3-2004

Supply Chain Management in Humanitarian Relief Logistics

William K. Rodman

SUPPLY CHAIN MANAGEMENT IN HUMANITARIAN RELIEF LOGISTICS

THESIS

William K. Rodman, Captain, USAF

AFIT/GLM/ENS/04-16

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AFIT/GLM/ENS/04-16

SUPPLY CHAIN MANAGEMENT IN HUMANITARIAN RELIEF LOGISTICS

THESIS

Presented to the Faculty

Department of Operational Sciences

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

William K. Rodman, BS

Captain, USAF

March 2004

AFIT/GLM/ENS/04-16

SUPPLY CHAIN MANAGEMENT IN HUMANITARIAN RELIEF LOGISTICS

William K. Rodman, BS
Captain, USAF

Approved:

_____	_____
Stephan P. Brady, Lt Col, USAF (Chairman)	Date
_____	_____
Kirk A. Patterson, Maj, USAF (Member)	Date
_____	_____
Guy J. Fritchman, M.S. (Member)	Date

AFIT/GLM/ENS/04-16

Abstract

Hundreds of millions of people are affected by disasters each year. This thesis explores the use of supply chain management techniques to overcome barriers encountered by logistics managers during humanitarian relief operations. Using grounded theory methodology, barriers were analyzed based on academic, organizational, and contemporary literature. Possible solutions to these barriers were selected from available supply chain management literature. This work is different from others in that it marries supply chain principles from different disciplines (including private, nonprofit, and military sectors) to benefit humanitarian operations. It also serves to advance the body of knowledge so that future managers can build upon the concept. The result of the study puts forth a simple framework of supply chain management solutions for overcoming logistics difficulties during relief operations and explains why managers should consider their use.

I would like to express my sincere appreciation to: my committee for allowing me to address such an important topic, my wife and friends for keeping me mostly sane, and Thor Heyerdahl for reminding me that much of the adventure is hidden in its preparation.

Table of Contents

Page

Page

List of Tables

Page

SUPPLY CHAIN MANAGEMENT IN HUMANITARIAN RELIEF LOGISTICS

I. Introduction

Background

According to the International Federation of Red Cross/Red Crescent Societies (IFRC), disasters resulted in 24,000 deaths, affected 608 million people, and caused $27 billion in damage worldwide in 2002 (IFRC, 2003). The numbers show the effects of natural disasters such as earthquakes, floods, and hurricanes, as well as manmade disasters such as chemical accidents. A disaster is any event which causes widespread human suffering, and may also be characterized as an event responsible for a breakdown in the normal functioning of a community that also overwhelms local response capability (PAHO, 2000:4 and PAHO, 2001:1). Whether natural or manmade, all disasters have wide scale human suffering in common. Without mobilization of aid missions from countries around the globe, the cumulative damage would be much worse.

Emergency relief involves many of the same logistics processes encountered in the private sector, but modern logistics practices have only recently been applied to disaster aid and recovery. Humanitarian logistics is slowly emerging as its own discipline within supply chain and logistics management. Thomas explains that "Humanitarian logistics refers to the processes and systems involved in mobilizing people, resources, skills, and knowledge to help vulnerable people affected by natural disasters and complex emergencies" (2003:3). This discipline is comprised of "a range of

activities similar to private-sector logistics including transport, tracking and tracing, customs clearance, local transportation, warehousing and last mile delivery," (Thomas, 2003:3) as well as procurement, forecasting, and insurance (Moody, 2001). The Pan American Health Organization states "it is crucial to keep in mind that these components are closely related, like links in a chain that depend on each other, and that the rupture or poor functioning of any one of them will affect the performance of the others" (PAHO, 2000:16). No matter what your definition of "supply chain," the need for a systems-approach or global-view of the entire relief effort is critical to managing the web of interrelated mission segments. In the systems approach, "all functions or activities need to be understood in terms of how they affect, and are affected by, other elements and activities with which they interact" (Stock and Lambert, 2001:4). The objective is to operate the whole system effectively, not just the individual parts (Coyle and others, 2003:58).

In emergency humanitarian logistics, managers must also realize that time value is more important than transportation value. That is to say, it is more important to transport aid quickly than it is to waste time using cheaper, slower transportation. Logistics is critical to the assessment of need and rapid mobilization of personnel, equipment, and material in response. "Inventory management in relief operations is unique in that the time value of the commodities are much greater than the inventory carrying costs. Having the food available and moving it as rapidly as possible is much more important than holding minimal stock levels" (Long and Wood, 1995:221). Expedited deliveries are the cornerstone of humanitarian logistics.

The unique nature of humanitarian emergencies is explained by Long and Wood. They give four reasons for the complexity of humanitarian logistics (Long and Wood, 1995:213). The first reason is the tendency of emergencies to occur in undeveloped regions where populations and infrastructure are more vulnerable. Second, since donors are the source of funding and demand precise accountability for how aid is administered, they are the considered the primary customers. This is in contrast to the small amount of control that victims can exercise over the aid process. Third, there is a blending of military and commercial delivery characteristics due to the absence of profit motive, competition for funds, and desire to deliver aid in the fastest and most efficient manner. Finally, political considerations such as customs and entry requirements complicate rapid reaction to the disaster. Long states that "relief operations are often described as 'paramilitary' because they are special events that take place in an emergency environment. In contrast to disaster relief, industrial logistics are designed for more routine actions such as repetitive manufacturing" (Long, 1997:26).

Hundreds of governmental, non-government (NGOs), and private organizations donate manpower, money, and material resources to aid the victims of disasters. "The number of disparate actors involved in providing humanitarian assistance complicate efforts to improve coordination" (Byman, 2000:81). In Southern Africa, for example, the World Food Program (WFP) deals with "six different recipient governments as well as several other governments for logistical reasons, and identifying more than 50 partner NGOs which could distribute food to the beneficiaries and also help these agencies to build a relief capacity, toward which most were not oriented" (Stewart, 2003:18). Organizations with different capabilities and specialties provide various levels of

assistance, sometimes creating inefficiencies by duplicating efforts. "The heads of logistics tend to each fight their own battles with little collaboration" (Thomas, 2003:7) and "the highly decentralized, feudal nature of the response system" (Natsios, 1995b:416) is a severe impediment to coordination. "The greatest single endemic weakness of NGOs is their reluctance to cede managerial or programme autonomy towards the goal of greater strategic coherence or managerial efficiency" (Natsios, 1995b:413).

Problem Statement

No standard model exists for using supply chain management (SCM) techniques to provide relief to populations affected by disasters. For managers within the humanitarian sector, coordinating logistics during a relief effort is often a daunting task that can result in the loss of life and resources if not done quickly and effectively. As Anisya Thomas, Executive Director for the Fritz Institute, states, "humanitarian logistics has much in common with corporate logistics, yet the best practices from the corporate world, or from other humanitarian organizations in many cases, have not crossed over" (Thomas, 2003:2). And yet, humanitarian logistics offers challenges rarely faced in commercial operations.

Research Objectives

The objective of this research is to construct an easily understood framework of solutions to logistics problems encountered by humanitarian organizations. As explained later, some of the barriers facing humanitarian organizations are unpredictable demand, degraded infrastructure, difficulties with personnel, and funding issues. The proposed solutions will be based on SCM methods used in other humanitarian organizations, the military, and the private sector to overcome similar problems. The research will require

the identification of critical relief resources and barriers followed by an analysis of current SCM practices from multiple sectors. The end result will be both a tool for humanitarian logisticians in the field and a cornerstone for further discussions regarding standardized logistics policies and practices within the humanitarian sector.

Methodology

Following the methods of Strauss and Corbin (1990), the principles of Grounded Theory will be used to identify common elements from the private and humanitarian sectors. The results are "emergent" in nature because information from multiple disciplines are being dissected, categorized, and woven together to form a single approach. The results will lay the groundwork for further analysis, experimentation, operational practice, and eventual institutionalization.

Assumptions and Limitations

The main focus of this paper will remain on initial response to humanitarian emergencies involving natural disasters, civil conflict, and war, which affect 200 million people per year (Thomas, 2003:3). This is not intended to discount the tragic consequences of longer term crises such as epidemic disease and famine, which may benefit from the implementation of many of these same methods, but serves to reinforce the unique problems involved with rapid onset and complex humanitarian emergencies. In any case, humanitarian organizations seek to rapidly provide relief as soon as a problem is recognized.

Focusing on those disasters which require the most rapid response also eliminates branches of the relief sector specializing in disaster prevention, reconstruction, and development. Relief logistics could be classified as a form of "event logistics" whereby a

network of activities, facilities, and personnel are assembled and deployed for an event (a relief mission in this case) then withdrawn after the event concludes (Coyle and others, 2003:40). Relief operations are the first in a series of events set in motion by a disaster. These activities are relief, recovery/rehabilitation, development, mitigation, and preparedness. This paper primarily deals with logistical elements of the relief phase. For the purposes of this paper, the most urgent demands of emergency disaster relief are: search and rescue, food, electricity, water, medical (life saving as well as epidemiological), and sanitation (garbage, sanitary sewer) and temporary shelter (Aall 2000:125 and Natsios 1995:407).

In addition, this paper assumes that the reader is familiar with transportation, warehouse, and inventory management techniques at the organizational level. Many resources are available for further reference in these areas, and each organization is likely to have previously established policies. The reader should consider the recommendations of this text for strategic level implementation between his/her organization and partner organizations.

Implications

This work is different from others in that it marries supply chain principles from different disciplines (including private, nonprofit, and military sectors) to benefit humanitarian operations. It also serves to advance the body of knowledge so that future managers can build upon the concept. As Moody states, “Emergency relief logistics is also one of the most unheralded parts of the logistics sector, and little has been written about it” (2001). The resulting document will be an up-to-date catalog of demands and

barriers facing humanitarian organizations in the days immediately following a disaster and will give an array of possible solutions for overcoming those barriers.

Although admittedly qualitative in its current form, future research might expand on the observations and categorizations found herein to provide quantitative evidence that commercial SCM methods can be successfully used during relief operations. With further research and adaptation to unique organizational mandates, the proposed framework could eventually serve as common reference for further discussions on standardizing logistics practices within the realm of humanitarian operations.

II. Literature Review

Background

This literature review will identify the critical requirements for the initial stages of emergency response, analyze barriers to efficient relief logistics, and propose solutions to those barriers. The chapter will conclude with an examination of the current practices of a few prolific humanitarian organizations and a brief consideration of benchmarking.

Critical Requirements for Emergency Response.

Humanitarian logistics plays an integral role in response and recovery following a disaster. As previously mentioned, this paper will focus on those resources needed in the days immediately following a disaster. Primarily, these resources are required to save lives and sustain the affected population until they begin the process of rebuilding. This paper will assume the critical resources to be: search and rescue services, food, electricity, water, medical aid (life saving as well as epidemiological), blankets, temporary shelter, and sanitation (garbage, sanitary sewer). These elements were indicated by Pamela Aall (2000:125), Andrew Natsios (1995:407) and PAHO (2000:21). Each category may consist of a combination of personnel, equipment, and supplies. The importance of logistics to humanitarian response cannot be ignored; without the rapid establishment of supply and distribution channels for aid resources, the disaster will certainly be more protracted and damaging for the affected population.

Barriers to Effective Delivery of Aid

Each of the following subsections presents issues that negatively impact logistics operations during humanitarian relief missions. The manager tasked with controlling the

influence of these factors is challenged to direct not only those operations within his or her span of control, but must also consider the effect of the following barriers on his or her agency, partners, and relief beneficiaries.

Uncertainty.

The most challenging obstacle in humanitarian logistics is uncertainty. Usually, there will be no indication as to when a disaster will strike, how many people will be affected, what infrastructure will be left intact, which suppliers will donate, or what other obstacles may arise. Uncertainty can stem from many elements relating to the mission, the organization itself, or nature of the demand. For example, uncertainty may arise from inherent characteristics such as what and how much material is demanded, product traits, process fluctuations, and supply problems (Van der Vorst and Beulens, 2002:424). Van der Vorst and Beulens also recognize how supply chain configuration and control structures, long forecast horizons, decision complexity, poor information reliability, and agency culture may create uncertainty (2002:424-426). As supply chains become larger and more geographically diverse, natural and man-made disasters can also disrupt the supply chain (Simchi-Levi and others, 2003:5). Regarding uncertainty, Sowinski quotes Lynn Fritz, founder of the Fritz Institute:

> "...disasters are the embodiment of randomness. You don't know when they're going to happen, where it's going to happen, and who's going to be affected. This is the ultimate execution of a sophisticated supply chain, particularly from an algorithmic planning basis. Every other supply chain is based on predictability" (Sowinski, 2003:19).

Like their commercial counterparts, managers of logistics in humanitarian missions would prefer the ideal environment of predictable demand, easy access, and cooperative partners. Instead, what commonly occurs is a chaotic, possibly hostile,

environment where every passing minute could mean another life saved. Gooley writes, "The nature of the situation ensures that the business of transporting humanitarian aid is highly unpredictable. Logisticians often have little or no notice of what and how much material they must move, not to mention when and where it is to go" (1999:83). This problem is amplified by distance. Long and Wood note that often the office coordinating the aid mission is far away from the actual disaster site and must make assumptions about the types and quantities of aid that should be supplied. Once response teams are in place at the disaster site, the supply pipeline can transition from a "push" system to a "pull" system based on more accurate needs assessments and communications back to headquarters and donors (Long and Wood, 1995:218). These assessments should also include anticipated needs (PAHO, 2000:21). If supplies are "pushed" through a system, quantities are dictated by an upstream authority with little or no input from the customer. In a "pull" system, quantities are determined at the point of consumption.

