Analyzing Barriers of Humanitarian Supply Chain towards Building Community Resilience for Multiple Disasters

A Thesis of Master of Science

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Analyzing Barriers of Humanitarian Supply Chain towards Building Community Resilience for Multiple Disasters

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THESIS ACCEPTANCE CERTIFICATE

Certified that the final copy of MS thesis written by **Muhammad Shahjahan Raza** (**Registration No. NUST-2015-MS DM-00000118915**), of **MILITARY COLLEGE OF ENGINEERING (MCE),** has been vetted by the undersigned, found complete in all respects as per NUST Statutes/Regulations, is free of plagiarism, errors, and mistakes and is accepted as partial fulfillment for the award of MS degree. It is further certified that necessary amendments as pointed out by GEC members of the scholar have also been incorporated in the said thesis.

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Declaration

I certify that this research work titled "*Analyzing Barriers of Humanitarian Supply Chain towards Building Community Resilience for Multiple Disasters*" is my own work. The work has not been presented elsewhere for assessment. The material that has been used from other sources it has been properly acknowledged / referred.

Signature of Student

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Dedicated to my loving Family

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ABSTRACT

With increasing frequency and intensity of multiple disasters, increase in its impacts on livelihood is being recorded. There is a need of effective management system that can mitigate the harmful impacts of disasters and build community resilience. This can be done with the help of successful humanitarian supply chain. This research has been conducted to identify barriers of humanitarian supply chain management to ensure building community resilience. Barriers of humanitarian supply chain were analysed with the help of Interpretive Structure Modelling (ISM). List of barriers was collected through survey and consulting experts related to academia and disaster management organizations. Further previous researches were also taken into consideration. ISM was applied to find out relationship among identified barriers. Data was collected through experts, academic research papers and interviewing practitioners. Identified barriers will help community to improve their existing resilience for disasters. 18 barriers were identified with the help of questionnaire. Response from 12 personnel was recorded with the help of semi structured interviews. 4 were from field of academia, 4 were from provincial disaster management authorities and 4 were field staff working in different emergency and response departments. ISM model shows that lack of leadership is one of the most influence barriers of humanitarian supply chain. It has highest driving power and zero dependence power. It is driving 17 other barriers of HSC. Lack of government standards & polices, confusion due to multiple stakeholders, cultural differences and language barriers are driven by only one barriers i.e. lack of leadership. And they have high driving power and low dependence power. They are influencing 13 other barriers. Lack of central warehousing occupies the top slot in model which shows that it has zero driving power and highest dependence power. It is not influencing any other barrier but highly influenced by 17 barriers fall below following ISM model.

Key Words: *Disaster, Resilience, Humanitarian Supply Chain, Interpretive Structural Modelling, Community Resilience.*

CHAPTER 1
INTRODUCTION

1.1 Disaster Management and its Phases

Natural disasters have always been part of our lives. World is facing disaster since the creation of this universe. Disaster by its nature is form of destruction which not only disrupts natural flow of livelihood but also leads to live losses of both human and animal. Disaster is defined by several researcher and organization to establish a consensus in understanding its meaning and impacts. UNISDR has defined disaster as a serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts (UNISDR, 2017).

International Federation of Red Crescent defined disaster as occasion that cause massive disruption in human life flow which not only affect individual but community in general. Such massive disruption overcomes capacity of a community. Statistics shows that more than 2500 deaths, 600 million injuries were recorded in year of 2000. Disaster has caused loss of USD 28 billion worldwide (IFRC, 2003). Scientific innovation and advancement has failed to achieve technology which can prevent natural disasters. If we review previous occurrence of disaster, we witness several catastrophic disasters. According to a report more than 460000 people lost their lives as a result of earthquake in Pakistan, Turkey, Taiwan, Iran, India, China and Haiti. (Izmit, 1999; Chichi, 1999; Gujurat, 2001; Bam, 2003; Kashmir, 2004; Sichuan, 2008). Just three hazards have caused death of more than 300000 people, loss of billions of dollar and millions of people

homeless. These three disasters were; Katrine in USA during 2005, Tsunami in Indonesia during 2004 and Floods in Pakistan during 2010 (Barzinpour, 2014). Awaran earthquake in Baluchistan caused 823 deaths and more than 700 injuries, 6.2 magnitude earthquake were recorded (Baloshictan 2013). 2015 earthquake caused major destruction in Afghanistan and Pakistan. 400 deaths and 3000 injuries were recorded in Afghanistan, where as 100 deaths and 500 injuries were recorded in Pakistan.

Below table reflects some major disasters with their significant impact and scale;

Table 1.1: Major Disaster and their Impact; Source: (Barzinpour, 2014)

Event/Date	Significance
Hurricane Katrina, United States 28 August 2005	• Costliest natural disaster in U.S. history • Even with disaster plans in place, the fifth-deadliest disaster (1,833 deaths) • Federal disaster area of 90,000 square miles
Cyclone Nargis, Myanmar 5 May 2008	• 138,000 killed • Deadliest named cyclone
Loma Prieta, CA, earthquake 17 October 1989	• 6.9 Richter scale • 63 killed
Kashmir, Pakistan, earthquake 8 October 2005	• 7.6 Richter scale • 75,000 killed
Haiti earthquake 12 January 2010	• 7.0 Richter scale • 316,000 killed
Christchurch, NZ, earthquake 22 February 2011	• 6.3 Richter scale • 185 killed
Indian Ocean tsunami 26 December 2004	• Triggered by a 9.1 Richter scale earthquake • More than 300,000 killed
Tohoku, Japan, earthquake and tsunami, 7 April 2011	• Triggered by a 9.0 Richter scale earthquake • 15,883 killed

Centre of Research on Epidemiology of Disasters CRED defined disaster as circumstance which demolishes nearby limit and make them demand national and global organizations for outside help. Disaster is an unexpected occasion that causes

gigantic harm, annihilation and human affliction (CRED, 2014). Cozzolino defined disaster in his research as a term which refers to disruption that physically affects a system and threatens its priority and goal (Cozzolino, 2012). Cannon has defined Disaster as combination of natural hazards and vulnerabilities during which prone communities fail to cope up with it and leads to major destruction (Cannon, 2018)

Multiple disaster is a term used of all kind of hazards, it includes earthquake, land sliding, floods, cyclones, storms, avalanches and manmade disaster such as accidents, war and riots etc.

Disaster Management Framework consists of 3 phases; Pre-Disaster phase, Disaster phase and Post Disaster phase. In Pre-disaster phase, the focus of international humanitarian agencies is to choose such measures that can help in mitigation. Further it helps community and other organization to stay well prepared to deal with any kind of disaster within the community. Disaster phases are actual destructive phase which require rescue and relief activities through successful humanitarian supply chain activities. Post disaster phase is rehabilitation and recovery phase where focus of humanitarian agencies is to ensure proper restoration of livelihood and humanitarian wellbeing. Disaster management cycle illustrate all phases of disaster in a figure 1.1 and 1.2.
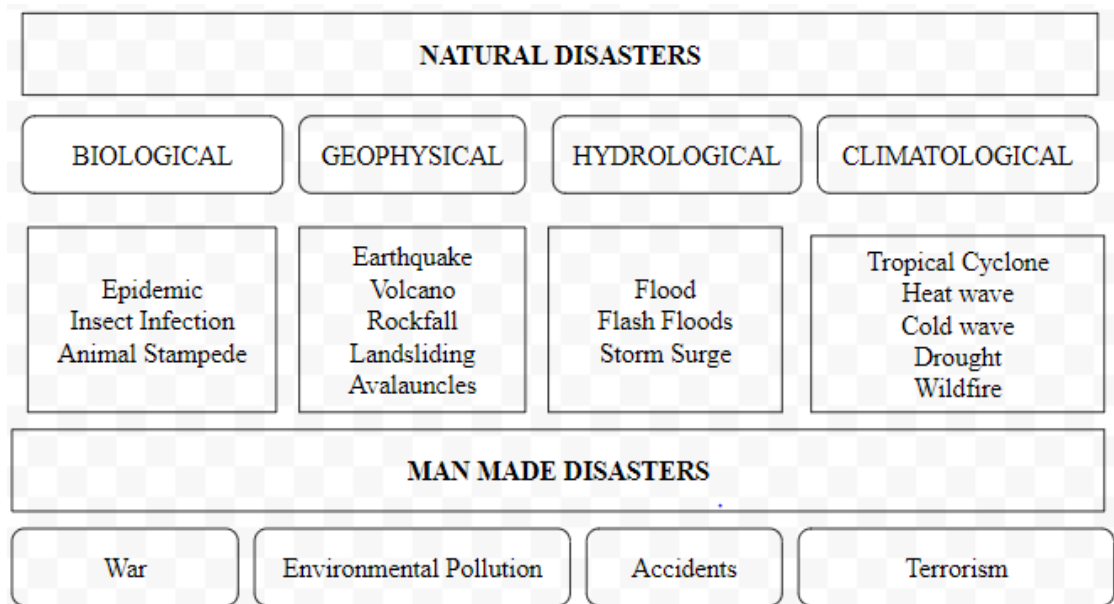
Fig 1.1 Classification of Disaster by its Origin: CRED, 2012

Fig 1.2 Disaster Response Cycle: Source: Minthapala, IUCN, 2008

Prevention in disaster management refers to not letting hazard to occur. Prevention is also known as avoiding disaster or eliminating disaster threat. By nature of hazard, it is not possible to prevent disaster complete but preventive measures can be adapted. Mitigation mean reducing the magnitude of disaster of minimizing its harmful impacts. Preparedness refer to structural and non-structural measures that

can reduce expected losses. During pre-disaster phase, vulnerable communities are advised to evacuate or adapt such measure that can save their livelihood. Relief phase refers to immediate response after the onset of disaster. Aim to relief is to search and rescue affected community and provide them basic life facilities. Evacuation, provision of medical first aid and food, temporarily shelter are the focus of relief activities. Recovery is state of bringing back to normality. Recovery stage take time but highly important to restore community life. Rebuilding is another form reconstruction. It refers to reconstruction of destroyed facilities.

Following table shows overview of major disaster events in Europe, 1998-2009.

Table: 1.2: Major Disaster in Europe, Source (EMSA, 2010)

Hazard type	Recorded events	Number of fatalities	Overall losses (EUR billion)
Storm	155	729	44.338
Extreme temperature events	101	77 551	9.962
Forest fires	35	191	6.917
Drought	8	0	4.940
Flood	213	1 126	52.173
Snow avalanche	8	130	0.742
Landslide	9	212	0.551
Earthquake	46	18 864	29.205
Volcano	1	0	0.004
Oil spills	9	n/a	No comprehensive data available [a]
Industrial accidents	339	169	No comprehensive data available [b]
Toxic spills	4	n/a	No comprehensive data available [c]
Total	928	98 972	148.831

Global Framework of Disaster Risk Reduction has reported disaster profile of Pakistan. Pakistan face series of disasters every year. Major disasters in Pakistan includes; Earthquake, Floods, Land sliding, Droughts and Cyclones etc. Earthquake of 2005 has been the most catastrophic disaster. It was very high magnitude earthquake and caused destruction and life losses on major scale. More than 6800 people died, monetary loss exceeded USD 600, Cost of relief, recovery and reconstruction was USD 5.2 billion. Natural disaster is a major threat to Pakistan. Flooding cause approximately annual economic impact of 4 percent of federal budget. Floods of 2010 were one of unprecedented and affected entire country. It affected 79 districts and overall 20 million people were highly affected. Damage and need assessment estimated USD 10 billion for recovery and reconstruction. Floods of 2011 affected 10 million people of Pakistan from major provinces. Pakistan is still in the phase of recovery due to onset of floods every year. (GFDRR, 2017).

1.2 Humanitarian Supply Chain

Humanitarian Supply is a part of coordination which works in sorting out the conveyance and warehousing of provisions during disastrous events or complex crises to the influenced territory and individuals. Although they have been for the most part used in business supply chain, coordination is one of the most significant instruments now disaster relief activities.

Humanitarian Supply Chain is an important type of logistics. Humanitarian supply chain can be defined in several terms. Worldwide concept of humanitarian supply chain is utilized during disasters and other emergency situations. There is no single definition of humanitarian supply chain. It has been defined in diverse ways. According to Mehtzer, Humanitarian supply chain is a system made through the progression of provisions, administrations, funds and data between benefactors, recipients, providers and various units of humanitarian organizations for giving physical aid to recipients (Mentzer et al. 2001). Humanitarian supply chain is a coordination of providers, stockrooms and stores, so product is produces at the best quality, to the right area and at the right time to limit delay and reduce cost of supply (Levi et al 2003). In humanitarian supply, the role of supplier and donor are important to achieve ultimate objective to effective response to events like disasters and subsequent emergencies. Humanitarian supply chain has its key role in disaster relief operations (Charles, 2010).

Watcharvee has defined humanitarian supply as a course of planning, executing, and monitoring the efficient, cost effective flow and storage of properties and services, as well as associated data from supplier to consumer for purpose of

facilitating the victims of vulnerable people as a result of disaster (Watcharvee, 2014). Information, account, warehousing, network and communication, transport, response time and stakeholders are major elements of humanitarian supply chain (Hadiguna, 2012; Holguin et al, 2012).

Effective humanitarian supply chain guarantees warehousing to store all important things that are the apparatuses used in disaster response. Storerooms must be planned by adapting protective measures for contamination or loss of resources and ordered to ease distributions to the anticipated zone at the chosen time and quantities. Effective humanitarian activities also accept that supply centres are in the right area, which is clearly closer to the area susceptible to disaster and can be specified through established system. The accountable authorities intend to enhance response and reduce delivery time, money utilized and amount of supply centres. Management of the distribution of goods, teams, supplies and apparatus movement is realized by deployment centres, which are situated near the affected area. Taking safety measures before the onset of disaster is to organize emergency response plans which will help preparation and therefore deployment in the period of the disaster.

The Fritz institution has well-defined humanitarian supply chain as a course of planning, executing and monitoring the competent, cost effective stream and storing goods and resources, together with associated data, from point of source to point of receiver to attain humanitarian relief through accomplishment of recipient necessities (Thomas and Mizushima 2014). Planning, preparedness, transportation, warehousing, distribution and recipient satisfaction make humanitarian response successful. (Wassenhove 2003). Leindorfer and Van Wassenhove defined

humanitarian supply chain as a network consisting of suppliers, manufacturers, distributors, and consumer (Kleindorfer and Van Wassenhove, 2004).

