

# Humanitarian logistics- Unawareness of last mile distribution system

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Humanitarian logistics present many unique logistics challenges with problems include damaged infrastructure, limited collaboration and communication. Last mile distribution (LMD) is core part of humanitarian logistics. LMD is crucial to the effectiveness and speed of response for humanitarian aid distribution. Social expectation, constraint and bottlenecks pose sufficient challenges in last mile network design and operation. We provide detail description of last mile distribution constraint to provide further understanding of this core part. We also identify the factors that affecting the last mile distribution network design.

**Key Words :** *Humanitarian logistics ,Business logistics, last mile distribution, disaster response, Impartial aid distribution*

## 1. INTRODUCTION

The number of natural disasters and the people affected by disaster has increased over recent years on an unprecedented way. The number of total disaster occurred in 2010 was counted as 385 which killed more than 297,000 people worldwide. The annual average number of victim by disaster during 2000 to 2009 was 227.5 million<sup>1</sup>. The total number of affected people in 2010 was 20 million more than that of in 2009. Nearly 85% of total death toll due to natural disaster was in Asia during 2000-2009 while 75% of total death toll in 2010 was in Americas. The increasing trend of number of disaster and massive scale disaster like Chilean earthquake (27<sup>th</sup> Feb 2010), Haiti Earthquake (12<sup>th</sup> Jan, 2010), Flood in China and Pakistan (2010) have brought growing attention to the need for more research on disaster response.

**Table 1** Top ten disasters by Death toll in last decade<sup>1</sup>

Country	Year	Death toll	Hazard
Indian ocean tsunami	2004	227,898	Earthquake and tsunami
Haiti	2010	2,22,570	Earthquake
Myanmar	2008	1,38,366	Cyclone

China	2008	87,476	Earthquake
Pakistan	2005	73,338	Earthquake
Russia	2010	55,736	Heat wave
Japan	2011	28,050	Earthquake and Tsunami
Iran	2003	26,796	Earthquake
Italy	2003	20,089	Heat wave
India	2001	20,005	earthquake

A table of the top ten (by the number of lives lost) in last decade is presented above. Table is derived from data at EM-DAT, a global database for disaster information.

The World Health Organization defines a disaster as any occurrence that cause damage, destruction, ecological disruption, loss of human life, human suffering, deterioration of health and health services on a scale of sufficient to warrant an extraordinary response from outside the affected community. Disaster response structure can be different depending on the nature of disaster. Disaster response may require evacuating people to safe shelter or hospital, supplying food and water, medical assistance etc. The goals of disaster response are to ensure the safety of people and the availability of aid at the right time at right place. Consequently, how to make quick response to emergency incidents becomes the crucial

task of emergency relief work. Humanitarian logistics, one special kind of logistics, comes out along with emergency situation. This paper focuses on the logistics aspect of disaster response, more precisely on the deployment of the relief aid within affected regions from locally stored location which is known as last mile distribution (LMD).

The objectives of this paper are to further the understanding of humanitarian logistics and to examine the process involved in humanitarian logistics operation. The rest of the paper is organized as follows. In section 2, we present the concerned issues for humanitarian logistics that differ from business logistics. In section 3, we identify the characteristics of last mile distribution system. Based on humanitarian logistics consideration in section 4, we outline the conceptual framework for aid distribution. In section 5, we conclude with discussing future research direction.

## 2. HUMANITARIAN LOGISTICS

In literature, various terms are used to represent logistics for disaster relief such as ‘disaster relief logistics’, ‘emergency logistics’, ‘humanitarian logistics’. In this paper, we will use the term ‘humanitarian logistics’ hereafter to describe the relief distribution after disaster. The objective of humanitarian logistics is to provide relief (emergency food, water etc) to victims after disaster, so as to minimize the human suffering and death<sup>2</sup>. Sheu<sup>3</sup> defined humanitarian logistics as a process of planning, managing, and controlling the efficient flows of relief, information, services from the points of origin to point of destination to meet the urgent needs of the affected people under emergency situation. Humanitarian logistics gain interest in disaster response for several reasons<sup>4</sup>. First, it is crucial to the effectiveness and speed of response for major humanitarian programs such as health, food, water, shelter and sanitation. Second, with procurement and transportation included in the function, it can be one of the most expensive parts. Third, it has scope to learn knowledge from past experience.

