since there are multiple objectives in this hierarchical structure, an iterative coordination heuristic is designed to enable the information exchange between the tactical problem and the operational problem.

- Time-dependent models

Haghani and Oh (1996) address a large-scale multi-commodity, multi-modal network flow problem with time windows. They determine the detailed routing and scheduling of the available transportation modes, delivery schedules of the various commodities at their destinations, and the load plans for each of the transportation modes. The formulation of the problem is based on the concept of a time-space network. Özdamar, Ekinci, & Küçükyazici (2004) present a time-dependent logistics problem that is a hybrid of two sub-problems: the multi-period multi-commodity network flow problem and the multi-period VRP with multiple transportation modes. The model continuously regenerates plans incorporating new information. It indicates the optimal mixed pickup and delivery schedules for vehicles as well as the optimal quantities to be delivered during the defined time frame. Chen, Chou, Ho, & Wang (2011) address the task of repairing damaged infrastructures as a series of multi-depot VRP with time windows in a time-rolling horizon. Each VRP problem is solved using a two-stage solution algorithm in which an initial solution is generated in the first stage and further improved upon in the second stage. To deal with this type of problem, the authors propose a heuristic and include an outside source, which is Hsueh et al.'s (2008).

- Location - routing models

Yi & Özdamar (2006) describe an integrated location-distribution model for coordinating logistics support and evacuation operations in disaster response activities. The proposed model is a mixed integer multi-commodity network flow model that treats vehicles as integer commodity flows rather than binary variables. The authors classify the model as an integrated capacitated location-routing model with a network flow based routing formulation. The proposed modeling framework is designed as a flexible dynamic (multi-period).

2.1.2.1.2. Stochastic models

Barbarosoğlu & Arda (2004) extend these deterministic models and propose a two-stage stochastic programming model to plan the transportation of vital first-aid commodities to disaster-affected areas during emergency response. In this stochastic problem, randomness arises not only from demand but also from supply and route capacity perspectives. A multi-commodity, multi-modal network flow formulation is developed to describe the flow of material over an urban transportation network. The first-stage is fixed and free of any uncertainty, and the second-stage is affected by the uncertainty in input data.

- Routing – distribution models

Yi & Kumar (2007) present a meta-heuristic of ant colony optimization for solving the logistics problem. The problem they describe deals with the coordination of commodity transportation from major supply centers to distribution centers in the affected areas and the transport of wounded people from those areas to the emergency medical centers. The problem is decomposed into two phases of decision making, the stochastic vehicle route construction, and the multi-commodity dispatch based on the resulting vehicle flows.

2.1.2.2. Last-mile distribution problems

2.1.2.2.1. Deterministic models

In the context of last-mile distribution, Balcik, Beamon, & Smilowitz (2008) propose a mixed integer programming model that determines delivery schedules for vehicles and equitably allocates resources, based on supply, vehicle capacity, and delivery time restrictions. The authors use a rolling-horizon framework to capture the dynamic and stochastic aspects of the problem. They assume that the location of the local distribution center is predetermined and its capacity is sufficient to serve its service region. In the same context and in addition,

Özdamar & Demir (2011) include both delivery and pickup functions in the last mile distribution problem. They propose a hierarchical cluster and route procedure for coordinating vehicle routing in large-scale post-disaster distribution and evacuation activities. This approach is based on clustering demand nodes and solving the aggregate problem in order to find the optimal allocation of warehouses and hospitals to demand cluster centers.

2.1.2.2.2. Stochastic models

Noyan, Balcik, & Atakan (2015) study the stochastic last mile relief network design problem, which determines the locations and capacities of the relief distribution points in the last mile network, while considering demand- and network-related uncertainties in the post-disaster environment. It develops a two-stage stochastic programming model that incorporates the hybrid allocation policy and achieves high levels of accessibility and equity simultaneously.

2.1.2.3. Distribution problems

Nolz, Semet, & Doerner (2011) consider the problem of designing the logistic system to assure adequate distribution of relief aid in a post-natural-disaster situation, when damages to infrastructure may disrupt the delivery of relief aid. The paper focus on the aspect of risk on delivery tours for disaster relief supplies. Ji and Zhu (2012) see the problem as how to efficiently distribute the urgent relief service from the multiple urgent relief distribution centers to various affected areas. The authors develop a two-objective optimization model with the time-varying fill rate maximization of relief service in the affected areas and the relief distribution time-varying time window minimization. Lin, Batta, Rogerson, Blatt, & Flanigan (2011) propose a logistics model for the delivery of prioritized items in disaster relief operations. They consider multi-items, multi-vehicles, multi-periods, soft time windows, and a split delivery strategy scenario, and this is formulated as a multi-objective integer programming model. The distinguishing feature of their work is to consider the delivery priorities of different items and to encompass this idea as an objective.

Victoriano, Ortuño, Tirado, & Montero (2011) present an original model for humanitarian aid distribution, proposing a new approach to the problem taking into account cost, time, equity, priority, reliability and security. The goal programming model results in a mixed integer linear programming model. Ransikarbum & Mason (2016) develop a multiple objective model for strategic decision-making regarding supply distribution and network restoration

decisions during post-disaster operations. The model provides an equity-based solution for constrained capacity, budget and resource problems in post-disaster logistics management.

2.1.2.3. Location problems

2.1.2.3.1. Deterministic models

Afshar and Haghani (2012) propose a mathematical model that controls the flow of relief items from source to recipients. They consider finding the optimal locations for temporal facilities while considering capacity constraints for each facility and for the transportation problem. Balcik and Beamon (2008) develop a mathematical model that determines the number and locations of the distribution centers in the relief network and the amount of relief supplies to be stocked at each distribution center. Their formulation incorporates pre-disaster and post-disaster costs.

2.1.2.3.2. Stochastic models

The model presented by Bozorgi-Amiri, Jabalameli, & Mirzapour Al-e-Hashem (2011) tackles the disaster relief logistics problem under uncertainty as a multi-objective, stochastic, mixed-integer, non-linear programming model. The uncertain parameters considered are the demand, the supplies and the costs of procurement and transportation. The model consists of two stages; the first stage determines the location of relief distribution centers and the required inventory quantities for each type of relief items, and the second stage determines the amount of transportation from relief distribution centers to beneficiaries. Döyen, Aras, & Barbarosoğlu, (2011) develop a two-stage stochastic programming model for a humanitarian relief logistics problem which helps to build up an optimal pre-disaster plan while considering the post-disaster decisions. It is formulated as a two-stage stochastic facility location model. The second echelon facilities are set up after the disaster so they are modeled as second stage variables. Thus, the model includes binary variables in the second stage which is not the case for recently mentioned two-stage stochastic models.

2.1.3. SUMMARY AND IDENTIFICATION OF THE SIMILARITIES BETWEEN THE MATHEMATICAL MODELS

Most of the mathematical models are assimilated to vehicle routing problems (VRP) even though, according to me, the VRP addressed in humanitarian logistics present all the complications of typical VRPs. Those complications are asymmetric costs, heterogeneous vehicle fleet, a total time duration of routes that is constrained, a time of delivery to customers that is constrained to fall within time windows and the use of multiple depots. VRPs encountered in humanitarian logistics are a mix of capacitated VRP, VRP with time windows, multiple-depot VRP, split delivery VRP and especially stochastic VRP.

In the analysis of such emergency situations, Chen et al. (2011), Haghani & Oh (1996), Ji & Zhu (2012) and Lin et al. (2011) highlight the time-dependent structure of the response system by referring to time windows. It's an essential feature to take into account. These authors state that the systems must be updated regularly to incorporate new information on demand, vehicle availability and supplies. Özdamar et al. (2006) add that decisions have to be made regarding real-time information. As the demand fluctuates among some period of time, the distribution problem is also seen as a multi-period problem according to Lin et al. (2011), Ozdamar et al. (2004) and Yi & Özdamar (2006).

Afshar & Haghani (2011), Yi & Kumar (2007), Özdamar et al. (2004) and Barbarosoglu et al. (2002) see this problem as a VRP with the pick up or delivery schedules, taking into account the capacity constraints for each location and transportation system. A few authors, Afshar & Haghani (2011), Balcik et al. (2008) and Ransikarbum & Mason (2016) consider fair supply allocation among the different demand points. Noyan et al. (2015) incorporate accessibility in addition to equity into the formulation of the problem. Balcik et al. (2008), Özdamar & Demir (2011) and Noyan et al. (2015) study the last-mile relief distribution problem. Özdamar et al. (2004), Haghani & Oh (1996) and Barbarosoğlu & Arda (2004) address this problem taking into account multi-modal network, whereas Yi and Kumar (2006) and Yi & Özdamar (2006) take a single transportation model for the sake of simplicity. However, only Chen et al. (2011) speak of multi-depot.

Even though the large majority of the research on this topic is deterministic, an increasing number of researchers now offer stochastic models in order to better take into account the uncertainty aspects of emergency supply chains. Barbarosoğlu & Arda (2004) and Yi & Kumar (2011) build stochastic models for scheduling and routing problems, Noyan et al.

(2015) for the last-mile distribution problem and Bozorgi-Amiri et al. (2011) and Döyen et al. (2011) for the distribution problem. But, regardless of the stochastic aspects of the problem, the real difficulty is that natural disasters, as well as the associated demand, is tough to predict. Uncertainty in demand, supply and cost is incorporated in the mathematical model by Bozorgi-Amiri et al. (2011) and Rottkemper et al. (2011).

The objectives of those mathematical models are quite common; they include minimizing the unsatisfied demand, over all commodities, time and demand points, by minimizing the service delay. Balcik & Beamon (2008) have as objective the minimization of transportation costs in addition to maximizing the benefits to aid recipients. Ransikarb & Mason (2016) want to maximize equity and fairness in the distribution of relief supplies in addition to minimizing the unsatisfied demand and minimizing the total network costs.

2.2. CHALLENGES AND CHARACTERISTICS UNDERLYING THE RESPONSE OPERATIONS FOR NATURAL DISASTERS

The challenges occurring during the response operations carried out by humanitarian organizations and the features of these operations will be divided into two sections, respectively the transportation of relief items and the communication and coordination between the humanitarian teams.

2.2.1. CHALLENGES AND CHARACTERISTICS LINKED TO THE TRANSPORTATION OF RELIEF ITEMS

After having generally addressed how the humanitarian logistics problem is defined, it seems necessary to focus now on the specificities, challenges and characteristics that should be taken into account while analyzing emergency logistics in the scope of natural disasters.

2.2.1.1 Characteristics related to the transportation of relief items

As already stated above, commercial supply chains are different than humanitarian ones. The main challenge in humanitarian logistics is to minimize the delay in the arrival of commodities at demand centers. The requirements at aid centers should be met at the defined time. Humanitarian logistics is, therefore, a time-dependent logistics, because there are high stakes associated with the accurate delivery time of relief supplies.

Özdamar et al. (2004), Afshar & Haghani (2011), Balcik et al. (2009), Caunhye et al. (2011), Balcik & Beamon (2008), Nolz et al. (2011), Day (2013), Ji & Zhu (2012), Tomasini & Wassenhove (2009), Noyan et al. (2015) and Bozorgi-Amiri et al. (2011) pinpoint the dominant characteristics of humanitarian logistics that are the uncertainties linked to the emergency context. This makes it difficult to match the demand with the supply given the high level of uncertainty in post-disaster situations. Another prevailing characteristic that has to be taken into consideration during the whole transportation process, and which is of a higher importance during emergency situations, is that humanitarian organizations operate in an unsafe environment. This concerns both the people and the equipment (Caunhye et al., 2011; Safeer, Anbuudayasankar, Balkumar, & Ganesh, 2014 ; Victoriano et al., 2010).

- *Limited access to on-site information*

The uncertainties are associated with a lack of information available on the disaster area, such as the demand, the vehicle availability, the road conditions, the location of the facilities, their capacities, etc. As Day (2013) mentioned, disaster relief supply networks operate in a more uncertain context than commercial networks. This engenders the unpredictability of demand, regarding the time, the type, the quantity and the location, according to Balcik & Beamon (2008) and Balcik et al. (2008).

- *Limited availability of resources on the ground*

Because of uncertainties and lack of information and time, another challenge linked to humanitarian logistics is the limited availability of resources (supplies, people, vehicles, infrastructure, communication, etc.) in terms of quantities and regarding the time (Balcik et al., 2008; Yi & Özdamar, 2006). Yi & Kumar (2007) and Balcik et al. (2008) identify limited supply availability in the initial phases of the disaster response process. Indeed, in consideration of the assessment period to identify and position the needs, the time taken to communicate this information and to coordinate the relief actions makes the disaster's impact unknown and, thus, makes it difficult to provide appropriate supplies.

2.2.1.2. Challenges related to the transportation of relief items

- *Transportation of the relief items*

As Balcik et al. (2009) say, in an emergency context, it is difficult to get vehicles, because they may be scarce and local prices may go up as the demand suddenly increases from all relief actors on site.

Another challenge is to efficiently manage the last-mile distribution, meaning the delivery of relief supplies from the distribution centers to the demand centers, where people affected by the disaster are located (Balcik et al., 2008; Balcik & Beamon, 2008). The success of the last-mile delivery relies on the accessibility to the demand centers and on the transportation modes to reach the final destination. Natural disasters often happen in remote areas, so destructed or damaged infrastructures may lead to unanticipated cascading effects (Day, 2013). Geographic features and climatic conditions can also affect the relief operations. Furthermore, to appropriately fulfill the needs of affected people and regarding the geographical position of the affected zone, organizations should deal with more than one transportation mode (Afshar & Haghani, 2011; Ozdamar et al., 2004).

The sudden presence of numerous actors in the relief process may create congestion that organizations will have to deal with (Yuan & Wang, 2008). Moreover, some roads may be inaccessible due to the impact of the disaster, so this can impact the previously designed path and reassigned the vehicle to a new path with real time information. As a result, this will affect the vehicle choice, delivery routes and the travel time. As a direct result comes one more challenge consisting in being able to access real-time information regarding actual road conditions (Balcik et al., 2008).