The crux of humanitarian supply chain defined in above studies is similar. My purpose is to give a basic understanding for role of humanitarian supply chain in disaster events. Since humanitarian supply chain is considered a backbone of disaster management operation there for it is important to consider it as major component towards building resilience of community. According to my understanding, humanitarian supply chain is delivery of relief, support and required aid from source to place of disaster effected communities with the help of effective medium. Source in humanitarian supply chain is donor and other humanitarian agencies, international and local NGO's and government organizations etc. They will provide immediate assistance in the form of supply of goods, services, and relief items. Receiver is the effected communities hit by disasters. Medium in humanitarian supply chain is transportation; through roads, telecommunication and other transportation modes. Concept of humanitarian supply chain is reflected in a figure 1.3 below.

UPSTREAM			DOWN STREAM
Source/Supplier	Medium/ Mode of Communication		Consumer/ Receiver
Donor Agencies National and International GO Donor Government Other Stakeholder in Supplying Humanitarian AID UNO Agencies	Air Transportation Road Communication Shipping		Community effected by onset of disaster
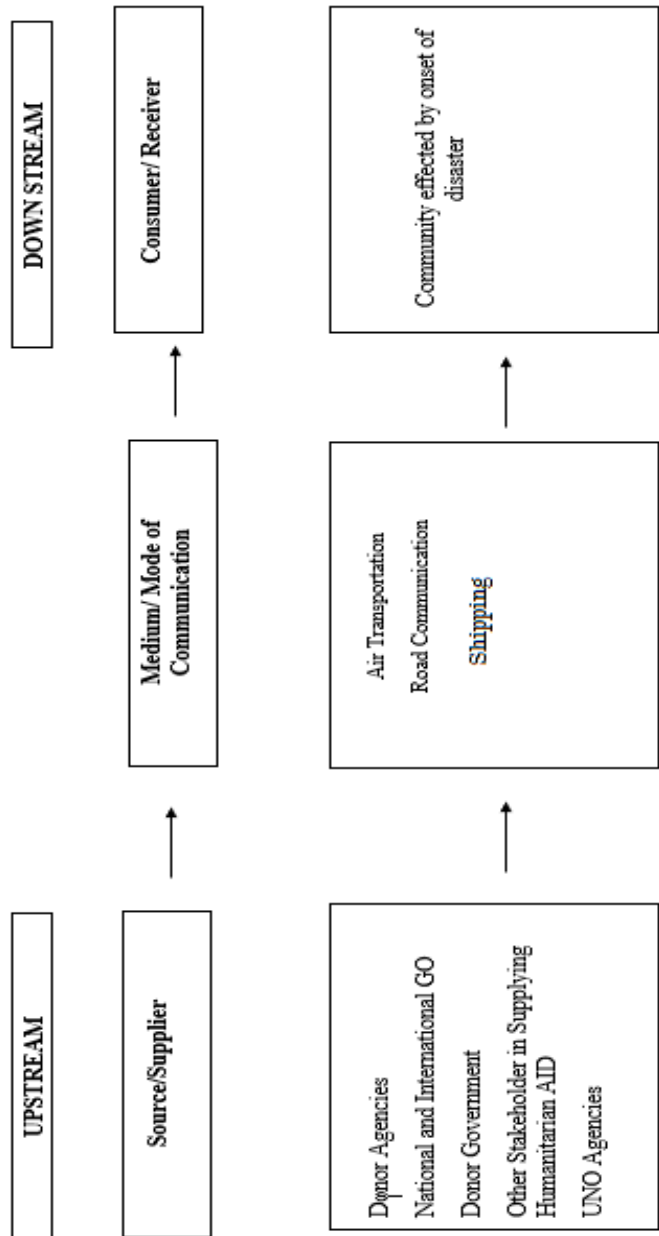
Fig1.3a: Humanitarian Supply Chain

Figure 1.3b: Humanitarian Supply Chain Network, Source; Richard Grey, 2016

1.3 Community

Community is defined as a group of people having common characteristics and social believes shares same geographical location. Community is a social unit where people shares common norms, values, and identifies under same administrative government (Kegeles, Strauss et al. 2017).

Pakistan has four provinces and federally controlled Gilgit Baltistan and Azad Kashmir. In total there are 154 districts of Pakistan including Capital territory, Azad Kashmir and Gilgit Baltistan. As per government act, Azad Jammu and Kashmir and Gilgit Baltistan has 10 districts and Capital Islamabad has only 1 district. Punjab has 36 districts, KPK and Balochistan has 34 districts and Sindh has 29 districts. Districts are further divided into Tehsils (Pakistan Bureau of Statistics).

Scope of research is community; therefore, the target community level is Tehsil level administration. Area fall within the territory of Tehsil is operationally defined as community in my research. National Disaster Management Ordinance of 2007 has defined role and responsibilities of disaster management organizations from

national to tehsil level administration. National Disaster Management Authority is federally controlled, and its chairman is appointed by Prime Minister. Provincial Disaster Management Authorities are provincially controlled, and its chairman is appointed by Chief Minister of province. District Disaster Management Organizations operate at district level. Key role of these organizations is to control disaster management operations at local level. District Disaster Management Authorities have been established in all districts and agencies of Provinces, Azad Kashmir, Gilgit Baltistan and FATA. DDMAs are controlled and administered by District Coordination Officer DCO and government officers at district levels. District Disaster Management Authorities are main help responsible for district level coordination and planning, operational strategies and implementations for disaster management operations at district levels. They are primary responder also knows as first responder available at local level. DDMA operates as per government rules and regulations by national and provincial disaster management authorities.

Pakistan Army has key role during relief operations in Pakistan. General Headquarters of all armed forced work in collaboration with Prime Minister and NDMA. Corps headquarters work in collaboration with Chief Ministers and PDMAs respectively. Divisional Headquarters and Battalions/Units works in collaboration with District Coordination Officer at district-tehsil levels. (NDMA, 2007).

DM ORGANIZATIONAL STRUCTURE
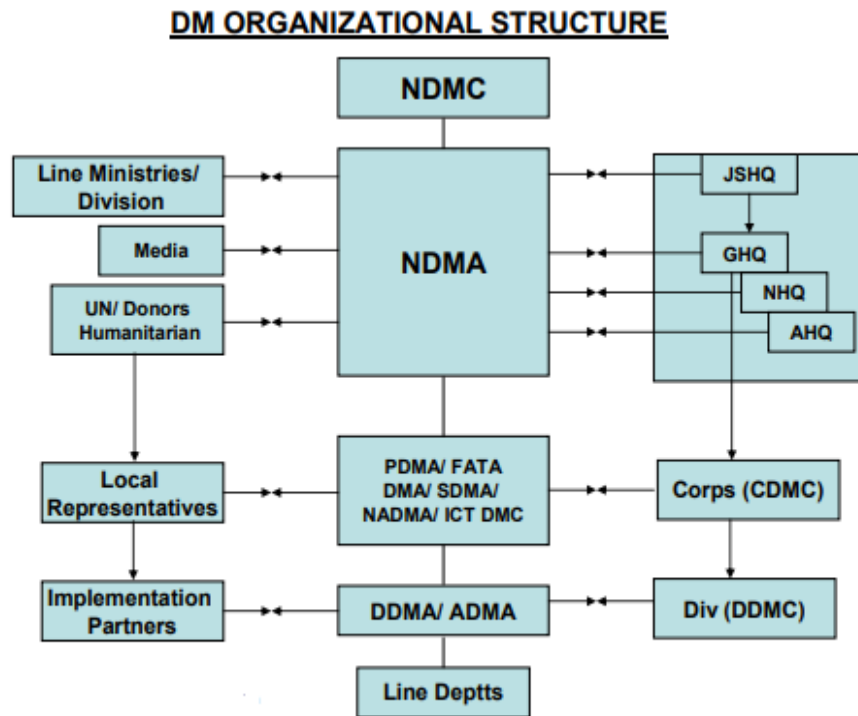
Fig 1.4: Disaster Management Structure (NDMA 2010)

1.4 Community Resilience

Word resilience has a strong linkage with disaster management globally. There are several ways to define true meaning of resilience. In simply resilience reflect overall capacity to deal with emergency in the form of effective response and mitigation. Longstaff defined resilience as maintaining state of stability by any individual, groups or organization during sudden disruption or set back, such as hazards etc. He stressed that resilience is found in a system that are highly adaptable and have diverse resources (Longstaff, 2005). Resilience is ability of community to withstand external shocks to their social infrastructures (Adger, 2000). Another definition by Adger is that resilience as ability to persist and ability to adapt to change, unforeseen circumstances and risk (Adger, 2003).

Resilience can be divided into several types such as organizational resilience, community resilience, psychosocial resilience etc. depending upon scope and condition. Community resilience is one of important type of resilience which improves overall community level of preparedness and ability to response and reacts to any unforeseen events. Considering multiple disasters, communities are always at risk in terms of hazard and vulnerability. Communities are the first responder for all kinds of natural and manmade disaster. Therefore, building community resilience has key role in process of disaster management. Like multiple definitions of resilience, community resilience is defined in several ways. Mileti defined community resilience as capacity to sustain any extreme event without suffering major damages, losses, diminished productivity or quality of life without getting assistance outside community. He termed community resilience as community power to absorb and event and bounce back to normality on their own strength (Milei 1999). The capacity of community units to alleviate disaster, contain the impacts of disasters when they happen, and carry out recovery operations in ways that reduces community disruption and minimize the impacts of forthcoming disasters (Bruneau, 2003). Godschalk defined community resilience as sustainable network physical system and human communities, capable of handling risky events during calamities. Physical structures and human community should endure under extreme hazard (Godschalk, 2003). It is also defined as capacity to react to calamities in ways that reinforce community ties, properties and community's ability to resist (Chenoweth, 2001).

Previous research work carried out in field of humanitarian supply chain, community resilience and disaster management listed below table 1.3.

Table 1.3: Previous Researches

	Title	Reference	Method	Focus	Area	Results
1	Resilience and Agility: The Crucial Properties of Humanitarian Supply Chain	(Dubey 2019)	Confirmatory factor analysis (CFA)	Resilience and humanitarian supply chain. Research from Switzerland	Switzerland	Supply chain agility is crucial factor for pre-disaster performance. Supply chain resilience is crucial factor for post disaster performance
2	We Just Want to Help"-Non-profits Contributions to Community Resilience in the Disaster Space	(Roberts, Archer et al. 2019)	Qualitative research methods, Thematic analysis, and Case studies	Strengthening community resilience through the active role of Non-Prophet Organizations	Australia	Sendai guiding principles of engaging, empowering, and enabling the community to build disaster resilience
3	Understanding activated network resilience: A comparative analysis of co-located and co-cluster disaster response networks	(Lai and Hsu 2019)	Logistic regression-QAP (LR-QAP)	Analysing disaster response network in Nepal and Ecuador	China	During Cyclone, response networks resemble a predefined cluster design. During earthquake no formal networking recorded.
4	Involvement in emergency supply chain	(Dwivedi, Shareef et al. 2018)	Qualitative Investigation Technique	Understand primary problem	Bangladesh	Finding reflects the managerial struggle, radical

				linked with abnormal behaviour towards disaster management activities in Bangladesh		biasness and specialised development has substantial impact on behaviour. Impact of uncertainty is non-significant on behaviour.
5	Humanitarian medical supply chain in disaster response	(Dolinskaya, Besiou et al. 2018)	Interviewing and Case studies	Role of medical assistance during emergency supply chain following large scale disaster	Japan	The factors affecting the effectiveness of the HMSC are identified
6	Humanitarian logistics in disaster relief operations	(Kovács and Spens 2007)	Analysis of previous literature published	Understanding of planning and carrying out logistics operations in disaster relief.	Nepal	Creates a framework distinguishing between actors, phases, and logistical processes of disaster relief.
7	Analysis of critical success factors of humanitarian supply chain: An application of Interpretive Structural Modeling	(Yadav and Barve 2015)	Interpretive Structural Modelling ISM. MIC MAC Analysis	Identification of CSFs of humanitarian supply chain.	India	Government policies and Organizational structure is the most dominating factor.
8	Interpretive structural modelling of supply chain risks	(Pfohl, Gallus et al. 2011)	ISM MICMAC Analysis	interdependencies among risks to be derived and structured into a	UK	Model's insight would assist supply chain risk managers in the effective allocation of risk

				hierarchy to derive subsystems of interdependent elements with corresponding driving power and dependency.		management resources in the subsequent risk management phase
9	Factors Affecting Disaster Preparedness, Response, and Recovery Using the Community Capitals Framework	(Himes-Cornell, Ormond et al. 2018)	Community capitals framework	To understand community level practices towards dealing with preparedness, response and compete restoration after disaster strike.	Holland	Community perform well due to strong social, political and fanatical aspects towards disasters, enabling long transformation or restoration.

10	Designing Humanitarian supply chain by incorporating actual post disaster decisions	Tzur and Reut, 2018	Rule of Thumb, Tabu search Methodology	Role of humanitarian constraint towards post disaster situations	Iran	Using the humanitarian constraints improves the entire supply chain performance. Therefore, it is critical to accurately incorporate post-disaster decisions during the pre-disaster planning phase
11.	Agility and discipline: Critical success factors for	(Harrald 2006)	Content Analysis	Strengthening Post disaster response	UK	Factors towards agility and discipline are crucial. They must be an integral component towards

	disaster response				successful disaster response.
12	Supply chain management: a strategic perspective	(Bechlet, 2017)	Survey	Critical review of supply chain management literature and by suggesting a research agenda for the future.	Texas USA	Model provides a tool for identifying the major contributions in the literature. Framework of agenda was developed.
13	Community resilience to flood hazards in KPK province of Pakistan	(Qasim, Qasim et al. 2016)	Survey	Measure factor enhancing community resilience	PAK	Improvement in economical, institutional and physical indicators enhance disaster preparedness.

Research have been conducted in the field humanitarian supply chain, community resilience and disaster management distinctively. There is a huge gap of research that integrate all above areas.

1. Dubey, 2019 studied role of supply chain agility as critical success factor for pre-disaster performance and supply chain for post disaster performance. His research is based on previous literature. His study lack element of resilience on community level for effective disaster response.

   Dolinskaya et al, 2018 identified factor affecting effectiveness of medical supply chain in disaster response. His research is limited to case study and does not address community resilience.

   Kovac, 2007 prepared a framework of disaster response operation based on previous researches. His research lack scientific methodology and does not integrate role of humanitarian supply chain at community level.

   Tzur, 2018 studies role of humanitarian supply chain in decision making for post disaster activities. His research lack scientific methodology and doesn't not address community resilience.

2. Yadev, 2015 conducted research on identification of critical success factor to enhance resilience of organizations. His research lack prospects of community resilience and multiple disasters.

