

Coordinating the Relief Chain in the Chinese Context



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Coordinating the relief chain in the Chinese context

Master thesis report

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This report is the result of a graduation assignment for the master study Engineering & Policy Analysis at Delft University of Technology in the Netherlands. It included a six month research on the topic of coordination issue in the Chinese disaster relief chain context.

This master thesis research explores the coordination prospects in the disaster relief chain for the Chinese actors. This insight provides added value for the Chinese relief responders and helps them to better deal with the logistics arrangement in future disasters.

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List of abbreviations

SC: Supply Chain

SCM: Supply Chain Management

NGO: Non-governmental Organization

INGO: International non-governmental organization

JP: Joint Procurement

QR: Quick response

CRP: Continuous Replenishment Program

VMI: Vendor Managed Inventory

JMI: Joint Managed Inventory

CFPR: Continuous, Forecasting, Planning and Replenishment

VICS: Voluntary Inter industry Commerce Standards

TPL: Third Party Logistics

UN: United Nation

OCHA: Office for the Coordination of Humanitarian Affairs

USAID: United States Agency for International Development

Executive Summary

In the past decade, there has been an increasing number of natural disasters that led to catastrophic damage to mankind. China is one of the countries most affected by natural disasters in the world. Although logistics activities account for a large percentage of total operations in aftermath relief, they have frequently not been recognized as key levers for improving the effectiveness and efficiency of humanitarian organizations and as being crucial to operational excellence. Meanwhile, due to the large number of relief actors involved in the Chinese context, the coordination among various players becomes a very prominent challenge to cope with. Therefore, this master study aims to explore how to improve the coordination among actors in the Chinese relief chain context.

This research consists of theoretical and empirical parts. In the theoretical part, this thesis explores the prospects of transferring lessons learnt from the commercial supply chain to the relief chain by finding out the existing coordination mechanisms in the commercial logistics operations. Some coordination mechanisms- i.e. Joint Procurement, Quick Response, Continuous Replenishment Program, Vendor Managed Inventory, Joint Managed Inventory, Continuous Planning, Forecasting and Replenishment and 3rd party logistics are the practiced coordination mechanisms in procurement, inventory and transportation processes together with corresponding characteristics and requirements to adopt them. Besides specific coordination mechanisms, generic lessons learnt from the commercial supply chain are also abstracted. They are Resource Sharing, Joint Decision Making and Outsourcing, which can be performed on strategic, tactical or operational levels based on the orientations of relationships among coordinating alliance. These experiences from the commercial supply chain come as a foreground for relief actors to step on. Although the objective of the relief chain and commercial supply chain remains the same i.e. delivering right amount of materials to the right places, some factors existing after major disasters distinguish the relief chain from the commercial supply chain fundamentally. These factors are 1) Urgency 2) Uncertainty 3) Complexity of operation conditions 4) Co-existence of various actors. Due to the existence of these challenging factors in disaster aftermath, the current practicing coordination mechanisms in the commercial supply chain can't be transferred directly into the relief chain. As the application level for these coordination mechanisms are evaluated respectively in this thesis, it turns out Joint Procurement, Quick Response and 3rd party logistics are those promising mechanisms with a high level of application prospect in the relief chain. Meanwhile, the generic lessons from the commercial supply chain still hold in the relief chain and especially when they are put in practice operationally or tactically among organizations.

The theoretical study provides the research a direction to further explore the reality. The Wenchuan earthquake case study is conducted to test the prospects of these coordination methods in Chinese context. Through this case study, all the specific promising coordination mechanisms are found with some changes adapted to specific situations. Some coordination initiatives that reflect the generic approaches (Resource Sharing) in commercial chain are also discovered i.e. demand information sharing and inventory capacity sharing. Meanwhile, some new coordination initiatives are invented uniquely by relief actors. They are coordination to have a complementary supply effect and coordination for the sake of legal operation.

In order to better involve actors in the relief chain, the following recommendations are offered to humanitarian organizations during the preparation phase 1) Non-governmental can be incorporated into existing relief system to achieve an overall complemented effect to governmental relief 2) Build up sustainable relations with suppliers on emergency supply 3) NGOs Identify strategic alliance before emergency. During response phase, it is advisable for NGOs to 1) Spot their position in less attention areas to avoid media's framing effect 2) Coordination by standing by when information is unclear.

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1. Introduction

1.1. Problem context

1.1.1. Disaster relief

An emergency is a situation that poses an immediate risk to health, life, property or environment. Some emergencies are daily bases which don't involve in many converging entities, have more autonomy of action and can stick to routine performance standards (Quarantelli, 2006). However, an emergency situation can develop into a disaster when the community's capacity to cope is overwhelmed. Then the situation is declared a disaster and urgent intervention is requested to prevent unexpected and severe consequences. Sometimes disasters can be foreseen, but most of the time they just happen all in a sudden, leaving the world in destruction and chaos. Worse than disasters, catastrophes are high consequence events that generate even more comprehensive and crippling impacts (Tricia Wachtendorf et al., 2010). For example, China had a series of winter storms that affected large portions of southern and central parts of the country in 2008. At the very beginning of this disaster, it was considered as an emergency only in Hunan province. However, the continuous heavy snows, ice and cold temperatures turned this regional event into a catastrophe which caused at least 129 deaths, extensive damage and transportation disruption for several thousand travelers. This 2008 winter storm was Chinese worst winter catastrophe in the last half century. The conceptual relations among emergency, disaster and catastrophe are shown in figure 1:

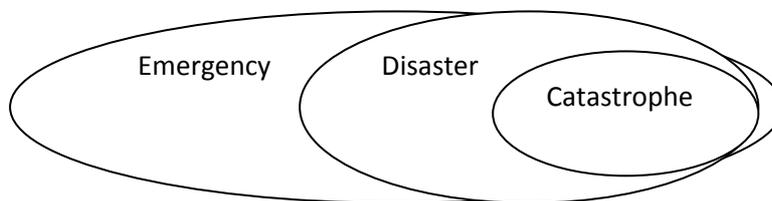


Figure 1: Conceptual relations among emergency, disaster and catastrophe

Disaster response is a complex process that involves severe time pressure and high uncertainties (Janssen et al., 2010). Among all the activities conducted in aftermath relief, logistics accounts for 80% of the relief operations (Van Wassenhove, 2006). The critical role relief logistics plays is about delivering the emergency resources to victims for whom it is a matter of life or death. During relief supply, no single actor has sufficient resources to respond effectively to a major disaster (Bui et al., 2000). Despite the fact that the government is the most important actor in the relief field (Balcik et al., 2010); the government still doesn't have adequate resources to undertake the aftermath relief, especially after a catastrophe when the damage is destructive and the whole society is concerned. Lots of actors are involved in the major disasters response, for instance, regional government, militaries, non-governmental organizations, non-profit organizations, foundations, private sectors, and international rescue teams. These actors have different interests, resources and supply chain arrangements. Hence, efficiency and effectiveness of the coordination in the relief chain must be improved in terms of cost, time and quality in the aftermath relief. (Therrien, 1995; Baker and Refsgaard, 2007; Balcik et al., 2010).

1.1.2. Actors in the Chinese relief context

In 2006, the Chinese government proposed “Contingency plans for sudden onset public emergency events” and define the concept of “sudden onset public emergency events” as events that happen suddenly and cause or might cause severe injuries or death, property loss, ecological damage and threat to public safety. In this context, public emergency events include natural disasters, accidental disasters, public safety disasters and public health disasters. As many as several hundred humanitarian organizations can appear at the scene of a disaster, with different political agendas, ideologies and all of them fight for media and donor attention (Blecken, 2009). Therefore, it is important to identify various actors and their interests, resources and networks they have in the relief context. The understanding on actors’ objectives, interests, resources, conflicts and interdependency in Chinese context will provide an insight for further evaluation on coordination issues.

Appendix 1 maps the critical actors with their objectives, perceptions, resources and networks. From this table, we can see that although the perceptions for all the participating actors are the same, i.e. rescue lives and alleviate suffering, their fundamental objectives vary a lot.

Government

Typically, the government of the affected country is responsible for the conduct of disaster relief operations, and other actors are obliged to abide by the laws of the country in which they are operating (Balcik et al., 2010). In the Chinese central government system, National Emergency Office is built up within the state council to take charge of emergency events response and to deploy disaster relief operations at state level. The current framework of the national emergency system is shown in Appendix 2. For specific disasters, different departments (shown in Appendix 3) are assigned to cope with daily emergency events and also take the lead to respond to major disasters. At the provincial level, there are corresponding lower agencies for organizing and undertaking disaster management tasks. For major disasters, like the Wenchuan earthquake, or the 2008 Chinese snow storms, the impacted zones were so large that it exceeded the provincial ability to deal with so that the national government was activated to lead the regional government and conduct the emergency response collectively.

Military is the most critical resource that government has to deploy for relief work. In general, military forces can assume three roles during emergencies (Rietjens et al., 2007). They can promote a climate of security for civilian populations and humanitarian organizations and provide protection for the relief effort. They can provide technical or logistical support to humanitarian organizations. Finally, they can provide direct assistance to populations in need. In the Chinese relief context, militaries and armed police are the most important force to conduct excavation, re-connect infrastructure, deliver goods and undertake almost all the tasks in the aftermath relief. For example, during the Wenchuan earthquake, till 18th May 2008, the military and armed police deployed 113080 soldiers in total from 5 military regions with 20 branches of the armed forces involved; 1069 military airplanes and 92 military trains were used, moving 11000 transportation and logistics facilities. Thanks to the aid from military forces, 21566 people were evacuated from ruins, 34051 injured were cured, 205371 inhabitants or tourists were transferred, 7.8 ton of emergency resources were delivered and 557 kilometers of road were reconnected (State Council Information Office, 05/18/2008).

Another important resource of the government in such situations is policy and regulation regarding relief response. The regulations that the government sets up have a significant impact on other humanitarian organizations during relief operations since all the humanitarian organizations need to react according to the governmental regulations.

Non-governmental organization

Generally, there are four types of non-governmental organizations existing in the Chinese relief context (Zhu et al., 2009).

The *first* type is NGOs with a governmental support background. This kind of NGOs used to be agencies registered in the government's system and had financial support from the government as well, but gradually developed into an independent organization from the government's system, like China Foundation for Poverty Alleviation or China Youth Development Foundation. The *second* type of NGOs can be established by an individual person or a corporation with specific mission for public good or social service. For instance, Friend of Nature and Global village in Beijing are both examples of this type of NGOs which is also called grassroots NGOs by the public. The *third* type of NGOs has international background and entered China under the Chinese government's support or acquiescence, with the mission of doing good deed for the local society, like Oxfam or World Vision international. The *fourth* type of NGOs is labeled as community organizations or volunteers groups with a more flexible organization structure. The large numbers of this kind of community organizations are very active in daily life so that they are also a non-negligible force in the Chinese relief context (Zhu et al., 2009). However, because complicated registration procedures that set up barriers for the fourth type of NGOs, most of them don't get formal registration and only exist informally in the community (Zhu et al., 2009).

Table 1: Summary of NGOs in Chinese context

Type of NGOs	Resources	Contribution on relief performance
NGOs with governmental background	Government support, Personnel, Funds	Large amount of donation collection and supplies
Grass root NGOs	Personnel, Public trust	Flexible, timely accurate mobilization of relief supplies
International NGOs	Expertise/ Experience	Professional expertise provision
Community groups or Volunteer groups	Local knowledge	Flexible, timely accurate mobilization of relief supplies

Although the principle of non-government organization remains the same as to do good to society, their objectives vary. Each of them has different objectives regarding their overall mission as organizations. For example, the primary goal for Foundation of Children and Women is to pay attention on their targeted victims i.e. children and women in relief response, rather than other group of victims so the priority is in line with their missions. The resources that different NGOs are able to deploy vary as well due to their different scales and backgrounds or different levels of cultivated public trust. For example, in aftermath relief, the 3rd type of NGOs with international background could have better knowledge on disaster relief but on the other hand, they may lack understanding on local circumstances, like the local landscape, culture or language. Or, like the 1st type of NGOs with the government support, they can provide more emergency supplies to impacted zones than the 4th type of NGOs can. However, because of the large volume of emergency purchase, they need to go through more complicated procurement procedures to keep it open and transparent to public, which is also a time consuming process. Community NGOs, on the other hand, have a small amount of emergency supplies so that they can operate in a more flexible way and even respond to emergency demand faster than the 1st type of NGOs do (Zhu et al., 2009). From the

example above, we can see the importance for NGOs to conduct relief tasks in a cooperative manner. The overall review of NGOs objectives, perceptions, resources and network is illustrated in Table 1.

Private sector

In the Chinese relief context, private sector's engagement attracted great attention from both humanitarian organizations and the public during the Wenchuan earthquake. Private sectors emerged as donors, commercial suppliers or humanitarian organizations' partners with both commercial and non-commercial orientations. For example, in the case of the Wenchuan earthquake, as a donor, the private sector donated more than 7.1 billion RMB (around 710 million euro) to victims in total after the earthquake. As suppliers, private companies provided key emergency materials to impacted areas. For instance, a large number of firms launched emergency manufacturing in order to bridge the huge gap of tents supply after the earthquake happened. As partners, private companies provided expertise and facilities for other humanitarian organizations. For example, Chuanqiu airline provided airplanes for local non-governmental organizations for free with the only requirement of mentioning Chuanqiu Airline Company's name. Some engineering and construction companies, like ARUP, also engaged in aftermath response in Wenchuan by providing their expertise in logistics and construction.

Media

Information is the most valuable resource throughout a crisis, but it is scarce, incomplete, dispersed and evolving (Samii, 2008). In China, the government keeps an eye on propaganda channels, especially when it comes to aftermath contexts. China used to experience a period of very strong governmental control on media, resulting in low transparency regarding real disaster information. For instance, when SARS prevailed in China in 1998, the number of people affected was hidden from the public in order to avoid public panic. However, the trend of covering real disaster information has dramatically decreased in recent years (Wan, 2010). During the Wenchuan earthquake in 2008, the government kept the updated disaster and relief information open to the public and information was transparent and reflective on reality (Wan, 2010).

Public donors

From the public donors' point of view, they are concerned about how their donation will be allocated or spent. In other words, public sponsors require transparency about the expenditure of their donations. If an organization solely relies on the public donations (most NGOs indeed do (Seaman, 1999)), meaning relief work can only be conducted based upon the arrival of funds, in these cases, public donors can be regarded as the customers of these organizations and humanitarian organizations have to meet the openness requirement from their "customers" to maintain accountability. In the Chinese context however, public donors are not well informed about the ways of donations spending. For example, after the Wenchuan earthquake, one survey conducted by Tsinghua University shows that only 4.7% of the donors know where their donations went and most of donors did not have a clue about where their donations ended up (Beijing News, 2009). The credibility of humanitarian organizations could be challenged by the Chinese public donors and this situation would likely jeopardize the public donors' donation willingness in the future.

From the humanitarian organizations' point of view, as public donations' receivers, they are also under pressure to spend the available money in a short period of time (Moore et al., 2003). For example, after the Wenchuan earthquake, the local NGO Sichuan Red Cross Foundation with 17 staffs received more than 2 billion RMB (around 222 million Euros) from public donors and started to get very panic since they really didn't have experience on spending this huge amount of donation. Actually, Sichuan Red Cross Foundation

was not the only Chinese NGO who lacked the experience to deal with huge amounts of donations from the public, research shows that 80% of public donations collected from NGOs eventually went into the government's account after the Wenchuan earthquake (Xin Hua News, 2009).

The description above gives an overview of critical and dedicated actors in the Chinese relief context and the understanding of their roles will provide a foundation for research in coordination.

1.2. Research objectives

This master thesis intends to contribute towards the development of theories in the field of disaster or emergency management. Consequently, it is a theoretical-oriented research. The overall research objective *is to make recommendations to humanitarian organizations for improvement in the relief chain coordination to better supply emergency resources.* In order to achieve this overall goal to improve coordination among actors, the following means-ends diagram in figure 1 which indicates appropriate coordination mechanisms that need to be introduced. However, there is no existing coordination mechanism in the relief chain context which can be adopted directly by humanitarian organizations. Therefore, the existing coordination mechanisms in the commercial supply chain will be studied in order to learn from those existing and more developed theories. The reason that the experience can be transferred from the commercial supply chain into the relief chain is because the objectives and the way they work remain the same, i.e. delivery of goods to where they are called for. Consequently, if a coordination mechanism can sustain in the commercial supply chain then it might still hold in the relief chain.

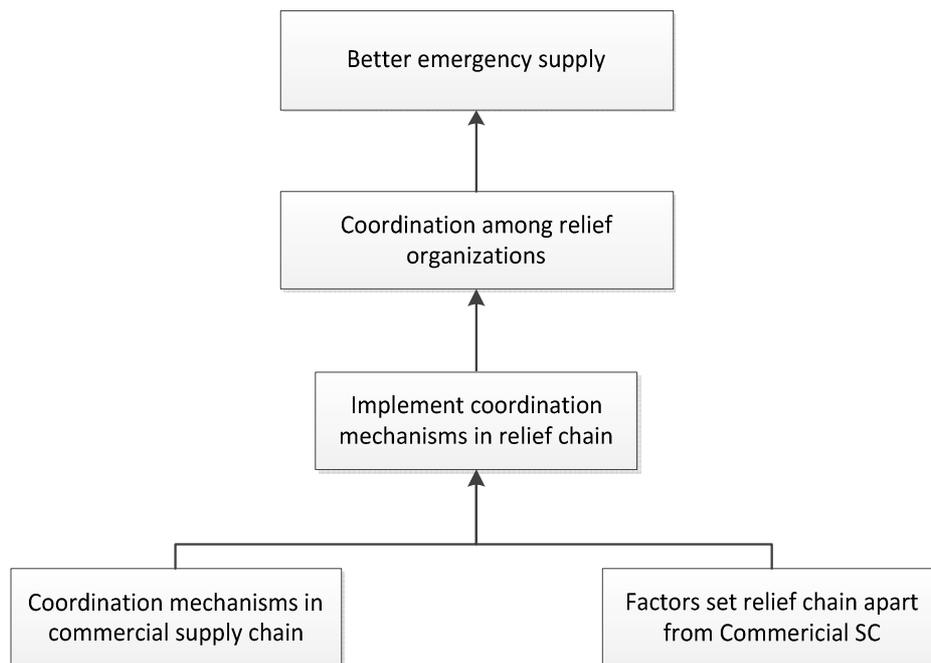


Figure 1: Means-ends diagram for research objective

1.3. Definition of key concepts and research boundary

1.3.1. Key concepts

Coordination mechanism: coordination mechanisms here refers to the strategies that organizations adopt by joining their efforts together in order to increase overall efficiency, in this case, to increase the relief chain efficiency.

Relief chain: the relief chain (humanitarian logistics is also used interchangeably with relief chain referring to the same concept) is defined as the process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from the point of origin to the point of consumption for the purpose of alleviating the suffering of vulnerable people (Thomas and Kopczak, 2005)

Actors/ Humanitarian organization: actors involved in disaster environment consist of humanitarian organizations who conduct the relief response tasks and also the victims who receive the help from humanitarian organizations. The humanitarian organizations in this research refer to the organizations who aim to alleviate sufferings and rescue lives, including governmental agencies, non-governmental organizations, militaries, foundations and even private sectors. In the relief context, the humanitarian organizations are the dominant actors who control the emergency supply chain and victims on the other hand, almost have no control over (Blecken, 2009). This thesis therefore only addresses the humanitarian organizations and the interaction among them.

1.3.2. Research boundary

- Time

The time span that this research addresses is during disaster preparation and response phases. There is no definite time line drawn between preparedness and response phase since response activities are dependent on and very likely influenced by preparedness measures. Hence the preparedness and response phases during disaster relief are both taken into account.

The response phase (or emergency response) is the phase during which the activities focus on emergency relief in order to save lives and meet basic human needs, consisting two stages (Thevenaz and Resodihardjo, 2010). The first stage is the life-saving/sustaining response and the second one is the self-sufficiency response. The life-saving component consists of search and rescue operations. For instance, victims are buried in debris after an earthquake or trapped in water after a flood; the second one life-sustaining component involves the provision of the basic human needs, i.e. food, water and temporary shelter (Thevenaz and Resodihardjo, 2010). During the self-sufficiency response stage, responders aim to reduce the affected populations' dependence on outside assistance to satisfy their basic needs (Thevenaz and Resodihardjo, 2010). This process is a prerequisite to help disasters' victims restore pre-disaster living conditions and become autonomous again (Thevenaz and Resodihardjo, 2010).

- Geographic

The geographic area that this research addresses on is China. The coordination mechanisms proposed in this paper will be applicable in the Chinese relief chain context. Framework among coordination actors is also based on characteristics of Chinese relief actors.

- Type of disaster

The research will narrow down to natural disasters, especially catastrophes, which have a long lasting disaster aftermath. Most of this kind of disasters usually involves large scale coordination. The everyday emergency situations aren't taken into account.

- Resources

The research only focuses on the material resources, like water, food, shelter and medication, moving along the relief chain. The financial resources and human resources are not included in the research scope.

1.4. Research questions

The main research question is **how to coordinate different actors involved in the Chinese relief chain context?**

Theoretical sub-question:

What coordination mechanisms can be used in the relief chain to better allocate emergency resources?

- 1) What are the coordination mechanisms in the commercial supply chain?
- 2) What are the challenging factors in the relief environment?
- 3) What are the coordination mechanisms in SCM which are applicable into the relief environment?

Empirical sub-question:

To what extent those promising coordination mechanisms discussed in the theoretical part can be applied in the Chinese context?

- a) Whether the discussed coordination mechanisms are practiced? If yes, are there any changes? If no, what prevents the application?
- b) Besides coordination mechanisms found in a), do any other coordination mechanisms emerge? Why?
- c) What types of humanitarian organizations are practicing them?

Prescriptive questions:

- d) What can actors do to facilitate coordination in the Chinese relief chain?

1.5. Research Framework

The whole research framework is illustrated in Figure 1. As stated above, in order to explore the coordination mechanisms in the Chinese relief context, the coordination mechanisms in commercial supply chain needs to come as a base to have the knowledge about the characteristics and conditions for organizations to adopt them. After knowing the common practiced coordination mechanisms and their features in commercial supply chain, the factors which set the relief chain apart from normal supply chain will be identified.

Considering these dominating factors in relief environment, the existing coordination mechanisms in supply chain will be tested to see whether they are still suitable in the relief context. Whatever coordination mechanisms in SC can sustain the assessment process will be further examined by an actual disaster case.

For the empirical study, an in-depth case analysis together with interviews will be conducted to find out these currently practiced coordination mechanisms in the relief chain from a real case. The outputs of the theoretical analysis together with the empirical study will contribute to the recommendations on the prospects of promising relief chain coordination mechanisms. Another insight that case study will bring is about the involvement and participation of various actors. Considering both actors relationships and recommended coordination mechanisms, the final recommendations will be offered to humanitarian organizations about their roles and partnerships in the relief chain.

Introduction

The research questions stated above can be linked with this research framework. Every part of content from framework can answer one or two research sub- questions. Part A as a whole can answers the main theoretical question and part B answers the empirical question. The output of both A and B combined together answer the prescriptive question and at the same time, achieve the objective of this study.

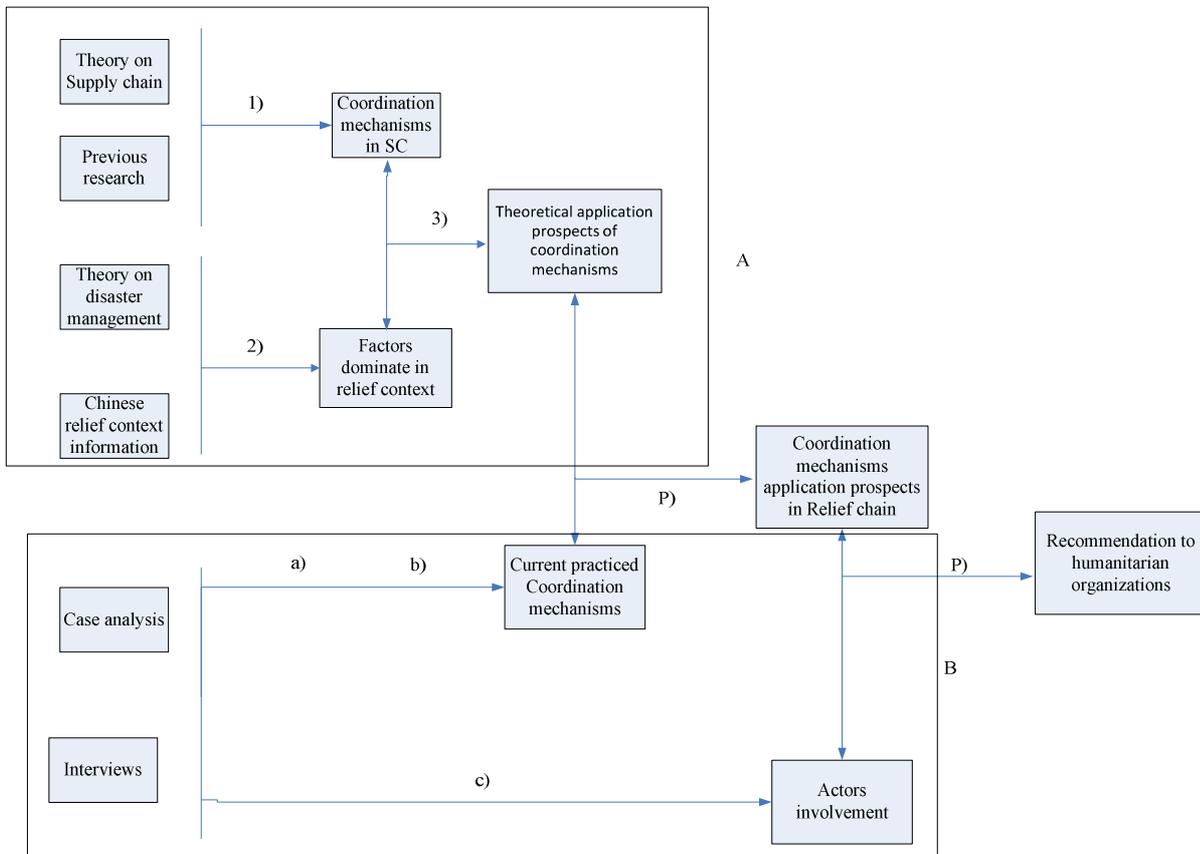


Figure 1: Research Framework

1.6. Research design

1.6.1. Theoretical study and case study

The whole research consists of two parts: theoretical study and empirical study which will be done by a case study.

The suitable condition to use case study is when a “ how” or “ why” question is being asked about a contemporary set of events over which the investigator has little or no control over (Yin, 1994). The reason that case study is chosen here is because the research is more an exploratory research rather than a descriptive or explanatory research. In exploratory research “how” or “why” questions will be asked rather than “what”. From the above empirical research questions we can see, I am aiming to answer a question starting with” to what extent” which is more a “How” question rather than a “what “question. Plus, the coordination mechanism’s prospects in the contemporary disaster events will be explored. Therefore, the case study is a suitable strategy to explore the answers for these research questions.

In the case study part, the 2008 Wenchuan earthquake catastrophe is chosen for case study with the following reasons:

- *The representativeness of this case*

Introduction

This Wenchuan earthquake is a representative case with very large scale of coordination in the relief chain including humanitarian actors from governmental organizations, both large and small non-governmental organizations, foundations, volunteers, international humanitarian teams, and private sectors. Emergency resources were delivered to Sichuan province from all the actors. The scale and diversity of coordination in the relief chain was never seen before and after this earthquake, no comparable catastrophe in China strikes. What is more, this kind of major catastrophe requires longer response and recovery duration till everything goes back to normal. The cross regional supply and long duration relief context set up barriers for humanitarian organizations to coordinate. So if there were still any coordination mechanisms practiced in this less favorable environment, then it is worthwhile assessing the potential prospects to apply them in other disaster circumstances. Therefore, it is a valuable case to study in-depth to understand the practiced coordination mechanisms in the Chinese relief chain context.

- More objective data channels

Due to the large amount of actors' involvement and participation, a lot of actors published reports regarding their efforts in the Wenchuan earthquake emergency supply which provide different perspectives for this research, enabling a relatively objective overview of what had happened even before interviewing different actors. Collecting data from different perspectives can assist me verify data and increase credibility.

-The high level of information exposure

After a disaster happens in China, especially in old times, the Chinese government tended to keep information under secrecy and public media was also under strict control by the government agencies. For instance, when SARS happens in China, the real daily statistics of infected or deaths at the early stage of the disaster was under cover by the government to avoid public panic. However, this trend of hiding real disaster data was not as prevalent as before when the Wenchuan earthquake struck due to the devastating damage and global attention. During the response phase of this catastrophe, the government kept the public updated with the latest efforts from both governmental and non-governmental organizations. Therefore, the coordination initiatives could also be collected from the news or announcements from various media channels.

1.6.2. Data collection technique

There are mainly two data collection techniques that are used in this thesis: desk research and interview. The data collected from desk research will help to answer both the theoretical questions and the empirical questions. The data collected from interviews are primarily for empirical case study. The connections between data collection sources and research questions are illustrated in Table 2, showing what information gives input on which part of the research.

- Desk research

The following shows the sources of data for desk research:

-Academic literature

-Policy documents from the emergency office of state council and regional government

-Documented serials study after major disasters from research institutes

There is a series of books on the Wenchuan earthquake topic jointly conducted by researchers and field practitioners. One of the books includes the interviews as well as interpretations of interviews on relief

Introduction

response. Although the questions may not be directly related to the relief chain coordination, there is still quite some valuable information that I can get out of it.

-Internal reports from non-governmental organizations

-Internal reports from private sectors

Besides reports from the private sector, some other institute, like Fritz institute is also doing research on private sector engagement in aftermath relief.

- Interview

In the empirical case study part, interview is an important approach to collect detailed information and data which are difficult to be found from desk study. The case study in this research relies on open-ended semi-structured interviews that interview is guided by prepared written list of questions¹ and topics but encourage involved interviewees to feel free to express their opinions and provide the information and issues they think are important. Due to different actors' involvement, interviews were conducted with different stakeholders who come from governmental and non-governmental organizations taking charge of emergency supply, private company who was the partner in the relief chain or volunteers who experienced organizational coordination. In total 4 in-depth interviews were conducted with each of them around 1 hour. Some valuable data has been collected from these interviews. The summary of the interviews is attached in the appendix.

