The Humanitarian Relief Supply Chain: Analysis of the 2004 South East Asia Earthquake and Tsunami
By Tim Russell

Doctors Without Borders … has already received as much money as it can spend …
What is needed are supply-managers without borders: people to sort goods, identify priorities, track deliveries and direct the traffic of a relief effort in full gear.
The Economist.com (The Economist Global Agenda on January 5, 2005)

The humanitarian relief supply chain aspires to deliver the right supplies to the right people, at the right place, at the right time, and in the right quantities (Cottam, Roe, & Challacombe, 2004; WFP, 2005). It is clear that relief should be supplied but less clear how to deliver it. To accomplish this task more effectively, relief logisticians should abstract their feelings from the process. This research advances efforts in that direction by describing the relief chain, analyzing survey responses, and establishing baseline data for a sector with little formal measurement.

The analysis of the survey, created by the Fritz Institute in collaboration with KPMG, revealed that relief organizations share common problems regardless of size, focus, or structure. While the survey determined that relief delivery was effective, the findings illuminated deficiencies in the following areas: initial assessment, collaboration, trained logistics experts, and supply chain analysis. Finally, the thesis suggests plans to address these issues and future research. Anecdotal evidence from the Tsunami supports these conclusions.

Tsunami Overview
At 7:58 AM, 26 December 2004, a 9.0 magnitude earthquake off the coast of northwest Sumatra produced a series of giant waves traveling at 600 miles per hour. Fourteen hours and twelve countries later the waves reached the eastern coast of Africa. After the water receded, an estimated 300,000 people were dead or missing, placing the Tsunami among the most deadly natural disasters.

The 2004 South East Asia Earthquake and Tsunami was also exceptional in that it was a multi-country, multi–continent event that came and went very quickly. The damage stretched across thousands of miles of coastline and left over five million survivors facing years of painful and uncertain recovery, having lost breadwinners and family members, homes and livelihoods.
(Darcy, 2005). The long-term economic impact of the disaster is difficult to measure. The United Nations reports $6.8 Billion USD has been pledged for Tsunami relief and recovery (FTS, 2005), the last five years only averaged $361 Million USD per year. Estimates of damage from insurance companies have been almost twice that amount. It may take years before the true scope of the economic damage is known. The relief chain enables humanitarian organizations to translate donors’ generosity into assistance in support of those in need.

**Relief Chain Processes**

The relief chain links stakeholders in the relief process – donors, humanitarian organizations, military, governments, and beneficiaries. This is difficult. Often large amounts of people, food, shelter, clothing, heavy machinery, and medical supplies must be moved into and around the disaster area using different modes of transportation. This must be done quickly, while holding down costs. Haghani and Oh (1995) describe the relief chain as a multi-commodity, multi-modal network flow problem with time windows, a complex problem in operations research.

Traditional supply chain activities such as planning, forecasting, procurement, transportation, warehousing, and delivery are supplemented by appeal and mobilization in relief chains. Anisya Thomas, Managing Director of the Fritz Institute, subdivided the relief chain into processes. It was further modified by Mitsuko Mizushima, Chief Logistics Officer of the Fritz Institute, in preparation for the 2005 Humanitarian Logistics Conference in Geneva, postponed from January until April due to the Tsunami. The processes are pictured in Figure 1.

\[\text{Figure 1 Relief Chain (Thomas, 2004) modified by Mizushima}\]

Relief chain processes differ from commercial supply chain processes. While preparedness corresponds to planning and assessment to forecasting, other processes are unique
to relief chains. After assessing needs, relief organizations launch an appeal where they ask for contributions to fund their efforts. In the commercial sector, resources are previously mobilized as part of an ongoing process. The relief sector must obtain financial and human resources and make them available. Tracking and tracing, while present in both types of supply chains, are inadequately developed in the relief chain. In fact, tracking is usually done in Excel. The resulting lack of visibility into inbound shipments impedes the tasks of receiving, clearing customs, shipping to intermediate warehouses, and distribution along the supply chain. The last difference between relief and commercial supply chains centers on monitoring and evaluation. Most humanitarian organizations do not monitor supply chain metrics and thus have an imprecise picture of their own performance. The systems that can provide the data necessary to evaluate performance are expensive and require training. Relief organizations prefer to spend money on programs rather than systems that donors may view as overhead.

**Tsunami Relief Chain Survey**

The survey thoroughly investigated the relief chain and its processes. The intent of this survey was to collect data from organizations involved in Tsunami relief operations building on anecdotal accounts with numerical data to identify supply chain issues and opportunities. These data were used to bring to light problems and inefficiencies, determine the causes, and benchmark current practices. Results were shared with the relief logistics community in order to foster discussion, create plans for improvement, and enhance the design of future surveys.

