

2016-12-31

Comment: Humanitarian Relief Logistics: Pre-positioning Warehouse Strategy

Roh, S

<http://hdl.handle.net/10026.1/19121>

10.54007/ijmaf.2016.8.2.1

KMI International Journal of Maritime Affairs and Fisheries

Korea Maritime Institute

All content in PEARL is protected by copyright law. Author manuscripts are made available in accordance with publisher policies. Please cite only the published version using the details provided on the item record or document. In the absence of an open licence (e.g. Creative Commons), permissions for further reuse of content should be sought from the publisher or author.

Comment: Humanitarian Relief Logistics: Pre-positioning Warehouse Strategy

Saeyeon Roh* and Chang–Su Kim**

ABSTRACT

The importance of preparedness is emphasised in humanitarian relief logistics as it gets even more sophisticated. Pre-purchased relief items are stocked in pre-positioned warehouses around the world by various relief organisations which is commonly taken to improve their capacities to deliver sufficient relief aid within a relatively short time frame. This comment paper provides a better understanding about the humanitarian disaster management with the comparison between the commercial logistics. Furthermore, pre-positioned warehousing strategy is overviewed along with the global warehouse locations operated by international relief organisations.

Keywords: Logistics, humanitarian relief logistics, pre-positioned warehouse strategy

* International Shipping and Logistics Group, Plymouth Business School, Plymouth University, United Kingdom
E-mail: Saeyeon.roh@plymouth.ac.uk

** International Shipping and Logistics Group, Plymouth Business School, Plymouth University, United Kingdom
E-mail: kcs4194@gmail.com

1. Introduction

It is clear from recent studies statistics that natural and man-made disasters are occurring more frequently. It has been shown that natural disasters around the world have increased up to nine fold in the last thirty years (Fritz Institute, 2005; EM-DAT, 2008). An increase in disasters are estimated to strike our planet, killing around 75,000 people and impacting more than 200 million others (Van Wassenhove, 2006). The importance of an emergency relief response operation increases as the numbers of disasters rise. The large number of disasters around the world has illustrated the importance of emergency relief response logistics. One of the most serious problems affecting the modern world is the vulnerability of nations or regions to natural disasters (e.g. earthquakes, floods, droughts) or man-made crises (e.g. civil unrest, war, and political or tribal disturbance) (Pettit and Beresford, 2006). Even though advanced technology is working hard to predict natural disasters, most disasters remain unpredictable.

Disaster relief logistics management is categorised into three phases, which are: preparation, immediate response, and reconstruction (Kovacs and Spens, 2006). The three key phases which cannot be designated to specific time periods are consistently part of the preparation reaction process and logistics serves as a bridge between disaster preparedness and immediate response (Thomas, 2003). The overall goal for preparedness is to improve rapid response facilities so as to allow the timely delivery of food aid in emergency situations (Scott-Bowden, 2003). Speed of delivery is considered one of the important factors in the relief chain where the pressure of time in the relief chain is often not a question of money but the difference between life and death (Van Wassenhove, 2006).

A number of decision support systems and technologies have been developed for the preparation phase. One of the decision support systems is facility location, while stock pre-positioning decisions in the relief chain are critical components of disaster preparedness and, hence, require long-term planning to achieve a high-performance disaster response (Balcik and Beamon, 2008). Pre-positioning in strategic locations around the world is a strategy that has recently been implemented by some humanitarian relief organisations to improve their capacities in delivering sufficient relief aid within a relatively short timeframe and with improved mobilisation (Balcik and Beamon, 2008). The basic purpose for establishing an emergency stockpile is to support life-saving operations during the first few days after a sudden-onset disaster through an immediate delivery of required relief items (UNDHA, 1994). Many relief organisations have recently established a pre-positioned strategic model to carry out extensive work to strengthen their logistical preparedness and capacity (Scott-Bowden, 2003).

In these circumstances, it is imperative to understand the differences of humanitarian relief logistics from commercial logistics, including the characteristics of humanitarian relief logistics. The logistics structure and the process of humanitarian relief, including the different stages of operation phase dealing with disaster occurrence. The importance of the preparedness of the operation phase is covered. Lastly, the structure and the location of pre-positioned warehouses will be analysed in the last section.

