Supply and demand in a humanitarian supply chain commerce essay

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As majority of Supply Chain research is focussed on managing and optimising the commercial supply of goods and services, Humanitarian Supply Chain has received less attention. However, in the current global scenario, due to increasing population and developing infrastructure, more emphasis has been given on the unpredictable emergencies (like earthquake, floods and so on) wherein millions of lives will be at stake and would depend on the adequate and timely supply of food and other resources. In Humanitarian Supply Chain, due to its uniqueness, more emphasis should be given on demand uncertainties and managing and optimising material flow to be delivered to the right people, at right time and to the desired location.

As Humanitarian Supply Chain operates on mission critical projects, time is the critical factor than cost and should be given ample importance. Supplies consist of relief items, personnel/ volunteers, transportation and construction resources and others. Major factor in the supply aspect is the inappropriate timing and quantities to be delivered and arrived. There are many critical issues encountered in the storage and transportation of relief items due to inappropriate delivery and arrival and also due to lack of implementation of appropriate SC strategy (Push and Pull which would be explained later). There have been many cases in the past including major disasters like Tsunami, wherein problems were encountered in transparency in the Supply Chain (lack of Corporate Social Responsibility/ CSR), tracking and tracing of supplies (right quantities including monetary and other resources to be delivered to the desired location).

Customers in a Humanitarian (Disaster) Supply Chain include the population at the affected area and also intermediate customers in the local or global storage facilities and depend on the type of disasters and the timeline. Disaster demand forecasting would also be difficult due to the lack of historical data regardless of maintenance of databases by both NGOs and governments and would sometimes be inadequate due to inappropriate/ inconsistent data collection and reporting problems. Disasters are basically unique regardless of locations and depend on the population structure, economic conditions and so on.

Coordination and management of Disaster Supply Chain has challenging problems. The supply network is very large and involves many players like Donors, NGOs, Government, Military and Suppliers and it is very difficult to coordinate all the items amongst all the players. Despite the different cultural, political, geographical and historical differences among them, collaboration and specialization of the tasks between NGOs, military, government and private business are increasingly needed in the humanitarian supply chains (Van Wassenhove, 2006). Despite having good awareness of key points in the Humanitarian Supply Chain, Logisticians in most NGOs or other Humanitarian Organisations would not be specialised in using the tools and techniques for solving the problems that would occur during the operations. Also, goals and performance metrics of Humanitarian and regular Supply Chains do vary considerably.

Table 1. 1 Differences between Commercial and Humanitarian Supply Chain:

Commercial Supply Chain

Humanitarian Relief Chain

Demand Pattern

Demand pattern is relatively stable and predictable and occurs from fixed locations and in set quantities.

Demand is highly uncertain and unpredictable in terms of location, timing, type and size. Demand requirements are estimated based on the assessment of disaster characteristics.

Lead Time

Lead time would be determined by the Supplier-Manufacturer-DC-Retailer chain.

Zero (approx) lead time requirements (between the occurrence of the demand and the need for the demand) and the actual lead time would be still determined by the chain of material flow.

Distribution Network Configuration

Number and locations of Distribution Centres (DC) are systematically defined.

Challenging and unpredictable due to the nature of unknowns (location, timing, type and size).

Inventory Control

Inventory levels are determined based on well-defined methods on demand, lead time and target customer service levels.

Inventory control is very much challenging due to high variations in the lead time, demand and the location.

Information System

Well-defined with advanced technology.

Information is highly challenging, unreliable, insufficient and inconsistent.

Strategic Tools

High quality product or service at low cost to maximise profit margin and increase customer satisfaction.

Minimise loss of life and alleviate suffering [Thomas (2003)].

Performance Measurement System

Focussed on resource performance measures such as maximising profit margin or minimising the cost.

Primary focus would be on the output performance measures such as the time required to respond to a disaster or the ability to meet or exceed the needs of the disaster (customer satisfaction).

Perception of demand

Products

Supplies and People

1. 2 Relief Mission Life Cycle:

Figure 1. 1 Relief Mission Life Cycle [modified from Thomas (2002)]

There are basically four distinct phases for the life cycle of a relief mission.

1) Assessment: Based on the disaster characteristics, minimal resources are required to identify the need.

2) Deployment: Ramping up of resource requirements to meet a desired need.