- *Storage of the equipment brought by the humanitarian organizations*

A true characteristic of humanitarian logistics, that could also be completed in advance, is to pre-position inventory. Kovács & Tatham (2009) refer to the concept of a vendor managed inventory (VMI) when speaking about pre-positioned inventory. Positioning relief supplies in advance in strategic locations allow organizations to receive, arrange and ship the commodities. Most importantly, it improves the transportation of the commodities toward the demand points and enables delivering critical items in the shortest possible time (Balcik & Beamon, 2008 and Afshar & Haghani , 2011).

- *Distribution of the relief items*

Considering the position we are in, that is, a context of emergency aiming at maximizing the survival rate of the wounded people, one challenge of humanitarian logistics is to fairly share the limited resources among the affected persons. Equity and fairness become of a major concern regarding the distribution of relief items in the response phase of a disaster. Moreover, as most humanitarian organizations work under specific principles such as impartiality, neutrality and humanity, this specificity seems consistent (Afshar & Haghani, 2011; Balcik et al., 2008; Campbell, Vandenbussche & Hermann, 2008; Starr & Van Wassenhove, 2014; Van Wassenhove & Pedraza Martinez, 2010).

2.3.2. CHALLENGES AND CHARACTERISTICS LINKED TO THE COMMUNICATION AND COORDINATION BETWEEN THE HUMANITARIAN TEAMS

In this part, I will review the literature so as to detect the challenges and characteristics that arise when focusing on both communication and coordination among the humanitarian teams. This can be seen as a two-echelon exchange. First, the exchange of information and the coordination inside a specific organization and then, the same sharing of information and efforts of coordination between all humanitarian actors involved in the response process.

2.3.2.1. Characteristics and challenges related to the communication and coordination within a specific team

The first characteristic related to the communication and the coordination inside humanitarian teams is, as Balcik & Beamon (2008) and Balcik et al. (2009) mentioned, the unavailable or disruptive communication systems. Balcik et al. (2009) highlight this characteristic in the last mile distribution problem. The main challenge is to efficiently manage the time and the cost of coordination. Time is spent in order to get information by going to collaborative meetings. However, during an emergency situation, humanitarian organizations don't have time to "waste" in those meetings; each second matters when it comes to saving lives. Another feature of humanitarian logistics is the rapid assessment of the needs and of geographical information about the territory hit by the disaster in order to know where to assign the teams and the composition of the teams. Starr & Van Wassenhove (2014) refer to the need of having good scouts in order to map the territory. Swanson & Smith (2013) mention the utility to proceed to regular assessments, in order to readjust the quantities provided and thus, better

face the actual demand. The ability of humanitarian organizations to rapidly mobilize the resources, based on the needs detected during the assessment period, is crucial for the success of the relief operations (Balcik & Beamon, 2008; Perry, 2007 (mentioned by Day, 2014); Malilay et al., 2014; Tomasini & Wassenhove, 2009; Swanson & Smith, 2013).

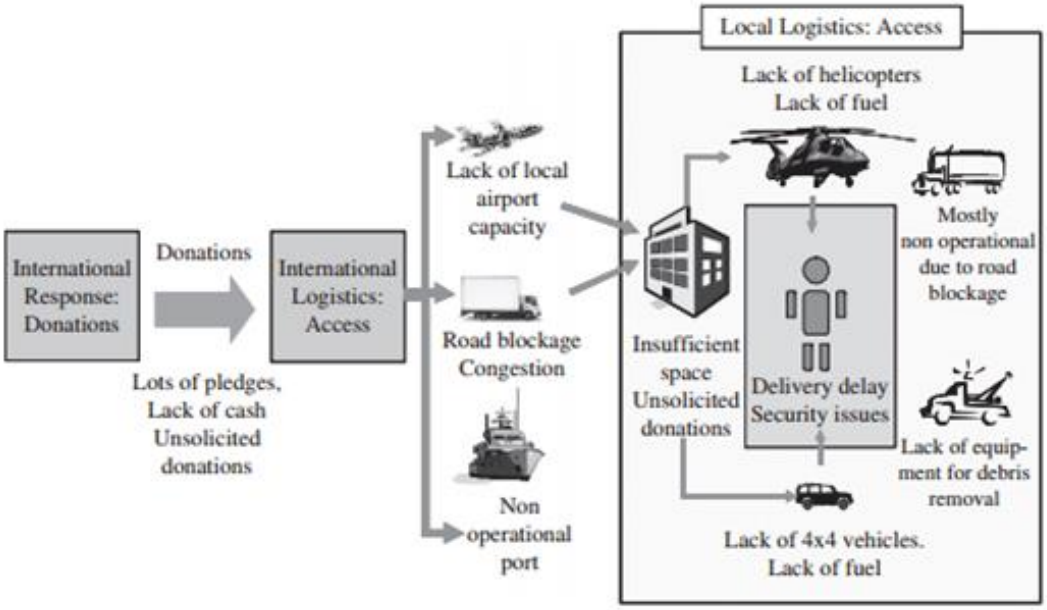
2.3.2.2. Challenges related to the coordination with the other teams

Given the large number of humanitarian organizations that arrive in the disaster area carrying large amounts of relief items, one challenge is to coordinate that logistics. Each organization is looking for transportation modes and other resources and this leads to competition between the organizations as well as a lack of coordination between them. One challenge is to manage the oversupply and to coordinate all the on-site relief actors (Balcik et al., 2009; Day, 2013).

As stated before, there are multiple actors involved in the relief process, so there is a need to communicate efficiently within one's own team but also to communicate adequately with the other organizations. Inter-organization is a real challenge, as each actor has its own principles, vision and working conditions. This is made difficult by the damaged communication lines, the involvement of many parties and the lack of real-time or, at least, the lack of updated information. The presence of so many entities represents a real challenge as it can quickly hamper coordination. Indeed, differences in cultures and languages may create additional challenges in the coordination process (Starr &Van Wassenhove, 2014; Balcik et al., 2009, Caunhye et al., 2011; Day, 2013). The success of a humanitarian operation doesn't depend only on its own capacity to respond, it also depends on the type of disaster, as some organizations are more familiar with specific disasters, on the region, and last but not least, on the whole humanitarian associations network. The collaboration with local humanitarian organizations clearly impacts the success of relief operations. Indeed, the immediate response both comes from the local actors and from international actors that have a local presence in the disaster-affected area. Moreover, the specificities of each country regarding the culture and the customs also have a great influence on the good realization of the relief operations. Definitely, a successful operation requires a good understanding of the local community. Another reason that emphasizes the importance to collaborate with locals is that working together with locals speeds up the relief operations as access to information on the needs and on the territory is simplified. This collaboration is required in order to acquire commodities from local suppliers with a shorter lead time and by avoiding a too high increase in the prices. To sum up, locals are essential resources in the humanitarian response process (Balcik &

Beamon, 2008; Balcik et al., 2009; Tomasini & Wassenhove, 2009; Van Wassenhove & Pedraza Martinez, 2010; Kovács & Tatham, 2009).

Here is a visual representation of the most encountered challenges that humanitarian logisticians may face after a natural disaster:



Source: (Pedraza Martinez et al., 2010a mentioned by Van Wassenhove & Pedraza Martinez, 2010)

2.4. OUTLINE OF THE OBJECTIVES, CONSTRAINTS AND SOLUTIONS UNDERLYING THE RESPONSE OPERATIONS CARRIED OUT BY HUMANITARIAN ORGANIZATIONS

The following table displays the objectives that should be achieved by humanitarian organizations in the response phase of a disaster, the related constraints and the solutions to implement in order to face those obstacles. It distinguishes the different objectives, constraints and solutions according to the transportation of relief items and the communication and coordination between the humanitarian teams.

Transportation of relief items	Communication and coordination between the teams
Objectives that humanitarian response operations should achieve	
• Send a number of different relief commodities (medicine, food, water and shelter) from various origins to several distribution points and from those distribution points to recipients using different modes of transportation in the shortest possible time • Distribute the relief supplies considering fairness and equity among the beneficiaries • Mobilize all resources (vehicles, drivers, humanitarian teams, relief commodities) as quickly as possible	• Coordinate the actions of all humanitarian organizations that arrive in the disaster-affected area in a shortest possible time • Coordinate the large amount of relief supplies that organizations brought into the affected area to avoid their transformation into oversupply • Access updated information and take decisions as quickly as possible • Collaborate with local actors (inhabitants, NGOs, authorities, etc.) • Rapidly mobilize the human resources based on the assessments periods
Constraints encountered in the field of humanitarian response operations	
• Many uncertainties are linked to the emergency context, they are associated with the lack of information available on the disaster area (the disaster's impact, the demand, the vehicle availability, the	• Each humanitarian organization has its own principles, vision and working conditions • The communication through disruptive or unavailable

road conditions, the facilities location and facilities capacity)

- The infrastructures (facilities, roads) may be damaged so may hinder the accessibility to the demand centers
- Geographic features and climatic conditions of the area hit by the disaster may also hinder the accessibility to demand centers
- The availability of resources such as supplies, people, vehicles, facilities and communication infrastructures is limited in terms of quantity. This scarcity in the resources may result in price increases and competition
- The sudden presence of numerous humanitarian actors may create congestion on the roads and the oversupply brought by them may require more resources

communication systems

- The coordination of the massive arrival of actors
- The different interests of each organizations that turn into competition
- The time dependence and cost related to the management of the coordination
- The differences in cultures and languages between the organizations

Solutions to face the difficulties of the emergency context and achieve the objectives

- Pre-position relief supplies in strategic locations close to disaster-affected countries to allow organizations to receive and ship the commodities to the disaster area in the shortest possible time
- Use multi-modal transportation to fulfill the needs of affected people regarding their geographical position as quickly as possible

- Participate to collaborative meetings with all the humanitarian organizations
- Proceed to rapid assessments of the needs in the affected area and of the road and infrastructure conditions in order to know where to assign the teams and adjust the quantities by doing regular assessments
- Collaborate with local humanitarian organizations, local government, local authorities, local drivers

3. UNDERSTANDING THE REALITY THROUGH THE INTERVIEW OF FOUR HUMANITARIAN ORGANIZATIONS

Theory being set, reality now has to be taken into account. The international humanitarian agencies are largely represented by the United Nations and the regional Red Cross and Red Crescent Societies. As I am studying in Belgium, I decided to interview the well-known Belgian humanitarian organizations including MSF Belgium, B-FAST, the Belgian Red Cross and a French one, SOS Attitude, which is becoming more and more popular in its sector and whose logistics' partner is located in Belgium.

The information retrieved from the interview will be divided into two parts, as I did for the identification of the main challenges in the response part.

3.1. MEDECINS SANS FRONTIÈRES (MSF)[8]

The first interview I have conducted concerns MSF Belgium and the following explanations were provided by Bruno De Vos, a former volunteer at MSF Belgium and currently field supply IS tools referent at the storage center MSF-Supply in Neder-Over-Heembek (Brussels).

3.1.1 ABOUT MSF

Médecins Sans Frontières (MSF) is "an international, independent, medical humanitarian organization that delivers emergency aid to people affected by armed conflict, epidemics, natural disasters and exclusion from healthcare. MSF offers assistance to people based on need, irrespective of race, religion, gender or political affiliation." (Medecins sans frontières, 2016). It is a non-profit, self-governed organization that was created in Paris in 1971 in the aftermath of the war in Nigeria. Regarding the terrible situation in the country, a small group of doctors and journalists believed the world needed to know about those events, where civilians were being murdered and were starving by blockading forces. From this indignation, MSF, a new brand of humanitarianism, was born.

[8] The complete interview report is given in appendix 2

MSF belongs to a worldwide movement composed of 24 associations, bound together as MSF International, based in Switzerland. The whole network of MSF, divided in five operational centers with their respective sections, is available in appendix 3.
Its financial resources enable MSF to operate as a totally independent entity, as more than 90% of its overall funding comes from private sources and not governments.

3.1.2 TRANSPORTATION OF RELIEF ITEMS AND TEAMS

3.1.2.1. Transportation modes

The transportation modes depend on the country hit by the disaster, more precisely on the on-going situation there and also on the accessibility. If time permits, MSF will use boats to transport the relief items, as it's cheaper, otherwise it will use planes. The time to receive the supplies varies according to the time to clear the customs and the congestion at the airport and on the roads. Concretely, MSF Belgium has a list of transportation agents who have available planes. Once a disaster strikes, they conduct a quick assessment of the volumes and weights that will be sent and, on the basis of this information, they ask brokers who will check which plane is available and at which price. The process can be very fast.

3.1.2.2. Logistics supplies and services

MSF Belgium has a warehouse in Belgium, "MSF Supply"[9], where I conducted the interview. This warehouse handles the stock of MSF Spain and MSF Holland, so it manages the stock of three sections and has to supply those sections with the same priority. The biggest warehouse of the MSF network is located in Dubai, which is a strategic location for the non-perishable items such as tents and blankets. However, the group of MSF members assigned for a particular mission also needs to locally stock up. For example in India, due to the Indian law, they have to buy medicine inside the country.

Regarding the prepositioning of the items, MSF has emergency stocks in some countries where it is active (e.g. Haiti, Congo and South Soudan) that enables it to be responsive even faster. Concerning the relief items, MSF has pre-designed kits called "risk kits" that ease the ordering process. Those are surgery kits, which are smaller and which can be taken as heavy luggage in the plane usually by a team of four people (a surgeon, an anesthesiologist, a

[9] https://www.msfsupply.be/

computer scientist and an administrator). MSF teams and their equipment don't arrive at the same time in the affected country, because, as I previously explained, a certain time is required to clear the customs of the charter. For some specific situations, MSF teams try to bring their equipment on site before the disaster, as they know in advance the kind of disaster, the location and the population. For example, this situation happens before the rainy season in South Sudan in order to manage the floods. Another thing included in the equipment is the money to be reactive in the affected country. MSF is financially independent; it doesn't need to wait for donations before leaving.

