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Humanitarian Supply Chain Model for Flood Relief - A Case Study Analysis

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***Abstract* - Now a day, many disasters are striking all the corners of India and the globe. Much of human loss and unnecessary destruction of infrastructure can be avoided with more foresighted specific planning. During emergencies various service organizations often face significant problems in transporting large quantities of food, clothing, medicine, medical supplies, machinery and personnel from different points of origin to different destinations in the disaster hit areas. The transportation of supplies and relief must be done quickly and efficiently to maximize the survival rate of the affected population and minimize the cost of such operations.**

Unfortunately, the inadequate response to Tsunami and Earth quakes showed the incredible need for the better mechanisms in emergency operations. Initial research in this area showed that it is an emerging field and there are great potentials for research in emergency logistics and disaster response. Hence, this paper attempts to develop a comprehensive model that describes the integrated supply chain operations in response to natural disasters. Total cost in the model considers the capacity constraints for each facility and the transportation system. An analysis of the data is carried by Taha Operations Research Analysis (TORA) software.

***Keywords:* *Supply Chain Management (SCM), TORA software, Disaster Management, Humanitarian logistics, Transportation cost, Flood relief*.**

INTRODUCTION

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. Humanitarian logistics is emerging as its own discipline within supply chain and logistics management. "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". 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. 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".

"Supply Chain Management," (SCM) is a systems-approach and global-view of the entire relief effort to manage the web of interrelated mission segments. No standard model exists for using supply chain management techniques to provide relief to populations affected by disasters. For managers of 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 (2003), 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".

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

NATURAL DISASTERS

From a global perspective, the number of natural disasters is increasing every year. As shown in Fig 1, an increase of this magnitude can be explained partially by the global warming theory, and partially by the attention of the media which has increased the numbers of reported disasters all over the world.

MOTIVATION AND OBJECTIVE OF THE PAPER

The objective of this paper is to show, how we can respond to natural disasters in the most efficient manner to minimize the loss of life and maximize the efficiency of the rescue operations. In case of these emergencies various organizations often face significant problems of transporting quantities of food, clothing, medicine, medical supplies, machinery, and personnel from different points of origin to different destinations in the disaster hit areas. The transportation of supplies and relief personnel must be sent quickly and efficiently to maximize the survival rate of the affected population and minimize the cost of such operations.

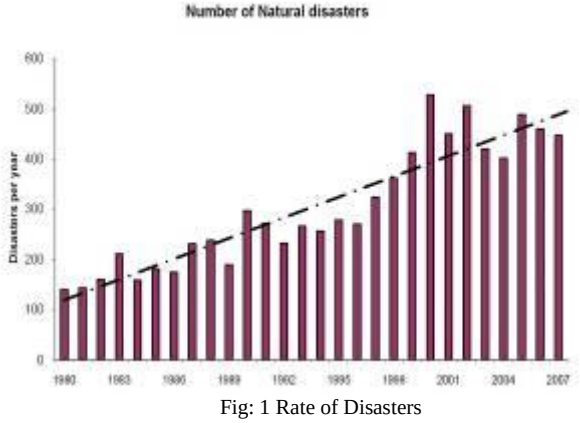


Fig: 1 Rate of Disasters
Source: www.fritzinstitute.org

Need for Supply Chain

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 (Beamonetal. 2006, Yi. w et al, Aall Pamela 2001, Barry et al 2002, Brown et al 2001, and Byman et al 2000) is 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".

EMERGENCY MANAGEMENT

Emergency management (or) disaster management is the discipline of avoiding risks and dealing with risks (Haddow et al. 2007, Alexander et al 1993, Altray ek al 2006). No country and no community are immune from the risk of disasters. However, it is possible to prepare for, respond to and recover from disasters and limit the loss to a certain degree. Emergency management is a discipline that involves preparing for disaster before it strikes, responding immediately, as well as supporting and rebuilding societies after the natural or man-made disasters.

Emergency management is a continuous process. It is essential to have comprehensive emergency plans and evaluate and improve the plans continuously. The related activities are usually classified as four phases of Preparedness, Response, Recovery, and Mitigation. The Fig 2 illustrates the order of these phases according to the concept of the disaster. Appropriate actions at all points in the cycle lead to greater preparedness, better cautions, reduced vulnerability (or) the prevention of disasters during the next iteration of the cycle and so on. The requirements of food, commodities and non-food items are shown in Table 1 to Table 3.