Kovacs and Spens<sup>5</sup> pointed that humanitarian logistics, as well as, business logistics, encompasses a range of activities including preparedness, planning, procurement, transport, warehousing, tracking and tracing, and customs clearance. Americas Relief Team<sup>6</sup> illustrates the activities involved in humanitarian logistics. It initiates with the urge for help to aid agency from affected country while a system or country is not able to cope with disaster<sup>7</sup>. After primary assessment of uncertain demand and product requirement, aid agency place order to product sup-

plier based on expected demand. Various items are collected from different suppliers. Items from different sources are delivered to a collection point where consolidation and documentation with other logistics activities accomplish. Those processed items are transported by using international carrier to affected country’s point of entry. The term ‘Point of entry’ includes airport, seaport, and any other spot where custom clearance are executed. Performed logistics activities before point of entry take place in outside of disaster affected country. With the fulfillment of custom clearance, logistics activities such as storing, sorting and packing, among other, execute by using limited storage capacity, disrupted transport and communication network.

Accord with Kovacs and Spens<sup>5</sup> findings about the similar activities that take place in both humanitarian and business logistics, it is also noting that there are sky-scraping differences exist between two systems. The first and fundamental difference is in the motivation of the logistics process, i.e. humanitarian logistics go beyond profitability while business logistics centered on maximization of profit. Ballou<sup>8</sup> mentioned the three objectives for a business logistics strategy: cost reduction, capital reduction, and service improvement. Besides motivational difference, some other differences are mentioned below.

Demand for products in humanitarian logistics is highly uncertain and unpredictable, in terms of location, type, and size. Disaster occurrence time is not easy (if not impossible) to predict. For instance, where will the next earthquake strike? Addition to uncertain about demand location, after the occurrence of disaster, it is difficult to assess accurate demand information just aftermath of disaster due to communication network disruption. In the business logistics demand is fairly stable and can be predicted using historical data to determine when to place an order and the amount of inventory to buy or make.

Humanitarian logistics is unique in fund sourcing. Funds are collected to meet social demand from government funding, charitable donation, and in-kind donation (non-monetary items like clothes etc.). On the other hand, business logistics raise fund by providing or selling services to customer. Besides different form of fund sources, emergency response activities (includes demand assessment, aid distribution etc) have to be carried out in crisis condition as physical infrastructure, such as roads, bridges, and airports, is commonly damaged by disaster, transport capacity is often severely limited<sup>9</sup> and shortage of resources in terms of supply, human resources, technology, funding etc create difficulties humanitarian logistics operation.

Emergency situation triggers zero lead time (i.e. the time gap between disaster occurrence and de-

mand generation) and quick delivery is predominant target aftermath of disaster. The initial 72 hours is the crucial to save or rescue life just after the earthquake. After 72 hours the probability of rescuing human life reduces dramatically. This represents the time sensitivity characteristic of humanitarian logistics comparing business logistics as humanitarian logistics is life or death situation not just about money.

Though both humanitarian logistics and business logistics require controlling inventory to meet unexpected demand, strategies for inventory decision are different. Humanitarian logistics inventory is one form of social inventory<sup>10</sup> in contrast to strategic inventory in business logistics. Objective of social inventory is to serve broad social objectives as opposed to being used for the benefit of an individual enterprise. Ownership of such inventory also differs from business logistics. It stored in local government, international or nongovernmental organization (NGO), or other private relief organizations. As a consequence, Information about the total available inventory is always unknown.

Difference can also be observed in performance measurement of distribution system. Business logistics manager make logistics decision (for example, inventory, transport mode choice) based on cost and benefit used for decision theory available for quantification of these decisions to enterprise. There are some established variable to support manager's decision. These proxy indicators include the percentage of demand that can be met from inventory or length of time that demand is in queue due to product unavailability. Those indicators are well established and mathematical forms have been developed, since financial metrics are accessible and profit is a good test of market need satisfaction. On the other hand, humanitarian logistics are still naïve to measure the performance. The benefit of this system is intangible and outcome is unknown. The proxy indicator for humanitarian logistics may include saved lives, recovered livelihood opportunities and other humanitarian outcomes.

The distinctions between business logistics and humanitarian logistics stress that network design for humanitarian logistics require divergent consideration. Only cost minimization or profit maximization based solution can not translate the need of humanitarian logistics. Addition to it, different consideration required for distribution strategy. Difficulties arise with limited available relief. In case of less available relief situation, affected areas need to be prioritized to make balance aid distribution based on statistical value for example minimization of maximum regret value<sup>11</sup>. If available relief is more than requirement, aid distribution decision maker is required to consider distribution strategy such as wastage is mini-

mized.

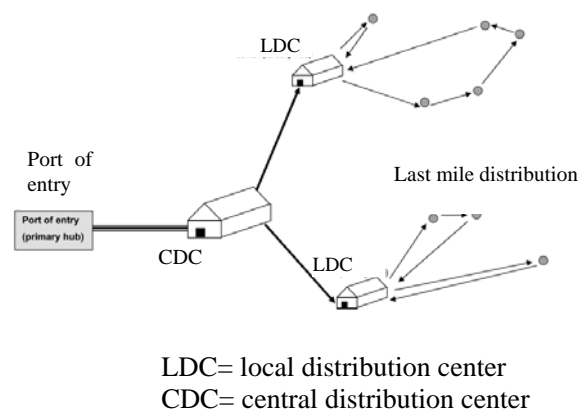
Distribution strategy problem arise also from the point of view of vulnerability or risks. Risk value may differ in different places. High vulnerable area need quick deliver and more care than the low vulnerable area.