   Robert et al, 2019; Lai and Hsu, 2019 worked on strengthening community resilience and preparing a network for strengthen community resilience respectively. Their research lack role of humanitarian supply chain network towards building resilience.

3. Shreef et al, 2018 studied problem associated with abnormal behaviour towards disaster management activities. His research lack integration of humanitarian supply chain and community resilience.

   Himes et al, 2018 prepared a community-based framework for disaster response and recovery. His research lack integration of humanitarian supply chain and community resilience.

4. Qasim et al, 2016 analysed community resilience to flood in KPK province of Pakistan. His study measures community resilience again floods with the help of factors like social, ecumenical and institution serve as indicators towards disaster preparedness. His research is limited to flood only. It lacks multiple disaster approach. Further there is role of humanitarian supply chain in his research that can strengthen disaster response.

   Several researches reflect that there is immense need of research to integrate humanitarian supply chain, multiple disaster and community resilience to ensure a successful humanitarian supply chain making resilient community. My research has integrated all areas to enhance community resilience with the help of successful humanitarian supply chain.

1.4 Rationale:

Disaster risk reduction is now a key focus of disaster management worldwide. Supply chain management is basis to ensure successful disaster risk reduction with the help of effective management. By identifying barriers, we can focus on those factors to ensure building community resilience. This will not only help in disaster mitigation, but it will help towards disaster preparedness as well. Having a

successful model highlighting key barriers can help community to improve their resilience. This way they can prepare their own disaster preparedness and mitigation plans. Ultimately it will help towards disaster risk reduction. The main reason of selecting this topic is lack of research in this field in Pakistani context. We do not have effective supply chain management in terms of disaster risk reduction in our local communities. Further we need to have a framework of identified barriers of humanitarian supply chain that can be implemented to improve resilience.

1.5 Objectives:

a. To identify barriers of community resilience for humanitarian supply chain.

b. To establish contextual relationship among identified barriers.

c. Formulating a framework for humanitarian supply chain towards building community resilience for multiple disasters.

1.6 Relevance to National Needs:

Damage and loss because of disaster are mainly due to lack of effective supply chain management in Pakistani communities. At the time of disaster; supply of most relevant and needed assistance and support will increase preparedness and mitigation during pre-disaster phase and so increase effectiveness of response and recovery in post disaster phase. Having a framework that can help stakeholder, government and related organization to work out the factors that need more attention to ensure effective disaster risk management in all kinds of organizations is a necessity. In 2005 earthquake, mismanagement and supply of unappropriated

relief items resulted in failure of successful response and recovery operations. Therefore, life losses, economic damages etc. were very high.

1.7 Advantages

- Successful and effective ISM mode for supply chain management will improve level of preparedness before onset of disaster and relief activities in disaster and post disaster phase.

- Building community resilience.

- Disaster risk reduction plans can be made with the help of factors identified. Different organizations can have their own effective risk reduction plans with the help of ISM model.

1.8 Research Roadmap

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│      LITERATURE REVIEW       │
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│      LIST OF IDENTIFIED      │
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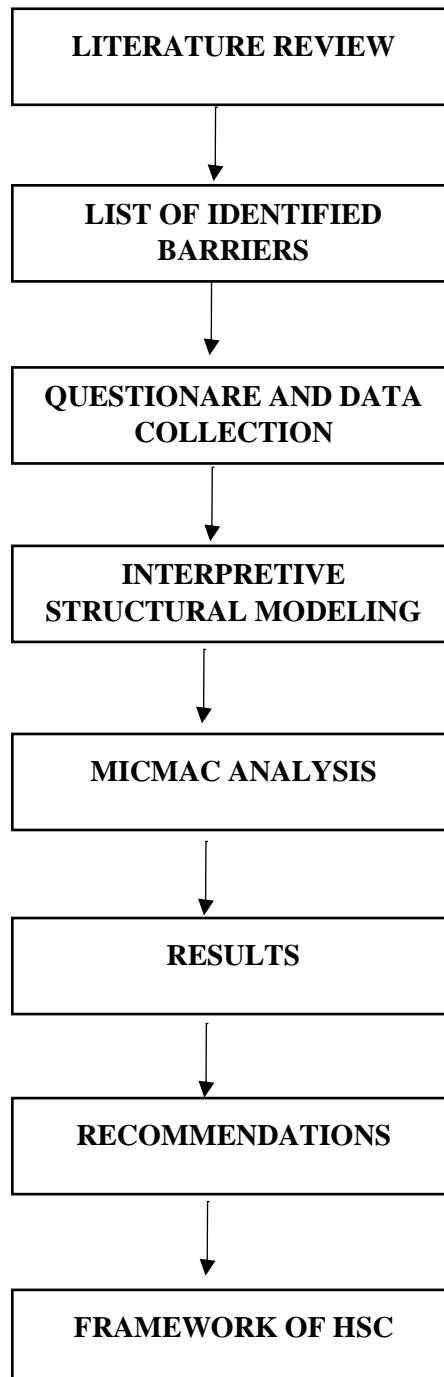
CHAPTER 2

LITERATURE REVIEW

2.1 Identification of Barriers for Humanitarian Supply Chain

The actual barriers of humanitarian supply chain in disaster depend on the type of disaster as well as the region where disaster strikes. The purpose of this research is to analyse all possible barriers of humanitarian supply chain that will help in increase of community resilience. Resilient community is one of core objective in the field of disaster risk management. Therefore, it is important to address all possible barriers that may destroy core objective. Globally researches have been conducted on highlighting various issues toward humanitarian supply chain for building resilience. A brief literature has been reviewed and barrier were identified with the help of past researches. It is important to mention that barriers of humanitarian supply chain will be analyses in context to response phases of disaster. Barrier of humanitarian supply chain have been discussing in various researched by researchers.

Glenn Richey conducted a research and prepared a framework of barriers towards humanitarian supply chain in Ghanna. Main barriers in their research were; lack of standards and indicators, lack of coordination, low recognition of logistics and inadequate infrastructures (Glenn et al 2009). Mohebbifar identified managerial and structural challenge by reviewing case study of relief operation during disaster in Iran. He argued that different organizations like health, civil defence, education, defence forces were working parallel during relief operations. There were lack of

centralization with no common command and control system. Their activities overlapped with each other and gave setback to humanitarian supply chain (Mohebbifar, 2008).

Seaman and Stephenson in their respective researched highlighted barrier associated with role of government. They argued, in developing counties role of government is not satisfactory to strengthen humanitarian supply chain. Further government rules and law toward acceptance of foreign aid is big challenge towards humanitarian supply chain. Several countries refuse to accept aid due to multiple issues. Such difference makes role of government as another barrier towards successful humanitarian supply chain (Seaman, 1999; Stephen, 2005).

Balcik in his research reviewed issued faced in humanitarian relief chain. He figured our number of actors, diversity of actors, finding mechanism, competition in funding, expectation of donor, impact of media, uncertainty irregular resources and cost of coordination as major challenges in humanitarian supply chain. Balcik further added geographical/cultural differences and variation on organizational policies are also leading barriers (Balcik, 2010). These barriers were identified by Van Wassenhove as well. He added that communication is such a big challenge that also causes organizational disruption and leads towards failure in coordination (Van Wassenhove, 2006).

Funding is major disruption towards humanitarian supply chain process according to Seasman. Relief organization has strong dependence on donor agencies. It would not be wrong to call it supporter for each other. Relief organization cannot work without funding from national or international donor agencies. Therefore, most of

humanitarian supply chain fails to achieve its objective due to having no proper funding. Many NGOs offer to aid in disaster country if provided surety of funding through donors (Kend, 1987; Seaman, 1999). Zares studies role of education in disaster situation. He studied a case study of Iran earthquake, where he made an analysis of role of education in disaster relief operations. Most people who are affected by disaster lack formal education on disaster risk reduction. Lack of education for disaster will be an obstacle towards successful humanitarian supply chain (Zares, 2017).

Unethical issues such as terrorism, theft and deception are another barrier of humanitarian supply chain. Willner stated in his research that no proper security to humanitarian supply chain is another obstacle which restrict international agencies to take part in disaster relief activities (Willlner, Zaferidils, 2013). Many humanitarian relief agencies require safety of their teams and demand safe and secure environment. In country like Pakistan, humanitarian aid face big obstacle in the form of terrorism and geo political instability. Such environment makes international relief organization reluctant to operate during any disaster situation.

Lack of psychological support to affected community will bring insecurities and trauma within the community. This will make community more vulnerable. Because of which community cannot fully cooperate with relief agencies. Along with this lack of management system is major barrier of humanitarian supply chain (Dolynskaya, 2011).

Uncertainty is one of most common obstacle towards humanitarian supply chain in all disaster situations. By nature, disaster is mostly unpredictable; therefore, it is impossible to indicate when and where a disaster will strike, where disaster can exactly occur and likewise how any people can come under the radar of disaster destruction. It is very difficult to make an assessment regarding helping stakeholder and preparation of requirement roster in such a short span of time. This is what uncertainty is. Uncertainty can be emerged in the form of any element such operational mission, organization involved and nature of demand. According to Van der Vorst and Beulens, ambiguity might ascend from innate features like what and how much goods are required, product quality, and stock glitches. Beulens and Van der Vorst found triggering features of ambiguity in humanitarian supply. Triggering factors according to Beulen and Van der Vorst are formation of supply chain, decision making problems, lack of reliable information mechanism and organizational culture. (Van der Vorst and Beulens, 2002).

Poor transportation infrastructure is another obstacle towards effective and successful humanitarian supply chain. According to DMTP guideline, Optimum utilization of supply chain can be successfully achieved if transportation is considered as integral part of planning for humanitarian supply chain for all kinds of disaster events (DMTP, 1993). When disaster strikes, it disrupts normal functioning of community. It also destroys existing transporting facilities. In most of disaster affected areas the condition of transports in the form of trucks, busses etc. are already in poor condition and fail to meet requirement for effective humanitarian supply chain operations. Therefore, poor transport facility is critical barrier of humanitarian supply chain. Transportation is considered as the back bone

of logistics, likewise lack of effective transport structure will further increase chaos instead of relief (Gooley, 1999). In a research conducted by long and Wood in 1995 states, "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, 1995). Logistics manager can deal with delivery mediums through containers, aeroplane, railing, and vehicles. Simultaneously, those routes might have shut or locked (Moody, 2001) restrictive delivery to box wildlife. These hindrances should be handled on a case wise because of unstable influences of calamities and susceptibility of structure.

Lack of systematic communication setback humanitarian supply chain. Without proper communication networking, humanitarian activities cannot be implemented. Language barrier is big hurdle in communicating different stakeholder during relief operations. Communication and coordination is a strong tool towards successful humanitarian supply chain. When a disaster strikes, concern organization give call to all national and international agencies for disaster relief and recovery. Stake holders like foreign agencies, donor and all experts require communicating with each other with the help of understandable language. In most of relief operations, different stakeholders have different languages and fail to understand each other. This is language barrier. Field teams working at the site of disaster fail to communicate upstream with headquarter or donors. This lack of communication will not let headquarter and donor regarding appropriate needs. Research conducted by Long and Woods states that; successful humanitarian supply chain in disaster relief operation cannot be achieved if there is language barrier. Different

organizational language and terminologies may hamper humanitarian supply chain during disaster events.

Difference in organizational and cultural language leads towards ineffective coordination for emergency response and relief operations. It not only slow down humanitarian supply chain process but also create disputes between different organization. Lack of information sharing cause duplication of resources (Long and Wood, 1997; PAHO, 2000).

Communications glitches prevails after the impacts of catastrophe are mitigated. Sowinski revealed that deficiency of finance towards the end of a humanitarian deed frequently bounds recording finest practices and pursuing the info on composite supply chain circumstances. It thus delays learning prospects and organizational recall regarding achievements and glitches (Sowinski, 2003). Because of monetary crisis, the relief operations and its workers fade into the background, events could be ignored. Additional failing of numerous activities through inclusive variation in the value of field programs and the technical competence of staff is that recipients and supporters frequently have no options to measure the efficiency and responsibility of humanitarian stakeholders at the field level (Natsios, 1995). Possibly these hindrances are amongst the whys and wherefores that humanitarian supply chain is the only a grown discipline whereas worldwide reaction to disasters has been going on for a long span.

Quality of humanitarian supply chain is badly influenced by poor training of man power. Field manager face abundance of requirement in all relief operations. It includes demand from effected populace and native administration. Along with this

influence from international media, international surveillance agencies, and likewise restriction imposed by donors due to mismanagement and poor human resource. In context to this misunderstanding, ground manages are facing record progress and conveying data back to their head office and media associates in addition to providing a list of actions for future managerial staff.

Research conducted by Thomas, 2003, states poor human resource is mainly due to reliability factor of employments. Employees working in organization for humanitarian supply chain lack indigenous knowledge in relevant field. Thomas identifies that most of humanitarian supply chain organization are headed by personnel from irrelevant field, such as actor, writer, and journalist. Most people from development agencies have backgrounds in public policy or third world development and professional logisticians are rare (Long, 1997).

The impulsive feature of risks makes it difficult to get the services of skilled employees, and those who are trained and skill in the field of disaster are mostly unpaid volunteer and work for limited time. After work they must get back to their original jobs. Organizations might face up to 80% increase in yearly revenue in field logistics. This cause a continual increase of unqualified staffs, in expertise in logistics. (Thomas, 2003). Natsios makes a histrionic point by stating that United Nation organizations and Non-Government Organizations are progressively deploying unskilled staff to the area of operation to funtion major tasks that regular managers would find difficult (Natsios,1995).

Another big obstacle faced by logistics managers in humanitarian organizations is that the benefactor has major influence over where and how assistance is dispersed

while the target is a third party with little voice in the matter. Financing for administrative provision and structure is often ignored under benefactor demands that as much assistance as possible is pushed to sufferers. Therefore, supply networks might face difficulties as warehouses, apparatus, transportations structure, and exercise remain unchanged or disappearing (Long and Wood, 1995).

2.2 List of Identified Barriers

List of barriers along with their description is given below in following table 2.1.