Table 1: Daily Requirements per head

Daily requirement (non-food items) per head									
	Bed sheets	Wollen blankets	Dhotis	Sarees	Feeding bottles	Towels	Rubber boots	Mosquito net	Water sanitation
Children(1-5)	1	1	0	0	1	1	0	1	10
Above-65(male)	1	1	1	0	0	1	0	1	15
Others (male)	1	1	1	0	0	1	0	1	15
Lactating mothers	1	1	0	1	0	1	0	1	15
Pregnant mothers	1	1	0	1	0	1	0	1	15
Others (female)	1	1	0	1	0	1	0	1	15
Volunteers	0	0	0	0	0	0	1	0	10
Price/unit	80	200	110	120	110	30	400	175	0.2
Requirement	69497	69497	34750	33407	1340	69497	0	69497	1035755
Total cost	5559760	138994001	3822500	4008840	147400	2084910	0	12161975	207151
Total cost of non food items(₹)									481891936

Fig: 2 Disaster Cycle
Source: - www.dallascounty.org

Table 2 : Commodity Requirement

NAME OF COMMODITY	Nos. required	Total requiremen	Pric e	Total cost
Water-Proof	100	300	432	1296000
Water	10	30	650	195000
Water	50	150	458	687000
Sanitation Kit	500	1500	210	315000

Tents	1000	3000	870	2610000
Buckets	2000	6000	45	270000
Ropes in Kgs	250	750	35	26250
Portable	20	60	600	360000
First-reponder kit	1000	3000	450	1350000
Recommended	5000	15000	93	1395000
Recommended	10000	30000	370	1110000
Volunteers(To	400	12000	0	0
Total Cost Of Bulk	55244250			

Table 3: Daily Requirement per head

Daily Requirement (Food Items) Per Head								
	Water(drinking)(litres)	Milk(ltr)	Milk powder (kg)	Bananas	Eggs	Lemon rice (packets)	Curd rice (packets)	Biscuits (packets)
Children(1-5)	3	0.6	0	1	1	3	3	2
Above-65(Male)	3	0	0.4	1	0	3	3	2
Others(Male)	3	0	0.4	1	0	3	3	2
Lactating Mothers	3	0	0.4	1	1	3	3	2
Pregnant Mothers	3	0	0.4	1	1	3	3	2
Others(female)	3	0	0.4	1	0	3	3	2
Volunteers	2	0	0	1	0	2	2	2
Price/Unit	1	25	155	1.5	4	7	10	4
Requirement	210891	804	2726.28	70697	2210	210891	210891	141394
Total Cost	210891	20100	422573.4	106045.5	8840	1476237	2108910	565576
Total Cost of Food Items (₹)								4919172.9

MODEL DEVELOPMENT

The main problems of immediate response lie in the pre-positioning of aid supplies against the unpredictability of demand. This paper develops a model as a means of anticipating the types and quantities of aid supplies to be kept in the pre-positioned facility. Problems often impose demands that cannot be met, given the natural human cognitive and physical limitations. The formulation will ensure the inclusion of all relevant disasters that can occur, taking into account the possible effect and impact of the disaster. The output of the model shall provide for the amount and types of aid supplies required after a disaster has occurred. These supplies will be retained in inventory at the pre-positioned facilities. It must however be anticipated that supplies may be damaged during a disaster event and that perishables will have to be replaced if they are not used within a certain time period. This will evidently affect the types and quantities of aid supplies to be stocked. Even when permission is granted, there are still occasional conflicts of authority and delays in decision making, due to distance, communication impediments or misunderstanding. In the private sector world, there may be delays in decision making, but conflicts of authority are very unusual even across great distances. Due to the unpredictable nature of a disaster, disaster management is a process that cannot be one hundred percent efficient. The capacities of resource providers are the key components in managing response efforts subsequent to disaster events, but that only a small amount of research has been conducted on the planning of aid supplies kept in inventory at pre-positioned facilities. The pre-positioned stock should thus meet the needs of a disrupted region by taking the effect of the disaster into consideration. In summary, the above-mentioned problem variants should be addressed by focusing on the uncertainty of a disaster and how demand can be addressed.