3) Sustainment: Operations are sustained for a certain period of time.

4) Reconfiguration: Operations are reduced, and then terminated.

The above life cycle will be experienced by all the Humanitarian Organisations responding to a disaster. After the reconfiguration cycle of the relief mission, there would be occurrence of another deployment cycle related to the development effort.

2. 0 Stakeholders in a Humanitarian Relief Supply Chain:

The following are list of Stakeholders in a typical Humanitarian (Disaster) Supply Chain:

Government

Non Governmental Organisations (NGO)/ Humanitarian Organisations

Suppliers

Donors

Military

Media

Beneficiaries

In a typical Humanitarian Supply Chain, Government and NGOs are the Primary Stakeholders involved in the operation. Governments hold the main power with the direct control over political and economic policies which would affect the flow of Relief Supply Chain. After the 2004 tsunami, for instance, the Indian government did not invite international aid agencies to participate at all in the first 60 days of the relief effort, and functioned during that period with the local sources of supplies (Thomas and Fritz, 2006). Donors, Military and the Media are the other significant Stakeholders in the Relief Supply Chain.

3. 0 Identification of Specific Humanitarian Relief Supply Chain:

The chosen Humanitarian Supply Chain activity is on the Tsunami disaster which took place on 26th of Dec 2004 affecting Indonesia, Sri Lanka and South India. Tsunami was a huge disaster which affected lot of lives, infrastructure and changed the economic level of the country. Tsunami did set a challenge for the Humanitarian Logisticians to respond to the most uncertain relief operations and forecast the uncertain demand with the real time data.

4. 0 Identification of challenges at Macro, Meso and Micro level for the Tsunami disaster Supply Chain:

Micro:

1) Lack of trained logisticians within Humanitarian Organisation:

2) Ad-hoc internal operations (Supply Chain process):

Meso:

1) Limited collaboration and coordination:

2) Contracting agreements

Macro:

1) Policies and political pressure

2) Economic instability

3) Customs and operating procedures:

5. 0 Tsunami disaster Supply Chain Relief process:

Figure 5. 1 Relief Supply Chain (Thomas, 2004) modified by Mizushima

5. 1 Analysis of issues in the Tsunami Relief Chain process:

According to the survey conducted by the Fritz Institute, lot of international Organisations did encounter issues with regards to humanitarian logistics after the Tsunami disaster. The following are the elements of the Tsunami Relief Chain process and shows the issues concerned with them.

1) Preparedness:

This step shows the effectiveness of the plan of action prepared by the Organisations for the disaster relief. According to the survey, original plans developed by the Organisations for the Tsunami disaster relief were not accurate enough to follow the established processes and move efficiently to the next steps of assessment, appeal and resource mobilisation. As per the survey, most of the Organisations involved with the Tsunami relief agreed on the communication processes as one of the root causes of inaccurate original plan of action.

2) Assessment and Appeal:

During Tsunami disaster, most of the Organisations did not have accurate information on the number of beneficiaries, locations and other programs due to the lack of availability of clear ground information. Lack of trained local staff and destruction of infrastructure limiting access to impacted areas made many Organisations unable to leverage knowledge from other Organisations and compensate these challenges in obtaining better information.

Another major issue was the knowledge of the assessment staff conducting the assessment of the information on the tsunami affected regions. As most of the assessment team members were international, the lack of team members with local knowledge and skilled logisticians made them difficult to gather useful information.

3) Resource Mobilisation:

Analysis of resource mobilisation was based on three categories: Financial Resources, Human Resources and Organisational Set Up.

Financial Resources:

The intensity of destruction caused by Tsunami created an exceptional response from People and Organisations around the world. However many Organisations did mention that financial resources were inadequate during the time of the disaster.

Human Resources:

When analysing the mobilisation of Human Resources, the survey did examine the quality, quantity and training level of the staff at the regional, national and international level. Based on the research, it was examined that international staff members were rated to have more expertise; however they were not able to cope with the knowledge of local affected regions.

Also, there were some contracting issues during the relief operation. Many Organisations did implement temporary contracting strategy for 1-3 months and there were only small percentage of Contractor agreements which lasted for more than 6 months and these strategies did arise a lot of issues related to mobilisation of Human Resources to different affected regions.