	Theoretical part			
Research questions	1)	2)	3)	
Data Collection	Academic literature	Academic literature + Policy documents +Internal reports from NGO	Output of 1)+2)	
Data Analysis	Content analysis	Content analysis	Logical Analysis	
	Empirical part			Prescriptive
Research questions	a)	b)	c)	d) Recommendations
Data Collection	Academic Literatures+ Documented serials study+ Internal report from NGO, private sector	Internal report from NGO, private sector+ Documented serial study+ interviews	Internal report from NGO, Private sector+ Documental serial study	Overall T+E
Data Analysis	Pattern-matching	Content analysis	Content analysis	Analytic Induction

Table 2: Link among research questions, data collection and analysis techniques

¹ Refer to Appendix 4 Question guidelines for Interviews

1.6.3. Data analysis techniques

Table 2 summarizes the link between research questions, data collection techniques and data analysis techniques.

Data analysis techniques for the theoretical part:

Content analysis :

During the theoretical part, the content analysis techniques were used to analyze the information gathered from documented materials. Core questions of content analysis are: "Who says what, to whom, why, to what extent and with what effect?" Look at documents, text, or speech to see what themes emerge. What do people talk about the most? See how themes relate to each other (Ratcliff, 1995). So in this case, this technique will be helpful to identify the important coordination mechanisms practiced nowadays and the critical factors which set the relief chain apart from the commercial chain.

Logical Analysis

Using the output of analysis from both question 1 and 2, logical analysis was used to answer theoretical research question 3. Logical analysis refers to an outline of generalized causation and logical reasoning process. In this case, the application levels of each coordination mechanism in business supply chain with influential factors in the relief context were tested.

Data analysis techniques for case study part:

General analytic strategy: Relying on theoretical propositions:

According to Yin, the first and more preferred strategy is to follow the theoretical propositions that led to the case study. The propositions from the theory part would have shaped the data collection plan and therefore would have given priorities to the relevant analytic strategy. The proposition helps to focus the attention on certain data and to ignore others. The proposition also helps to organize the entire case study and to define the alternative explanations to be examined.

In this case, the analysis outcome for theoretical part will be the propositions to guide the data analysis. For example, after getting the application prospects of the commercial coordination mechanisms in the relief environment, some of coordination mechanisms might be traced in case study. For each traceable coordination mechanism, how they were used by whom and the possible changes adopted according to specific situations will be examined.

Specific analytic strategy 1: Pattern-Matching

An analytic strategy used for case study is pattern-matching; such a technique compares an empirically based pattern with a theoretical predicted one. If the patterns coincide, the results can help a case study strengthen its conclusion. In this case, the predicted patterns are the promising coordination mechanisms after screening in commercial supply chain. After doing the empirical study, we will see whether predicted patterns (existing promising coordination mechanisms in commercial chain) match the actual found ones (practicing coordination mechanisms in relief field). If the results are as predicted and can be found in relief context, then we can draw a solid conclusion that those are applicable coordination mechanisms even in the relief chain. However, if the results fail in matching, then it is a new emerging coordination mechanisms invented by humanitarian organizations, which will be studied further.

Specific analytic strategy 2: Content analysis:

Those which failed matching with existing commercial coordination mechanisms will be the new coordination mechanisms which should be further examined by content analysis to find out how these coordination mechanisms emerged and to what extent they influence the relief response.

Data analysis techniques for prescriptive part:

Analytic Induction:

In order to use analytic induction, researchers need to look at an event and develop a hypothetical statement of what happened. Then look at another similar event and see if it fits the hypothesis. If it doesn't, revise hypothesis. Begin looking for exceptions to hypothesis, when find it, revise hypothesis to fit all examples encountered. Eventually the hypothesis will develop into statements that account for all observed cases. In this case, the recommendations should also be concluded based on all the analysis above and should be feasible for humanitarian organizations in the Chinese relief context in general, to assist them to better respond to emergency relief.

1.7. Thesis outline

In order to answer the research questions defined in this chapter, theoretical and empirical studies are going to be conducted based on the research design.

From the second chapter to forth chapter is the theoretical section, which will address the problems regarding transferring the knowledge and experience from commercial supply chain to relief chain. The 2nd Chapter will start with listing most common practiced coordination mechanisms in SC. In this chapter, the characteristics of each coordination mechanisms will be elaborated to give an insight into the characteristics of these mechanisms so that the requirements for organizations to use them will be identified. Generic lessons learnt from the commercial supply chain will be also abstracted. Acknowledge the features of coordination mechanisms isn't enough for application them into relief chain since the factors setting relief chain apart from commercial supply chain are still unknown, therefore, chapter 3 will look into those factors that dominate and complicate the relief environment. After knowing what happened in business SC and the influential factors in relief chain, the preparation for application is ready. Chapter 4 will testify the potential application level of commercial coordination mechanisms (chapter 2) considering all the important factors (chapter 3). In this chapter, each of the coordination mechanisms discussed above will go through a assessment process, i.e. the analysis outcome considering both chapter 2 and 3, whichever survive the screening will be regarded as the promising coordination mechanisms that are likely to be practiced in relief chain.

From the fifth chapter, the empirical study comes in with a real catastrophe case happened in China. From this case study, I will further explore the feasibility of those potential coordination mechanisms among different stakeholders and find out the new emerging coordination initiatives. In sixth chapter, the recommendations for further improve coordination in Chinese relief chain will be offered, the limitations and future research directions will also be discussed.

2. Coordination mechanisms in the Commercial Chain

2.1. Coordination in supply chain

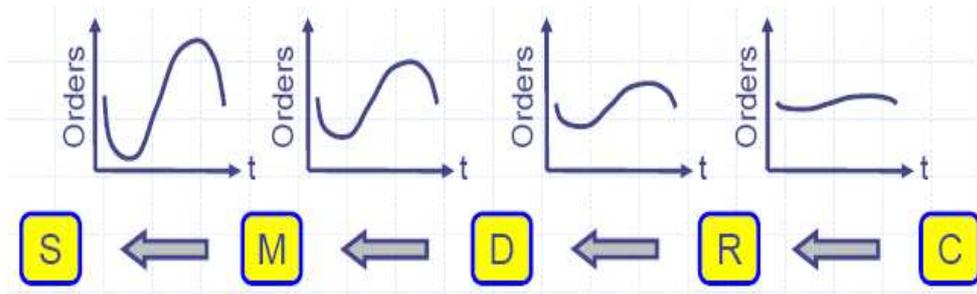
2.1.1. The concept of coordination

Besides coordination, there are two other concepts- cooperation and collaboration which need to be explained upfront. The coordinating level from coordination to collaboration goes higher, in other words, comparing with collaboration, coordination and cooperation achieve less ambitious collective undertakings. The reason that coordination is chosen for this study is because coordination makes the assumption that coordinating parties are different and it addresses on efficiency (Denise, 2007). In relief context, humanitarian organizations are different by their natures and the objective of coordination among relief organizations is to increase the relief chain efficiency. Therefore, coordination is the term to describe the phenomena that organizations or people work together in the relief chain context. Meanwhile, there might be some coordination initiatives in the relief chain which exceed the coordination and possibly reaches cooperation or even collaboration. However the difference usage of these synonyms isn't the focus of this study, instead of using different terms, the different level of coordination is indicated by different coordination orientation (namely operational, tactical and strategic coordination) to simply different concepts, which will be further elaborated in sub-chapter 2.6.

2.1.2. The rational to coordinate in supply chain

When we talk about coordination in commercial supply chain, we can see the commercial supply chain is a decentralized chain with different trading partners who are interconnected with information, financial and material flows. Each member along the supply chain attempts to optimize their own profit without full consideration on the impact of their trading partners which would result in an inefficient allocation of scarce resources, higher system costs, compromised customer service and a weakened strategic position (Fugate et al., 2006). In order to avoid these undesirable consequences, trading partners started to initiate coordination. Good coordination can reduce uncertainty in supply chain networks, which in turn translates into reduced variability (Kaipia, 2007). Some researcher states that dealing with uncertainty is the rational for supply chain coordination (Simatupang, et al., 2004). An important concept related to variability and uncertainty in supply chain management is bullwhip effect, which is a phenomenon that actors coordinate their efforts to cope with.

Figure 2 illustrates how bullwhip effect happens along the supply distribution channel. From the right hand, the demand information originates from customers and passes to retailers. Because customer demand is rarely perfectly stable, when the demand information gets to retailer, it oscillates a bit. The demand information carries on moving from retailers to distributors with even more fluctuating wave due to the information time delay and inaccurate forecast. As this piece of demand information passes by manufacturers and eventually reaches raw material suppliers, it has changed its original shape and has a significant magnification effect while it was moving to upstream. This phenomenon of magnification oscillating demand in supply chain is called bullwhip effect.



S: Supplier; M: Manufacturer; D: Distributor; R: Retailer; C: Customer

Figure 2: Generation of Bullwhip effect (Yossi, 2007)

Coordination is the main mechanism to control this bullwhip effect in supply chain (Sridhar Tayur et al., 1999; Yossi, 2007). Since coordination allows information sharing among customers, retailers, distributors, manufactures and suppliers, which aids in mitigating oscillation and forecasting demand. Besides the benefit of mitigating bullwhip effect, coordination among raw-material suppliers, manufacturers, distributors, third-party logistics providers and retailers can also provide risk reduction, access to resources or competitive advantage (Min, 2001) and consequently lower the cost for all the participants (Porter. 1985). Coordination is the key to attaining the flexibility necessary to enable them to progressively improve logistics processes in response to rapidly changing market conditions (Simatupang et al., 2002).

For example, coordination of procurement, inventory and transportation between upstream and downstream supply chain participants can provide inventory reductions of up to twenty-five percent (Lee et al., 1997). More inter-organizational coordination yields lower total costs and higher profits for coordination participants (Jeuland and Shugan, 1983; McDermot et al., 1993; Cachon, 2004). Some of the negative consequences of poor coordination include higher inventory costs, longer delivery times, higher transportation costs, higher levels of loss and damage, and lowered customer service (Lee et al., 1997).

2.1.3. Coordinating relationships

From coordinating actors perspective

Given all the benefits for initiating coordination in supply chain, whom should a firm coordinate with i.e. collaborative relationships among possible coordinating partners are studied by researchers. Yossi Sheffi proposes a conceptual model shown in Figure 3 which summarizes the possible coordinating relationships that exist among partners. According to the potential target alliance in supply chain, there are two types of coordination patterns in general, vertical coordination and horizontal coordination. The vertical coordination in supply chain refers to the coordination between the upstream or the downstream players, like a product company coordinates with its customers or suppliers. The horizontal coordination in supply chain refers to the coordination between companies with competitors or with horizontal partners.

Coordination mechanisms in the Commercial Chain

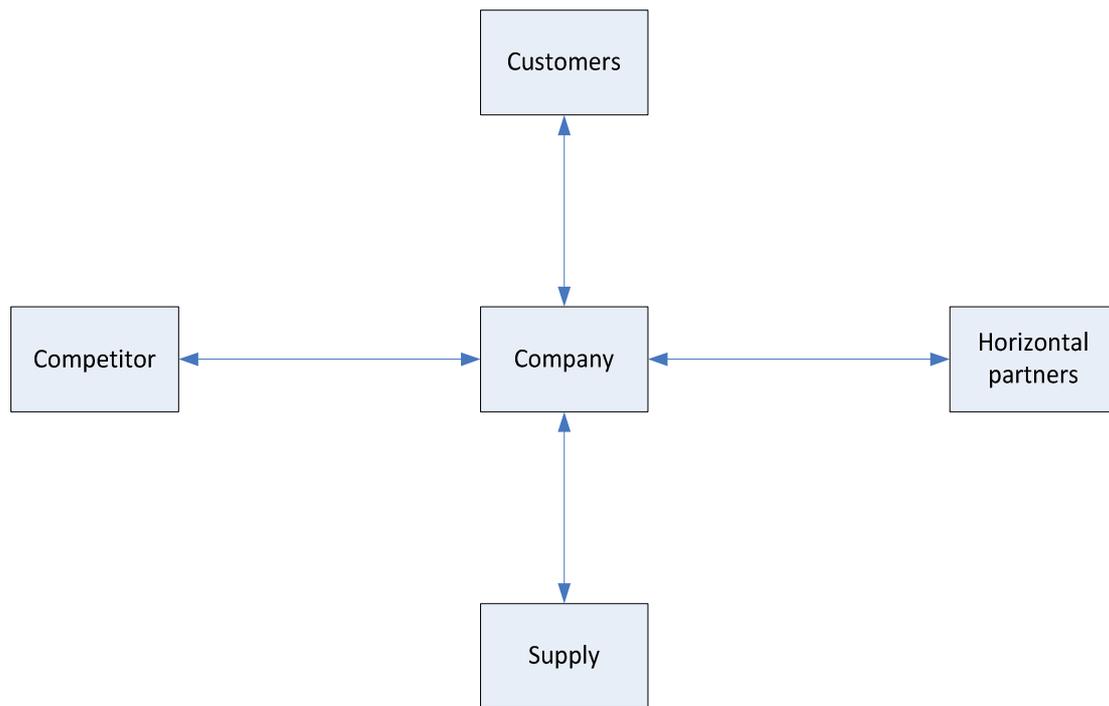


Figure 3: Collaborative relationships (Sheffi, 2007)

From coordinating orientation perspective

There are three levels of supply chain management decisions-strategic, tactical and operational (Gunasekaran et al., 2003). Here I would like to also define the coordinating orientations among partners in these three levels:

- Strategic coordination orientation refers to the coordinating decisions made based on long-term orientation which probably require high level of resource commitment, besides other resources required for strategic coordination, like human resources or financial support, the resource here mostly refers to information. On strategic coordination level, the information shared among coordinating alliance could touch R&D plan or strategic planning. The establishment of strategic coordination will have a profound influence on company and it may also take a while for company to find or foster a strategic partner. Consequently, strategic coordination doesn't encourage frequent switching of coordinating partners.
- Tactical oriented decisions can be made under the overall strategic consideration and aim to achieve a set of key operating targets (such as desired safety stocks level or reduction in lead time). The tactical coordination is the guidance for coordinating partners to operate business operationally. An example of tactical coordination could be communication between managers in the same function from different firms to achieve consistency or jointly developing inventory and production plans.
- Operational oriented decisions can be made in everyday operations within a company with the awareness of its strategic and tactical orientations. Operational coordination decisions can be identified in daily production, distribution or planning. The coordination in operational level is to coordinate each other to fulfill daily tasks. For example: the decision on making replenishment plan or some inbound operations, like transportation from suppliers or moving products to inventory.

2.1.4. Scope of chosen Coordination mechanism

After knowing the possible coordinating relationships and orientations, the next question comes up, what are the coordination mechanisms that bridge different players on different coordinating orientation levels? In order to answer this question, I am going to map some of the most practiced coordination mechanisms which primarily on operational linkage (shown in Table 3) in supply chain in chapter 2.2, 2.3 and 2.4. Before starting reviewing these mechanisms, it is necessary to clarify that why the following coordination mechanisms are chosen over the others.

Table 3: Mode of coordination (from Simatupang et al., 2002).

		Mutuality of Coordination	
		Complementarity	Coherency
Focus of coordination	Operational Linkage	Physical Flow Coordination	Information Sharing
		Object: Products, services or logistics processes	Object: Information
	Organizational Linkage	Incentive Alignment	Collective Learning
		Object: Benefits and risks	Object: Knowledge and Capacity

According to Simatupang et al., the mutuality of coordination refers to the requirement on sharing responsibility in achieving better performance, which can be achieved in two ways: by adding complementarity (how chain members collectively increase value) or coherency (creating common understanding). There are two focus of coordination in commercial supply chain available: operational linkage and organizational linkage. The former one refers to physical flow coordination focusing on products or services and the logistics processes. The way to achieve better performance in operational linkage is through information sharing among partners, aiming to give relevant, timely, and accurate information available for coordinating partners. The organizational level of coordination mechanisms on the other hand focus on incentives which reward or punish on actions that supply participants take to reach collective learning. The objects for them to work on collectively are benefits and risks instead of physical flow. However, for relief context, the main concern for supply chain practitioners are not driven by cost or benefits, their primarily concern is about deliver the physical flow in an accurate time manner. What is more, actors won't get reward nor punished financially by its coordinating partners. Hence, coordination mechanisms belong to organizational linkage doesn't apply for the relief chain context at the first place. So the organizational level of coordination mechanisms, like Revenue sharing, Sales rebate, price discount, buyback return are excluded from coordination mechanisms mapping in this chapter.

In the remaining chapter, I will analyze the characteristics of these coordination mechanisms on operational linkage, together with the conditions they require. There are three main processes in supply chain: procurement, inventory and transportation. The coordination mechanisms in each of process will be discussed from now on.

2.2. Coordination mechanisms in procurement

Joint procurement (JP) is a commonly practiced coordination mechanism in procurement process.

➤ Concept and Characteristics

Joint procurement or collaborative procurement refers to two or more independent companies conduct their procurement activities together either organizing by a third party or by a coordinating member aiming to reduce procurement cost or purchasing more qualified products or service.

Joint procurement can be always found in the government. In China, especially for small scale cities with relatively lower budget, smaller purchase volume and dispersed location, joint procurement can be chosen to overcome these shortcomings and increase the attractiveness to the potential suppliers. One way to conduct governmental joint procurement is to assign an agent city who will collect all the demand information from other cities geographically nearby in order to depute the whole procurement activities. JP is also widely found in the business supply chain for the similar consideration: increase the bargaining power over suppliers to reduce cost. There is even a new industry, third-party purchasing, emerging due to the boom of joint procurement in China. For example, China National Petroleum Corporation (CNPC) and Hutchison Whampoa established a collaborative third party procurement stage named “Energy No.1”, which provides joint procurement activities and already save billions of cost for CNPC.

In either governmental or commercial areas, normally there are three types of joint procurement available, each of them are organizing by 1) a joint union consists of all the members from the procurement league, or 2) accomplished with the help from a lead organization, or 3) operating by a third party (Chen, 2008). The conceptual models for these three types of joint procurement are illustrated in Figure 4, Figure 5 and Figure 6.

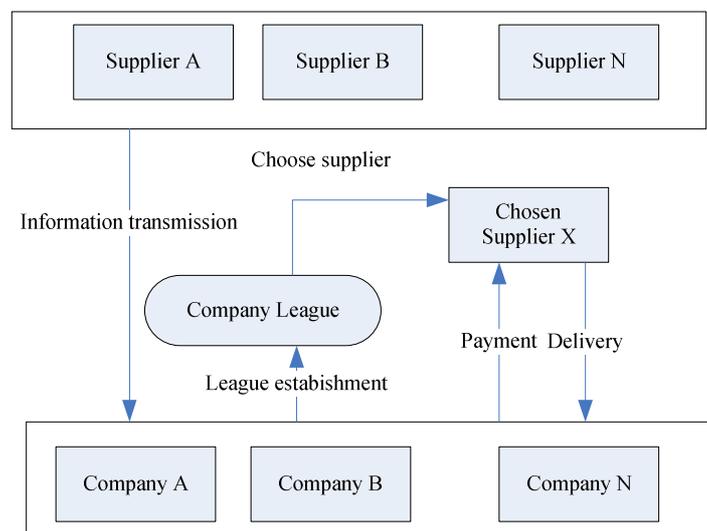


Figure 4: Joint procurement organized by a company league-1st type of JP

➤ Conditions to use joint procurement

The condition for 1st type of joint procurement is the common willingness to make collective purchase among all participants. The league is more like a temporary or virtual organization with assigned personnel responsible for that specific procurement activity. On behalf of their own companies, representatives could share the supplier information together in order to get the best deal in the

market. This kind of procurement organization is established stochastically based on the common purchase willingness and the league dissolves after procurement.

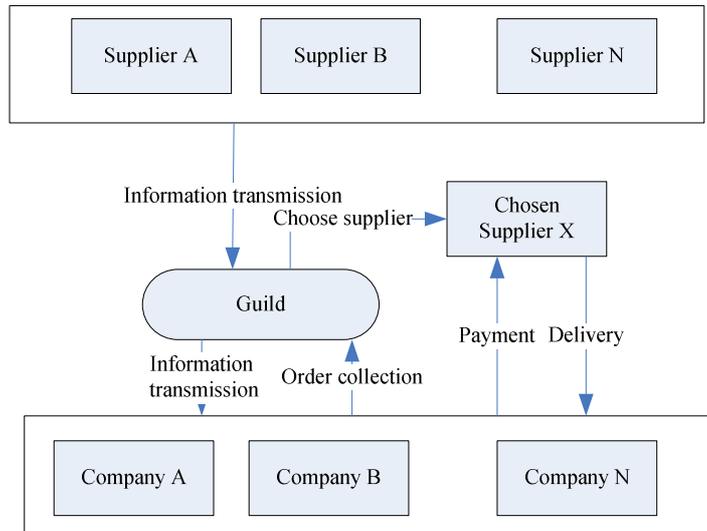


Figure 5: Joint procurement organized by a lead organization-2nd type of JP

The condition to use the 2nd type of joint procurement is 1) the emergence of a lead organization in relevant industry and the 2) willingness of collectively purchasing from all the participant companies. A lead organization could be the guild in that area which can collect and screen relevant procurement information and help the other smaller companies to identify the right supplier to do the business with. From Figure 5 we can see that, the lead organization (guild) functions as a mediator who accommodate information between suppliers and small companies. However, the actual payment and offer process are only between supplier and companies so that the lead organization doesn't play a role in final transaction.

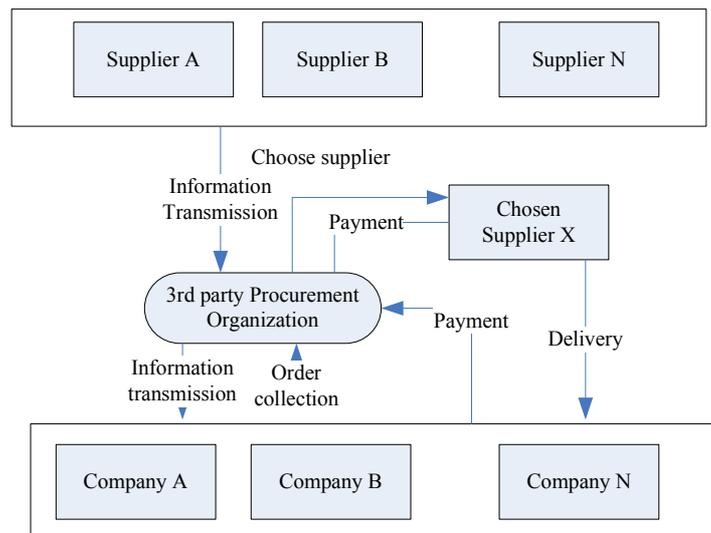


Figure 6: Joint procurement organized by a 3rd party-3rd type of JP

The condition or 3rd party procurement league to build is 1) a reliable 3rd party organization that can offer the optimal purchase deal for purchasing companies, and at the same time 2) common willingness is still indispensable. This 3rd party organization also makes profit out of the business. We

can see from figure 5 that all the 3rd party procurement organization is the hub of information and payment transaction.

From these three types of collaborative phenomenon, we can see that in general an umbrella organization is the condition for joint procurement. An umbrella organization is an association of institutions (often industry-specific), who work together formally to coordinate activities or pool resources together. The reason to establish or join an umbrella organization is that the activities couldn't be carried out or accomplished alone due to economies of scale, better pool of exchanging experience or know-how. In joint procurement, the umbrella organization consists of every firm in the alliance and it doesn't necessarily involve formal contract like hiring a 3rd party, a good guild organization or establishment of company league can also function as the umbrella organization, helping the coordinating companies to close the purchasing deal.

2.3. Coordination mechanisms in inventory

Several coordination mechanisms are available for players in supply chain during inventory processes. Some of common practiced ones are quick response (QR), continuous replenishment program (CRP), vendor managed inventory (VMI), joint managed inventory (JMI), collaborative planning forecasting and replenishment (CPFR) and 3rd party warehousing.

2.3.1. QR and CRP

QR and CRP are early emerged coordination mechanisms in inventory process and also have a lot similarity regarding the basic idea and principles. The earliest evolvement of coordination mechanism in inventory process can be traced back to quick response, which was developed to reduce lead-time and inventory by information sharing among coordinating partners. Under this mechanism, suppliers receive point of sale (POS) data from retailers to synchronize their production and inventory level. Retailers are the ones who place order and suppliers make use of POS and historical data to forecaster demand in order to decide production volume. The benefits for companies to adopt QR is minimizing product cycle time from raw material to sales point and at the same time, reducing the inventory level for all the trading partners.

From the idea of QR, the concept of continuous replenishment program (CRP) had been developed. CRP is a further movement from pushing manner to pulling manner (Lummus and Vokurka, 1999). Because usually on markets the consumers "pull" the goods they demand, while the vendors "push" them toward the consumers. In a CRP strategy, the "pull" is the main force since the flow of products is determined by real demand instead of forecasting. The real demand information, i.e. point of sales data can be received by vendors who use this information to prepare shipments at previously agreed intervals to maintain specific pre-determined inventory levels. Another important feature of using CRP is: it encourages the retailers to place small quantity of order with higher frequency. For example, War mart, as the retail giant, is using this continuous replenishment strategy. For each product, as long as the storage in warehouse is below a safety inventory level that is set up beforehand, the information system will place the order on vendor automatically through internet. The conceptual model of CRP is illustrated in figure 8.

Coordination mechanisms in the Commercial Chain

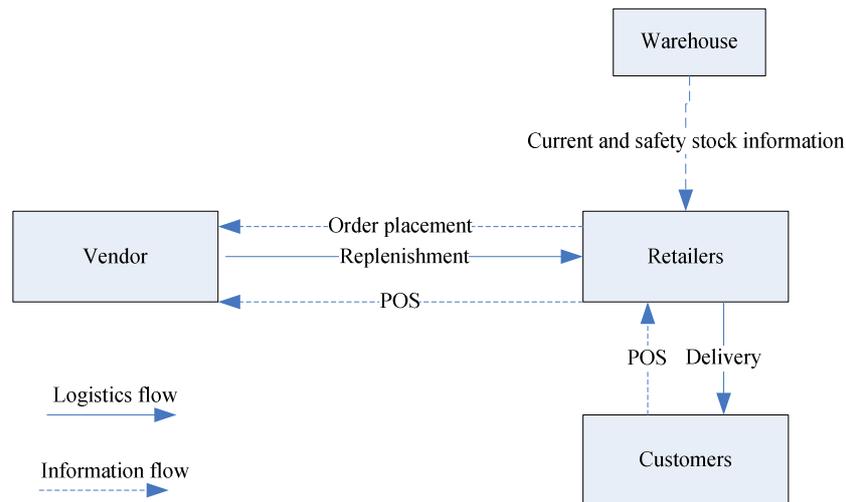


Figure 7: CRP model

➤ Conditions for QR

1) Information sharing

The key factor to enable QR is information sharing. Information sharing assists demand forecasting, which is one of the most important tasks for all the trading partners. With the shortening of product life cycles, and the increasing request for customization of made-to-order products, forecasting is even more challenging. Thus, information sharing is the critical condition for all the trading partners to alleviate bullwhip effect to predict demand more precisely and to make the production decisions correspondingly. The way of keeping the information (for example the sales information) in door doesn't help any more when companies seek to coordinate with trading partners through QR.

2) Technology requirement

In order to sharing information among trading partners, several hardware and software requirements are indispensable to forecast demand and response to customers' needs more quickly and precisely. Firstly, barcode is needed for data input and collection at the terminal sales points. A barcode is an optical machine-readable representation of data, which shows certain data on certain products (Wikipedia). Barcode system not only provides a set of reliable code identification system, but also enables a universal language for trading partners. The application of barcode system solves the problems during data input and data collection so it is a technical support for information sharing in QR. Secondly, POS (Point-of-Sales) is the location where a transaction occurs. It refers to a terminal where hardware and software used for checkouts, the equivalent of an electronic cash register. A POS terminal manages the selling process by a salesperson accessible interface which allows storage of product inventory information as well as the creation and printing of the receipt. POS can be used independently at one businesses terminal as well as connecting to a network. The POS system can connect the entire transaction terminals with the mainframe computer within certain business information system and realize the overall management of procurement, sale and storage. So POS is another technical tool that facilitates information sharing among trading partners within network. POS data need to transfer among coordinating partners through EDI. Electronic data interchange (EDI) is the structured transmission of data between organizations by electronic means. It is used to transfer electronic documents or business data from one computer system to another, i.e. from one trading

partner to another without human intervention. So far we can see some basic technical conditions required for trading partners to use QR.

➤ **Conditions for CRP**

Apart from information sharing and technological requirements, another extra condition to use CRP is the good order handling ability. Since we know that the prominent characteristic of continuous replenishment is fewer orders made more frequently, this will have a profound effect in companies. For the buyer, it could potentially receive a substantial increase in the number of suppliers' deliveries, which might create greater congestion at the distribution enter. In some cases, they may be overwhelmed by the amount of sorting out work, resulting in long delays in unloading which have a significant negative impact on carrier productivity (Andraski, 1994). For supplier, they would incur higher expense in their distribution process since the cost of processing small orders is greater on a cost per unit basis than a truckload order. Therefore, the requirement for both partnership members to adopt CRP is demanding. They should be capable of dealing with either congestion problems caused by substantial increase in deliveries or higher cost resulted from more transportation frequency.

2.3.2. Vendor Managed Inventory

➤ **Concept and characteristics**

Vendor managed inventory is a popular coordination mechanism that has been widely adopted by many industries for years. Vendor managed inventory is based on agreement between suppliers and buyers under a formal contract, which specifies the responsibility of vendor, who should manage buyer's inventory through continuous monitoring and operating. VMI allows the vendor to monitor the buyer's inventory levels and make periodic replenishment decisions involving order quantities, delivery mode, and the timing of replenishments (Sahin and Robinson 2002; Waller et al., 1999). Vendors' replenishment decisions are made based on point of sales (POS) data that its buyer offers. The main goal is to provide a mutually beneficial relationship that both sides are able to control the flow of goods more smoothly and accurately (Zhang and Yuan, 2005). For buyers, VMI helps them to ease the inventory burden; for vendors, their manufacturing, inventory, replenishment and transportation activities are synchronized as well as integrated with their clients, which can help them to reduce overall costs and maintain long term relationships with clients. The abstract conceptual model is shown as follows

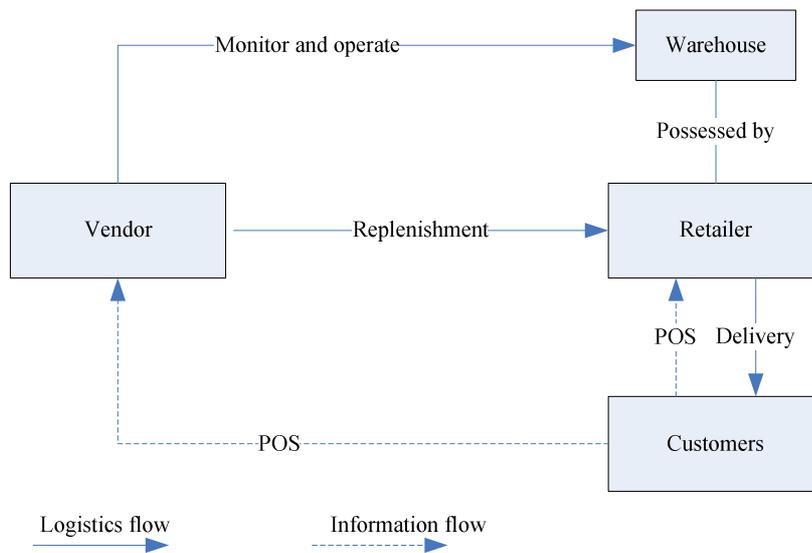


Figure 8: VMI Model

➤ Conditions to use VMI

1) Information sharing

The requirement for QR still stands for VMI. As shown in

Figure 8, POS data has to be transferred to vendor who will make use of this information to forecast future demand and also make the inventory level accordingly. In the implementation progresses, an increased transaction quantity between the chain members will be resulted from more information sharing, better visibility and availability of information, and more accurate forecast (Tyan and Wee, 2003). Information sharing is done by management information system which is also the technical requirement for this coordination mechanism.

