

RESEARCH ISSUES IN HUMANITARIAN AID SUPPLY CHAIN MANAGEMENT

Avninder Gill*

Abstract

Humanitarian supply chains involve a very high degree of uncertainty in terms of timing, magnitude, location and scope. Commercial supply chain management concepts have shown good potential to address some of these issues. However, there is minimal knowledge available in humanitarian logistics to address these issues. The present paper surveys the relevant literature, outlines the main features of humanitarian logistics operations and compares and contrasts them with the commercial supply chains. The paper also explores ways in which the public sector operations research can help the humanitarian relief operations.

Keywords: Humanitarian Aid, Public Sector Operations Research, Supply Chain

Introduction

Fritz Institute defines the humanitarian logistics as the processes and systems involved in mobilizing people, resources, skills and knowledge to help victims of disaster events. The term disaster is defined as a disruption that physically affects the priorities and goals of a system in a negative manner. Disasters can have various categories. Disasters can be natural (e.g. a flood, Tsunami) or man-made (e.g. a terrorist strike, arson etc). They can also be events with a sudden on-set (e.g. earth quake) or a slow on-set (e.g. drought, refugee crisis). They can also be classified as cyclic and repetitive events or one-time events. Each year, approximately 500 disasters happen that take away 75,000 human lives or otherwise affect 200 million people. With an overall objective to deliver the right amount and type of food and supplies to the affected areas in a timely and cost-efficient manner is the essence of humanitarian relief supply chain management. Supply chain management acts as a crucial mechanism to convert the disaster preparedness to disaster response, link the procurement channels to the distribution channels, and also acts as a bridge between the headquarters and field operations (Thomas & Mizushima 2005).

*Associate Professor, School of Business & Economics, Thompson Rivers University, 900 McGill Road, Kamloops, BC, Canada, V2C 0C8; Email: agill@tru.ca; Phone: 250-828-5155; Fax: 250-828-5051

The importance of logistics and supply chain concepts has been long recognized in the commercial sector. The vast majority of available literature focuses on managing and optimizing the importance of logistics and supply chain concepts has been long recognized in the commercial sector. The vast majority of available literature focuses on managing and optimizing supply of physical goods and services. The humanitarian relief logistics-although an important application area-has hardly received any attention in the past from logistics practitioners and supply chain researchers. Recently, humanitarian organizations have begun to emphasize the importance of supply chain concepts in relief operations. These types of organizations have mainly humanitarian goals as opposed to commercial supply chains that have financial goals, but majority of the relief organizations essential perform similar logistical functions that you would perform in a commercial setting. United Nations Joint Logistic Centre (an inter-agency service provider) with a mandate to provide logistics information management support and services to humanitarian agencies during complex and large scale disaster is an example of some the recent efforts made in this direction.

Literature Survey

Thomas & Kopczak (2005) discussed some of the challenges faced in humanitarian supply chains and provide a five point strategy to address five pain points. Oloruntoba & Gray (2006) provided a discussion on speed of response and agility and its relevance for the humanitarian aid operations. Pettit and Beresford (2009) reviewed some critical success factors, such as strategic planning, resource and capacity management and discussed their relevance to humanitarian aid supply chains. Thomas and Fritz (2006) outlined the major challenges and issues that exist in forming strategic partnerships in humanitarian aid supply chains. The article also discussed various partnership models and strategies to manage these alliances. Van Wassenhove (2006) provided arguments that the lessons learned in commercial supply chains are equally valid in humanitarian supply chains. The paper emphasized on the importance of supply chain collaboration and also proposed a five-dimensional model for disaster preparedness. Tan-Mullins et al (2007) provided a fairly extensive review on the events surrounding the 2004 tsunami in Thailand. The paper cited examples where the existing localized community networks work more efficiently than the government and outside aid agencies. Tatham & Kovács (2010) introduced the idea of “swift trust” in disaster relief operations, a concept where people in disaster operations develop a trust level far quicker than under normal circumstances and it accords well to achieve the collaboration needed in humanitarian supply chains. Martinez et al. (2011) focused on the

management of 4X4 vehicles fleets and stress on vehicle fleet coordination. Gibbons & Samaddar (2009) used computer simulation to demonstrate the importance of referral networks in health related emergency services. Lodree & Taskin (2009) developed a probabilistic inventory model for recovery planning during hurricanes to assess what would be the optimal delay in decisions to achieve a good balance between logistics efficiency and forecast accuracy. Scholten et al (2010) applied the concept of legality for humanitarian supply chains where the overriding priority for upstream entities is being lean and for downstream it is the agility. Scholten et al (2010) also observed that 80 per cent of humanitarian aid operations costs are supply chain related.