2. Humanitarian Relief Logistics

Humanitarian relief logistics is defined as: the process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from the point of origin to the point of consumption for the purpose of alleviating the suffering of vulnerable people. (Thomas and Kopczak, 2005). Long and Wood (1995) defined relief itself as a 'foreign intervention into a society with the intention of helping local citizens'. The objective of the relief chain is to provide humanitarian assistance in the forms of food, water, medicine, shelter, and supplies to areas affected by large-scale emergencies (Beamon and Balcik, 2008). Several reports have emphasised that it is crucial that humanitarian logistics should be located in the centre of the disaster relief operation. Chaikin (2003) reported that humanitarian aid logistics require logisticians with professional management experience. Logistics actually serves as a bridge between disaster preparedness and response (Thomas, 2003); therefore, humanitarian logistics is crucial to the effectiveness and speed of response for major humanitarian programs. Procurement and transportation in the logistics function are often one of the most expensive parts of the relief operation. (Thomas and Kopczak, 2005).

2.1. Characteristics of Humanitarian Logistics

Since most natural disasters are unpredictable, the demand for goods in these disasters is also unpredictable. Consequently, it is difficult to rely on demand information for quick-onset disasters for humanitarian relief supply chains (Balcik and Beamon, 2008). Gustavsson (2003) reported the hindering factors that a relief organisation could learn from the commercial supply chain, which are: lack of depth in knowledge, funding that is biased towards short-term responses, and lack of investment in technology and communication. The characteristics of humanitarian logistics are summarised in Table 1.

Table 1. Characteristics of humanitarian logistics

The main aim	Alleviating the suffering of vulnerable people.
Actor structure	Stakeholder focus with no clear links to each other, dominance of NGOs and governmental sector. Existence of vertical coordination and horizontal coordination.
3-phase setup	Preparation, immediate response, reconstruction.
Basic features	Variability in supplies and suppliers, large-scale activities, irregular demand, and unusual constraints in large-scale.
Supply chain philosophy	Supplies are 'pushed' to the disaster location in the immediate response phase. Pull philosophy added in reconstruction phase. Short lead times for a wide variety of suppliers. Unpredictability of demand, in terms of timing, location, type, and size. Lack of resources.
Transportation and infrastructure	Infrastructure destabilised and lack of possibilities to assure quality of food and medical supplies.
Time effects	Time delays may result in loss of lives. Speed of delivery affects people's lives. High stakes associated with adequate and timely delivery.
Bounded knowledge actions	The nature of most disasters demands an immediate response: hence, supply chains need to be designed and deployed at once even though the knowledge of the situation is very limited. Dynamic and chaotic environments.
Supplier structure	Choice limited, there are even sometimes unwanted suppliers.
Control aspects	Lack of control over operations due to emergency situations.

Source: Balcik et al. (2010), Blacik and Beamon (2008), Cassidy (2003), Kovacs and Spens (2007), Long and Wood (1995)

2.2. *The Comparison of Humanitarian Relief and Commercial Logistics*

There are clear parallels between business logistics and relief logistics; however, to date the transfer of knowledge between the two has been limited and the latter remains relatively unsophisticated, although more recently greater effort has been put into understanding and developing system which can improve the relief supply chain (Fritz Institute, 2005). Table 2 shows the comparison and contrast between commercial logistics and humanitarian logistics.

Table 2. A comparison of commercial and humanitarian logistics

Criteria	Commercial	Humanitarian
Revenue Sources	Earned from sale of products and services to customers	Government funding, charitable donations, and in-kind donation
Goals	Make profits and provide satisfactory financial returns to shareholder interests	Achieve its social purpose and mission Financial stability is crucial to mission and survival Constraints rather than
Motivation	Profit	Beyond profitability to alleviating the suffering of vulnerable people
Coordination	Well-coordinated	Lacks coordination

Criteria	Commercial	Humanitarian
Strategic Goals	Cost reduction Capital reduction Service improvement	Mission effectiveness Financial sustainability
Stakeholders	Homogenous interests of the owners of a firm guide the firm's policy	Multitude of constituencies whose goals and needs may be heterogeneous
Demand	Products and service Individuals or organisations receiving the products Stable, predictable external demand patterns, often from fixed locations in set quantities, and regular intervals	Supplies and people (aid recipients) Generated from random events that are unpredictable in terms of timing, locations, type, and size No 'true demand' Demand is accessed through aid agencies Lack of customer pressure
Lead Times	Customers accept a lead time of several days to one week between the time they place an order and their shipment arrives	Zero lead time
Performance Measurement	Profits are measured easily and they are a good test of market-need satisfaction and an organisation's ability to operate efficiently	Intangibility of the services offered, immeasurability of the missions, unknowable outcomes, variety of interests and standards of stakeholders

Source: Adapted from (2004), Beamon and Balcik (2008), Beamon and Kotleba (2006), Cassidy (2003), Ernst (2003), Kovacs and Spens (2009), Thomas and Kopczak (2005), Tomasini and Van Wassenhove (2009), Tzeng et al. (2007), Van Wassenhove (2006) arranged by author