Table 2.1: List of Initial Barriers Identified

	Barriers Identified	Brief Description of Barrier	References
1	Lack of standards and indicators	Humanitarian agencies and other stakeholder lack common operational standard, rules and regulations. No standards make humanitarian supply chain weaker	Glenn et al 2009
2	Lack of coordination	Coordination mean establishment of understanding among all stakeholders. No coordination will increase chaos and confusion. Lack of coordination set back disaster relief operation	Glenn et al 2009 Long and Wood, 1995
3	No recognition to logistics	Logistics is not under a system that can control when and where what type of logistic is needed.	Glenn et al 2009
4	Inadequate infrastructure	Humanitarian agencies lack basic tools and material that is needed for successful supply chain. No critical facilities and infrastructure is prominent barrier of HSC	Glenn et al 2009
5	Poor managerial structure	Humanitarian relief agencies lack competence and organization in their management. Lack of administration is an obstacle for humanitarian supply chain.	Mohebbifar, 2008
6	Unsatisfactory role of Government	Government role is poor due to multiple factors like political influence, corruption and competence. Unsatisfactory role of government makes HSC weaker.	Seaman, 1999; Stephen, 2005
7	Confusion due to multiple stakeholders	Lack of linkage among various stakeholders involved. No coordination will setback humanitarian operations.	Balcik, 2010
8	Lack of funding	Without proper financial resources, humanitarian supply chain for disaster relief operation cannot be successful.	Kend, 1987; Seaman, 1999

9	Lack of funding mechanism	Humanitarian agencies and other organization lack mechanism and transparency for effective funding and its utility	Kend, 1987; Seaman, 1999
10	Expectation of donor	Donors have their own interest. Difference in expectations of donor is another barrier for successful humanitarian supply chain	Zares, 2017
11	Role of media	Disseminating incorrect information to donors and other relief agencies can disrupts successful humanitarian supply chain process.	Zares, 2017
12	Cost of coordination	Cost of coordination refers to flaws in coordination during humanitarian supply chain. This result in financial losses and leads to failure of HSC.	Zares, 2017
13	Irregular resources	Irregular recourses refer to lack of necessities for effective humanitarian supply chain. For example, lack of transport, lack of funds. Right resource for the right task is lacking	Zares, 2017
14	Geographical and cultural differences	Cultural differences make humanitarian supply chain difficult. Different culture has variation in their way of life, values etc.	Balcik, 2010 Turnwell et al, 2013
15	Variation in organizational policies	All stakeholders and other organization has variation in their policies and strategies. Such variation is a barrier towards disaster relief activities.	Balcik, 2010
16	Lack of communication network	In most of rural and unprivileged areas, there is no proper networking established for communication. Such lack of networking is a barrier for humanitarian relief activities.	Van Wassenhove, 2006 Sowinski, 2003 Long and Wood, 1995,225
17	Language barrier	Language barrier exist when worker in relief agencies working together have different languages and fail to understand any common language. Language barrier is main hurdle for humanitarian relief operations.	Zares, 2017
18	Lack of community education	Education and awareness is a key of all humanitarian activities. In	Zares, 2017

		community where people lack knowledge of hazards and relief activities, makes it difficult to have successful humanitarian supply chain activities.	Long and Wood, 1995, 225
19	Instability in the form of event like terrorism	Security lapse and unsafe environment is a barrier for all humanitarian agencies to work in such surrounding. Many international agencies need security for their worker first. Events like terrorism setback humanitarian activities.	Willlner, Zaferidils, 2013
20	lack of psychological support	Psychological support ensures healthy and proactive environment for both stakeholder and sufferers. Lack of psychological support is a barrier for humanitarian supply chain	Dolynskaya, 2011
21	Uncertainty	Uncertainty is a condition of doubt in which anything unexpected and adverse can happen.	Van der Vorst and Beulens, 2002
22	Poor transportation	Transporting machinery such as vehicles etc. are not in good performance to take part in relief activities.	DMTP, 1993 Gooley, 1999 Moody, 2001
23	Reliability factor of employees	Employs credibility and competency is valuable tool of humanitarian supply chain process. Employees with no skills and no proper training make them ineffective	Thomas, 2003
24	Lack of central warehousing	Warehouse is a storing point where supplier items are stored and further supplied to point of receiving	Wassenhove, 2016
25	Lack of Accountability	Lack of accountability in HSC is having no proper check and balance towards operations. This is due to having no system for monitoring and evaluation for humanitarian supply chain operations	Turnwell et al, 2013
26	Lack of leadership	This barrier emerges because of having no common and unified command system. Multiple leadership has different dimension of work. This result in	Turnwell et al, 2013

		coordination and conflict for humanitarian operations	
27	Lack of risk and need assessment	No proper working to need and risk assessment. This refer to lack of survey and basic study of existing requirement. Without risk and need assessment, clear picture of scenario cannot be depicted.	Warchrvee, 2015
28	Lack of coordination and communication with other relief agencies	Different agencies are involved in humanitarian supply chain operations. Their unified command and control, coordination and communication are basic requirement towards successful humanitarian supply chain.	Wachrvee. 2015

2.7 Research Gaps

Role of humanitarian supply chain in disaster risk reduction have always been an integral component towards making it successful. Worldwide researches have been conducted to understand humanitarian supply chain reducing disaster risk. Researches have been mostly conducted in countries like China, Indian, Japan etc. in field of humanitarian supply chain for disaster response and effective management. However, in context to Pakistan, we lack research work in the field of humanitarian supply chain for disaster management.

Role of humanitarian supply chain has been identified and analysed with the help of Fussy Model, Delphi Methods and Structural Equation Modelling. We don't see much work done using ISM Interpretive Structural Modelling. There is a need to analysing humanitarian supply chain variable with the help of ISM within Pakistani context. In Pakistan there is no single research work done in specifically field of humanitarian supply chain for disaster like events. Further Interpretive Structural Modelling is an advance, validated and reliable methodology to analyse numerous

factors of humanitarian supply chain. There is a need to identify the barriers of humanitarian supply chain towards disaster management and building community resilience. Previous researches have been conducted to identify barriers of humanitarian supply chain using methods like Delphi, Fussy etc. My research has used Interpretive Structural Modelling followed by identification and analysis of humanitarian supply chain barriers.

Humanitarian supply chain has its implications in various field of services, it has been utilized in supplying goods and services, procurement and other business matters. My focus is to analyse humanitarian supply chain in context to disaster relief activities. Whenever a disaster strike, it disrupts normal functioning of livelihood. It destroys infrastructure, leads to loss of lives and other major damages. Soon after disaster strike, there is immediate need to response and rescues. Needs such as first aid, evacuation of victims, supply of food items like water and basic eatables, providing alternative shelter to victims. These activities are immediate requirement right after onset of any disaster event. These activities require humanitarian agencies, stakeholders, government and non-government organization and international supporting agencies. All these stakeholder's supply goods and services with the help of effective humanitarian supply chain mechanism. Focus of my research is limited to disaster response and relief stage. However humanitarian supply chain has its role in all stages of disaster management, from preparedness to complete recovery and restoration of livelihood. Disaster response is a stage of immediate and quick response without any delay. Humanitarian supply chain is effective only when it is done timely and fast. First 72 hours of post disaster event are important. Humanitarian supply chain activities

for disaster response should be carried effective within above mentioned time frame. Otherwise aim of humanitarian supply chain cannot be achieved. Delay in humanitarian relief will increase damages and losses. Therefore, effective and timely response is pillar of humanitarian supply chain.

In Pakistan, mostly damages and losses are result of poor management and response. This is because of lack of effective humanitarian supply chain. My research has identified major barriers of humanitarian supply chain towards building community resilience for multiple disaster. Barrier identified with the help of extensive literature review and consulting experts were analysed with the help of interpretive structural modelling. ISM generates a model of barriers which will help individuals and organizations to ensure effective humanitarian supply chain for disasters. This study will open ways for new researches. Future research can be done combining ISM with other methods such as TOPSIS, SEM etc.

There is a need to improve community resilience to cope up with sudden disasters. No work has been done in perspective of improving community resilience. Humanitarian supply chain will not only improve disaster response but also build community resilience. This can be done with the help of successful humanitarian supply chain operation. Community resilience is a key area of my study with target to increase it and enable environment of disaster risk reduction.

Interpretive structural modelling is suitable for establishing contextual relationship among variables. It has high credibility and reliability. It is qualitative research methodology which is based upon expert's opinion. What makes ISM more credible is its transitivity check. Any discrepancy or inaccuracy among data collected from

experts is rectified through transitivity check. Therefore, it is called error free methodology. ISM approach is understandable to number of people. It has ability of integrate opinion of number of participant in a group and provide a way to handle variety of elements and relationships of complex issues. It is investigative as model suitability can be assessed and in-depth understanding of the system is possible. ISM has ability to communicate with greater number of audience and user friendly. It has a potential to communicate complex situation and resolve it.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

3.1.1 Types of Researches

There are three major types of research methodology. Qualitative, Quantitative and Mixed research methodologies (Saunders, 2007). Qualitative methodology deals with logic and human opinion. It analyses and investigate the method of human decision making. It uses empirical support towards formulation of research hypothesis and objectives. Qualitative research is used to gain in-depth understanding of reasons, opinions and motivation for limit amount of group or target population. Mixed methodology is research combination of both qualitative and quantitative research. Data collection in qualitative research is unstructured based on semi structured techniques. Sample size in qualitative research is usually small and responders are selected based on research requirement. It provides detailed account of subject without any limitation of response. Respondent are free to express their views. Data in qualitative research is mostly in word or narrative form depend on purely responder point of view.

Quantitative method on other hand deals with mathematical and statistical bases for finding solution to any problem. It is based on empirical evidence and uses empirical models for research. The goal of quantitative research methodology is to develop an empirical and mathematical model or theory (Collis & Hussey 2003; Langkos, 2014).

3.1.2 Qualitative Vs Quantitative Research

Following table shows comparison of qualitative research and quantitative research.

Table 3.1: Features of Qualitative & Quantitative Research Adapted from: Miles & Huberman (2004).

Qualitative research	Quantitative Research
The aim is a complete, detailed description	The aim is to classify features, count them, and construct statistical models to explain what is observed.
Researcher may only know roughly in advance what he/she is looking for. Researcher knows clearly in advance what he/she is looking for. Recommended during earlier phases of research projects. Recommended during latter phases of research projects.	Researcher knows clearly in advance what he/she is looking for
Recommended during earlier phases of research projects.	Recommended during latter phases of research projects.
The design emerges as the study unfolds.	All aspects of the study are carefully designed before data is collected.
Researcher is the data gathering instrument.	Researcher uses tools, such as questionnaires or equipment to collect numerical data.
Data is in the form of words, pictures or objects.	Data is in the form of numbers and statistics
Subjective – individuals interpretation of events is important., e.g. uses participant observation, in-depth interviews etc	Objective: seeks precise measurement & analysis of target concepts, e.g., uses surveys, questionnaires etc
Qualitative data is 'richer', time consuming, and less able to be generalized	Quantitative data is more efficient, able to test hypotheses, but may miss contextual detail.
Researcher tends to become subjectively immersed in the subject matter.	Researcher tends to remain objectively separated from the subject matter

3.1.3 Research Approaches

3.1.3.1 Deductive Approach:

Deductive research is scientifically based on testing already existing hypothesis. Researchers in deductive research analyse and review other researches, theories and results to generate their own new finding supported by previous theories. It quantitative research which address causal relationship between variables. Sample is selected from a general group to generate conclusion (Saunders, Lewis et al. 2007).

3.1.3.2 Inductive Approach:

Inductive research is beginning by gathering data related your topic. It is based on generating new theory from old data. It uses research question to narrow the scope of research. It is qualitative research. It works moving from specific observation to broader generalization and theory (Saunders, Lewis et al. 2007).

3.1.4 Quantitative Research Techniques:

3.1.4.1 Survey

Survey is based upon questioning individuals or groups on related topic to get their response as answer. Survey methodology collects data to test concepts, record individual perception based upon their experience and judgement. Survey technique is widely used on both qualitative as well as quantitative researches. Survey methodology serves two purposes; describes certain aspect of community or

population and testing the hypothesis about nature of relationship of given population(Fowler Jr 2013).

3.1.4.2 Structure Equation Modelling

Structure equation modelling is exceptionally common statistically modelling procedure, which is broadly utilized within the behavioural sciences. It is a combination of factor analysis and regression or path analysis. The intrigued in SEM is regularly on hypothetical develops, which are spoken to by inactive factors. The connection between hypothetical constructs is spoken to by regression or path coefficients between the components. The SEM suggests a structure for the co-variances between the observed factors, which gives the alternative name covariance structure modelling(Lomax and Schumacker 2004).

3.1.4.3 Correlational Research

Correlational research is non-experiment research technique in which the relationship between two variables are studies. Correlational research focus on impact of one variable on another. The impact is in the form of relationship. This can be positive relationship and negative relationship. Positive relationship is called positive correlation whereas negative relationship is called negative correlation. In correlational research, no external variable is involved (Saunders, Lewis et al. 2007).

3.1.5 Qualitative Research Techniques:

3.1.5.1 Analytical Hierarchical Process - AHP

Analytical Hierarchical Process is theory for measuring immaterial variables with the help of judgement from scale 1 to 9. It is used for decision making by forming hierarchical model with an objective. The hierarchical model is based upon pairwise relationship and connectivity among two variables. Variable with strong dominance power with fall below in hierarchical model and variable with weak dominance power will occupy top level in hierarchical model. Judgement in AHP is based on expert's opinions (Zahedi 2006).

3.1.5.2 Analytic Network Process - ANP

Analytic Network Process work based on tactical knowledge. Instead of hierarchical formation, ANP split variable in the form of clusters. Linkage is established from parent variable in cluster to other variables. ANP form a network of clusters, variables and linkage. The ANP is a descriptive theory that merge variables to relate what people do or guides them to do well than they were earlier using only qualitative thinking and not restricted to the top-down thinking of the hierarchic models. A simple network can be extended to complex multi-level models of networks of benefits, opportunities, costs and risks (Gencer and Gürpinar 2007).

3.1.5.3 Delphi Method Technique

Delphi method is based upon the principle of prediction. It is a process in which responses are collected in the form of questionnaire filled by multiple groups of experts. After first round of response gathered through questionnaire, results are revealed anonymous and shared with the group. In next round of questionnaire, experts are given choice to change their response. After multiple rounds the results are shared with group and inform them what a group think. Delphi method try to find the correct response with the help of consensus (Rowe and Wright 2011).

3.1.5.4 Interpretive Structural Modelling

ISM, Interpretive Structural Modelling is powerful mathematical based model, qualitative tool developed by Jhon Warfield in 1973. ISM is well established methodology which transform unclear and difficult variable into defined and structured variables. It helps in understanding relationship among elements which are originally unclear and problematic. ISM is an innovative and interactive technique which offer a systemic model which transform complex elements which are directly or indirectly involved into more organized and structured model. In ISM, decision regarding interdependency of listed variables are purely based on expert's judgement and reviews. ISM methodology intends to impose order and direction on complexity of relationships among elements(Attri, Dev et al. 2013).

Comparing ISM to other methods like Delphi, SEM, and Interpretive Structural Model requires less number of experts. ISM has the capacity to develop model through managerial techniques such as brain storming. This way ISM transform poor, unclear model into refined and well-structured model.