2) Technical requirement

The technological requirements stated above for QR or CRP, like POS, EDI, bar-coding and internet are still very critical for VMI practice. For VMI, the business processing is like this: POS will be collected at the terminals and sent to vendor through internet. Warehouse manager revises the forecasting factor according to the POS, out of stock, promotion, and updated inventory data and then makes the delivery quantity decision and deliveries the order directly to retailer instead of sending ordering back. The whole vendor managed inventory system is based on internet and telecommunication system.

3) Organization structure

Since VMI shifts inventory management responsibility from retailer to vendor. A high level of mutual trust and regular review scheme has to be established to ensure the continuous success (Tyan and Wee, 2003). Consequently, within organizations, the frequent contact personnel from both sides shifts from the sales or marketing personnel to the logistic ones so that re-structure job responsibility and

new compensation scheme need to be implemented to adjust to those changes and reduce resistance inside organizations (Tyan, Wee, 2003)

4) High level commitment from top managers

The VMI coordination mechanism requires transparency in relationships which includes the two-way exchange of sales, costs, inventories, information, and knowledge between the retailer and the supplier (Lamming et al., 2001) After VMI is implemented, vendor will take more responsibility on the inventory management, so if problem occurs, like products are returned from customers back to warehouse, the inventory cost for vendor to bear will be higher than without VMI. Therefore, top managers from both sides need to negotiate on the benefit and risk allocation before VMI is put in place.

5) Trust among trading partners

First of all, the trust on fair allocation of risks and benefits is essential. Sometimes in VMI operation, the product may be in the possession of the retailer but is not owned by the retailer until the sale takes place, meaning that the retailer simply houses (and assists with the sale of) the product in exchange for a predetermined commission or profit (VMI Homepage). So the trust on fair allocation of risks and benefits built on pre-determined plan or contracts need both sides strictly stick to. The trust on fulfillment of contracts regarding risks and benefits is the basic level of trust among coordinating partners. The second level of trust is reputation oriented. Since a vendor probably serves several clients and manages their inventories at the same time, so retailers are explored to leakiness of confidential information to their competitors. Therefore, vendor should be obliged to deal with the information carefully and make sure to keep each client's internal information confidential inside without spreading. Thus, high level of mutual trust is required.

2.3.3. Joint managed inventory

VMI also has some limitations stemming from its instinct characteristics since it is a one way decision process from vendors instead of making decisions on mutual adjustment from both vendors and retailers. Insufficient discussion or asymmetric information might result in mistakes. Joint managed inventory (JMI) therefore has been developed in order to overcome the shortcomings vendor managed inventory has. JIM is a coordination mechanism that both vendor and buyers joint together to manage the inventory, balancing the responsibility of upstream and downstream companies by involving both partner members. The essence of JMI remains the same as VMI. The benefits of applying this coordination mechanism still lie in reduction on distorted demand information. But JMI emphasis more on the co-efforts on inventory plan making between partners. As shown in Figure 9, JMI transforms two separate warehouses of trading partners into a joint operated one since vendor can cancel its finished products storage and place them in the joint warehouse, which is possessed by both of members. JMI requires more communication between vendor and buyers about their inventory or replenishment plans and therefore further reduce the level of the safety stock and the average stock in the supply chain. Joint managed inventories can happen between the supplier and the manufacturer, and also between the manufacturer and the distributor.

Coordination mechanisms in the Commercial Chain

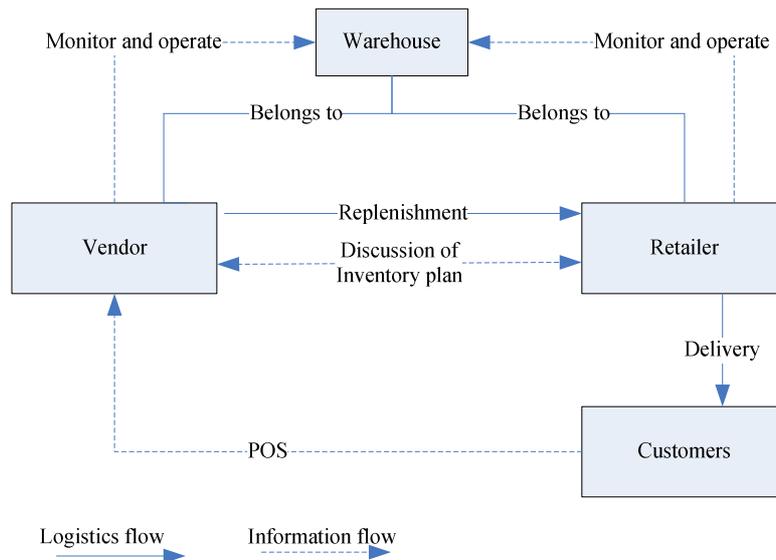


Figure 9: JMI model

Compared to VMI, both vendor and buyer need to participate in the inventory operation so that both of them need to take the responsibility to manage and operate inventory. In this sense, vendor doesn't have to absorb unsold products or bear more inventory costs. The conditions need for VMI still hold for JMI:

- 1) Information sharing
- 2) Technological requirement
- 3) Organization structure
- 4) High level commitment from top managers
- 5) Trust among trading partners
- 6) Regular communication and Consensus on demand forecasting

Another extra pre-condition for companies to use JMI is regular communication and consensus on demand forecasting which originates from the settings of JMI. Since it requires trading partners' discussion on the demand forecasting and reaches a consensus in order to manage inventory together. Hence, companies need to communicate with each other on a fairly regular basis and make replenishment plan accordingly. Therefore, comparing to VMI, JMI adds an additional requirement for companies: not only vendor but also retailer need to put more efforts and be committed to inventory operation and management.

2.3.4. Collaborative Planning Forecasting and Replenishment

➤ Concept and characteristics

CPFR is developed based on the ideas of QR, CRP, VMI and JMI. Taking a look at the developing path from QR to CPFR; we can see that the coordination initiatives before CPFR didn't integrate the supply chain in a large scale. CPFR on the other hand, coordinate trading partners to work together from collaborative planning, forecasting to replenishing processes. CPFR's underlying premise is that broad integration of firms within the supply chain will lead to a better focus on customers (VICS, 2008). According to VICS²'s CPFR overview research in 2004, the CPFR model (Figure 10) is proposed which

² VICS refers to Voluntary Interindustry Commerce Standards. The webpage for CPFR: <http://www.vics.org/committees/cpfr/>

provides a general framework for the collaborative aspects of planning, forecasting and replenishment processes. Buyers and sellers along the supply chain, as collaboration participants, work together to satisfy the demands of end customers who are at the center of the model. To increase performance, the buyer and the seller are involved in four collaboration activities that are listed in logical order, but companies often engage in these activities simultaneously (VICS, 2008).

The first collaboration activity is “Strategy and Planning” during when trading partners will establish the ground rules for the collaborative relationships and determine product and event plans. The second activity is “Demand and Supply Management” when customer demand and shipping requirements are forecasted. The third activity is “Execution” when orders are placed, deliver shipments are prepared, orders are received and stored, transactions are recorded and payments are made. In the forth “Analysis” activity, the executed activities are monitored and key performance indicators are measured for continuous further improvement. Collaboration efforts do not need to apply all four activities, partial CPFR can be implemented, which concentrates on some activities while the rest are achieved through standard firm processes (VICS, 2008).

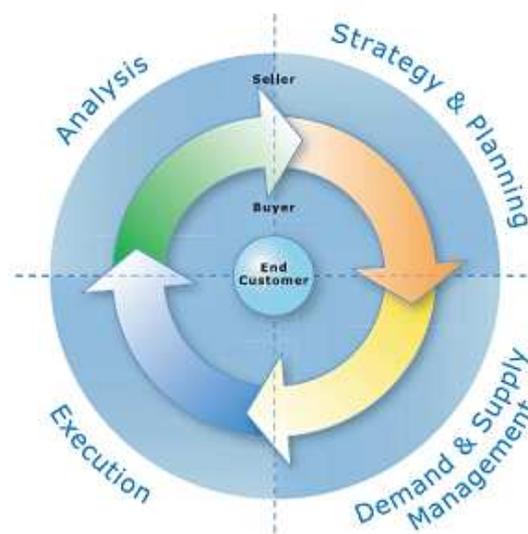


Figure 10 CPFR Model (VICS, 2004)

➤ Conditions for CPFR

From the concept stated above we can sense the high integration among partners along the supply chain, consequently it requires the company to integrate its planning and operation processes across departments boundaries within organization. Some fundamental collaborative changes within each firm also need to be made, which also set up some challenging preconditions for firms who intend to introduce CPFR.

1) Information sharing

Like other coordination mechanisms discussed above, information sharing is the key to success in CPFR.

2) Technical requirement

The basic technology stated in VMI section is still inevitable for CPFR. Plus CPFR is the latest coordination mechanism in supply chain filed and because of the potential and benefits of implementation, some well-known software developer like SPA, Manugistics, and I2 are developing the software for CPFR. During the last five years, vendors started to come up with different packages

to facilitate CPFR information sharing and they still are exploring the suitable technical tools for CPFR in order to move CPFR pilot project into wide organization implementation (Sheffi, 2002).

3) Trust among supply chain partners

Due to large scale of coordination among supply chain partners, the level of trust among each other is even higher compared to VMI or JMI. Since coordination happens not only on the operational or tactical level, but also touch upon the strategic planning. Therefore, trading partners need to believe in their partners 'ability to fulfill the agreements and also need to be trustful in their ability and reputation. Trust and a long term strategic relationship are the simulators for adopting CPFR (VICS, 2008).

4) Organizational structure

Figure 11 shows the traditional organization structure without using CPFR, all the activities including sales forecasting, promotions, order plans and shipments involve the participation of both sides from corresponding departments. Figure 11 takes the example of downstream company as a manufacturer and upstream company as its retailer. Before CPFR is adopted, if replenishment personnel in upstream retailer determine the order quantities, then the downstream manufacturer customer service and logistics personnel mobilize the resources to fulfill them. However, Figure 11 isn't a desirable structure with CPFR approach. Figure 12 shows the collaborative organizational structure which requires more focus on inter-discipline instead of functioning independency. In this desirable structure for CPFR shown in figure 11, the manufacturer needs to establish cross-functional and customer-specific teams to provide a single face to its customers. The organizational requirements for retailers is challenging as well since it is usually not practical for planning, buying and replenishment personnel to re-organize around suppliers(VICS, 2004), but they sometimes can create cross-functional category teams (VICS, 2004) like what is shown in figure 11. The biggest change may come within the replenishment organization itself: the store and replenishment functions must carefully orchestrate distribution to reduce out-of-stocks on one hand and on the other hand maintain low level of inventory, so some retailers have combined their store and replenishment teams together to reduce disconnects (VICS, 2004). Therefore, for trading partners, there are quite some changes regarding organizational structures due to CPFR adoption.

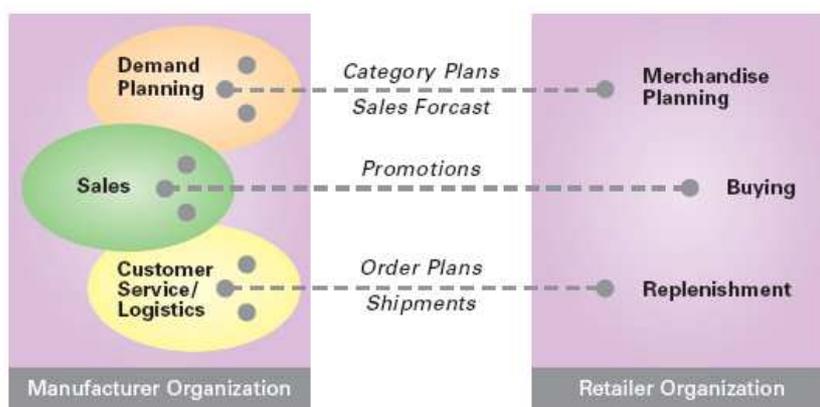


Figure 11: Conventional Organization rules (VICS, 2004)

Coordination mechanisms in the Commercial Chain

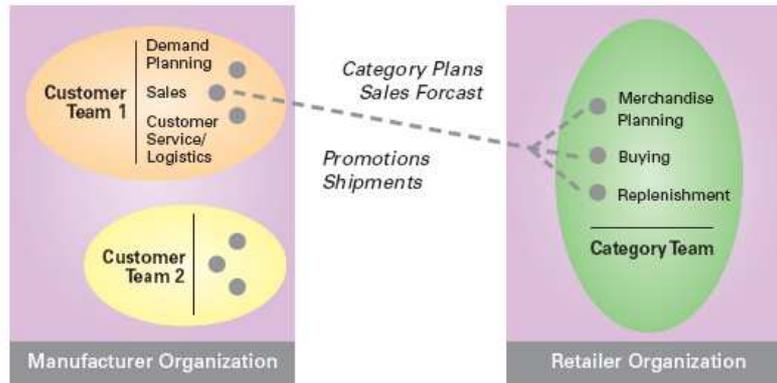


Figure 12: Collaborative Organizational Structure (VICS, 2004)

5) Refine business strategy on collaboration focus

Like the precondition stated above for implementing VMI or JMI, the commitment of top managers is vital for steering coordination. For CPFR, it requires more than agreement from top managers on initiating coordination, but also the entire company is expected to understand the necessity to change its strategic focus on coordination (VICS, 2008). The most crucial prerequisite for successful CPFR implementations is to have strategic alliance (Cederlund, 2007.) not only with participating partners but also internally – alliance of the process, organizational and technology strategies with collaborative business strategies (VICS, 2008).

2.3.5. 3rd party warehousing

This 3rd party warehousing coordination mechanism in inventory doesn't only involve in the trading partners along supply chain, but also put 3rd party logistics provider on board. Before I go into the characteristics and conditions to use 3rd party warehousing, the concepts related 3rd party logistics are reviewed first.

➤ 3rd party logistics (TPL)

Outsourcing is increasingly viewed as a way to reduce the focus on non-value added activities by using a specialized service provider for those functions (Vakil, 2005). It allows companies to focus on their core competence. Terms such as “third party logistics” “logistics outsourcing” “logistics alliances” and “contract logistics” have been used interchangeably to describe the organizational practice of outsourcing part of or all logistics activities that were previously performed in-house (Selviaridis and Spring, 2007). Berglund (1999) defines third-party logistics as “activities carried out by a logistics service provider on behalf of a shipper and consisting of at least management and execution of transportation or warehousing. In addition, other activities can be included, for example inventory management, information related activities, such as tracking and tracing or value added activities, such as secondary assembly and installation of products (van Laarhoven et al., 2000).

In fact, companies tend to start outsourcing in a limited, focused way and after gaining more experience and have some success with outsourcing, they expand their use of the services that 3rd party logistics provider offer. Hereby, I classify the type of 3rd party logistics into three levels:

- ✓ First type: The logistics functionality could consist of operational activities, such as warehousing or transportation. In the first type, the product owner companies (shipper) could simply contract out the inventory or transportation activities used to be in-house to a third party.

- ✓ Second type: After companies gain experience and also more trust and understanding from their partners, the outsourced activities could be expanded and could also involve longer time orientation. For example, the third party logistics company develops its own logistics system and offer it to products owner and manage the in house logistics with the self-designed system.
- ✓ Third type: There could be a broader range of activities than first two types. These activities could include supply chain planning, information technology, order management, or customer service. In this type, the 3rd party logistics provider coordinates with its customers strategically. For instance, in this level of outsourcing, from product owner's point of view, Third Party Logistics Company could design a personalized logistics system and also take responsibility to run it.

We can see that from the first level to third level of coordination is moving from operational activities to a strategic planning. Companies can choose how collaborative they want to be based on their strategic plan and the availability of an appropriate 3rd party partner.

➤ Drivers stimulate 3rd party logistics (TPL)

Kant Rao and Richard R. Young (1994) identified the key drivers which influence the decision of TPL. These drivers are like the catalyst that offers a friendly atmosphere to stimulate outsourcing activities. The drivers can be summarized as “complexity of logistics”, consisting of three aspects:

1) Network complexity

The network complexity refers to both the geographic dispersion of a firm's trading partners as well as the intensiveness of transactions with selected trading partners. There are some variables contribute to this network complexity, for instance, large number of suppliers or distribution trading partners, dispersion of the origins or destinations. A large number of trading partners increase the logistics transactions need to be managed and dispersed regions also raise the logistics difficulties. If the regional transportation or infrastructure isn't well developed then the problem is aggravating. Therefore, network complexity drives firms to look for a 3rd party to take care of the warehousing or transportation instead of tackling these challenges themselves.

2) Process complexity

According to Kant Rao and Richard R. Young, this driver refers to time and task compression in supply chain. When the logistics processes are complicated by the numbers of tasks which have to be performed and coordinated within a short span of time, numerous service tradeoffs and functional interdependency arise in operations. In other words, if time is limited for a company to accomplish one set of transaction tasks, it stimulates favorable atmosphere for TPL. For example, materials inbound to meet other materials in an assembly process, or the movement of highly perishable goods. Huge lost may incur because of unsatisfactory performance in the process of fulfill these tasks, creating urgency to coordinate with a professional logistics party.

3) Product complexity

Goods, like easy-deteriorating food or hazardous materials, with special requirements during transportation, storage or handling makes it more difficult for companies to deal with warehousing or transportation alone.

These three factors, process complexity, network complexity and product complexity influence firm's decision on initiating TPL. However, even in the “TPL friendly environment”, there are still some more

conditions that need to be met by companies before the coordinating alliance is set up. These conditions will be elaborated in the following content.

➤ Other Conditions to use TPL

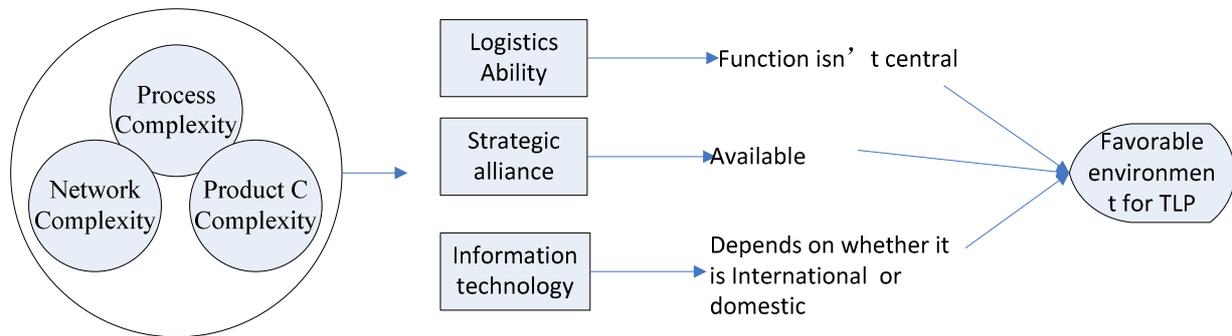


Figure 12: Conditions for 3rd party logistics (Source: Kant Rao and Richard R. Young, 1994)

Like illustrated in Figure 12, the complexity of logistics effect the other preconditions to launch 3rd part logistics activities.

1) Logistics ability

Before making the decision to coordinate with a TPL, the primary concern for a company is to see to what extent will the in-house logistics distracts from its core business. What role does logistics play- a supporting activity or core competence? For instance, if network complexity forces company to put a lot effort in transporting which happens not to be its strong business point, then it is likely for them to consider outsourcing as an option to focus on their core competitiveness instead.

2) Availability of strategic partner

For a company who is thinking about outsourcing its logistics function to a TPL provider, another condition to put this thought into practice is whether a strategic TPL partner is available. Studies revealed that the service providers were a source of market intelligence to the company in a variety of ways: learning about sourcing alternatives in far-off places; options about volumes, specific commodities, and origins and destinations (Rao and Young, 1994). However, this kind of strategic TPL partner isn't always available. Take Chinese logistics market as an example, one constrain that Chinese TPL only takes less than 20% of whole logistics market is due to the laciness of customized or value added service from the third party. Most third party logistics providers simply act as a carrier but can't play as market intelligence. For companies who are searching for strategic alliance to work with in a long run, insufficient service from third party would hamper the coordination.

3) Information technology

From the other coordination mechanisms' conditions stated above, we know that information technology facilitates the communication among coordinating traders. For domestic third party logistics activities, the information technology is still very essential since it is feasible to integrate and bundle with software and information system. Information processing and communication technology supports the outsourcing of logistics activities to third-party firms as IT allows buyers and sellers of logistics services to communicate directly over data rich, easy-to-use information channels, thereby reducing coordination costs and fostering strategic partnerships (Marasco, 2007).

However, the role of information technology plays for TPL varies and depends on the scale of transaction we talk about. According to the research Kant Rao and Richard R. Young did, International logistics, on the other hand is sufficiently different from domestic logistics due to the complexity of its transaction. The very complexity of booking, cross-border tracking and the global reach of the logistics processes increases the cost of building the necessary telecommunication and information systems. Furthermore, international logistics usually entails several carriers, making seamless electronic data interchange throughout the transportation pipeline difficult (Rao and Young, 1994). Therefore, these barriers for using information technology at the same time open an opportunity for a third party service provider to enter the market. With their help, the shippers don't necessarily need to create new system or spending extra on modifying existing system to integrate with trading partners' technological standard. Consequently, lack of information technology could be a barrier for TPL or in some context, a force to stimulate coordination in others.

➤ **Concept, characteristics and conditions for 3rd party warehousing**

After clarifying the concept and conditions of using third party logistics, we now take a look at one aspect of the 3rd party logistics activities in inventory process, namely 3rd party warehousing. As a third-party warehousing provider, it doesn't process products but warehousing expertise and professional service. The functions that 3PL warehousing provide can include receiving, sorting and direct put-away, wave management, merge and pack-out, manifest documents, label or bar code printing, kitting, and pick/pack activities (Vaidyanathan, 2005). After reviewing the characteristics, drivers and using conditions for TPL, we know that 3rd party warehousing is one function in TPL services so that the using condition is in line with the general requirements.

2.4. Coordination mechanisms in transportation

Together with Third party warehousing, third party transportation is another coordination mechanisms which can be used in transportation process. Some basic functions that 3rd party transportation has are fleet management, cross docking and product return. However, the 3rd party logistics provider doesn't necessarily have the in-house transport capability; they can also only take care of the logistics system design and system operation. In this case, the profit 3rd party transportation provider gains doesn't come from client's cost or payout, like transportation fee or warehousing fee, instead the profit generates from new value added service that 3PL offers together with their clients. Hence, the benefits are tightly connected with product owner's logistics efficiency and level of service. 3rd party logistics provider could be more than a pure carrier (like the 1st type of TPL) but a strategic ally (the 3rd type of TPL) with their ultimate goal of continuously enhancing logistics efficiency. The conditions to use it are the same as the ones for 3rd party warehousing.

2.5. Generic lessons learned from the commercial supply chain

Based on the specific coordination mechanisms listed above, we can extract some generic lessons learned from commercial supply chain. Here I would like to summarize three coordination approaches in general: resource sharing, joint decision making and outsourcing.

- For resource sharing, the resource mostly refers to information shared among supply chain members, like demand, orders, inventory information and POS data, etc. Like the joint procurement coordination mechanisms, information regarding supplier availability can be

exchanged among coordinating alliance to pick up the most appropriate supplier to do the business with.

- Joint decision making helps in resolving conflicts among supply chain members, in handling in case of any future potential uncertainty and in reducing costs. For example, JMI and CPFR are typical examples for joint decision making. For JMI, two parties collaboratively make the replenishment decisions which would decrease the inventory level. For CPFR, two or more parties jointly plan a number of promotional activities and work out synchronized forecasts, on the basis of which the production and replenishment processes are determined (Larsen et al., 2003). Take the CPFR as an example, some of the benefits of joint decision making are increased sales, higher service levels, faster order response time, lower product inventories, faster cycle times, reduced capacity requirements, improved forecast accuracy and lower system expenses (Arshinder et al., 2008).
- Outsourcing includes 3rd party warehousing and transportation-as the coordination mechanisms stated above. The prominent benefits to use this regime are to help companies focus on their main competence and get less distracted from the logistics functions.

Companies in supply chain can adopt any of these generic approaches or combination of them to initiate coordination. We can see the coordination mechanisms contain one or more than one of these generic approaches. The following table gives all the generic approaches used by all the coordination mechanisms.

Table 4: Relations between specific coordination mechanisms and generic approaches

	Resource sharing	Joint decision making	Outsourcing
JP	√	√	
QR	√		
CRP	√		
VMI	√		
JMI	√	√	
CPFR	√	√	
3rd party warehousing			√
3rd party transportation			√

Since we know from previous chapter, there are three levels of coordination orientation -strategic, tactical and operational (Miller, 2002). Here these three generic coordination approaches are defined on these three levels as well:

- On strategic coordination level, the resources shared among coordinating alliance could be information touch R&D plan or strategic planning or company’s capital investment planning for the coming years. If joint decision making reaches strategic level, the decisions made collaboratively would have a long term effect on companies and can also require trust or long term commitment from both sides. For example, if companies initiate CPFR, partners would need to develop their products together. This can lead to a profound coordination and require trust and long term commitment. For outsourcing, the strategic level of coordination refers to the third type of outsourcing that outsourcing company involve in designing the supply chain configuration for their clients. Since the establishment of strategic coordination will have a long lasting

influence on company and it may also take a while for company to find or foster a strategic partner. Consequently, strategic coordination doesn't encourage frequent switching of coordinating partners.

- On tactical level, the resource shared among coordinating alliance could be the information exchange between managers in the same function from different firms to achieve consistency or jointly developing inventory and production plans. Tactical oriented joint decisions can be made under the overall strategic consideration and aim to achieve a set of key operating targets (such as desired safety stocks level or reduction in lead times). The tactical coordination is the guidance for coordinating partners to operate business operationally. For outsourcing activity, the second type of outsourcing would be regarded as tactical coordination among alliance.
- Resources shared on operational level could be information regarding point of sales data for instance. Operational oriented decisions can be made in everyday operations within a company with the awareness of its strategic and tactical orientations. Operational coordination decisions can be identified in daily production, distribution or planning. The coordination in operational level is to coordinate each other to fulfill daily tasks. For example: the decision on making replenishment plan or some inbound operations, like transportation from suppliers or receiving inventory. The first type of outsourcing belongs to operational level orientations. Coordinating partners don't really evolve in each other's planning and can simply finish what the tasks are described.

2.6. Classification of coordination mechanisms

2.6.1. From actors perspective

At the beginning of this chapter, we have already clarified the coordinating relationships with either horizontal or vertical partners in supply chain. After broadly reviewing these practiced coordination mechanisms in commercial supply chain in this chapter, I am going to place these mechanisms in Figure 13 to help companies find the right trading partner to coordinate with using the right coordination mechanism. From Figure 13, we can see that a company can be connected with customers, suppliers, competitors or horizontal partners by using one of these coordination mechanisms. An interesting finding is except outsourcing and joint procurement, all the other coordination mechanisms fall in vertical category. This finding indicates the importance to address the attention on vertical coordination among supply chain players. We can see vendor managed inventory, joint managed inventory, continuous replenishment program, quick response, effective customer response and continuous, planning, forecasting & replenishment are the coordination mechanisms built between company and its suppliers. At the same time, coordination mechanism CPFR link a company with both its downstream customers and upstream suppliers into a coordinating alliance, manifesting that this coordination mechanisms are integrating supply chain in a large scale and it is close to general supply chain managerial value. A third party logistics provider can't fit into this model directly since a 3PL provider is an independent outsider who doesn't belong to either of these customers, suppliers, competitors nor horizontal partners categories. But this independent player becomes a part of this network after coordinating with a company and then TPL will link its client with suppliers using 3PL warehousing or connect its client with its customers using 3PL transportation.