Organisational Set Up:

4) Procurement:

Although many Humanitarian Organisations had pre-established procurement processes, over half of them did experience procurement delays at the time of Tsunami disaster relief. Many Organisations did chase for same items and with same quantities causing shortages and more delays resulting in the inappropriate execution of the proposed procurement plan.

Many Organisations had pre-established framework agreements with their suppliers for food items, medical supplies and vehicle with latter indicating higher percentage. Only small percentage were allocated to food items due to which many Organisations did face many hassles like shortage of food supplies to be delivered to the desired location.

Also, prioritising solicited from unsolicited donations did have an impact on the Tsunami relief chain. However only some Humanitarian Organisations had established process of prioritising these donations before they were allowed to reach the affected destinations. Finally, lack of Corporate Social Responsibility (CSR) with many Organisations did cause many unethical practices with inappropriate procurement strategy in place and affecting the relief process.

5) Transportation Execution:

Destruction of infrastructure such as roads and airfields and also customs delays did cite many hassles to transportation execution. Many Humanitarian Organisations did encounter problems in assessing the affected locations especially in Indonesia and Sri Lanka which created a lot of congestion for many Organisations for the limited transport capacity through helicopters or on few working roads.

Secondly, there were many delays in the transportation of particular items like medical supplies due to hectic customs procedures at the airport. Also, lack of communication of the changes in procedures including customs and other requirements and shear volume of goods did cause bottleneck to many Organisations.

6) Tracking and Tracing:

According to the survey, many Humanitarian Organisations did use ad-hoc solutions like Excel spreadsheet and manual functionality to update the process of track and trace and only 26% of them used software based technology to handle track and trace process for procured products. Due to this, many Organisations did face bottleneck situation in receiving the regular updates on critical information along the Supply Chain

7) Stock Asset Management:

Most of the respondents stated they had warehousing and inventory management systems and procedures in place and 85% stated they met the needs of the operation. While these systems met their needs, the organizations deployed them in new locations. 71% reported that they did not use already existing regional logistics set-ups, thus obliging them to create novel local structures for this response.

Not all inventories were put into place after the Tsunami struck. Recent efforts have been made to strategically pre-position stock. By looking at the individual responses in the table below, pre-positioning occurs primarily at the international level with only modest success. At the regional level and

below, pre-positioning is not common and when used not able to meet needs. Future work could determine why the pre-positioning did not perform better.

8) Extended Point of Delivery/ Distribution (POD) and Relief to Beneficiaries:

An extended delivery point/ POD is an inland destination close to affected areas wherein goods can be staged before letting them to beneficiaries. During Tsunami relief operation, many Organisations faced lot of problems with limited POD’s and affected other processes in the relief chain.

Monitoring, Evaluation and Reporting:

Monitoring and evaluation create the information base for decision making during the implementation of relief chain. Lack of logistics trained personnel, relying on ad-hoc manual monitoring, evaluation and reporting process than Information Technology (IT) systems caused many Humanitarian Organisations difficult to measure their relief chain’s budget performance, velocity performance, efficiency, and quality against the targeted result (Forecast).

Communication, Collaboration and Coordination:

Basically, collaboration was done based on ad-hoc, “ immediate needs” basis. Many Humanitarian Organisations did struggle to cope with their internal operations and desire to work with other agencies was in vein. Lack of operating procedures, inappropriateness in the relief chain process and lack of optimisation of on-site coordination and management did make these Organisations face the bottleneck situation during the Tsunami relief.

5. 2 Logistics Flows:

Figure 5. 2. a Product Flows

Figure 5. 2. b Information Flows

Figure 5. 2. c Financial/ Cash Flows

Figures illustrate the three types of flows along the Relief Supply Chain.

Physical logistics flows occur between the following processes: Resource mobilisation, procurement, transportation, stock asset management and extended point of delivery.

Information flows connect the following relief chain processes: Preparedness; assessment and appeal; track and trace; monitoring, evaluation and reporting; and communications.

Financial/ Cash flows take place during the subsequent processes: Preparedness; assessment and appeal; procurement; and monitoring, evaluation and reporting.