3.1.3 COMMUNICATION AND COORDINATION BETWEEN THE TEAMS

This part will be about the communication and coordination within the MSF Belgium team but also with the other MSFs and other humanitarian associations.

3.1.3.1. A competitive network

There are five MSF operational sections in the world: in Belgium, France, Spain, Holland and Switzerland. The remaining countries where MSF is active are linked to one operational section, meaning that they don't go on missions but rather do fundraising and recruiting. MSF highlights the fact that it is an independent entity. This results in a kind of competition between the different sections, each one trying to be the first to provide relief. But, still, they try to collaborate in order to avoid repeated actions or to be present in some areas and not in other.

3.1.3.2. The staff

The first thing to know is that there are two kinds of employees at MSF: locals and expats, who are on stand-by, ready to leave at any time. The duration of their stay is usually one month in case of an emergency and around six months in a classical case (e.g. a chronic disease). Employees don't stay a long time at MSF. This is explained by the stress, the living conditions in the affected area and the working hours. This results in a high turnover. Members selected to go are usually the ones with the knowledge of the country and the experience. There are also people outside of MSF that, thanks to an agreement with their employer, are ready to leave in case of emergency. As I mentioned in the transportation part, some members of MSF may already be working in the area affected by the disaster. This

represents high benefits in terms of information and time savings as well as local collaboration and equipment. The first move of MSF is therefore to contact MSF teams that are already present in the affected country or to find contacts among the locals thanks to the international presence of MSF.

3.2.3.3. In the field

Once in the disaster area, MSF quickly has to find locals to collaborate with, in order to get interpreters, transportation means and drivers but especially to have a better understanding of the situation. At this stage, given the high number of international actors, prices of everything go up. MSF proceeds to exploratory missions in order to assess the needs, only if MSF wasn't present in the area before the crisis starts. Those missions are conducted jointly with one administrator, one doctor and one logistician. Regarding the inter-coordination, there is one team leader, who coordinates the operations, himself supervised by the emergency desk in Brussels. This person in charge of the missions is often someone that knows well the affected country and that will go to the meetings with the other NGOs in order to share information. Regarding the global coordination, the US army is often the one that will take the coordinator role by implementing clusters. MSF doesn't want to lose time going to the meetings, but it is important to get contacts. As a reminder, MSF is a neutral and independent association, and as such, does not get to meet and work with other organizations on a regular basis. As you might have understood, the successful operations are the ones when MSF was present before the disaster. Indeed, by receiving the information before the emergency, teams are able to pre-position, anticipate the needs and integrate local partners in their efforts[10].

[10] This was the case during the tsunami in Indonesia in 2014. MSF, present in the Banda Aceh area, was immediately able to respond, to meet the needs

3.2. BELGIAN FIRST AID AND SUPPORT TEAM (B-FAST)[11]

For my second interview, I met Michel MOORS, who is a B-FAST volunteer and base camp manager, attached to the Civil Protection in Crisnée, Belgium.

3.2.1. ABOUT B-FAST

B-FAST is the rapid response structure of the Belgian government for emergency relief abroad. It was created by the 28.02.2003 Royal Decree by the Belgian federal government. It is consequently completely different than MSF, which is a non-governmental organization.
Following the Turkey earthquake in 1999, where Belgium provided emergency assistance, the Belgian Federal Government deemed it necessary to set up a more permanent structure for relief assistance operations that could be mobilized at any time. These improvements led to the creation of B-FAST.
B-FAST is an inter-departmental coordination structure among various federal ministries (Federal Public Services). All decisions to send teams abroad are taken at the level of the Council of Ministers, the executive branch of the Belgian Federal Government.
The financial resources of B-FAST come from a specific annual budget administered by the FPS Foreign Affairs. So it enables B-FAST to quickly respond to the disaster.
B-FAST adheres to the European standards set out under the Union Civil Protection Mechanism for Civil Protection. As far as USAR[12]- capacities are concerned, these standards fully adhere to the UN-INSARAG[13] guidelines. The INSARAG Guidelines are a world-wide accepted methodology for the coordination of international USAR teams. They set up minimum standards for the USAR assistance. Without this qualification, B-FAST cannot go abroad with the ONU.
There are three levels in the INSARAG-USAR team classification system: light, medium and heavy. B-FAST belongs to the medium USAR team, which means that it has the operational capability for technical search and rescue operations in structural collapse incidents. International Medium USAR teams travelling to an affected country should be operational in the affected country within 32 hours of the disaster. A medium team must be adequately staffed to allow for 24 hour operations at one site for up to 7 days.

[11] The complete interview report is given in appendix 4
[12] Urban Search and Rescue Teams
[13] International search and rescue advisory group

3.2.2. TRANSPORTATION OF RELIEF ITEMS AND TEAMS

The warehouse of B-FAST is located in Peutie, Belgium. This city is located near Melsbroek, the military airport, where there is a hall intended for B-FAST with its stored equipment. This equipment is the minimum one defined accordingly to the INSARAG guidelines. Thanks to this location, B-FAST uses the army planes or army trucks, but can also take its own vehicles in some of the army planes[14]. Therefore, teams and equipment always travel together.
Once in the disaster area, if B-FAST wasn't able to take its own vehicles, the team will look for local vehicles and drivers, as it's the case for all humanitarian organizations.

According to the guidelines, B-FAST is able to set up:

- ✓ Field hospitals and advanced medical posts
- ✓ High capacity pumping systems (in case of floods)
- ✓ Emergency temporary shelters such as tents
- ✓ CBRN Detection and Sampling systems (Chemical, Biological, Radiological and Nuclear)

3.2.3. COMMUNICATION AND COORDINATION BETWEEN THE TEAMS

In the case of B-FAST, the different entities in charge of the coordination are the following:

3.2.3.1. The Reception Departure Center (RDC)

The RDC is established at points of entry into an affected country for international response by the UNDAC[15] team or by first arriving USAR teams. Its primary responsibility is to facilitate the arrival and then later, the departure of international response teams. At the RDC, and for each organization, the composition of the team is defined as well as arrangements with the local authorities such as the transportations modes available.

3.2.3.2. The Local Emergency Management Agency (LEMA)

The LEMA of an affected country is the ultimate responsible authority for the overall command, coordination and management of the response operation as its represents the host government. LEMA can refer to national, regional or local authorities, or combinations

[14] C130 plane
[15] United Nations Disaster Assessment and Coordination

thereof, which are collectively responsible for the disaster response operation. Here in Belgium it's the crisis center in Brussels.

3.2.3.3. The On Sight Operations Coordination Centre (OSOCC)

The OSOCC is a leading cell, set up by the UNDAC team or by the first arriving international USAR team. It serves as the coordination point for international responders. The OSOCC is established close to the LEMA and as close to the disaster site as possible. The main purpose of the OSOCC is to assist LEMA with the coordination of international and national USAR teams as well as establishing inter-cluster coordination mechanisms. B-FAST is able to set up a RDC and an OSOCC, as it is part of the requirements written in the ISARAG guidelines. B-FAST cannot take any decisions, cannot initiate interventions on its own. Everything is headed by OSOCC and LEMA.

The central point of coordination of the team lies with the USAR team leader. However, on-site operations are determined by the LEMA in coordination with the OSOCC. The USAR team leader is responsible for briefing the USAR team before deployment about an affected country's culture, religion, customs and laws. The team leader has the overall responsibility of personnel, equipment, and operations from the team's activation until its return home. He is required to attend scheduled OSOCC briefings to ensure the team is kept informed of current issues and latest developments.

3.2.3.4. The staff

The USAR team is composed of two functional components namely management and operations. The management component is supported by the safety and security, information and planning, coordination and public information functions. The operations component manages the tactical operations such as site assessments, search, rescue and medical care. Meetings are mandatory, but they don't represent a loss of time as B-FAST teams are pretty well-organized as each member has a specific role. Generic functions are there to deal with more administrative stuff in contrast to the operational functions.

Profiles have been developed on the basis of UN standards for generic functions such as, a team leader, a liaison officer, safety and security officers, doctors and nurses, communication officers and logistics officers.

Finally, the duration of an intervention is limited to fourteen days, because of the physical constraints but also primarily because the success of a rescue operation is determined within the first 72 hours following a disaster.

To sum up, it is a less complicated process than with MSF because the organization has to follow specific guidelines. For each intervention, B-FAST takes minimum resources to the disaster area, as it is clearly defined in the guidelines.

3.3. THE BELGIAN RED CROSS

Another interview was conducted with the Belgian Red Cross. I had the pleasure to interview Lise Taviet, who is the operational assistant and desk responsible for the programs conducted in the southern part of the world.

3.3.1. ABOUT THE RED CROSS

3.3.1.1. The international network

The International Federation of Red Cross and Red Crescent Societies (IFRC) is the world's largest volunteer-based humanitarian network with headquarters in Geneva, Switzerland. This network is made of 189 National Red Cross and Red Crescent Societies worldwide. It reaches 97 million people annually through long-term services and development programs as well as 85 million people through disaster response and early recovery programs. The IFRC enables healthy and safe communities, reduce vulnerabilities, strengthen resilience and foster a culture of peace around the world with impartiality as to nationality, race, gender, religious beliefs, class and political opinions.

Together with the International Committee of the Red Cross (ICRC[16]) and the International Federation of Red Cross and Red Crescent Societies (International Federation), the movement is composed of National Societies from almost all countries in the world, with tens of millions of members and volunteers. The IFRC is present in the peaceful territories, whereas the ICRC is present in the conflict areas. The IFRC and its member National Societies (the Belgian Red Cross is one of them) work to reduce the impact of disasters and disease through relief and development activities. These Societies embody the work and principles of the International Red Cross and Red Crescent Movement. The organization's work is guided by seven fundamental principles: humanity, impartiality, neutrality, independence, voluntary service, unity and universality.

3.3.1.2. The Belgian Red Cross (BRC)

The Belgian Red Cross is more seen as a development non-governmental organization. Indeed, the most significant activities of the BRC are concentrated in development programs such as

[16] Impartial, neutral and independent organization whose mission is to protect the lives and dignity of victims of armed conflict and other situations of violence to provide them with assistance

resilience, health and nutrition but not emergency programs. However, emergency is not underestimated as the movement has special tools to respond and as it belongs to a worldwide network.

In case of a disaster, the movement can activate *three specific mechanisms* regarding this one:

3.3.1.3. The Emergency Response Units (ERU)

In the context of large-scale disaster, these units refer to emergency teams, made of qualified and trained personnel that are ready to be deployed in the 48 hours following a disaster, in order to provide the affected area with relief and assistance.

The ERU are deployed only at the request of the local National Society affected by the disaster and on validation of the International Federation. The local National Society call for international help when it considers itself not able to manage the disaster alone, meaning that it doesn't have the necessary resources to respond. The IFRC decides which ERU is needed, in contact with the local National Society at the end of a field assessment conducted by a specialized team called FACT[17].
The BRC belongs to the BENELUX ERU with the RKV[18] and the RCLux[19]. Each of them has around ten to fifteen delegates trained for on-the-field missions.
There are several units in the movement; each one specialized in a theme such as logistics, Information Technology, hospital, base camp, basic health care, telecommunication, WASH (Water Sanitation Hygiene) and relief. The BRC belongs to the ERU-relief, meaning it ensures the distribution of commodities.

3.3.1.4. The Disaster Relief Emergency Funds (DREF)

The DREF is an emergency fund of around 600 000€[20] set up by the IFRC in order to respond to medium-scale disasters, barely mentioned in the media, for which specific criteria must be met and for which the National Society cannot respond alone. In this mechanism, the National Societies only send money; there is no need for humanitarian presence. These funds will be allocated to specific countries belonging to the Belgian development cooperation. In 2015, thirteen DREF have been financed regarding floods, famines and migrations.

[17] Field Assessment Coordination Team
[18] Rode Kruis-Vlaanderen, Red Cross of the Flemish region http://www.rodekruis.be/
[19] Red Cross of Luxembourg http://www.croix-rouge.lu/
[20] Yearly amount

3.3.1.5. Equities

Considered as emergency funds, this is referred to as an "envelope" of money available in case of small-scale disaster. The beneficiaries are partner countries[21] that don't benefit from ERU nor DREF.

3.3.2. TRANSPORTATION OF RELIEF ITEMS AND TEAMS

The Global Logistics Service (GLS) is the logistics provider of the International Federation. The GLS holds pre-positioned stock at its logistics units in Kuala Lumpur, Panama, Nairobi and Las Palmas in order to meet the immediate needs of vulnerable people quickly, efficiently and closer to the operations. When the Emergency Response Units arrive in the affected area, the role and geographical area of action of each relief actors has already been defined by the International Federation. Thanks to the FACT and the collaboration with the National Society, the Federation had previously identified and located the needs, the available warehouses and transshipment points and had selected vehicles. Stocks of relief items are pre-positioned according to the identified needs and to the possibilities offered by the local Red Cross.

The material doesn't come from Belgium, everything is coordinated by the IFRC, so emergency relief teams just need to take a flight with their survival kit on them (a tent, food, computers, etc.) such that they are immediately operational. The Federation is responsible for the stock handling. The quantities are also decided by the IFRC on the basis of the initial assessment made by the FACT and on regular assessments.

3.3.3. COMMUNICATION AND COORDINATION BETWEEN THE TEAMS

Each Emergency Response Unit includes a team leader. He goes to the coordination meetings with the Federation and then tells the team what to do. Upon arrival, the staff is briefed by the Federation. The RC works as an independent and autonomous organization, but it doesn't mean that it doesn't coordinate with other organizations. Most interactions are with the ONU.

The Red Cross considers itself as more efficient than the other organizations because it is in contact with the locals, the National Societies.

The Red Cross is always requested by the local National Society, so has to respond to the specific needs of the affected country.

[21] Countries that are developing projects with Belgium

3.4. SOS ATTITUDE

I chose a French NGO, SOS Attitude, as last NGO to interview, since Belgian humanitarian organizations are not so numerous. SOS Attitude it is located in Grenoble, France, I made the interview on the phone. I conversed with Tess Diksa, who is the communication responsible for SOS Attitude as well as one ready-to-go employee.