The variety of supplies varies with time, during and after a disaster, and these varying needs are addressed. The model is based on knowledge of existing models and the data gathered during research. Population size, disaster type and the disaster impact are used as data input for the model. Based on these inputs, the model is formulated to give an output of the amounts and types of inventory to be kept at a pre-positioned facility, to satisfy demand in the crunch time. Fig 3 shows RFID application in disaster relief operated.

These supplies are classified into the following types based on their usage:

1) Food items 2) Non-food items 3) Medicines and first aid 4) Sanitation

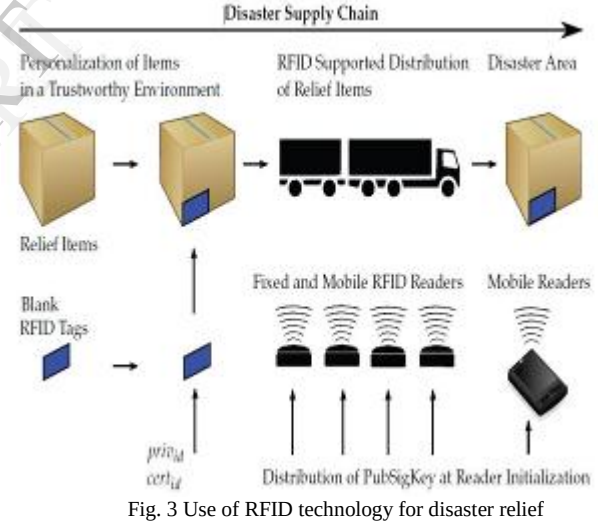


Fig. 3 Use of RFID technology for disaster relief

Source: - www.rfidc.com

HUMANITARIAN SUPPLY CHAIN

Humanitarian Supply Chain (Banbarosogulu at al 2004, Beamon 1999 & Van Wannenhove et al 2006) specializes in organizing the delivery and warehousing of supplies during natural disasters or complex emergencies to the affected area and people. Fig 4 explain the process of Humanitarian Supply chain.

These include:

- Zero lead time that dramatically affects inventory availability, procurement, and distribution.
- High stakes (often life-and-death) that requires speed and efficiency

- Unreliable, incomplete, or non-existent supply and transportation infrastructure.
- Many relief operations are naturally ad hoc, without effective monitoring and control.
- Variable levels of technology is available depending on the disaster area

Fig: 4 Graphic of a Humanitarian Supply Chain
Source : www.supernet.isenberg.umass.edu

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. Fig.5 explains the relief chain in Humanitarian Supply chain. There are nine main steps in the humanitarian supply chain to consider when responding to major disasters like floods, earthquakes etc.

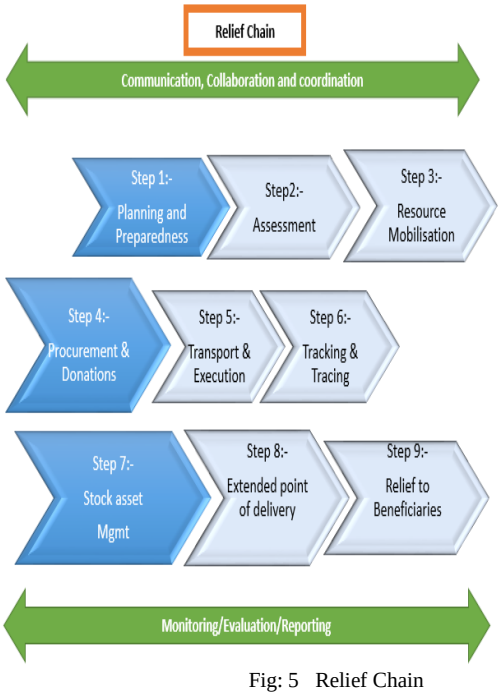


Fig: 5 Relief Chain
Source: fritz institute, 2005

BARRIERS FOR HUMANITARIAN SUPPLY CHAIN

Following are the obstacles in Humanitarian Supply chain. They are

UNCERTAINTY

The most challenging obstacle in humanitarian logistics is uncertainty. 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 2006). They also recognize how supply chain configuration and control structures, long forecast horizons, decision complexity, poor information reliability, and agency culture may create uncertainty. As supply chains become larger and more geographically diverse, natural and man-made disasters can also disrupt the supply chain

DEGRADED INFRASTRUCTURE

Inadequate transportation and communication infrastructure is another barrier to effective delivery of aid. In the DMTP (Disaster management training programmer) logistics handbook, it states "the overall effectiveness of relief logistics often depends on the level of prior investment in both the transport and communication infrastructure and how far relief requirements have been considered in the planning". System-wide, the logistics manager could encounter delivery options ranging through ships, aircraft, rail, and trucks. At the same time, those routes may close or clogged limiting the

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 in the effective 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.