Another element of uncertainty creeps in as well-intentioned donors generate supplies and manpower support for the relief effort that are of the wrong type or condition. Variability in quantity, quality, and suitability burdens the process of sorting, storing, and distribution. "When individuals and local organizations respond in times of crisis, they add an element of unpredictability that may unintentionally create logistical headaches for the very organization they are trying to help" (Gooley, 1999:83). The United Nations Disaster Management Training Programme (DMTP) states that "consistently, many of the internationally supplied relief goods flown into countries…prove to be inappropriate and unnecessary…[and] may even be a barrier to more important deliveries" (DMTP, 1993:10). In anticipation of excess, inappropriate, or

unneeded goods, “the logistics pipeline…needs to have at the origin, some mechanism to discriminate among donations” (Long and Wood, 1995:220).

Degraded Infrastructure.

Inadequate transportation and communications infrastructure is another barrier to effective delivery of aid. In the DMTP logistics handbook, it states “the overall effectiveness of relief logistics often depends on the level of prior investment in both the transport and communications infrastructure and how far relief requirements have been considered in the planning” (DMTP, 1993:12). Rapid onset of a disaster may degrade the country’s existing infrastructure to the point where delivery of aid is severely hampered. “Often…transportation infrastructure is in poor condition and cannot handle the huge numbers of refugees, military vehicles, and relief shipments that pour into these areas in times of disaster. (Gooley, 1999:82). “Accurate assessment of the road infrastructure is critical…a road may be a five-foot wide strip of mud only inches above the water line that can accommodate only scooters and livestock, or it can be an eight-lane highway pocketed with bomb craters” (Long and Wood, 1995:225). System-wide, the logistics manager could encounter delivery options ranging through ships, aircraft, rail, and trucks. At the same time, those routes may closed or clogged (Moody, 2001) limiting distribution to pack animals. These are obstacles that must be dealt with on a case-by-case basis due to the unpredictable effects of disasters and the vulnerability of the infrastructure.

Communications.

Poor communication is a major barrier to delivery of aid. Not only are there obvious difficulties associated with speaking to someone using a different language, but the communications infrastructure may be crippled by a disaster (if it ever existed in the

first place). Teams at a disaster site may not be able to communicate upstream with headquarters or donors. The relief agency may not be able to effectively communicate needs to donors. Long and Wood explain that organizational language and terminology may hamper the aid process. For example, some organizations estimate need on a family basis and others use a per person basis. (Long and Wood, 1995:218). Organizations may use different names and definitions for transportation modes, supplies, the composition of worker teams, etc. "Ironically, interorganizational relations are usually a challenge to the relief effort instead of a source of support. Each organization has its own operating methods and goals, and it is only with great effort that they coordinate their plans and share resources" (Long and Wood, 1995:216). This is an indication that organizational and cultural language may lead to procedural difficulties (Long, 1997:28). This inability to coordinate effectively is common during emergency response and is only made worse by disputes between organizations, and reluctance to share information which will ultimately lead to duplicated efforts and wasted resources (PAHO, 2000:5).

Communications problems exist long after the effects of a disaster are mitigated. Sowinski states that a lack of funds at the end of a humanitarian action often limits recording of best practices and tracking of information on complex supply chain conditions. It thereby hampers learning opportunities and institutional memory regarding successes and failures (Sowinski, 2003:20). As the money runs low and the relief mission and its workers fade into the background, it is understandable that events could slip by unrecorded. Another shortcoming of many operations with "wide variation in the quality of field programs and the technical competence of staff" is that beneficiaries and donors often have no way to gauge the effectiveness and accountability of humanitarian

agencies at the field level (Natsios, 1995b:409). Perhaps these barriers are among the reasons that humanitarian logistics is only now maturing as a discipline while international response to disasters has been going on for the better part of a century.

Human Resources.

Poor or nonexistent training ultimately affects the quality of any logistics operation. Field managers are faced with an onslaught of requirements during the relief effort, including demands from the affected population and local government, pressure from international media, monitoring agency attention, and restrictions imposed by donors on how aid is administered. In the midst of this confusion, field operations managers are also faced with recording progress and passing information back to their headquarters and media partners as well as providing a record of events for future managers.

Thomas points out that there may be problems with employee reliability (2003:7) stemming from lack of training. There is a notable lack of employees who are knowledgeable in supply chain or logistics management. Thomas points out that "an actor, an osteopath, an extreme sports enthusiast, a nurse and a country manager" were acting as head logisticians in the organizations she studied. "Neither their backgrounds nor their values are geared toward process improvement" (2003:7). Likewise, Long notes that "most people from development agencies…have backgrounds in public policy or third world development, and professional logisticians are rare" (1997:27).

Humanitarian organizations, especially private voluntary organizations (PVOs) and development organizations, who maintain a presence within a country, will often be the first on the scene when a disaster strikes. Long and Wood state that these "young and

predominantly single…[PVO] staffers are not usually trained for emergency situations" (1995:217). It should be noted that in the United States the term "private voluntary organization" is sometimes used, while most other countries use the term "nongovernmental organization"(NGO) (Natsios, 1995a:69). Natsios goes on to state that most recruits are trained on the job, with few standardized instructional resources, "and where PVO doctrine does exist, it comes out of generally shared experiences and responses, is seldom written down, and is not always followed uniformly" (1995a:70).

The unpredictable nature of disasters makes it difficult to retain well trained employees, and those who have been trained are often volunteers who can only work for short periods before they must return to their "real world" jobs. Organizations may experience as high as 80% annual turnover in field logistics personnel (Thomas, 2003:7), further compounding personnel issues. This results in a constant influx of untrained personnel, inexperienced in the particulars of logistics within the organization and relief as a whole. Natsios makes a dramatic point by stating that the "rolling tide of complex emergencies" has caused organizations to be "drawn into each new major crisis before completing work on the last…this has meant that NGOs and UN organizations are increasingly sending inexperienced staff to the field to run massive operations that even seasoned managers would find intimidating" (1995b:417-418).

The "lack of universally accepted performance indicators" (Macrae and others, 2002:5) makes gauging mission success and learning lessons from the operation difficult. The Sphere Project handbook, though accepted as a reference for performance measures in the humanitarian sector, lacks thorough detail on logistics matters. The book advocates supply chain management to integrate "many different players" (Sphere

Project, 2004:166) but doesn't state specific measures for evaluating performance of the network. The handbook's short supply chain management logistics checklist focuses on accountability, warehouse and distribution management (Sphere Project, 2004:192-193). Even in the United Nations (UN) humanitarian system, "evaluation and lessons learning is something that the IASC [Inter-Agency Standing Committee] has yet to tackle in a serious way" (Jones and Stoddard, 2003:17). Without performance standards, employees have no means to gauge their success and no reference for making their operations better.

Earmarking of Funds.

Another major problem faced by logistics managers in humanitarian organizations is that the donor has significant influence over where and how aid is distributed while the victim is a third party with little voice in the matter (Long and Wood, 1995:225). Funding for organizational support and infrastructure is often neglected under donor demands that as much aid as possible is pushed to victims. Thus, distribution channels may suffer as warehouses, equipment, communications infrastructure, and training remain unimproved or deteriorating. Thomas writes:

> "Donor scrutiny over the usage of funds, concern that contributions flow directly through to beneficiaries combined with earmarking of donations for particular relief operations, drives HROs (humanitarian relief organizations) to focus on direct relief rather than investing in systems and processes that will reduce expenses or make relief more effective over the long-term. Thus, operational disaster response approaches are encouraged by the funding mechanism and strategic disaster preparedness opportunities are discouraged. This results in an underinvestment in infrastructure such as information systems and warehousing facilities, and a reluctance to preposition inventory to improve responsiveness." (Thomas, 2003:7).

As a result, there may be aid available, but the organization may be incapable of effective delivery in a timely manner due to limiting factors in the distribution process.

Organizations may, for example, be "reluctant to spend money on a sophisticated information system that would actually improve their efficiency in the long run" (Long, 1997:29). Earmarking funds specifically for the affected population can also lead to a lack of parts and service support for the truck and planes required to move material aid (Long and Wood, 1995:226) and lack of funding for unallocable costs such as headquarters expenses (Randel and German, 2002:22).

In effect, the earmarking of funds violates the humanitarian ethos of impartiality by placing stipulations on how relief is administered. Macrae and others point out that "the idea of humanitarian aid as a distinctive form of assistance governed by principles of impartiality and neutrality is being gradually eroded. In particular, its independence from the foreign policy objectives of donor states is under threat, both in principle and in practice" (2002:7). This is a political and administrative problem that has underlying implications for logistics managers since earmarking aid focuses the relief agency on delivering the most aid to the most affected populations in the most visible crises, not on promoting efficiency in logistics operations. In effect, "in spite of their nonprofit nature, PVOs [Private Voluntary Organizations] need to compete;…the quality of their field programs affects their capacity to gather government grant funding and their public visibility affects their private contributions" (Natsios, 1995a:72). Donor earmarking of funds and stipulation of how materiel aid is distributed also inhibits rapid progress during relief operations and is noted by Macrae and others as a method to "influence the global policy of humanitarian organizations" (2002:5) because of the fear that funding will be "turned off" if donor stipulations are not met.

Other Barriers.

Many countries have specific dietary needs and. For example some countries have banned foods containing genetically modified ingredients, and Islamic populations have a religious prohibition from using pork products in their diet. PAHO advocates making a careful examination of all types of socio-environmental and cultural aspects so that no segments of the affected population are neglected (2000:23-24).

Special packaging requirements dictate what type of food can be brought into a country. The standard transport container for grain products is a 50kg bag. This is the largest parcel that one person can carry, and is more practical than bulk issue. In addition, bags can easily be loaded and unloaded from many different transportation modes, but they are not impervious to moisture or pests. Medical goods such as pharmaceuticals, blood, and equipment often have temperature and moisture sensitivities, as well as an associated manpower burden thanks to a variety of wrappings and markings that complicate sorting and storage (PAHO, 2000:9).

Long and Wood indicate that there are also challenges posed by inventory shrinkage through damage and theft by parties along the distribution chain (Long and Wood, 1995:218). They note that sometimes the only way to get enough food to the intended population was to flood the pipeline with so much material that the thieves would take their fill and let the rest pass (Long and Wood, 1995:219).

Complex documentation requirements for customs and port clearance can also be a problem (Long and Wood, 1995:225). Aid must sometimes travel through several countries using several modes of transportation. Each time the goods change hands, an inventory must also be done for accountability purposes. Movement may be made easier

by collaborating with local governments to streamline importation permits and internal movement (Stewart, 2003:25), however this may not be possible if the host government does not exercise sufficient control over the ports or if cooperating with that government compromises the humanitarian organization's condition of neutrality.

Potential Methods for Overcoming Barriers

Supply chain management is used to efficiently integrate suppliers, manufacturers, warehouses, and outlets; so that services or products are produced and distributed at the right quantities, to the right locations, at the right time, in order to minimize systemwide costs while satisfying service level requirements (Simchi-Levi and others, 2003:1). For HROs, this means satisfying as much demand for relief services and materials as possible, while reducing the mission cost in terms of funding, manpower, delivery time, supplies, etc. "In a well functioning supply chain, at every link, each unit should treat the next unit as a customer, always focusing on service to the ultimate customer, the end user" (Family Planning Logistics Management/John Snow, Inc., 2000b:25).

Supply chain management is also an exercise in systems theory; i.e., the manager seeks to improve the performance of the entire supply and distribution system by analyzing and improving its components. The supply chain itself is the "system of connected logistics networks between the original vendors and the ultimate final consumer" (Coyle and others, 2003:15). As such, the humanitarian logistics manager is faced with making tradeoffs to serve the affected population. Elements of the supply chain that must be managed include inventory levels, landed costs at the end of the pipeline, information, customer service level, and roles and relationships of partners

(Coyle and others, 2003:22-24). The manager must also be mindful of agency goals, donor policies, host government requirements, security and accountability issues, and a multitude of criteria that may not be so easily defined.

An ideal solution to providing emergency humanitarian aid could be described as:

> "…a contingency approach. The supply line should be able to turn on or off at very short notice. The origin and destination of supplies can change quickly. Management controls are designed to anticipate as many such contingencies as possible, and react to the unanticipated events quickly. Whereas many distribution models are suited for repetitious actions, a model for famine relief would emphasize quick reaction capabilities, and efficiencies are gained from flexibility and effective real time communications. Decision criteria would include many variables that defy quantification, such as humanitarian need" (Long and Wood, 1995:214).

A general strategy for reducing the effect of disasters on the supply chain is to utilize the five steps set forth by the Council of Logistics Management (CLM) for the continuity of supply networks in the commercial sector. Helferich explains the CLM strategy as a simple, flexible, clearly defined sequence of planning, mitigation, detection, response, and recovery (Helferich, 2002:1). He places emphasis on mitigation of harmful effects of disaster on critical components of the firm's supply chain, such as infrastructure, production facilities, supplier networks, transportation networks, information and communications, electricity, water, and other critical services (Helferich, 2002:3). The critical areas are identified though prior planning, mitigation is used to reduce vulnerability to disasters, and "what if" exercises limit confusion in the aftermath. In a broad sense, we can view countries or regions which are susceptible to disasters as Helferich's firm and the HRO and its partners as the supply chain. The same five steps can be transferred from commercial practice to benefit emergency humanitarian response

procedures. Components of these generic approaches will be explored further in the following sections.