3.4.1. ABOUT SOS ATTITUDE

SOS Attitude is an independent French humanitarian organization[22], made of volunteers only and specialized in emergency shelters. It provides relief in case of armed conflicts and natural or technological disasters causing population to move, that is to say in the context of massive infrastructure destruction that makes people homeless. Its mission, in case of disasters, is to provide relief as quick as possible to the most vulnerable populations by providing them with a shelter. They provide tents, called Rapid Emergency Dome (RED), able to shelter a whole family. Those tents are designed to withstand the bad weather and extreme temperatures as well as to provide protection against diseases and epidemics through integrated mosquito net. SOS Attitude also installs tents to accommodate medical care, school classes or other community needs. Since 2008, SOS Attitude made 38 interventions in 23 countries, providing shelters to more than 6915 families (press release 2014-2015).

3.4.2. TRANSPORTATION OF RELIEF ITEMS AND TEAMS

The mission of SOS Attitude is to finance and stock upstream tents in order to deploy them when needed. Their main supplier is Alpinter[23], based in Belgium, which is specialized in humanitarian logistics. It designs, transports and stores the tents. When SOS Attitude makes a request, it unblocks the stocks. Alpinter is thus responsible for handling the whole transportation of the tents, using its own containers and aircrafts. This company pre-position stocks in warehouses in Dubai, Belgium, Uganda, Hong Kong, Bulgaria, Germany, Pakistan and China, and then chooses from which warehouse to send the goods depending on the disaster's location. Thanks to its global positioning, it can quickly respond to any emergency. An overview of Alpinter' supply chain is given in appendix 7.

[22] SOS Attitude is an "organization law 1901", meaning that it's under the French law of July, 1st 1901, enabling two or more people to create non-profit organizations. See more on http://association1901.fr/
[23] http://www.alpinter.com/

According to the climatic situation in the country, SOS Attitude can deliver tents upgraded with a "winter kit".

Depending on the location of the crisis, SOS Attitude can operate autonomously. They recently bought a trailer that can handle thirty tents, and thanks to their warehouse in Grenoble, this new capacity allows them to do interventions in Europe, North Africa and up to the Eastern countries.

Team and equipment don't leave together as the entire logistics is handled by Alpinter but leave at approximately the same time. Therefore, teams are usually on the ground in order to collect the tents.

Furthermore, SOS Attitude doesn't go where all humanitarian help arrive. The volunteers try to go where marginal needs are not satisfied by most organizations. When SOS Attitude tents are received at the airport of the affected area, the NGO has to find means to dispatch those tents. For example, in Nepal, the SOS Attitude volunteers made a request to the World Food Program, the logistics cluster, to get a helicopter to transport a hundred of tents. This is the most challenging part and the role of their partners is tremendous at this moment.

It's sometimes difficult to reach some remote villages, that is why SOS Attitude tents can be carried on people's back.

3.4.3. COMMUNICATION AND COORDINATION BETWEEN THE TEAMS

The specificity of SOS Attitude is its rapid response ability to disaster, which makes it often the first arrived among all humanitarian organizations. This ability to intervene so fast is due to its light and autonomous structure, its trained operational team and its international network. Indeed, SOS Attitude is composed of twelve volunteers ready to go. This enables decisions to be made quickly and enable team to arrive in the affected area in 24-48h. They usually pave the way for the imminent arrival of international aid. SOS Attitude partners play an important role in this efficient and rapid intervention teams. Logistics partners, in addition of the major one, Alpinter, are SDV[24] and "Aviation Sans Frontières". Moreover, they have also partners on the field, such as IMO[25], IFRC, MSF in case of natural disasters and UNHCR[26], CICR in case of conflicts. Thanks to another partner, the Rotary network, SOS Attitude can rely on some local actors present in the affected area. For example, after the earthquake that hit

[24] Bollore Africa Logistics group
[25] International Migration Organization
[26] United Nations High Commissioner for Refugees

Afghanistan in october 2015, SOS Attitude worked with the Kaboul Rotary Club that ensured the distribution of the tents on-site, as security conditions weren't allowing SOS Attitude to send a team in this country.

Let's talk about the intervention process now. In the hours following a disaster, a first response team, called "team A" and composed of two volunteers, is sent to the field in order to assess the damage and needs of the affected population. In parallel, a cell prepares the reception of the material. This mission lasts around a week. Then, a second team, called "team B" and also composed of 2 volunteers, arrives in the disaster area in order to ensure the distribution of tents to the more isolated and vulnerable population. This mission lasts ten to fifteen days. These two teams intervene one after another. One day or two is required to ensure the transition. In each team, there is a team leader.

4. ILLUSTRATION OF THE MANAGEMENT OF RESPONSE OPERATIONS DURING THE DISASTER IN ECUADOR (2016)

In this part, I will take the concrete example of the Earthquake that hit the northern coast of Ecuador on April, 16th 2016. This is the deadliest earthquake in America Latina since 2010. I will explain the actions and the process of intervention of the last organization that I interviewed, which is SOS Attitude.

4.1. CONTEXTUALIZATION

The disaster occurred during the night between Saturday, 16th and Sunday, 17th. All the members certified to go on mission with SOS Attitude were connected to the system of alert GDACS[27] and received an alert. The certified members are the ones who are trained and are thus ready to go on the field. A meeting was held the next morning in order to decide whether SOS Attitude will send a team or not to Ecuador and the decision to leave was taken on Sunday morning, the 17th. From the moment where the decision was taken, the association consulted among all the "validated" volunteers who were available to leave. The approach of SOS Attitude is to send a team of two people. I had the chance to interview François Bieber, who was chosen to go to Ecuador with John Diksa[28] as members of the first team. François Bieber is a business manager and belongs to the board of SOS Attitude; he is one of the qualified members of the association.

4.2. INTERVENTION PROCESS

The intervention process will be explained in a chronological way. The action plan of this intervention is available in appendix 8.

4.2.1. TO-DO LIST BEFORE LEAVING

The following steps have to be done for each intervention in order to ensure its success.

[27] GDACS is a cooperation framework between the United Nations, the European Commission and disaster managers worldwide to improve alerts, information exchange and coordination in the first phase after major sudden-onset disasters. (http://www.gdacs.org/)
[28] John Diksa is the president of the association SOS Attitude

Right after the decision to leave was taken; there were three main things to do. The thirst step was to prepare the logistics for the shipping of the equipment (the tents in the case of SOS Attitude). For this earthquake and for the first team, the logistics partner was Aviation Sans Frontières[29].

The second step was to prepare all the contacts you can generate on the field. SOS Attitude always manages to get or create contacts on site through different networks. They use in fact different channels, both professional and private. In Ecuador, they worked with the French embassy and were in contact with the Ecuadorian Ministry of foreign affairs and the Rotary International. The first team activated personal contacts as well; François Bieber had a professional relation, which has a subsidiary in Ecuador and also used his network of friends who are living in Ecuador. When there are disasters like this, the people who are concerned can be easily reached. The NGO activated contacts that will be useful for the action on the field afterwards.

The third thing to do for the team was to prepare their personal stuff and inform their collaborators of their departure.

Another important thing to do before the departure of the team was to look at the information provided by the media of the affected country so as to already understand where the most affected areas are and where the needs are.

4.2.2. THE ASSESSMENT PHASE

SOS Attitude was the first NGO that arrives in Ecuador, thanks to its light team and short decision-making process. Firstly, there was an assessment period. The first team, called team A, left on Monday, 18th in order to carry out global on-site assessments, do the preparation of the mission and define the plan of distribution. This assessment phase is essential. The approach of SOS Attitude is to help the poorest and the most vulnerable people such as families with children and elderly people. Normally, team A only realizes the assessment and then, a second team, called team B, does the distribution of the tents. In Ecuador, the mission of the first team was to assess shelter needs on the ground, organize a logistics platform on site and already distribute a first batch of a hundred tents on arrival.

The members of SOS Attitude conducted a global assessment. The vision of SOS Attitude is to identify the global needs and coordinate the local response. The members have the

[29] This association provides logistic support to dozens of NGOs and international organizations. (http://www.asf-fr.org)

CCCM[30]'s accreditation. Consequently, they know all the structuration of the different clusters; therefore, when they carry out on-site assessments, they evaluate all the components such as health care, food, energy, water, security, etc. They undertake global assessments to give the on-site information to the other NGOs. SOS Attitude only covers the cluster shelter, which belongs to the three fundamental elements to provide in the aftermath of a disaster, which are respectively health care, water and shelter. For the rest of the needs (outside shelter), SOS Attitude doesn't have the size neither the equipment nor the expertise of the big NGOs to provide health care for example. This is the reason why they always collaborate with other NGOs; this is automatic for SOS Attitude.

4.2.3. CONTACTS IN ECUADOR

SOS Attitude benefited from close contacts with the Rotary Club of Quito Colonial that accompanied them, in partnership with the local government, at an administrative and logistics point of view once the team arrived in the disaster area. The local Rotary Club allowed them to identify suitable areas of intervention where the needs were pressing. SOS Attitude was also in contact with Pompiers de l'urgence internationale[31] who helped them deliver the hundred tents and also with Oxfam and the Red Cross. Another contact was their interpreter, found thanks to their network again. This was an Ecuadorian who had planned to go to help on the disaster area so was ready to go with John and François. He was their driver and interpreter as he knew the field very well. SOS Attitude is always in a logic of partnership with other NGO because its action is not dedicated to meet all needs and because it prefers to perform well in its cluster shelter.

From a European point of view, the earthquake in Ecuador was another earthquake among a lot of others. From an Ecuadorian's point of view, it was a rush of national solidarity. A huge quantity of people from Ecuador sent food, water and clothes. This disaster generated an incredible mobilization. It was thus easier to find people ready to help.

[30] The Global CCCM Cluster supports field operations with tools, guidance and capacity building to coordinate and manage displaced populations effectively. (http://www.globalcccmcluster.org/)

[31] This is a French association of solidarity made up of 140 professional and volunteer firefighters, medical and logistical staff who provide voluntarily relief to the international community in case of natural or humanitarian disasters (https://www.pompiers-urgence.org/)

4.2.4. TRANSPORTATION OF THE TENTS

As I explained in the interview of SOS Attitude, their equipment are only tents as this association is specialized in providing emergency shelter.

The logistics is always planned in two parts:

1. The logistics to bring the equipment to the disaster area

The aim is to arrive close to the disaster area and handle the logistics operations in this area. The operations have to be extremely fast. SOS Attitude tries to arrive within the first five to ten days. This time slot is the best period to obtain vehicles, help and to make contacts. As François Bieber said, it's incredible what we can get during these days because there are nobody and needs are huge.

For the earthquake in Ecuador, a first batch of a hundred tents was sent according to the scale of the disaster and especially according to the budget restrictions. This number of tents represented the maximal budget of SOS Attitude. One has to remember that SOS Attitude is only financed by private funds. With a hundred tents, the team was able to be hypermobile and it prevented them to be blocked because of transporting more tents. They received complementary funds so sent a second batch of tents in the wake of the first intervention. With a hundred tents, the team A was able to transport the whole batch directly in one truck, no storage place were needed. They received complementary funds so were able to send a secondary batch of tents. A NGO from Ecuador were responsible for the transportation part of the second batch of tents.

2. The distribution of the equipment

Once the stock is received, there are different approaches to deliver it. SOS Attitude looks for the neediest areas whereas other NGOs, and especially the bigger ones, focus on the areas with the highest number of casualties.

In Ecuador, the first team looked for the areas the most difficult to reach. The area of the earthquake was a zone where traditional housing was made of wood and bamboo walls that resist to earthquakes very well. The poorest part of the population lives in the remote area, in these traditional houses, hence the punctual needs.

The tents were received at Quito's airport. John Diksa and François Bieber were in Pedernales at that moment and the road was closed so the Ecuadorian Minister of Interior, who was on

site, put a helicopter at their disposal in order to reach the city on the other side and be able to deliver their tents. The Minister made this happen because SOS Attitude had resources to be transported in order to provide assistance to affected people.

For the distribution of the tent, what SOS Attitude did in the area of Pedernales was to convince the local authorities of a scheme more oriented on the shelter. The NGO wanted to allow the families to stay close to their houses. The Ecuadorean authorities wanted to set up camps but SOS Attitude knows, from experience, that it is a bad idea that will turn into problems because the needs in logistics are huge for those camps. SOS Attitude thinks that it is better to let the inhabitants stay close to their house because they want to rebuild their house and they often have animals or vegetables' plantations close to their home so there are associated livelihoods. SOS Attitude listens to the voice of the population.

4.2.5. ENCOUNTERED OBSTACLES AND ACTIONS TO ANTICIPATE THEM

To overcome the many obstacles that humanitarian organizations face, the mobilization of resources is the key. Since the associations arrive in the affected area with resources, they find solutions. When they arrive on site without resources, they are considered as parasites because they consume the resources on site, while there is already a shortage of resources.

In Ecuador, there were some delays for the logistics operations so SOS Attitude sent a team B to do the setting up of the tents. There was a three-day delay in the transportation of the tents. The tents were sent from Paris to Amsterdam and then an airline company was responsible to prepare the freight. The delay happened at this step as the airline company waited for the plane to be filled up and other late events. At the arrival of the tents in Ecuador, the customs were cleared within one hour thanks to the contact previously created with the French Embassy and the Ecuadorian Minister of Interior. This shows that the preliminary work is crucial in order to solve the logistics' problem. SOS Attitude had prepared different plans, different actions so as to facilitate the customs clearance process, in order to be sure that the tents will be rapidly cleared.

On April, 25th, team B arrived composed of two other members of SOS Attitude. They took over John and François and were taken in charge, again, by the local rotary club and went to Pedernales, the epicenter zone in the northern part of the country. They took seven hours to drive through the 290 km of mountain roads from Quito, because of landslides being cleared.