6. 0 Modelling, Simulation and Optimisation of Tsunami Relief Chain Process:

Modelling and Simulation techniques for the Humanitarian Supply Chain are far different from Commercial Supply Chain. Unlike Commercial Supply Chain, Humanitarian Supply Chain elements such as inventory management, distribution network modelling and transportation planning requires meaningful analytical models for disaster response which can be developed only with the intimate knowledge of the government and NGOs.

Forecast modelling:

One of the tested simulation models for the purpose of forecasting the Tsunami is the Method of Splitting Tsunami (MOST) developed by Titov of PMEL and Synolakis of University of Southern California is the current standard model used at the National Oceanic and Atmospheric Administration (NOAA) Centre for Tsunami Research [NCTR]. This model is capable of simulating three processes of Tsunami evolution: earthquake, transoceanic propagation and inundation of dry land.

The main objective of a forecast model is to provide an estimate of wave arrival time, wave height and inundation area immediately after a Tsunami event. Tsunami forecast models are run on the availability of real time data under uncertain situations.

Tracking and tracing of supplies:

Relief Logisticians must procure and track supplies from appeal to delivery stage of the supply chain ensuring all the relevant financial information and movement of goods along the relief pipeline. Despite their role in providing relief to beneficiaries, logisticians are rarely incorporated in the purchase and development of information technology solutions relating to relief operations (Lee & Zbinden, 2003).

To integrate all the functions across the relief chain and to advance the information technology, Fritz Institute along with the International Federation of the Red Cross (IFRC) has developed Humanitarian Logistics Software (HLS) in order to address many deficiencies present in the current logistics

systems. Based on the analysis performed on the logistics systems used leading NGOs, the following IT software's could be integrated into the Humanitarian Supply Chain in order to achieve the best result from appeal to delivery stage of the relief chain.

SUMA (Humanitarian Supply Management System)/ PAHO

Microsoft- FACTS (Save the Children/ Mercy Corps)

Commodity Tracking Systems CTS2000 (World Vision)

CTS (Save the Children)

Purchase Plus PALMAS (Oxfam/ IRC)

Log 6. 5 (Medecins Sans Frontières)

Disaster Preparedness and Response Modelling:

Disaster preparedness and response modelling consists of four areas:

1) Supply Chain model

2) Point of Distribution (POD) model

3) Demand model

4) Disaster model

These four elements constitute the simulation framework developed by IBM called i-DRuM (IBM's Disaster Response simulation Model). This model can be customised to any type and size of disaster responses.

The Supply Chain Model describes the flow of relief supplies from Humanitarian Organisations to Distribution Centres (DCs), to local governments and finally to the Points of Distribution (POD). The POD distribution model describes about the distribution of relief supplies to victims who gather at POD to receive supplies. The demand model describes the occurrence of disaster victims needing relief supplies with respect to time and location. Finally, the disaster model describes the arrival and progression of disasters with respect to time and location.

The disaster model affects and influences the number of victims (the demand model), activation of supply chain nodes and transportation (the supply chain model) and the efficiency of POD operations (POD distribution model). All these models contribute to the impact of disasters and constitute the overall effectiveness of disaster preparedness and response plans and operations.

The disaster response modelling framework consists of two parts:

1) Simulation

2) Optimisation

Simulation model is developed to understand the adverse impact of disasters, disaster response operations and the results of the alternative policies of preparedness and response.

Analytic models are developed to optimise the relief supply chain and distribution operations.

Development of Analytic Models for Transporting Relief Supplies to POD:

In most disaster scenarios (including Tsunami), disaster relief supplies would reach different PODs at different speed and with varying quantities. In order to reduce the imbalance between the demand and supply and improve the effectiveness of distribution, two analytical models have been developed:

1) Optimal Dispatching Model

This model describes the best destination POD for each shipment from the local region.

2) Optimal Cross shipping (Levelling) Model:

This model determines the most effective cross levelling shipments (time of ship, origination POD, and destination PODs and cross levelling quantity) by considering forecast of anticipated victims in each POD, on-hand inventory, in-transit inventory to PODs, availability and capacity of cross shipping trucks, transit time, minimum shipment size for cross shipping and frequency of cross levelling etc. This model is very effective when the local area is located far away from POD destination.

Role of RFID in Humanitarian Supply Chain:

Radio Frequency Identification (RFID) tags and readers plays an important role in tracking the disaster relief supplies sent from Humanitarian Organisations to Distribution Centres (DCs), to local governments and finally to the Points of Distribution (POD). It helps in optimising the process of effective management of stock assets.