Based on the barriers uncovered in the first part of this literature review, a targeted review of SCM literature was undertaken to find solutions. Management methods for dealing with uncertainty, acting on a local or regional scale, improving command and control, conducting assessments, improving collaboration and using logistics information systems will be examined. In addition the use of military partners, resource management, and transportation management methods are considered. Whether implemented in part or in whole, the methods serve to improve response to disasters when applied to the humanitarian logistics network.

Dealing With Uncertainty.

There are many different sources of uncertainty. Although uncertainty can not be eliminated entirely, there are SCM methods which can minimize the effect (Simchi-Levi and others, 2003:5). Many of these techniques focus on reducing performance variability of separate functions in an effort to reduce negative effects on the system. Another method involves using information to forecast supply and demand (Stock and Lambert, 2001:281-282). As explained later, careful collaboration and planning with partners helps cut down uncertainty.

Uncertainty stemming from inconsistent supply can complicate relief planning. To manage donated goods of the wrong type or quantity, Stewart writes that the World Food Programme (WFP) uses port captains at debarkation points to screen donations for usefulness. Wet or infested food and damaged goods are eliminated at the port before it moves inland, eliminating the wasteful transportation of useless goods (Stewart,

2003:19). Sorting out the proper food/supplies early in the pipeline can reduce the amount of improper material being transported, thus freeing transportation and personnel resources to move the items that are truly needed. Even better, the affected country should make a detailed assessment of needs before generating a request for assistance, thus ensuring the importation of "only those materials and help that would be useful because they have been requested based on a real appraisal of needs" (PAHO, 2000:10).

Van der Vorst and Beulens (2002) compiled multiple methods for coping with uncertainty based on comprehensive literature review. Table 1 below is a summary of pertinent strategies. Some of these strategies also serve as solutions for other barriers to effective humanitarian logistics thereby providing further reason to consider their implementation.

Table 1. Dealing with Uncertainty.

Source of Uncertainty	Supply Chain Redesign Strategies
Inherent Characteristics	
Product characteristics, demand, process and supply characteristics	Reallocate the roles partners perform in the supply network Eliminate non-value-adding activities Improve the reliability of supply and production quantity/quality Coordinate and redesign policies Exhange demand, supply, and inventory information
Supply Chain Configuration	
Chain Infrastructure Parallel Interaction Chain Facilities	Change or reduce the parties involved Reallocate the roles partners perform in the supply network Increase frequency for all processes Establish information exchange infrastructure and use it Jointly define network objectives and performance indicators Change the location of facilities
Supply Chain Control Structure	
Information lead time and decision process time Supply, manufacturing, and distribution lead time Order sales period Administrative and Decision Procedure Decision Complexity	Implement information and computer technology (ICT) for information exchange and decision support Reduce non-value-added waiting times Change or reduce the parties involved Change the location of facilities Reallocate the roles partners perform in the supply network Eliminate non-value-adding activities Create parallel administrative and logistics processes Urge partners to increase manufacturing flexibility Coordinate and redesign policies Increase frequency for all processes Decrease lot sizes ordered Differentiate products, systems and processes Simplify structures, systems, processes, and products
Supply chain information system	
Data timeliness Data and definition accuracy and applicability Information availability	Establish information exchange infrastructure and use it Implement (ICT) for information exchange and decision support Reduce non-value-added waiting times Develop a common database Standardize bar coding/radio frequency tags Jointly define network objectives and performance indicators Agree on how to measure logistical performance
Supply chain organization structure	
Authority/responsibility Human behavior	Align employee incentives with network objectives Eliminate or reduce human interventions

Adapted from Van der Vorst and Beulens (2002).

Acting on a Local or Regional Scale

Many authors point out that local authorities, if capable, should be the first source of relief for the affected population (DMTP, 1993:9, Gooley, 1999:85, Long and Wood, 1995:219-221, PAHO, 2000:5, Stewart, 2003:25). This permits a response tailored to the cultures and lifestyles of the victims, stimulates the local economy through increased commerce and use of local labor, keeps the local government involved in the process while preventing issues of infringed sovereignty, and eliminates much of the logistical

burden in transporting and storing supplies from outside the region. Sourcing locally also increases pride and confidence that relief efforts are being conducted effectively. Even "logistical planning should give first priority to information coming from local personnel" (Long and Wood, 1995:221) as this point of demand information is the most accurate and reliable. Logistics planning should be conducted on the regional level rather than from global headquarters to more sufficiently address local needs.

One benefit accorded to large developmental organizations is that they may have personnel already working in a region when a disaster strikes; therefore they are good sources of initial knowledge on local terrain, culture and the immediate requirements of the affected population (Natsios, 1995b:407). For these reasons, indigenous NGOs are also extremely beneficial partners at the outset of relief activities, possessing "an intuitive understanding of local conditions that international NGOs could not hope to equal" (Natsios, 1995b:410). The use of local and national response mechanisms as the first course-of-action is strongly encouraged.

Decisive Command and Control

Probably the single most beneficial step to managing the supply chain is to improve communication, command, and control. This reduces the variances encountered in the supply pipeline by coordinating all entities involved in the chain. Gooley recommends giving a single person ultimate authority and maintaining a strict hierarchy governing communications, operations, and decision-making authority (Gooley, 1999:83-85), a sentiment echoed by PAHO in their recommendation for a coordinator to "act as a link between the segments" (2000:15). The IASC utilizes a humanitarian coordinator (HC) to facilitate inter-agency collaboration. The HC concept supports "the deployment

of a senior and seasoned official to start up coordination…[and] can be used to great advantage, especially for responding to fast-breaking crises" (Jones and Stoddard, 2003:9). The advisor needs the ability to "facilitate coordination among program units and among programs, donors, and other agencies" (Family Planning Logistics Management/John Snow, Inc., 2000a:172).

In a contingency environment, having a coordinator gives all partners one ultimate source to consult in the orchestration of the relief mission. The chain of command also provides structure by which responsibilities and procedures are delineated. Although this ignores the obvious potential for political or religious conflict between partners, the single command and control chain should keep relief operations focused on the victims.

Pre- and Post-Disaster Assessments

Another command and control tool that feeds into information sharing and forecast preparation is the vulnerability assessment. To conduct a vulnerability assessment, a team of experts is sent to a region with known vulnerabilities to record the state of the infrastructure, local response capability, and current status of the population. Detailing ongoing WFP actions in Southern Africa, Stewart writes that "rolling assessments are highly sophisticated and involve analysis of a variety of issues, using both food-related and non-food-related criteria….It takes an assessment to understand the scope and depth of this crisis, which to a casual observer, might not be so apparent" (2003:23). If no organizational personnel are in place, other assessment teams are deployed after a disaster strikes. "Initially supplies are 'pushed'" and when relief personnel arrive, "they reassess the situation, and try to correct the mistakes. Once better

assessments have been made and communicated to the origin of supplies, a "pull" system is put into effect and the process becomes much more effective" (Long and Wood, 1995:218). To further improve the effectiveness of assessments, PAHO recommends that joint examinations of the situation be conducted to gain an "interdisciplinary view" (2001:24). This also lays the groundwork for detailed response plans (DMTP, 1993:25-27) and continued collaboration in the relief effort.

The vulnerability assessment can be a simple census, a series of overlays in a Geographic Information System, or as complex as satellite imagery. One method of rapid needs assessment is "cluster sampling" of residences and statistical extrapolation following the methodology of Drysdale, Howarth, Powell and Healing (2000) used in Chechnya. Cluster sampling estimates needs by surveying representative areas or households and using that data as a basis for statistical inference on what aid is required by the larger affected population. Morrow writes "effective planners and managers look beyond geographical vulnerability to understand how unique social and political patterns in their communities result in accentuated risk for some categories of people" (Morrow, 1999:10). She recommends the method of first gathering data on at-risk groups, followed by establishing mitigation and response programs based on the "Community Vulnerability Maps" and available regional relief capabilities. This is a Federal Emergency Management Agency standard in the United States and could be expanded to regional planning around the globe. The Pan American Health Organization recommends logistical considerations, such as nationwide record of infrastructure vulnerability, strategic resources and consumables, and current status of plans be heavily integrated into these assessments (PAHO, 2000:14-15). Other assessment methods include Risk Map,

Classification and Regression Trees, or Artificial Neural Networks (Stephen and Downing, 2001), and area sampling (Brown, Jacquier, Coulombier, Balandine, Belanger, and Legros, 2001).

Collaboration

Collaborative planning between supply chain partners is another command and control strategy. Collaboration is way to use strategic partnerships with other organizations to achieve a common goal while sharing both rewards and risks (Simchi-Levi and others, 2003:147). Partners may be other HROs, suppliers, donors, government agencies, etc. An HRO considering collaboration should perform a strategic assessment of its needs, goals and objectives before deciding whether a partner would be useful under the circumstances. This sets the stage for evaluating alternatives, selecting partners with the right capabilities, then structuring and implementing the relationship (Coyle and others, 2003:421-424). Some of the traits of the "right partner" are having a stable line of desired products, compatible technology, aligned corporate cultures, sound financial position, and a high degree of trust between top management levels (Karonis, 1999:175). Logistics managers will find that collaborating with fellow organizations for the purchase and transportation of relief supplies allows increased leverage and better bargaining position with suppliers due to the larger amount of services or goods purchased per transaction.

Collaboration is a means to improve system-wide performance. In the business world, the pinnacle of collaborative management is known as Collaborative Planning, Forecasting, and Replenishment (CPFR®). Partners using CPFR participate in demand planning using shared data, execute unified production or service response outlined

during joint capacity planning, and finally fulfill consumer need in a coordinated and comprehensive response (Coyle and others, 2003:83-84). By motivating all players towards a single goal, the entire system becomes better at achieving those goals.

In the "complex and convoluted structure" of the United Nations humanitarian system, "the most feasible and salutary changes that might now be made would be to aggregate relief actors within each organizational sector" (Natsios, 1995b:417). In essence, combining the best capabilities from several agencies during a relief effort would be a good first step toward collaboration in the field. Collaboration up the supply chain is a more delicate matter as retailers, suppliers, and carriers may often be motivated more by profit than philanthropy. "Traditional supplier-retailer relationships have been founded not on trust, but rather on exploitation" (Karonis, 1999:174).

Partnerships can be extended outside the ring of relief organizations to harness the resources and expertise of commercial firms. Speaking on behalf of USAID, James Kunder said, "Unleashing the enormous capacity of the American private sector, both nonprofit and for-profit, has been a key component of the U.S. Government's ability to alleviate human suffering as wars end (Kunder, 2003). He went on to state that proactive collaboration between civilian and military agencies was a key to rapid response after the second Gulf War. In their Disaster Resource Network, the WEF has started a database listing engineering and logistics firms that have experience in humanitarian missions and those willing work with relief organizations in disaster response. As another example, the WFP contracts "dedicated fleets—companies that set aside a certain number of trucks…[and] operate and maintain the trucks, while WFP decides their destination" (Stewart, 2003:18). The WFP also contracts the management of port operations (Stewart,

2003:18) in a proactive effort to enlist the help of local seasoned personnel to facilitate cargo movement.

Gilliland and Prince describe collaboration as a method for dealing with uncertain demand. They state, "products with little or no history or with a highly erratic history are the best candidates for a collaborative approach" (Gilliland and Prince, 2001:11). They recognize that this approach can be management intensive, expensive, and requires sharing any data available on demand patterns (Gilliland and Prince, 2001:11). This approach might work for emergency logistics if suppliers fully understand that they are on-call to provide specific items or services in a prearranged time frame.

Logistics Information Systems (LIS)

Implementation of logistics information systems for the humanitarian relief community would greatly enhance coordination between partners, sharing of training and lessons learned, and storage of data that would aid in inventory visibility and demand forecasting. Long characterizes information systems as "arguably the single most important factor in determining the success of an emergency logistical operation" (1997:27-28). Already there are Internet-based clearinghouses such as the Disaster Resource Network operated by the World Economic Forum (WEF), the Relief Web and the World Food Program websites operated by the UN. Natsios writes that larger NGOs "have developed many of the management information, evaluation and control systems of private sector corporations to monitor quality in their projects (1995:409). The basic functions of an electronic data interchange are reduction in paperwork, improved accuracy due to less manual processing, increased speed of information transfer, reduced administrative manpower, reduced ordering costs, increased employee productivity, and

better inventory accuracy and order response leading to reduced inventory (Stock and Lambert, 2001:161).

Although these systems along with other initiatives are a step in the right direction, their lack of integration limits their usefulness as an interagency communications tool. Long and Wood write:

> "Relief workers, both in the disaster site and at their respective headquarters, need to know what supplies are available, where the supplies are located, and how best to transport them. The ideal information system must therefore accommodate multiple organizational users and their different operating methods, plus world class communications capabilities. The parts of such an information system have already been developed, but institutional inertia has prevented their integration" (Long and Wood, 1995:227).

As an example, Stewart notes that frequent meetings with partners, "a constantly updated website," and other forms of communications greatly benefit the World Food Program distribution network in Southern Africa (Stewart, 2003:19). The manager should keep in mind that while information systems would enhance performance measurement and sharing of data/lessons learned, any information system will be ineffective if communications infrastructure is degraded, reporting is not timely, or employees are poorly trained in the use of the tools (Thomas, 2003:6). Information is a stepping stone for a better educated and more prepared staff as long as the system is implemented based on a familiar and well-established organizational structure.