The fundamental differences between humanitarian and commercial logistics were found to be in terms of strategic goals, the customer and demand characteristics, environmental factors, and in the motivation for improving the logistics process. The ultimate goal of humanitarian relief logistics is to deliver the right supplies in the right quantities to the right locations at the right time to save lives and reduce human suffering within given financial constraints (Beamon and Balcik, 2008). Although cost reduction and service improvement are common considerations for both logistics and the relief logistics, the differences between the two sectors bring different dimensions to these common objectives. Humanitarian logistics characterised by large-scale activities, irregular demand and unusual constraints (Beamon and Kotleba, 2006). For example, the humanitarian sector often has difficulty establishing reliable transportation routes and it is affected by political instability, in-country infrastructure, and topography. Most of the operations are carried out in an environment with destabilised infrastructures or weather delays of air or sea links (Cassidy, 2003; Long and Wood, 1995). The problems can range from a lack of electricity supplies to limited transport infrastructure and include 'controlled' environments with some minor variability (Kovacs and Spens, 2009).

Commercial logistics are normally planned in advance of demand while most commercial logistics operations are relatively well established while relief logistics decisions are made within shorter time frames. In addition, commercial logistics usually deal with a predetermined set of suppliers, manufacturing sites, and a stable or at least predictable demand, which are all unknown in humanitarian logistics (Cassidy, 2003). The major factors concerning humanitarian relief logistics in decision making after disasters occur are the uncertainties and variability (Balcik and Beamon, 2008). In the commercial sector, many businesses are driven by customers while

humanitarian organisations are mostly driven by donors (Tomasini and Van Wassenhove, 2009). In humanitarian relief operations, the customer, who are aid recipients, actually have no choice and, therefore 'true demand' is not created in humanitarian logistics (Kovacs and Spens, 2009).

3. Humanitarian Relief Logistics Management

A number of models have been identified which incorporate many of the key stages of the emergency relief cycle: however, there is no single model that can accommodate all of the variables in the supply of emergency relief materials (Pettit and Beresford, 2006). Humanitarian logistics literature distinguishes between different phases of disaster relief. Most relief organisations engage in two broad types of activities: relief and development (Byman et al. 2000). Firstly, relief activities provide relief for victims of large-scale emergencies, these tend to be short-term activities that focus on providing goods and services to minimise immediate risks to human health and survival. Secondly, development activities provide long-term aid, focusing on community self-sufficiency and sustainability, these activities include establishing permanent and reliable transportation, healthcare, housing, and food.

Disaster management helps regional actors in the phase of operating for disasters, while extra-regional actors can turn to strategic planning during the disaster relief operation (Lee and Zbinden, 2003). In the immediate response phase, regional actors learn from crisis management, or even from the response to disruptions in material flows in business logistics (Kovacs and Spens, 2007). The reconstruction phase is in fact similar to a business environment, although it does not aim to generate a profit. Their three-phased model included 1) prepare an immediate response and reconstruction; 2) preparedness during the operation; and 3) post-operations. The phases of disasters can be distinguished as: before the disaster strikes, instantly after a disaster strikes, and the aftermath of a natural disaster.

3.1. Preparation Phase

The preparation phase is the time in which aid agencies can develop collaborative platforms. Coordination in the preparation phase is an important challenge for many different aid agencies because suppliers and local and regional actors all have their own ways and structures of operating. Unfortunately, many emergency preparedness plans lack any insight into disaster relief logistics (Chaikin, 2003). In addition, since donors insist that their money goes directly to help victims and not to finance back-office operations, preparation and training are often neglected. Meanwhile, the donors place importance on the donated money or goods being used for another emergency or in another place. The failure of early warning system could lead to a major catastrophic disaster and the improvements that are learnt from the past experience often lead to a successful responding to the future disasters (Hale and Moberg, 2005).

3.2 Immediate Response Phase

The main problem in the immediate response phase lies in coordinating supply, the unpredictability of demand, and the last mile problem of transporting necessary items to disaster victims (Tomasini and van Wassenhove, 2004). It is found in various studies that less developed regions are also more prone to a larger scale destruction of their infrastructure once a disaster strikes. In addition, there exist different difficulties such as demand assessment, language barriers, demand forecasting and so on. The speed of relief operations during the first days of the disaster significantly affects the lives of many people threatened by the disaster (Balcik and Beamon, 2008). Aid agencies receive many unsolicited and unwanted donations which could clog airports and warehouses.