The tents arrived in Pedernales and the custom clearance was fast thanks to the French embassy and the Rotary Quito Colonial.

4.3. CONCLUSION - LESSONS LEARNED FROM THIS INTERVENTION IN ECUADOR

The following conclusions are the ones given by François Bieber.

It is of paramount importance to anticipate the problems, get alternatives scenarios, alternative options such as planning different paths for the vehicles. The team handles two or three different paths at the same time so as to optimize its ability to achieve its goals.

The logistics operations have to be reactive, especially in the first five days, since all the delays are due to the logistics problems. SOS Attitude always tries to reach the disaster area within five days, because at this time the field is relatively free. Between five to ten days it begins to form a bottleneck and after ten days it is a complete traffic jam. Everything is easier to coordinate once on the field.

Actions on the field are only the tip of the iceberg; there is a lot of work which is done beforehand. The success and speed of the operations are the result of a preparatory work divided into fundraising, in order to get enough money and get the stock of tents, and the training of the teams to be responsive on the field.

5. IDENTIFICATION OF THE GAPS BETWEEN LITERATURE AND REALITY

After having analyzed the literature and having understood the functioning of four humanitarian organizations, I am now able to identify and present the existing gaps between literature and reality.

5.1. OVERVIEW OF THE MAIN DIFFERENCES IDENTIFIED BETWEEN THE HUMANITARIAN LOGISTICS PROBLEM ADDRESSED IN THE LITERATURE AND THE ONE EXPLAINED BY HUMANITARIAN ORGANIZATIONS

The interview of humanitarian organizations' members made me realized that in reality the management of response operations in case of natural disaster is different and especially less structured and planed than it is approached in the literature.

5.1.1. THE TWO-ECHELON LOGISTICS PROBLEM

In reality, the logistics problem that arises in emergency situations should be clearly divided into two phases of decision-making, respectively the location problem of pre-positioned stocks (from a central warehouse to a distribution center) and the distribution problem of relief items as well as the scheduling and routing problem of the vehicles (from the distribution center to the people in the relief area). The reality may correspond to the literature for the facility location models as it results in a long-term decision process. Indeed, the location of the warehouses to pre-position stock can be determined through the use of mathematical models and different software to find the optimal locations. Most of humanitarian organizations already have identified these strategic locations. Yet, the reality is really different when it comes to the distribution of relief items in the last-mile phase. For the distribution of items in the affected areas, no prepared plans are used and, according to me, cannot be used since each disaster has its own characteristics: type, scale, location, extent of the damage. Moreover, since each humanitarian organization has its own specificities, no common models can be applied.

5.1.2. THE EXISTING STRUCTURES AND MECHANISMS

5.1.2.1. The specificities of each humanitarian organization

Each humanitarian organization has its own mechanisms to respond to disasters and belongs to different structures from where the decisions and orders come from. For example, B-FAST follow specific guidelines and has to provide minimum relief assistance, which is pre-determined in the guidelines. The Belgian Red Cross also follows orders from a superior entity, which is the IFRC. Another example to show the specificity of each humanitarian organization is that, for the case of the Red Cross, some pre-established mechanisms can be activated for the coordination of the teams and the preparation of the equipment (see the IFRC's example in which three mechanisms can be used according to the scale of the disaster)[32].

Another thing is that humanitarian organisms do not use mathematical models nor software to take decisions because of the time-dependent success of response operations; therefore, fast decisions are made based on the real and current conditions and needs on the field so as to be responsive in the shortest possible time. Each association has its own way to operate and its own interests. For example, MSF will provide assistance in areas where most of the needs are regrouped, whereas SOS Attitude will provide relief in the remote areas where accessibility is limited and especially where no international assistance is provided. It is essential to understand that humanitarian organizations can only take decisions once on the ground, after having gathered information through the assessment periods. The results of this assessment period are the underlying foundation for the whole response operations.

5.1.2.2. The cluster classification

The cluster classification is a solution for the coordination problems in humanitarian logistics. This is a realistic aspect that is not enough mentioned in the literature.

At the global level, humanitarian response is organized in clusters, with the World Food Programme[33] being the cluster for logistics, due to its expertise. "The cluster approach was adopted in 2005 to address consistent gaps and weaknesses and to improve international responses to humanitarian crisis. It is a mean to strengthen response capacity, coordination

[32] See page 34

[33] The World Food Programme is the world's largest humanitarian agency fighting hunger worldwide. WFP is part of the United Nations system and is voluntarily funded

and accountability by enhancing partnerships in key sectors including WASH, Shelter, Protection, Nutrition, Health, Food, Security, Emergency, Telecommunications, Education, Early Recovery, Camp Coordination and Camp Management, and Logistics" (Logistics cluster, 2016). The WFP manage one network called the UNHRD network[34]. Recognized as a leader in pre-positioning, storage and handling of emergency supplies and support equipment, the network manages strategic emergency relief stocks. These stocks include medical kits, shelter items, ready-to-use food, IT equipment and operational support assets. It is designed to strengthen and enhance organizational response efforts at the onset of an emergency. The network is made up of six strategic locations, located in Ghana, United Arab Emirates, Malaysia, Panama, Italy and Spain. Hubs are strategically located near disaster-prone areas, within airport complexes, close to ports and main roads. Because of this pro-active positioning, when emergencies strike, relief items can be delivered to affected areas worldwide within 24 to 48 hours. This shows the importance of the clusters, especially the WFP. SOS Attitude has already worked with them in Nepal; the WFP provided them with a helicopter in order to transport a hundred of tents.

There is also a logistics cluster[35] which is a group of organizations working together to improve the logistics response to emergencies. On the logistics cluster's website, humanitarian associations can find valuable information such as maps with closed, restricted or alternative routes and access constraints, coordination meeting dates and places and temporary storage places. An updated map of Ecuador displaying this information is available in appendix 9.

5.2. RECOMMENDATIONS

This part refers to the characteristics and challenges that, according to me, are not enough taken into account in the management of response operations in case of natural disasters but that are relevant and that should be considered all the time.

[34] It is a preparedness tool that supports the strategic stockpiling efforts of the wider humanitarian community

[35] www.logcluster.org

- Consider the transportation and coordination aspects together in the determination of the logistics problem

In the literature review part, I divided my analysis into two distinct sections, the transportation of relief items and the communication and coordination between the humanitarian teams. Nonetheless, through the interviews I have conducted, I noted that the two concepts of transportation and coordination are dependent and, consequently, should be considered jointly. The transportation problem has to be taken into account at the same time as the collaboration problem. Indeed, in order to find pre-positioned storage places, find vehicles, identify distribution centers and especially identify where the needs are, each organization has to communicate and coordinate its activities with the local organizations as well as with the other organizations coming as international help.

- Consider all criteria together in the determination of the logistics problem

Another important step that I would like to suggest is that all criteria such as uncertainty, pre-positioning, multi-modal transportation, equity, safety, should be considered together when planning response operations. Indeed, in each models addressing humanitarian logistics issues, some constraints are approached while other are not mentioned at all and this is the same regarding the objectives. Yet, in real disaster situations, various objectives and constraints usually are present and should be considered together in order to provide fast relief to a maximum number of affected people.

- Consider equity all the time in the determination of the distribution schedules

A few mathematical models take into account equity and fairness in the distribution of supplies, while I would consider it all the time. This is the role of all humanitarian organizations in the end and as they present themselves. I take MSF as an example, their aim is to offer assistance to people “based on need, irrespective of race, religion, gender or political affiliation” (MSF, 2016).

- Provide relief assistance only if the local country requested it

A specific characteristic of humanitarian logistics and which is not addressed in the literature is the arrival of a lot of humanitarian organizations at the same airport, or designated place to land, at the same period of time. This massive arrival can create many problems and requires an effective coordination. The coordination of all humanitarian actors is time consuming but

provides great savings. It is really important to understand that affected countries need help only when they request it, only when their own resources are not enough to provide relief and assistance to their affected population. If humanitarian organizations arrive in the disaster area without having previously made a request, the on-site teams will have to deal with oversupply and worse, this will create bottlenecks hampering transportation. The use of aid resources should be defined and should be consistent with the assistance to be provided; otherwise, this good initiative will result in the end in a huge waste of time, money and efforts.

- Understand the importance of multiple stakeholders that act with different objectives

As I have understood during my interview, each humanitarian organization has its own characteristics, interests and way of thinking but they can be complementary as well. Sometimes they can help other organizations to respond faster through information and equipment sharing. Thanks to their diversity, it is important to collaborate with other humanitarian organizations. They all bring past experiences and lessons learned.

- Regroup all the logistics efforts in the last-mile distribution phase

The last-mile distribution of supplies accounts for a lot of challenges because it is closer to the disaster area so it is subject to more unexpected difficulties such as destroyed roads and infrastructures and limited availability of vehicles that will affect the supply chain responsiveness. According to me, this is the most relevant part, compared to the transportation from central warehouses to distribution centers, with as unique goal to reach the demanders with the accurate relief supplies. The maximization of the survival rate is mainly impacted by the success of this last-mile distribution. This is one challenge that was addressed in the 2009 humanitarian logistics conference[36].

- Collaborate with local actors[37]

Another fact I noticed when going through the literature is that the importance of local actors in not highlighted all the time, while they are for me the most essential resource. There are many reasons that demonstrate their importance. Local actors are obviously always the first to

[36] HumLog'09 brought together humanitarian practitioners and researchers from around the world.. This event focused on topics relevant to planning, preparing, and responding to disasters, long term development, and health efforts.

[37] Local actors can refer to local humanitarian organizations, national authorities or International NGOs such as the National Red Cross and Red Crescent Societies, which I mentioned in the interview of the Belgian Red Cross, or simply local inhabitants

respond, hence the ones that save the most lives and address quickly the needs of affected people, as the first 72 hours are determinant for the rescue operations. Thanks to their proximity and their understanding of the local context, they also bring their own perspectives. But that is not their only strengths. Indeed, local actors often have access to population groups that live in remote areas that international actors struggle to reach. Moreover, they are much better connected to the population in terms of language and culture. According to the world disasters report 2015 of the IFRC, "there is a growing feeling that strengthening the role of local actors may finally help to redress some of the perennial challenges of humanitarian aid such as shrinking access, fragmentation and incoherency in operations, and the gaps between response, recovery and development" (IFRC, 2016).

Speaking locally, another point that is often mentioned in literature, but on which I would like to add comments, is the importance of local pre-positioning. Often, supplies will be, whenever possible, stored in local warehouses. The regionalized structures ensure the sourcing and delivery of relief items and services so as to assist the demanders in the shortest possible time thanks to a close proximity to operations. Regional pre-positioning clearly provides a better, cheaper and faster response. What is important to keep in mind, and what I found was missing in most of the articles about humanitarian logistics, is that the most valuable resources are the ones already on the ground.

This emphasis on the local actors is the first lesson that has been learned after the Nepal earthquake, and that is stated in a report from the ALNAP[38]. In this report, and this applies to all disaster response operations, international responders are strongly encouraged to work hand-in-hand with national and local actors and through national structures and networks.

Understanding the regional political, economic and socioeconomic conditions is crucial for the success of any humanitarian operations. This would be achieved, once again, through a better communication between international and local responders or through a local presence of the international association.

- Proceed to regular assessments

Most of scientific authors refer to the need to conduct preliminary assessments to get an overview of the needs and the quality of the on-site infrastructures but only a few mentions the utility of conducting regular assessments. What I remark, and what is common to every organizations, is that a team is previously sent to assess the needs, and then another team,

[38] See page 7

bigger, comes and responds to the assessed needs. In reality, conducting regular assessments is more coherent with the field, because at first, there is a huge demand that progressively evolves. The demand is a parameter so difficult to estimate that doing regular assessments would be useful and would avoid losing time and losing equipment by doing empty trips for example. One lesson learned (the 10th) after the Nepal earthquake on the ALNAP report refers to the fact that assessment is the foundation for appropriate response. Another lesson (the 16th) points out that health and WASH's needs quickly change and require continuous assessment and adaptive responses.

- Base the response operations on the results of the assessments

As I already said, conducting assessments is essential in the proper functioning of response operations. Their importance is, according to me, not enough addressed in the literature. I think that logisticians should incorporate the assessments' conclusion in the determining of their mathematical models. Yet, even if they take the results of the assessment periods into consideration in their distribution model for example, too much time is lost doing this rather than already implement actions on the ground.

- Provide alternative scenarios in the scheduling, routing and distribution problems

To reflect the reality, only one final solution, one final path is not coherent as road conditions evolve regularly. Humanitarian logisticians should provide alternative solutions; they should take into account several paths at a time, in order to increase their responsiveness.

6. CONCLUSION

The aim of this research was to identify the factors that must be taken into account in order to manage efficiently the logistics operations in case of natural disasters, through the detection of the real features and specificities of humanitarian supply chains. The identification of the real characteristics of disaster management was made on the basis of mathematical models, scientific research and on interviews of humanitarian organizations.

The main finding is that, transportation problems are well addressed in the literature but don't take into account the specificities and interests of each humanitarian organization nor the importance of the coordination among the different organizations. Another finding of this research lies in the fact that the logistics problem arising in humanitarian relief chain is a two-echelon problem related to different decision-making processes. The first level of decision is the location of pre-positioning facilities; it is compatible with the literature as it implies the use of mathematical models and any software since it requires long-term decision-making processes. While the second level concerns the distribution of relief items and the scheduling and routing of the vehicles, which implies fast decision-making processes through preliminary assessments and real-time information and which cannot be planned in advance as it depends too much on the on-site situation.

The management of emergency supply chains is complex. Fist, some trade-offs have to be done. Indeed, there exist solutions to improve the responsiveness of the emergency supply chain but they are linked to important financial costs. For example, pre-positioning inventory near disaster-affected areas costs a lot but provides a huge advantage in term of time saving and at the same time reduces the cost of transportation from central warehouses to local distribution centers. Then, the complexity also arises when regarding the number of stakeholders, the reliance on them and the uncertain and unpredictable environment that characterize the relief system. For this reason, I consider that planning response operations before being on the disaster area is not relevant. There are no common response operations that can be applied to every disaster. Indeed, the response operations are driven by the characteristics of the disaster itself.