3.1.6 Research Onion (Saunders, 2007)
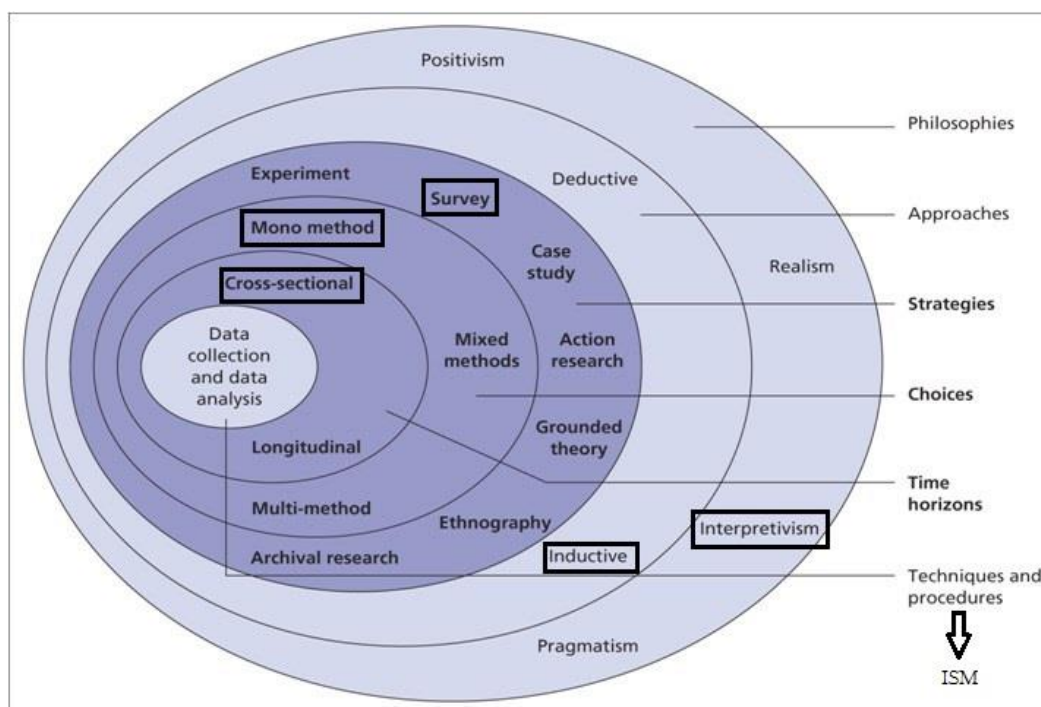
Fig 3.1: Research Onion (Saunders, Lewis et al. 2007)

3.2 Research Design

Several kinds of research methodology are available to achieve research objectives. Keeping in view of analysing barriers of humanitarian supply chain towards building community resilience, this study used qualitative method to explore contextual relationship among listed barriers for humanitarian supply chain. More specifically, Interpretive Structural Model (ISM) will be applied. List of barriers were selected through brief literature review based on previous researches. Further barriers were shortlisted with the help of expert which include, field experts, academia and disaster management workers. Data was recorded with the help of

investigative questionnaire. The questionnaire recorded review from field experts and academia personnel which helped in deriving contextual relationship among listed barriers for humanitarian supply chain. Research methodology followed steps involved in ISM. Further result was concluded with the help of MICMAC analysis. Objective of my research is to establish pairwise relationship among barriers of humanitarian supply chain. This was best possible with the help of ISM approach. This was the reason behind preferring ISM.

3.3 Reason for Selecting ISM

ISM approach is simple and easily understandable to number of users. It has ability to integrate opinion of variety of individual in a group and provide way to handle variety of elements and relationships of complex issues. It is investigative as model suitability can be assessed in depth, understanding of system will be highly possible. This tool can communicate with greater number of audience and easily useable. ISM has been successfully applied in the field of logistics, green supply chain management, six sigma and improvement of products.

There are other research methods which find out pairwise relationship as well. AHP form a hierarchical model based on pairwise relationship but does not form clusters and levels. ANP is another tool for pairwise relationship but it does not form a hierarchical model. It is more like a network among its variables. Delphi method is another tool for gathering opinion from experts in the form of rounds of interviews.

ISM is unique and suitable enough to meet the objectives of my research. It not only establishes pairwise contextual relationship but also make partitions to establish levels based to driving and defence power of variables. Variables with

more influencing power will have more driving power and occupy bottom level in hierarchical model. Likewise, variable with lease influencing power will have high dependence power, will occupy top place in hierarchical model.

3.4 Data Collection

Data collection in Interpretive Structural Modelling is purely based on expert's opinion. Experts from relevant field give their judgement and assumption based on their expertise. Semi structure interview is conducted to record response from experts with the help of Questionnaire.

Data is collected from experts with background of academia and working organizations. 10 to 15 persons are required for interviews, and their response are recorded in the form of questionnaire (Attri, Dev et al. 2013).

3.5 Steps involved in ISM

There are several steps involved in ISM methodology. Steps are as following.

➢ Identification of elements that are related to an issue. This is done either by survey or with the help of brief literature review on relevant issue.

➢ Establish a contextual relationship among elements.

➢ Development of structural self-interaction (SSIM) matrix of element, which indicates pairwise relationship between elements identified.

➢ To develop reachability matrix from SSIM and checking its transitivity. Transitivity established for contextually relationship is purely based on assumptions.

➢ After transitivity, next step is partitioning it into various levels. This is called reachability matrix.

➢ Next step is development of graph DIAGRAPH from reachability matrix based on relationship established and then remove transitivity.

➢ Conversion of DIAGRAPH into ISM Model

➢ Analyse ISM model to check for any concrete discrepancy and make essential changes.

3.6 ISM Flowchart
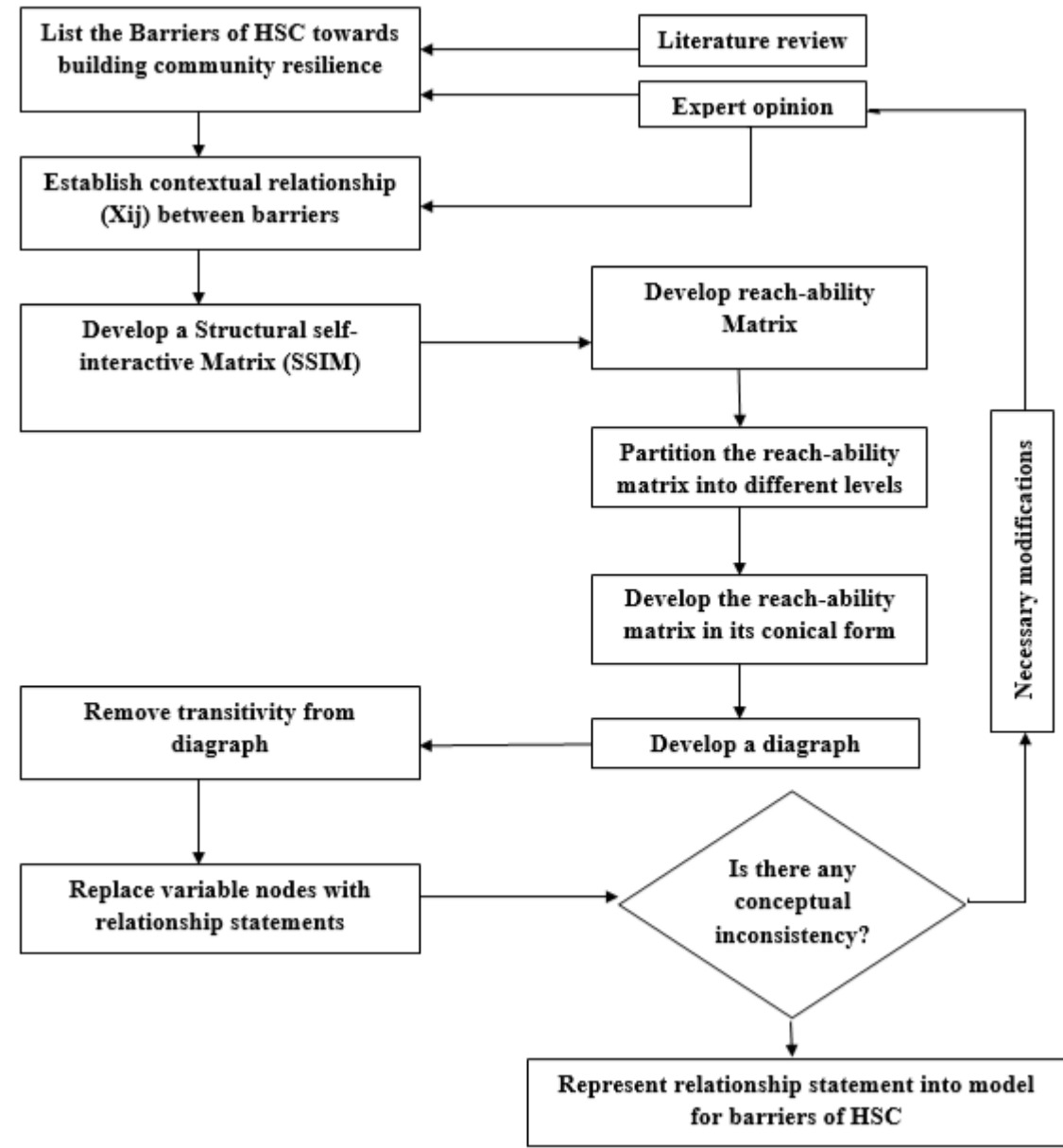
Fig 3.2: ISM Flowchart (Yadav and Barve 2015)

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Identification of Barriers for Humanitarian Supply

Various barriers of humanitarian supply chain towards building community resilience were identified based on extensive literature review and discussion with experts from multiple fields. 20 number of barriers were identified purely from reviewing previous researches regarding humanitarian supply chain issues for disaster management, humanitarian obstacles towards building organization resilience. With brief exploring and consulting expert's opinion 8 additional barriers were identified. These barriers were identified with the help of discussion with expert. Experts were from academia, government disaster management officials and some private disaster risk management practitioners. Discussion was made by contacting 12 number of personnel, 4 academia, 4 provincial disaster management authority personnel and 4 were field staff from rescue department. Initially 28 numbers of barriers were identified which later shortlisted to 18 numbers. With the help of expert opinion and analysing 28 barriers, some related and parallel barriers were grouped into single barrier. This was 18 barriers were finalized. List of experts given below in table 4.1.

Table 4.1: Experts for Data Collection

	EXPERTS	QUALIFICATION	ORGANIZATION	EXPERIENCE
1	LECTURER	MASTERS	PRIVATE UNI	4 YRS
2	LECTURER	MASTERS	GOVT UNI	3 YRS
3	ASSISTANT PROF	MASTERS	PRVATE UNI	5 YRS
4	ASSISTANT PROF	PHD	GOVT UNI	8 YRS
5	ASSISTANT DIRECTOR	BE	DM ORG	5 YRS
6	PROJECT MANAGER	BE	DM ORG	7 YRS
7	PROJECT COORD	MASTERS	DM ORG	5 YRS
8	PROJECT COORD	MASTERS	DM ORG	3 YRS
9	MANAGER	BA	GR STAFF DM	10 YRS
10	MANAGER	BA	GR STAFF DM	7 YRS
11	MANAGER	BA	GR STAFF DM	8 YRS
12	MANAGER	BA	GR STAFF DM	7 YRS

UNI	UNIVERSITY
GOVT	GOVERNMENT
PROF	PROFESSOR
DM	DISASTER MANAGEMENT
ORG	ORGANIZATION
GR	GROUND

Final list of selected barriers is listed in below table 4.2.

Table 4.2: List of Barriers

Barriers No	Barriers Name
Barrier No 1	Lack of Gov. standards & policies
Barrier No 2	Poor transportation and logistics
Barrier No 3	Inadequate infrastructure
Barrier No 4	Poor managerial structure
Barrier No 5	Unsatisfactory role of government
Barrier No 6	Confusion due to multiple stakeholders
Barrier No 7	Lack of funding
Barrier No 8	Irregular resources
Barrier No 9	Geographical & cultural differences
Barrier No 10	Language barrier
Barrier No 11	Lack of community education
Barrier No 12	Uncertainty
Barrier No 13	Reliability factor of employees
Barrier No 14	lack of central warehousing
Barrier No 15	Lack of accountability
Barrier No 16	Lack of leadership
Barrier No 17	Lack of communication & coordination among relief originations
Barrier No 18	Lack of risk & need assessment

4.2 Structural Self-Interaction Matrix (SSIM):

To established contextual relationship among listed barriers of humanitarian supply chain, next step in ISM is structural self-interaction matrix. This was done with the help of view from experts. For this purpose, questionnaire was prepared and meeting with several experts were arranged to record their response. During meeting, questionnaire was filled by experts and their view on relationship between different barriers were noted. Questionnaire was developed containing list of all barriers and established relation between two variables labelled as I and J were asked in questionnaire. This was purely a semi structure interview session where expert was brief by researched about context of relation among barrier, after complete understanding expert's filled questionnaire with their most suitable responses. Their response was based on their experience, knowledge and professional judgement. Interpretive structure modelling is purely qualitative research technique which require limited number of responses from professional experts. Therefore 12 number of response were collected by meting every single person personally. After collecting data from 12 experts, questionnaire was than analysed and average response were noted. Most average response were then used as basis to establish a contextual relationship among barriers of humanitarian supply chain. Based on judgement of experts SSIM was prepared and shown in table 4.3.

One variable helps to attain another variable. Based on this principle, contextual relationship among the designated variables is established. For investigating the factors in developing Structural Self Interaction Matrix, following symbols reflects the relationship between variables I and J.

Variable I will help to achieve variable J   (V)

Variable I will be achieved by variable J   (A)

Variable I and J will help to achieve each other   (O)

Variable I and J are unrelated   (X)

Row wise barriers are indicated as I variable and column wise barriers are indicated as J variable.