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 the aid is administered.

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. Funding for organizational support and infrastructure is often neglected under donor demands that as much aid as possible is pushed to victims.

OTHER BARRIERS

A careful examination of all types of socio-environmental and cultural aspects so that no segments of the affected population are neglected

Potential Methods for Overcoming Barriers
Logistics Information Systems (LIS), Resource Management and Training & Education.

DESIGNING OF A RELIEF SUPPLY CHAIN

Design considerations

An effective logistics system and proper supply chains are undoubtedly the are major principals to humanitarian aid and natural disasters management. Here are some important factors to consider while designing a supply chain. Fig 6 shows all stake holders involved in relief supply chain.

- Production/Distribution Scheduling: Scheduling the manufacturing and/or distribution.
- Inventory Levels: Determining the amount and location of every raw material, subassembly, and final assembly storage.
- Number of Stages (Echelons): Determining the number of stages (or echelons) that will comprise the supply chain. This involves either increasing or decreasing the chain's level of vertical integration by combining (or eliminating) stages or separating (or adding) stages, respectively.
- Distribution Center (DC) - Customer Assignment: Determining which DC(s) will serve which customer(s).
- Number of Product Types Held in Inventory*:* Determining the number of different product types that will be held in finished goods inventory

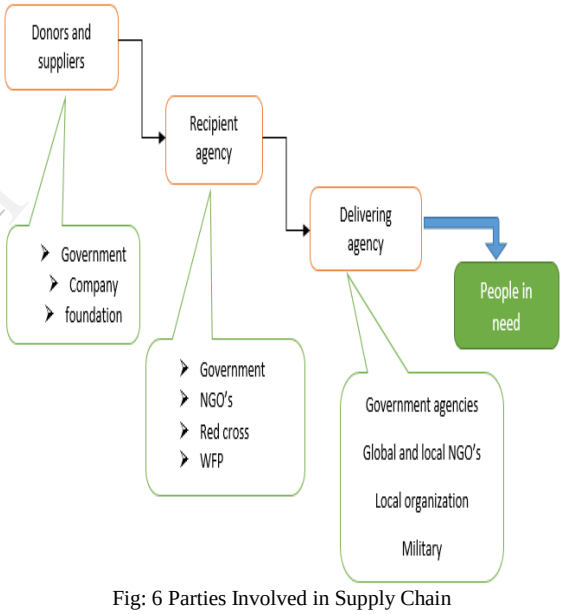


Fig: 6 Parties Involved in Supply Chain
Source: www.disasterlogistics.org

Based on the study there are six main components in the supply chain to provide relief commodities for disaster victims are described here. Fig 7 shows Supply chain network for humanitarian operations.

Logistics Centre (LC)

Permanent facilities that receive, store, ship, and recover disaster commodities and equipment. Examples of disaster relief commodities include ice, water, meals ready to eat (MREs), blankets, cots, flashlights, tarps, sleeping bags and tents. Disaster relief equipment's include emergency generators, personal toilet kits, and refrigerated vans.

Private Storage Sites (PSS)

Permanent facilities that are owned and operated by private industry and store commodities under a deal with government. Products mainly depend upon the type of facility.

Vendors Sites (VS)

Representing vendors from whom commodities are purchased and managed.

Mobilization Vehicles (MVS)

They basically have certain non-perishable items and usually are under the control of government agencies.

Temporary storage sites (TSS)

All the shipment is stored in this place and the new stock is directed to TSS.

Regional Distribution Sites (RDS)

These are at the affected area and from them goods are distributed to the people.