Coordination mechanisms in the Commercial Chain

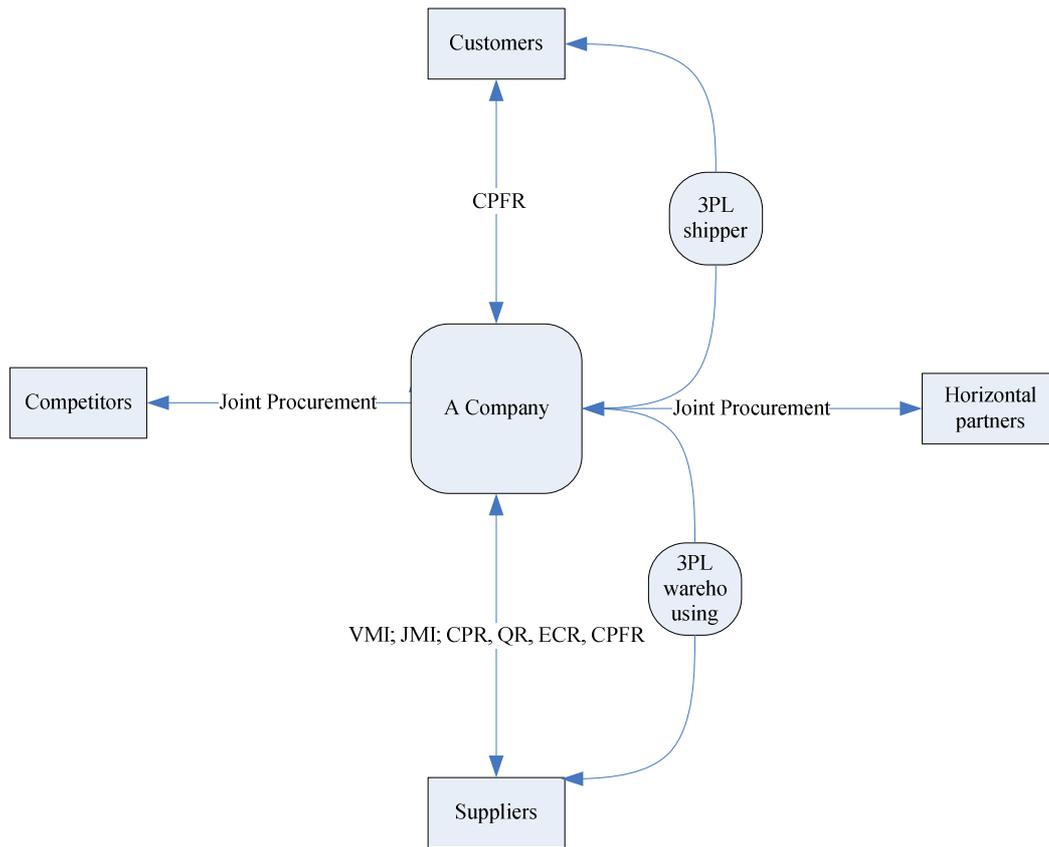
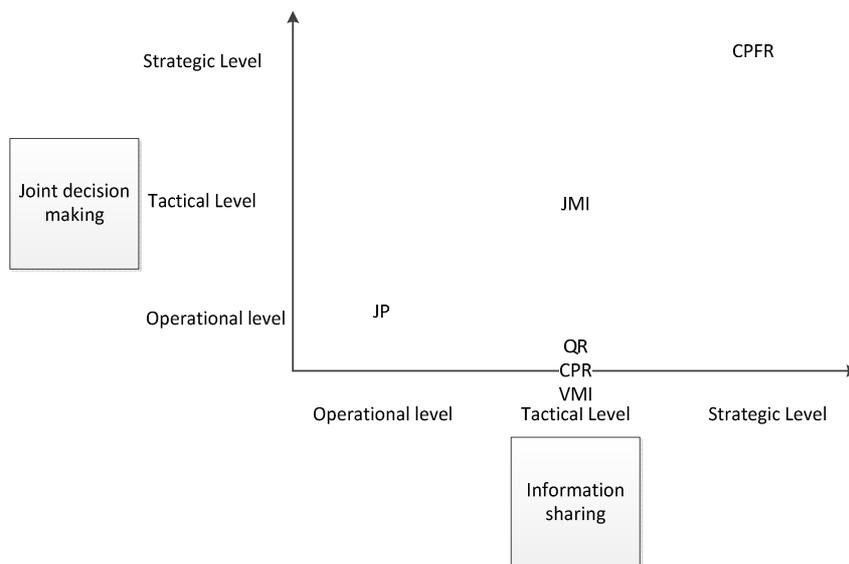


Figure 13: Classification of coordination mechanisms

2.6.2. From orientation perspective

In Figure 14, all the coordination mechanisms are put into the axis based on their orientation levels. From the figure we can see that the higher level of coordination orientation is, the more requirements the coordination mechanism has.



Coordination mechanisms in the Commercial Chain

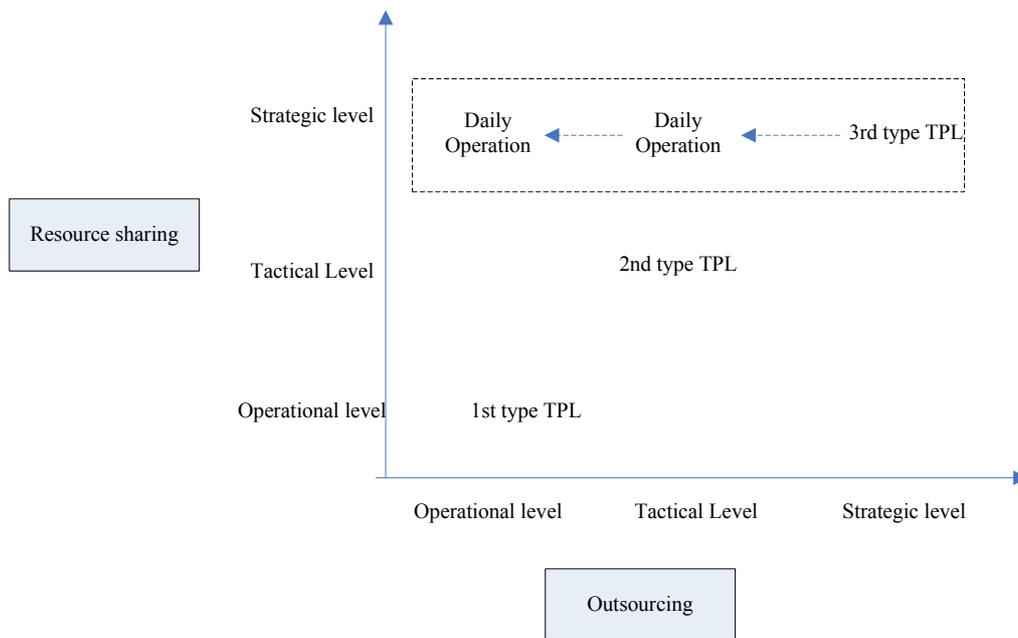


Figure 14: Coordination orientation

For example, CPFR reaches strategic level for both information sharing and joint decision making. From the above analysis, we know that the conditions to use CPFR are very challenging and require companies commit a lot, involving in-depth information sharing, high level of trust among alliance and even possible changes on their organizational structures. For Joint procurement, the resource sharing and joint decision making stay on operational levels since the information sharing and joint decision making is an ad hoc operational action without long time orientation. The coordination alliance dissolves after the procurement is done.

For 3rd part logistics, different types of TPL are placed in the axis based on different coordination orientations. For example, in 1st type of TPL, logistics provider may just simply conduct certain logistics functions without much engagement into supply chain design or long term planning. Therefore, the level of information shared and the extent of outsourcing activities stays on operational level. While, in the 3rd type of 3rd party logistics, the level of engagement from logistics provider reaches strategic planning or collaboration. Therefore, it positions in strategic outsourcing and resource sharing.

Overall, what the figure shows is the coordination orientation for each coordination mechanism. However, in real circumstances, the relations among alliances could be more complex. On one hand, companies may initiate different coordination mechanisms at operational level, on the other hand, these coordination mechanisms at operational level could be a reflection on the company's strategic or tactical planning, meaning that there could be a combination of coordination mechanisms exhibited at different levels. For example, like illustrated in dash line box in Figure 14, there could be a circumstance that two parties engage in TPL on a strategic level and from time to time, third party logistics providers are asked to perform some daily operations for its partner under their strategic or tactical agreement as well. Therefore, the coordination mechanisms adopted among alliance could be multiple and more complicated.

2.7. Conclusion

In this chapter, we listed the current practiced coordination mechanisms in commercial chain with their characteristics. In order to implement these coordination mechanisms, certain requirements have to be met. After reviewing all the coordination mechanisms and characteristics accordingly, there are some generic lessons learned from the commercial supply chain players, i.e. resource sharing, joint-decision making and outsourcing. When actors seek to coordinate with others, they can use one or more of the three general approaches or even go one step further to choose one of these coordination mechanisms specifically. Coordination orientations for these three general approaches were also classified into strategic, tactical and operational levels based on the depth of coordination. Later on, specific coordination mechanisms were put into the orientation axis based on the approach they use and depth of orientation they have. The higher coordination orientation gets, the more demanding for firms to adopt.

Until now, the specific practiced coordination mechanisms are discussed with their characteristics and using requirements. The more generic approaches that commercial suppliers adopt are also abstracted from specific coordination mechanisms. Comparing the specific coordination mechanisms, these more general lessons learned from commercial supply chain are more likely to be discovered in real cases. In the next chapter, I am going to analysis the influencing factors that set the relief chain apart from commercial chain and provide a foundation for experience transfer from the commercial world into the relief context.

3. Challenging factors in relief response

Both normal business supply chain and relief chain workflows are about delivering the right goods or service to the right target group of people at the right location and the right time. These basic ideas of logistics functions still remain the same in relief context. However, because of the complex aftermath setting, there are some factors which significantly distinguish the relief chain from the business supply chain. For example, the attention for logistics players isn't on cost or benefits anymore (Zheng, 2009; Wang, 2009); the focus is on rescuing lives and alleviating sufferings in a very tight time schedule. The players in supply chain field aren't manufacturers, suppliers, distributors or retailers anymore, most of the dominant actors in relief field are governmental organizations, military or non-governmental organizations, with various political agenda and interests. Plus, with the uncertainties of demand and supply information coupled with the complexity of operation conditions, all these factors together complicate the relief environment even more, challenging the effectiveness of supply chain arrangement and also the coordination among the stakeholders involved. In this chapter, I will explore the following areas: 1) identify the various factors set the relief chain apart from the commercial supply chain that complicate the relief response and 2) analyze their impacts on supply chain arrangement.

3.1. Urgency

In normal supply chains, the practitioners have the urge to respond to clients' needs accurately and quickly based on clients' requirements. The incentives to have this urge for business supply chain practitioners are higher level of customer's satisfaction which would yield more orders and profits for firms in the future. For humanitarian organizations in the relief chain however, what they deal with concerns life and death. Therefore, they tend to pursue immediate response which means the desire for humanitarian organizations is to deliver immediate supplies as soon as possible. For example, the time for Chinese national government to respond to the Wenchuan earthquake is only less than 2 hours. Earthquake happened at 14: 28 and Prime Minister Wen already arrived at Sichuan province at 15:50 to deploy the relief work.

-Influence on the relief chain

Firstly, the feature of urgency influences the relief chain on procurement process.

For the government organizations under the normal operation circumstances, they need to initiate procurement through public bidding, which allows buyers to pick up the most appropriate supplier in an open and fairly competitive manner. However, this public bidding approach to screen the final supplier is a time consuming process. According to the Chinese government purchase regulations, 20 days is the minimum period for public bidding which is too long for relief responders to wait. The Chinese government purchase regulations also clarifies that the emergency purchases made under major natural disasters or other force majeure don't need to follow normal purchasing procedures. In China, not only the government that serves as the main force in aftermath relief needed to undertake the emergency purchase mission, but some big non-governmental organizations like China Charity or Red Cross Society of China also need to participate in large amount of purchase activities as well due to huge amount of donations these big NGOs received. So when it comes to emergency procurement, these non-governmental organizations also refer to governmental purchase regulations. However, the official regulation guiding emergency purchase hasn't carried out yet in China. Currently, Chinese

humanitarian organizations are exploring their own way to accomplish emergency purchase in a more simplified and open way. For example, after the Wenchuan earthquake, Ministry of Finance carried out a temporary emergency purchase regulation for this catastrophe which specifies the following rule: during the Wenchuan earthquake response, recovery and re-construction, purchasing activities related to victim relief, rehabilitation, epidemic prevention or temporary aid can be regarded as emergency purchasing projects. So relief organizations can initiate purchasing activities directly from single or multiple suppliers without following normal procurement procedures.

Secondly, the urgency characteristics influence the inventory process in the relief chain. Since people don't know the exact time the disaster strikes and as long as it happens, the immediate supplies need to be guaranteed. Hence, emergency resources are pre-stored on strategic positions. In China, there are 10 central warehouses strategically located with the most common needed commodities in them, like blanket, drinking water and shelters. In contrast to commercial supply chain in which players pursue low inventory, the relief chain need to maintain certain level of storage all years long in case of emergency.

Thirdly, the urgency characteristic affects relief supply on transportation as well. In a disaster relief situation, responders need to figure out the fastest transport means to finish the delivery with much less consideration on the cost wise comparing to the commercial supply chain. For example, the second day after the Wenchuan earthquake, the Chinese government deployed 34 helicopters, which constantly flew 79 times and delivered 11,420 soldiers to Sichuan province to conduct aftermath relief, setting a new record with the most frequent delivery in one day's time in Chinese air force history (News from Xinhua net, 2008). The decision about delivering materials by helicopters wouldn't be economically wise in a commercial supply chain, but it was highly needed in relief context.

3.2. Uncertainty

There are various sources of uncertainties in a disaster relief environment. Some of them originate from the inherited characteristics of disasters; others can result from response arrangement, configuration of supply chain or the general political atmosphere. Here I am going to identify the uncertainties from the scope of the disaster, demand, supply and policy aspects to illustrate how these uncertainties affect disaster response and the relief chain arrangement.

3.2.1. Scope of natural disasters

For natural disasters, especially sudden onset ones, it is difficult for responders to know the type of disasters, the magnitude, the impacted areas, the impacted population, as well as the time they strike. Because of these uncertainties, the size of impacted areas, the number of people injured or the possibility of second disaster are also hard to predict beforehand. These inherited uncertainties from the scope of natural disasters that have different impacts on relief response. A disaster happens in mountainous areas at night time would have more severe consequences than it happens at flat lands in day time given other conditions are the same. For example, the 1976 Tangshan earthquake in China happened at night is partially the reason why so many people died (News.cn, 2008) and one reason why the relief task for the Wenchuan earthquake was so challenging is because the mountain and gorge landscape in impacted areas made relief delivery difficult. Disaster happens in poor rural areas is also not comparable to the same thing happens in a rich city due to accessibility of infrastructure and vulnerability of victims.

Not only the scope of natural disaster, but also the weather conditions after disaster strikes sometimes will create difficulties for the responders (Thevenaz, Resodihardjo, 2010). For example, if the roads to reach victims have been destroyed and if a heavy storm does not allow helicopter landing, then the emergency responders will not have the means to convey assistance to the victims. Like during the Wenchuan earthquake, most of the impacted disaster areas had rainy weather which resulted in flash flood, hampering the relief work even more.

-Influence on the relief chain

The high uncertainty of disaster scope challenges responders to conduct relief tasks almost in every aspect: demand estimation, resources supply, warehousing management or transportation. For example, the type of disasters determines the type of resources needed; the magnitude and the population in impacted areas affect the amount of resources require; the location of disasters determines the relief transportation network arrangement; the landscape influences the difficulty of relief operations. Despite the uncertainties caused by both the disaster scope and the weather conditions, these are external factors which can't be controlled by responders and they result in other uncertainties and complicate the overall relief environment. Demand uncertainty is one of the uncertainties caused by and the instinctive scope of natural disasters, which is going to be elaborated in the following content.

3.2.2. Demand uncertainty

The demand information from victims could contain resources type, amount and structure. The types of emergency materials are determined by the scope of natural disasters. The amount of demand is determined by number of people injured, which is also determined by the scope of disaster event, like magnitude of disaster for instance. The structure of demand refers to the ratio of different types of resources allocated in delivery package. For example, the aids should not only consider the amount of medication prepared but also the medical facilities come with the medicine to complete a set. The demand structure is at the same time affected by dynamics evolvement of disasters since different emergency portfolio is needed on different stages of relief (Sheu, 2009). Therefore, all the three demand parameters: demand type, amount and structure are influenced by scope of natural disasters which like stated above is in high uncertainty. Consequently, the emergency demand is irregular and stochastic as well.

-Influence on the relief chain

Unlike commercial supply chains, accurate demand information can be collected on point of sales by retailers and can be shared among other supplier traders, the responders in relief context on the other hand can't make accurate estimation or prediction of commodities demand due to instinct high uncertainty in relief demand and damaged infrastructure. Hence, demand uncertainty significantly affects resource collection and preparation. Especially in an early stage of relief work, when demand information is all unclear and communication with victims is not feasible, responders have to "push" supplies to disaster location based on assumptions. Only in later stages of relief operation can more accurate data on the needs of disaster victims is assembled, till then responders are able to change "push" suppliers into more "pull" approach (Long and Wood, 1995). The quantity uncertainty sometimes can be amplified by distance since office coordinating the aid mission sometimes far away from disaster site and they have to make assumptions on the quantities of aid (Long and Wood, 1995).

3.2.3. Supply uncertainty

For the business supply chain, the chosen suppliers and receivers can predetermine lead time, delivery type, quantity and quality based on the contract. The relief chain on the other hand, has much more supply channels and the supply sources are also more stochastic and random, including pre-storage, in-house donors, commercial manufacturing suppliers and international donations etc.

The variety of supply channels result in a big uncertainty on the quantity, quality and suitability of emergency materials. Researches show that aid agencies receive many unsolicited and sometimes even unwanted donations (Chomolier et al., 2003). These can include drugs and foods that are past their expiry dates (Murray, 2005); laptops need electricity but infrastructure has been destroyed; heavy clothing those are not suitable for tropical regions (Dignan, 2005). Therefore, as a humanitarian organization, it is pretty hard to predict what, how much, from where emergency resources will be coming to fill in the warehouses without any notice beforehand.

-Influence on the relief chain

Variability in quantity, quality, and suitability burdens the process of sorting, storing, and distribution (Rodman, 2004). Unsolicited supply contributes in largely on variability and uncertainties of emergency supply since the type, amount or quality of resources are all unknown before they arrive. Unsolicited supply sometimes can help responders to bridge the gap between massive demand and limited supply. In other cases however, unsolicited supply create additional burden for supply chain response and distracts personnel's efforts and attention. Contending with unsolicited donations is challenging in any disaster (Wachtendorf et al., 2010). Some relief chain practitioners even refer unsolicited supply as a second disaster (Wachtendorf et al., 2010).

First of all, the unsolicited supply imposes an overwhelming workload on warehouse management since personnel or limited resources are sacrificed to sort out and store these unsolicited supplies, such as the need to sort perishable and low priority goods from high priority items or store unneeded supplies in limited warehouse space (Wachtendorf et al., 2010; Balcik et al., 2010). For example, during the Wenchuan earthquake relief, the relief logistician experienced the problems of dealing with pressure from unsolicited supply on their warehouses. According to field practitioners, large quantities of unsolicited foreign medicines and supplies accumulated in the airport warehouses (donated primarily by organizations without a physical presence in Sichuan), where the provincial health bureau needed to appoint pharmacology students to sort, translate and test these donations before they could be distributed to victims.

Secondly, the unsolicited supplies flood into the busy aftermath transportation flow, which could cause further blockage. We know that the infrastructure in a disaster aftermath is fragile, which is hard for the infrastructure to afford additional volume of vehicles with unsuitable suppliers to crash into impacted areas. These vehicles with unsolicited supplies may further worsen the traffic condition by blocking the victims' life lines to disaster sites.

The uncertainty of supply not only comes from unsolicited supply, even solicited supplies arrive in unmanageable forms could set up difficulties and uncertainties for humanitarian organizations to deal with (Kovacs and Spens, 2007). For example, humanitarian organizations or individual donors involved in the aftermath relief send their emergency materials with labels in a variety of forms or even languages. The lack of standard labeling of supplies is also one of the biggest problems of distributing

aid at sites (Murray, 2005). During the Wenchuan earthquake, a well-known local NGO, Yi Foundation said that they were suffering from wrong labels of supplies all the time. It always appeared the resources turned out not to be the thing it was labeled on the containers. The personnel needed to check what was really packed inside before resources could be distributed.

From the analysis above, we can see that the supply in the relief chain is in high uncertainty in terms of quantity and quality, making the warehouse management challenging and also putting pressure on aftermath transportation.

3.2.4. Policy uncertainty

A compounding feature of many contemporary disasters is their increasingly politicized nature (Boin et al., 2005). Disaster management is more than the coping capacity of governmental institutions and public policies; it should be considered a deeply controversial and intensely political activity ('t Hart, 1993). If the government as the main dominant humanitarian organization failed to respond to disasters, their legitimacy would be challenged which may cause successive incidents due to the change of political arena.

-Influence on the relief chain

In order to better respond to disasters, the government as the main relief actor in a disaster relief carries out policies to regulate the “relief market”, which would have significant impacts on other humanitarian organizations. Let us take the Wenchuan earthquake as an example; the state council purposed the principle of “The Government dominant and society participate” in the *Wenchuan earthquake recovery and reconstruction Act* which encouraged coordination among governmental agencies, humanitarian organizations and public. In this coordination-friendly atmosphere, the government also tolerated the fact that lots of non-government organizations were actively operating their relief supply without legally registering at the local regions. In other words, the government didn't intervene too much on the illegal existence of these non-governmental organizations. Because of the government's “permit in silence”, so many non-government organizations could emerge in the Wenchuan aftermath relief and played an important role in material supply. This policy regarding the whole society participation built up a favorable environment for other humanitarian organizations to engage in the relief response.

However, the policy from governmental agencies can also restrict humanitarian organizations' activities in order to achieve over efficiency. After the earthquake, within certain areas of Sichuan impacted areas, local government only allowed the vehicles with appointed certificate from official governmental agencies entering the impacted zones, vehicles from non-governmental organizations was forbade entering. Additionally, the movement of people was strictly regulated in the affected areas as well. For months after disaster stuck during disaster response and recovery phases, the police and military put down roadblocks to prevent non-essential personnel from entering the disaster zones (Hoyer, 2009). Right after this policy was carried out, some of NGOs weren't aware of this implementation so they still sent trucks to impacted areas which had to stop at the tollgate, resulting in traffic congestion.

Since the uncertainty of authoritarian measures, which are only known after a disaster, significantly influence humanitarian organizations activities. Therefore humanitarian organizations need to adjust themselves in line with these regulations in order to conduct their relief response legally.

3.3. Complexity of operation conditions

The inherited characteristics of disasters like urgency or uncertainties make the relief environment unpredictable, the following operating related factors complex the system even more, making disaster response more difficult to manage.

3.3.1. Damaged infrastructure

After a major disaster, transportation infrastructure is often in poor conditions and cannot handle the huge numbers of refugees, military vehicles, and relief shipments that pour into these areas (Gooley, 1999). Not only the transportation infrastructure, like roads, bridges or railways, but other critical infrastructures such as electricity, water, and communication systems can also be disrupted, and then it becomes hard to satisfy basic needs. Like the 2008 snow storm in China, the catastrophe totally shut down the railway between Beijing and Guangzhou, Shanghai and Kunming; disrupt nearly 20 000 kilometers highway and 220000 kilometers regular roads. 14 airports had to close resulting in lots of air lines were delayed or cancelled. At the same time, the continuously lasting low temperature and snow resulted in electricity network disrupted. The power distribution and transmission were badly affected in 13 provinces, the electricity supply was completely cut down in 170 cities (towns), 36700 circuits and 2018 transformer substation stopped operating. We can see from this example, the impacted areas could be isolated from “outside world” due to the dysfunctional of the transportation and communication systems and the basic life needs can’t be met due to the disrupted of critical infrastructures.

If the damaged infrastructures are humanitarian organizations’ bases, like warehouse with emergency resources storage, then the humanitarian organizations and staffs are themselves being victims. The relief capacity thus will be overwhelmed due to inadequate resources or personnel. The relief tasks are twofold in this situation: they need to recovery from the disaster themselves first and then conduct the relief jobs to provide aids to others.

-Influence on the relief chain

First of all, the malfunction of transportation system hampers just in time aid delivery. If an area is isolated due to a catastrophe, the roads could be completely shut down so that responders and emergency material can’t get into the impacted regions which will significantly delay the lead time. For example, 4 days after the Wenchuan earthquake, the damaged infrastructures in the most severe impacted areas only started to recovery, the most critical and nearest road from distribution center Chengdu to the epicenter of Wenchuan was however still not re-connected and governmental responders had to choose a very detour route to deliver key materials through road transportation. The distance from Chengdu and Wenchuan is 100 kilometers which turned to 800 kilometers after the disaster due to the road damage. After 800 kilometers driving, 44 trucks with 255 tons of tents, food, drinking water and medicines were delivered to Wenchuan, which was the first bunch of emergency supply delivered to Wenchuan by road after the earthquake happened 4 days. (News Release Conference, 05, 16, 2008).

Even if the infrastructure is not completely shut down or the sites aren’t totally isolated and infrastructure is accessible to some extent, the partially damaged infrastructure still very much hampers the aid delivery efficiency and may result in new problems. For example, after Hurricane Katrina, damage to local roads and bridges forced drivers constantly change their route. The detour

Challenging factors in relief response

way made it difficult for truck drivers who weren't familiar with New Orleans got really confused about directions. As a result, many drivers got lost and put deliveries at stand during immediate response. (Tricia Wachtendorf et al., 2010). These trucks further blocked the roads to impacted zones, making the bad transportation conditions even worse.

Not only the disrupted transportation infrastructure hampers aid delivery, but also the damage of telecommunication would significantly decrease the relief efficiency due to the unknown or inaccurate information from impacted areas. Teams at a disaster site may not be able to communicate with headquarters or donors to transfer the exact emergency demand. Lack of communication among different humanitarian organizations can also cause duplicated workload or overlooked jobs. For example, at 14:28 12th of May 2008, the time when the Wenchuan earthquake happened, the communication system was completely shut down because of the damage on optical cable, communication base station, holding poles or other communication infrastructures. Impacted disaster areas couldn't be able to contact people outside and responders couldn't get to know what happened inside, putting the whole deployment work in the headquarters to a halt. It took communication operators 150 hours to recovery communication for all impacted cities and towns after the earthquake.

Therefore, facing the infrastructure damage in major disasters, the immediate challenges for humanitarian organizations are always twofold: repair or reconnect basic infrastructure (such as roads, telecommunication infrastructures and power station) and provide aid under disaster-imposed hurdles.

3.3.2. Lack of own professional staffs and high staff turnover

Well trained volunteers working on the relief field are always in short supply (Van Wassenhove, 2006; A.S. Tomas, 2005). Fitz institute conducted a field survey on approximately 300 humanitarian organizations with the purpose of investigating the training in humanitarian organizations and the logistics functions the trainings encompassed. Over 90% of respondents in the survey indicated that the training was directly linked to performance on disaster filed, however only 73% had access to logistics training while 27% had no access. For those with access, training was most often provided by co-workers on whom the content largely dependent. The respondents indicated frustration with lack of consistency in training or lack of specific training in logistics aspect. Since there is a lack of professional staffs and training, unqualified staffs are not able to undertake relief tasks, resulting in a high turnover on one hand. On the other hand, even the well trained staffs are available, most of them are engaging in volunteer work who can only work for short periods before returning back to their regular jobs. What is more, the unpredictable nature of disasters makes it difficult to retain employees due to high emotional and physical demands on them. In fact, organizations may experience as high as 80% annual turnover in field logistics personnel (Thomas, 2003).

During the Wenchuan earthquake relief, the lack of volunteers with professional skills was a very prominent problem in aftermath relief. Officials from governmental agencies stated that volunteers indeed helped a lot during recovery and response; however, they were also trouble makers sometimes due to lack in response knowledge.

-Influence on the relief chain

High turnover rate left one very direct consequence on the relief chain management, i.e. it is hard to transfer experience to the future generations. Lack of experience transfer not only stems from high

turnover, but also from the urgency feature of disaster response since responders are always in very tight schedule. Right after accomplishing one task, responders usually don't have time to review, they normally just rush into next task, or they leave. Because of this high turnover and urgency of a disaster response, the lessons learned from one disaster to another are often missing so that it is even harder to transfer the experience from one field to another.

3.3.3. Media's framing effect

The media can be a very important source to encourage public support and provision of suppliers (Wachtendorf et al., 2010). Governmental officials can make use of media to convey the message about what are appropriated materials to donate and to where. Unlike humanitarian organizations, gathering information is the primary job for media so that media may even get access to more updated information than humanitarian organizations (Wachtendorf et al., 2010). At the same time, media can affect the amount of funds that humanitarian organizations collect since the amount of donations is determined by organization's reputation and visibility, coverage and acknowledgement by the public. Therefore humanitarian organizations would like to attract more attention from media to enhance their mobilization outreach.

-Influence on the relief chain

By attracting massive attention from public, media can influence the material flow by spreading demand information away. Because of the information from media, donors can know the updated demand information from impacted areas and delivery their donations to the people in need.

However, given the fact media doesn't really sort out the information systematically or media simply doesn't have comprehensive information(Wachtendorf et al., 2010) to play the role as the general" information coordinator", the information media gives could have a limited perspective. According to the past disaster relief experience from Karina or Chinese Wenchuan earthquake (Wachtendorf et al.,2010), the media sometimes put their focus on the hotspot, in this context, the most damaged or impacted areas, which means it serves as a critical force that pushes donated supply to particular areas at the exclusion of other (Wachtendorf et al., 2010). Because of constant attention from public on specific impacted regions, the public donations would flood into these "hotspot", which could ease the burden of inadequate supply but after some time, when the amount of supply is abundant if the media's framing effect still push the donations to the severe areas, those areas would be over supplied, like the problem unsolicited supply brings in, the suppliers to hotspot areas may be overdone and cause warehousing or transportation problems. At the same time, the other less impacted regions which don't attract that much of attention from media would suffer from lacking of emergency material since the overall suppliers from responders are limited after all.

Figure 15 the causal loop diagram illustrates how the framing effect from media changes the emergency resources flow. The more severe the area gets affected by the catastrophe, the more attention they attract from the media in the first place and therefore more emergency deliveries are sent to the impacted areas. Consequently, the more news will appear to report these relief efforts, which in turn strengthens the positive feedback loop. Since the overall supplies are limited, less severe areas would put up with the framing effect the media brings to them and might suffer from resources shortage.

Challenging factors in relief response

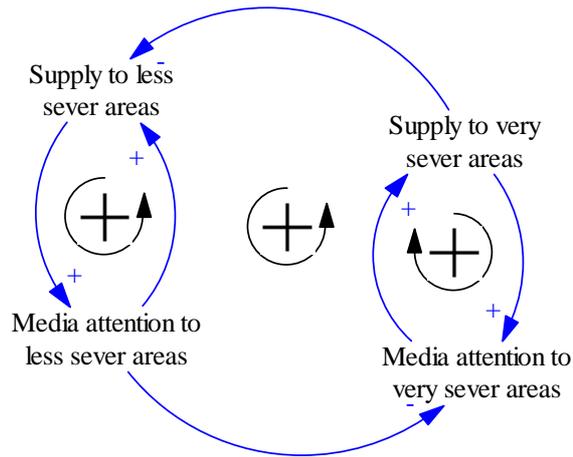


Figure 15: Media's framing effect on severe and less severe areas

3.4. Co-existence of Various Actors

From the background information of the Chinese relief context, we know the various actors co-existing in Chinese relief response field. The actors are governmental agencies (including the national government and the regional government), militaries, non-governmental organizations, media, private sectors, and public donors. Figure 16 illustrates the physical flows, financial flows as well as information flows among all the actors. First of all, media spread disaster information to all the actors in relief environment; after getting the information, public donors provide funds support for humanitarian organizations; Secondly, as emergency suppliers, according to emergency orders, private sectors supply the emergency resources to humanitarian organizations, including the government and non-governmental organizations; Thirdly, the humanitarian organizations start to delivery emergency supply to victims. The government is the most important actor, which can commands military and armed policy to conduct this task.

Different stakeholders illustrated above are instrumental to an effective response. They are largely independent, with many having their own funding channels or supply chain arrangement. Therefore, the co-existence of various actors has a profound influence on the relief chain.