Some decisions can be taken and some actions can be implemented before the happening of the disaster such as finding logistics partners for the transportation of emergency stocks but once on the field, once the disaster has hit a country, all decisions will depend on the on-site

situation in the affected area. This is the reason why I suggest not to use mathematical models neither software to schedule the relief operations on the ground but rather to conduct regular assessments and update information continuously so as to be as most responsive as possible. In this state of mind, the importance of coordinating the relief operations with local actors in the same time as establishing distribution and scheduling plans is the key. Unlike commercial supply chains in which logistical operations are well-defined in advance, most logistics decisions in emergency context are taken within short time frames.

As I previously mentioned, the literature about disaster management is abundant today. However, few studies have so far attempted to make a link between theory and practice. Indeed, many scientific authors present mathematical models without taking into account the impractical aspect of their model on the field. Through the interviews of humanitarian organizations, I was able to make a connection between theory and reality, to push forward some prevailing characteristics and to identify the logistics part for which planning can be useful and others for which planning is useless.

This research, however, has its own limitations. Indeed, this analysis is based on only four Belgian and French humanitarian organizations. More interviews and especially interviews of, for example, Japanese or Nepalese humanitarian organization would have improved the realistic aspects of the research as these are country that often face natural disasters hence their better preparation, compared to Belgium. This could be an interesting avenue for future research.

TABLE OF APPENDICES

Appendix 1: Total number of reported disasters between 2005 and 2014

TABLE 5 Total number of reported disasters, by type of phenomenon and year (2005–2014)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total[1]
Droughts[2]	28	20	13	21	31	27	24	31	13	15	223
Dry mass movements[3]	n.d.r.	1	n.d.r.	3	1	n.d.r.	n.d.r.	1	1	n.d.r.	7
Earthquakes[4]	25	24	21	23	22	25	30	29	28	26	253
Extreme temperatures	29	32	25	11	26	34	19	52	17	17	262
Floods[5]	193	232	219	175	160	190	160	141	149	132	1,751
Insect infestations	n.d.r.	1	n.d.r.	n.d.r.	1	1	1	n.d.r.	n.d.r.	n.d.r.	4
Landslides	12	20	10	12	28	32	17	13	11	15	170
Storms	132	77	105	111	87	95	86	90	106	99	988
Volcanic activities	8	12	6	7	3	6	6	1	4	8	61
Wildfires	13	10	18	5	9	7	8	7	10	3	90
Subtotal climato-, hydro- and meteorological disasters	*407*	*392*	*390*	*335*	*342*	*386*	*315*	*334*	*306*	*281*	*3,488*
Subtotal geophysical disasters	*33*	*37*	*27*	*33*	*26*	*31*	*36*	*31*	*33*	*34*	*321*
Total natural disasters	**440**	**429**	**417**	**368**	**368**	**417**	**351**	**365**	**339**	**315**	**3,809**
Industrial accidents	76	64	53	38	43	36	32	25	25	27	419
Miscellaneous accidents	66	33	43	30	27	47	34	26	31	32	369
Transport accidents	229	205	181	192	160	152	178	137	136	144	1,714
Total technological disasters	**371**	**302**	**277**	**260**	**230**	**235**	**244**	**188**	**192**	**203**	**2,502**
Total	**811**	**731**	**694**	**628**	**598**	**652**	**595**	**553**	**531**	**518**	**6,311**

Source: EM-DAT, CRED, University of Louvain, Belgium

Source: http://ifrc-media.org/interactive/world-disasters-report-2015/

Appendix 2: Interview report – Médecins Sans Frontières- February 2016

The structure of Medecins Sans Frontières

MSF belongs to a global network made up of five operational sections: MSF Belgium, France, Spain, Holland and Switzerland. The sections have a big decision-making and managerial point of view. There is a competition between the different sections of MSF; they all try to arrive the first on the disaster area. Despite that, they try to coordinate their operations in order to avoid doing the same things or to be present in the same geographical location. Apart from the operational sections, there is MSF International that supervises everything. All other MSF' sections are attached to an operational section. They do fundraising, recruiting, communication or lobbying in order to collect money. For example MSF Belgium hires members from MSF Italy to go on missions with the Belgian section. Moreover, each cell (e.g. coordination, HR, financial, logistics, medical) is responsible for a portfolio of countries.

Staff

There are two kinds of members at MSF: the expats that go on the field and the locals that stay in the country. There is, thus, a high employee turnover. In case of an emergency situation, People with experiences are the one who leave so it is often the same people. There is an emergency center with people ready to leave in case of emergency. Some people outside of MSF also have an arrangement with their employers and are ready to leave in case of emergency. Otherwise they move employee that were active elsewhere but that can leave their current actions for that new emergency.

"Normal" situations

In a regular context without emergencies, MSF has around twenty permanent missions worldwide. They are called "projets par choix" and refer to activities in which MSF wants to develop itself. In those situations, time is not crucial; there is a preparation time and a time relatively important to collect information. The duration of a normal situation is around six months.

Emergency situations

They are called "projets par défaut" and refer to emergency situations. The duration of an emergency situation is around one month.

- Before leaving

Before leaving to the disaster-affected country, the center in Brussels has to find planes, people and money; indeed, they need cash to be reactive. The human resources team looks for people, another team prepares the equipment and an additional one contact other MSF sections to already coordinate their activities. At this step, information collection is really important. The most important thing to do first, is to find a local team as fast as possible. Does MSF know someone there? Or if they work with Filipinos for ex, do they know someone that can help MSF? ➔ Networking is essential at MSF. Then, MSF has to find a warehouse to store everything, find transportation modes on sites and get staff to unload the charter.

- Inventory management

Regarding the pre-positioning of the equipment, MSF has storage centers in some countries. In Dubai, there is the most important one in term of volumes. It concerns the non-perishable stocks such as tents and blankets. MSF has "risk-kits" that are pre-packaged in order to smooth the ordering process. For surgery, the kit can be taken in the place with a team of four persons: a surgeon, an anesthesiologist, a computer scientist and an administrator. In some specific cases, the teams need to source locally; for example in India, medicine should be bought locally. At the end of a mission, MSF there is often oversupply that will be left for other humanitarian organizations in the disaster area or not according to MSF teams' decision.

- Transportation modes

Concerning the transportation modes, it depends on the geographic location of the country and accessibility of the disaster area. For example, MSF sent the equipment by boat to the Philippines as everything was covered by water. MSF prefers to work with boats as it is cheaper but it will depend on the impact of the disaster and time to provide the relief. The teams often arrive before the material because time is spent to clear the customs of the charter. Once on the disaster area, MSF must find trucks. The prices of the transportation modes (and of most of the things) often go up because the demand increases and local inhabitants want to get their part of the pie. For example, the prices of wood increases as humanitarian organizations construct shelter with wood. As all humanitarian organizations arrive in the same time, there are sometimes problems of congestion at the airports. For example in Nepal, MSF's plane had to land off in India. This leads to delays in the arrival of equipment.

- Coordination

Regarding the coordination of the operations, the US army takes the role of the coordinator when everything is destroyed. The clusters (USA) try to be responsible for the coordination; they publish lists with phone numbers and organize big meetings. Yet, MSF wants to avoid losing time to go to those meetings even if it is interesting to get information and contacts. Reminder: MSF is independent, neutral. At MSF, there is a team leader, who is responsible for onsite activities and who is supervised by someone in Brussels (emergency desk). Things are done in consultation. However, this team leader can take some decisions alone; he is usually a person that knows well the country.

- Specificity of MSF - Independence

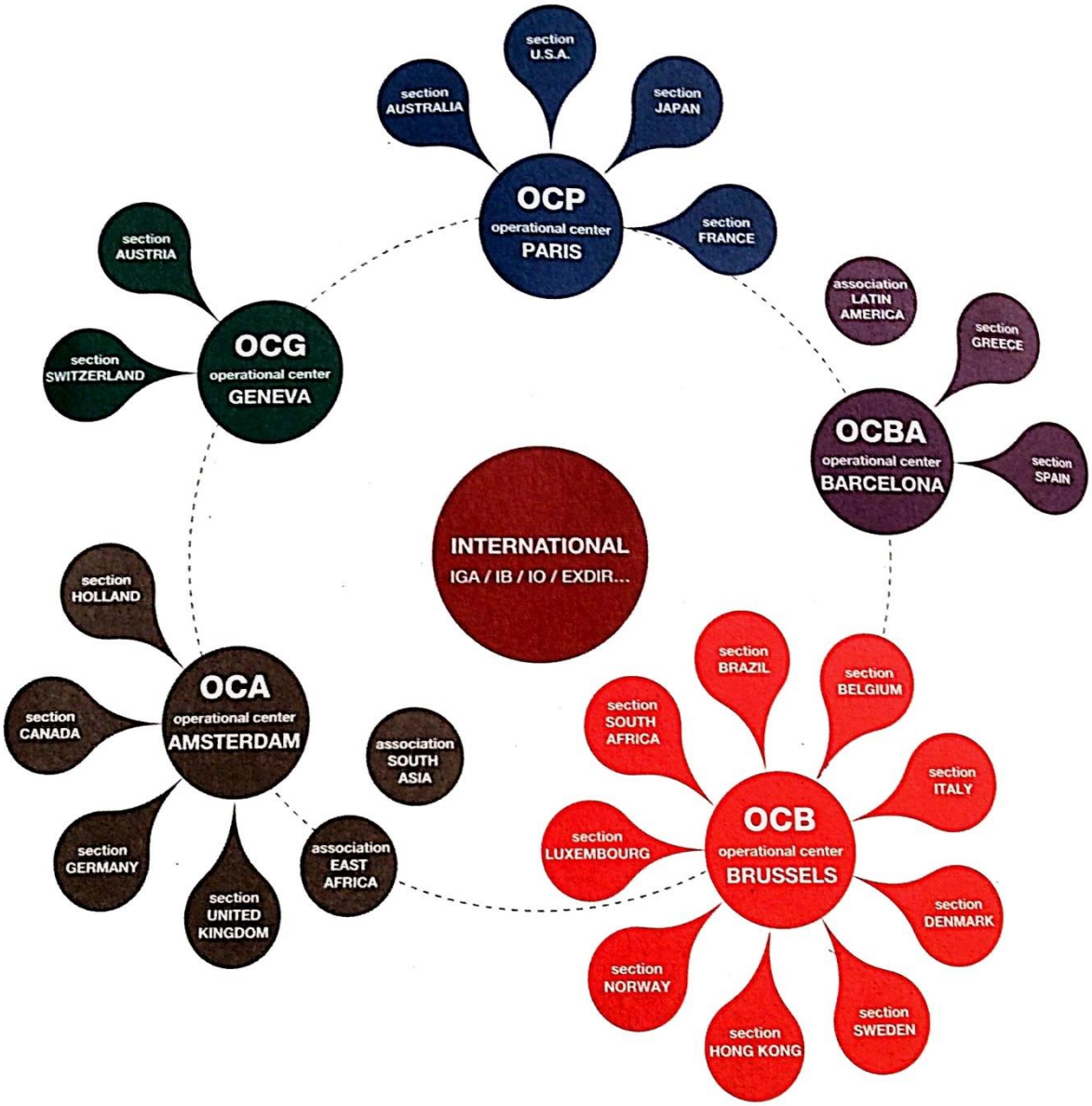
MSF is independent on emergency, the organization sends what is considered as important; it depends on the disaster but typically experts know what to send. MSF also decides where to operate. MSF works in the capitals because the stock of relief items is located there and because this is often the place where the teams are developing some projects. For the distribution of relief items and medical care, MSF will do strategic decisions often based on the demographics. MSF usually goes in the capitals or in the big cities where there are more people to help. It is independent even in its communication systems. MSF doesn't want to rely on local phones operators so they use radio and satellites.

➔ The biggest problem regarding the emergency situations isn't the money, since MSF can leave directly thanks to its continuous fundraisings, but rather the human resources.

<u>Previous and current interventions of MSF - Examples</u>

MSF provided help in Afghanistan. Because of coalition issues and public funds issues, they couldn't bring the money that was coming from the State. Hopefully, MSF also have private funds so this hasn't stop them to act. Recently, MSF took actions to support the migrant crisis by having boats in the Mediterranean Sea. In Nepal, MSF sent a team and a charter within 24 hours. This represented a punctual mission of three months. MSF didn't have any contacts nor pre-positioned stocks there. Haiti represent a chronic emergency for MSF because there are high needs outside of any emergency so MSF teams stayed longer after the disaster response operations, they are still in Haiti for an indefinite duration as there is a leak of doctors. For disasters in Haiti, South Soudan and Congo, MSF was already on-site when the disasters happened. Consequently, they had emergency stocks and staff there. At the time of my interview, emergencies were still Syria, Ebola and the migrants.

Appendix 3: MSF international network



Source: Who's who 2015 – MSF – Operation Center Brussels

Appendix 4: Interview report – B-FAST – March 2016

The structure of B-FAST

B-FAST is a Belgian governmental organization, which works mainly abroad in emergency situations. It did one intervention in Europe; it was the building's explosion that happened in Liège. The civil protection belongs to the interior ministry and to other ministries. In fact, B-FAST depends on several modules, which is unique in the world. It works jointly with the United Nation Disaster Assessment Coordination (UNDAC). The United Nations and Europe are the biggest actors in humanitarian relief; they are also the ones with the most important amount of money and the highest number of relief units.

Staff

At the unit located in Crisnée, there is a colonel and staff ready to leave at any time. Relief operations are physically constraining; that is why the forms work by six-hour shifts: six-hour sleep followed by six-hour work. However, this is not easy to respect. The staff of each operation is called a unit. The composition of this unit is defined in the guidelines. There are also drivers' functions in the team so that the rest of the team can have a rest during the journey and are operational once there (for the case in which they use trucks). USAR and other people that belong to B-FAST have to go at least once a year to attend an international training. They learn how to settle tents, use medical equipment, rescue victims, etc.