At the most basic level, "to make logistics decisions, a logistics manager needs three essential data items: stock on hand, rate of consumption, and losses and adjustments" (Family Planning Logistics Management/John Snow, Inc., 2000a:26). These items, in addition to any other specifically requested data, can be used to make

informed decisions for supply chain management. Some of the general benefits of inventory visibility, all facilitated by the LIS, are: order statuses, minimization of order error and backorders, accurate and timely requirement relay, and enhanced response to delays and stockouts (Coyle and others, 2003:211). Simchi-Levi and others recommend aggregating very detailed data into representative groups that can simplify distribution planning based on geography, customer type, or product type (Simchi-Levi and others, 2003:27). This enables more accurate forecasts due to the likelihood that high demand in one subset of the group will be offset by low demand in another (Simchi-Levi and others, 2003:66).

A robust logistics information system enables forecasting techniques based on frequency and intensity of past disasters and help limit the unpredictability experienced in humanitarian missions. Long and Wood write "the management of information during a crisis is the single greatest determinant of success. Forecasts allow regions at risk to prepare themselves, and for relief agencies to prepare their efforts" (1995:218). Historical data and a contingency plan prepared in advance can drastically cut down response time. "By reviewing information from past operations and implementing regional strategy based on flexible, readily deployable mechanisms, logistics can be transformed from an activity that is almost exclusively reactive to one based on preparedness and experience-based action" (Thomas, 2003:12).

Logistics information systems also set the stage for identifying strengths and weaknesses of the supply chain. Quantifiable performance measures can be reviewed and used as a gauge for adjusting policies and practices. For example "some indicators of logistics system functioning are: actual lead time compared with expected lead time,

frequency of stockouts, and frequency of emergency orders" among others (Family Planning Logistics Management/John Snow, Inc., 2000a:152). Improved performance metrics is one of the benefits of timely accurate information (Coyle and others, 2003:211). It should be understood that quantifiable measures will not always be available. "Logistics gives an intangible service, and its quality relies to a large extent on subjective evaluation" and "logistics is so closely integrated with other operations and outside influences that it cannot be evaluated in isolation" (Waters, 1999:141). This is to say that due to hard to define goals such as customer satisfaction and due to the complex interactions of the supply chain, performance may not easily be gauged. Managers must also recognize that their customers, the donors and recipients, may have implicit and explicit measures which are expected to be met as a part of operational success (Van Brabant, 2003:44).

Military Partners

The use of military forces to provide elements of the relief effort is often a necessary part of rapid response. For humanitarian organizations, this is a special form of collaboration because of the political and ethical implications of using a non-neutral party in the relief effort. Military forces can supply specialized capabilities such as force protection, information sharing, airlift, overland trucking, bridge and road repair, and water sanitation among other requirements. According to Natsios, "the two most important capabilities the military brings to any emergency response remain logistics and security: they are the tasks that relief organizations can never match but increasingly need in complex emergencies" (1995a:80). In addition, military logisticians are trained with a

"mission oriented" mentality (Long, 1997:27) and are experienced in moving massive amounts of materiel.

These contributions do not come without a price, both in the sense of donor country expenditures and moral and ethical implications of employing foreign military forces in a region. "It is essential that these two roles—impartial humanitarian assistance as a response to an urgent and inalienable right, and peace operations with their inevitably partial and political mandates—are kept separate" (Barry and Jeffrys, 2002:2). There is a blurred line between using military forces in an impartial manner and using them to advance political or social objectives. As Barry and Jeffrys point out, shared "information is not a neutral commodity, but may have important tactical or political value" (2002:5) and linked military and humanitarian missions are "increasingly used as an instrument of political intervention" (2002:8). This sentiment is also noted by other authors (Macrae, 2002:16, Reindorp, 2002:29, Graham, 2003:40, and Aall, 2000:127). Barry and Jeffrys go on to define impartiality as relief given solely on the basis of need, not used to further political, military or any other objectives (2002:11).

Humanitarian organizations and military organizations should settle on a common language regarding relief missions and agree that military resources should only be used as a last resort (Barry and Jeffrys, 2002:16-17). The relationship between humanitarian and military agencies has grown in the past decade as "exposure to each other's strengths and capabilities has served to increase the military's respect for the innovation and dedication of NGOs, and to foster and appreciation among NGOs for the unsurpassed logistical capacity of the military" (Aall, 2000:133). It is important to clearly define the responsibilities of military partners as "the military sometimes misses the mark on

humanitarian mission statements where objectives can be implicit and intangible" (Natsios, 1995a:70). This is to say that military partners can contribute significantly to the effort given clearly defined roles within the collaboration.

Resource Management

The fundamental purpose of a logistics network is to procure resources such as manpower, supplies, and equipment and move them to a point of need. Inventory exists to: secure efficiencies in transportation through batch discounts or to make use of existing transportation schedules, provide safety stock to guard against unpredictable demand, hold stock to conserve storage space at later supply points, and build up stock in anticipation of a predicted future need (Owens and Warner, 1996:1, and Simchi-Levi and others, 2003:45). "The key to dealing with inventory is to recognize that it has to be managed from a systems perspective, in which tradeoffs are measured comprehensively and accurately" (Coyle and others, 2003:260).

Procurement of items or services is the foundation for satisfying demand. "Procurement consists of all those activities necessary to acquire goods and services consistent with user requirements (Coyle and others, 2003:119). This process includes: identifying needs, defining user requirements, deciding to make or buy the item or service, deciding how the item will be obtained, searching the market and selecting a supplier, taking delivery and evaluating the purchase (Coyle and others, 2003:119-122). Selecting a supplier is an important part of constructing a reliable and responsive supply channel. When procuring inventory, the logistics manager should consider quality of the product, reliability, capability, and financial stability of the vendor, and other desirable qualities such as proximity and hidden costs (Coyle and others, 2003:127-129).

The traditional solution for dealing with uncertain demand is to maintain a safety stock of inventory "just in case" a surge in demand occurs. "Forecasting demand is a common approach to help resolve uncertainty, but it is never completely accurate…the net result of uncertainty is usually the same: companies accumulate safety stock to buffer themselves against uncertainty" (Coyle and others, 2003:194). Safety stock protects against uncertainty and fluctuation in production, lead times, and demand surges by providing a minimum reserve level of stock to prevent stockouts under unusual supply chain disruptions. Keeping "anticipatory stock" is another way for an organization to prepare for an unusual event (Coyle and others, 2003:196). For the humanitarian organization these methods help prepare for both unpredictable and undesirable events.

The safety and anticipatory stock concepts can be extended to logistics practices of HROs via consolidation and prepositioning of stockpiles and staff. Sharing warehouse space at a forward location cuts personnel requirements for multiple organizations while simultaneously providing employees who are familiar with local ways and who are able to relay situation reports in the event of a regional disaster. During the Second Gulf War, USAID prepositioned staff in neighboring countries around Iraq (Kunder, 2003). While this may not be practical for those disasters which are not foreseen, the concept may be employed by placing small cells of staff over a wide area. The members of these cells could rapidly converge on a region of need to form one large contingent of trained support personnel once the disaster happens. This method would bolster the local contingent with personnel already somewhat familiar with regional customs, requirements, and practices. Kunder went on to state that certain specialties such as

public administration specialists will be in immediate demand and should be kept on-call for emergency response (Kunder, 2003).

Prepositioning stocks may have other unintended consequences, however. The United Kingdom-based Iraqi Refugee Aid Council cautioned that prepositioning relief materiel could signal impending disaster or become a draw to refugees, exposing them to more vulnerability (Graham, 2003:38). Consider the concern that might be generated if humanitarian operations centers and warehouses full of aid materials started popping up outside your hometown. In addition, Graham notes that "effective response demands availability of standby resources and there are very real worries that agencies will have to divert funds from emergencies in order to achieve a minimal level of preparedness" (2003:40). This assumes that stockpiles of aid materiel will tie up massive amounts of capital that would otherwise be spent elsewhere by the humanitarian organization. There is also a risk that aid will be positioned in the wrong location, thereby tying up additional transportation resources to move the supplies when they are needed elsewhere.

Risk pooling is an inventory management method which is used to aggregate stock from many locations into one centralized warehouse. This method assumes that high demand at one outlet will be offset by low demand at another (Simchi-Levi and others, 2003:66). The main advantage of risk pooling is lower total inventory level due to retail outlets not having to keep separate safety stocks. This assumes that transportation capacity and lead time will be sufficient to reach the consumer when goods are needed. In general, shipping times will be longer to the consumer, but less money will be tied up in inventory, and warehousing costs will be lower due to operating a few centralized facilities rather than many satellites (Simchi-Levi and others, 2003:137).

Another inventory management method would be to contract for more numerous, yet smaller batch sizes of supplies from multiple sources. "In terms of reactivity and predictability, big order lot sizes with long lead times are the most problematic, since adjusting an order to a new level should be done far more in advance than in the case of small batches" (Helo, 2000:4528). Bearing in mind that smaller batch sizes are easier to produce and deliver to the point of debarkation quickly, higher transportation costs are likely to be incurred due to the demand for faster and more frequent delivery performance (Helo, 2000:4530). The small batch concept can be employed using local vendors of bulk commodities whereby a large quantity is purchased in advance, and the vendor distributes increments upon request (PAHO, 2000:25). This relieves some storage burden from relief agencies.

The minute details of warehouse management are beyond the intent of this paper, however the humanitarian logistics manager should consider the fundamental value-added functions of maintaining a warehouse. These are: the ability to consolidate small loads to save on transportation costs, the ability to mix product types to fulfill orders at the destination, improved service levels due to reduced lead times and stockouts, and contingency protection against unexpected delays and interruptions (Coyle and others, 2003:286). Information on warehousing is widely available.

Transportation Management

Management of the distribution function should be an integral part of system management. "The activities of each function must be closely tied with the function down stream to avoid delays at handoff points in the logistics network" (Thomas, 2003:6). The operations must be physically and conceptually compatible. For example,

one method for making the distribution process more robust would be to establish multiple distribution channels comprised of redundant routes and delivery methods for supplies (Coyle and others, 2003:107-109). Likewise, the distribution system should have built-in mechanisms to allow for tradeoffs between transportation costs and service level. More costly, faster transportation allows lower inventory levels to be kept due to a more responsive system (Coyle and others, 2003:340). If the system is unified in its distribution plan, disruption and delay will be minimized.

Transshipment is the movement of goods between facilities at the same level in the supply chain, most often at the retail level (Simchi-Levi and others, 2003:136). This method shares inventory between all partners, but places a burden upon the transportation system due to the need to move goods more than once. Transshipment is facilitated by a good information system and makes use of the "risk pooling concept, even if no central warehouse exists, because one can view inventory in different retail outlets as part of a large, single pool" (Simchi-Levi and others, 2003:136).

Direct shipment is another method by which aid may be delivered. In the commercial sector, "the need for an emergency transshipment [direct shipment] may arise due to rush orders from the customer that may not normally be met by the 'gateway' stock or due to a short-term measure to ensure customer service level in the light of capacity constraints" (Hong-Minh and others, 2000:789). The basic form of direct shipment is for the manufacturer or supplier to bypass warehouses and distribution centers to deliver goods directly to the retail level (Simchi-Levi and others, 2003:134), thereby allowing a rapid reaction to increased demand for inventory (Hong-Minh and others, 2000:794-795). Direct shipment is often used when lead times are critical

because of perishability issues and when stockouts are unacceptable. While direct shipment may be infeasible in many humanitarian disaster situations due to degraded or non-existent infrastructure, it should be considered if infrastructure and capacity are adequate (such as in industrialized nations where ports and airfields are left intact after a disaster).

Another strategy which focuses on the physical infrastructure of the affected region is to provide for special operations, outside of the normal realm of HRO expertise, which will facilitate the distribution of aid. In the context of humanitarian relief (not military operations), a special operation (SO) is "an activity to rehabilitate and enhance transport infrastructure, if necessary in extraordinary circumstances, to permit speedy and efficient delivery of food assistance to meet emergency and protracted relief needs" (Stewart, 2003:21). Examples given by Stewart are repairs to roads, bridges, airports, ports, and railways as well as possibly establishing a joint logistics center or communications capability (Stewart, 2003:21).

Another method to cut documentation and eliminate frustration of managing international movements is to contract freight forwarders and third party logistics (3PL) providers specializing in relief and international freight movements (Long and Wood, 1995:225). Knowledgeable freight companies will help smooth out customs procedures, road tolls, and country-specific import restrictions (Stewart, 2003:19). Contracting 3PL services, facilities, and equipment allows the HRO to focus on its core competencies while the 3PL leverages its expertise and buying power to decrease distribution costs (Simchi-Levi and others, 2003:152). Outsourcing functions which are beyond the capabilities of the HRO has the potential to reduce overall costs while improving service,

avoiding investment in facilities and equipment, while improving access to logistics expertise (McKinnon, 1999:215).

Some miscellaneous measures to overcome barriers to aid are: construct distribution centers outside the area of operations to prevent damage from the very disaster you are trying to relieve and build a storage facility anywhere there is a change in transportation mode to prevent damage and loss while waiting on onward transportation (Long and Wood, 1995:222). By centralizing stockpiles, the concept of risk pooling is employed. Another consideration would be to collaborate with the manufacturer to design more compact and securely packaged products to help reduce the transportation burden and guard against adverse environmental conditions (Simchi-Levi and others, 2003:215).

See the Pan American Health Organization logistics and supply management handbooks (PAHO, 2000 and PAHO, 2001) for a thorough summary of field-level acquisition, warehouse management, fleet management, and distribution methods. Two other very detailed sources on distribution, storage, and forecasting are references from Family Planning Logistics Management/John Snow, Incorporated (2000a and 2000b).