Table 4.3: Structural Self Interaction Matrix SSIM

Barriers	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1. LGSP	V	V	A	V	V	V	V	O	O	O	V	V	V	X	X	X	V	
2. PTL	V	X	A	X	V	O	O	O	O	O	A	A	X	A	A	A		
3. II	V	X	A	X	V	X	V	V	O	O	X	A	V	A	A			
4. PMS	V	V	A	V	V	A	X	V	O	A	V	V	X	V				
5. URG	V	V	A	A	V	X	X	V	O	X	V	V	V					
6. CMS	V	V	X	V	V	V	V	V	V	O	O	O						
7. LF	V	X	A	A	V	X	X	V	O	O	X							
8. IR	V	X	A	V	V	X	X	V	O	O								
9. GCD	V	V	O	V	V	O	V	V	X									
10. LB	V	V	O	V	V	O	V	V										
11. LCE	V	X	A	V	O	O	X											
12. U	X	X	A	V	V	O												
13. RFE	V	V	X	X	V													
14. LCW	A	A	A	O														
15. LA	O	A	X															
16. LL	V	V																
17. LCCR	A																	
18. LRNA																		

4.3 Reachability Matrix:

SSIM has been converted into a binary matrix called reachability matrix. Variables with contextual relationship of A V X and O were converted into binary number of 1 and 0 as per rules of ISM. The substitution of 1 and 0 as per rules are given below.

- In case if (IJ) entry in SSIM is V; (IJ) entry in reachability matrix will become 1 and (JI) entry will become 0.

- If (IJ) entry in SSIM is A; (IJ) entry in reachability matrix will become 0 and (JI) entry will become 1.

- If (IJ) entry in SSIM is X; (IJ) entry in reachability matrix will become 1 and (JI) entry will be same 1.

- If (IJ) entry in SSIM is O; (IJ) entry in reachability matrix will become O and (JI) entry will be same 0.

  Table 4.4 shows conversation of SSIM into Reachability Matrix.

Table 4.4: Conversion of Reachability Matrix from SSIM Relationship into Binary Numbers

Barriers	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1. LGSP	1	1	0	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1
2. PTL	1	1	0	1	1	0	0	0	0	0	0	0	1	0	0	0	1	0
3. II	1	1	0	1	1	1	1	1	0	0	1	0	1	0	0	1	1	1
4. PMS	1	1	0	1	1	0	1	1	0	0	1	1	1	1	1	1	1	1
5. URG	1	1	0	0	1	1	1	1	0	1	1	1	1	1	0	1	1	1
6. CMS	1	1	1	1	1	1	1	1	1	0	0	0	1	0	1	0	1	0
7. LF	1	1	0	0	1	1	1	1	0	0	1	1	0	0	0	1	1	0
8. IR	1	1	0	1	1	1	1	1	0	0	1	1	0	0	0	1	1	0
9. GCD	1	1	0	1	1	0	1	1	1	1	0	0	0	1	1	0	0	0
10. LB	1	1	0	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0
11. LCE	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0
12. U	1	1	0	1	1	0	1	1	0	0	1	1	0	1	1	0	0	0
13. RFE	1	1	1	1	1	1	0	0	0	0	1	1	0	1	1	1	0	0
14. LCW	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
15. LA	0	0	1	1	0	1	0	0	0	0	0	1	0	1	0	1	1	0
16. LL	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1
17. LCCR	0	1	1	1	1	0	1	1	0	0	1	1	0	0	0	1	1	0
18. LRNA	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0

Following reachability rule, above table obtained by converting variables in to binary numbers. The reachability obtained is knows as initial reachability. Transitivity check was applied on reachability to fill the gaps within matrix. The purpose to applying transitivity check is to ensure data is free from all kinds of errors.

Transitivity check is the basic assumption of ISM technique which states, if barrier A is related to barrier B and barrier B is related to barrier C, then barrier A will be necessarily related to barrier C. This assumption is known as transitivity check. Instead of following manual procedure of transitivity, it was done with the help of MS EXCEL software. Matrix were transferred into excel sheet for transitivity.

Table 4.5a Inertial Reachability Matrix

Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0
2	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	0
3	1	0	1	1	1	0	0	0	0	0	0	0	1	0	1	1	1	0
4	1	0	0	1	0	1	0	0	1	0	0	1	1	0	0	1	0	0
5	1	0	0	1	1	0	0	0	1	0	0	1	1	0	1	1	0	0
6	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0
7	1	0	0	1	1	0	1	1	0	0	0	1	1	0	1	1	1	0
8	1	0	1	1	1	0	1	1	0	0	0	1	1	0	0	1	1	0
9	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0
10	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0
11	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0
12	1	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1
13	1	0	1	0	1	1	1	1	0	0	0	0	1	0	1	1	0	0
14	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1
15	1	1	1	1	0	1	0	1	1	1	1	1	1	0	1	1	1	0
16	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0
17	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1
18	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1

Table 4.5b: Final Reachability Matrix

Barriers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1	0	1	1	1	1	0	0	1	1	0	0	0	0	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
3	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
4	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
6	1	1	1	1	1	1	0	0	1	1	0	0	0	0	1	1	1	1
7	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
8	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1
9	1	0	0	1	1	1	0	0	1	1	0	0	0	0	1	1	1	1
10	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
12	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
13	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
14	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
16	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1
17	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
18	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1

Initial reachability matrix is obtained after incorporating transitivity rule. Final reachability matrix is obtained after conversion into binary numbers as mentioned in Table 4.5.

4.4 Ranking and Driving Power and Dependence Power:

Table 4.6: Reachability Matrix with Driving Power and Dependence Power

Barriers	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Dr Power
LGSP	1	1	1*	1	1	1	1	1*	1*	1	1	1	1	1	1	1	1	1	18
PTL	1	1	1*	1	1	1*	1*	1*	1*	0	1*	1*	1*	1*	1*	1*	1	0	16
II	1	1	1*	1	1	1	1	1	1*	0	1	1*	1	1*	1*	1	1	1	17
PMS	1	1	1*	1	1	1*	1	1	1*	1*	1	1	1	1	1	1	1	1	18
URG	1	1	1*	1*	1	1	1	1	1*	1	1	1	1	1	1*	1	1	1	18
CMS	1	1	1	1	1	1	1	1	1	1*	1*	1*	1	1*	1	1*	1	1*	18
LF	1	1	0	1*	1	1	1	1	0	0	1	1	0	1*	1*	1	1	0	13
IR	1	1	0	1	1	1	1	1	0	0	1	1	0	1*	1*	1	1	0	13
GCD	1	1	0	1	1	1*	1	1	1	1	1*	1*	1*	1	1	1*	1*	1*	17
LB	1	1	0	1	1	1*	1	1	1	1	1*	1*	1*	1*	1*	1*	1*	1*	17
LCE	1	1	0	1	1*	1*	1	1	0	0	1*	1*	0	1*	1*	1*	1*	0	13
U	1	1	0	1	1	1*	1	1	0	0	1	1	0	1	1	1*	1*	0	13
RFE	1	1	1	1	1	1	1*	1*	0	0	1	1	0	1	1	1	1*	0	14
LCW	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	01
LA	1*	1*	1	1	1*	1	0	1*	0	1*	0	1	1*	1	1*	1	1	1*	15
LL	1	1	1	1	1	1	1	1	1*	1*	1	1	1	1	1	1	1	1	18
LCCR	1*	1	1	1	1	1*	1	1	1*	1*	1	1	1*	1*	1*	1	1	1*	18
LRNA	1	1	1*	1*	1	1*	1	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	18
Dep Power	17	17	11	17	18	17	16	17	11	10	16	17	12	17	17	17	17	10	

Driving power reflects the ability of factor that many have a strong influence on other factors. They are lease dependent and more independent. Dependence power reflects the ability of factors what can be strongly influenced by other factors. They are totally dependent on other factors. Driving and depended power for each variable is calculated and shown in given above table 4.6. Driving power of given variable refers to the total number of variables influenced by it. Likewise, dependence power refers to total number of variables affecting it. Below table 4.7 reflect ranking based on driving and dependence power:

Table 4.7: Ranking

Barriers	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	Dr Power	Rank
1. LGSP	1	1	1*	1	1	1	1	1*	1*	1	1	1	1	1	1	1	1	1	18	I
2. PTL	1	1	1*	1	1	1*	1*	1*	1*	0	1*	1*	1*	1*	1*	1*	1	0	16	III
3. II	1	1	1*	1	1	1	1	1	1*	0	1	1*	1	1*	1*	1	1	1	17	II
4. PMS	1	1	1*	1	1	1*	1	1	1*	1*	1	1	1	1	1	1	1	1	18	I
5. URG	1	1	1*	1*	1	1	1	1	1*	1	1	1	1	1	1*	1	1	1	18	I
6. CMS	1	1	1	1	1	1	1	1	1	1*	1*	1*	1	1*	1	1*	1	1*	18	I
7. LF	1	1	0	1*	1	1	1	1	0	0	1	1	0	1*	1*	1	1	0	13	V
8. IR	1	1	0	1	1	1	1	1	0	0	1	1	0	1*	1*	1	1	0	13	V
9. GCD	1	1	0	1	1	1*	1	1	1	1	1*	1*	1*	1	1	1*	1*	1*	17	II
10. LB	1	1	0	1	1	1*	1	1	1	1	1*	1*	1*	1*	1*	1*	1*	1*	17	II
11. LCE	1	1	0	1	1*	1*	1	1	0	0	1*	1*	0	1*	1*	1*	1*	0	13	V
12. U	1	1	0	1	1	1*	1	1	0	0	1	1	0	1	1	1*	1*	0	13	V
13. RFE	1	1	1	1	1	1	1*	1*	0	0	1	1	0	1	1	1	1*	0	14	VI
14. LCW	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	01	VII
15. LA	1*	1*	1	1	1*	1	0	1*	0	1*	0	1	1*	1	1*	1	1	1*	15	IV
16. LL	1	1	1	1	1	1	1	1	1*	1*	1	1	1	1	1	1	1	1	18	I
17. LCCR	1*	1	1	1	1	1*	1	1	1*	1*	1	1	1*	1*	1*	1	1	1*	18	I
18. LRNA	1	1	1*	1*	1	1*	1	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	18	I
Dep Power	17	17	11	17	18	17	16	17	11	10	16	17	12	17	17	17	17	10		
Rank	II	II	V	II	I	II	III	II	V	VI	III	II	IV	II	II	II	II	VI		

4.4 Level Partition:

Reachability sets, and antecedent sets were derived from final reachability matrix. Reachability set mean, variable itself and other variables it might impact. In another word reachability set are set of variables itself and other variables that it might help to achieve. Antecedent sets mean, variable itself and other variables that might impact it. Antecedent sets consist of variable itself and the other variable that may help to achieve it. After deriving reachability and antecedent sets, interaction sets were derived. Set of variables which are common in reachability and antecedent sets became part of interaction set. Interaction sets are union of reachability and antecedent sets. After that levels were determined. Variables for which reachability set and interaction set were same occupied top level of ISM hierarchy. Top level variables were those which will not help to achieve the other variables above their own level in hierarchy. After determination of first level variable, it was removed from the table for further consideration. This same process was repeated till the level of each variable were identified. These levels helped in building diagraph and ISM model.

Table 4.8a to 4.8g shows partition levels. Level partitioning was made with the help of iterations. 6 levels were made from level 1 to level 6.

Iteriaiton Level I

Table 4.8a: Level Partitioning

	Barriers	Reachability set	Antecedent set	Intersection set	Level
1	Lack of Gov. stand. & policies	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,3,4,5,6,9.10,15,16,17,18	1,3,4,5,6 ,9,10,15,16,17,18	
2	Poor transportation and logistics	2,3,4,5,6,7,8,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	2,3,4,5,6,7,8,10,11,12,13,15,16,17,18,	
3	Inadequate infrastructure	1,2,3,4,5,6,7,8,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9.10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,10,11,12,13,15,16,17,18	
4	Poor managerial structure	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	
5	Unsatisfactory role of government	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	
6	Confusion due to multiple stakeholders	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,9,10,15,16,17,18	1,2,3,4,5,6,9,10,15,16,17,18	
7	Lack of funding	2,3,4,5,7,8,11,12,13,14,15,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	2,3,4,5,7,8,11,12,13,15,17,18	
8	Irregular resources	2,3,4,5,7,8,11,12,13,14,15,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18	2,3,4,5,7,8,11,12,13,17,18	
9	Geographical & cultural differences	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18	1,4,5,6,9,10,15,16,17,18	1,4,5,6,9,10,15,17,18,	
10	Language barrier	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,17,18	1,2,3,4,5,6,9,10,16,17,18	1,2,3,4,5,6,9,10,17,18	
11	Lack of community education	2,3,4,5,7,8,11,12,13,14,15,17,18	1,2,3,4,5,6,7,8,9,10,11,12,14,15,16,17,18	2,3,4,5,7,8,11,12,14,15,17,18	
12	Uncertainty	2,3,4,5,7,8,11,12,13,14,15,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18	2,3,4,5,7,8,11,12,13,17,18	
13	Reliability factor of employees	2,3,4,5,7,8,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	2,3,4,5,7,8,11,12,13,15,16,17,18	
14	lack of central warehousing	14	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	14	1
15	Lack of accountability	1,2,3,4,5,6,7,9,11,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,9,11,13,15,16,17,18	
16	Lack of leadership	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,13,15,16,17,18	1,2,3,4,5,6, 13,15,16,17,18	
17	Lack of com. & coord among relief originations	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	
18	Lack of risk & need assessment	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	

Iteriaiton Level II

Table 4.8b: Level Partitioning

	Barriers	Reachability set	Antecedent set	Intersection set	Level
1.	Lack of Gov. standards & policies	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,3,4,5,6 ,9.10,15,16,17,18	1,3,4,5,6,9.10,15,16,17,18	
2.	Poor transportation and logistics	2,3,4,5,6,7,8,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9.10,11,12,13,15,16,17,18	2,3,4,5,6,7,8,10,11,12,13,15,16,17,18,	
3.	Inadequate infrastructure	1,2,3,4,5,6,7,8,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9.10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,10,11,12,13,15,16,17,18	
4.	Poor managerial structure	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	2
5.	Unsatisfactory role of government	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	2
6.	Confusion due to multiple stakeholders	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,9,10,15,16,17,18	1,2,3,4,5,6,9,10,15,16,17,18	
7.	Lack of funding	2,3,4,5,7,8,11,12,13,14,15,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	2,3,4,5,7,8,11,12,13,15,17,18	
8.	Irregular resources	2,3,4,5,7,8,11,12,13,15,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18	2,3,4,5,7,8,11,12,13,17,18	
9.	Geographical & cultural differences	1,2,3,4,5,6,7,8,9,10,11,12,13,15,17,18	1,4,5,6,9,10, 15,16,17,18	1,4,5,6,9,10,15,17,18,	
10.	Language barrier	1,2,3,4,5,6,7,8,9,10,11,12,13,15,17,18	1,2,3,4,5,6, 9,10,16,17,18	1,2,3,4,5,6,9,10,17,18	
11.	Lack of community education	2,3,4,5,7,8,11,12,13,15,17,18	1,2,3,4,5,6,7,8,9,10,11,12,15,16,17,18	2,3,4,5,7,8,11,12,14,15,17,18	
12.	Uncertainty	2,3,4,5,7,8,11,12,13,15,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,16,17,18	2,3,4,5,7,8,11,12,13,17,18	
13.	Reliability factor of employees	2,3,4,5,7,8,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	2,3,4,5,7,8,11,12,13,15,16,17,18	
15.	Lack of accountability	1,2,3,4,5,6,7,9,11,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,9,11,13,15,16,17,18	
16.	Lack of leadership	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6, 13,15,16,17,18	1,2,3,4,5,6,13,15,16,17,18	
17.	Lack of communication & coordination among relief originations	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	2
18.	Lack of risk & need assessment	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	1,2,3,4,5,6,7,8,9,10,11,12,13,15,16,17,18	2