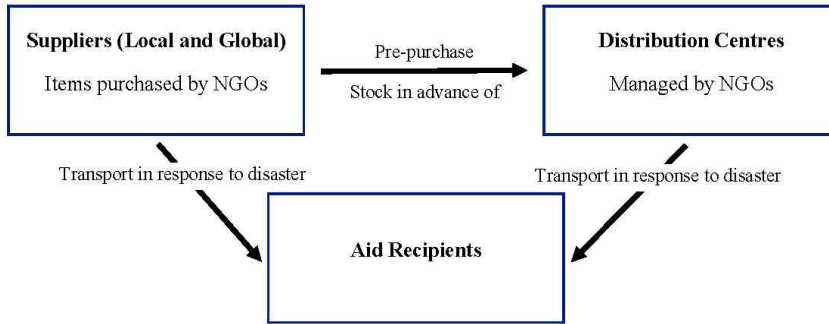
3.3 Reconstruction Phase

The reconstruction phase is important since disaster can have long-term effects on a region where most cases international aid agencies provide technical and financial assistance for the disaster affected population (Chang et al. 2011). It is also argued that humanitarian relief should focus on the reconstruction phase for continuous planning should be successfully in place (Kovacs and Spens, 2007). Categorising disaster management into the phases may be too rigid, allowing insufficient flexibility for external influences and unforeseen problems in the crisis management plan (Pettit and Beresford, 2006). The three elements cannot be designated to specific time periods but they are all consistently part of preparation-reaction process (Brown, 1979).

4. Humanitarian Relief Logistics Network

Once a disaster occurs, humanitarian organisations can acquire relief supplies from three main sources: local suppliers, global suppliers, and distribution centres (pre-positioned warehouse) (Balcik and Beamon, 2008). Figure 1 illustrates the simplified overview structure of humanitarian relief chain to show how relief goods are distributed.

Figure 1. Simplified relief chain overview



Source: Balcik and Beamon (2008)

Acquiring the necessary supplies for disaster relief chain can be done both locally and globally depending on the various situation and circumstances. The advantages and disadvantages of the integrated procurement process are shown in Table 3.

Table 3. Advantages and disadvantages in relief logistics procurement

Procurement type	Advantages	Disadvantages
Local procurement	Low transport cost Prompt deliveries Local economy support	Risk strategy to operate solely Unavailability of enough quantity and quality needed Create shortage in the local market
Global procurement	Increase the availability of large quantities of high-quality supplies	Longer deliver times Higher transportation cost Supplies not delivered to affected area during the initial critical days due to bidding process
Pre-positioned stocks	Deliver sufficient relief aid within a relatively short timeframe Less expensive than post-disaster supply procurement Increase the ability of mobilisation Efficient (low cost less duplication of efforts, less waste of resource) Effective (quick response, satisfied demand)	Financially prohibitive Complex Too many uncertainties Only few can operate Impossible to depend solely in case of large scale disasters Capacity limitations

Source: Adinolfi et al. (2005), Beamon and Balcik (2008), Balcik and Beamon (2008), Strash (2004), PAHO (2001), Salisbury (2007)

4.1 Local Procurement

Acquiring supplies locally may be advantageous due to low transportation costs and prompt deliveries. Local procurement provides support to the local economy. Although meeting a country's emergency needs from local resources could be considered as the best procurement scenario, it may be risky to develop a response strategy that depends solely on local sources. Local procurement can also create local competition among relief organisations trying to purchase the same types of supply and may,

therefore, create shortages in the local market (PAHO, 2001). Relief agencies procuring locally must develop contingencies for acquiring supplies from other sources (Balcik and Beamon, 2008).

4.2 Global Procurement

Using global supplies in disaster relief procurement increases the availability of large quantities of high-quality supplies (Balcik and Bemaon, 2008). Meanwhile, the potential disadvantages lie in the longer delivery times and higher transportation costs (PAHO, 2001). The time-consuming bidding process during the initial critical days following disaster led some humanitarian organisations to begin to establish pre-purchasing agreement with suppliers, specifying the quality and delivery requirements for certain critical emergency items (Balcik and Beamon, 2008). The problems of the disaster relief logistics procurement process unable to obtain and deliver emergency supplies to affected area within a critical response time period. This emphasises the necessity of the preparedness logistics activities of pre-disaster response.

4.3 Pre-positioned Stocks

In the initial days of the deployment phase, most of the critical supplies arriving to the disaster areas are sourced from a relief organisation's global pre-positioned stocks. Cost is one of the reasons for pre-purchasing the supplies because it means that they are able to purchase them at a reasonable price (Salisbury, 2007). Once a disaster occurs, demand for supplies increases dramatically and suppliers will often raise their prices in response (Beamon and Balcik, 2008). Meanwhile, the distribution centres are located as close as possible to the emergency area, depending on their strategic operations. Furthermore, the pre-disaster activities mean that the relied organisation is able to react quickly to a disaster.