Emergency situations

The maximum duration of one B-FAST intervention is 14 days, because of the physical constraints in one hand, and because the success or failure of a rescue operation is determined within the first 72 hours in the other hand. It can last longer than 14 days if it is a specific mission, but for the teams, it is not physically possible to work more than 14 days (mud, dust, work in the rubble, etc).

- Before leaving – procedure

When a disaster strikes, B-FAST is alerted by Geneva (ONU). A button is pushed and information is dispatched everywhere. The B-FAST secretary, which is handled by the foreign affair ministry is alerted through a call. The secretary then warns the planning committee, who decides if B-FAST is able to do the mission or not regarding the available resources. If they do, they create the coordination committee and send a text message to warn

volunteers, referred to as “units”, that they may be called (possible deployment). The council of ministers will finally give the green light by giving a call to the teams saying they have six hours to reach the central warehouse of B-FAST located in Peutie, Belgium (confirmation of the deployment). Peutie is situated close to the military airport of Melsbroeck. During the six hours, a team prepares the loading while another do to do medical checkup, documentation checkup and airport check-in. BFAST can leave instantaneously thanks to the state’s budget allocated for B-FAST.

- Inventory management

The equipment is stored in Peutie according to the INSARAG guidelines. There are kits for food, water and emergency temporary shelter, which include everything to accommodate a family. Water and food are left in the affected area if there is surplus. Teams take back the laboratory equipment as it is expensive but they leave tents as it is quite cheap. The decision depends on the council of ministers. B-FAST must justify the losses, the left-behind of the equipment.

- Transportation modes

Teams and equipment always travel together. B-FAST uses the army’s and civil protection’s trucks as well as the army’s airplanes, in a less measure. The transportation mode to go to the disaster-affected area depends on the availability of the army planes. For example, they went to Haiti with an A320 otherwise they use a C130 (they can take their vehicles in the C130 airplane). Having a BFAST vehicle is unusual. For example, in Indonesia, B-FAST had two jeeps given by the Belgian government and it left the jeeps in Indonesia as cost to transport them to Belgium was too expensive.

- Coordination

Once the team arrives in the affected area it has to register at the LEMA. The OSOCC will tell the team where they can be accommodated. In the disaster area, B-FAST members have to respect the traditions and the culture of the country. The relations with the local population are very important. In addition to good contacts, it can also enable the units to get information. For B-FAST units, meetings are mandatory, but it doesn’t represent a loss of time as they are well organized. This is the role of the generic functions, in contrast with the operational function. The team leader has to collect information but in most cases, he receives everything from the OSOCC. Team leader is also responsible for finding local drivers. For the planning

of the operations, the rules of the country have to be taken into account. For example, in some countries, organizations were not allowed to go out between the sunrise and the sunset.

- Specificity of B-FAST – The INSARAG Guidelines

B-FAST follows the INSARAG guidelines that are of three types: light, medium and heavy. Without this qualification, BFAST cannot intervene in disaster affected area with the ONU. B-FAST is of type medium, therefore it should have minimum one doctor and minimum two nurses in the team USAR. They have to be able to do specific things such as amputate.

According to the guidelines, B-FAST is able to set up a RDC and to create an OSOCC. The RDC is the reception department center. The first country that arrives in the affected area has to open a RDC. The first team has to write its team composition as well as its needs and arrangements are to be taken with the local authorities. For example, the affected country will put vehicles at B-FAST's disposition. The OSOCC is the on sight office of coordination center; it is a command cell set up by the UN or by one onsite team. Another component of the INSARAG-Guidelines are the LEMA: the local emergency management agency; here in Belgium, it's the crisis center in Brussels.

➔ B-FAST cannot take any decisions by itself regarding any interventions. Everything is handled by OSOCC and LEMA. Sometimes, B-FAST can be in the reinforcement of other NGOs.

- Interventions – others mechanisms

The ERCC in Brussels is the European Research Crisis Center. In the case of Algeria, a request to all country members was sent to see which organization can send what and who was ready to leave for Algeria. The ERCC will respond to Algeria specifying the available items and asking the one needed. Then, Algeria will choose according to its affinities with the countries, or according to the language. This example shows that demanding countries choose with whom they want to work.

Another example is the one in which Guinee asked Europe for health aid. B-FAST sent experts to assess the needs and was asked to form people.

Appendix 5: interview report – Belgian Red Cross – April 2016

The structure of the Red Cross Movement

The Belgian Red Cross belongs to a worldwide movement composed of around 190 National Societies. It is a specific movement. Its actions are governed by seven specific principles. The International Federation is in charge of the whole movement, its headquarters are located in Geneva. The IFRC is active is peaceful territories whereas the CICR is active in armed conflict area. In Belgium, there is a Dutch part of the Belgian Red Cross in Malignes (RKV); its aim is to be in different countries to avoid competition. The most important activity at Brussels' department is the development. The Belgian Red Cross (BRC) is more seen as a development non-governmental organization. Indeed, the most significant activities of the BRC are concentrated in development programs such as resilience, health, nutrition but not emergency programs. However, emergency is not underestimated as the movement has special tools to respond and as it belongs to a worldwide network. The BRC is mainly based in Africa (Sahel and lakes) but also in MENA (Palestine and Lebanon) where they provide food kits, survival kits and develop "emergency" projects. The BRC works with Africa for strategic reasons such as the language and historical reasons. The objective of the BRC is to support programs run by South National Societies facing natural disasters. It supports actions aimed at preventing further damage and restore short-term livelihood and take part in programs aiming at supporting the medium and long-term recovery.

The staff

The BRC belongs to ERU BENELUX. There are three parts, each one has around 10 to 15 delegated formed to go on the field within 48 hours and recycled every year. Those people are hired among the permanent staff of BRC on the basis of criteria such as being fluent in English, having experience in crisis management abroad (multicultural management). To keep the list of people updated, an email is sent every month to know who, among the employees, is available for leaving in the two following months. Teams leave with their own "survival" equipment but not with the working equipment. They take their computer and stuff to sleep and eat in order to be operational directly. The Belgian team doesn't take material, they leave with regular flights; this is not a state mission, they pay their plane tickets themselves.

Emergency situations

The duration of the project depends on the situation in the country. For example, in Haiti, they made shifts: during four weeks a team was sent and after another one, because it is physically very difficult. If the RC receives too much money from donors, it stays in the affected country for the reconstruction phase or use this money for another disaster. However, the RC has to carefully respect the donors wish. The donor don't like when their money goes for reconstruction projects, they prefer knowing that their money helped to save people's lives. There are monthly donations, not specific to a disaster.

A specific tool of the movement is the Emergency Response Units for large-scale disasters. Its aim is to deploy a team within 48 hours. The ERU will be deployed only according to the request of the local national society, when it feels overwhelmed and on validation of the federation. The aim is thus to help the local RC to face the disaster. There are several units in the movement, each one being specialized in one theme: logistics, IT, hospitals, base camps, health care, telecommunication, WASH and relief. At the French speaking BRC, that's a relief ERU unit, which assumes the distribution of first necessity goods. The IFRC decides which ERU is needed, in contact with the local National Society at the end of a field assessment conducted by a specialized team called FACT (Field Assessment Coordination Team). The FACT defines the needs (or Host National Society can do it also). The BRC doesn't have a staff formed for FACT. The Federation fixes everything and ERU are deployed if needed.
Each ERU wants to send its delegates; hence, there is a kind of competition, because the staff is interested to leave and because there are not so many disasters a year so everybody is motivated to leave). People with the best profile are selected (experience, knowledge of the country). The Staff of the RC is prioritized compared to people that work outside RC and who have arrangement with their boss.

- Before leaving

The Belgian Red Cross receives a text message from the IFRC with three stages: ERU-I: information: don't do anything, ERU-A: let know to Geneva if available for deployment ERU-D: deployment order. In practice, people from RC learn about the disaster like everybody through the media. It is faster than those sms systems or disaster management information systems). Then, the Federation will call saying it needs that particular ERU, so that the BRC can decide who leaves.

- Inventory management

The federation coordinates all the logistics with the Host National Societies (NHS). Thanks to this collaboration, the equipment can be either already on site or can arrive after. The stock is prepositioned according to the needs and possibilities. There is not a single rule, it depends on the context. The quantity of relief items depends on the different assessments. The necessary material is managed by the IFRC based on IFRC assessments; the needs are listed.

- Coordination

When teams arrive on site, their role is defined, as well as their operating zone. The aim of the intervention and their roles are already defined before arriving on the disaster area, based on the results of the FACT mission and the identified needs. It's the IFRC that assigns operations, on the basis of FACT and in coordination with HNS. Each ERU deployed has a team leader, who goes to the coordination meetings with the federation and then, tells the team what to do. In general, the RC work in an independent way, but this doesn't mean that they don't coordinate. IFRC has interactions with other aid agencies (UN agencies, NGOs, etc.). The teams do what the local government tells them, they have the possibility to negotiate with the authorities thanks to their good relations.

- Specificity of the RC – the proximity with the locals

The RC is more efficient because it is in contact with the locals (NS); this represents the strength of the movement. The locals are the ones who know best the needs.

<u>Interventions – other mechanisms</u>

Currently, there is one expat per country for the development of projects. The aim is really to provide reinforcement to existing project in some countries. Yet, the presence of international RC is not well seen by the locals, so the RC tries to decrease this presence. Some NS don't want this help as they think they have the necessary human resources.
Sometimes, the mechanism can be declined into different responses. Outside of deployment of ERU, there is also possible to deploy people when particular requests are made from other NS (ex: Germany asked for help to the BRC ERU after the massive arrival of migrants).
Other mechanisms can be activated for emergency situations, for medium and small-scale disasters; there are respectively the DREF and the emergency funds. The DREF is an

emergency fund of around 600 000€[39] set up by the IFRC in order to respond to medium-scale disasters, barely mentioned in the media, for which specific criteria must be met and for which the National Society cannot respond alone. In this mechanism, the National Societies only send money; there is no need for humanitarian presence. These funds will be allocated to specific countries belonging to the Belgian development cooperation. In 2015, thirteen DREF have been financed regarding floods, famines and migrations. It is coordinated by the IFRC as well. For example, during the cold wave in Morocco, they only sent a financial help which covered 20-30% of the operations. There is a list of countries that the BRC supply instead of others, those who belong to the Belgian development cooperation. This is the Belgian state agency that grants funds. The BRC finances only the countries from this list; this is the same for the RKV. They just have to unblock the money from the bank account (in Swiss Franc). The IFRC and the Belgian government are notified.

The emergency fund is referred to as an "envelope" of money (around 20 000 – 50 000€) available in case of small-scale disaster. The beneficiaries are partner countries[40] that have asked for help and that couldn't benefit from ERU nor DREF. For example this mechanism will be activated in case of floods. The aim is really to help the HNS.

[39] Yearly amount

[40] Countries that are developing projects with Belgium

Appendix 6: Interview report - SOS Attitude – April 2016

The structure of SOS Attitude

SOS Attitude is a humanitarian organization which provides tents or emergency shelters to vulnerable people in case of natural disasters or armed conflicts. It is an association law 1901 whose purpose is to maintain the safety and dignity of affected populations in the aftermath of disasters by providing support and humanitarian assistance on a global level through equipment, materials or any other appropriate form. The mission of SOS Attitude is to finance and stock upstream tents and to deploy them when needed.

The staff

SOS Attitude's members work in small teams that follow regular trainings. There are twelve volunteers at SOS Attitude, each of them located in different places in France. They are characterized by a high speed of intervention thanks to the small size of their team. They always go on mission in pairs. A first team (A), composed of two people is sent in order to assess the needs of the population and to prepare the delivery and reception of the tents. Then, another team (B) composed of two people as well is sent in order to distribute the tents to the most vulnerable population. The two teams will work one after another; they meet on site during one or two days to ensure the transition, especially the sharing of information. The material often arrives during the intervention of the team B.

Emergency situations

A mission lasts around fifteen days to maximum one month.

- Before leaving

A technological monitoring system alerts SOS Attitude by phone in case of disasters. The members can also be alerted by the media or by partner NGOs. Before leaving, a first team, called team "A", prepares the departure of the equipment and blinds the process upstream.

- Inventory management-equipment

SOS Attitude's tents are designed and tested to withstand the weather, extreme temperatures and UV, and to provide protection against diseases and epidemics through integrated mosquito nets. The family tent called RED (Rapid Emergency Dome) allows to shelter a whole family and costs 300 €. The logistics partner, Alpinter, handles the design, storage and

delivery of the tents. It prepositions the stock in warehouse in Dubai, South America and chooses from which warehouse to send the equipment according to the location of the natural disaster. The amount of the inventory depends on the magnitude of the disaster, the amount of the finding before and during the intervention and the humanitarian aid on site. The influx of donations related to a disaster is used to restock as SOS Attitude need tents before leaving.

- Transportation modes

The supplier of SOS Attitude is Alpinter, based in Belgium. This society handles the transportation of the equipment by air freight or by cargo. The equipment leaves immediately so that there are more available flights and especially cheaper flights. They also work with the NGO "Aviation sans frontières". Each mission is different so they have a network of transportation partners. Thanks to these different partnerships, SOS Attitude has someone to receive the tents in the affected country, a consignee.