Iteriaiton Level III

Table 4.8c: Level Partitioning

	Barriers	Reachability set	Antecedent set	Intersection set	Level
1.	Lack of Gov. standards & policies	1,2,3,6,7,8,9, 10,11,12,13,15, 16	1,3,6 ,9. 10,15, 16	1,3,6 ,9. 10,15, 16	
2.	Poor transportation and logistics	2,3,6,7,8, 10,11,12,13,15, 16	1,2,3,6,7,8,9. 10,11,12,13,15, 16	2,3,6,7,8, 10,11,12,13,15, 16	3
3.	Inadequate infrastructure	1,2,3,6,7,8, 10,11,12,13,15, 16	1,2,3,6,7,8,9. 10,11,12,13,15, 16	1,2,3,6,7,8, 10,11,12,13,15, 16	3
6.	Confusion due to multiple stakeholders	1,2,3,6,7,8,9, 10,11,12,13,15, 16	1,2,3,6,9, 10,15, 16	1,2,3,6,9, 10,15, 16	
7.	Lack of funding	2,3,7,8,11,12,13, 15	1,2,3,6,7,8,9, 10,11,12,13,15, 16	2,3,7,8,11,12,13, 15	3
8.	Irregular resources	2,3,7,8,11,12,13,15	1,2,3,6,7,8,9, 10,11,12,13, 16	2,3,7,8,11,12, 13	
9.	Geographical & cultural differences	1,2,3,6,7,8,9, 10,11,12,13,15	1,6,9, 10, 15, 16	1,4,6,9,10,15	
10.	Language barrier	1,2,3,6,7,8,9, 10,11,12,13,15	1,2,3,6, 9, 10,16	1,2,3,9,10	
11.	Lack of community education	2,3,7,8,11,12,13,15	1,2,3,6,7,8,9, 10,11,12,15, 16	2,3,7,8,11,12,15	
12.	Uncertainty	2,3,7,8,11,12,13,15	1,2,3,6,7,8,9, 10,11,12,13, 16	2,3,7,8,11,12,13	
13.	Reliability factor of employees	2,3,7,8,11,12,13,15, 16	1,2,3,6,7,8,9, 10,11,12,13,15, 16	2,3,7,8,11,12,13,15, 16	3
15.	Lack of accountability	1,2,3,6,7,9,11,13,15, 16	1,2,3,6,7,8,9, 10,11,12,13,15, 16	1,2,3,6,7,9,11,13, 15,16	3
16.	Lack of leadership	1,2,3,6,7,8,9, 10,11,12,13,15, 16	1,2,6, 13,15, 16	1,2,3,6, 13,15, 16	

Iteriaiton Level IV

Table 4.8a: Level Partitioning

	Barriers	Reachability set	Antecedent set	Intersection set	Level
1.	Lack of Gov. standards & policies	1,6,8,9,10,11,12,16	1,6 ,9.10,16	1,6 ,9.10,16	
6.	Confusion due to multiple stakeholders	1,6,8,9,10,11,12,16	1,6,9,10,16	1,6,9,10,16	
8.	Irregular resources	8,11,12	1,6,8,9,10,11,12,16	8,11,12	4
9.	Geographical & cultural differences	16,8,9, 10,11,12	1,6,9,10,16	1,4,6,9,10	
10.	Language barrier	1,6,8,9,10,11,12	1,6, 9,10,16	1,9,10,	
11.	Lack of community education	8,11,12	1,6,8,9,10,11,12,16	8,11,12	4
12.	Uncertainty	8,11,12	6,7,8,9,10,11,12,16	8,11,12	4
16.	Lack of leadership	1,6,8,9,10,11,12,16	1,6,16	1,6,16	

Iteriaiton Level V

Table 4.8e: Level Partitioning

	Barriers	Reachability set	Antecedent set	Intersection set	Level
1.	Lack of Gov. standards & policies	1,6,9,10,16	1,6 ,9.10,16	1,6 ,9.10,16	5
6.	Confusion due to multiple stakeholders	1,6,9,10,16	1,6,9,10,16	1,6,9,10,16	5
9.	Geographical & cultural differences	1,6,9,10,	1,6,9,10,16	1,6,9,10	5
10.	Language barrier	1,6,9,10,	1,6, 9,10,16	1,6,9,10,	5
16.	Lack of leadership	1,6,9,10,16	1,6,16	1,6,16	

Iteriaiton Level VI

Table 4.8f: Level Partitioning

	Barriers	Reachability set	Antecedent set	Intersection set	Level
16.	Lack of leadership	16	16	16	6

Table 4.8g: Overall Level Partitions

	Barriers	Reachability set	Antecedent set	Intersection set	Level
1	lack of central warehousing	14	1,2,3,4,5,6,7,8,9, 10,11,12,13,14,15, 16,17,18	14	1
2	Poor managerial structure	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	2
3	Unsatisfactory role of government	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	2
4	Lack of communication & coordination among relief originations	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	2
5	Lack of risk & need assessment	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	1,2,3,4,5,6,7,8,9, 10,11,12,13,15, 16,17,18	2
6	Poor transportation and logistics	2,3,6,7,8, 10,11,12,13,15,16	1,2,3,6,7,8,9. 10,11,12,13,15,16	2,3,6,7,8,10,11,12,1 3,15,16	3
7	Inadequate infrastructure	1,2,3,6,7,8, 10,11,12,13,15,16	1,2,3,6,7,8,9. 10,11,12,13,15,16	1,2,3,6,7,8, 10,11,12,13,15,16	3
8	Lack of funding	2,3,7,8,11,12,13,15	1,2,3,6,7,8,9, 10,11,12,13,15,16	2,3,7,8,11,12,13,15	3
9	Reliability factor of employees	2,3,7,8,11,12,13,15, 16	1,2,3,6,7,8,9,10,11, 12,13,15,16	2,3,7,8,11,12,13,15, 16	3
10	Lack of accountability	1,2,3,6,7,9,11,13,15, 16	1,2,3,6,7,8,9, 10,11,12,13,15,16	1,2,3,6,7,9,11,13, 15,16	3
11	Irregular resources	8,11,12	1,6,8,9,10,11,12,16	8,11,12	4
12	Lack of community education	8,11,12	1,6,8,9,10,11,1216	8,11,12	4
13	Uncertainty	8,11,12	6,7,8,9,10,11,12,16	8,11,12	4
14	Lack of Gov. standards & policies	1,6,9,10,16	1,6 ,9.10,16	1,6 ,9.10,16	5
15	Confusion due to multiple stakeholders	1,6,9,10,16	1,6,9,10,16	1,6,9,10,16	5
16	Geographical & cultural differences	1,6,9,10,	1,6,9,10,16	1,6,9,10	5
17	Language barrier	1,6,9, 10,	1,6, 9, 10,16	1,6,9,10,	5
18	Lack of leadership	16	16	16	6

4.5 Conical Matrix

 Conical matrix was developed by gathering factors in the same level in the form of rows and columns of the final reachability matrix. This is called clustering of factors based on driving power and dependence power. Following table 4.9 reflects clustering of factors (Attri R. 2012).

Table 4.9: Conical Matrix

Barriers	14	4	5	17	18	2	3	7	13	15	8	11	12	1	6	9	10	16
14. LCW	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04. PMS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
05. URG	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17. LCCR	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18. LRNA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
02. PTL	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1
03. II	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
07. LF	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
13. RFE	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
15. LA	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0
08. IR	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
11. LCE	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
12. U	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
01. LGSP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
06. CMS	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
09. GCD	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
10. LB	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
16. LL	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

4.6 Diagraph

Diagraph is obtained from conical matrix with the help of converting matrix into transitive links. It is done with the help of node and lines. Diagraph represent interdependency of elements in the form of nodes and edges. Below figure 4.1 illustrates diagraph.
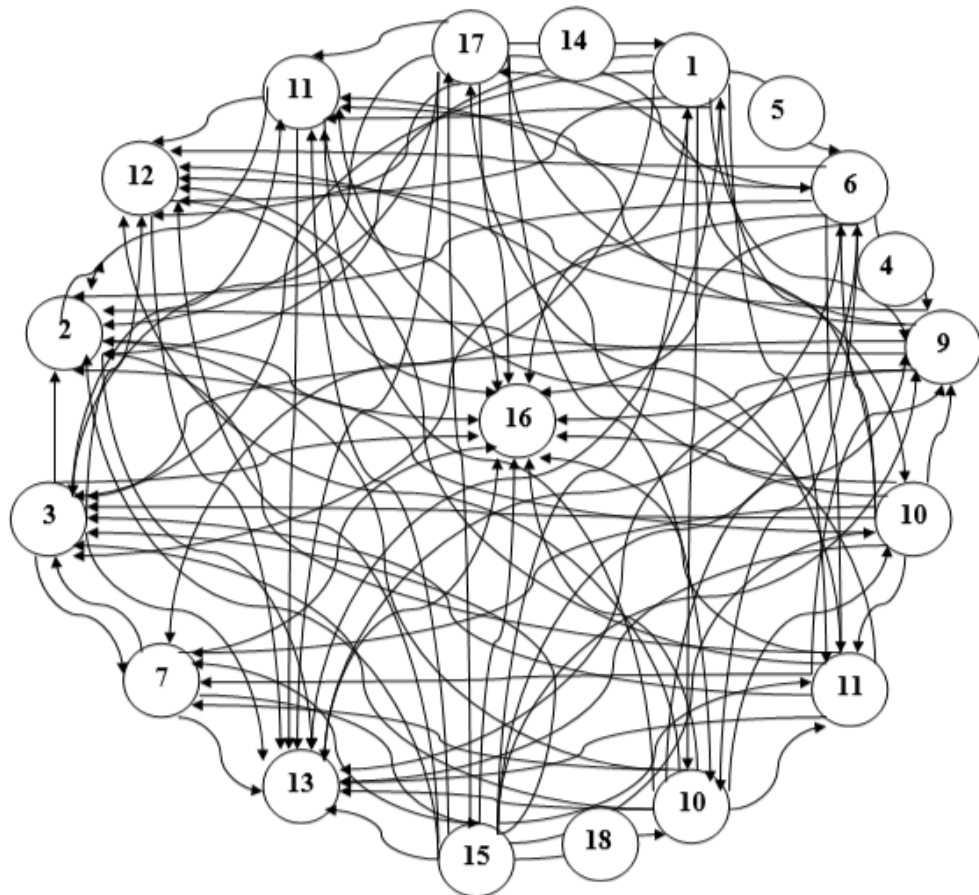

Fig 4.1: ISM Diagraph

4.7 ISM Model

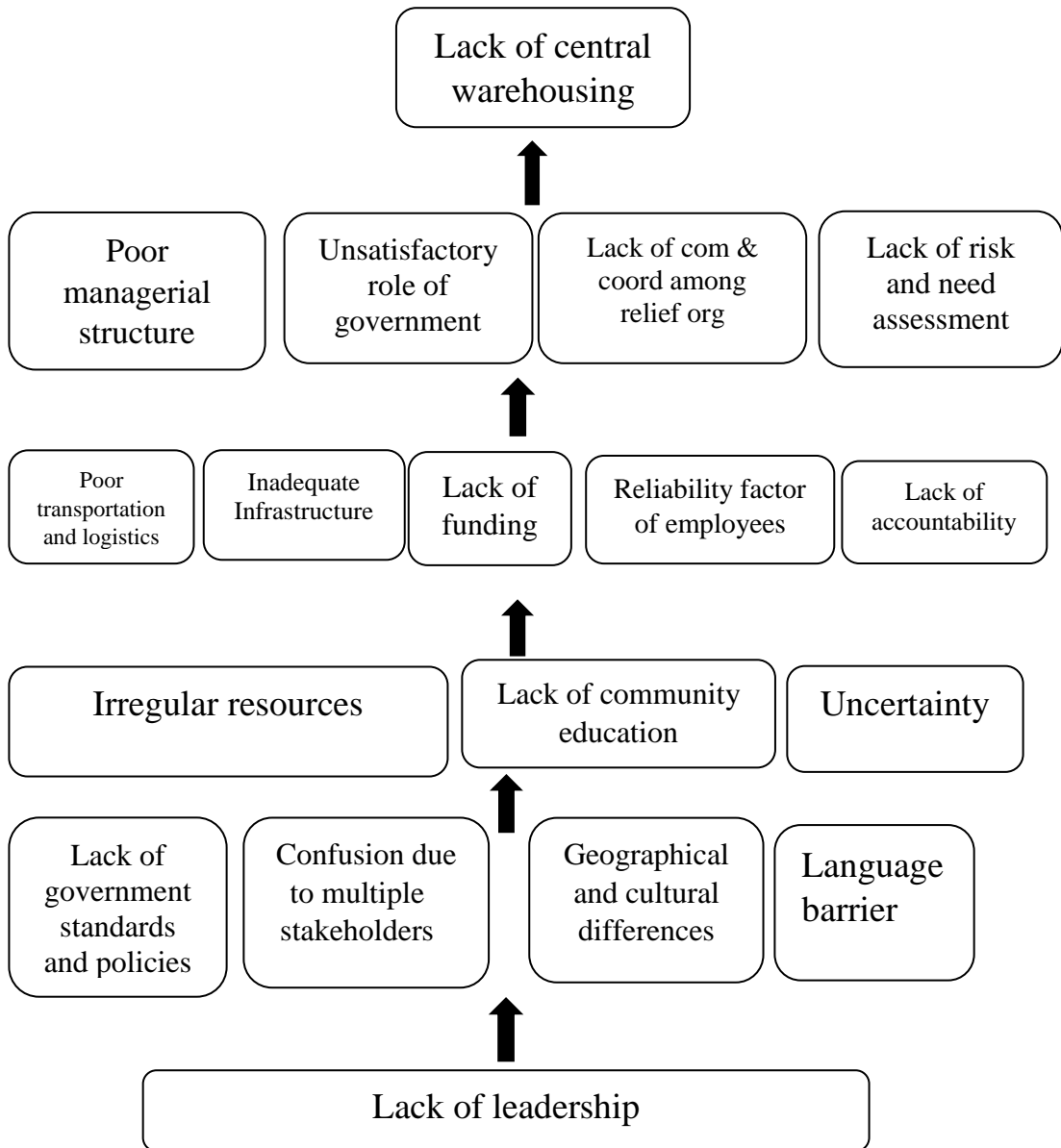Final model of ISM is given below in the form of figure 4.2.