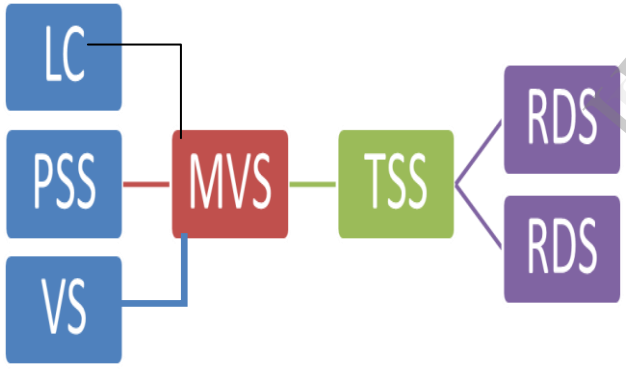


Fig: 7 Supply chain network for humanitarian operations

PERFORMANCE METRICS OF A SUPPLY CHAIN

A performance measure or a set of performance measures (Blackwell et al 1999, Arade Kani et al 1988) is used to determine the efficiency and/or effectiveness of an existing system, or to compare competing alternative systems. Performance measures are also used to design proposed systems, by determining the values of the decision variables that yield the most desirable level(s) of performance. These measures may be categorized as either qualitative or quantitative. But as we are dealing with humanitarian supply chain, we consider only qualitative methods.

QUALITATIVE PERFORMANCE MEASURES:

Qualitative performance measures are those measures for which there is no single direct numerical measurement, although some aspects of them may be quantified. These objectives have been identified as important, but are not used in the models reviewed here.

CUSTOMER SATISFACTION

The degree to which customers are satisfied with the product and/or service received, and may apply to internal customers or external customers.
Customer satisfaction is comprised of following three elements:
(1) ***Pre-Transaction Satisfaction***: satisfaction associated with service elements occurring prior to product purchase.
(2) ***Transaction Satisfaction***: satisfaction associated with service elements directly involved in the physical distribution of products.
(3) ***Post-Transaction Satisfaction***: satisfaction associated with support provided for products while in use.

- ***Flexibility:*** The degree to which the supply chain can respond to random fluctuations in the demand pattern.
- ***Information and Material Flow Integration*****:** The extent to which all functions within the supply chain communicate information and transport materials.
- ***Effective Risk Management*****:** All of the relationships within the supply chain contain inherent risk. Effective risk management describes the degree to which the effects of these risks are minimized.
- ***Supplier Performance*****:** With what consistency suppliers deliver the raw materials to the production facilities on time and in good condition.

EMERGENCY OPERATING CENTERS (EOC) / INCIDENT COMMANDER

An emergency operating center (EOC) is a central command and control facility responsible for carrying out the principles of emergency preparedness and emergency management, or disaster management functions at a strategic level in an emergency situation, and ensuring the continuity of operation of a company, political subdivision or other organization. Fig 8 shows the working plan of an emergency operation center

The common functions of all EOC's is to collect, gather and analyze data; make decisions that protect life and property, maintain continuity of the organization, within the scope of applicable laws; and disseminate those decisions to all concerned agencies and individuals. There is one individual in charge In most EOC's and that is the Emergency Manager.

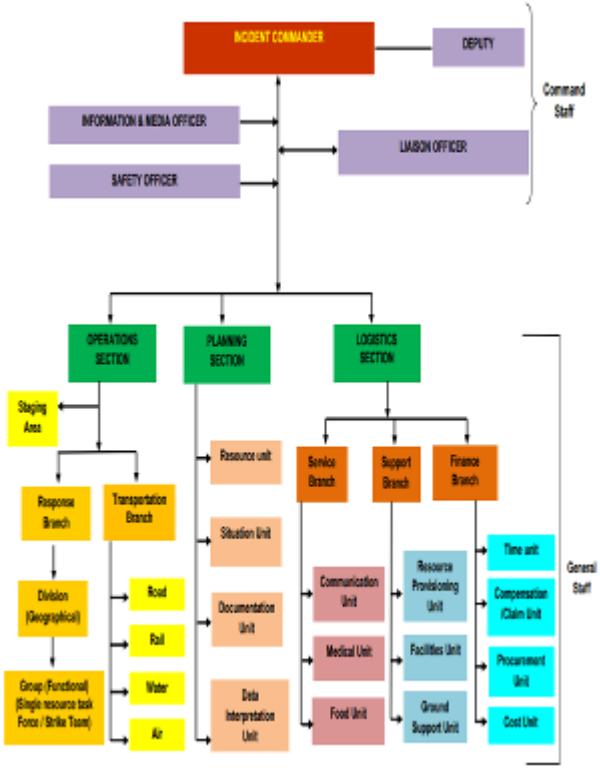


Fig. 8 Plan of an emergency operation center
Source : www.training.fema.gov

During an emergency or disaster, the District Administration will take immediate and appropriate action to determine, direct, mobilize, and coordinate reconsider officials time to take preventive, precautionary or protective measures to reduce loss of life and minimize damages. The City Administration takes initiative to establish, equip, an Emergency Operations Center (EOC) at Municipal corporation Office premises from which all emergency activities will be managed. The EOC will communicate with the other city and district administration to ensure close cooperation in emergencies and disasters. Fig 9 shows the Flow chart of working of Emergency operation center. The following are function of EOC. They are