- Coordination

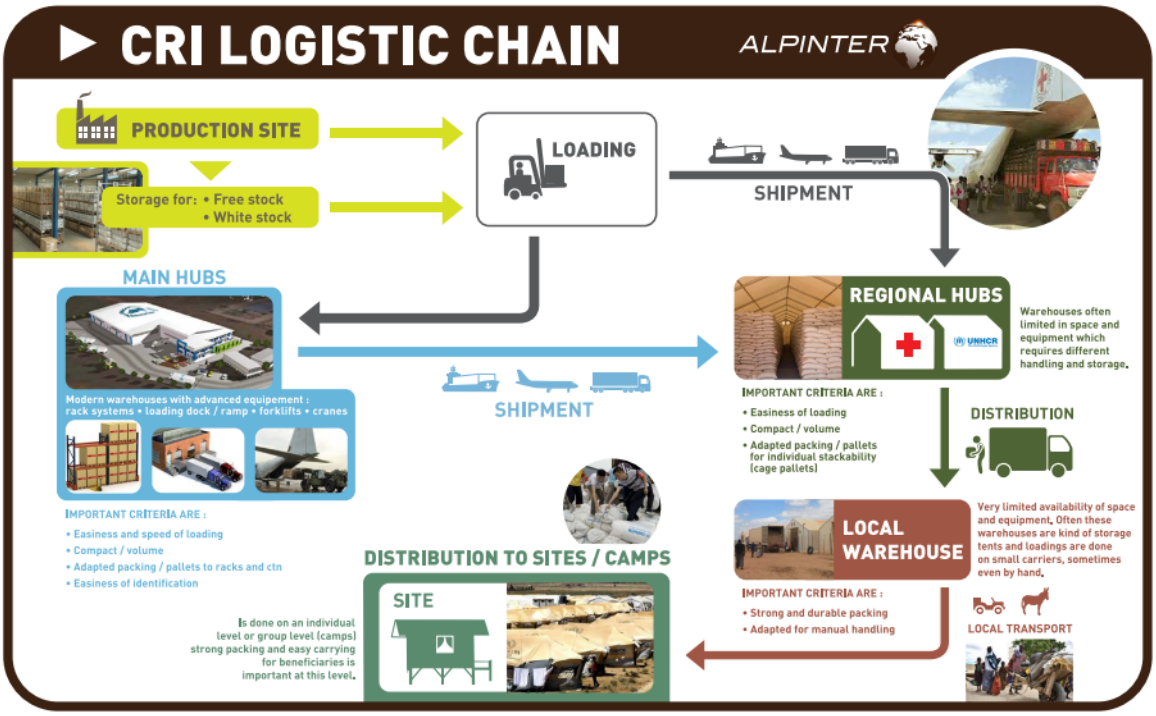
SOS Attitude's members take the decision to leave for providing relief in case of natural disaster; while in case of armed conflicts they have partnerships with organizations that need shelters so they have to coordinate with them. For example, during the migrant crises they received requests for shelters. SOS Attitude has several partnerships with for example the Red Cross, "Medecins du monde" Belgium and "Pompiers de l'Urgence Internationale". They created those partnerships through different meetings on-site. During the earthquake in Nepal, SOS Attitude attempted to exploit a partnership with the Nepalese Ministry of foreign affairs. SOS Attitude strongly works together with the Rotary network. A lot of members from SOS Attitude belong to this network, which makes the logistics' strength of SOS Attitude. The Rotary members are present worldwide so they are precious contacts on the field. The coordination with the locals is essential; they need an interpreter, they need to know the rules of the country and they need to collaborate with the administrative authorities to make the customs clearance easier.

- Specificity of SOS Attitude – Provide relief in remote areas

SOS Attitude doesn't provide shelter where most of the humanitarian aid is located. It tries to go where the marginal needs are not managed by the large structures. For example, in Nepal, they went into the mountains. As a result, they try to carry the equipment by themselves. Another example was during the large-scale disaster in Philippines where the media played an

important role in the areas to provide assistance (Tacoban was the concentrated area of NGOs). Yet, SOS Attitude decided not to go to this area but rather to go to other small islands.

Appendix 7: The structure of Alpinter's supply chain



Source: http://www.alpinter.com/logistics_supplychains.html

Appendix 8: Action plan of SOS Attitude regarding the quake in Ecuador

ACTION PLAN

Here is the plan as of April, 23th and after 5 days in the disaster area.

I) - Tents Customs Clearance & Transportation to Pedernales

• Team 2 to arrive in Quito Saturday at 20:55
• Team 2 & Alfredo to ensure customs clearance for tents
• Estimated time of arrival in Pedernales = Sunday end of day
• The storage of the tents will be close to Pedernales (main area of distribution).
• If there is a secure storage in Cojimies (information from Alfredo), we can use it. If not we can use our contacts at the town authorities.

Important
The organization team (Rotary and co) in Quito must secure the fact that the truck is OK to deliver the tents to Pedernales (and not San Vincente).

II) - Distribution Plan

Philippe & Guislain will accompany Team 2 throughout the time in the field as they did with Team 1 (Thanks to them).
Philippe and Guislain have all our feedback about our assessments and all the contacts established in the field, and they will fully brief Team 2 on Team 1's activities & findings on arrival in Pedernales.

• 20 tents to be given to VIRBAC in Quito (Alfredo is coordinating this with their representatives, Jorge & Daniela Valenzuela)
• 60 tents to be distributed in Pedernales in coordination with the town authorities
• 5 tents to be deployed in San Vincente area (Philippe & Guislain will manage this)
• 5 tents to be deployed at Las Tecas (10km south of Pedernales)
• Remaining 10 tents to be deployed at the discretion of Team 2 (Maybe Muisne, Pedernales)

III) - Timing for Pedernales Distribution

Important
There is no need to hurry. Take Your Time !
It is recommended that all tents should be erected under the supervision of Team 2 ensuring that (a) the tents are erected properly, (b) they are going to the most needy families, and (c) that the tents are being used properly.

• Monday Morning (25 April) :
15 tents in Pedernales Zone One.
(We are trying to ensure Mayor's presence for this first batch).

• Monday Afternoon (25 April) :
15 tents in Pedernales Zone Two.

• Tuesday Morning (26 April) :

15 more tents in Pedernales back in Zone One (if you are happy with the results from the day before)

• Tuesday Afternoon (25 April) :
15 more tents in Pedernales back in Zone Two (if you are happy with the results from the day before)

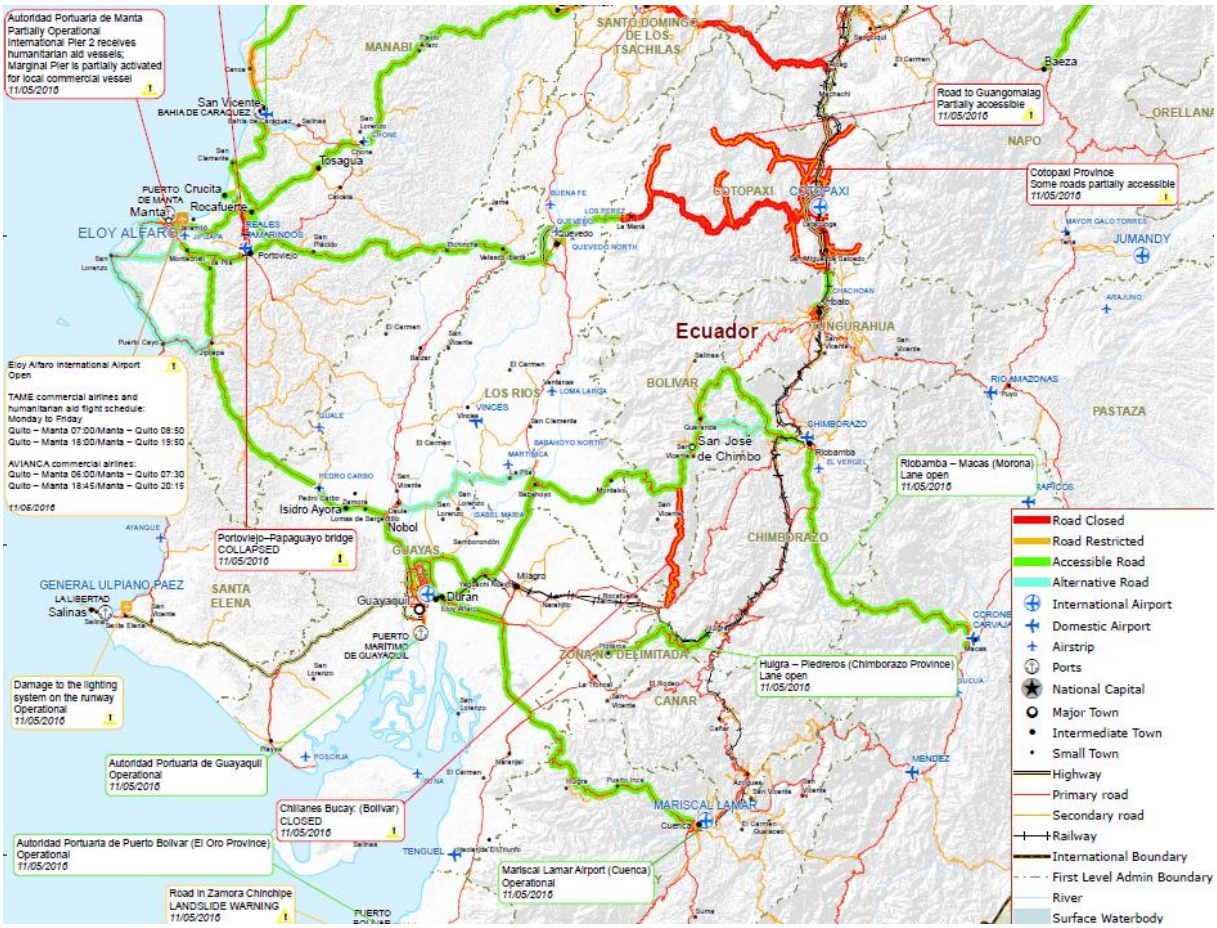
The town authorities will be present during distribution, and the local Pedernales scouts might send a group of 4/5 scouts to help with the distribution.

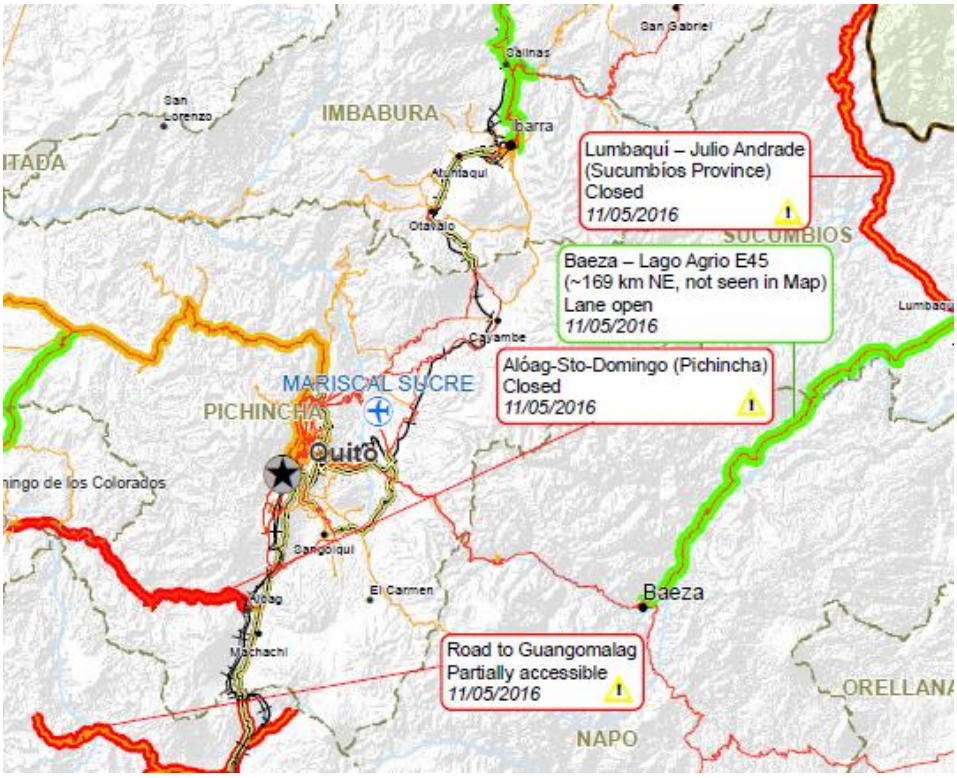
IV - Timing for remaining 20 tents
To be decided in the field.

V - Field Assessments
Team 2 to carry out field assessments in regions north of Pedernales (and other areas of their choice) with a view to identifying potential needs for shelter.

VI - Team 1
Team 1 to leave to field on Sunday 24 April to rejoin Quito (either by road or by air)
They will try to meet up with the French Ambassador in Quito on Monday morning for a full report on their week.
They will then quit Quito at 18:20.
Team 1 will continue to explore financing opportunities for bringing more tents into the field according to findings from Team 2 & continued communication with the authorities.

Appendix 9: Map of the logistics cluster displaying roads conditions in Ecuador





Source: http://www.logcluster.org/

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EXECUTIVE SUMMARY

The global impact of an increasing number of natural disasters in recent years has resulted in an increased interest and focus by scientific and academic researchers on disaster management. Looking back into the past, there were 317 natural disasters reported in 2014. This increasing number of natural disasters leads humanitarian organizations to grow, be better prepared and, thus, develop better responsive strategies to face them. Disasters have enormous impacts in terms of deaths and financial losses that are not avoidable, but that can be reduced thanks to an appropriate management of the response operations in the emergency supply chain.

This paper aims at identifying the gaps that exist, between the literature and the reality, in the management of response operations in case of natural disasters and to detect and understand the specificities of humanitarian supply chains in order to improve the management of those response operations.

This paper is to be divided into five parts. It begins with the positioning of the concept of disaster management by providing an overview of the disaster management cycle and its components. A focus on the response operations conducted in the aftermath of a disaster is then made; especially on the challenges and characteristics linked respectively to the transportation of relief items and to the communication and coordination between the humanitarian teams. After that, on the basis of interviews I have conducted, the intervention processes of four humanitarian organizations when responding to disasters are explained. This part is illustrated by a concrete example of the management of response operations through the interview of one volunteer back from a relief mission in Ecuador regarding the earthquake of April 2016. Finally, a comparison of what was found in the literature with the information that was provided in the interviews is given in order to identify the true characteristics and challenges of emergency logistics.

Key words: Disaster management, Humanitarian logistics, Emergency supply chain, Humanitarian organizations, Relief operations.