Figure 4.2: ISM based Model for Barriers of Humanitarian Supply Chain towards Building Community Resilience.

4.8 MICMAC (Cross Impact Matrix Multiplication Applied to Classification)

Strong 18							1	16			6						4,5,17,18	
17									9	10							3	
16																	2	
15																	15	
14																	13	
13			IV													8,12	7,11	
12											III							
11																		
10																		
9																		
8																		
7																		
6																		
5																		
4			I								II							
3																		
2																		
Weak 1																		14
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Driving Power (vertical axis), Dependence Power (horizontal axis): Weak ... Strong

Figure 4.3: Cluster of Barriers of Humanitarian Supply Chain towards Building Community resilience

- Quadrant I = Autonomous Barriers
- Quadrant II = Dependent Barriers
- Quadrant III = Linkage Barriers
- Quadrant IV = Independent Barriers

4.9 MICMAC Analysis

Figure 4.3 illustrates clusters of barriers of humanitarian supply chain towards building community resilience. MICMAC is abbreviation of cross impact matrix multiplication applied to classification. MICMAC analysis was done to analyse driving power and dependency power for barriers identified. The analysis was done with the help of a DIAPRAPH given below. It was clustered into 4 categories or quadrants. Autonomous, Linkage, Dependent and Independent are the four quadrants. Driving power for 18 barriers were listed along Y-AXIS and dependence power for barriers were listed along X-AXIS. Barriers based on their driving and dependency power were recorded to their suitable nodes within graph.

4.9.1 Autonomous Factor:

The factors with weak dependence and weak indolence power are clustered as autonomous factors. They have very little impact on the system. This is the first quadrant labelled as I. No barrier falls in autonomous cluster.

4.9.2 Dependent Factor:

Factors with weak driving power and strong dependence power as clustered as dependence factors. They are dependent of other factor but does not have any influence of impact on other factors, therefore they have weak driving power and they do not drive any further factors. Only barrier 14 falls in dependent quadrant.

4.9.3 Linkage Factor:

These factors have strong driving and strong dependence power. There has a strong impact on other factors. They are equally linkage with rest of factors. Majority of

barriers falls in this cluster. All barriers within this cluster are equally inter-linked. Barrier 2,3,4,5,6,7,9,10,11,12, 13,15,17, and 18 falls in this quadrant.

4.9.4 Independent Factor:

These factors have strong driving power and weak dependence power. They are least dependent on another variable. They have strong driving impact on other factors. Barrier 1 and 16 falls in this quadrant. They have impact on all other barriers.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Humanitarian supply chain is backbone of successful disaster response operation and help towards increasing overall resilience. To ensure successful humanitarian supply chain we need to identify its barrier and later rectify those barriers and ensure successful humanitarian operation. Disaster response all depend upon timely delivery of humanitarian aid and assistance from donor agencies to effected and vulnerable community. For successful humanitarian supply chain, we identified 18 barriers listed above. Those 18 barriers were analysed with the help of ISM. ISM model reflects 6 levels of barriers. Level 1 placed at the bottom of model and level 6 occupied the top hierarchy. There was only one barrier in level 1; lack of leadership. Lack of leadership has highest driving power and of has zero defence power. It is driving all 17 barrier of humanitarian supply chain. Four barriers i.e. lack government standards and policies, confusion due to multiple stakeholders, geographical and cultural differences and language barrier were placed on level 2. All four barriers are interlinked; they have equal relationship among each other. All these four barriers are influenced by level 1 and driving all barriers falling in above levels. Their dependence power little low and driving power is higher. Level 3 has three barriers i.e. irregular resources, lack of community education and uncertainty. These barriers have strong driving and dependence powers. They are depended and influenced by barriers of level 2 and 1 and driving barriers of levels above them. Level 4 has five barriers i.e. poor transportation, inadequate infrastructure, lack of funding, reliability factors of employees and lack of accountability. These barriers

have strong driving and dependence power. They are dependent of level fall below them and driving level falling above them. Level 5 has four barriers i.e. poor managerial structure, lack of communication and coordination among relief agencies and lack of risk and need assessment. They have strong dependence and low driving power. They are dependent of all barriers fall below and driving only one barrier falling on above level. Final level contains only one barrier which is lack of central warehousing. This level has no driving power and highest dependence power. Lack of central warehousing does not have any influence on any other barrier where as other barriers have impact on it. MICMAC analysed driving and dependency power for all barriers. No barrier falls in autonomous quadrant, 2 barriers fall in dependence quadrant, 13 barriers fall in linkage quadrant and 2 barriers fall independent quadrant.

Core objective of disaster management is to establish disaster resilient communities. Disaster risk reduction and spontaneous disaster response operations can save livelihood. Every year Pakistan is facing various kinds of disaster due to diversity of its geographical aspects. Every year poor humanitarian supply chain activities make disaster response weaker and result in damages. This study has critical analysed numerous factors which act as barriers towards successful humanitarian supply chain towards building community resilience for multiple disasters. List of barriers were identified with the help of experts from disaster management organizations and academia. List if identified berries were analysed with the help of interpretive structural modelling. ISM model was prepared to reflect intensity of barriers towards disaster management. ISM model can be utilised by government organization and specially disaster management

organizations. In Pakistan, NDMA, PDMA and other emergency department can utilize this ISM model while during planning and strategy making for disaster response activities. ISM model will be helpful by taking barriers into the consideration while preparing disaster preparedness and response plans. Stakeholders, NGOS, INGOS and international humanitarian agencies can focus to addressing core barriers and ensure these barriers can be neutralized at all levels of disaster preparedness and response.

Stakeholders will be aware of core barriers with the help of this ISM model. Identification of barriers and awareness of their dependence power and driving power will help stakeholders to focus on them and prioritise these barriers as strategic issues. During preparation of strategic plan stakeholder can tackle these barriers as priority and minimise them to ensure a successful step towards effective humanitarian supply chain for disaster response. ISM model further serves a benchmark tool, through which the basic root cause can be addressed. Our study reveals that lack of leadership has strong driving power and no dependence power. This mean by having an effective leadership other barrier can be neutralised as lack of leadership will leads to lack of government standards and polices and so leads towards remaining barriers. Framework for successful humanitarian supply chain towards building community resilience has been developed with the help of ISM model. It has priority-based recommendations for specific barriers. Address role and responsibilities for specific stakeholder to overcome specific barriers. Framework addresses recommendation considering driving and dependence power of barriers. Framework serve as guideline towards future planning and decision for disaster risk reduction.

5.2 Recommendations

1. To ensure skilled and qualified managers and high command authorities working in community. There should be proper training programs, awareness campaign to enhance individual capacity of leadership at community level.

2. There should be proper guideline in the form of government policies and standards towards disaster mitigation and response activities in context of community. Integration of national level guideline with local community. Implementation of national level policies towards humanitarian supply chain for disaster response should be ensured in communities.

3. A unified mode of communication should be adapted within the community. Availability of stakeholder representative form local community can avoid confusion. Roster of stakeholder should be maintained in each community to ensure all stakeholder play their respective role in community. Community based mechanism should be devised for effective working.

4. While working in different communities with diverse cultural and geography, there should be a mechanism to respond in accordance to their cultural values at community level.

5. There should be a common language for all stakeholder working for disaster response operations at community level.

6. Availability of equal and well required resources should ensure. Government organizations and other stakeholder should ensure

provision of regular resources to field organizations for successful humanitarian supply chain towards disaster relief and response operations in communities.

7. Provision of disaster education, knowledge and awareness should be ensured to all stakeholders, working staff working in communities.

8. Government and security organization should ensure provision of safe environments for international organization to work in local communities.

9. Stakeholder should ensure availability of best transporting and logistics measures at community level. Establishment of transport terminals in all communities so that time availability of transport is ensured.

10. Provision of accurate and enough infrastructure should be ensured by stakeholders at community level.

11. Proper funding should be made available for both disaster relief organizations and community. Community based fund should be allocated for respective communities.

12. Employees working in disaster management organization should be qualified in relevant field. Disaster management qualified staff in all department should be ensured and all projects should be headed by disaster management qualified and skilled personnel.

13. Government should ensure accountability for disaster relief operations. This can be done with proper monitoring and evaluation. Regular audit for disaster relief projects should be ensured. Community based accountability units should be established.

14. Well established and structured management system should be ensured. With the help of government standard and policies, well organized management structure should be ensured in communities.

15. Role of government should be supporting and help responsible for all kinds of disaster relief and response operations. Mature and satisfying role of government should be ensured.

16. There should be mechanism and system of networking to ensure communication and coordination among relief organizations in communities.

17. Risk and need assessment for vulnerable community should be conducted regularly at community level.

18. Provision of warehouses to store relief items such as food, medicine and other necessities in all communities.

5.3 Framework of Successful HSC

Table 5.1: Framework of HSC

S. No	Rank	Barriers	Stake holders	MICMAC (Quadrants)	Recommendations
PRIORITY 1 4th Quadrant (Strong Driving and Weak Dependence Power)					
1.	I	Lack of leadership	Government	STRONG Driving Power. WEAK Dependence Power.	To ensure skilled and qualified managers and Tehsil level authorities working in community. There should be proper training programs, awareness campaign to enhance individual capacity of leadership at community and district level.
PRIORITY 2 3rd Quadrant (Strong Driving and Strong Dependence power)					
2.	II	Lack of government standards and policies Confusion due to multiple stakeholders Geographical and cultural differences	Government, UN Agencies, NGOs, INGOS	SRTONG Driving Power. STRONG Dependence Power	There should be proper guideline in the form of government policies and standards towards disaster mitigation and response activities in context of community. Integration of national level guideline with local community. Implementation of national level policies

		Language barrier		94	towards humanitarian supply chain for disaster response should be ensured in communities. A unified mode of communication should be adapted within the community. Availability of stakeholder representative from local community can avoid confusion. Roster of stakeholder should be maintained and disseminated in each community to ensure all stakeholder play their respective roles and responsibilities. Community based mechanism should be devised for effective working. While working in different communities with diverse culture and geographical spread, there should be a

					mechanism to respond in accordance to their cultural values at community level.
					There should be a common mode of communication for all stakeholders working for disaster response operations at community level
3	III	Irregular resources Lack of community education Uncertainty	Government Ministry of Education and line departments Military and Government Security agencies	SRTONG Driving Power. STRONG Dependence Power	Availability of equal and required resources should be ensured and prioritized. Government organizations and other stakeholders should ensure provision of regular resources to field organizations for successful humanitarian supply chain towards disaster relief and response operations in communities. Provision of disaster education, knowledge and awareness should be ensured to all

					stakeholders and staff working in communities. Government and security organization should ensure provision of safe environment for international organizations working in local communities.
4	IV	Poor transportation and logistics Inadequate Infrastructure Lack of funding Reliability factor of employees Lack of accountability	Government, UN Agencies, International and National Donors	SRTONG Driving Power. STRONG Dependence Power	Stakeholders should ensure availability of best transportation and logistics measures at community level. Establishment of appropriate entry/exist points for timely and uninterrupted supply of provisions in case of disaster event. Provision of adequate and appropriate infrastructure should be ensured by stakeholders to avoid hinderances in humanitarian supply chain management at community level.

					Proper funding should be made available for both disaster relief organizations and community. Community based funds must be utilized in building resilient communities. Employees working in disaster management organization should be qualified and skilled in relevant field. Availability of such staff must be ensured in projects for risk reduction or response to disasters. Government should ensure accountability of disaster relief operations. This can be ensured through an effective monitoring and evaluation mechanism at all stages of the operation. Regular audit for disaster relief projects

					should be ensured. Community based accountability units should be established to highlight discrepancies.
5	V	Poor managerial structure Unsatisfactory role of government Lack of com & coordination among relief org Lack of risk and need assessment	Government, Military Leadership, UN Agencies, National Disaster Management Authority, PDMA DDMAs	SRTONG Driving Power. STRONG Dependence Power	Well established and efficient management system should be ensured at all tiers of decision making and implementation to ensure implementation of disaster related policies and strategies at community level. Government should inculcate the culture of community-based initiatives for disaster relief and response. Proper administrative assistance must be provided to community level organizations for building resilience. There should be a mechanism of networking among

					disaster management stakeholders to ensure coordinated and effective relief operations. Risk and need assessment for vulnerable community should be conducted regularly and updated during disaster relief operations.
PRIORITY 3 2nd Quadrant (Weak Driving and Strong Dependence power)					
6	VI	Lack of central warehousing	Government. UN Agencies NDMA. PDMAs	WEAK Driving Power. STRONG Dependence Power	Provision of warehouses to store relief items such as food, medicine and other necessities in all communities must be ensured. Maintenance of these facilities also needs to be addressed to guarantee their availability during disasters.

5.3 Future Scope:

ISM model open gate for further research in multiple fields. ISM model is based purely on professional and expert's opinion and judgement. Future studies validate finding of this results with the help of using techniques like FUSSY TOPSIS and structural equation modelling SEM.

Annexure A: Questionnaire/Protocol for Experts

Name: _____

Profession: _____

The following table is intended to register the perception of professionals from academia, field experts from disaster management organization and ground staff with experience in disaster relief operations; to develop a pairwise contextual relationship between barriers of humanitarian supply chain towards building community resilience. Please fill in the white boxes of the Table using one of the following symbols:

V= barrier i will help to achieve/alleviate barrier j
A= barrier j will help to achieve/alleviate barrier i
X= barriers i and j will help to achieve/alleviate each other
O = barriers i and j are unrelated

	Barrier j ⟶ / Barrier i ↓	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1	Lack of Gov. standards & policies																		
2	Poor transportation and logistics																		
3	Inadequate infrastructure																		
4	Poor managerial structure																		
5	Unsatisfactory role of government																		
6	Confusion due to multiple stakeholders																		
7	Lack of funding																		
8	Irregular resources																		
9	Geographical & cultural differences																		
10	Language barrier																		
11	Lack of community education																		
12	Uncertainty																		
13	Reliability factor of employees																		
14	lack of central warehousing																		
15	Lack of accountability																		
16	Lack of leadership																		
17	Lack of communication & coordination among relief organisations																		
18	Lack of risk & need assessment																		

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