Challenging factors in relief response

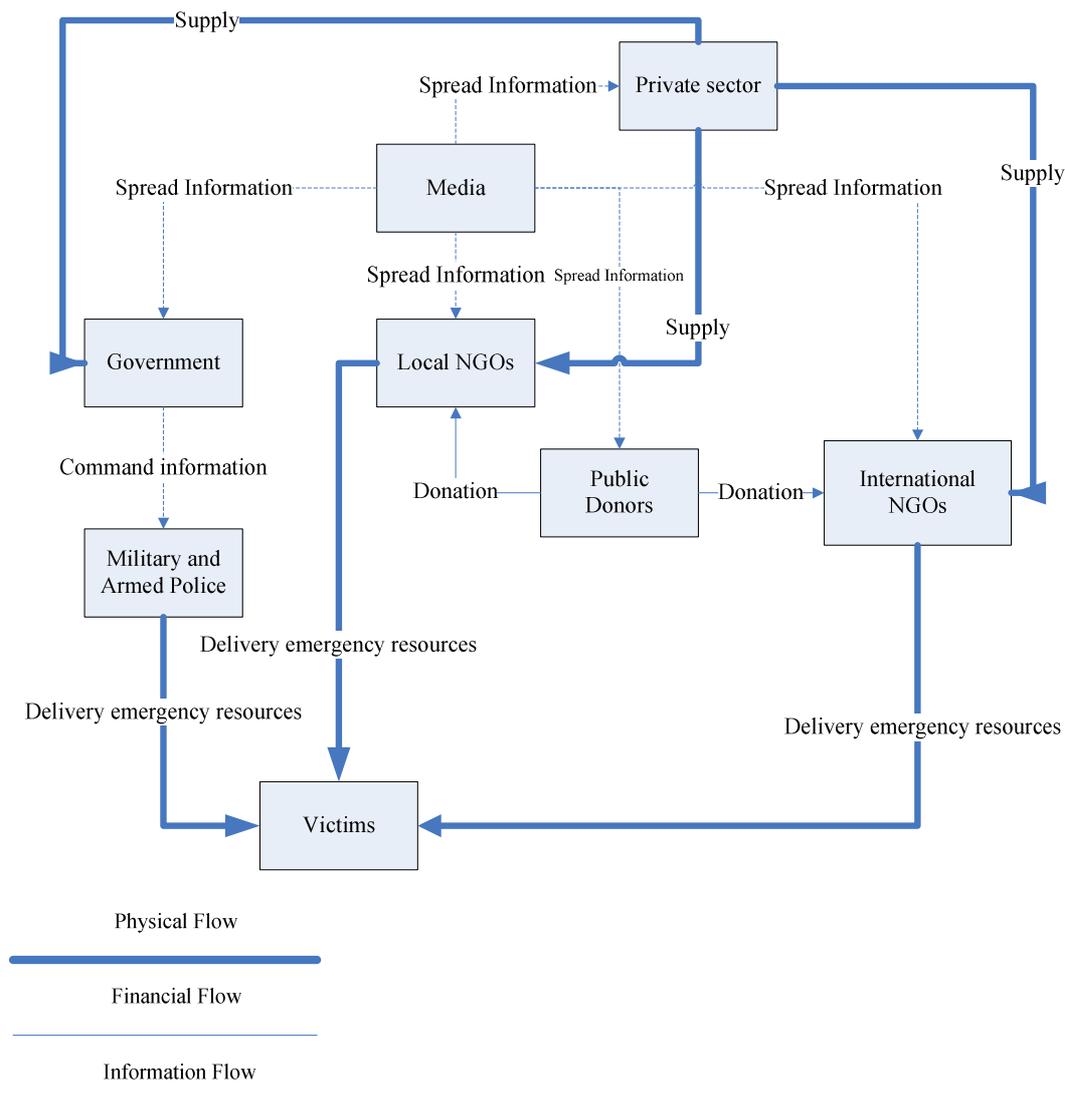


Figure 16: Information, financial and physical flows among actor

-Influence on the relief chain

- Non-traditional actor –private sector involvement

Besides the traditional humanitarian actors in the relief field, there is a new actor-private sector also involved in relief responses. Research shows that the business sector engagement in humanitarian relief has expanded in scope and size in recent years (Binder and Witte, 2007). The motivations for private sector to engage in the aftermath relief may vary, such as profit, corporate social responsibility, build up reputation, staff motivation (Binder and Witte, 2007). The roles that private sector can undertake are multiple. First of all, private sectors with key emergency resources manufacturing line could be the commercial suppliers for humanitarian organizations; In humanitarian supply chain, suppliers situated close to operational site are frequently preferred (Blecken, 2009). Secondly, at a time when companies are under pressure to demonstrate their corporate social responsibility (CSR) and are no longer concerned solely with increasing profits (Carroll, 1979;

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Lichtenstein et al., 2004; Lindgreen, et al., 2008; Luo and Bhattacharya, 2006; Maignan et al., 1999), they are becoming a crucial source of public donations in terms of materialized commodities; Thirdly, more than just a donor providing tangible emergency materials, private sectors could be a partner who coordinate with other humanitarian organizations by providing expertise, technology, and infrastructure. For instance, the most prominent example is the coordination between international shipping company TNT and World Food Program (WFP).

The orientations of involvement consist of two in general, commercial oriented or non-commercial orientated. Some of the firms fall in the first category regard the disaster aftermath as a “market” and engage in this market by providing services that is not provided by non-profit actors and filling gaps where these traditional actors lack expertise – for instance in the procurement and transportation of relief supplies such as machinery, electrical appliances or information technology products (Binder and Witte, 2007). WFP, for example, has long contract with logistic firms to move relief goods from one place to another (Binder and Witte, 2007). Some firms engage in non-profit activities in disaster aftermath, driven by a desire to build a positive brand, staff motivation, an attempt to gather business intelligence, or a desire to ‘do good’ to society (Binder and Witte, 2007).

Private sectors’ core competence in specific fields related to disaster relief, like logistics, construction or IT, could provide more appropriate help on traditional humanitarian organizations with more long term effect than simply provide financial support (Rieth, 2004).

- **Overlap or insufficient efforts**

From the above actor analysis, we can see that if actors behave in a coordinative manner, then these differences among humanitarian organizations theoretically should point to the concept of complementarity, which means that humanitarian organizations should use different modes of actions or techniques in fulfilling their responsibilities to provide assistance (Blecken, 2009). They should support or/and complement existing the government services in terms of structure, design and long-term sustainability (The Sphere Project, 2004). However, without coordination this complementary system can’t be built up. The differences in geographical, background and organizational policies for humanitarian organizations create additional barriers for them to work in a coordinating manner (Van Wassenhove, 2006). Relief tasks could be duplicated or some impacted areas were not well covered. In China, the government is responsible for the conduct of disaster relief operations and other actors are obliged to abide by the laws and regulations from the government. Unfortunately, the government may not be able to organize appropriate coordination initiatives when the effects of disasters are overwhelming. In situations in which the government is either non-functional or dysfunctional, the roles of relief actors are often unclear (Seaman, 1999). During the Wenchuan earthquake, the government responded to the disaster in a very effective manner and relief efforts were well coordinated by the government. As the most critical resources from the government, the army participated actively and extensively in operations. The strength and leadership of the government therefore had a deep impact on relief operations in China.

- **Competition of resources**

The resources that various humanitarian organizations compete can encompass material resources, like public donations, or critical facilities, like limited space on road, or media’s attention. The competition on funding is especially true during the early stage of relief response, during which there is intense global attention and funding levels are high (Stephenson and Schnitzer, 2006). Not only the financial channel is competed in relief environment, but other critical resources are competed among

humanitarian organizations as well. For example, after 2004 South East Asia Earthquake and Tsunami, in Indonesia, organizations competed on vehicle purchases. The vehicle on the market was emptied after the disaster happened and some organizations have to import vehicles from abroad to launch their emergency supply (Russell, 2005). In China, the competition among humanitarian organizations on infrastructures also happened in past relief events. During the 2010Yushu earthquake for instance, since governmental agencies together with local NGOs and volunteers all rush into impacted areas with emergency resources filled with their trucks, resulting in 50 kilometers huge traffic congestions on the critical route to disaster areas. The traffic conditions only got better after 3 days of strict traffic control. Apart from tangible resources, like funds or infrastructure, humanitarian organizations also compete for media's attention to leverage exposure to increases amount of donation.

3.5. Time to cope with these factors

The above factors discussed are all triggered by certain disaster events and can be dealt with during response phase after a disaster strikes. However, they can be already coped with even before disaster incident during the preparation phase (Harrald, 2006). For example, regardless of urgency characteristic, uncertainties on scope of disasters or uncertainties in supplies, humanitarian organizations could still pre-store emergency materials which are generic required by different kinds of disasters (like food, water or medications) at strategic locations. Through this way, humanitarian organizations could immediately respond to the demand in case of disasters. Therefore, pre-storage is a measure to mitigate some of the challenging factors, like "scope uncertainty", "supply uncertainty" or "urgency". The consideration for taking measures before a disaster strikes is quite strategic in the sense of long-time effort investing (Askari and Putnam, 2007).For example, if humanitarian organizations would like to deal with the challenging factor of professional staff shortage, they could initiate trainings within organizations or even seek to work with professional logistics companies to solve their problems. These kinds of arrangements require long term oriented commitment. Therefore, I would argue the actions taken before the disaster in order to tackle these challenging factors have reached a strategic level of operation. The Figure 17 illustrates the operation orientation against time line.

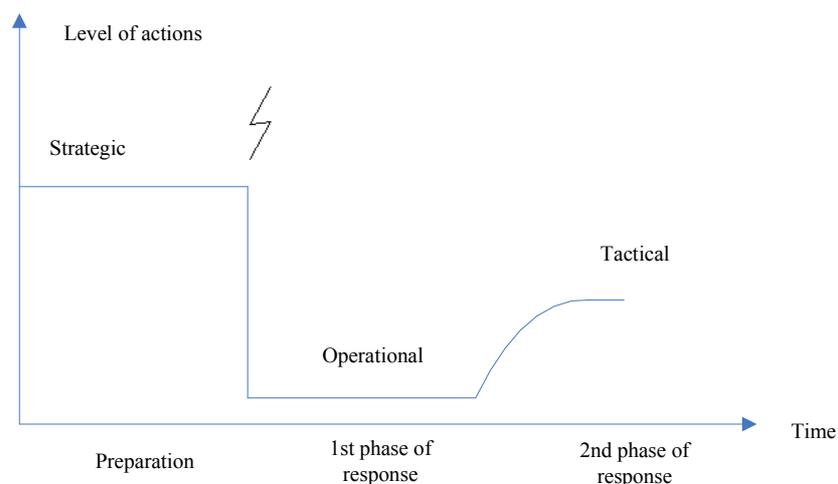


Figure 17: The level that relief action taken to tackle challenging factors against time_1

Challenging factors in relief response

Once a disaster strikes, it leaves the world in chaos. During the very first period of response phase, the situation after a catastrophe could be filled with uncertainties and overloaded tasks (Thomas and Kopczak, 2005). Given the fact that humanitarian organizations wouldn't be able to gain access to sufficient information during the immediate response period, some actions on operational level would rather be taken, such as, delivering the pre-stored materials to the victims or collecting demand information on the impacted sites. While time passes by and more information comes in, meanwhile, humanitarian organizations also started to learn from its own operations. When the recovery enters the 2nd phase, some actions on tactical level could be in place to cope with these challenging factors.

For example, at the very first period of disaster response, the government may regulate the aftermath participation by prohibiting the entrance into the impacted zone, which places policy uncertainty on other humanitarian organizations, who might fail to delivery the emergency resources to victims at the very first period of response. Later on, these non-governmental organizations might discovery that building up coordinating relations with authorities is a measure to tackle this challenging factor. The actions taken at later stage of response by humanitarian organizations could reach tactical or even strategic level due to better understanding on the situation and more available information. Figure 17 shows the evolvement of actions relief organization could take.

Meanwhile, there are also some factors which can't be dealt with before disaster strikes, like demand uncertainty, damaged infrastructure or media's framing effect. The moment a disaster strikes, these factors come in. After some time, relief organizations would also learn from their own experience and start to seek more tactical or even strategic measures to deal with these factors as well. For instance, in order to deal with demand uncertainty, at first they could send staffs to investigate demand information at impacted areas to give firsthand information (Operational level). Afterwards, organizations start to share this information among each other to shorten the response time and increase the relief efficiency. Figure 18 shows the timing and level of operation for relief organizations to deal with "demand uncertainty, damaged infrastructure or media's framing effect".

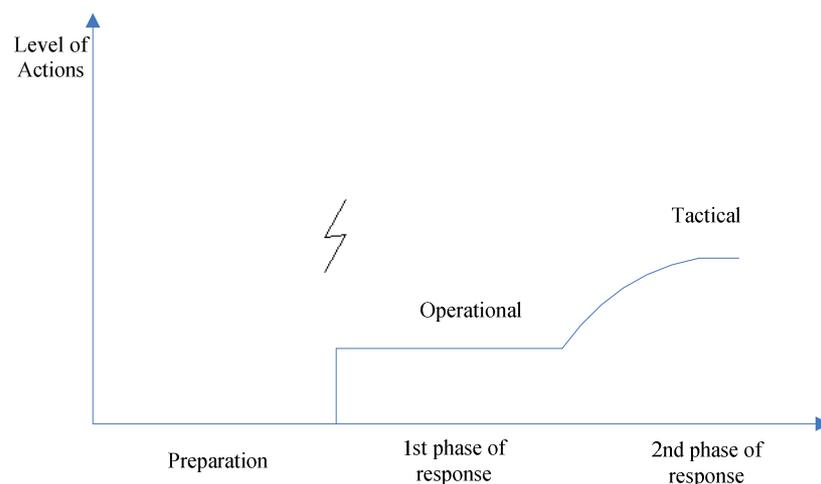


Figure 18: The level that relief action taken to tackle challenging factors against time_2

3.6. Conclusion

Until now, we have talked about the factors that complicate the relief response and set apart the relief chain from the commercial chain. **Error! Not a valid bookmark self-reference.** gives an overview of these factors and their impacts on the relief chain.

Table 5: The impact of influential factors in the relief chain

Factors affect the relief chain		Impact on the relief chain	Time to cope with
Urgency		Emergency procurement, pre-storage, quick delivery	Preparation/Response
Uncertainty	Scope of natural disasters	Unpredicted demand	Preparation/Response
	Demand uncertainty	Inaccurate demand estimation and inaccurate supply	Response
	Supply uncertainty	Warehousing problems, transportation congestion	Preparation/Response
	Policy uncertainty	Encouragement or restriction on relief operations	Preparation/Response
Complex working conditions	Damaged infrastructure	Lead time delay, communication hampered	Response
	Lack of own professional staffs high turnover	Lack of experience transfer	Preparation/Response
	Media's framing effect	Over supply or inadequate supply	Response
Different actors		Competition on resources, overlap or insufficient efforts	Preparation/Response

The first factor we take into account which differentiates the relief chain from supply chain is the need for urgency when a disaster strikes. The impact of this factor on the relief chain can be seen from all the relief chain processes: procurement, warehousing and transportation. Due to the great urgency, all the three processes need to be adjusted accordingly, like initiating emergency purchases, placing strategic pre-storage or accommodating transport means to deliver supplies as fast as possible. In order to cope with this urgency factor, actors can take actions in preparation phase already, such as pre-storing the emergency resources in a strategic location. After a disaster happens, actors need to constantly fight for this sense of urgency by launching emergency purchase or delivery emergency supplies quickly.

The second factor which challenges the aftermath relief is that uncertainty arises when natural disasters strike, affecting the status quo. The unknown scope of natural disaster results in unpredictable demand patterns, which sets up difficulties in estimating accurate demand information, consequently resulting in inaccurate supply. Furthermore, unsolicited supply increases the uncertainty of supply, contributing in both warehousing issues as well as transporting bottlenecks. The overall policy regulation is another source of uncertainty which will either encourage or hamper individual humanitarian organizations' relief operations. Regarding the timing for actors to deal with these uncertainties in the relief chain, most of the uncertainties can be alleviated to some extent during the

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preparation phase. For instance, although the location, magnitude of the disaster and the amount of supplies are unknown beforehand, humanitarian organizations can always keep emergency resources pre-stored just in case of emergency. Although the policy regulation is unknown as well, humanitarian organizations can try to build up connections with the governmental agencies. Becoming an alliance of the government can help them lower policy uncertainties in relief operations. Demand uncertainty however, is the factor that can be only known after disaster strikes and can't be mitigated before it rises.

The third factor is the complexity of operation conditions, encompassing mainly three factors, damaged infrastructure, lack of professional staffs & high staff turnover and media's framing effect. These factors focus on the influential elements from operational condition's aspect. Damaged infrastructure will delay responders' lead time and also set up the barriers for communication. Lack of professional staffs and high staff turnover is the typical challenge that humanitarian organization always face, making it hard to transfer valuable experience from past to future. Media, as the very critical information distributor, can also maneuver the physical flow of emergency resources by putting its spotlight on particular impacted areas by exclusion of others, resulting in an oversupply for certain areas and inadequate supply for the others. One factor in this category that can be dealt with in preparation phase is the lack of professional staffs and high staff turnover. Humanitarian organizations can provide trainings to their staffs on emergency logistics issues or they can also seek coordination before disasters with professional logistics companies to take advantage of their expertise.

The forth factor influencing the relief work is the variety of actors co-existing in the relief field. The differences among them make them hard to behave collaboratively, resulting in resources competition, duplicated or insufficient efforts. This challenging factor can be dealt with in both preparation and response phases by initiating coordination among actors. Responsibilities and relief focus among humanitarian organizations could be discussed based on the characteristics of the organizations during preparation.

These factors discussed above complicate the relief chain from different aspects. In chapter 4, I am going to use these factors to test the application level of coordination mechanisms in the commercial supply chain and see to what extent these factors will influence the coordination mechanisms' adaptability.

4. Application of coordination mechanism in the relief chain

In chapter 2 and 3, we have talked about the current practicing coordination mechanisms in the commercial supply chain as well as the factors which set apart the relief chain from commercial supply chain. Until now, it is ready to apply these coordination mechanisms into the relief chain and evaluate the feasibility of them in relief context.

4.1. The criteria to decide application prospects

In order to say whether a coordination mechanism is applicable in theory or not, the strategy I am going to use here is to assume that the conditions for using these mechanisms still hold and the coordination mechanisms are all applicable in relief context. Then I will find the obstacles stemmed from all the factors we have talked about in chapter 3 and see which condition will be hampered by the obstacles and to what extent these obstacles would stop the coordination mechanisms from applying. If certain obstacles indeed affect the application, but the conditions are still attainable under certain requirements, then the coordination mechanism is applicable to some extent and specific requirements will be discussed. If the obstacles completely shut down the application prospects regardless of any circumstances, then the mechanism is not applicable for relief environment any more. In the end, I will give an overall application prospect of all the coordination mechanisms and also shows which factors affect which conditions. For those have a promising application prospects, the potential coordinating partners and coordination relationships are suggested.

4.2. Coordination mechanisms in the procurement process

From the conclusion in chapter 2, we know that Joint procurement is the coordination mechanism in the procurement process with the application condition of “the emergence of an umbrella organization in relevant industry”.

In the relief context, given all the factors discussed in chapter 3, I would like to argue that the umbrella organization is still an attainable condition for humanitarian organizations. In emergency context, humanitarian organizations can still join an umbrella organization with common procurement desire. Especially for some relief organizations with small purchasing volumes, the joint procurement activities will make the order more attractive to suppliers and help them to close the emergency purchase deal in tight time schedule. Given the fact that competition among relief organizations increases emergency resources' price in the aftermath market (Culpepper and Block, 2008), joint procurement activities can also help buyers to stabilize the price and increase relief organizations' bargaining power. In Chinese relief context, a number of grass root non-governmental organizations who only engage in the aftermath response after a certain disaster event so that they lack of experience in emergency purchase and also don't process sufficient information regarding suppliers (Zhu et al., 2009). Therefore, there is common willingness among these grass root humanitarian organizations to join an umbrella organization in order to exchange information and launch procurement with the help of others.

In fact, collaborative procurement in emergency context has already been adapted in American government agencies. General Service Administration (GSA) is the official agency who launches joint procurement activities for other federal government agencies under normal operation circumstances in the United States. Under an emergency situation, like a natural disasters or a terrorist attack, GSA

collects the demand information from all the departments within American federal government system and order the emergency material from partner suppliers who have agreement with before emergency events³. After receiving emergency materials from pre-determined contractors, GSA will allocate these materials to each department. The feature of this joint procurement example under emergency context is close to the 2nd type of joint procurement pattern stated in chapter 2: Joint procurement organized by a lead organization. So in this case, GSA is the lead organization that initiates and organizes purchase activity on behalf of other governmental agencies.

From this example, we can see that an umbrella organization could be an alliance of governmental agencies. In China, although there is not a governmental agency like GSA which takes charge of governmental procurement collectively, joint procurement initiatives can still be launched in relief environment among governmental agencies given the condition that an umbrella organization exists. An umbrella organization can also embrace neighboring non-governmental organizations that have common needs to launch procurement together. The coordination under joint procurement mechanism is most likely to happen after a disaster strikes instead of during the preparation phase due to the uncertainty of the scope of a natural disaster. Because of uncertain scope of a natural disaster, a humanitarian organization is most of the time not able to tell before a disaster strikes who to coordinate with at which location, or what emergency resources are in great need. Only after a certain disaster happens and more demand information from victims has been collected, relief organizations geographically nearby are able to search for coordinating partners who are also in need of specific resources supply. Then joint procurement can be organized. Like stated in chapter 3, this umbrella organization for joint procurement is established provisionally and dissolves after it serves its collective needs. Therefore, the coordination is expected more on an operational level instead of a tactical or strategic level.

4.3. Coordination mechanisms in inventory process

4.3.1. Quick response

We know from the conclusion in chapter 2 that the pre-condition for using QR or CRP is Information sharing. The technology requirement is the tool to facilitate information sharing for these coordination mechanisms. Now Let us see whether information sharing is still feasible under the relief chain.

From chapter 2, we know that the essence of information sharing is about forecasting demand information more precisely with the point of sales and historical sales data to reduce lead-time and inventory for all the trading partners. Different from the commercial chain, the “clients” that relief logisticians serve are victims in the relief chain, so the demand from victims is the data that humanitarian organizations need to collect and need to be shared with each other. However, like discussed in chapter 3, the demand information in disaster aftermath is in high uncertainty with much fluctuated trends and unpredictable characteristics, forcing humanitarian organizations have to make assumptions on their supplies. In commercial chain, point of sales is the indicator to reflect the demand of clients. For the relief chain however, the equivalent concept of “point of sale”, i.e. the amount of resources that is dispatched to victims from responders, is not always in line with victims’ actual needs. It is especially true during the early stage of relief work when the amount of emergency

³ Information is from GSA website under emergency response: <http://www.gsa.gov/portal/content/105086>

resources is unknown. Responders have to “push” the resources to victims instead of “pull” emergency supply based on their real demand. Therefore getting real demand information is very challenging for humanitarian organizations at the first place, not to mention to forecast demand trend given the dynamics and uncertainty of disaster evolvement. What is more, in QR or CRP coordination mechanisms, historical data regarding customers’ demand is also shared among actors in the commercial chain. In the relief context however, it is uncertain that to what extent the historical data regarding one specific disaster in the past can assist the demand forecasting for another disaster that happens in the future, due to the uniqueness of each natural disaster. Since each disaster has its own attributes, like the type, location, magnitude etc., it is not feasible for responders to take the previous experience as references to estimate the demand arise for following events. Therefore, we can see that the demand information can not be accurately forecasted nor the historical data could assist in prediction.

But we can not overlook that the demand information could be collected if responders can get access to the impacted areas when road or communication infrastructures are re-connected so that the type of resources or the amount of demand become known to responders. If so, this demand information can be shared from humanitarian organizations to suppliers, helping them to synchronize their production in line with the actual needs. But this only happens after responders finish investigating in the situation within impacted zones.

Secondly, the technical requirement is the tool for organizations to facilitate information sharing. Humanitarian organizations that have these facilities can share inventory or demand information with their suppliers through electronic data interchange for instance. To ensure information sharing, the key thing is accessibility to internet which requires connectivity with critical infrastructure within telecommunication system. It is also challenging, since like stated above, that the infrastructure are damaged after disasters. The humanitarian organizations that could fulfill this technical requirement are more likely to be governmental agencies or big NGOs with more human resources or fund support, who can equip themselves with technical facilities as well as technicians (Balcik et al., 2010). And also because of these big humanitarian organizations could have multiple locations and are less dependent on critical infrastructure at the disaster location.

From the analysis above, we can see demand forecasting isn’t realistic in the relief chain given the fact that uncertain and lumpy demand trend, but information sharing is achievable as long as current demand information is available. The objective of information sharing in this case is not about prediction on future demand anymore; it is rather about sharing contemporary demand to let relief organizations and suppliers respond simultaneously. So humanitarian responders should take the responsibility to collect the up-to-date demand information from impacted fields, place the orders to its suppliers and let suppliers synchronize the production level accordingly. Since demand forecasting is disabled for suppliers, then the responsibility of suppliers would simply accept orders from humanitarian organizations and produce. In other words, suppliers don’t have the initiative to maintain certain inventory level based on future demand estimation. Therefore, it is more a procurement coordination between relief organizations and suppliers based on precise order placement rather than inventory coordination based on clients’ demand forecasting. The potential for the implementation of Quick Response would likely be higher for big NGOs since they respond to a greater number of disasters, leading to larger, smoother(risk-pooled)demand patterns overall (Balcik et al., 2010). This will ease difficulties for the suppliers to prepare orders or maintain inventory level.

Larger NGOs also have more technological and human resources, both of which would be beneficial in collecting up-to-date demand information as well as establishing and managing electronic data tracking and exchange systems.

4.3.2. Continuous replenishment program

Besides information sharing and the technological requirement, an additional feature Continuous Replenishment Program has is “fewer orders made more frequently” which is not realistic in the relief chain. The urgency of natural disasters does not allow suppliers or humanitarian organizations to take any more time on transporting more frequent materials. If certain resources are in great demand, humanitarian organizations need to “have it all” due to the urgency of demand and competition among other aid organizations. What is more, more orders deliveries generate more mobilization of vehicles and personnel, which could be rare resources after a major disaster. More traffic also puts more pressure on fragile aftermath infrastructure and may block the life line connecting impacted zone and responders. Therefore, the CRP coordination mechanism in the relief chain does not have a promising prospect in the relief chain.

4.3.3. Vendor managed inventory

Let us first take a look at the inherited feature of this coordination mechanism. Vendor managed inventory switches the responsibility for warehousing management from buyers to vendors. Vendors will make the replenishment plan and monitor warehouses on behalf of buyers. Under such circumstances, the uncertainty of demand is the main obstacles for the information sharing condition in the relief chain. It would be too risky for suppliers to guarantee inventory performance for relief organizations under lumpy and uncertainty demand in the relief chain given the fact that demand prediction isn't possible. Plus, the additional barriers that damaged infrastructure set up for communication among relief participants, hampering the just in time demand information sharing and delay the time for suppliers to receive up-to-date orders.

Moreover, the uncertainty of supplies from humanitarian organizations is another obstacle for vendor managed inventory. From chapter 3 we know that unsolicited supply creates an additional burden for supply chain response and distracts personnel's efforts and attention. Massive supplies flood into humanitarian origination's warehouses without notice beforehand result in heavy warehouse workload to sort out or store different emergency items. If vendor managed inventory is adopted, then the supplier would be the one who deals with the problematic warehouse in the relief context. But it does not make sense since the supplier needs to commit too much and even need to change its business focus in order to take care of the overwhelmed warehouses. Besides, dealing with inventory is not a core competence for suppliers as well. Therefore, vendor managed inventory does not have a good application prospect in relief context because of the obstacles “uncertain demand and supply “on conditions”, “information sharing” and “Organization structure”.

4.3.4. Joint managed inventory

Besides the obstacles discussed above for vendor managed inventory, joint managed inventory has an additional condition which is “regular communication and Consensus on demand forecasting”. From the analysis above, not only the demand forecasting is not feasible, but also regular communication between actors is a time consuming process. Under great urgency, it is hard for personnel in humanitarian organizations to review what they did before rushing into the next task. This additional

requirement for joint managed inventory makes the implementation prospects even more unlikely. Hence, uncertain demand, uncertain supply as well as urgency characteristics prevent *joint managed inventory's* conditions from applying.

4.3.5. Collaborative planning forecasting and replenishment

From the listed conditions in chapter 4, we can tell that the requirements on organizations to use collaborative planning forecasting and replenishment are demanding since there is a broad integration of firms within the supply chain. Thus, departments and functionalities are built up around the theme of coordination. One of the conditions is to re-structure organizations to adjust their structures in line with strategic coordination consideration to facilitate communication among coordinating partners. The other condition is to refine business strategy on collaboration focus. However, these conditions are not attainable in relief context due to the co-existence of various actors, who are significantly different in terms of organizational structures, primary interests and mandates. For example, the focus of the government is to deploy the entire relief work in an effective manner. Sometimes they may even need to push down centralized decision to keep the discipline in relief field, like no entry regulation posed by the government during the Wehchuan earthquake. In order to obtain rare emergency resources, humanitarian organizations might also need to compete to purchase key resources in the aftermath market with other actors in the field. Due to the competition among humanitarian organizations, commercial suppliers also have the incentives to take advantage of the relief market by increasing their product price and gain extra profit out of the relief supply industry. So there could be occasions for relief actors to sacrifice overall coordination but where they seek for benefits instead. Therefore, for each of the humanitarian organizations with various interests and mandates, it is not practical to accommodate coordinating actors' relief strategy into collaboration or adjust the organizational structure around the theme of coordination. Plus the requirement on information sharing is also missing for relief organizations. Therefore, co-existence of various actors, uncertain demand pattern hampers three of the conditions to use CPFR in relief context, leaving the CPFR a very thin chance to be applied in relief context.

4.3.6. 3rd party warehousing

From the discussion in chapter 2, we know that there are several drivers that could stimulate a favorable atmosphere for third party logistics service. The drivers are process complexity, network complexity and product complexity. In a relief environment, all the factors discussed in chapter 3 deviate the environment from normal business supply chain and at the same time, also change the attributes of these drivers. Therefore, the first condition to check the application level of 3rd party warehousing is to see whether there are still drivers that stimulate the favorable atmosphere for the 3rd party participation in the relief chain.