Scope, Issues & Uncertainty

Humanitarian logistics has a very wide scope in terms of the range of activities involved. It deals with response preparedness, resource planning, procurement of supplies and resources, transportation, fleet management, warehousing, tracking and tracing of supplies and their physical distribution. The scope of humanitarian logistics can also be gauged by the types of supplies needed and the associated supply chains that are affected by such operations. The types of supply chains affected by these operations include health, food, shelter, clothing, water, sanitation products and construction equipment. Some of the major challenges in humanitarian aid supply chains include the unpredictability about the timing, type, location, magnitude and the range of supplies needed in a disaster event. Disasters may happen at remote locations with hardly any transportation infrastructure or in most case, the infrastructure would be damaged and dysfunctional due to the disaster event. The nature and magnitude of disaster events makes it hard to predict the type and amount of supplies needed. In most of the natural disaster scenarios, the first 24 hours are very critical as human lives are at stake. Therefore, the disaster response warrants a very fast lead time. Most of the humanitarian aid organizations must operate and coordinate their activities through the local governments which are already in a state of disarray or going through a conflict situation.

Performane Measure and Accountability

In general, humanitarian relief organizations would report to the donors on the usage of funds and supplies for a given relief project. Donors have mainly humanitarian reasons for participating in such operations. However, they are quite justified if they demand accountability and transparency in order to ensure that their donations are used in an efficient and timely manner. However, there is minimal effort to measure the performance on a certain

event and document the lessons learnt. Electronic data repositories and IT capabilities can play a big role to process the data and evaluate the performance measures on relief operations and compare these performances with the past performance and across other events. Such capabilities will allow the humanitarian organizations to identify root causes of performance break-down and address them; achieve continuous improvement on performance measures; will facilitate reporting to the donors and the media; and will enhance the ability of these organizations to generate more donations and pledges. Considerable work needs to be accomplished to develop relevant metrics in the field of humanitarian logistics. Academic researchers can play a big role prescribe such performance measures. Several frameworks already exist in commercial supply chains, continuous improvement measures exist in service sector and in project management, but the frameworks need to be developed for the humanitarian sector. Although the goals of humanitarian and commercial supply chains may differ, but the models such as minimizing the cost of design and operation are still applicable to humanitarian operations. Similarly the measures developed in commercial supply chains for flexibility, agility and fill-rates can be modified in the humanitarian context.

Supply Chain View

The three essential features of a supply chain view are the supply channel, demand channel and the supply chain linkage. These views have been described below (Ergun et. al 2009).

Supply Channel

In humanitarian aid operations, the major supplies consist of relief items, employees, volunteers, and transportation and construction resources. However, most of the supplies fall under the relief items category. The relief supplies that come from the donations present a challenge in the sense that their quantity, mix and timing are highly unpredictable. Certain consumable supplies with a shelf-life may arrive too early to create storage, blockage and obsolescence problems whereas some of the essential items may arrive too late to be used for that particular event. Autier et al. (1990) discuss the case of drug supplies after the 1988 Armenian earthquake where only 30% of the 5000 tons of drugs and supplies sent by international relief operations were used and 20% of these supplies had to be destroyed. Any unsuitable donations may cause transportation clogs and bottlenecks thereby, creating problems in the storage and transportation functions.

Demand Channel

The main consumers in a humanitarian aid supply chain are the people affected by the event as well as the intermediate storage points in the chain. Their requirements change significantly depending on the disaster type and the stage of the event. A high degree of uncertainty is what really sets a humanitarian supply chain apart from a commercial one. Humanitarian workers are always faced with the unknown: when, where, what, how much, where from and how many times. In short, the basic parameters needed for an efficient supply chain setup are highly uncertain (Van Wassenhove, 2006). Demand forecasting is a highly daunting task in humanitarian supply chains due to the lack of historical data. Some databases such as the Emergency Events Database (EMDAT) do exist but they are unusable due to lack of information or due to the fact that for most disaster events, the magnitude, timing and the locations cannot be predicted with a reasonable degree of accuracy. The population, demographics and economic conditions are other dynamic variables which further makes forecasting difficult.