Training and Education

Each of the previous recommendations may present a radical change to the policies and procedures of the HRO. "Even small changes in policy or procedure may suggest the need for formal training" (Family Planning Logistics Management/John Snow, Inc., 2000a:170). Changes in organizational process may require ensuring employees have the following enablers (Family Planning Logistics Management/John Snow, Inc., 2000b:35):

- Specific skills, knowledge, and attitudes.
- Natural strength, mental, and emotional capacity.
- Motivation to succeed.
- Information, including equipment and instructions needed to perform a job.
- Tools and settings, including equipment, physical space and an appropriate social environment to do the job.
- Incentives, including compensation, recognition, praise, and rewards.

The importance of training in establishing these personnel traits cannot be ignored. However, equipping individuals with these traits will not necessarily result in improved performance. Granville notes that organizational factors must also be incorporated such as information on strategies, goals, and performance criteria, reinforcement and reward programs, and integrated personnel involvement to help close organizational gaps (1999:260).

Current Practices

It is appropriate to recognize how the affected population and humanitarian organizations use elements of supply chain management in their operations. The initial and presumably fastest reaction to a disaster comes from the affected community itself, which may intuitively integrate all available resources to provide a supply chain of relief. "Financial assistance to people affected by conflict and disasters…comes from many sources. The most immediate providers of assistance are the affected communities and countries themselves, and often neighboring states" (Randel and German, 2002:19). Furthermore, "it is common for the victims of a disaster to recover quickly from the initial shock and participate spontaneously in search and rescue efforts and other relief initiatives such as the storage and distribution of emergency supplies." (PAHO, 2001:2) The affected population is never entirely helpless. Neighbors, local governments,

indigenous humanitarian organizations, and regional allies will often serve as the first line of relief after a disaster.

Humanitarian Organizations

Due to the large number of humanitarian organizations capable of international relief operations, I chose to sample supply chain practices from a few of the largest and most prolific agencies. Obviously, agencies other than those described here also use elements of SCM just as they might provide alternative supply and distribution capabilities. Abby Stoddard states "although all of these agencies conduct programmes across sectors, most also occupy a specific operational niche…In emergencies, these NGOs often serve as coordinator or lead agency for other smaller organizations in their niche area." (2003:26). The varied talents of organizations, their partners, and their donors is what makes the humanitarian sector fertile ground for the implementation of SCM.

A comprehensive review of HROs exceeds the scope of this paper, so I have chosen from a cross section of 15 humanitarian relief agencies considered major players as described by Aall, 2000:123, Natsios, 1995a:71, Natsios, 1995b:410, Reindorp, 2002:34, Stoddard, 2003:26, Stoddard, 2002:48, and Thomas, 2003:2. From this list I've selected the World Food Programme (WFP), the International Committee of the Red Cross (ICRC), CARE International, Catholic Relief Services (CRS), and Oxfam. This provides two chartered intergovernmental (WFP and the ICRC) and three nongovernmental organizations (CARE, CRS, and Oxfam) representing a range of experience in relief operations. Although government agencies such as the U.S. Office of Foreign Disaster Assistance (OFDA) and the European Commission's Humanitarian Aid

Office (ECHO) certainly could have given examples of supply chain elements, these agencies were not examined in order to limit the scope of this section.

The World Food Programme is a United Nations agency which falls under the purview of the Office for Coordination of Humanitarian Affairs (OCHA). A decade ago, the United Nations Disaster Management Training Programme (DMTP) published a logistics handbook that addressed some of the processes that make up the supply chain. In addition to recognizing the benefits of supporting and reinforcing local response (1993:9), the DMTP recommends using small targeted shipments of specifically requested or pre-designated supplies and services for a quick impact (1993:10), using an LIS for control and accountability (1993:14), and using international HRO and military partners as appropriate (1993:15 and 11). The DMTP made mention of "systems exercise" (1993:9), partners (1993:15) and "supply chain" (1993:17), but stopped short of modern SCM, focusing instead on the distribution function (1993:17-24).

These logistics management recommendations grew into the current framework for response used by the WFP today. More SCM techniques have been embraced by the WFP in order to improve response capabilities. These include: conducting special operations to construct roads and bridges or rehabilitate ports and railways, collaboration with more than 1,100 NGOs for technical expertise, storage, and transportation capacities, and conducting emergency operations that also support continued economic and social development (WFP, 2004a). WFP-NGO partnerships are intended to complement host government operations or fill gaps in government service by making use of complementary capabilities and capacities between the organizations (WFP, 2000:6) especially using NGOs for local assessment and distribution functions (WFP,

2000:9) and to facilitate community participation in the relief effort (WFP, 2001:6). There are long-term partnerships between the WFP and 16 major international NGOs, but the same long-term relationships have not been achieved with national and local NGOs (WFP, 2001:4). WFP operations take advantage of many distribution methods to ensure delivery to affected populations. Some of these include maintaining a fleet of 40 ships with food supplies afloat at any one time, contracting smaller vessels and landing craft to distribute food when ports are unavailable, maintaining or contracting heavy trucks, locomotives, airlift to include airdrop capabilities, and even pack animals for the delivery of supplies (WFP, 2004b). With such a wide network of partners and resources to manage, the WFP has established an experienced staff of logistics experts to facilitate operations. These "Augmented Intervention Team[s] for Emergencies (ALITE) serve to enhance regional and local humanitarian staff, widen standby partnerships, and facilitate civil-military cooperation when needed (WFP, 2004b). The WFP also operates a centralized logistics depot in Brindisi, Italy for food, supplies, and equipment (WFP, 2004b). All of these capabilities are tied together by an extensive information system, field deployable telecommunications capabilities, and a vulnerability and analysis mapping tool (WFP, 2004b).

The ICRC focuses on family reunification and communication, prisoner of war and civilian protection, and emergency humanitarian relief and is the only non-United Nations humanitarian organization with a mandate under international law (Natsios, 1995a:73). The Committee is part of the Red Cross/Red Crescent Movement along with national societies and the International Federation of the Red Cross/Red Crescent (IFRC). From a logistics standpoint, the organization makes use of its capacity to coordinate

multiple organizations to achieve humanitarian relief. For example, in Afghanistan, the ICRC has hand picked transport operators and freight forwarders for their expertise in an area while maintaining distribution hubs in nearby countries the influence of conflict and warlord influence (Kuhn, 2002). In addition the ICRC leverages its buying power to obtain affordable commodities from outlying countries (Kuhn, 2002). Like the WFP, the ICRC makes use of multiple modes across land, sea, and air to deliver aid and also prefers to procure goods from the local economy, when possible (Charest, 2003). The ICRC also takes part in contingency relief planning with governments involved in armed conflict and undertakes emergency projects to establish medical and water/sanitation (ICRC, 2004a.). The organization maintains several Emergency Response Units (ERUs) with personnel and equipment donated by member countries. A self-sufficient Logistics ERU has be developed with personnel to perform post-disaster assessments and facilitate the forward movement of relief by establishing procurement, transport, warehousing, tracking/tracing, liaisons with partners, and communications (ICRC, 2004b). The ICRC also maintains partnerships within the private sector to promote humanitarian principles among firms in conflict zones, international and local companies, professional associations and trade unions (ICRC, 2004c). Like the WFP, the ICRC places a high value on collaboration and thorough planning.

In general, NGOs serve a more limited role than intergovernmental agencies. CARE International is an example of an NGO that assumes many types of missions including long term programs to alleviate poverty, hunger, lack of education, and HIV/AIDS, as well as emergency relief. CARE's emergency relief function utilizes community resources and local partnerships to deliver food, clean water, temporary

shelter, and sanitation services (CARE, 2004b). In addition, CARE has developed many corporate donor alliances, NGO partners, and government agency collaborations (CARE, 2004c). The organization also maintains response teams capable of providing assistance to country office within 72 hours (CARE, 2004a). CARE's strong field presence would make it a prime candidate as a partner in a larger collaborative relief effort.

Catholic Relief Services provides many local services on par with CARE. The organization assesses the needs of the population and provides a range of emergency health, food, shelter, and household necessities through a network of in-country employees, technical partners, and donors (CRS, 2004a). CRS also coordinates delivery of aid from local and regional sources and participates in infrastructure rehabilitation to facilitate those deliveries (CRS, 2004b.). Again, the network of partners and established local capabilities of CRS would make the organization valuable to a larger coalition.

Oxfam International is a system of 12 international branches and over 3,000 partners with presence in over 100 countries (Oxfam, 2004b). This presence allows rapid assessment of needs, even as disasters are happening. Oxfam also maintains a deployable staff of logistics experts to help other employees already in the affected country by managing partnerships and local purchases (Oxfam, 2004a). Meanwhile, pre-established donor mechanisms begin generating funds for the relief effort. For Oxfam Great Britain, for example, this money comes from the British government, ECHO, and many other organizations that fall under the "Disasters Emergency Committee" umbrella (Oxfam, 2004a). In addition, material aid is rapidly prepared for shipment from Oxfam's humanitarian supply warehouse in Oxford which is purportedly the "largest in the world"

(Oxfam, 2004a). In this case, elements of supply chain management focus on collaboration, eliminating supply unpredictability, and rapid assessment.

In summary, this brief sampling of humanitarian organization capabilities gives an idea of the variety of logistics tools available to improve the supply chain. Integrating the capabilities of these organizations can provide a unified approach to overcoming the logistical and operational barriers of the relief mission. The hundreds of HROs not covered in this section potentially provide an even greater catalogue of talents from which to choose.

Benchmarking.

David Santhouse states that "benchmarking is the planned and structured search for industry best practices and procedures…At its best it is skilful appropriation and adaptation requiring imagination and innovation; at its worst it is an expensive and time consuming search up a blind alley" (1999:193). The responsible manager should recognize that borrowing practices from other organizations may have benefits and drawbacks. Comparing your organization to another similar organization has great value in advancing both knowledge of operational practices and progress in specific technological areas. Best practices can be adopted to enhance the organization's performance without the time, expense, and uncertainty of pioneering said practice (Santhouse, 1999:194).

The manager should exercise caution, however, in measuring his organization only against others who perform similar operations on a similar scale. It would be better, for example, for an NGO field manager to look to commercial warehouse and distribution operations for advice on food storage and movement over rough terrain. In that vain,

managers should be creative enough to look outside their own industry for innovative ways to tackle problems.

There are also pitfalls in making improper comparisons, for example taking cost-saving and profit-making lessons from the corporate sector when relief operations demand higher expenditures due to rapid delivery requirements. Improper application of the borrowed techniques is another pitfall (Santhouse, 1999:195). "The challenge for managers, monitors, reviewers and evaluators is to more consciously consider the range of possible benchmarks, including those that are obligatory because of their legal status, and to choose those that seem most relevant in a given context" (Van Brabant, 2003:43).

Summary

This chapter presented justification for using SCM in humanitarian relief operations. The critical requirements for the initial stages of emergency response were identified, followed by a summary of the barriers to efficient relief logistics. Based on this information solutions to those barriers were proposed. The chapter concluded with an examination of the current practices of a few prolific humanitarian organizations and a brief consideration of benchmarking.

III. Methodology

Background

Due to the developing nature of employing SCM methods in humanitarian logistics, this study will use qualitative methods to explore the issues affecting the humanitarian logistics and the solutions that SCM may provide. More specifically, Grounded Theory analysis will be used to tie together information from the disciplines of humanitarian aid and supply chain management. The investigative questions will be answered via evaluation of available academic and contemporary literature and organizational media. Data will primarily be drawn from a comprehensive literature search of academic and contemporary sources. The proposed model will be developed from academic sources, humanitarian publications, industry best practices, and literature provided by existing governmental and non-governmental HROs. The recommendations will be adapted for non-partisan application.

Grounded Theory

The basis of Grounded Theory is that the researcher evaluates all available data surrounding a phenomenon without a preconceived picture of how the events tie together. The goal of Grounded Theory is to allow theory to "emerge" from the available data. To quote Strauss and Corbin, "one does not begin with a theory then prove it. Rather, one begins with an area of study and what is relevant to that area is allowed to emerge" (1990:23). This method evolved from use in social research where large amounts of field data must be sorted into categories to detect recurrent trends (Strauss and Corbin, 1990:24).

The following steps summarize the practice of Grounded Theory. First the researcher must analyze the data by "open coding." "Open coding is the part of analysis that pertains specifically to the naming and categorizing of phenomena through close examination of data" (Strauss and Corbin, 1990:62). During open coding, I reviewed the available literature on humanitarian logistics, emergency relief operations, supply chain management, organizational practices, and so on. During this stage it is important to review data from many sources so that major categories emerge on their own. The information was categorized by key traits so that the current state of logistics in the humanitarian industry could be characterized, barriers to logistics could be classified, and tools from SCM brought forth. Open coding is essential to providing definitions for the emerging theory so that the reader might stay oriented.

Axial Coding is the next step. During this stage, each category and subcategory is developed in more detail according to what caused it, the category's specific properties and dimensions, outside conditions which bound the phenomenon, any response to the situation, and its consequences (Strauss and Corbin, 1990:98-109). Essentially, the individual category must be analyzed to discover the chain of cause and effect relationships within. By this analysis, the critical areas for improvement will be uncovered.

The third step is Selective Coding, during which the categories are integrated to explain the central phenomenon, in this case how SCM might be used to overcome barriers to humanitarian logistics. Strauss and Corbin call this "explicating the story line" (1990:119). In this thesis, there is not a story, rather two major phenomena are linked by similar supporting details. Through continued and targeted sampling during the Open

Coding, Axial Coding, and Selective Coding stages, more information is sought out to provide justification for each category's existence. During Selective Coding, the theory becomes grounded, i.e. supported by the facts uncovered during the coding process.