1) High network complexity

Comparing to a commercial supply chain, the network complexity in the relief chain is much higher due to the geographic dispersion of the large amount of suppliers (both business suppliers and donors worldwide), intensive frequency of deliveries and uncertain transportation routes. Figure 19 illustrates the physical flow before and after a disaster. The complexity of the network first of all stems from the large number of suppliers (either business suppliers or donors) dispersed in wide range of regions, increasing the volume and complexity of transactions. Secondly, the distribution route is not always straightforward but with several intermediary stocking points or local distribution points in the middle,

increasing the frequency of transportation network; Thirdly, the damaged infrastructure, limited transportation resources and bulk of supplies to be transported all make the last mile distribution from local distribution points to victims challenging (Balcik et al., 2010).

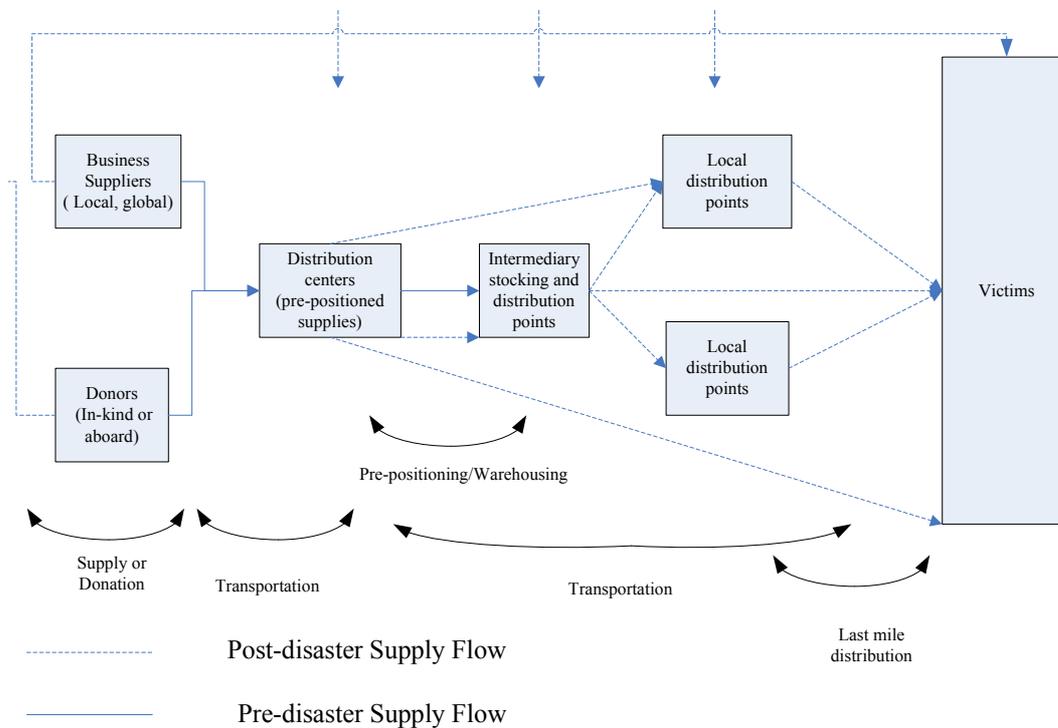


Figure 19: Relief chain structure (source: Balcik et al., 2010)

2) High process complexity

Like stated above, this driver refers to time and task compression in supply chain. We have already known that the urgency characteristic, which is a very prominent characteristic that distinguishes the relief chain from the commercial supply chain, driving all the humanitarian organizations to conduct relief tasks in a limited time span. Besides the pressure from time, the tasks facing humanitarian organizations are multiple as well: encompassing re-connect infrastructure, evacuate victims from ground, emergency procurement, emergency delivery and epidemic control. Even within the relief chain scope, there is a series of task components for humanitarian organizations to undertake (stated in the Figure 20). Under such a high level of process complexity environment, outsourcing some process components in the relief chain to a 3rd party would be a way to ease the pressure for humanitarian organizations from undertaking multiple tasks in the relief chain.

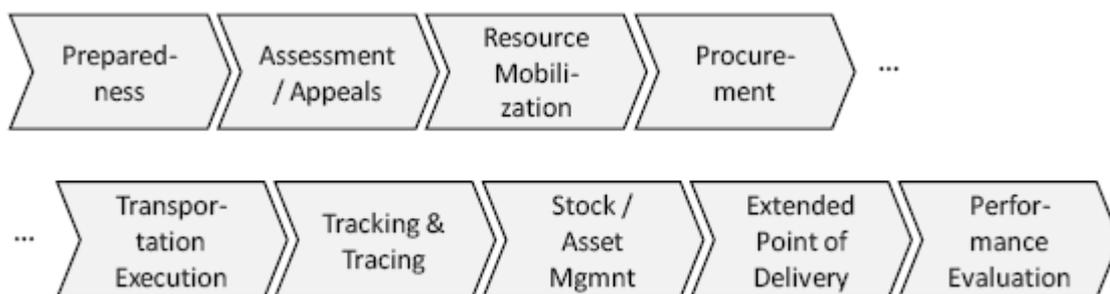


Figure 20: Tasks in the relief chain (Source: Tomas, 2004)

From the analysis above, we can see that these two drivers stimulate a favorable atmosphere for applying the 3rd party logistics service since both the network and process complexity are high, creating a window opportunity for professional logistics providers to enter in and assist in managing the logistics network.

The second pre-condition to use 3rd party logistics is to check whether the role of logistics is the core competence for a company and how much does logistics distract the company from its main business. For the most dominant humanitarian organization- the government, the military and armed police are the main forces to conduct emergency delivery in Chinese relief context. Military has sufficient human resources as well as the critical transporters, like vehicles or airplanes, which stand by in normal circumstances and can be deployed under emergency situations. Therefore, military's high logistics competence makes it the most reliable force in emergency logistics. However, for other humanitarian organizations, like NGOs, logistics isn't their core competence. They may only participate in aftermath relief when certain disaster triggers. These humanitarian organizations lack of logistics expertise as well as essential transporting resources. What is more, from analysis in chapter 3, we know that governmental agencies or NGOs are both distracted a lot from inventory management due to uncertainty in supply. Resources and valuable time are wasted on sorting out, storing or prioritizing emergency supplies. This phenomenon also distracts relief organization from rescuing lives and alleviating sufferings. Hence, for some of the humanitarian organization, logistics is not their core competence and for some logistics components, they distract relief organizations to conduct relief tasks effectively.

The third pre-condition to use 3rd party logistics is the availability of a strategic partner. From chapter 3, we know that there are commercial actors motivated by different reasons engage in "relief industry", among all the companies participate in relief work; the logistics companies are one of the active actors in the relief environment.

We have already classified 3rd party logistics into three different types based on the coordination orientation. For the 1st type of 3rd party logistics, the availability of a logistics partner in relief context is attainable theoretically since the activities that 3rd party logistics provider perform are basic logistics functions that mostly stay on operational level or ad hoc decisions made by both parties that don't require long term planning. For example, a relief organization without sufficient transporters might ask a logistics company to assist in transferring their materials from A to B. However, for 2nd and 3rd type of 3rd party logistics, as a 3rd logistics provider, the 3rd party needs to take more responsibilities and commit more into the coordination and possibly engage in the coordination before the disaster strikes.

For example, the international logistics company Deutsche Post World Net has set up a partnership with the United Nations Development Program and the United Nations Office for the Coordination of Humanitarian Affairs to provide "the management of complex logistics and transportation processes"⁴. Another prominent example between a humanitarian organization and a logistics company is TNT's cooperation with the World Food Program.

⁴ DHL Website: http://www.dp-dhl.com/en/responsibility/society/disaster_response_teams.html

DHL coordination initiatives

DHL Disaster Management Program: With a comprehensive logistics network and a worldwide presence DHL help people and communities affected by major sudden onset natural disasters. Among the three key components of DHL's disaster management program, two are directly linked top SCM issues: (1) sharing skills and knowledge in disaster preparedness phase, (2) supporting the disaster relief organizations' response to major sudden-onset natural disasters through a comprehensive disaster response program. DHL partners include United Nations Office for the Coordination of Humanitarian Affairs (OCHA) as well as national and local governments, NGOs (e.g. national Red Cross and Red Crescent societies).

DHL provided relief aid within a day after the tsunami hit the Asia Pacific region. It also provided free delivery of relief materials via planes, vans, flight charters and staff volunteers. Its Airport Emergency Team was deployed and assembled resources and expertise to set up working flows at airports so that relief efforts could be sent directly to regions in need. DHL also provided storage space in its warehouses for relief material. During Hurricane Katrina, DHL made use of its standby Disaster Response Team, which works closely with UN OCHA. The team supported USAID and the Office of Foreign Disaster Assistance with transportation and logistical expertise. As well as unloading and reloading aircrafts and sending shipments to the correct locations, the team delivered supplies from all over the world to the affected areas by plane.

Source: (François Maon et al., 2007; Lothar Rieth, 2009)

TNT coordinates with World Food Program

TNT assisted WFP in a series of emergencies by utilizing its physical resources (e.g., airplanes, trucks, warehouses), human capital (e.g., experienced and knowledgeable managers and staff), and organizational capability (e.g., tracking and routing systems).

In response to the 2004 tsunami, TNT supplemented WFP's efforts by assisting in the transportation of food and non food items to four countries in the region. In Indonesia, Sri Lanka, Thailand and India, TNT set up emergency coordination rooms, established food supply lines, provided transport management, temporary storage capacity and airport ramp handling services. By end April 2005, the in-kind support of TNT in terms of staff time and assets amounted to €2.3m.

TNT recognizes that, as a logistics company, it can offer more by leveraging its core business expertise and assets in a partnership, than by simply donating money (Maitland,2004).

Source: (Ramina Samii, 2008)

From these examples, we can see that higher oriented relationships with private companies can not be obtained overnight but need to be cultivated before a disaster strikes. Private companies are expected to dedicate into aftermath relief with their pre-reserved resources like the examples shown

above. Therefore, the availability of a strategic 3rd party logistics provider requires extra requirements that also depend on specific situation. For coordinating partners, long term agreement regarding relief coordination need to be in place even before disasters in order to ensure quick response. In the next chapter, the possibility and extent of 3rd party logistics providers' involvement in Chinese relief context will be studied further more.

The fourth condition that influences the adoption of third party logistics is information technology. From the analysis in chapter 2, we know that information technology is an important tool for humanitarian organizations to coordinate with each other domestically. When transaction reaches larger scale and lead to international transportation, the absence of information technology becomes a simulator for third party logistics service. The relief environment has the feature of international transaction since the networks are complex and processes have a wide range and variety. Therefore coordination with a third party logistics provider could be a way for relief organizations to seek information technology support to facilitate relief communication.

From the analysis above, we know most of the conditions for applying 3rd party logistics still stand in the relief context (Figure 21). The conditions for adopting 1st type of TPL hold in the relief chain. For this operational level of coordination, the initiative could be launched after disaster happens, like providing warehousing facilities or space for NGOs to help them sort out the massive amount of suppliers from all over the world. If strategic partners are available, tactical or strategic coordination could happen between large scale of humanitarian organizations and logistics companies based on pre-agreements before disaster events, like the long term strategic partnerships for DHL Disaster Management Program, or the partnership between TNT and WFP.

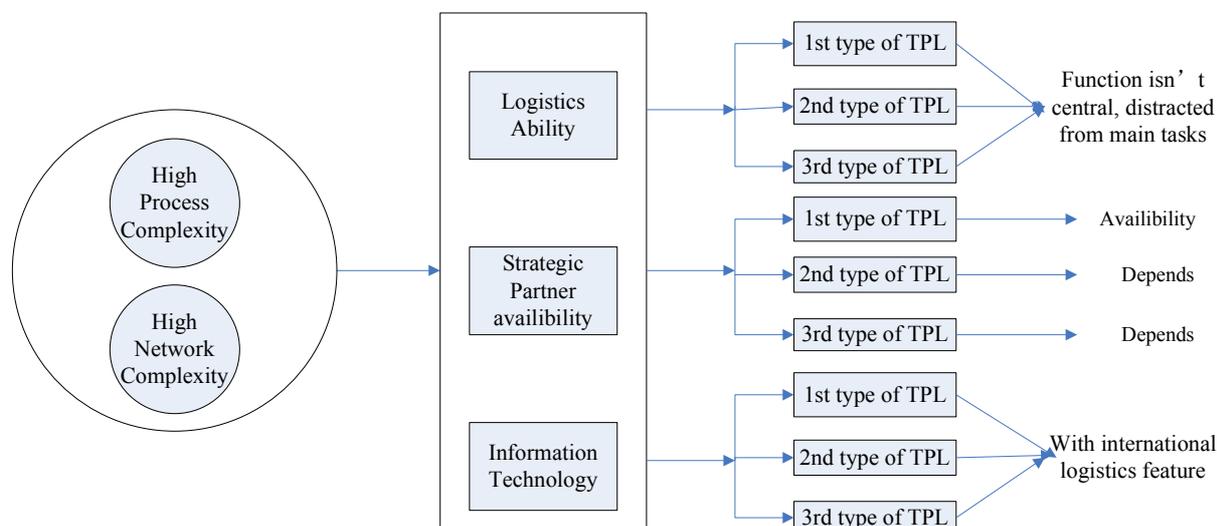


Figure 21: Conditions for 3rd party logistics in the relief chain

No matter what kind of coordination orientation the relationships remain, the private sector with logistics expertise can offer coordination organizations solution packages that are more sophisticated and to some degree more efficiently organized than those carried out by traditional humanitarian organizations, like non-governmental organizations or local government (Rieth, 2009). As a third party logistics provider, a commercial company provides a supplementary role to traditional humanitarian organizations and the traditional humanitarian organizations in relief field are obliged to be more

open-minded with the present of business sector and initiate coordination with them since the victims of a natural disaster are entitled to every type of adequate help (Rieth, 2009).

4.4. Coordination mechanisms in transportation process

The application prospects of 3rd party logistics have already discussed in last sub-chapter 4.3 and transportation is one of the functionalities that 3rd party logistics offers to relief organization so the application prospect remains the same.

4.5. Conclusion

4.5.1. Specific coordination mechanisms transferred to the relief chain

In this chapter, we have talked about the application prospects of coordination mechanisms listed in chapter 2. Table 6 gives an overview of the application level for coordination mechanisms and Table 7 indicates the actors who can practice them.

Firstly, the coordination mechanisms in the procurement process namely joint procurement is still applicable in relief context since the condition- umbrella organization still can be established in disaster environment. *Various actors co-existence* is the driver for this pre-condition. The coordinating relationship would be among regional governmental agencies or local NGOs geographical nearby. The initiatives would be launched after a disaster strikes during the response phase, when the coordinating partners can be identified as well as the type or amount of resources is clear for humanitarian organizations to conduct purchase collaboratively.

Secondly, the uncertain demand and damaged infrastructure set up barriers for application prospects for Quick Response on information sharing and technical requirement respectively. However, there is still a possibility for large scales of humanitarian organizations, like the government or big NGOs to adopt QR due to their relatively larger and smoother demand pattern. The urgency characteristic prevents small orders made more frequently; consequently this hampers the application of Continuous Replenishment Program. Disability in demand forecasting due to high uncertain demand places the first obstacle for using VMI or JMI in relief context. Plus, uncertain aftermath supply originates massive workload for warehousing managing so that relief organization couldn't switch inventory responsibilities to suppliers anymore, because it doesn't make sense for commercial suppliers to change its business focus on humanitarian tasks which aren't suppliers' core competence either. What is more, very frequent communication between coordinating partners isn't attainable for the relief chain because of urgency and damaged infrastructure. Hence, both VMI and JMI aren't promising coordination mechanisms in disaster environment. The prospect to use CPFR in the relief chain doesn't turn positive either. Besides the obstacles hamper other coordination mechanisms in inventory process, it isn't feasible for several of relief organizations with different agenda to turn their focus on coordination instead of their prioritized relief tasks. Contrary to other coordination mechanisms in inventory process, the 1st type of 3rd party logistics is still a potential coordination mechanism in relief context since the availability of private sector with warehousing or transportation expertise would ease the tension for relief organization on managing the complex logistics tasks. The existence of the private sector in the relief field (co-existence of various actors) is also a driver for application. However, the 2nd or 3rd type of 3rd party logistics require more resources committed from private companies and long-term orientation with pre-determined partnerships agreement.

Application of coordination mechanism in the relief chain

Thirdly, the 3rd party transportation stays the same application prospects as 3rd party warehousing. The 1st type is promising and 2nd and 3rd types depend on strategic partner's availability.

Application of coordination mechanisms in the relief chain

Table 6: Coordination mechanisms and their application prospects

	Urgency	Uncertainty				Complexity of Operation conditions			Co-existence of Various Actors	Application level
		Scope	Demand	Supply	Policy	Damaged infrastructure	professional staff shortage	Media's framing effect		
JP										
1) lead organization in relevant industry										
2) Willingness of collectively purchasing										
QR										
1) Information sharing										
2) Technology requirement										
CRP										
1) Information sharing										
2) Technology requirement										
3) Few order made more frequently										
VMI										
1) Information sharing										
2) Technical requirement										
3) Organization structure										
4) High level of commitment of top managers										
5) Trust among trading partners										
JMI										
1) Information sharing										
2) Technical requirement										

Application of coordination mechanism in the relief chain

3) Organization structure										
4) High level of commitment of top managers										
5) Trust among trading partners										
6) Regular communication on demand forecasting										
CPFR										
1) Information sharing										
2) Technical requirement										
3) Organizational structure										
4) Trust among trading partners										
5) Refine business strategy on collaboration focus										
1st type of 3rd party logistics										
1) The role of warehousing in entire business portfolio										
2) Availability of strategic partner										
3) Information technology										
2nd type of 3rd party logistics										
1) The role of transportation in entire business portfolio										
2) Availability of strategic partner										
3) Information technology										
3rd type of 3rd party logistics										
1) The role of transportation in entire business portfolio										
2) Availability of strategic partner										
3) Information technology										

Application of coordination mechanisms in the relief chain

Legend:

Red: Obstacles/ Not applicable

Green: Facilitators/Applicable

Yellow: Applicable under certain circumstances

Blank cells: Not have a major effect

Table 7: Promising coordination mechanisms and practicing actors

	Actor			
	Government	Big NGOs	Small NGOs	Private sectors
Joint procurement	✓		✓	
QR	✓	✓		✓
1 st type of TPL	✓	✓	✓	✓
2 nd type of TPL	✓	✓		✓
3 rd type of TPL	✓	✓		✓

4.5.2. Generic lessons transferred to the relief chain

Table 8: Factors’ impact on Commercial chain’s generic coordination approaches

	Urgency	Uncertainty				Complexity of Operation conditions			Co-existence of Various Actors
		Scope	Demand	Supply	Policy	Damaged infrastructure	Professional staff shortage	Media’s framing effect	
Resource Sharing									
Joint Decision Making									
Outsourcing									

Legend: Red: Obstacles; Green: Facilitator

Table 8 gives an overall picture about challenging factors’ impact on these three generic coordination approaches in the commercial supply chain. Firstly of all, demand uncertainty again is the hampering factor in resource sharing, especially information sharing among humanitarian organizations. Damaged infrastructure also places the obstacle on joint decision making due to destroyed infrastructure set up barriers for in time communication among players. What is more, urgency is another factor that might delay joint decision making since the urgent characteristics doesn’t allow thorough planning and discussion among coordinating partners. Meanwhile, the challenging factors could also stimulate players to seek for coordination. For example, due to lack of own professional staff and high staff turnover, humanitarian organization would turn to a third party logistics provider to help them in logistics facility or expertise provision. The co-existence of various players on relief field also provides the ground for different organizations to exchange resources or make better decision collaboratively or even outsource their tasks to another player.

After reviewing the obstacles and facilitators for generic coordination, I would like to see the application prospect for these generic approaches. According to the above analysis for specific coordination mechanisms, we colored the coordination mechanisms in the Figure 14 and show them in Figure 22. We can see that the lower level (Operational or tactical) of joint decision making, resource sharing and outsourcing are more likely to be transferred into the relief chain. The lower coordination orientation is, the easier the coordination mechanism can transfer into relief environment. That is basically because there are fewer requirements and efforts or constrains for humanitarian organizations to adopt comparing to higher level of coordination orientation. Pre-agreement among humanitarian organizations would need to be reached in order to build up strategic alliance in a long run.

Application of coordination mechanisms in the relief chain

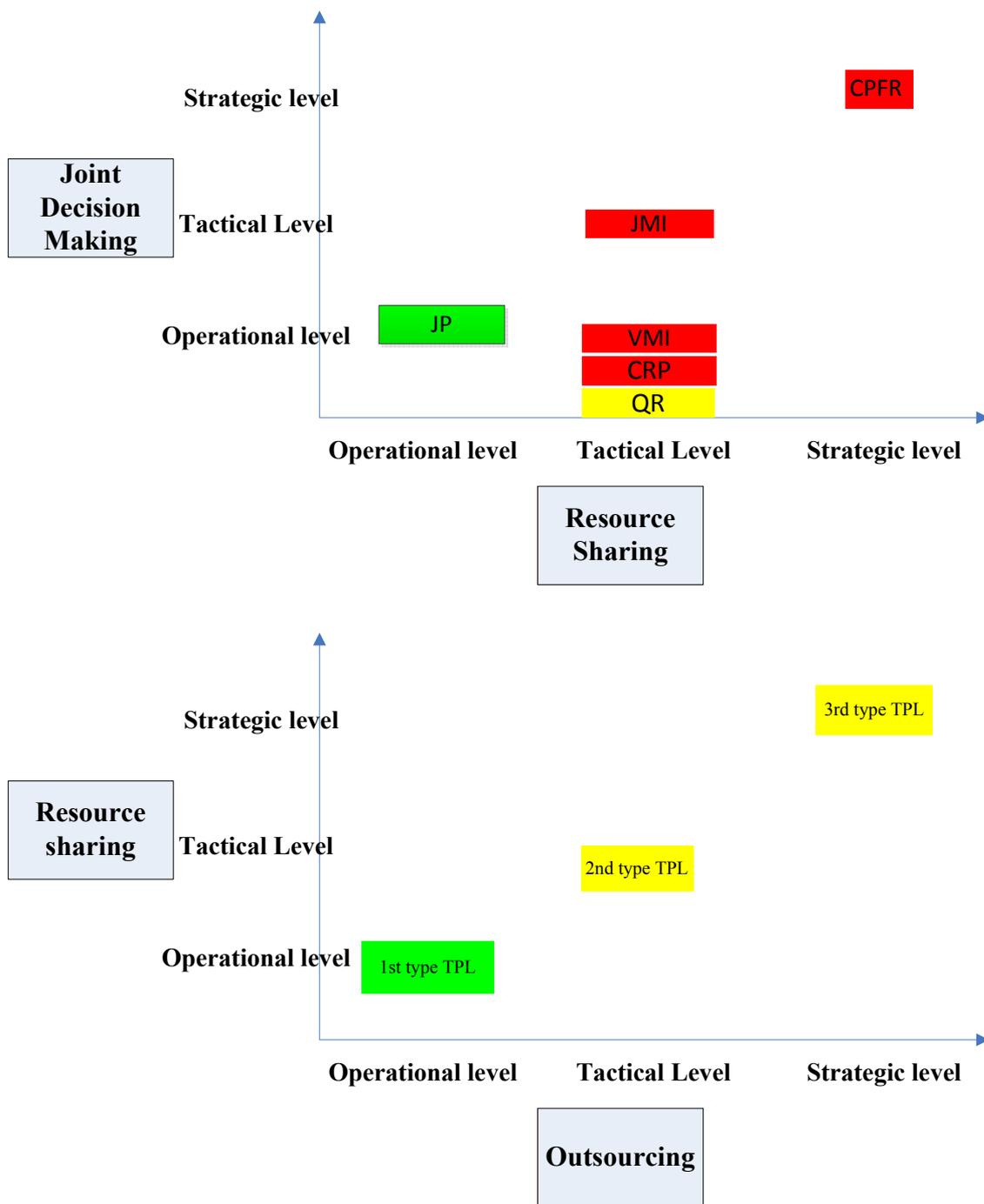


Figure 22: Genetic approach application prospect in the relief chain

5. Case study - the Wenchuan earthquake in China

On 2:28:04 PM, 12th of May, 2008, an earthquake with 8.0 magnitudes happened in Sichuan province in the south part of China, which is also named as The Wenchuan earthquake after the earthquake's epicenter.

Wenchuan is 80 kilometers away from Chengdu, the capital of Sichuan province. The areas that appear dark orange on the map are the most severe areas in this earthquake, including Sichuan, Gansu and Shanxi Provinces. The areas appear light orange felt the earthquake when it struck. The Wenchuan earthquake is deemed as the most devastating earthquake after the establishment of the Peoples' Republic of China.



There are several very distinctive characteristics of this earthquake.

5.1. Characteristics of the Wenchuan relief

1) *High magnitude with frequent aftershocks.* This earthquake had the magnitude of 8, but the epicenter had reached the strongest magnitude of 11. Until 21st of October 2008, 33,000 aftershocks were detected including more than 600 times with the magnitude of 4, 60 times with the magnitude of 5 and 7 times with the magnitude of 6.

2) *Very severe damage.* Official figures (as until 18th of Sep 2008) state that 69,227 people were confirmed dead, 17,923 were still missing and 374,643 were injured. Secondly, houses were destroyed to a large extent. Beichuan and Wenchuan (in total approximately 2 million populations) were totally razed to the ground; thirdly, the severe damage of infrastructure isolates Wenchuan. 15 highways and 5 railways around epicenter were cut down, the electricity, telecommunication and water supply system couldn't function anymore; fourthly, the regular life can't operate since the hospital, governmental agencies or schools were themselves hit by the earthquake.

3) *The 2nd disaster strikes after the earthquake.* The earthquake resulted in large scale of landslides. There was constant rain since the night after the earthquake of 12th May 2008, which caused frequent mud-rock flow and collapse. The huge landslides also played a major threat on the Barriers Lake caused by the earthquake.

4) *Difficulties in relief.* The most severe disaster areas are full of mountains and ravines so villagers who mostly live on the top or half way on the mountain were difficult to rescue. Furthermore, the collapse of

transportation and communication infrastructures caused difficulties for material, trucks, helicopters and big relief facilitates to enter in. What is more, the disaster areas are mostly poor areas making the people more vulnerable.

5.2. Relief works done by different actors

May 12th-15th: Establishment of Emergency General Headquarter at national and local level

The standing committee of the Political Bureau held a conference on the 12th of May, deciding to establish the State Council Relief General Headquarter, with Prime Minister Wen as the Chief Director. This General Headquarter would be fully responsible for the Wenchuan relief, undertaking tasks, including generally collecting, generalizing, analyzing, distributing and reporting important information. Related ministries like the Ministry of Civil Affairs, the Ministry of Earthquake Bureau, the Ministry of Health and the Ministry of propaganda all activated the emergency respond mode to act in concert with state council. On 15th of May, the General Headquarter established a "Front Line Headquarter" in Chengdu, which generally deployed and coordinated all the relief work at front lines on the operational level. Meanwhile, governmental agencies at regional levels established relief headquarter respectively. For instance, Sichuan province built up "5.12" Relief Headquarter in Chengdu.

May 12th-20th: Rescue survivals under the ruins

Rescuing lives was the primary task right after the disaster. People's Liberation Army, Armed Police Force and various kinds of specialized rescue teams were the main forces for this relief stage. In total, the number of people for rescuing survivals was more than 170,000, including 157,000 soldiers and armed policemen and 18,000 professional rescuers. The total number of people saved in this period was approximately around 87,000, including 70,000 self-rescue or rescued by local people, 10,000 rescued by military, 7,439 rescued by professional aid teams (UNDP, 2009). After 20th of May, the chance for survivors under the ruins to be alive was very slim that is why the main rescue force terminated this task after 20th of May.

May 12th-30th: Victims Treatment and Cure

Five minutes after the earthquake, the hospital from Chengdu Military region urgently built up a temporary treatment spot and started to treat the first injured 7 minutes after the earthquake. Until 31st of May, Sichuan disaster areas transferred 10,015 injured to more than 340 hospitals in 20 provinces all over China.

May 12th - August: Re-connect the destroyed life lines

The life lines connected to the impacted areas with outside world consists of highways, railways and telecommunication lines. After the earthquake, the highways connected with the very severe impacted area Yingxiu were completely cut off. The first road that could go to Wenchuan after the earthquake was re-connected by Militaries after 47 hours. Until 7th of June, 95% of the roads were successfully re-connected within the most severe damaged area of Wenchuan. For railways, until 24th of May, all the important railways to Sichuan areas were re-connected with the assistance of the Ministry of Railway. Through the effort from Ministry of Telecommunication, until 18th of May, there were 8 towns in Sichuan,

amongst the most severe areas, that have got telecommunications. The entire Sichuan province had temporary public telecommunications until 20th of August (UNDP, 2009).

May 12th - August, 2008: Re-settle the victims

46 million people were deemed as victims in this earthquake and 15 million of them needed to be transferred and re-settled (UNDP, 2009). Therefore, millions of tents and temporary housing were needed by victims during the response phase.

May 12th -Now: Mobilize resources from the whole society

Resources from the whole society, no matter from the militaries, NGOs and volunteers, or private sectors were largely mobilized during the disaster relief. For example, Friend of Nature, as a grass root NGO initiated the famous activity “Small Movement + Lost of People=Big Difference!” on the day the earthquake happened to encourage citizens taking actions for the Wenchuan relief. The second day after the earthquake, as one of the biggest NGOs with governmental support, China Poverty Alleviation Foundation, China Youth Development Foundations and other grass root NGOs jointly released the “Promise from Chinese NGOs on Wenchuan Relief” and started to raise funds for relief aid. Until now, there are still volunteers devoted themselves on psychological aid for people in Sichuan disaster areas. The resources in the whole society were mobilized during Wenchun relief. On 8th of June, the government carried out a regulation which specified the principle of “Government dominants and public participation” for the Wenchuan relief, updating the public participation to a strategic level.

May 19th - Aug.2010: Aftermath disease prevention

The Ministry of Health took the necessary treatment on corpse and monitored the epidemic disease to prevention second disasters right after the earthquake. Disease outbreak was successfully avoided by the relief effort from the Ministry of Health and other responders devoted into disaster prevention.

June 1st -10th: Exclude the threat of Barrier Lake

The earthquake and constant rainy weather brought in another threat on people’s lives and property i.e. barrier lake, which may flood all neighborhood. Therefore, Military forces dug a hundred meters long launder, through which the pressure from Barrier Lake was successfully removed.