The Fritz Institute delivered the comprehensive twenty-two page survey to 39 organizations actively participating in the Tsunami relief effort. The survey achieved a 47% response rate as 18 surveys, with input from over one hundred people, were returned by April 8, 2005. Headquarters and field operations staff consolidated responses while completing the survey in order to provide a more complete picture. After collecting the surveys, the data were entered into a database at MIT and analyzed in partnership with the Fritz Institute. Problems common to those responding to the Tsunami are discussed below.

**Relief Efforts and Issues That Hinder Them**

During relief efforts problems, obstacles, and hindrances can derail or delay the delivery of goods to those in need. These pain points are seen repeatedly in relief efforts around the world. Examples from the Tsunami are discussed below.
Unsolicited and Unsuitable Goods

The Tsunami generated an incredibly generous response. A portion of that response has been unsolicited goods donated by individuals, groups, and corporations. Relief aid is sensitive to context. In general, goods are location sensitive and expensive to transport, due to both weight and the location of the people that need it. The beneficiaries are often in hard to reach locations or in places with damaged infrastructure. The goods need to be culturally and technologically appropriate. These facts appear straightforward, yet disasters elicit unsolicited and unsuitable goods. These donations can be ineffective and consume precious time and resources.

In Sri Lanka, unwanted aid accumulated at government buildings, aid agencies, and refugee camps. Many weeks after initial appeals for water, significant numbers of boxes of bottled water continued to arrive after water and sanitation services were restored. Water is heavy and expensive to transport. Winter jackets, winter tents, expired cans of salmon, cologne, high-heeled stiletto shoes, and sequin-studded black evening dresses were sent by well meaning people and organizations (Barta & Bellman, 2005). More widely reported were the donations of thong panties and Viagra from Australia. While useful, items can be technologically inappropriate. For example, without technology canned food donations destined for victims living in camps without can openers and baby bottles sent to refugees in Sri Lanka who lack the ability to sterilize them are unsuitable. Other items are culturally inappropriate. Bath gel, lotion, and other western cosmetics are novel and confusing. Used clothes, kitchen utensils, and pots and pans frustrated those they were meant to help. In refugee camps, these secondhand clothes were used as potholders when cooking over open fires (Senanayake, 2005). The victims of the Tsunami would be better served if money were sent to relief workers in the region who know the needs and cultural sensibilities of the people they are serving.

Wasted time and effort are also associated with unsolicited donations. A survey respondent wrote about a shipment of unsolicited medical supplies. It took three weeks of one person’s time to unload and catalog the supplies. In Sri Lanka, an organization spent time passing goods through customs, cataloging and separating them, and shipping them out to be distributed, only to have the local population refuse them. They felt that they should not be expected to wear clothes that someone else threw away. A rumor that the used clothing was removed from dead bodies compounded this problem.
Infrastructure

In disaster relief, infrastructure inadequacies lead to bottlenecks, delays, and congestion at entry points to the disaster area. As goods flood into a region, they can collect at ports, border crossings, and airports due to lack of transportation, permission to enter certain areas, or even roads.

In Sumatra, for example, the major airports and seaports were open; the infrastructure beyond them was damaged. Banda Aceh's small airport went from three flights a day before the disaster to round-the-clock traffic. Insufficient ground crews to handle goods slowed the unloading of planes. Undamaged vehicles to transport unloaded supplies were in short supply and had difficulty moving through the region. The large trucks that could get through traveled on cleared roads and were unable to reach victims away from the roads. Limited storage space led to offloaded cargo that quickly filled available tarmac space. As a result, helicopters became a much-coveted asset, as it was easier to fly in supplies than to transport them overland.

Assessment

Directly after a disaster, work must be done to determine the nature of the disaster, the extent of the damage, the initial needs of the victims, the secondary threats to the population, the local response capacity, the need for international assistance, and the means for delivering any needed assistance. Recommendations must be clear, concise, timely, practical, and operational. They become blueprints for planning disaster response activities (USAID OFDA, 1998; UNDAC assessment procedures, 1995).

Assessments are snapshots of a changing situation. Makeshift refugee camps were situated near Lhokseumawe, a port city in Aceh Province, Indonesia. An organization noted their location during an assessment. When the relief team sent by the organization arrived, the camp was no longer there (Hilarie Cranmer MD, personal communication, February 18, 2005). The supply chain created to serve that population had to be changed. This happens in refugee camps on a smaller scale as refugees search for family members and leave to live with relatives.

Political Pressures

In some cases, Tsunami aid became politicized adding unpredictable constraints to the relief logistics. Both national and dissident groups wanted to control aid for areas of Indonesia
and Sri Lanka experiencing internal security disputes. Customs regulations became a tool used by the government to shape organizational responses. Relief was delayed until governments could relax requirements and communicate new rules to customs officials. Radios and communication equipment were treated as sensitive items due to the possibility that the equipment could end up in the hands of rebel groups. India turned down Tsunami relief due to its desire to project itself as a self-sufficient regional power and its campaign to become a permanent member of the UN Security Council. The Indonesian government denied the US military permission to land in Sumatra. Even visits by dignitaries slowed relief efforts. These political acts consequences felt by relief chains.