The final step is to present the grounded theory in a graphical or narrative fashion as robustly as possible. Strauss and Corbin recommend a "conditional matrix" to clearly identify relationships from the most general case to the most specific. For the purposes of this study, a table representing the crossroads of SCM and humanitarian logistics barriers will be constructed. The end result will be humanitarian categories and subcategories on the vertical axis addressed by SCM solutions in the body of the table.

The Framework

The full framework in Chapter IV is a summary of the significant findings relating to barriers to humanitarian aid and proposed solutions uncovered through a targeted search of literature. The problems and barriers are broken down by major categories and subcategories along the horizontal axis and the proposed solutions are referenced in the main body of the table. Numbered references will be made according to which author indicated the problem or solution, and if an author specifically recommended a remedy it will be so noted within the body of the table. More in-depth information regarding that solution can be found by reading the indicated author's work, which is referenced in the bibliography.

Scope and Limitations

This study will recognize, but not attempt to solve political and regional issues acting as barriers to the aid process. The focus is limited to the application of leading logistics methods to improve the coordination of humanitarian aid delivery. The study

may be affected in a subjective way due to the author's interpretation of what logistical barriers exist in humanitarian logistics and which SCM methods were possible solutions. As Strauss and Corbin point out, "building theory, by its very nature, implies interpreting data" (1990:23) which is an inherent danger of qualitative research.

It became apparent during the literature review that humanitarian organizations are just beginning to embrace supply chain management practices that have been used commercially for decades. For humanitarian personnel managing logistics, some justification for the use of SCM must be provided. Underlying Grounded Theory research is "the assumption that all of the concepts pertaining to a given phenomenon have not yet been identified," or "someone has never asked this particular research question in quite the same way, so it is as yet impossible to determine which variables pertain to this area and which do not" (Strauss and Corbin: 1990:37). For this reason, as SCM methods gain ground in humanitarian logistics, more quantifiable justification can be provided for the utility of SCM to HRO strategy.

More statistically rigorous methods were not suitable for this thesis because after reviewing the literature available on the topic of humanitarian logistics, very few in-depth sources concerning operational level humanitarian logistics were found. As such, Grounded Theory was chosen as the analysis method to provide a foundation for further research into the applications of SCM to humanitarian logistics. As this field of study matures into the realm of quantitative data, more rigorous methods will become appropriate in order to prove the usefulness of SCM in the humanitarian arena.

Validation of Findings

The results of this thesis will be validated using methods for qualitative studies as described in Creswell, 2003. Specifically, triangulation, recognition of bias, findings of negative or discrepant information, the use of peer debriefing, and the use external auditors (Creswell, 2003:196) will help bring validity to the study.

Triangulation.

As the study progressed, the literature yielded some recurrent categories of barriers to humanitarian aid and groups of possible remedies. An example is "degraded infrastructure" being cited as a barrier to aid in several sources. Because several authors consider this to be a barrier, it lends validity to the idea that "degraded infrastructure" might indeed be a problem. Likewise, where several sources advocate the use of "alternate transportation methods" to overcome "degraded infrastructure," it lends credibility to investing in this area of the supply chain.

Researcher Bias.

As described above, the author is forced to make subjective assessments of what is a pertinent finding in the literature. Furthermore, the author has a limited knowledge of both SCM and humanitarian practices. This thesis is meant to expand the experience of the author in both fields while providing a tool for practicing logisticians in the humanitarian sector.

Although the application of modern logistics practices in humanitarian work was the seed of the research question in this study, the exact theory did not appear until data was gathered. There was a preconceived idea that SCM could help overcome certain

barriers, however details of *how* the disciplines could be combined were left to emerge on their own as part of the Grounded Theory methodology.

Negative or Discrepant Information.

Strauss and Corbin state that "what you can't find in your data becomes one of the limitations in your study" (1990:112). In this thesis I was limited by my own theoretical sensitivity. That is to say, although some areas of SCM had obvious application to overcoming barriers in humanitarian logistics, I could not make a recommendation for their use in a specific instance because I had neither data to back up the inference, nor enough personal expertise to make the conclusion.

Furthermore, although I proposed that disasters and relief needs were generally hard to predict, there was evidence that some regard disasters as predictable given proper planning. The Pan American Health Organization writes "the erroneous idea that logistics may be improvised at the moment of a disaster depending on needs 'indicated by the situation' must be eliminated" and goes on to state that disasters and needs are usually predictable (PAHO, 2000:12). This paper focuses on the general trend of agencies responding in an unplanned manner from the outside, favoring quick-impact relief missions that generate funds quickly (Natsios, 1995b:409) and situations where preparedness and mitigation programs are non-existent or not adequate to provide stability for an effected population.

In a recent independent review of the United Nations (UN) Interagency Standing Committee (IASC) which mediates between humanitarian agencies, it was noted that "there is evidence that field level coordination has improved, at least among the UN system of agencies and with a sub-set of the major international NGOs" (Jones and

Stoddard, 2003:iii). This counters claims that, especially in UN organizations, coordination between agencies is lacking. The Jones and Stoddard report does not specifically address logistics issues apart from stating that they had "found much less evidence of progress on [the IASC] solving perennial problems of mandate gaps, capacity gaps, or system-wide problems" (2003:iv).

Peer Debriefing.

This thesis will be distributed to several humanitarian and academic organizations currently developing logistics policies. In addition, the typescript will be available for peer review in the Air Force Institute of Technology Library and through the Defense Technical Information Center (DTIC).

External Auditors.

Three faculty members of the Air Force Institute of Technology served as auditors for this study. Their disciplines ranged through logistics plans, materiel acquisition, transportation, and supply chain management.

Summary

This chapter introduced the basic principles of Grounded Theory research and provided an explanation as to why it was used in this study. The framework of barriers and solutions was briefly introduced, and will be expanded in Chapter IV, Results and Analysis. The scope and limitations of this study were addressed, followed by the tools used for validation.

IV. Results and Analysis

Background

This chapter matches the barriers to humanitarian logistics detailed in Chapter II with their potential solutions. The following narrative explains the role each SCM technique plays in helping the humanitarian logistics manager deal with barriers. In some cases, solutions are applicable to more than one problem, just as some problems have multiple mitigation strategies. Table 2 summarizes the barriers and solutions.

Supply Chain Management Applications in Disaster Relief

The major categories of barriers uncovered during the open coding phase of this research dealt with uncertainty, infrastructure limitations, communications problems, human resources problems, political interference, and a category for miscellaneous obstacles. Each of the major categories had multiple subcategories which were refined during the axial coding phase. The subcategories address individual facets of the major categories which pose more specific problems for the humanitarian logistics manager. Potential solutions to these problems were uncovered during a targeted literature review during the selective coding phase of the research. The solutions were explained in Chapter II, and will be briefly recounted below.

Uncertainty.

Within the category of uncertainty, there are subcategories for unpredictable supply, unpredictable demand, and inconsistent processes. Unpredictable supply problems include issues such as inconsistent quantity, quality, and lead time. Potential SCM methods for dealing with supply problems are to obtain materials, equipment and

labor locally, or procure safety/anticipatory stocks to protect against demand surges. Collaboration is another valuable tool for coping with supply uncertainty. The production quantity and quality can be stipulated by contract as part of a contingency plan and partners can agree to share information on incoming supplies as part of CPFR. This may require a reallocation of the roles some partners play in the network. Military partners can smooth out variability in lead times by utilizing fast airlift to ensure timely delivery. Likewise, a hired 3PL can leverage expertise, buying power, and specialty equipment to facilitate faster shipments.

Investment in the distribution function can also remove some unpredictability from the supply process. For example, creating parallel logistics and administrative processes and redundant routes and delivery methods can keep the system running when one of the channels fails unexpectedly. An alternative to trucks might be airlift. Also, transshipment and direct shipment between locations is an option if problems arise at the port or intermediate warehouses. Distribution facilities might have to be constructed outside of danger areas or constructed in a more central location to better serve community needs. Stocks can be moved to the central location to take advantage of risk pooling.

Information tools can also be used to reduce supply uncertainty. Forecasts and vulnerability maps might be used to predict problems in the process, or a database of local and partner inventory might be used to form a "virtual warehouse."

Unpredictable demand problems include not knowing what, when, where, or how much aid will be required. Potential SCM methods for dealing with demand problems are to create safety/anticipatory stocks to protect against spikes in demand, move stocks

back to a centralized storage facility to take advantage of risk pooling, or simply investing in faster transportation. Other techniques are information oriented. Forecasting and assessments, and sharing information on demands and available inventory through a common logistics information system are good ways to reduce uncertainty. Accurate information from a local source is important to relay what the affected population actually needs.

Inconsistencies within the process include problems initiated by poor organization, variability in lead time, and agency culture. Potential SCM methods for dealing with process inconsistencies include improving the existing process by jointly defining network objectives and performance measures with partner organizations while sharing information through an LIS. If the process must be changed, a clear chain of command should be established with a single focal point or coordinator as an authority. Partners can be added or removed to make the process more efficient, and remaining parties should collaborate on redesigning the supply chain policy.

The distribution process may need attention through investment in safety/anticipatory stock to prevent stockouts, transshipment or direct shipment to keep the process from failing at the retail end, or hiring a 3PL to facilitate logistics so that partners can concentrate on core competencies.

Infrastructure.

Within the category of infrastructure, there are subcategories for degraded infrastructure and exceeded capacity. The degraded infrastructure subcategory concerns roads, ports, airstrips, warehouses, communications lines, etc. that are damaged in the disaster or were non-existent to begin with in the affected region. These problems can be

addressed by purchasing supplies and services locally, collaborating with a military partner, and investing in transshipment/direct shipment. Partners should seek out alternative transportation methods to reduce the burden on the degraded system.

When infrastructure or personnel capacity is exceeded, logistics efficiency declines rapidly. The system becomes overloaded to the extent that aid cannot get to its destination. SCM can help in this situation by bolstering imported supplies with local purchases, increasing frequency of events such as ordering and shipments, and collaborating with partners to jointly plan the use of infrastructure capacity. Joint capacity planning can be facilitated by an LIS. In addition, requesting help from a military partner or investing in transshipments/direct shipments might be useful.

Communications.

Problems from the communications category are varied and include the lack of standard terminology, absence of media for institutional learning and relaying best practices, and lack of information intra- and inter-agency information sharing. Also communications problems might concern the reliability of information and poor coordination. Across the community of humanitarian organizations, different languages and word definitions act as a barrier to carrying out the mission. Principles of SCM that can be applied to this problem include using an LIS and common database to standardize information transfer. Standard tracking technology such as barcodes and radio frequency identification tags feed into the LIS. Partners will have to collaborate in advance if this system is to work. Issues with lack of institutional learning, information sharing, and poor coordination can be addressed using some of the same tools. Logistics information

systems can be used to train employees on common scenarios and share post-action reports to further enhance learning opportunities.

Lack of information sharing is another communications problem. A common database makes the process more understandable for partners as they can see system capacities across the network. This is especially true when the partners are exercising CPFR. They can anticipate a demand and form a unified reaction because the doctrine and implantation tools are readily understood and accessible. Poor coordination between those partners can also be reduced by the availability common information; however collaboration may have to be facilitated by other means such as reassigning roles of partners, or appointing a single coordinator and chain of command.

Problems with reliability of information are generated by several sources, including gaps created by infrastructure failures and quality issues stemming from inadequate data systems, formatting, or practices. Accurate information on supply, demand, mission progress, and outcome is very important to managing the relief effort an LIS and common database can alleviate some problems by standardizing the data format and how it is transmitted between partners. Infrastructure failures might be dealt with by commissioning special operation to repair the malfunction or circumventing the problem by using satellite phone or radio data transmissions.

Performance measures and doctrine will first have to be jointly defined by all partners. Standardized formal training can help employees understand how the system is supposed to function. Performance measures and doctrine can be disseminated using an LIS, also.

Human Resources.

Human resources play an important part in the success of the relief mission. Personnel problems result from the subcategories of inadequate training and high turnover. Personnel problems can be addressed using SCM techniques such as automating as much data transfer as possible, i.e. reduce manual input to the data system. A robust LIS will make this easier, however good training will help employees understand the importance of inputting accurate information into the system. Accurate information is one key to getting the right aid at the right time. Employees compensation should include incentives for properly accounted for and damage free movement of aid. High turnover can be addressed by recognizing and rewarding work that is beneficial to the entire supply chain. This reinforces the team concept.

Politics.

The politics category has subcategories for earmarking and donor influence. Earmarking of funds has important supply chain implications because it reduces the flexibility to invest in critical logistics infrastructure and processes. Some SCM methods for coping with earmarking are to collaborate with partners to fill gaps in aid/funding in the same manner that capacity gaps would be covered. Collaboration with donors might also convince them that placing stipulation on funds restricts efficient operations and ultimately hurts the relief operation. To draw attention away from the tendency of partners to compete for funds, the organizations should focus on matching complimentary core competencies and approaching the relief mission in an integrated manner. Pooling resources is a good SCM technique.

Other.

Some miscellaneous obstacles affecting the logistics system are specific dietary requirements, packaging requirements, shrinkage and theft, and documentation requirements. Specific dietary requirements can be anticipated through contingency planning and dealt with by purchasing from the local economy or creating safety stocks of generic dietary staples such as flour, maize, cooking oil, etc. Likewise, packaging requirements can be identified during contingency planning and coordinated in advance with suppliers. As an alternative, packaging requirements can be reduces if supplies can be procured locally. Shrinkage and theft can be addressed by pulling inventories out of the field into a more secure central location or using an LIS for tracking, tracing, and accountability. Documentation requirements and customs clearance can also be simplified by standard forms available in an LIS. Contracting a 3PL familiar with local requirements or collaborating with the host government to reduce restrictions are also alternatives.