After reviewing the main work done during the earthquake response period, we can see that the government is with no doubt the most dominant player in relief field with military forces and armed polices as the most critical resources under deployment. The amount of human resources, transporters or other critical equipment that governmental agencies deployed were far more abundant then other organizations could possibly have after a major disaster. However, no single actor could undertake the relief work in major disasters (Bui et al., 2000). Non-governmental agencies also had their unique role during relief. Now I will walk through the coordination initiatives found among different humanitarian organizations in this Wenchuan relief case study in sub-chapter 5.2. According to the way they were organized on the field and the characteristics of these coordination initiatives, the promising coordination mechanisms discussed in chapter 4 will be matched with the current practicing ones. In addition, some other coordination initiatives which are applicable to relief environment but not found in the commercial supply chain will be identified and analyzed as well.

Until now, the general relief work is introduced and I am going to explore the coordination initiatives used in the relief chain during the Wenchuan earthquake. The following initiatives found in the case were collected from documented case description published by research institutions, interviews, and newspapers and governmental / NGOs/ Private companies' report regarding Wenchuan relief. If the above sources mentioned the coordination among humanitarian organizations in the relief chain process, the exact coordination pattern would be investigated in order to see how it was organized and what the added value was to the relief chain.

5.3. Matching practicing coordination initiatives with promising specific ones

5.3.1. Joint procurement

Joint procurement were classified into two types based on the actors practiced them and also the way it was organized.

1) Joint procurement within NGOs united organization

During the Wenchuan relief, there was a very dominant feature of NGOs' behavior, i.e. joint action. Not only in the severe disaster impacted areas, but almost all the regions within China, no matter big NGOs with governmental support or small group of volunteers, they were all involved in the Wenchuan earthquake relief. Due to relatively fewer resources a NGO have, comparing to a governmental agency, NGOs chose to pool resources together by coordinating with each other⁵.

An influential force stemmed from grass root organizations in Chengdu, namely "5.12 NGO Sichuan Relief Coordination Office" who in total mobilized and delivered more than 10 million RMB (1.1 million euro) emergency materials to impacted areas. Most of the tasks 5.12 NGO alliance undertook, like demand information collection, emergency resource purchasing or delivering, were under joint efforts in order to make best use of each member's resources. Procurements were done in a collaborative way as well. Most of the suppliers 5.12 NGO Sichuan Relief Coordination Office chose were local ones, whom the coordinating partners had good knowledge of and also easily got access to. We have already known from chapter 2 that the existence of umbrella organizations facilitates joint procurement. In this case, "5.12 NGO Sichuan Relief Coordination Office" was the umbrella organization that facilitated joint procurements during the Wenchuan relief.

This Coordination Office is just one representative of NGO joint effort. There were other similar practices national wide among NGOs, Foundations or Volunteer groups who united their resources together, for instance, the New Hump Group in Shanghai and the Sichuan Relief Service Center. Although joint procurement was practiced frequently in the Wenchuan relief, there is a difference in this context comparing to that in the commercial supply chain. Since NGOs chose to work together during the Wenchuan relief, rather than reporting demand information separately to umbrella organization, umbrella organization operated as a whole to collect demand information. On behalf of every member, it is the umbrella organization that launched the procurement activities. The purchased materials were also under disposal of the united organization instead of individual coordinating members. Unlike as stated in chapter

⁵ Refer to interview summary 2 in Appendix 5

2, the umbrella organization dissolved after procurement activity, it still existed and carried on providing other relief assistances in a joint effort form in the Wenchuan context.

2) Joint procurement between the government and NGOs

In the above “NGOs united organization” example, we could see that responsibilities among coordinating partners weren’t differentiated during joint procurement activities. There was another kind of joint procurement activity organized between the government and NGO, differentiating the responsibilities among coordinating members to maximize the joint effort.

AmeriCare was one of the very few international NGOs without Chinese affiliated background, engaging in Wenchuan emergency response. During the aftermath relief, AmeriCare initiated a joint procurement together with local government for hospital equipment⁶. On one hand, AmeriCare fully financed this purchasing and on the other hand, local government took over the suppliers screening tasks due to its good knowledge on local suppliers. Quotations were provided in advance to AmeriCares and approved by AmeriCares. Apart from a small deposit to the suppliers, payment was sent electronically directly to the suppliers. In the end, delivery of all equipment was then verified by AmeriCares. The purchased medical equipment was used by both sides in aftermath relief. We can see from this example, the procurement was done by making use of the coordination partners’ advantages and couldn’t be accomplished without either side. Although procurement was done collaboratively, the responsibilities for participants vary.

Added value of joint procurement:

The joint procurement among small NGOs enabled them to pool resources together and increased their bargaining power over suppliers. Especially for NGOs who weren’t familiar with local circumstances and suppliers availabilities, the joint procurement activity with local NGOs assisted them to identify appropriate suppliers. The joint procurement between local government and NGOs made best use of each player’s resources by allocating different tasks among them. Basically, both sides gave what they had and took what they desired. Therefore, a win-win situation was created by joint procurement coordination mechanism. Above all, we can see that joint procurement was organized more flexible and adoptive to urgency situation. Small scale non-governmental relief organizations will be the main beneficiaries from this coordination mechanism.

5.3.2. Quick response

On 20th of May, 2008, about a week after disaster struck, the gap for tents needed was more than 3 million. Until 20th of May, 1:00 pm, the total amount of tents delivered to Sichuan impacted areas were only 2,402,359 (Xinhua News, 23rd May 2008). The strategic storage for tents in 10 warehouses all over China was emptied in 48 hours (21CBN News, 23rd May 2008). Although the Ministry of Civil Affairs collected tents from various channels (asked for international help for instance), there was still a huge gap between supply and demand, which appeared to be the most serious problem in this emergency supply.

On 20th of May, the State Council held a Press Conference, through which Associate Minister of Civil Affairs urgently called for tents from suppliers all over China. This urgent purchasing mission passed down

⁶ Refer to interview summary 3 in Appendix 5.

from State Council to different provincial governments, who allocated the production plans to local suppliers. In order to undertake the urgent tents production plans, lots of suppliers stopped their primary production and switched to only tent manufacturing in order to finish the scheduled amount. Gaining profit aside, one reason for these suppliers to work overtime and postponed their existing orders to finish the relief orders first is out of willingness to do some deed under such a catastrophic event by providing essential supplies. On the other hand, another reason for these suppliers to coordinate with the government is out of the pressure from the local authorities. Since the provincial governments sent their staffs to factories to monitor the production progress in order to guarantee on time delivery. Tents production for the Wenchuan relief was a very urgent task pushed down from the Ministry of Civil Affairs rather than a regular business transaction between the government and private suppliers.

Like discussed in chapter 4, quick response could be practiced in the relief chain given the demand information is shared between humanitarian organizations and suppliers. In the Wenchuan case, the information about the big gap of tents was collected by humanitarian organizations and at the first time shared with suppliers all over China through public media. In order to bridge this gap, suppliers stopped their primary production to accelerate their response speed. In this sense, this practice in Wenchuan relief fits the characteristics of quick response coordination mechanism. However, like argued in chapter 4, this quick response coordination mechanisms is more a practice in the procurement process rather than in the inventory process since the demand information can't be really predicted so that suppliers couldn't adjust their inventory level nor synchronize their production plans.

Added value of Quick Response

First of all, quick response bridged the big gap between demand and supply in a short period. We know that urgency is an influential factor that challenges the relief response. Quick response coordination mechanism combines the effort from both suppliers and humanitarian organizations to deal with this challenging factor. The quick response from suppliers assists humanitarian organizations to provide necessities to victims more efficiently and consequently alleviate the sufferings. This is the main value that the quick response coordination mechanism added to the relief chain. Secondly, this coordination between the government and private suppliers also provide an opportunity for both sides to build up better understanding so that long time orientated coordination regarding disaster supplies could be initiated. Thirdly, the business transaction with the government on relief aid also entitled a good reputation for the private firms, who can use this intangible property as brand promotion or staff motivation. For instance, research shows that TNT attracted more talents and experienced fewer turnovers after their coordination with WFP (Binder and Witte, 2007).

One remark for emergency procurement: Problem occurred

The Ministry of Civil Affairs is the leading agency for initiating the key emergency supply, for instance water, food and shelters. However, the Ministry of Civil Affairs didn't have an emergency purchasing system to support a catastrophe like the Wenchuan earthquake. The director of the Ministry of Civil Affairs of Sichuan Mr. Zhao stated that they thought they could handle emergency purchase since the sufficient market system, i.e. plenty of suppliers are available so that sufficient production capacity should be available as well. Therefore, they didn't see the necessities to maintain contacts with suppliers for the emergency materials beforehand. However, problems occurred during the Wenchuan earthquake

because of lack connections with companies. The Ministry of Civil Affairs had to switch the responsibilities to the Ministry of Business at the beginning of the emergency purchase to let them organize instead due to their good networks with companies.

Meanwhile, we couldn't overlook that fact that during the Wenchuan relief, the coordinated quick response was achieved through the government's hierarchical approach. Decisions followed the chain of command from national to provincial and down to the prefecture and county levels.

5.3.3. Third party warehousing and transportation

1) Governmental NGO's initiative on third party logistics

Ten days after the earthquake, China Charity Federation wrote a letter to all the Chinese logistics companies to call for assistance⁷. In the letter, China Charity Federation, as one of the biggest NGOs in China with governmental background, appealed for assistance in terms of transportation means, professional experiences, and mature transportation network from all the logistics companies. China Charity aimed to initiate the coordination according to the plan like this: The China Charity Federation established "China Charity and Logistics team". Under this team, Chinese Emergency logistics Coordinating Center and China Relief Logistics Emergency Center were built up. According to the geographical location of the logistics companies, coordinating center would appoint one or multiple companies to take responsibilities for relief logistics at that area, including emergency resources transfer, transport and storage.

There were several famous national logistics companies engaged in this program. For instance, Hoau, as the wholly owned subsidiary company of TNT in China, participated in logistics resources and expertise provision through its comprehensive highways coverage and logistics network during Wenchuan relief. Hoau supported China Charity, China Foundation for Poverty Alleviation, China Youth Development Foundation and China Children and Teenagers' Fund by offering transportation capacity by total amount more than 2,300 tons.

2) Grass root NGO's initiative on third party logistics

Coordination initiatives were also found between private company and grass root NGOs. One Foundation is a grass root NGO which was very active in Wenchuan relief. In Shanghai, One Foundation's main receiving spot was the warehouses from a private company: Junyao Logistics Group. When donations or purchased emergency resources arrived at the warehouses, the employees from Junyao Logistics center would immediately register the type, the amount and weight of the resources. The volunteers from One Foundation and staffs from Junyao Group together managed the inventory. After collecting demand information from disaster sites, One Foundation passed on the demand information to Junyao Logistics Center, who arranged to dispatch the material based on their airline capacity. And then Jixiang Airline (Belongs to Junyao Group) took care of transporting the emergency material to Sichuan.

The coordination between One Foundation and Junyao Logistics Company was a typical initiative which exploited the advantages from a professional logistics company and let them serve as a third party logistics provider. One Foundation surely wasn't the only grass root NGO who worked with private firms on

⁷ Also mentioned by a interviewee, see interview summary 4 in Appendix 5

warehousing management and transportation. The similar coordination initiatives were found frequently in Wenchuan relief, for example the coordination between AmeriCare and FedEx⁸, and the coordination between New Hump Group and Chuanqiu Airline.

Although private sector engagements in the Wenchun relief were found quite frequently, most of coordination still stays on resources provision, like donating warehouses or providing transporters rather than providing logistics expertise. Through the interviews, an interviewer indicated that drivers from logistics companies showed reluctance to drive in the dangerous aftermath environment due to the possibilities of second disasters or aftershocks⁹. This could be one reason that contributed to the absence of logistics expertise provision. The other reason that contributes to this current situation could be the absence of pre-agreement between private companies and humanitarian organizations. Since expertise provision would be more complicated than simply offering physical facilities so that clear responsibilities need to be defined explicitly for participants before disasters.

Even for those private companies engaged in expertise provision, we shouldn't overlook the fact that the logistics activities weren't completely outsourced to a third party. The humanitarian organizations were still very much involved in each process. The engagement of humanitarian organizations during the Wenchuan relief was indispensable in the third party logistics coordination since the initiatives were mostly provisional without specified job responsibilities defined beforehand. Another reason that relief organizations need to be involved is because mutual supervision also increased the credibility to the public.

Therefore, we can see that from the previous discussion in chapter 4, the outsourcing can be done in three levels of coordination orientation theoretically. However, from the real case study, we can see it is only stays at a very primitive level in the sense that the private sector mostly provides their facilities in transportation or warehousing processes.

Added value of third party logistics:

Working with the professional logistics companies helps humanitarian organizations to deal with the challenge factor: "Lack of professional staffs and High staff turnover". Moreover, the private sector can also provide critical facilities like airlines, warehouses, and logistics expertise which assist humanitarian organizations to work on other challenge factors like "damaged infrastructure" and "urgency".

5.4. Match with generic approach in commercial chain

Although the following coordination initiatives found in the case study can't match with the specific coordination mechanisms in the commercial supply chain, they are still lessons that learned from the general approaches in the commercial supply chain as discussed in chapter 2. The following coordination initiatives "Demand information sharing", "Shared inventory capacity" are both experiences transferred from generic lessons "Resource sharing" in commercial chain to the relief chain.

⁸ Refer to interview summary 3 in Appendix 5

⁹ Refer to interview summary 2 in Appendix 5

5.4.1. Demand information sharing

In order to delivery right amount of supplies to the disaster sites, the strategy that local NGOs adopt was to send a team which was responsible for demand collection at front line¹⁰. This strategy lasted through the whole response period in most of disaster impacted areas. This group of people was well-trained and was very familiar with local circumstances. In order to complement the supply from the government, the communication between NGOs and the government was done by this group at front line as well. Therefore, the tasks for this front line demand collection groups are twofold: one was to assemble the accurate demand information from impacted sites; the other one is to connect with local government and accommodate their relief supply with the government to avoid duplication or insufficient supply.

5.4.2. Inventory capacity sharing

1) Pre-storage of emergency resources in shared warehouses

Among the large NGOs with the government support during the Wenchuan relief, China Foundation for Poverty Alleviation (CFPA) responded to the emergency supply very quickly after the disaster struck. That was due to its availabilities of pre-stored materials which reduced their lead time. CFPA had long time planning and coordination with the Ministry of Civil Affairs by renting their warehouses in Tianjin and Wuhan and stored the emergency resources with the value of 20-30 million RMB in those warehouses. In order to guarantee the quality of pre-stored materials, CFPA checked and updated the resources on a regular basis. This coordination with Ministry of Civil Affairs before disaster on pre-stored suppliers accelerated the speed of emergency supply from CFPA. This coordination on sharing inventory capacity between the Ministry of Civil Affairs and CFPA were built up with a long term orientation so that it required NGO with more abundant resources and also good connections with the authorities.

2) Shared inventory capacity after disaster

However, due to the uncertainty of disaster occurrences, funding tendencies in the sector, and the costs associated with operating distribution centers, only a few relief organizations can afford to pre-store their emergency supply (Balcik and Beamon, 2008). Other than governmental agencies and large NGOs like China Foundation for Poverty Alleviation, most of the humanitarian organizations didn't have warehouses to pre-store supplies before the earthquake. In order to keep materials during response, NGOs joint together to share warehouses capacities to save costs and make best use of limited resources. Like 5.12 NGO Sichuan Relief Coordination Office stated above, all the members within Coordination Office shared warehouse capacity in Chengdu. In their case, the warehouses were donated by a local private company in Chengdu. 5.12 NGO Sichuan Relief Coordination Office also offered their warehousing capacity to NGOs from other provinces, for instance Xiamen Green Cross and Fujian Tongren, enabling non-local NGOs from to temporarily store their emergency resources near disaster sites

Added value of sharing inventory capacity

From chapter 3 we know that uncertainty of disaster scope is one factor that challenges the aftermath relief since the location, magnitude or type of disaster are hard to predict beforehand. This coordination on sharing inventory capacity among humanitarian organizations can assist players to deal with this scope

¹⁰ Refer to interview summary 2 in Appendix 5

uncertainty. For larger NGOs, the pre-storage inventory shared with governmental agencies ensures the immediate respond. No matter when a disaster would happen, the essential materials are always available and can immediately be accessed in their warehouses. For smaller scale of humanitarian organizations, this coordination gives them flexibility since the decision about where to store the emergency resources can be made after a disaster. Above all, this shared inventory capacity coordination mechanism aid humanitarian organizations in tacking with scope uncertainty.

5.5. New found coordination mechanisms in case study

Besides the promising coordination mechanisms discussed in chapter 4, there are more coordination mechanisms found through the case study. They are illustrated from now on.

5.5.1. Coordination to avoid duplicated or insufficient supplies

Coordination happened between NGOs and the government also exhibits through the complementary type of resources they offered. The government took care of the main emergency supply, like food, water or shelters and NGOs on the other hand, paid more attention on the materials that the government overlooked. A very prominent example from interviews is that after the earthquake, milk powder and sanitary pads were urgently needed for kids and women¹¹. Moreover, local Muslims people also have special needs on their food provision. Since these needs weren't in a large amount comparing to water or tents that everybody required so that the government didn't fulfill those demand immediately. Through demand investigation done by "demand information collection team" at front line, local NGOs got the message about the urgency and the special needs from certain groups of victims and delivered milk powder, sanitary pads and food for Muslim to impacted areas in time and to a large extent alleviated the demand gap.

From the previous discussion in chapter 3 we know that the framing effect from the media would change the physical flow of resources allocation, the similar situation also happened also during the Wenchuan relief. Some very severe damaged areas around the epicenter like Wenchuan, Yingxiu and Qingchuan were under great exposure of the public media. Other less server damaged areas, like Pengzhou or Zhouqu, on the other hand were overlooked by the public. The dominant governmental relief force also mainly focused on very severe areas and conducted relief operations like removing death and evacuating trapped victims underneath ground or reconnecting infrastructure. At the same time, there wasn't sufficient effect on providing emergency supplies to less severe areas. At this moment, NGOs demonstrated their unique value to provide the complementary relief assistance by commit their resources on the "less attention areas."

Added value:

As we discussed in chapter 4, the "co-existence of various actors" complicate the aftermath relief environment which may cause duplicated effort without good communication or coordination. The demand information sharing is one way to tackle this challenge by exchanging supply plans with other responders.

¹¹ Refer to interview summary 2 in Appendix 5

Under such a catastrophe, the government is dominant player in relief provision with overloaded information to process and overwhelming tasks to conduct. Hence, the government does not have the flexibility or concern on relative minor issues like NGOs do. Therefore, the unique role of NGOs was exhibited through providing emergency resources to those relatively smaller groups of people. The overall supply which made the emergency supplies more comprehensive is the added value of this coordination mechanism provided, which also deals with the challenge factor “Framing effect from media”.

5.5.2. Coordination for the sake of governmental approval

1) Coordination in last mile distribution

In the Wenchuan earthquake, the government had a strict monitor and control on NGOs’ emergency supply activities, including access to the most affected areas and all final decision making on the assistance provided. For months, police and military forces blocked the roads around some disaster areas to prevent non-essential personnel from entering the disaster zone (Hoyer, 2009). According to my interviewer from an international NGO¹², in each town they worked, the organization had to receive permission from the local government and share all the information on their work. In addition, import medical aid (including medicines) was strictly regulated as well. In summary, non-governmental agencies would not have been allowed to carry out their work without behaving in line with the regulation of the authorities. Despite these strict regulations, there is a common believe among people that these authoritarian measures largely succeeded in saving lives and reducing the secondary disasters of disease, flooding and damage from strong aftershocks.

Because of the strict regulations, it was highly advisable for non-governmental organizations to dispatch last mile emergency supplies with the government instead of doing it alone. For example, Oxfam, as an influential international NGO with Chinese root, chose to work together with regional government agency that was responsible for poverty alleviation since Oxfam has connection with it before the disaster happened. At first, Oxfam requested to deliver their emergency supply directly to the impacted towns. However, the Sichuan provincial government only agreed them to deliver the material to city level and let the municipality government at city level took over the last mile distribution. After several rounds of negotiation and also better understanding built from each side, the government agreed Oxfam to deliver their emergency supply down to towns and even down to villages. Through this way, the targeted assisted areas and people were better defined, and the feedback from victims was more transparent. Undertaking the last mile distribution by Oxfam reduced workload for local government and at the same time helped Oxfam to evaluate their relief performance and response more effectively as well.

From this example, we can see that the general regulation from authority keep the order of relief works on disaster sites by the exclusion of non-essential personnel. However, coordinating with the professional humanitarian organizations, like Oxfam for instance, the governmental agencies can also ease the burden of heavy emergency supply work. This kind of coordination is only achieved after the government received positive feedbacks on partner’s performance, which helps the government to make sure that these organizations are really helpers instead of trouble makers.

¹² Refer to interview summary 3 in Appendix 5

2) Coordination for legally operation

As we know, the earthquake shook the entire country, non-governmental forces were highly motivated to participate in the aftermath relief. This force stemmed from public complemented governmental relief and therefore a very influential force during the Wenchuan aftermath.

However, because of the sudden emergency of huge amount of NGOs, lots of them didn't legally register and therefore wasn't legally approved by the government to collect large amount donations. This was a common problem for lots of NGOs emerging in the Wenchuan relief. Here I give an example to illustrate how this kind of NGO survived and contributed to relief through innovative coordination.

As a joint NGO organization consisted of 4 grass root NGOs and one media organization in Shanghai, "New Hump Group" acted as a bridge, successfully connected donors, logistics providers and receivers. Functioning as a material and information hub, New Hump Group demonstrated an innovative way of coordination among humanitarian organizations in Chinese relief context (Zhu et al., 2009).

At the beginning of New Hump Group's operation, New Hump Group managed to collect information about public donors (including private companies, foundations or charity groups) who were searching for reliable humanitarian organizations to donate their emergency resources to. New Hump Group also successfully put Chuanqiu Airline on board as their logistics provider. As long as New Hump Group processed legal operation documents, they can start the relief work. In order to provide itself a "legal identification", New Hump Group found itself a partner: Shanghai Charity Foundation (SCF), under whose name New Hump Group launched donation collection.

What the New Hump Group did first was to provide suppliers' information to public donors on internet regarding suppliers' locations, items available and the prices. Since after the earthquake, there were lots of donors who weren't willing to donate their money to governmental agencies due to their untraceable expenditure. They were more willing to purchase urgent needed emergency resources from suppliers and donated to reliable NGOs instead. Because through this way, they were aware of how their money had been spent. Since New Hump Group notified the public donors about suppliers' information and resources needed, donations quickly filled their warehouses. According to the agreement, Chunqiu Airline company as New Hump Group's logistics partner, transported the donations to Mianyang relief headquarter which was also contacted by New Hump Group to serve as the receiver, who would also took care of last mile distribution to victims. Figure 23 illustrates the coordination processes for New Hump Group.

From this example, we can see New Hump Group, located in Shanghai which was far away from impacted areas. They didn't process warehouses, transporters or even legal relief operation documents at first. However, it still managed to transport 60 tons (worth 2 million RMB) emergency resources to Sichuan by serving as an information and material hub-providing suppliers' information to public donors, coordinating with legally registered NGO, contacting logistics providers and local receivers in impacted areas.

Case study-the Wenchuan earthquake in China.

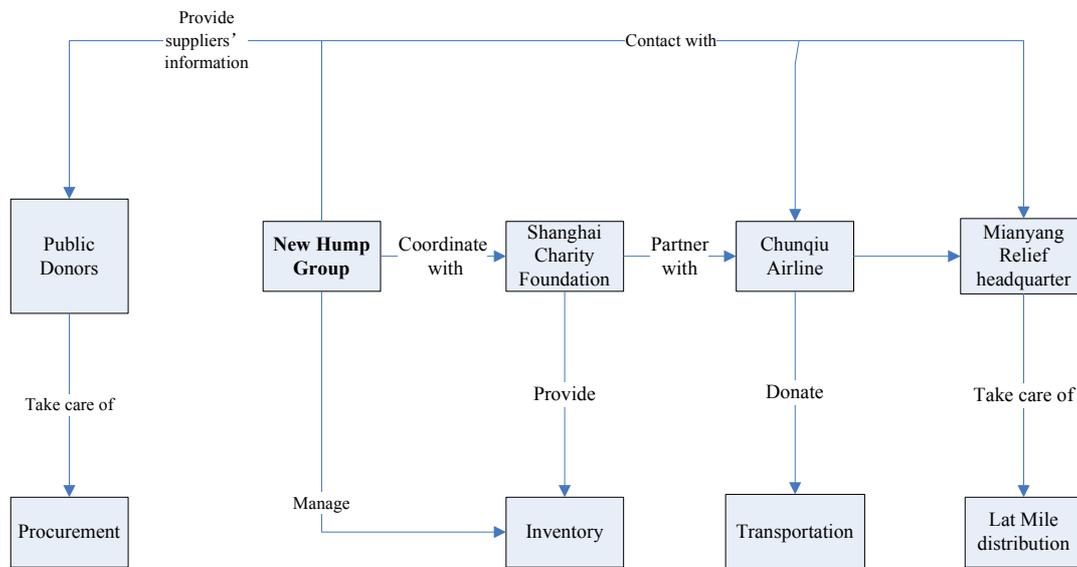


Figure 23: Coordination processes for New Hump Group

Added value:

Overall, the regulations from the government on “last mile distribution” keep the relief order on the disaster field by excluding the inexperienced partners. The benefits of the “Coordination in last mile” coordination mechanism between the government and NGOs are mutual. On the one hand, it helps NGOs to stay on the same page with the government to avoid potential conflicts with them. As we know from chapter 3, policy uncertainty is one factor that challenges humanitarian organizations. This coordination can help NGOs to avoid this uncertainty and provide more sustainable aid by staying in line with the government regulation and become part of its alliance. At the same time, the help under government’s supervision can ensure that no duplicated efforts are provided and also bring NGOs more in-depth involvement in disaster relief, increasing the accuracy of aid provision. On the other hand, the coordination with NGOs alleviates the pressure for the government in emergency resources provision. The coordination relationships enable entrance of qualified partners outside the government relief system and provide complementary effect on government’s supply like stated above. What is more, these non-governmental agencies were also very important channels for public fund raising since their transparent expenditure record is attractive to the public donors. Therefore, coordinating with these NGOs also helped the government to increase effective public participation in relief.

“Coordination for legally operation” granted NGOs legal operation identification, removing the potential conflicts with the government. This coordination pattern among non-governmental made the engagement of small scale of NGOs possible. Since the catastrophe stimulated the strong desire from non-governmental organizations to engage in aftermath relief, this ad hoc coordination initiative successfully fulfilled organizations’ demand and consequently add more emergency supply into the relief chain, which assist in bridge the demand gap.

5.6. Conclusions of chapter 5

In Chapter 4, the application level of coordination mechanisms in commercial supply chain were evaluated under relief context. We know that the coordination mechanisms colored in red were the ones that can't be transferred into relief environment. A quick scan on the screened coordination mechanisms was conducted to check whether these theoretical non-promising coordination mechanisms still appeared in the case. It turns out no surprising results were found through this double check process i.e. the theoretical non-promising coordination mechanisms are still not applicable in reality since no coordination initiatives with the red ones' characteristics were discovered through the case study.

Table 9 summarizes the found coordination practices which match with promising coordination mechanisms discussed in chapter 4 during the Wenchuan relief. From this table, we can see all the promising coordination mechanisms listed in chapter 4 were found in Chinese relief context with some changes adopted comparing to the practice in the commercial supply chain. In joint procurement, actors in joint purchase could undertake different responsibilities depending on the various advantages different actors have. For instance, one actor could be fully responsible for suppliers screening, while the other could be fund raiser. In short, the joint procurement could be more flexible and spontaneous given specific circumstances. Quick response is the coordination mechanism practiced between private sector and humanitarian organizations. This coordination mechanism happened after disaster struck until humanitarian organization could share demand information to private suppliers, then they started to engage in emergency production. This characteristic distinguishes quick response in the relief chain from the one in commercial chain. Regarding third party logistics, most of the initiatives still stay at physical material provision, indicating the third party logistics in the relief chain still stays at a primitive level comparing to the commercial supply chain, where expertise or supply chain configuration design are the key added value by 3rd party logistics providers.

Table 9: Summary of Promising coordination mechanisms found in case study

Promising coordination mechanisms	Found in the case?	Alteration from SC theory in relief chain	Actors	Contribution to relief chain performance
Joint procurement	Yes	Coordination mode is flexible	Among small scales NGOs or local governments	Reduction on response time and costs.
Quick respond	Yes	Information shared <i>after</i> disasters	Private sector+ government/Large NGOs	Reduction on response time
Third party warehousing	Yes	Stays mainly in resource provision	Private sector+ Government/NGOs	Resources or expertise provision
Third party transportation	Yes	Stays mainly in resource provision	Private sector+ Government/NGOs	Resources or expertise provision

Case study-the Wenchuan earthquake in China.

Table 10 illustrates the generic approaches found in the Wenchuan case, coincidentally, they all belong to the resource sharing pattern. For demand information sharing, the coordination is among humanitarian organizations to avoid the duplicated efforts and provide an overall comprehensive supply package to victims. Regarding inventory capacity sharing, different organizations would choose different timing to engage in this coordination based on their fund availability. Large scale humanitarian organization that processes abundant among of funds could choose to pre-store their key emergency resources. Through this way, the response time can be reduced since the emergency materials would be available upon requests. Most of humanitarian organizations shared inventory capacity with others temporarily after disaster.

Table 10: Generic approach found in the case

Coordination mechanisms	Practiced actors	Contribution to performance
Demand information sharing	Government+ NGOs	Avoid duplication efforts
Pre-storage of emergency resources	Government+ Large scale NGOs	Reduce respond time
Shared inventory capacity after disaster	Small scale NGOs	Reduce operational costs

Table 11 illustrates the new found coordination mechanisms in the Wenchuan relief and the actors practiced them accordingly. Why are these coordination mechanisms categorized as “new found” coordination mechanisms?

First of all, some of these coordination mechanisms (i.e. coordination in last mile distribution, coordination for legally operation) are exclusive to the relief chain and aren’t applicable for commercial environment since they are special phenomenon due to the provisional governmental regulations in the relief context.

Secondly, “Coordination to have a complemented Supply effect” would be seen as a marketing practice reflected in disaster aftermath. As in marketing theory, market segmentation underlines the view that markets, and their segments, are clusters of potential customers (Jenkins and McDonald, 1995).In the commercial supply chain, players could use “pull strategy” to launch “make-to-order” productions and fulfill different demands in different segmented market. Since in the relief chain, the customers for relief organizations are victims who have common emergency needs in general and meanwhile minority groups of victims also raise special requirements on emergency respond. Therefore, this “relief market” can be segmented based on emergency demand. However, comparing to the supply chain players, there are a lot more uncertainties for relief actors to have an overall complemented supply effect since the volatile demand information can not be predicted or accurately known. So for relief actors, instead of “pull strategy”, the “push strategy” always comes first to just delivery the emergency material based on responders’ assumption.