**Financial Supply Chains**

The financial response from public and private donors to the Tsunami was unprecedented. However, before relief could begin to flow, the financial supply chain must be in place. This is a difficult process in the beginning and takes time. Meanwhile, available cash reserves are quickly depleted. Before the processes for money transfers are in place and agreements with local banks and merchants are formalized, organizations can struggle.

In the first few days, cash flow problems abound. In areas with less developed banking infrastructure, organizations have used their creativity. In response to the survey, two NGOs reported difficulties during the early stages of their Tsunami response. They wrote that while financial resources were available, they encountered problems with cash availability. Immediately after the Tsunami, banks were closed in Jakarta due to Christmas holidays and the weekend. This complicated cash transfers from Europe and made it difficult to enter into agreements with merchants. Competition can hinder progress in this arena as well. An organization reported a problem hiring local staff as the cost of hiring labor off the local market was higher than they could offer.

**Competing Supply Chains**

When legions of humanitarian organizations flock to the scene of a disaster to help those in need, they need many of the same items concomitantly. As each agency sets up its own supply chain and starts procuring necessary supplies, the multiple relief chains can compete against each other. This is wasteful and slows the relief process. Humanitarian organizations are engaged in a
form of market-based survival. They must generate and sustain resources in order to survive. By responding to a disaster, organizations demonstrate their worth. This makes it difficult to eliminate competition of this kind.

In Indonesia, competing supply chains compounded the severe shortage of vehicles. Early on, every vehicle on the market was purchased. This forced other groups to import vehicles from abroad, slowing the relief effort. These competitive problems are found outside of the affected region. During the first week following the Tsunami, there were stories about hardware stores in Guam and Singapore being emptied. Organizations came in and bought all the shovels, hammers, nails, lumber, and generators in stock (Baum, 2005).

**Survey Findings**

Following the Tsunami, public health experts warned of a secondary disaster set to befall the survivors with of as many as 100,000 additional deaths due to disease and hunger. Instead, the relief effort was effective as food, medicine, and other goods were delivered as fast as transportation could be arranged. The survey reflected the excellent logistics work accomplished, perhaps resulting from the strong financial response to this disaster.

The analysis showed that the issues organizations face are fundamentally common and not significantly influenced by organizational size. It provided baseline numbers describing organizational responses. It also indicated that relief efforts need more attention on the following areas: assessment, collaboration, human resources, and supply chain analysis.

**Assessment:** Organizations responding to the survey were unable to specify accurately what was needed for the relief effort. Poor and damaged infrastructure, the lack of a pre-existing presence in separatist regions, and the limited availability of local and trained staff to perform assessments negatively impacted the organizations’ capability to produce better-quality information from the affected areas.

**Collaboration:** After the Tsunami, relief organizations descended on the disaster zone. They fought to involve themselves in the relief effort and justify their existence to their donors. One survey respondent reported, “Relief assistance reached a saturation point in Banda Aceh.” These competing supply chains caused bullwhip effects in procurement and congestion.
throughout the network. This competition reduced organizations’ ability to maximize donations from the corporate sector and to provide effective relief.

Coordination worked well for immediate needs, but was neglected when planning sustained needs. Inter-agency coordination hubs were used but could have been further utilized. More pre-disaster planning and quicker implementation could help utilization in the future. On a positive note, UNJLC’s high quality website, logistics bulletins, and maps were valuable tools in coordinating logistics and operations.

**Human resources:** The scarcity of trained and experience logistics personnel led to significant organizational reassignments. With no local capacity or staff, organizations pulled logisticians from other programs and disasters. This possibly reduced the effectiveness of relief efforts that lost personnel. Further, organizations may have ineffective processes to develop logistics skills in local staff. The general lack of logistics expertise reduced organizations’ capacity to implement their defined processes and led to more of an ad-hoc approach.

**Supply Chain Analysis:** Supply chain processes were in place but were primarily supported by manual or Excel-based systems. Relief organizations did not monitor the supply chain for operational improvement. Instead, donor reporting requirements drove information collection. Organizations assessed the performance of their pre-positioned stock rather poorly but were not clear on why it performed poorly. Once organizations understand the benefit of supply chain analysis, new information technology solutions can play a role to collect the necessary information and make reporting straightforward.

**Future Research**

Using the 2004 South East Asia Earthquake and Tsunami as a focal point, this research investigated the relief supply chain and identified areas that hampered the relief effort. Issues that can be addressed in future research include lack of trained staff, poor coordination, and underutilization of metrics. Future research should investigate these areas as well as look at further developing relief chain surveys, pre-positioning of stock, public / private partnerships, and donation earmarking.
**Bibliography**