- Dealing with incoming emergency calls and prioritizing them
- Taking the necessary information from the caller
- Recording details of incidents on computer systems
- Providing necessary advice and guidance
- Dispatching an emergency services team to deal with the incident
- Maintaining contact with the team at the scene of the incident to keep up to date with the situation and ensure staff safety

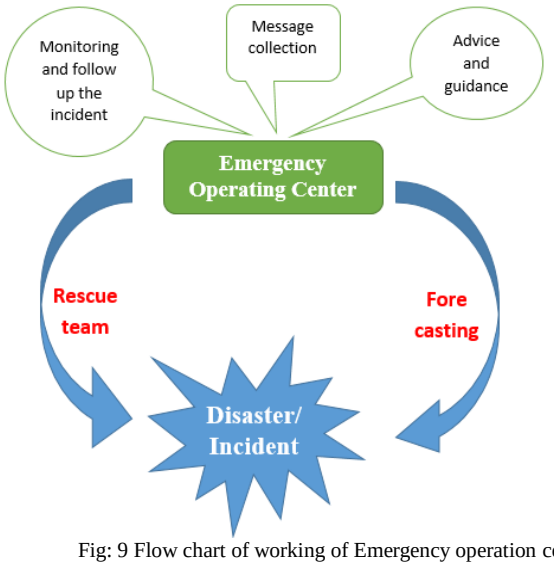


Fig: 9 Flow chart of working of Emergency operation center
Source www.training.fema.gov

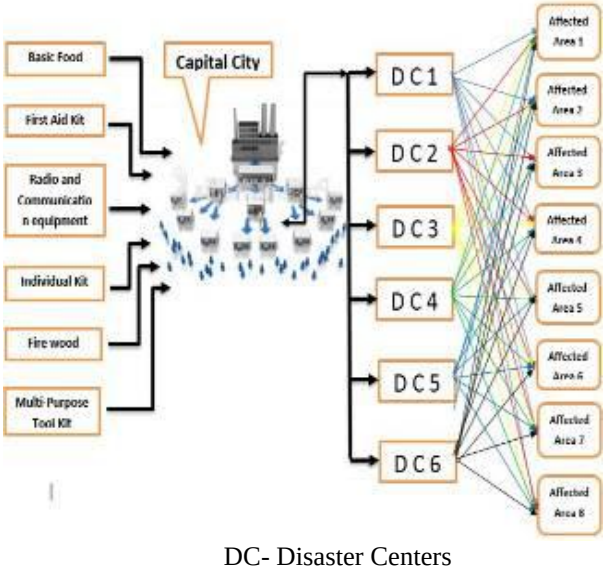
DATA COLLECTION

Consider a case-study analysis of flood relief operation.

Assumptions of the model

The model is based on following assumptions:

1. All the items required are grouped together and treated as a single unit.
2. Only one mode of transportation is used.
3. No perishability of items.
4. No damage to items during transportation.
5. The transportation system cost between different parts of state(s) and capital city and between capital-city to various DCs are ignored.



DC- Disaster Centers
Fig 10 Relief Supply Chain Network

Table: 4 The items required

Basic food		First aid kit	Communication Equipment	Cooking kit	Utensils
Raw food	Processed food				
1 kg of rice 1 kg of wheat 1 kg of oil 1 kg of dal 1 kg of spices	Bread Biscuits Fruits	Ointment Fever capsules Cold capsules Cotton Buds Capsules of body pains Bandages Plaster Cotton Anti-Septic Lotion	Radio Speaker Phone	Kerosene Stove Match box	Spoons Plates Knife Kitchen Tongs

The items are transported to Eight (8) affected areas, through Six (6) distribution centers (Say major towns). The supply capabilities of each distribution center and quantity requirements are qualified as shown in Table: 4. these items are first collected to a center point (Say capital city) and then, transported to various distribution centers (DC) and in turn to various affected areas. The items are collected across the state (or) states in the country are transported to capital city. The unit cost of transportation to various DC to different affected areas is also shown in the Table 5.