The inefficiency of ad-hoc methods brings attention to the need for pre-positioning facility location and stocking decisions (Adinofli et al. 2005). As the number, scale and complexity of emergencies have risen, the relief providers have found themselves unable to respond any longer to a sudden-onset disaster in a timely and appropriate manner using the traditional relief methods. (UNDHA) (1994). Emergency preparedness requirements for large-scale emergency in the pre-positioned or staging areas are critical because they enable a rapid disbursement of supplies from the stockpiles (Rawls and Turnquist, 2010).

5. Pre-positioned Strategy in Humanitarian Relief Logistics

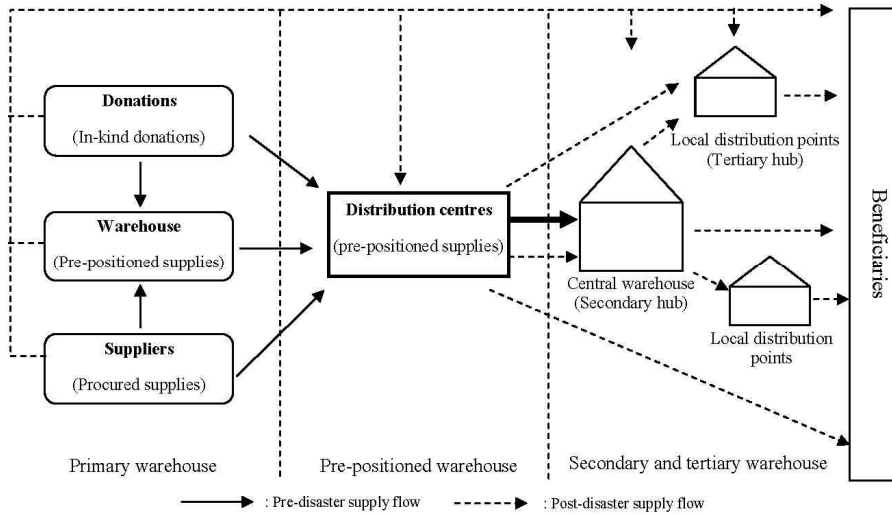
Pre-positioning in strategic locations around the world is a strategy that has recently been implemented by some humanitarian relief organisations to improve their capacities in delivering sufficient relief aid within a relatively short timeframe

with improved mobilisation (Balcik and Beamon, 2008). The main goal of emergency response efforts is to provide shelter and assistance to disaster victims as soon as possible. To achieve this goal, supplies can be pre-positioned at a strategic location so that they are readily available when needed (Rawls and Turnquist, 2010). The basic purpose for establishing an emergency stockpile is to support life-saving operations during the first few days after a sudden-onset disaster through an immediate delivery of required relief items (UNDHA, 1994). The challenge of logisticians consists of prepositioning items out of the reach of the potential demolishing impact of a disaster while at the same time ensuring that they are close enough to the disaster to deliver aid quickly and effectively (Balcik and Beamon, 2008). Agencies have established, or are establishing, global and/or regional prepositioning units that are capable of delivering critical emergency supplies, materials, vehicles and technical assistance to any place in the world within a short timeframe (Gustavsson, 2003). The emergency pre-positioned stockpile is not an end itself but is instead a specific tool to support the basic activities of the stockpile holder. Although it is a costly operation, it can be considered as a viable solution only if the activities it supports are sufficiently long-term (UNDHA, 1994).

The structure flow of supplies in relief chain is illustrated in Figure 2. Supplies flowing through the relief chain primarily consist of pre-positioned stocks in warehouses, supplies procured from the suppliers, and in-kind donations. Individuals, governments, and private sectors contribute in in-kind donations (Holguin-Veras et al. 2007). Supplies are shipped from various worldwide locations to a primary warehouse, which is usually located near a sea or airport, it is then moved to a secondary hub to be sorted. From the secondary hub, supplies are transferred to tertiary hubs, from where it is moved to the beneficiaries. The strategic pre-positioned warehouse will provide storage capacity and act as staging areas for response, which does not necessarily involve large stockpiles, with a focus on rapid local procurement capability (Scott-Bowden, 2003).

After a disaster occurs, the demand for aid supplies is likely to change over time. Items that are needed immediately at the earliest stage of relief operations tend to be stocked in the pre-positioned facility locations, while other items are safely supplied during the later stages of the relief effort. The pre-positioned stocks vary and choose to meet the immediate needs of those affected; they included food items, non-food items, medical supplies and equipment. Pre-disaster facilities are used for pre-positioning relief items, whereas post-disaster facilities are regional and local rescue centres (Doyen et al. 2012).