This achievement of complemented supply effect doesn’t necessarily require explicit agreement among humanitarian organizations given the assumption that different relief organizations are aware of their organizational capacities. As the dominant actor in aftermath relief, the government is obliged to be

Case study-the Wenchuan earthquake in China

responsible for majority of victims who raise most type and amount of demand. Other relief forces in society, like NGOs or volunteer groups can take the responsibility to provide aid to the minority groups of victims who have special needs. This scenario can be seen as a coordination initiative based on consensus on their organizational capacity and appropriate role undertaken in disaster aftermath among governmental and non-governmental relief force. The government could also regulate and intervene the “relief market” in order to have an overall complemented supply effect.

Table 11: Summary of New found coordination mechanisms in Case study

Coordination mechanisms	Practiced actors	Contribution to performance
Complemented supply focus	Government+ NGOs	Increase relief coverage
Coordination in last mile distribution	Government+ NGOs	De-conflicting with government
Coordination for legally operation	Large scale NGOs+ Small scale NGOs	

Until now, current practiced coordination mechanisms in Chinese relief context have been discussed through a representative case study. The results of the case study verify the feasibility of promising coordination mechanisms discussed in chapter 4. At the same time, the results also offer insights on new found coordination mechanisms in the Chinese relief context. Therefore, in the next chapter, we are going to conclude the thesis by offering the suitable coordination mechanisms to different actors. Possible improvements regarding coordination practice will be recommended as well.

6. Conclusions and recommendations

This chapter will provide the main findings and conclusions of this thesis. First of all, I would like to present the new insights that are found in order to answering all the research questions. Subsequently, I would like to provide policy recommendations and discuss the knowledge gaps that still remain and could still be worked on for further research.

6.1. Conclusions

The goal of this research is to provide an answer to this main question: ***How to coordinate different actors involved in Chinese relief chain context?***

This is answered through two main sub-questions which would be discussed within the reminding of this section.

Theoretical sub-question:

What coordination mechanisms can be used in relief chain to better allocate emergency resources?

In the commercial supply chain, there are several specific coordination mechanisms available. In procurement process, the companies can adopt joint procurement coordination mechanism. Quick response, Continuous Replenishment Program, Vendor Managed inventory, Joint Managed inventory and Continuous Planning, Forecasting and Replenishment, together with 3rd party warehousing are the coordination mechanisms available in inventory process. 3rd party transportation is the one suitable to adopt in the transportation procedure. Based on the features of specific coordination mechanisms, three generic coordination approaches are extracted: Resource Sharing, Joint Decision Making and Outsourcing. Companies can mix up these generic approaches to initiate the appropriate form of coordination.

However, these coordination initiatives can't be transferred directly into relief context due to the existence of challenging factors, i.e. Urgency, Uncertainty, Complexity Working Conditions and Co-existence of various actors. Uncertainties might happen because of scope of natural disasters, demand and supply or policy regulations. Complexity working conditions stemmed from damaged infrastructure, lacks of own professional staff and high turnover or media's framing effect. Most of these challenging factors can be dealt with even before disaster happens strategically and these measures require the long term efforts investment starting from the preparation phase. Right after the disaster strikes, these factors tend to be coped from an operational level due to the insufficient information and overloaded uncertainties. While it enters 2nd stage of response, tactical or even strategic level of actions can be taken to cope with these challenging factors.

Because of the existence of these challenging factors, lots of the coordination mechanisms practiced in the commercial supply chain are not applicable anymore. While the others still stand in the relief context, they are Joint Procurement, Quick Response, 3rd party warehousing and transportation. For the generic lessons learnt from commercial supply chain, all of them seem promising in the relief chain. However, one

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should be mindful that the higher level of coordination orientation requires, the harder for them to transfer.

Empirical sub-question:

To what extent those promising coordination mechanisms discussed in the theoretical part can be applied in the Chinese context?

Through the case study on the Wenchuan earthquake, the result shows that the theoretically promising coordination mechanisms are practiced within Chinese relief context. Joint procurement, Quick Respond, 3rd party warehousing and transportation are found in the Wenchuan relief, manifesting the high level application prospects of these coordination mechanisms. Meanwhile, some alterations on executing these mechanisms were adopted to fit in the specific relief context.

Not only the specific coordination mechanisms are found in the case, but also generic coordination approaches were discovered as well. Resource Sharing, Joint Decision Making and Outsourcing were all practiced among relief organizations in the case.

Besides the specific coordination mechanisms and the generic coordination approaches, some coordination initiatives were invented uniquely in relief context by humanitarian organizations. That is the time when the experience from commercial supply chain isn't sufficient enough to provide guidelines; the actors in relief context come up with some new initiatives. One initiative is coordination to provide complementary supply outcome among different relief suppliers; another one is coordination for the sake of legal operation in relief environment. The following table gives an overall of the promising coordination mechanisms and the practicing actors accordingly.

Promising coordination mechanisms	Actors
Joint procurement	Small scales of NGOs/Government+ NGOs
Quick response	Private sector+ government/NGOs
Third party warehousing	Private sector+ Government/NGOs
Third party transportation	Private sector+ Government/NGOs
Demand information sharing	Government+ NGOs
Pre-storage of emergency resources	Government+ Large scale NGOs
Shared inventory capacity after disaster	Small scale NGOs
Complementary supply focus	Government+ NGOs
Coordination in last mile distribution	Government+ NGOs
Coordination for legally operation	Large scale NGOs+ Small scale NGOs

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Besides these important conclusions in the central of research questions, there are also some extra important findings found:

- 1) The Chinese government is a dominant force with very clear regulations, and uses a hierarchal approach to keep the order of aftermath relief.

The Chinese government, as the most important actor in the Wenchuan earthquake relief, manifested a very strong role in controlling the relief situation by excluding non-essential staffs or excluding unsolicited supplies in the impacted zones. The coordination initiatives happened between the private sectors and the government also indicated the coordination was facilitated by a hierarchal approach. Both domestic and international media gave positive comments towards the Chinese government on their relief response and regard their relief efforts as effective towards saving lives and alleviating sufferings.

- 2) Joint effort and decision making among non-governmental forces are very predominant phenomenon in Chinese aftermath relief.

Since non-governmental forces could deploy fewer resources comparing to governmental agencies, Chinese NGOs, volunteer groups or communities forces chose to pool resources together and made use of each other's advantages. Smaller scale of non-governmental agencies could benefit from these coordination initiatives.

- 3) Private sector engages in almost every process of aftermath relief: procurement, warehousing or inventory. The engagement however mostly still stays on the operational level.

For private sectors, they actively participated in the Wenchuan earthquake relief with their resources and expertise. However, due to lack of long term planning and pre-agreement between private companies and relief organizations, these coordination initiatives were done provisionally after the disaster, which still stays on operational level.

We can see how the commercial supply chain provides us a foreground to step on, to gives us a starting point to further explore the situation of the relief chain. According to the characteristics of the actors in this Chinese relief context as well as the feature of coordination mechanisms, promising coordination mechanisms are recommended to relief actors in China. The specific ones are Joint procurement, Quick Response and 3rd party logistics. The generic approaches- Resource Sharing, Joint Decision Making and Outsourcing are still applicable in relief environment. The coordination initiatives found in case which match with theoretical recommendation further back up the theoretical recommendations. In addition, some new coordination initiatives can be duplicated for future relief work. These new found coordination mechanisms are "coordination to have complementary effect" and "coordination for the sake of legal operation". Examining these coordination mechanisms recommended in both theoretical or empirical studies, actors can choose for their own according to the organizational capacity and availability of partners in order to build up a more effective the relief chain, i.e. less lead time, more precise demand fulfillment, more supply coverage etc..

The Prescriptive question

"What can actors do to facilitate coordination in Chinese relief chain" leads us to the recommendations to relief actors in Chinese relief context.

6.2. Recommendations

From the findings regarding coordination mechanisms, we can see that most of the coordination initiatives applicable to the relief chain are the ones that are launched after disaster during the disaster response phase. This situation can be further improved by building up more strategic relationships among relief actors before a disaster strikes.

1) Authorities incorporate the non-governmental force to have a complementary effect

For the government, the approach they use is up down and for non-governmental agencies; the approach they use is bottom up. Non-governmental agencies are more flexible in adjusting dynamics demand information due to their relatively small supply volume. Meanwhile, they also complement the types of supplied resources that the government overlooked. The relief work would have complementary synergies if coordination is organized properly by integrating non-governmental agencies into the existing governmental emergency respond system.

From the case study, we could see NGOs, groups from society and volunteers actively participated in aftermath relief. The government set up restrictions on unsolicited supplies or impacted zones entrance privilege, leading to better controlled situation and more efficient use of resources, and overall the response was crucial in saving many lives. However, the absence of regulation before (instead of after) disasters on behavioral norms, like the regulation on NGO operation, permission for entrance impacted zones etc., caused some unnecessary resources waste and disorder in the field. Clear regulations regarding the non-governmental agencies participation are called for from authorities to mitigate the policy uncertainty and avoid resources waste or effort distraction.

If the Chinese government, as the dominant player in the aftermath relief field, can specify the responsibilities for Governmental agencies, military force as well as NGO groups. If the government can manage and guide the non-governmental force to take charge of the works (or groups of victims) that authorities overlook, then the overall complementary supply effect could be reached.

2) Build up sustainable relations with suppliers on emergency supply

From the analysis, we know that the connections between humanitarian organizations with private sector on emergency supplies were loose in the sense that they don't really have frequent contacts until something urgent happens. Like the example stated in the case study, the Ministry of Civil Affairs didn't maintain contact with tents providers, thus affecting the efficiency of emergency supply. Therefore, long term strategic relationships between humanitarian organizations and business suppliers are recommended to be built up in order to guarantee quick response.

Governmental agencies might contract with certain suppliers in different regions who can dedicate in producing key emergency resources during natural disasters. By signing emergency production contract with commercial suppliers, governmental agencies can therefore have a clear idea of who can come to during emergency purchase. The sustainable relationships between humanitarian organizations and commercial suppliers will assist in reducing lead time for emergency supply.

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3) Identify strategic alliance before emergency

For NGOs, joint effort is vital for them to exchange resources and make the best use of each other's advantages. Currently, these joint efforts or joint actions are mostly staying at an operational level and launched temporarily after disaster, such like joint procurement as previously mentioned. Therefore, it is advisable for NGOs, community organizations and volunteer groups to identify their potential coordinating partners even in the preparation phase, when they could have more abundant of time to determine the way of resource sharing and joint decision making.

Besides the recommendations for preparation phase, suggestions are offered to humanitarian organizations for the response phase as well:

1) Non-governmental agencies spot their position in less attention areas to avoid media's framing effect.

As we know, after major disasters, media tends to report the situation from the most severe areas which could result in insufficient attention on less exposure areas. The need from less exposure area might be overlooked or not well known by relief organizations. For non-governmental forces that are more flexible in their relief operations, they can then switch their attention on the less "well-known areas" to complement the efforts from the main governmental force in terms of emergency supply coverage.

2) Coordination by standing by when information is unclear

These two coordination mechanisms "Coordination in the last mile distribution" and "Coordination for the sake of legal operation" allow non-governmental force to engage in aftermath relief and meanwhile de-conflict with the government. However, we can't overlook the fact that the timing needed for non-governmental organizations to take actions to get involved is vital. From the example in "Coordination in the last mile distribution", we can also see that the NGO'S engagement is done step by step. Therefore, it is strongly advisable to non-governmental relief organizations to stand by and follow government's guidance instead of rushing into impacted zones during immediate response when information is unclear. The added value of NGOs could be exhibited only after they get enough information and define their role in aftermath relief properly. Therefore, we can see coordination with other relief organizations don't necessarily mean "do things", it can also imply "not do things" to keep the trouble makers away and maintain the order in impacted field.

6.3. Research contribution

Emergency logistics is an emerging field. This research explores this rather new area by transferring the experience from the commercial supply chain to the relief chain. In specific, the research contribution can be seen from three aspects:

1) Contribution on the disaster relief theory and practice. Since coordination study in the relief chain is still in its infancy, this thesis contributes the relief chain theory by exploring the possibilities to transfer the lessons from the commercial supply chain into the relief chain. Therefore the new insights fill in the gap in the existing disaster relief theory and at the same time, can be a guideline for the field practitioners to launch their relief work. Besides feasible and concrete coordination approaches, the

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possible coordinating actors and their relationships are also recommended. So for relief responders, specifically for the Chinese organizations, can refer to the coordination approaches recommended in this thesis to launch their relief work in the future.

- 2) Contribution to the supply chain theory. This master thesis reviews the specific coordination mechanisms existing in the supply chain on the operational linkage. Furthermore, the generic coordination approaches are abstracted based on the existing coordination mechanisms. This new insight provides a new classification of coordination mechanisms in supply chain and also gives a more general point of view to look at the coordination theory in the commercial supply chain from a higher level.
- 3) The value of case study. Firstly, the Wenchuan earthquake study illustrates a representative disaster relief response event by Chinese relief stakeholders. The way that different parties respond to that disaster event, especially when it comes to coordination, are explicitly demonstrated. Secondly, the case study identifies some problems occurred during the relief response with some possible solutions offered to tackle these problems. It is helpful for the Chinese responders to learn from past experience and avoid the similar problems in the future relief work.

6.4. Limitations and further research

First of all, one limitation stems from the constrained scope that this master research defined. This master thesis studies the preparation and immediate response phases of the Chinese relief chain and how the coordination relations among different actors were built up and how to further improve. However, more types of coordination patterns organized by relief organizations in other relief phases, like the recovery or reconstruction, could also contribute to the relief chain configuration and that part of coordination mechanisms are left out due to limited period of master thesis study. In fact, relief work is a constant procedure in which actors develop their learning experience while they undertake relief tasks. So experience regarding coordination can also be transferred into recovery or reconstruction phases and the lessons learnt in those later stages will in turn effect the preparation and response in future relief. These continuous learning processes aren't taken into account in this research.

Besides the time aspect of the research scope, this research only focuses on material resources in relief work. Besides physical flows, financial flows are also very critical in deploying the relief chain. However, the interaction between physical, financial and information flows and how they influence each other aren't touched upon in this research. For instance, the transparency of how the public donations are effectively collected by relief organizations will affect the amount of funds available for an organization to launch emergency purchases; will consequently influence the amount of physical resources that can be delivered to victims.

Secondly, there is also a limitation from doing a single case study in this research. Concentrating on a single case study provides much detailed information and informative explanation. However, on the other side, a single case study induces obvious limitation on research generalization.

Thirdly, the reason why some coordination initiatives can be organized on relief fields were due to personnel relationships within organizations, for instance between NGOs and local governmental

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agencies. This type of coordination initiatives were achieved due to more accidental factor, i.e. personal connections instead of replicable mechanisms. What is more, the agreement regarding coordination between organizations don't necessarily release to public. Hence, it is hard to know exactly how the existing relationship affects coordination in the relief chain and it is also difficult to generalize sustainable coordination mechanisms out of these initiatives for future learning.

Further research can be conducted by perfecting the limitations in this research and adding more values of this research:

1) Expand the study horizons into disaster recovery or reconstruction phases can have a better understanding on how humanitarian organizations develop the coordination relations along the time and how the learning processes on coordination through time span can contribute to relief supply. Since the relief chain is mingled with physical, financial and information flows, so how the interaction among them can be further studied in future research.

2) Multiple cases studies can be conducted in Chinese relief context on different type of natural disasters on different magnitudes at different regions of the country. Through this way, researchers can get an overall idea of what the generic problems are and how the coordination among actors could help to make a difference.

3) Possible strategy to figure out how the "*Guanxi*" relationship influences coordination among different humanitarian organizations is to build up personal "*Guanxi*" network with high status people within those organizations; however, it might take a lot effort and long time to realize that.

Finally, we can see that this master research addresses the experience transferring from commercial supply chain into the relief chain and explores the possibilities to apply the existing coordination mechanisms into relief context. At the same time, there are also learning aspects that can be transferred from the relief chain to commercial supply chain. For example, as we have seen actors in the relief chain are very agile and they are able to align the differing needs and dynamic roles of many players (Van Wassenhove, 2006). Private companies increasingly need the same sort of skills (Lee, 2004) given the dynamic demands and risks of operating global supply chains and the increased central role of logistics in making profits under these conditions (Van Wassenhove, 2006). Therefore, future research can also address these mutual learning possibilities between commercial supply chain and the relief chain and look into how relief actors assist commercial supply chain players in their business operations.

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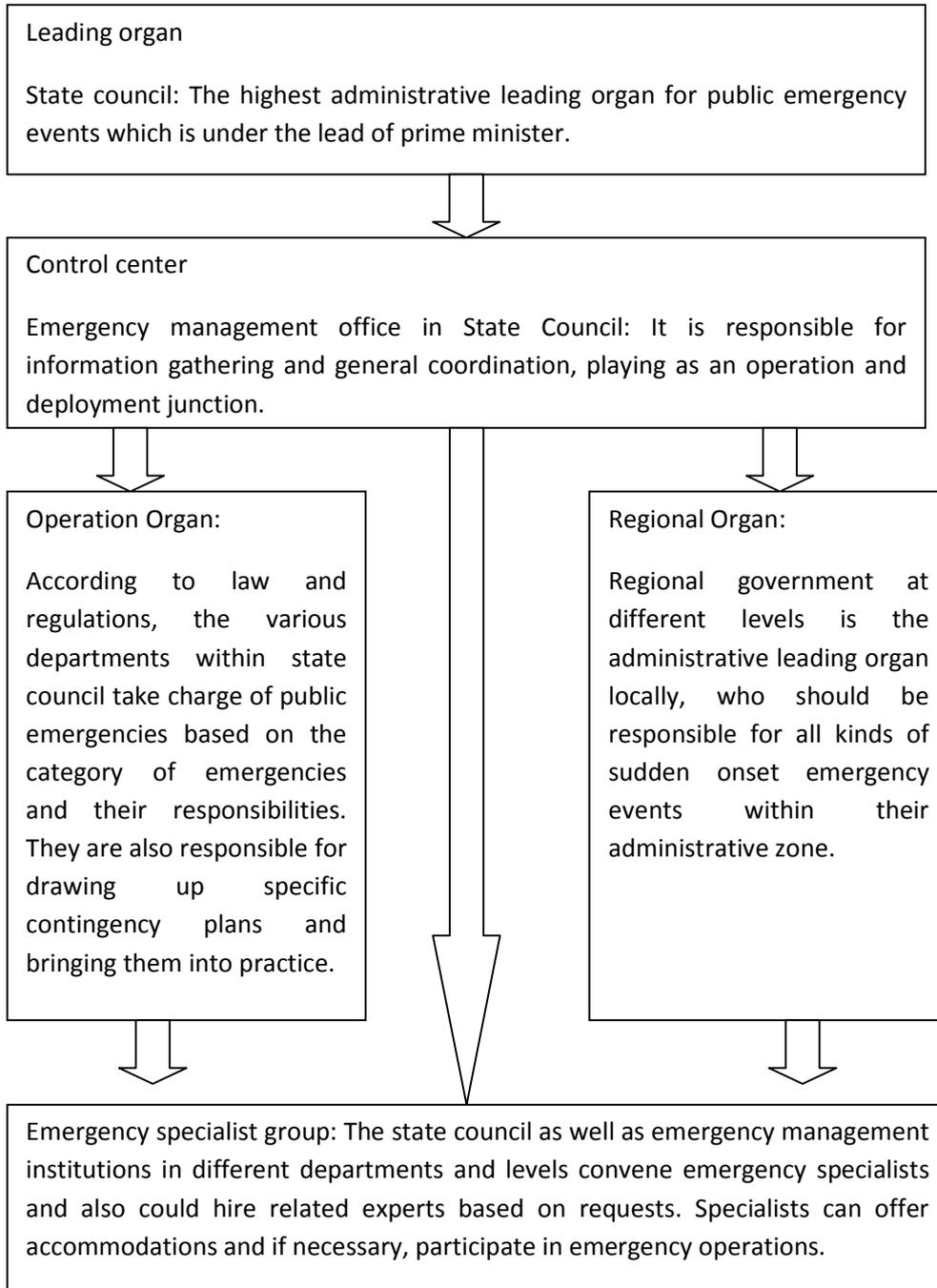
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Appendix 1

Appendix 1: List of actors in the Chinese relief chain context

Actors	Objective	Perceptions	Resources	Network
National government	Maintain harmonious society, keep society stable	Alleviate suffers, rescue lives	Military, Regulations, funds	Regional government, Media
Regional government	Regional stability, and economics development	Alleviate suffers, rescue lives	Knowledge on local circumstances, regulations, funds	National government, Media
Local NGOs	Collect more funds, build up trust	Alleviate suffers, rescue lives	Public trust, local network, donations	Local government, public, victims
International NGOs	Collect more funds, build up trust and international relationships	Alleviate suffers, rescue lives	Public trust, Professional experiences, donations	Donors, Victims
Private sector	Maximum profit, Good reputation	Alleviate suffers, rescue lives	Funds or emergency supplies, Specific expertise	Local government
Media	High audience rating	Alleviate suffers, rescue lives	Information/ Coverage	Government, public
Public donors	Doing good	Alleviate suffers, rescue lives	Funds	NGOs

Appendix 2: Framework of Chinese emergency response system



Appendix 3

Appendix 3: Corresponding departments' response to major disaster

Disaster category	Type	Responsible department
Natural disaster	Flood & Drought	Ministry of Water Resources
	Hurricane	National Weather Service
	Geologic hazard	Ministry of Land and Resources
	Earthquake	National Earthquake Bureau
	Fire in Forest and Grassland	National Forestry Bureau

Appendix 4: Question guidelines for Interviews

The focus of my research is on relief logistics and coordination among actors in the Wenchuan earthquake. Therefore, the questions are all somehow related to these issues. However, I am also more than happy to hear other facts/Information/stories from you regarding your experience in China during the Wenchuan earthquake. So feel free to talk to me if you would like to share more. Your help is highly appreciated.

–Danqi LIU

Introductory questions

I would like to know the environment that interview's organization was working in as well as general regulation regarding coordination.

- 1) What was the organization you were working for during the earthquake? Could you briefly describe your organization?
- 2) What were the responsibilities for you?
- 3) How many days after the earthquake did you /your organization get involved?
- 4) Where did you work during your relief work? (How far away was it from the areas you provided aid?)
- 5) How is logistics organized at field level? What kind of tasks do field logisticians have? Do you have dedicated supply chain specialists deployed at field level?
- 6) If your organization isn't a government agency, do you have connections with the government? Or get permission from the government?

Core question 1 :

Would you tell me the coordination initiatives that your organization engaged in procurement process and how they were organized?

Check list:

- 7) Through what channel did your organization get your emergency resources?
- 8) Did you encounter any problems on emergency materials procurement? How did you solve them ?
- 9) Did your organization ever purchase your emergency resources together with other organizations?
- 10) Did your organization ever have (a) coordinating supplier(s) to offer your emergency resources during response?
- 11) Did you have contract before the disaster with specific suppliers?
- 12) If so, what kind of partnership do you have? (Long term or short term for instance, when did you come to your partner?)

Core question 2:

I would like to know the coordination initiatives that your organization engaged and how they were organized in inventory process.

Check list:

- 13) Did you encounter any problems about storing your emergency materials? How did you solve them ?
- 14) Did your organization work together with other *humanitarian organizations* (may include the government, NGOs or foundations) on operating your warehouses?
- 15) If yes, how was it launched? (When you found these partners, what was the coordination orientation? Was it commercial engagement or non-commercial engagement?)
- 16) Did any *private sector* provide their expertise/ human resources/ facilities to help you on managing your *warehouses*?
- 17) If yes, how was it launched? (When you found these partners, what was the coordination orientation? Was it commercial engagement or non-commercial engagement?)

Core question 3:

I would like to know the coordination initiatives that your organization engaged and how they were organized in transportation process.

Check list:

- 18) Did you encounter any problems about transporting your emergency supply to the victims? How did they solved?
- 19) Did you ever work together with other organizations on transporting the emergency resources?
- 20) If yes, how was it launched? (When you found these partners, what was the coordination orientation? Was it commercial engagement or non-commercial engagement?)
- 21) Did any private sector provide their expertise/ human resources/ facilities to facilitate you on *transporting the emergency resources*?

Additional information

Additional information regarding coordination initiatives that haven't been discussed.

- 22) Besides the problems that we already talked about, were there any more problems that bother you/ your organization regarding emergency resources supply during the Wenchuan relief?
- 23) Was there any other coordination initiative among different humanitarian organizations (government, NGOs, private sector) that you engaged, or hear from other field practitioners?
- 24) Is there any more fact that you would like to share with me regarding relief coordination or humanitarian supply chain during the Wenchuan relief?

Thank you very much!

Appendix 5: Interview Summary

Interview Summary 1 - A volunteer from Red Cross Society of China

Red Cross Society of China is a very influential NGO with the governmental support who can accept public donations and widely engage in aftermath relief. During the Wenchuan relief, Red Cross Society of China collected 4.3 billion RMB donations.

When the earthquake strikes, I was a student in Sichuan University and the Red Cross Society of China recruited us three days after the earthquake from the campus as volunteers to help them move emergency resources. The main working responsibility for me is to upload all the materials from the warehouses to the trucks and sometimes unload the materials into the warehouses. It turned into the warehouses only for the emergency material storage after the earthquake strikes. The warehouses located near the Sichuan airport are fairly big and very well-organized with mostly food, drinking water stored. For example, I could see boxes of instant noodles and mineral water everywhere in the warehouses. I saw lots of trucks are from Chendu Cargo Center which is a united logistics organization that consists of different transportation and logistics companies in Chengdu. They had uniformed labels on their tracks that could prove that they were for disaster usage so they could enter warehouses or other disaster areas without restriction. Only people with permission could enter the warehouses. Everyday, during working time, all the volunteers would be picked up from campus and sent to the warehouses together. Individuals couldn't enter the warehouses on their own.

Interview summary 2 - A governmental coordinator from Sichuan Aftermath Coordination Office

During the Wenchuan earthquake, I was working for Sichuan Aftermath Coordination Office- under the Young league of Sichuan Province (An important organ in Chinese Communist Party). The main role that this office undertook is to coordinate relations between the government, NGOs and private companies to mobilize resources to the maximum usage.

Hundreds of NGOs, volunteer groups, foundations and community volunteers were involved in the response, recovery and reconstruction. They united and shared resources together to help each other overcome difficulties. It was very prominent phenomenon in the Wenchuan relief. The government also realized that NGOs were working together and the force wasn't negligible so that it was very necessary to build up a coordinating office. Through my experience, I found although the role that NGO could play in the Wenchuan earthquake was limited, they still could provide some complemented supplies that the government couldn't take care of. For example, the milk for kids, sanitary pads for women were some very typical materials that NGOs contributed. By comparing works that the government or non-governmental organizations did overtime, NGOs were also unique in providing "soft" support, for example, psychological aid to victims. Regarding the immediate response, lots of non-governmental forces emerged but lots of them didn't get registered so that the legal identification was a very serious issue for them. They had to process legal documents to be able to collect public funds for instance. Lots of small scale of NGOs also didn't have places to store the materials so most of rent or shared the warehouses with other organizations. Most of the trucks that NGOs had were rent from local logistics companies. The local drivers from logistics companies were more familiar with local landscape but they were afraid of aftershocks so they didn't want to drive for relief organizations. All the demand information for government or non-governmental agencies was collected by the investigation teams sent to front line. They were well-trained professional staffs. Overall, I think this relief was done 50% by Military Chengdu region, 30% by local government, 20% by local social forces and 10% done by the efforts from other provinces.

Interview Summary 3 - An employee from AmeriCares

AmeriCares is an international organization without a Chinese affiliated organization. The organization has worked for many years with partner organizations in China; however, none of these partners were active in the Wenchuan response.

The organization was immediately involved with coordination starting with the embassy, partner organizations, and other AmeriCares supporters past and present who have a connection with humanitarian work in China. We started coordination at the national level and replied to the request by Beijing to assist in the earthquake response. Then, coordination continued “on the ground” in Chengdu at the Provincial level mainly with the health authorities and authorities in charge of the earthquake response. For all stages of our work we worked in tandem with the government at both the provincial and the prefecture as well as municipality level. Even when travelling to the affected areas, including very close to the epicenter, we were always with the government officials and while staying in the affected areas we stayed at the hospitals where we were working. Including access to the areas most affected and all final decision making on the assistance provided. In addition, we quickly decided not to attempt to import medical aid (including medicines) mainly because they were not needed but also because of strict regulations. I do not consider this negative, as they informed much decision making with evidence and good needs assessments. In many ways, they were an excellent partner facilitating the work and expressing clearly the needs. We also shared some information with Chinese NGOs and civil society informally at the Chengdu level. For example, the Book Worm (a book store and café) hosted coordination meetings a few times and was active in distribution of emergency items. This coordination did not end up changing the course of our work or lead to more implementing partners, but was a good source of information.

Americares also launched a joint procurement with local government. We granted approximately \$100,000 to the local government authorities to purchase needed hospital equipment. Quotations were provided in advance and approved by AmeriCares and apart from a small deposit to the supplier(s) payment was sent electronically directly following purchase. Delivery of all equipment was then verified by AmeriCares staffs in China. Purchase itself was fully funded by AmeriCares but the purchasing was a joint activity. We did not have a warehouse. We did share an airlift of cargo supplies with another NGO at the early stage of the response and I believe the airlift itself was on a cargo plane donated by FedEx.

The earthquake affected a tremendous number of people and the response was similarly large in scale. Although the government was the primary actor in responding I met several incredibly strong, talented, brave and skilled individuals either in the hospital administration, local government or in the citizens in the affected areas who really were the driving force behind the response. I was also very impressed with the patience of those affected while they worked hard or waited to get their life back together.

Interview Summary 4-A manager from a local logistics company in Sichuan

Lingyun Logistics Company is a small local company with around 50 employees.

The most contribution our company made is to provide our trucks. We rent 20 trucks to Yi Foundation with normal price. We would never raise the renting price since it is also an opportunity for us as a company to do something for Sichuan. Some of our drivers also drove for Yi Foundation, but we didn't enter the very severe areas. We transport mainly in Chengdu. We didn't have contacts with Yi Foundation before the disasters, but after the earthquake, we saw the proposal from "United NGO Organizations" and also other news from media, which called for help from logistics companies. As a local logistics company, we thought we didn't have the excuses to say no. As far as I know, the things transferred by land were mainly food and drinking water. Besides our company, I know that some other local logistics company also rent their trucks to the government or NGOs and most of them were contacted first by the relief organizations. Transporters were in great need after all.

Within our company, we organized the inside donations to raise fund from top managers. Everybody made their own donations. Some of our colleagues suggested to also donate some clothing to disaster areas. But later on from the news, we knew they weren't really in need so we gave up that idea.