DATA ANALYSIS

A software package TORA is applied to find the solution to the given case-study. The solution to case-study problem is shown in Table: 6. Fig 11, Fig 12 and Fig 13 illustrates the procedure of TORA. The optimal allocation of quantity to various affected areas from different distribution centers is shown in Table 6.
Finally the optimal transportation cost is completed

Table: 5 Supply and Demand Requirement

	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	Supply
D C 1	71	65	51	43	95	50	73	79	122
D C 2	19	79	31	17	36	84	47	41	127
D C 3	46	68	93	86	43	94	69	73	144
D C 4	61	67	82	47	51	64	58	83	170
D C 5	54	87	90	71	74	83	49	71	145
D C 6	86	49	59	76	89	93	57	60	113
Demand	124	137	102	84	119	100	96	130	

A_i: Affected Areas (I = 1, 2, 3.....8)

Fig: 11 solution by TORA

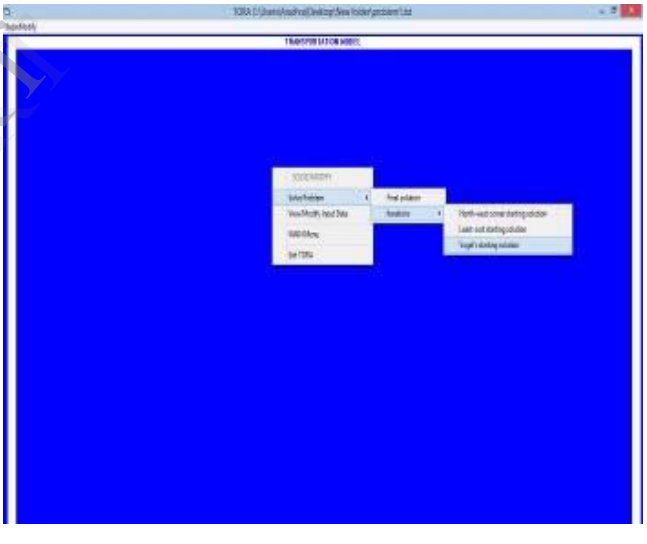


Fig: 12 solution by TORA

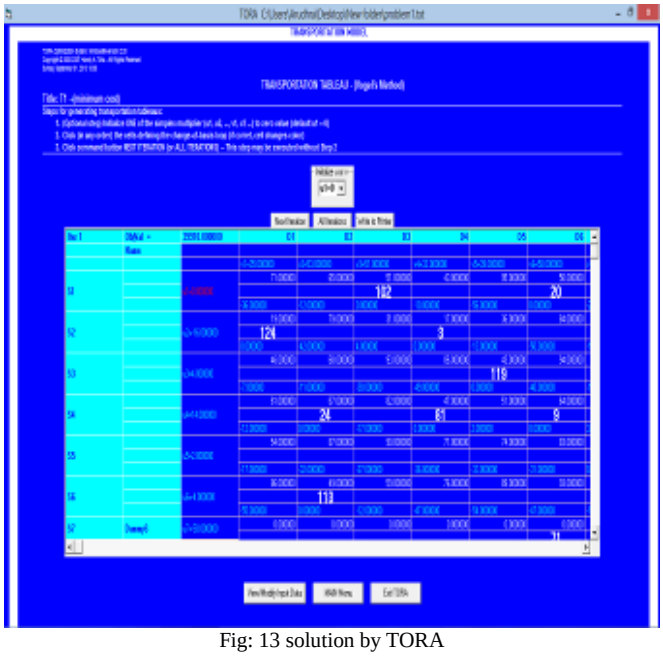


Fig: 13 solution by TORA

Table: 6 Optimal allocation of quantity

Objective Value:- 39910.000000								
From/To	A 1	A 2	A 3	A 4	A 5	A 6	A 7	A 8	Supply
D C 1	71	65	51 102	43	95	50 20	73	79	122
D C 2	19 124	79	31	17 3	36	84	47	41	127
D C 3	46	68	93	86	43 119	94	69	73 25	144
D C 4	61	67 24	82	47 81	51	64 9	58	83 56	170
D C 5	54	87	90	71	74	83	49 96	71 49	145
D C 6	86	49 113	59	76	89	93	57	60	113
	0	0	0	0	0	0 71	0	0	71
Demand	124	137	102	84	119	100	96	130	