Above stated problems are associated with the last mile distribution (LMD) system. Therefore, relief distribution manager require tools for making decision in emergency time swiftly and efficiently. It is required of further understanding of last mile distribution system. The following section explores the characteristics of last mile distribution system.

### 3. LAST MILE DISTRIBUTION SYSTEM

The growing body of humanitarian logistics research focuses on optimization of relief distribution in response to disaster. Though LMD is the core part of aid distribution, little knowledge is known about the LMD. Balick et al.<sup>2</sup> define LMD

*“The last stage of relief chain; it refers to delivery of relief supplies from local distribution centers to the people in affected area”*



**Fig. 1** Structure of relief chain Source Modified from UNDP Disaster Management Training Program, Logistics module <sup>2</sup>

LMD presents significant logistics problem. Limited understandings about the components involved in LMD impede the development. Society expectation, aid agency constraints, and unpredictable operating conditions make the LMD operation challenging. The following section lights on components characteristics.

#### (1) Society expectation

Complex emergencies require guidelines for impartial aid distribution. A Task Force on Ethical and

Legal Issues in Humanitarian Assistance composed of representative of major relief agencies, the United Nations (UN) and experts in humanitarian assistance issues was formed by the program on Humanitarian Assistance at the World Conference on Religion and Peace in 1994 to assess and make recommendations on the range of issues confronting agencies responsible for the delivery of humanitarian assistance. These guidelines cover following issues

**a) Humanity**

Human suffering should be addressed wherever it is found. The dignity and rights of all victims must be respected and protected

**b) Impartiality**

Humanitarian assistance should be provided without discriminating as to ethnic origin, gender, nationality, political opinions, race or religion. Relief of the suffering of individuals must be guided solely by their needs and priority must be given to the most urgent cases of distress.

**c) Neutrality**

Humanitarian assistance should be provided without engaging in hostilities or taking sides in controversies or a political, religious or ideological nature

**d) Independence**

The independence of action by humanitarian agencies should not be infringed upon or unduly influenced by political, military or other interest.

**e) Empowerment**

Humanitarian assistance should strive to revitalize local institutions, enabling them to provide for the needs of the affected community. Humanitarian assistance should provide a solid first step on the continuum of emergency relief, rehabilitation, reconstruction and development.

These issues are the base for humanitarian response in LMD.

**(2) Aid agency constraint**

Aid distributor faces the trade-off between equity and efficiency. Bevan<sup>12</sup> measure efficiency of ambulance operation in UK by calculating how many call was satisfied on time. Equity refers to access that depends on need, not on where people live<sup>12</sup>.

Accurate need assessment is crucial for balance aid distribution. Need assessment method varies among different aid agency. Need assessment capability increase LMD response efficiency. De la Torre et al.<sup>13</sup> did a survey organizations involved in aid distribution. They see that organization collect data for accountability to current aid agencies and to show the impact of efforts for further fund raising.

**(3) Unpredictable operating conditions- Network**

De la Torre et al.<sup>13</sup> stress on the importance of

awareness about cultural and political issues. In particular, these issues can effect on type of product will be distributed. They also found that commercial shipping contractor prefer to distribute relief where driver have an existing relationship with beneficiaries. Such uncertainties addition with damaged network poses challenge on successful operation of LMD.

Aid distribution in LMD is done by using different type of transport collaboration. Many transport service providers in Japan facilitate volunteer transport support in LMD during Japan great Tohoko earthquake, 2011. Similar support was found after Hurricane Rita<sup>14</sup>. Transport service providers are expected to distribute relief supplies following report of emergency. There is possibility to differ from expectation and real occurrence. These transport provider groups are not bound by contracts and monetary incentives and thus don't have same incentive to uphold agreements as commercial carriers. Such situation would likely cause uncertainty in LMD.

Transport capacity, reliability, accessibility, safety change in disaster affected area abruptly. This situation affects small size aid organizer as they may not have access to all updated information. In Haiti 2010, accessibility of roads was changing constantly and unpredictably due to the movements of rubble and government and military road blocks. It increased the travel time uncertainty.

## 4. CONCEPTUAL FRAMEWORK

This section provides description about the components involved in LMD system and preliminary factors that influence the LMD network design.