Figure 2. Example structure of pre-positioned relief chain



Source: Modified from Beamon and Balcik (2008), Balcik et al. (2010)

Relief organisations have established the pre-positioned strategic model in recent years, after carrying out extensive work to strengthen its logistical preparedness and capacity (Scott-Bowden, 2003). Many stockpiles of disaster relief times have been established and are being operated by a variety of organisations around the world. The locations of some of the pre-positioned warehouses that are operated by some of the humanitarian relief organisations are presented in Appendix 1. It is interesting to note that there are more than fifty stockpiles of disaster relief items, located in similar countries. Also the organisations implementing pre-positioned warehouse strategy are increasing in similar locations. All emergency stockpile holders stressed the promptness of the response is crucial in emergency situations and that the cost of delivery is of secondary importance. UNHRD developed the ‘four corner’ concept establishing strategic response depots to cover the four quarters of the world. It has been studied that pre-positioning of relief supplies near the affected area has proven to be an effective strategy for responding to emergencies (Beamon and Kotleba, 2014). Korea International Cooperation Agency (KOICA) also operates global warehouse in Dubai and Panama to reach the people in need to reduce time and save cost. Cost saving can be met due to the availability of storage space of free of charge by using the facility of UNHRD.

6. Concluding Remarks

Pre-positioning of build, maintain, stock and staff enable rapid response immediately following a disaster. The facilities can be stocked with equipment and non-perish-

able relief items which are built in-country or at regional location. The pre-positioning of stock closely relates to the preparation phase of a disaster and means that the organisation can ensure a rapid response when a disaster occurs. The two frequently mentioned advantages of operating the pre-positioned warehouses are that they are cost effective and reliable sources. As pre-positioning is undertaken in response to a risk profile, the possibility remains that the risk will not eventuate, and the pre-positioning site and equipment will not be used in an emergency response. For these reasons, it is important to consider ways to make a pre-positioning worthwhile, even in the event that no disaster is ever declared.

There are several challenges that need to overcome in order to ensure the smooth flow of the relief logistics. Difficulty in creating an effective pre-positioning plan includes uncertainty about whether or not natural disaster will occur and, if they do, where and with what magnitude. Consequently, operating a pre-positioning policy can be financially prohibitive and there are only a handful of relief organisations who can support the expense of operating international distribution centres to store and distribute relief supplies. Financial limitations and other resource restrictions limit the amount of relief supplies that can be stocked and shipped to disaster areas. Meanwhile, NGOs are encouraged to focus on operational disaster relief activities rather than disaster preparedness because this enables them to reduce expenses or make their relief operation more effective over the long-term. It has also been found that internal transport capacity is one of the most limited resources in determining the capacity where third-party logistics contractors need to be involved. Even though international humanitarian organisations provide warehouse space free of charge, relief organisations consider logistics as their own core competency and prefer to retain their own logistics infrastructure.

Despite of the limitations, it is shown that the need of implementing of the pre-positioned warehouse strategy is increasing in the humanitarian relief logistics. This could not only reduce the time during emergency occurrences when delivering relief items but also cost. Moreover, critical relief items could be standardised in advance before the disaster strikes and would able to avoid the uncertainty of distribution. The combination of the financial and resource limitations usually inherent in disaster relief activities led international relief organisations to establish their own emergency stockpiles. From this aspects, humanitarian relief organisations should also consider implementing pre-positioned warehouse strategy align with their emergency disaster relief to improve their efficient and effective logistics operations.

Acknowledgements

This paper is based on the second chapter of my Ph.D dissertation, “The Pre-positioning of Humanitarian Aid: The Warehouse Location Problem”.