Illustrated Results

As described Chapter II and summarized above, each of the barriers facing HROs can be countered by solutions which make the supply chain react faster and more decisively. Table 2 illustrates the barriers and some proposed solutions. For quick reference, Table 3 presents a compact version of the data in Table 2. A single solution may address many problems. Some situations can only be dealt with on an individual basis due to special circumstances; however, the solutions found below are strategic ways to use the supply chain to address common problems.

Table 2. Summary of Barriers and Solutions.

Barriers		Possible Solutions from Supply Chain Management
Uncertainty	Noted By*:	
Unpredictable Supply	1,3,4,5,16	Local supply (3,4,5,14) Safety/anticipatory stock (22,23,25) Product inspections (14) Change location of facilities (1) Construct distribution centers outside of vulnerable areas (4) Risk pooling (16) Create parallel logistics and administrative processes (1) Invest in redundant routes and delivery methods (22) Transshipment (16) Direct shipment (27) Forecasting (17) Exchange demand, supply, and inventory information (1) Community vulnerability maps (5,21) Reallocate the roles partners play in the network (1) Improve reliability of supply and production quantity/quality (1) Collaboration (16,22,23,24) Collaborative planning forecasting and replenishment (CPFR) (22) Collaborate with military partner (7,10) Collaborate with a third party logistics provider (3PL) (4,14,16,28)
Unpredictable Demand	1,2,3,5	Use local source information (4,8) Forecasting (17) Exchange demand, supply, and inventory information (1) Pre- and post-disaster assessment (4,14,19,30) Cluster sampling (20) Community vulnerability maps (5,21) Implement a logistics information system (LIS) (4,7,16,17,18,22) Safety/anticipatory stock (22,23,25) Local supply (3,4,5,14) Risk pooling (16) Invest in faster transportation (22)
Inconsistent Process	1	Establish a clear chain of command (3) Utilize a senior coordinator (3,5,12,18) Change or reduce the parties involved (1) Reallocate the roles partners play in the network (1) Eliminate non-value added activities (1) Coordinate and redesign policies (1) Jointly define network objectives and performance indicators (1) Collaboration (16,22) Utilize an LIS (4,7,16,17,18,22) Safety/anticipatory stock (22,23,25) Transshipment (16) Direct shipment (27 Collaborate with a 3PL (4,14,16,28)
Infrastructure		
Degraded Infrastructure	3,4,30	Local supply (3,4,5,14,30) Collaborate with military partner (7,10,30) Transshipment (16) Direct shipment (27)
Capacity Exceeded	3,6,30	Local supply (3,4,5,14,30) Increase frequency of processes (1,26) Collaboration and joint capacity planning (16,22, 23) Facilitate system management using an LIS (4,7,16,17,18,22) Collaborate with military partner (7,10) Transshipment (16) Direct shipment (27)

Table 2. Summary of Barriers and Solutions (Continued).

Barriers		Possible Solutions from Supply Chain Management
Communications		
No Standard Terminology	4,7,30	Utilize an LIS (1,4,7,16,17,18,22) Develop a common database (1) Standardize bar coding/radio frequency tags (1) Collaboration (16,22,30)
Lack of Inst. Learning or Recording Best Practices	2,12	Utilize an LIS for data management (4,7,16,17,18,22)
Lack of Information Sharing	5	Utilize an LIS (1,4,7,16,17,18,22) Develop a common database (1) CPFR (22)
Poor Coordination	5,8,9,15	Utilize an LIS (1,4,7,16,17,18,22) Develop a common database (1) Reallocate the roles partners play in the network (1) Establish a clear chain of command (3) Utilize a senior coordinator (3,5,12,18) Collaboration (16,22)
Information Reliability (Infrastructure or Quality)	1,4	Establish an information system (1) Develop a common database (1) Invest in formal training (18,29)
Inadequate Performance Measures/ Doctrine	8,10,11,12	Jointly define network objectives and performance indicators (1) Use a common LIS (18,22)
Human Resources		
Inadequate Training	4,7,8,9	Eliminate or reduce human interventions (1) Align employee incentives with network objectives (1) Utilize an LIS (4,7,16,17,18,22) Invest in formal training (18,29)
High Employee Turnover	9	Align employee incentives with network objectives (1)
Politics		
Earmarking / Donor Influence	4,9,13	Collaborate with other organizations to fill gaps in aid/funding (16,22,23,24)
Competition for Funds	7,10,11	Collaborate with partners to focus on core competencies and integrated mission approach (16,22,23,24)
Other		
Dietary Rqmts.	5,14	Local supply (3,4,5,14)
Packaging	4,5	Local supply (3,4,5,14), product reengineering (16)
Shrinkage/Theft	4	Invest in centralized warehousing (16) Use an LIS for control and accountability (30)
Documentation	4,14	Collaborate with a 3PL (4,14,16,28) Collaborate with the host government (14)

***** Described by the following authors:

1 Van der Vorst and Beulens (2002)
2 Sowinski (2003)
3 Gooley (1999)
4 Long and Wood (1995)
5 PAHO (2000)
6 Moody (2001)
7 Long (1997)
8 Natsios (1995b)
9 Thomas (2003)
10 Natsios (1995a)
11 Macrae and Others (2002)
12 Jones and Stoddard (2003)
13 Randel and German in Macrae (2002)
14 Stewart (2003)
15 Byman (2000)
16 Simchi-Levi and others (2003)
17 Stock and Lambert (2001)
18 Family Planning Logistics Management (2000a)
19 PAHO (2001)
20 Drysdale, Howarth, Powell, and Healing (2000)
21 Morrow (1999)
22 Coyle and others (2003)
23 Kunder (2003)
24 Gilliland and Prince (2001)
25 Owens and Warner (1996)
26 Helo (2000)
27 Hong-Minh and others (2000)
28 McKinnon (1999)
29 Granville (1999)
30 DMTP (1993)

Table 3. Pocket Reference

		Barriers																		
		Uncertainty			Infra-structure		Communications						Human Resources		Politics		Other			
		Unpredictable Supply	Unpredictable Demand	Inconsistent Process	Degraded Infrastructure	Capacity Exceeded	No Standard Terminology	Lack of Inst. Learning or Recording Best Practices	Lack of Information Sharing	Poor Coordination	Information Reliability (Infrastructure or Quality)	Inadequate Performance Measures/ Doctrine	Inadequate Training	High Employee Turnover	Earmarking / Donor Influence	Competition for Funds	Dietary Requirements	Packaging	Shrinkage / Theft	Documentation
Potential Solutions	Safety / Anticipatory Stock	X		X																
	Product Inspections	X																		
	Forecasting	X	X																	
	Create Parallel Logistics and Administrative Processes	X																		
	Invest in Redundant Routes and Delivery Methods	X																		
	Change Location of Facilities	X																		
	Construct Distribution Centers Outside of Vulnerable Areas	X																		
	Reallocate the Roles Partners Play in the Network	X		X						X										
	Eliminate Non-Value Added Activities			X																
	Improve Reliability of Supply and Production Quantity / Quality	X																		
	Eliminate or Reduce Human Interventions												X							
	Coordinate and Redesign Policies			X																
	Change or Reduce the Parties Involved			X																
	Increase Frequency of Processes					X														
	Local Supply	X	X		X	X											X	X		
	Use Local Source Information		X																	
	Utilize a Senior Coordinator			X						X										
	Establish a Clear Chain of Command			X						X										
	Community Vulnerability Maps	X	X																	
	Rolling Assessments	X	X																	
	Cluster Sampling / Other Technologies		X																	
	Collaboration	X		X			X			X										
	Collaborative Planning, Forecasting, and Replenishment	X							X											
	Collaborate with a Military Partner	X			X	X														
	Collaborate with a Third Party Logistics Provider (3PL)	X		X																X
	Joint Capacity Planning					X														
	Collaborate with Partners to Fill in Gaps in Aid / Funding														X					
	Collaborate to Focus on Competencies and Integrated Mission Approach															X				
	Jointly Define Network Objectives and Performance Indicators			X								X								
	Implement a Logistics Information System (LIS) and Use It	X	X	X		X	X	X	X	X	X	X	X							
	Develop a Common Database						X		X	X	X									
	Standardize Bar Coding / Radio Frequency Tags						X													
	Use an LIS for Control and Accountability																		X	
	Invest in Formal Training										X		X							
	Align Employee Incentives with Network Objectives												X	X						
	Risk Pooling (Centralization)	X	X																X	
	Product Reengineering																	X		
	Prepositioning																			
	Invest in Faster Transportation		X																	
	Collaborate with the Host Government																			X
	Transshipment	X		X	X	X														
	Direct Shipment	X		X	X	X														C

Summary

With imagination and persistence, the manager can make use of these methods to improve the quality of service provided to populations in need. It may take time to adapt supply chain management techniques to an existing organizational structure. As management and other interested organizations come to understand the utility of SCM in humanitarian logistics, the entire humanitarian community will begin to reap the benefits of integrated response to disasters.

V. Conclusion

Relevance of the Current Investigation

As stated earlier, this paper is an important first step toward wide-scale use of supply chain management techniques in the humanitarian sector. It provides a starting point for further research in the area and gives the professional logistician an opportunity to practice the craft in the humanitarian arena.

Supply chain management is important to humanitarian logistics managers because of the cost savings and operational efficiencies that can be realized through proper planning, collaboration, and holistic analysis of the relief effort. The web of activities influenced and facilitated by good logistics is intricate and far reaching. These activities can be unified towards faster, more efficient delivery of aid by employing the principles explained in this paper.

Future Research

Future research will hopefully carry on the idea of using SCM in humanitarian relief. The goal of future efforts should be to explore the concept through case studies, surveys, and perhaps even designed experiments to help the concept evolve towards more quantitatively rigorous validation. Later efforts might answer some of the following questions:

- What factors most affect transportation cost and cycle time?...Can minimum annual requirements of non-perishable commodities be anticipated by region and disaster type?" (Thomas, 2003:12).

- Construct case studies based on recent humanitarian relief operations in Iraq or Afghanistan. Describe how commercial supply chain management practices were or could have been applied to facilitate the response.

- Based on regional frequencies of natural disasters, perform location analysis for where to put consolidated and centralized warehouses of relief items.

- Based on magnitude of those predicted disasters, describe what stock level of essential non-perishable relief items (tarps, tents, blankets, water-treatment, etc.) should be maintained.

- As a sole respondent to a disaster, is the U.S. Military an effective provider of humanitarian relief? Under current policy, does the U.S. military employ SCM in their humanitarian missions?

- Perform a meta-analysis of current logistics practices across the humanitarian arena. Provide a baseline of information from which future analyses of SCM implementation can be formed.

These questions are meant to move the research beyond mere observation and categorization of facts and characteristics so that managers have quantifiable justification to put SCM to use in their organization.

Conclusion

This report presents evidence that supply chain management practices borrowed from multiple sources can be used to make humanitarian relief more efficient and cost effective. The intent is to help build the theory that SCM can be used in humanitarian logistics. It is my hope that this exercise in theory building will improve the way humanitarian organizations do business.

Appendix: Supply Chain Primer for Humanitarian Logistics Managers

Management of the supply chain can be summarized in two words: integration and tradeoffs. The systemwide approach toward inventory management requires time and expense to develop and implementation may not work; whereas optimizing inventory policies at a single location is less involved, but may result in suboptimal performance for the entire system (Coyle and others, 2003:225). Blackwell and Blackwell lay the groundwork for focusing supply chain management on the actual demands of the end user. They advocate:

- Gathering and analyzing knowledge about consumers, their problems, and their unmet needs.
- Identifying partners to perform the functions needed in the demand chain.
- Moving the functions that need to be done to the channel member that can perform them most effectively and efficiently.
- Sharing knowledge about consumers and customers, available technology, and logistics challenges and opportunities with the other chain members.
- Developing products and services that solve customers' problems.
- Developing and executing the best logistics, transportation, and distribution methods to deliver products and services to consumers in the desired format. (Blackwell and Blackwell, 1999:32).

Other considerations for the logistics system include:

Is there a national emergency plan, and are logistics aspects included?

Is there a central coordination body and is logistics represented?

What contingencies are considered?

Are logistics resources identified, inventoried, and assigned including those owned by the local population, host government, and indigenous humanitarian organizations?

Has anticipated demand been estimated? Have organizations been assigned to provide those resources?

Have arrangements been made to obtain those resources?

Has the communication and transportation infrastructure been evaluated? Are post-disaster assessment responsibilities identified and formally assigned?

Have agreements with the host government been made to make use of local response capacity and to facilitate customs clearance for humanitarian aid?

Have other partnerships been established to fill capability and capacity gaps? Are responsibilities clearly outlined?

Bibliography

Aall, Pamela. "NGOs, Conflict Management and Peacekeeping," *International Peacekeeping*, 7(1): 121-141 (Spring 2000).

Barry, Jane and Anna Jeffrys. *A Bridge too Far: Aid Agencies and the Military in Humanitarian Response.* Report to the Humanitarian Practice Network. London: Overseas Development Institute, January 2002.

Blackwell, Roger D. and Kristina Blackwell. "The Century of the Consumer: Converting Supply Chains into Demand Chains," *Supply Chain Management Review 3*, 3: 22-32 (Fall 1999).

Brown, Vincent, Guy Jacquier, Denis Coulombier, Serge Balandine, Francois Belanger, and Dominique Legros. "*Rapid Assessment of Population Size by Area Sampling in Disaster Situations,"* Disasters, 25(2): 164-171 (June 2001).