Hence with the implementation of appropriate simulation models and IT technologies to the Tsunami disaster relief operation, optimisation of relief supply chain response would be very effective.

7. 0 Push and Pull Strategy in a Humanitarian Supply Chain:

In a commercial push supply chain, production and distribution decisions are made on long term forecasts and the manufacturer uses orders received from the retailers' warehouses to forecast the demand.

In a pull strategy, true customer demand drives the production and distribution rather than forecasts.

In the context of Humanitarian Supply Chain, with uncertain demand situations, it is difficult to forecast demand on a long term basis based on historical data and would lead imbalance between the demand and supply.

With the pull strategy in place, demand forecast would be based on real time data and there would be reduction in the inventory costs, increase in service levels and reduced bull whip effect. However, as time is a critical factor in a Humanitarian Supply Chain, pull strategy breaks down when lead time becomes too long to react to the unpredictable demand.

These inherent strengths and weaknesses of these two strategies have led to the proposal new Hybrid Push-Pull strategy that takes advantage of the best of each while overcoming their respective drawbacks. In this Humanitarian Supply Chain, the initial stages would follow the Push strategy while the remaining stages would follow the Pull strategy. The interface between the

two stages is generally called Push-Pull boundary. Implementation of hybrid strategy would optimise the inventory management and the supply chain response along the pipeline of the relief supply chain.

Alongside this strategy, decentralisation, pre-positioning and pooling of relief items are key success factors for dramatic improvements in Humanitarian operations performance in disaster response and recovery.

8. 0 Corporate Social Responsibility (CSR) in a Humanitarian Supply Chain:

CSR is about capturing the whole set of values, issues and processes that companies must address in order to minimize any harm resulting from their activities and to create economic (profit), social (people), and environmental (planet) value.

CSR is very important as it is directly linked with micro, meso and macro factors and adds tangible and intangible value to the Organisation. It also offers sustainable competitive advantage to all the stakeholders. As more unethical practices take place in the humanitarian supply chain compared to commercial supply chain, strict compliance with the regulations is required by all the players. With the proper implementation of appropriate strategy and simulation models along the pipeline of relief chain process, Corporate Social Responsibility (CSR) would be optimised effectively.

9. 0 Conclusion:

Many Humanitarian Organisations realised the importance of logistics that played during the outcome of Tsunami. Humanitarian Organisations also realised the value of utilising integrated technology systems to capture and

analyse information resulting in a more effective and efficient relief effort. Also, the analysis of Tsunami Relief Chain process shows that the issues faced by Humanitarian Organisations are primarily common and not influenced by Organisational size. The analysis also mentioned that relief efforts need more attention on the following areas: Assessment, collaboration, human resources and supply chain analysis. The analysis of this case study also mentions about the implementation of strategies and simulation software in order to optimise the Relief Supply Chain response and to integrate, coordinate, collaborate and communicate between all the functions of the relief chain.

10. 0 Recommendations:

Based on the IT simulation software discussed and used by many Organisations including NGOs in the Commercial Supply Chain market could be well used in the Humanitarian Supply Chain as well. Humanitarian Logistics Software (HLS) needs trained logisticians and is very costly to implement at an early stage. However the complete benefit can be obtained once it is thoroughly implemented and integrates all the functions along the pipeline of the Relief Supply Chain. Secondly, implementation of Hybrid Push-Pull Supply Chain strategy would benefit tracking and tracing, inventory management and distribution of relief items.

11. 0 Glossary:

SC- Supply Chain

CSR- Corporate Social Responsibility

NGO- Non-Governmental Organisation

DC- Distribution Centre

POD- Point of Distribution

MOST- Method of Splitting Tsunami

NOAA- National Oceanic and Atmospheric Administration

NCTR- N (NOAA) Centre for Tsunami Research

IFRC- International Federation of the Red Cross

HLS- Humanitarian Logistics Software

SUMA- Humanitarian Supply Management System

PAHO- Pan American Health Organisation

CTS- Commodity Tracking System

i-DRuM- IBM’s Disaster Response simulation Model

IT- Information Technology

RFID- Radio Frequency Identification