References

- Adinolfi, C., Bassiouni, D.S., Lauritzen, H.F. and Williams, H.R. (2005) *Humanitarian Response Review*, United Nations, New York.
- Balcik, B. and Beamon, B.M. (2008) Facility location in humanitarian relief. *International Journal of Logistics: Research and Application* 11(2): 101-121.
- Balcik, B., Beamon, B.M., Krejci, C.C., Muramatsu, K.M. and Ramirez, M. (2010) Coordination in humanitarian relief chains: practices, challenges and opportunities. *International Journal of Production Economics* 126: 22-34.
- Beamon, B.M. and Balcik, B. (2008) Performance measurement in humanitarian relief chains. *International Journal of Public Sector Management* 21(1): 4-25.
- Beamon, B.M. and Kotleba, S.A. (2006) Inventory modelling for complex emergencies in humanitarian relief operations. *International Journal of Logistics: Research and Application* 9(1): 1-18.
- Brown, B.J. (1979) *Disaster Preparedness and the United Nations – Advance Planning for Disaster Relief*, Oxford: Pergamon Press.
- Byman, D., Lesser, I.O., Pirmie, B.R., Benard, C. and Waxman, M. (2000) *Strengthening the Partnership: Improving Military Coordination with Relief Agencies and Allies in Humanitarian Operations*, Santa Monica: Rand Corporation.
- Chaikin, D. (2003) Towards improved logistics: challenges and questions for logisticians and managers. *Forced Migration Review* 18: 10.
- Chang, Y., Wilkinson, S., Potangaroa, R. and Seville, E. (2010). Donor-driven resource procurement for post-disaster reconstruction: constraints and actions. *Habitat International* 35(2): 199-205.
- Cassidy, W.B. (2003) A logistics lifeline. *Traffic World* October (27): 1.
- Doyen, A., Aras, N. and Barbarosoglu, G. (2012) A two-echelon stochastic facility location model for humanitarian relief logistics. *Optimisation Letter*, 6: 1123-1145.
- EM-DAT (Emergency Events Database) (2008) *Emergency Events Database* Centre for Research on the Epidemiology of Disasters (CRED).
- Ernst, R. (2003) The academic side of commercial logistics and the importance of this special issue. *Forced Migration Review* 18: 5.
- Fritz Institute (2005) *From Logistics to Supply Chain Management: The Path Forward in the Humanitarian Sector*, Fritz Institute.
- Gustavsson, L. (2003) Humanitarian logistics – context and challenges. *Forced Migration Review* 18: 6-8.
- Hale, T.S. and Moberg, C.R. (2005) Improving supply chain disaster preparedness – a decision process for secure site location. *Distribution and Logistics Management* 35(3): 195-207.
- Holguin-Veras, J., Perez, N., Ukkusuri, S., Wachtendorf, T. and Brown, B. (2008) Emergency logistics issue affecting the response to Katrina. *Transportation Research Record: Journal of the Transportation Research Board*, 24(2): 212-224.

- Kaatrud, D.B., Samii, R. and Van Wassenhove, L.N. (2003) UN Joint Logistics Centre: a coordinated response to common humanitarian logistics concerns. *Forced Migration Review* 18: 11-14.
- Kovacs, G. and Spens, K.M (2007) Humanitarian logistics in disaster relief operations. *International Journal of Distribution and Logistics Management* 37(2): 99-114.
- Kovacs, G. and Spens, K.M. (2009) Identifying challenges in humanitarian logistics. *International Journal of Physical Distribution and Logistics Management* 39(6): 506-528.
- Lee, H.W. and Zbinden, M. (2003) Marrying logistics and technology for effective relief. *Forced Migration Review* 18: 120-126.
- Long, D.C. and Wood, D.F. (1995) The logistics of famine relief. *Journal of Business Logistics* 16(1): 213-220.
- Pettit, S.J. and Beresford, A.K.C (2006) Emergency relief logistics: an evaluation of military, non-military, and composite response models. *International Journal of Logistics: Research and Applications* 8(4): 313-331.
- Rawls, C.G. and Turnquist, M.A. (2010) Pre-positioning of emergency supplies for disaster response. *Transportation Research Part B* 44:521-534.
- Scott-Bowden, P. (2003) The World Food Programme: augmenting logistics. *Forced Migration Review* 18: 17-19.
- Thomas, A.S. (2003) Why logistics? *Forced Migration Review* 18: 4.
- Thomas, A. and Kopczak, L. (2005) *From Logistics to Supply Chain Management. The Path Forward in the Humanitarian Sector*, Fritz Institute.
- Tomasini, R.M. and Van Wassenhove, L.N. (2009) *Humanitarian Logistics*, London: Palgrave MacMillan.
- Tzeng, G.H., Cheng, H.J. and Huang, T.D. (2007) Multi-objective optimal planning for designing relief delivery systems. *Transportation Research Part E* 43(6): 673-686.
- UNICEF, Warehouse Operations, Accessed December 1, 2016. https://www.unicef.org/supply/index_warehouse.html.
- UNHRD, Our Depots, Accessed December 1, 2016. <https://www.unhrd.org/page/our-depots>.
- UNOCHA, Emergency Stockpiles, Accessed December 1, 2016. <https://www.unocha.org/what-we-do/coordination-tools/logistics-support/emergency-stockpiles>
- Van Wassenhove, L.N. (2006) Humanitarian aid logistics: supply chain management in high gear. *Journal of Operational Research Society* 57(5): 475-489.
- WHO, From a Warehouse in Dubai to a Hospital in Haiti: A Journey of Lifesaving Supplies, Accessed December 1, 2016. <https://www.who.int/features/2016/lifesaving-supplies-haiti/en/>.