The Supply Chain

The supply Chain in the context of disasters response refers to the network of people and organizations involved through upstream and downstream channels to carry out the processes to deliver commodities and services to the disaster victims. It includes distribution networks, procurement networks, transportation infrastructure and management, warehousing and inventory management, accountability and reporting systems and the last mile connectivity which may require multi-modal networks. The humanitarian supply chain can also be viewed as a linkage for the afore-mentioned supply and demand channels with the help of governments, international aid agencies, volunteer organizations and NGOs. Governments control the overall relief effort through their political, military and economic resources and have a major impact on the outcome of a relief operation. For example, the Indian government refused to receive help from outside agencies in the first phase of 2004 tsunami operations and depended solely on the local sources (Thomas and Fritz, 2006). Coordination and management of humanitarian supply chain is a daunting task as the supplier network consists of various players (donors, NGOs, government, military, and commercial suppliers) who differ in terms of geographical, organizational, cultural, religious, political, and other factors and may not be well-versed in the tools and skills required to be an effective logistician organization.

Commercial versus Humanitarian Supply Chains Differences

Commercial supply chains emphasize on the final customers since the customers are the sources of income and therefore most of the marketing efforts are geared towards customer relationships. In humanitarian supply chains, the end user (i.e. the recipient of aid) does not get involved in a commercial transaction, and therefore, the marketing efforts of the humanitarian organizations focus on the supplier/donors side. Some of the additional differences are provided in Table 1.

Criteria	Commercial Supply Chain	Humanitarian Relief Chain
Demand Pattern	Stable, predictable demand patterns in terms of locations and quantities. Follows demand supply relationships.	Purely random and unpredictable events in terms of timing, location, type, and size. Demand requirements are estimated after an event.
Lead Time	Lead times determined by the supplier-manufacturer-distribution cycles and driven by competition.	Zero lead time requirements between the occurrence of event and the need, but actual lead time are determined by the material flow.
Distribution Network Configuration	Well-defined methods for determining the number and locations of distribution centers.	Challenging due to the nature of unknowns (locations, type and size of events), politics.
Inventory Control	Utilizes well-defined methods for determining inventory levels based on lead time, demand and target customer service levels.	Inventory control is difficult due to high variation in lead times, demand, and locations.
Information System	Generally well-defined, using advanced technology.	Information is often unreliable, incomplete or non-existent.
Strategic Objectives	To produce high quality products at low cost to maximize profitability and achieve high customer satisfaction.	Minimize loss of life and alleviate suffering.
Performance Measurements	Focused on resource performance and financial measures.	Focused on output measures such as response time or ability to meet the needs of an event of a certain magnitude.
Demand	Products.	Supplies and people.

Dependency

Commercial and humanitarian supply chains are highly dependent on each other and complement each other most of the time. A natural disaster such as tsunami or earth quake can severely damage the transportation infrastructure and can cut off the supply lines for commercial supply chains making them dysfunctional and resulting in billions of dollars of commercial losses. On the other hand, a humanitarian relief supply chain immensely benefits from a functional commercial local supply chain. For example, the first 24 hours of the

disaster response are critical during events such as earth quakes as human lives are at stake. The humanitarian relief supply chains cannot wait for supplies from far-off depots and donors. In such cases, the humanitarian relief supply chains have to source from local commercial supply chains for food, medical, water and sanitary supplies until the organizational and donor help starts pouring in. Therefore, it can be seen that although commercial and humanitarian supply chains have certain differences, but each one highly complements the other one in order to be successful.

Role of Operations Researchers

The field of humanitarian logistics has witnessed an uneven growth. The military logistics which are often utilized in emergency relief operations, is a highly developed area. This in fact, is the origin of operations research techniques as the name operations research comes from military operations. However, the integration of this area with the organizations involved in a humanitarian relief work is still in its infancy. Similarly, the highly successful best practices of commercial supply chain and project management have not been fully utilized in the humanitarian context. The rising number of disasters, the higher degree of uncertainty involved and the need for reliability in such operations calls for research efforts in this area. Such efforts can go a long way in saving precious human lives and property. The importance of information flow, inventory management and lead times cannot be overemphasized and so is the need to document the knowledge on best past practices in terms of case studies. Public sector operations research has proved in the past that the analytical techniques developed by researchers in this area have immensely benefitted the mankind. Such work includes improving the efficiency of fire and rescue units, locating fire stations, optimizing the public transportation, efficient health-care supply chain, delivery of blood and essential pharmaceutical supplies, quicker delivery of meals, quickest route problems, collection depot problems, optimizing debris removal etc. However, more work is needed to modify these approaches for humanitarian relief operations in the context of highly variable scenarios, in a limited resource environment under multiple organizational structures and present them as a unified framework for humanitarian supply chain.