Byman, Daniel and others. *Strengthening the Partnership: Improving Military Coordination with Relief Agencies and Allies in Humanitarian Operations.* Santa Monica: RAND, 2000.

CARE USA. "Emergency and Humanitarian Assistance Unit." Online fact sheet. n. pag. Atlanta: CARE. http://www.careusa.org/careswork/whatwedo/relief/ehau.asp. 21 February 2004a.

-----. "Emergency Relief." Online fact sheet. n. pag. Atlanta: CARE. http://www.careusa.org/campaigns/emergency.asp. 21 February 2004b.

-----. "Partnerships." Online fact sheet. n. pag. Atlanta: CARE. http://www.careusa.org/partnerships/index.asp. 21 February 2004c.

Catholic Relief Services (CRS). "Emergency and Response and Transition Programming." Online fact sheet. n. pag. Baltimore MD: CRS. http://www.catholicrelief.org/what_we_do_overseas/emergency_response. 21 February 2004a.

-----. "Iraq Humanitarian Response: Archived 2003." Online fact sheet. n. pag. Baltimore MD: CRS. http://www.catholicrelief.org/emergency_responses/iraq_humanitarian_response/index_20030716.cfm. 21 February 2004b.

Charest, Susan. "Relief Logistics: Making it Happen in Eastern Africa." Online news release. n. pag. Geneva: ICRC, 16 December 2003. http://www.icrc.org/Web/Eng/siteeng0.nsf/iwpList74/39EB7BDE976B83B8C1256DFE004F692F. 21 February 2004.

Coyle, John J. and others. *The Management of Business Logistics: A Supply Chain Perspective* (7th Edition). Mason OH: South-Western/Thompson Learning, 2003.

Creswell, John W. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* Thousand Oaks CA: Sage Publications, 2003.

Disaster Management Training Programme (DMTP). *Logistics* (1st ed.). New York: United Nations Development Programme/Department of Humanitarian Affairs, 1993.

Drysdale, Sean, John Howarth, Valerie Powell, and Tim Healing. *"The Use of Cluster Sampling to Determine Aid Needs in Grozny, Chechnya in 1995,"* Disasters, 24(3): 217-227 (September 2000).

Family Planning Logistics Management/John Snow, Inc. *The Logistics Handbook: A Practical Guide for Supply Chain Managers in Family Planning and Health Programs.* Arlington VA: Family Planning Logistics Management/John Snow, Inc. for the U.S. Agency for International Development (USAID) 2000a.

-----. *Programs That Deliver: Logistics' Contributions to Better Health in Developing Countries.* Arlington VA: Family Planning Logistics Management/John Snow, Inc. for the U.S. Agency for International Development (USAID) 2000b.

Gilliland, Michael and Drew Prince. "New Approaches to 'Unforecastable' Demand," *The Journal of Business Forecasting,* 9-12 (Summer, 2001).

Gooley, Toby B. "In Time of Crisis, Logistics is on the Job." *Logistics Management and Distribution Report,* 38: 82-86 (September, 1999).

Graham, Clare. "Iraq: Dilemmas in Contingency Planning," *Forced Migration Review,* 17: 38-40 (May 2003).

Granville, David. "Retailer Training in Logistics," in *Global Logistics and Distribution Planning.* Ed. Donald Waters. Boca Raton FL: CRC Press, 1999.

Helferich, Omar K. "Securing the Supply Chain Against Disaster." *Distribution Management Business Journal,* 2: 1-5 (Summer, 2002).

Helo, P.T. "Dynamic Modelling of Surge Effect and Capacity Limitation in Supply Chains." *International Journal of Production Research*, 38(17): 4521-4533 (November, 2000).

Hong-Minh, S.M., S.M. Disney, and M.M. Naim. "The Dynamics of Emergency Transshipment Supply Chains," *International Journal of Physical Distribution and Logistics Management*, 30: 788-815 (May, 2000).

International Committee of the Red Cross (ICRC). "Assistance." Online fact sheet. n. pag. http://www.icrc.org/web/eng/siteeng0.nsf/iwpList78/CB0604AFDAFB1B82C1256D510033993A. 21 February 2004a.

-----. "ERU, Logistics." Online fact sheet. n. pag. http://www.redcross.int/en/eric/eric/screen%20tome%201/04ENGscreen/113ERULOG.pdf. 21 February 2004b.

-----. "Relations with the Corporate Sector." Online fact sheet. n. pag. http://www.icrc.org/web/eng/siteeng0.nsf/iwpList500/C665AC0184AE4AC4C1256D5100306CAB. 21 February 2004c.

International Federation of Red Cross and Red Crescent Societies (IFRC). *"Disaster Data: Key Trends and Statistics,"* World Disasters Report, 2003. 20 January 2004 http://www.ifrc.org/publicat/wdr2003/chapter8.asp.

Jones, Bruce and Abby Stoddard. *External Review of the Inter-Agency Standing Committee.* New York NY: Center on International Cooperation, December 2003.

Karonis, John. "Retailer-Supplier Relationships," in *Global Logistics and Distribution Planning.* Ed. Donald Waters. Boca Raton FL: CRC Press, 1999.

Kuhn, George. "*International Red Cross Logistics for Afghanistan,"* Logistics Quarterly, 8(4):n.pag. (Spring 2002). 21 February 2004. http://www.lq.ca/issues/spring2002/articles/article12.html.

Kunder, James, Deputy Assistant Administrator for Asia and the Near East, U.S. Agency for International Development. "Humanitarian Assistance Following Military Operations." Congressional testimony. Committee on House Government Reform, Subcommittee on National Security, Emerging Threats, and International Relations. 18 July 2003.

Long, Douglas C. "*Logistics for Disaster Relief,"* IIE Solutions, 29(6): 26-29 (June 1997).

Long, Douglas C. and Donald F. Wood. *"The Logistics of Famine Relief: Engineering on the Run,"* Journal of Business Logistics, 16: 213-229 (1995).

Macrae, Joanna. "Analysis and Synthesis," in *The New Humanitarianisms: A Review of Trends in Global Humanitarian Action.* Report to the Humanitarian Policy Group. Ed. Joanna Macrae. London: Overseas Development Institute, April 2002.

Macrae, Joanna and others. *Uncertain Power: The Changing Role of Official Donors in Humanitarian Action.* Report to the Humanitarian Policy Group. London: Overseas Development Institute, December 2002.

McKinnon, Alan C. "The Outsourcing of Logistical Activities," in *Global Logistics and Distribution Planning.* Ed. Donald Waters. Boca Raton FL: CRC Press, 1999.

Moody, Fred. *"Emergency Relief Logistics: A Faster Way Across the Global Divide,"* Logistics Quarterly, 7(2):n.pag. (Summer 2001). 9 March 2003 http://www.lq.ca/issues/summer2001/articles/article07.html.

Morrow, Betty H. *"Identifying and Mapping Community Vulnerability,"* Disasters, 23(1): 1-18 (March 1999).

Natsios, Andrew S. *"The International Humanitarian Response System,"* Parameters, 25: 68-81 (Spring 1995a).

-----. *"NGOs and the UN System in Complex Humanitarian Emergencies: Conflict or Cooperation?"* Third World Quarterly, 16(3): 405-419 (September 1995b).

Owens, Jr. Richard C. and Timothy Warner. *Concepts of Logistics System Design.* Arlington VA: Family Planning Logistics Management/John Snow, Inc. for the U.S. Agency for International Development (USAID) 1996.

Oxfam. "Emergency Fact File." Online fact sheet. n. pag. http://www.oxfam.org.uk/what_we_do/emergencies/how_we_work/factfile/index.htm. 21 February 2004a.

Oxfam. "Partners." Online fact sheet. n. pag. http://www.oxfam.org/eng/campaigns_part.htm. 21 February 2004b.

Pan American Health Organization. *Manual Logistical Management of Humanitarian Supply*. Washington: PAHO, September 2000.

-----. *Humanitarian Supply Management and Logistics in the Health Sector.* Washington: PAHO, 2001.

Randel, Judith and Tony German. "Trends in the Financing of Humanitarian Assistance," in *The New Humanitarianisms: A Review of Trends in Global Humanitarian Action.* Report to the Humanitarian Policy Group. Ed. Joanna Macrae. London: Overseas Development Institute, April 2002.

Reindorp, Nicola. "Trends and Challenges in the UN Humanitarian System," in *The New Humanitarianisms: A Review of Trends in Global Humanitarian Action.* Report to the Humanitarian Policy Group. Ed. Joanna Macrae. London: Overseas Development Institute, April 2002.

Santhouse, David. "Benchmarking," in *Global Logistics and Distribution Planning.* Ed. Donald Waters. Boca Raton FL: CRC Press, 1999.

Simchi-Levi, David and others. *Designing and Managing the Supply Chain: Concepts, Strategies and Case Studies* (2nd ed.). New York: McGraw-Hill, 2003.

Sphere Project, The. *Humanitarian Charter and Minimum Standards in Disaster Response.* Oxford: Distributed by Oxfam Publishing, 2004.

Sowinski, Lara L. *"The Lean, Mean Supply Chain and Its Human Counterpart,"* World Trade, 18-20 (June, 2003).

Stephan, Linda and Thomas E. Downing. *"Getting the Scale Right: A Comparison of Analytical Methods for Vulnerability Assessment and Household-level Targeting,"* Disasters, 25(2): 113-135 (June 2001).

Stewart, Julia. *"Moving Food,"* African Security Review, 12:17-27 (February 2003).

Stock, James R. and Douglas M. Lambert. *Strategic Logistics Management* (4th ed.). New York: McGraw-Hill, 2001.

Stoddard, Abby. "Humanitarian NGOs: Challenges and Trends," in *Humanitarian Action and the "Global War on Terror:" A Review of Trends and Issues.* Report to the Humanitarian Policy Group. Eds. Joanna Macrae and Adele Harmer. London: Overseas Development Institute, July 2003.

-----. "Trends in US Humanitarian Policy," in *The New Humanitarianisms: A Review of Trends in Global Humanitarian Action.* Report to the Humanitarian Policy Group. Ed. Joanna Macrae. London: Overseas Development Institute, April 2002.

Strauss, Anselm L. and Corbin, Juliet M. *Basics of Qualitative Research: Grounded Theory Procedures and Techniques.* Newbury Park: Sage Publications, 1990.

Thomas, Anisya S. "*Humanitarian Logistics: Enabling Disaster Response*." Position paper, Fritz Institute, San Francisco, CA, 2003.

Van der Vorst, Jack G.A.J, and Adrie J.M. Beulens. " Identifying sources of uncertainty to generate supply chain redesign strategies," *International Journal of Physical Distribution & Logistics Management,* 32(6): 409-430 (Spring 2002).

Van Brabant, Koenraad. "Benchmarks and Yardsticks for Humanitarian action: Broadening the Picture," *Forced Migration Review,* 17: 43-45 (May 2003).

Waters, Donald (ed.). *Global Logistics and Distribution Planning* (3rd ed.). Boca Raton FL: CRC Press, 1999.

World Food Programme (WFP). *Thematic Evaluation of WFP-NGO Partnerships.* Report to the Executive Board. World Food Programme, Rome, February 2000.

-----. *WFP Working with NGOs: A Framework for Partnership.* Report to the Executive Board. World Food Programme, Rome, April 2001.

-----. "About WFP." Online fact sheet. n. pag. http://www.wfp.org/index.asp?section=1. 18 February 2004a.

-----. "Operations." Online fact sheet. n. pag. http://www.wfp.org/index.asp?section=5. 18 February 2004b.

Vita

Captain William K. Rodman graduated from Lima Senior High School in Lima, Ohio. He entered undergraduate studies at the Otterbein College in Westerville, Ohio where he graduated with a Bachelor of Science degree in Life Sciences in June 1997. He was commissioned through Air Force Officer Training School in 1998.

His first assignment was at the 5th Bomb Wing, Minot AFB, North Dakota as a Logistics Plans officer. In December 2000, he was assigned to the 317th Airlift Group, Dyess AFB, Texas where he served as the Chief of Logistics Plans. While serving in Texas, he deployed overseas in March 2002 in support of Operation ENDURING FREEDOM. In September 2002, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology (AFIT). Upon graduation, he will be assigned as an instructor in the AFIT School of Systems and Logistics.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From – To)*
01-03-2004	**Master's Thesis**	Jun 2003 - Mar 2004

4. TITLE AND SUBTITLE
SUPPLY CHAIN MANAGEMENT IN HUMANITARIAN RELIEF LOGISTICS.

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Rodman, William K., Captain, USAF

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAMES(S) AND ADDRESS(S)
Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 Hobson Street, Building 642
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GLM/ENS/04-16

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
Hundreds of millions of people are affected by disasters each year. This thesis explores the use of supply chain management techniques to overcome barriers encountered by logistics managers during humanitarian relief operations. Using grounded theory methodology, barriers were analyzed based on academic, organizational, and cotemporary literature. Possible solutions to these barriers were selected from available supply chain management literature. This work is different from others in that it marries supply chain principles from different disciplines (including private, nonprofit, and military sectors) to benefit humanitarian operations. It also serves to advance the body of knowledge so that future managers can build upon the concept. The result of the study puts forth a simple framework of supply chain management solutions for overcoming logistics difficulties during relief operations and explains why managers should consider their use.

15. SUBJECT TERMS
Humanitarian Logistics, Emergency Relief, Supply Chain Management, Disaster Response

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Stephan P. Brady, Lt Col, USAF (ENS)
U	U	U	UU	86	**19b. TELEPHONE NUMBER** *(Include area code)* (937) 255-6565, ext 4701; e-mail: StephanBrady@afit.edu

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39-18