Total cost is
51*102+50*20+19*124+17*3+43*119+73*25+67*24+47*81 +64*9+83*56+49*96+71*49+49*113+71*0 = Rs.39910.00/-

CONCLUSION

Humanitarian logistics has the opportunity to increase its contribution to disaster relief and to be recognized for that contribution by implementing initiatives in the areas of knowledge management, technology, measurement, community, and positioning. While moving the relief items to disaster sites will continue to be an important role for logistics, the strategic focus must be on providing timely information, analyzing that information to rare insight as to how to improve operations.

Humanitarian logistics information systems can improve the effectiveness of humanitarian supply chains. The effectiveness can be ensured by providing timely and accurate information regarding the supplies required and their prompt delivery by, enabling the donors to be more responsive to the needs of beneficiaries. Humanitarian logistics operates across the disaster management cycle. Humanitarian logistics information systems can improve logistics activities in each of the phases and also help to provide continuity to humanitarian operations throughout the entire cycle.

FUTURE SCOPE OF RESEARCH

Analysis the total cost taken for each product of transportation from ware house to affected area. Based on regional frequencies of natural disasters, perform location analysis for where to put consolidated and centralized warehouses of relief items

1. All the items required can be treated as various single unit.
2. Multiple and combined modes of transportation can be used.
3 Perishable items can be transported with a secured package.
4. Damaged items can be replaced with new ones.
5. The transportation system cost between different parts of state(s) and capital city and between capital-city to various DCs can be considered.

REFERENCE

1. Anisya Thomas 2003, logistics to supply chain management, http://www.fritzinstitute.org/pdfs/whitepaper/fromlogisticsto.pdf
2. Alexander, D,E, 1993, Natural disasters. London: UCL Press
3. Altay, n.,, and Walter G. G. 2006. OR/MS research in disaster operations management. European journal of operational research. 175, p475-493
4. Ardekani S.A. and Hobeika A.(1988) logistics problems in the aftermath of the ico city earthquake. Transportation quarterly. 42(1), 107-124.
5. Barbarosoglu. G. and Arad, Y., A two stage stochastic programming framework for transportation planning in disaster response. Journal of the Operational Research Society, 2004, 55, 43-53.
6. Beamon, B., 1998. "Supply chain design and analysis: Models and methods", International journal of production Economics, vol. 55, no.3,pp.281-294.
7. Beamon,b., measuring supply chain performance. International journal of operations and production management; 1999, vol. 19 issue ¾, p275292.
8. Beamon, B. and kotleba, S., inventory modelling for complex emergencies in humanitarian relief operations. International journal of logistics, vol.9, no.1, march 2006, 1-18.
9. Beamon, B., Humanitarian relief chains: issues and challenges, in proceedings of the 34th international conference on computers and industrial engineering, san Francisco, CA, 2000
10. Van Wassenhove, L.N., humanitarian aid logistics: supply chain management in high gear.J.Oper.Res.Soc. 2006, 57(5), 475-489.
11. Yi. W. and Ozdamar, L., Adynamic logistics coordination model for evacuation an support in disaster response activities. European journal of operations research 179.
12. Aall, Pamela. "NGOs, conflict management and peacekeeping," international peacekeeping, 7(1): 121-141 (spring 2000).
13. Barry, Jane and Anna Jeffrys. A bridge too Far: Aid Agencies and military in Humanitarian Response. Report to the humanitarian practice network. London: Overseas Development institute, January 2002.
14. Blackwell, Roger D. and Kristina Blackwell. "The century of the consumer: converting supply chain into demand chains," supply chain management review 3, 3: 22-32 (fall 1999).
15. Brown, Vincent, guy Jacquier, Denis coulombier, Serge Balandine, Francois Belanger, and Dominique Legros. "Rapid Assessment of population size by Area sampling in disaster situation," Disasters, 25(2): 164-171 (june 2001)
16. Byman, Daniel and others. Strengthening the partnership: Improving Military coordination with relief agencies and Allies in humanitarian operations. Santa Minica: RAND, 2000.