Appendix 1. Example of humanitarian global warehouse locations

UN Agencies	Asia	Europe	Americas	Africa
UNDP	Dubai, UAE Kuala Lumpur, Malaysia			
UNFPA	Dubai, UAE			
UNHCR	Dubai, UAE Amman, Jordan	Copenhagen, Denmark		Accra, Ghana Douala, Cameroon Nairobi, Kenya Isaka, Tanzania
UNHRD (WFP)	Dubai, UAE Kuala Lumpur, Malaysia	Brindisi, Italy Las Palmas, Spain	Panama, Panama	Accra, Ghana
UNICEF	Dubai, UAE Shanghai, China	Copenhagen, Denmark	Panama, Panama	Accra, Ghana
UNOCHA	Dubai, UAE	Brindisi, Italy		
UNAMA	Dubai, UAE			
WHO	Dubai, UAE Kuala Lumpur, Malaysia		Panama, Panama	Accra, Ghana
NGOs				
AAR Japan	Dubai, UAE			
ACF	Dubai, UAE			Accra, Ghana
Care Int'l	Dubai, UAE			
CRS	Dubai, UAE			
CESVI	Dubai, UAE			
Concern Worldwide	Dubai, UAE			
Finn Church Aid	Dubai, UAE			
Mujeres por Africa	Dubai, UAE			
Global Soap Project	Dubai, UAE			
GMMP	Dubai, UAE			
Goal Ireland	Dubai, UAE			
Good Neighbors	Dubai, UAE			
Handicap Int'l	Dubai, UAE			
Humanity First	Dubai, UAE			
Oxfam	Dubai, UAE	Bicester, UK		
IDLO	Dubai, UAE			
IFRC	Dubai, UAE Kuala Lumpur, Malaysia	Las Palmas, Spain	Panama, Panama	Nairobi, Kenya
Int'l Medical Corps	Dubai, UAE Jakarta, Indonesia		Panama, Panama	Accra, Ghana
IOM	Dubai, UAE	Brindisi, Italy		
Int'l Rescue Committee	Dubai, UAE			

InterSOS	Dubai, UAE			
Islamic Relief	Dubai, UAE			
Japan Platform	Dubai, UAE			
Johanniter Int'l	Dubai, UAE			
Linking the World	Dubai, UAE			
Lion Clubs	Dubai, UAE			
Lutheran World Relief	Dubai, UAE			
MEDAIR	Dubai, UAE			
Mercy Corps	Dubai, UAE Bangkok, Thailand			
Mercy Malaysia	Dubai, UAE Kuala Lumpur, Malaysia			
Norwegian Church Aid	Dubai, UAE	Oslo, Norway		
NRC	Dubai, UAE			
Plan	Dubai, UAE			
Permiere Urgence Int'l	Dubai, UAE			
Qatar Charity	Dubai, UAE			
Save the Children	Dubai, UAE			
Shelter Box	Dubai, UAE Kuala Lumpur, Malaysia	Brindisi, Italy	Panama, Panama	Accra, Ghana
Solidarities Int'l	Dubai, UAE			
Swiss Red Cross	Dubai, UAE		Panama, Panama	
ADRA	Dubai, UAE			
Triangle G H	Dubai, UAE			
Welthungerhilfe	Dubai, UAE			
World Animal Protection	Dubai, UAE			
WVI	Dubai, UAE Subang, Malaysia Brisbane, Australia Kuala Lumpur, Malaysia	Brindisi, Italy Frankfurt, Germany	Pacific Northwest, USA Denver, USA North Texas, USA Chicago, USA Appalachia, USA Pittsburgh, USA Greater New York, USA Panama, Panama	Accra, Ghana
Governmental Organisations				
AECID	Dubai, UAE		Panama, Panama	
AHA ASEAN	Dubai, UAE Kuala Lumpur, Malaysia			
Australian AID	Kuala Lumpur, Malaysia			

BM.I	Dubai, UAE			
Cascos Blancos	Dubai, UAE		Panama, Panama	
Cooperazione Italiana	Dubai, UAE	Brindisi, Italy		Accra, Ghana
EU Humanitarian Aid	Dubai, UAE			
ECOWAS	Dubai, UAE			
Government of the French Republic	Dubai, UAE	Brindisi, Italy		
Irish Aid	Dubai, UAE Kuala Lumpur, Malaysia	Brindisi, Italy		Accra, Ghana
Italian Civil Protection	Dubai, UAE			
JICA	Dubai, UAE Kuala Lumpur, Malaysia Singapore, Singapore		Miami, USA	Accra, Ghana
KOICA	Dubai, UAE		Panama, Panama	
MSB	Dubai, UAE			
SDC/HA	Dubai, UAE	Switzerland		
USAID	Dubai, UAE Subang, Malaysia	Pisa, Italy	Miami, USA	

Source: UNHRD (2016), UNICEF (2016), UNOCHA (2016), WHO (2016)