There are specific areas where operations management and management science academicians can offer their expertise to transfer knowledge for the benefit of humanitarian supply chains. One area is the supply chain network design and depot location problems for humanitarian supply chains. Another area is to suggest strategic alliance models for the participating organizations. Yet, another potential area is the knowledge management from

past humanitarian projects and develops information systems to disseminate and report this knowledge. Furthermore, models can be developed to take into account the learning effect from past projects to further reduce the lead times in humanitarian aid operations. Whole arrays of tools exist under risk management and project life cycle approaches which can be suitably modified for the disaster responses. The process standardization and quality management tools can also be tailored to ensure the reliability needed for disaster responses. Debris management is another important area that needs attention from operations researchers. Forecasting models for debris location and quantity, and developing network models to decide which areas and roads should be cleared faster to maximize the relief efforts are some of the important research problems in this directions. Furthermore, formation of kits of essential supplies for various disaster types is another potential research problem. Similarly, modeling the trade-offs capacities, budgets, environmental impact of debris management are additional research areas. Finally, as discussed earlier, the performance measures and metrics can be developed for the humanitarian supply chains.

Steps in Humanitarian Logistics

Van Wassenhove et al (2009) and Tomasini & Van Wassenhove (2009) propose an eight step approach to manage an humanitarian relief operation. Below, we briefly outline and explain these steps. Details of these steps are available in Tomasini & Van Wassenhove (2009).

1. Planning & Preparedness

Planning and preparedness are essential for an effective response to a disaster event. *Planning* mainly involves designing scenario-based contingency plans to respond to the disaster events. *Preparedness* refers to the ability to enable a plan by committing and allocating adequate resources.

2. Assessment

Assessment is an exercise that is carried out during the first 72 hours after a disaster to establish the magnitude of the damage, the resource availability and the assessment of the needs of victims. Assessment is a demand estimation step to assess primarily the immediate needs (e.g. water, food, medicines, shelters, clothing etc) and sometimes not-so-immediate needs (e.g. rehabilitation, reconstruction & infrastructure development). Assessment forms the basis for appeals to donors and ensures the right kind of aid is supplied to the right people at right locations.

3. Resource Mobilization

Once the response is underway, humanitarian organizations allocate resources and request additional financial and human resources through the appeal process. Media and broker organizations (e.g. global impact) play an important role here.

4. Donations and Procurement Management

Donations arrive in various forms and from various sources using different routes. Planned and focused donations are meant to meet the needs assessed in step 2 whereas unplanned donations do not necessarily match with the needs. *Procurement* is carried out using available financial resources, pledged resources or on credit. Procurement process places orders and arranges a scheduled delivery at reasonable prices for the humanitarian causes. Most relief organizations prefer local procurement to meet the requirement of short lead times providing economic benefits to communities in distress and that's where one can see the complementary nature of human and commercial supply chains.

5. Transportation and Execution

Transportation fills the time and place gap in humanitarian supply chains to ensure aid at the right time and at the right place. The main transportation modes are air, road, water and animals. What makes this step really challenging is the fact that road infrastructure and port capacities are severely damaged during disaster events and humanitarian organizations have to follow a multi and inter-modal approach.

6. Tracking and Tracing

Tracking-a forward process to identify the path to be followed for efficient and faster distribution of supplies and *tracing*-a backward activity to find where the supplies are in the pipeline and to update the lead times; are the essential concepts to ensure that the supplies are distributed to the right people, at the right time, at the right locations and in the right condition.

7. Stock Management

Stock Management involves managing the inventory of essential supplies at warehouses as well as strategically locating these warehouses to provide coverage for futuristic disaster events.

8. Extended Delivery Points

Extended delivery points (called last mile distribution areas) are the forward staging areas for supplies before these supplies are distributed to disaster victims. These points are selected based on the infrastructure conditions, last mile transportation modes and proximity to

victims. The risks of supplies being stolen, ending up in black market and the security of these supplies are some of the main concerns during this phase.

Concluding Remarks

Humanitarian relief logistics are beginning to benefit from the tools developed by operation management community but at a very slow pace. The present paper brings out important differences in commercial and humanitarian supply chains operations and highlights their dependencies. It also provides a direction for futuristic research efforts and the role operations management community can play in addressing some of these problems. Such efforts by public sector operations researchers can go a long way to alleviate sufferings of victims, save human lives and property.

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