**(1) LMD component**

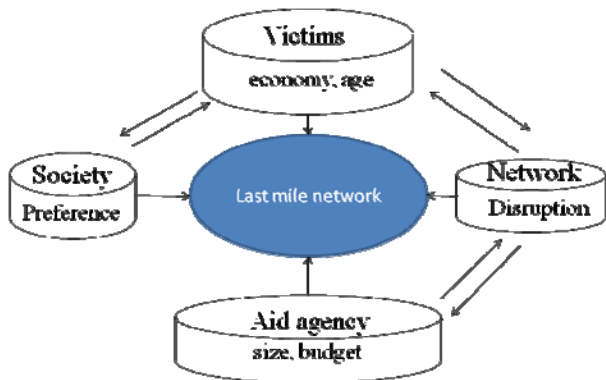
LMD is a core activity in humanitarian operation. Based on our discussion in last section, we have identified four key stakeholders who influence the LMD (figure 2). 1. Victims 2. Network (and service provider) 3. Aid agency 4. Society.

Providing aid to victims at the right place at right time are the objectives of LMD. Proper distribution network (distribution center, transport service etc.) make the link between victims and aid agency. Technically, link is equivalent to transporting relief supplies from local distribution center to victims. Hence, network design is a crucial part of LMD system.

Humanitarian LMD must pursue humanitarian principal (humanity, impartiality, neutrality, independence, and empowerment) while cope with the local social condition.

The objective of LMD network design is to man-

age scarce resources, identify and serve those in need impartially and neutrally<sup>15</sup>.



**Fig.2** Components of Last mile distribution in humanitarian logistics

**(2) Factors identification**

This section provides the conceptual framework for designing LMD network. This framework focuses on the factors affecting the network design. We have listed up the factors for each stake holder describe in previous sub-section. Factors divide again in two categories: those can be controlled by stakeholder and those are beyond control of stake holder.

**Table 2** Potential factors affecting last mile aid distribution in humanitarian operation

Stake holder	External factor	Internal factor
Aid agency	1. Fund structure	1. Strength A. Need assessment capability B. Data accessibility C. Collaboration 2. Fleet ownership
Victims	1. Location A. Access to transport network B. Access to shelter 2. Physical condition of victim	1. Custom and religious value
Network	1. Driver preference	1. Network connectivity 2. Driver availability
Society		1. priority setting

**a) Aid agency**

At the aid agency level factors are, we study, fund structure, strength, and fleet ownership. Fund source for humanitarian logistics are donation (described in section 2) which is beyond control of aid agency. Aid

agency can control its organizational strength such as need assessment capacity; collaboration etc. and also fleet ownership can be controlled by aid agency.

**b) Victims**

Victim has potential strong effect on LMD network design. Location influences significantly in LMD network design. Victim has two options for selecting location, first, move to shelter, second, stay in damaged area, Decision depends on two external factor access to transport network and access to shelter. Special consideration for physically disabled or injured people is required during network design.

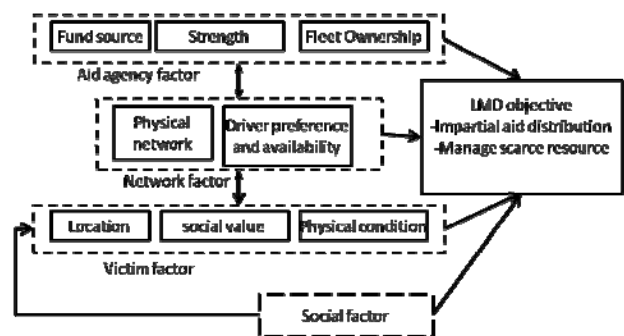
**c) Network**

Network indicates transport network owner or transport service provider. In section three, it was described about the difficulties and uncertainty involved in network.

**d) Society**

Society affects the priority setting in LMD network design.

In summary the conceptual framework, considers the potential factors affecting LMD network design (figure 3). Those factors were identified related to facility location consideration as well as specific aspects related to humanitarian operation. Victim’s physical condition and customs and religious value affect LMD network design. Aid agency’s strength and weakness also affect LMD network design.



**Fig.3** Conceptual framework showing potential factors affecting last mile aid distribution in humanitarian operation

**5. CONCLUSIONS**

This paper explains the activities involved in LMD as a components of humanitarian logistics. We focus on LMD network design. First our aim is to understand the difference between business logistics and humanitarian logistics for network design. Second, taking the humanitarian logistics into consideration, we identify the expectation, limitation and problems faced by aid agency to distribute aid in LMD. Humanitarian assistance guidelines provided by United Nations describe the expectation from Humanitarian operation. Uncertain funding source and operational

constraint inhibit aid agencies regular activities. The unpredictable operation conditions in LMD create difficulties to implement rational plan. Third, we present a conceptual framework for LMD network design to show how expectation, limitation and problem can affect on LMD network design.

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