Distribution Situations Concerning Transportation and Environmental Impact

Multiple Case Studies of Medical Manufacturers in China

Master Thesis, 5FE02E, 30ECTS

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Master Thesis

Dedication:

We dedicate this thesis in honour of our parents who have been the source of inspiration and motivation all lifelong....
Acknowledgement

Working on this thesis provided us with opportunity to explore our concepts profoundly as regard to Transportation and Environment. This work comprehensively developed our understanding and allowed us to spread out on modern-day perspectives of the issue. We shall take this opportunity to show our gratitude for all those who assisted us undertaking this thesis in time.

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Växjö, May 2011

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Summary

Title: Distribution Situations Concerning Transportation and Environmental Impact

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Date: May, 2011

Keywords: Distribution System, Transportation System, Efficiency in Transportation, Environmental Impact, Customer Service.

Background: The environmental aspect of transportation has got a lot of attention over the past years. It has its origin in the growing awareness of environmental problems such as the global warming. In Europe the transportation industry is responsible for 21 per cent of the total emission. While studies of the subject show that an environmental friendly distribution and transportation is considered a success factor for many companies, there is a lack of interest from them to invest to obtain it.

Purpose: The purpose of this paper is to find the current distribution situations and the factors that influence the transportation and environmental impacts while maintaining the same customer service level, as well as how these factors will influence distribution situations in some Chinese medical instrument manufacturing companies.

Method: To gather data the authors will conduct a qualitative multiple case studies in the form of interviews at couple of medical equipment manufacturing companies to create the deep understanding needed to comprehend a company’s distribution system.

Results, conclusion: Initially, the current situation of distribution system in Chinese medical instrument manufacturing companies has been found according to the cases companies’ analysis. Second, the four factors which would influence transportation and the environmental impact while keeping the same customer service level have been identified. They are fill rate, consolidation, standardization and postponement. Furthermore, benefiting how these factors will influence distribution situation through efficiency in transportation has been given as the suggestion and recommendation to some Chinese medical instrument manufacturing companies.

Future Work: One thing the authors find to be interesting would be to include the further implementation to the fill rate in term to find quantitative data analysis. Another topic to investigate would be that from a third-party perspectives investigate a logistics provider’s or a TPL’s role in finding efficient logistic solutions for distribution that would lead to a reduction of transportation costs as well as the environmental impacts.
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1. INTRODUCTION

In this chapter a background to the project is presented, by recognizing the importance of distribution situations and transportation system in logistics operations as well as environmental impact, the strategic importance of this study is emphasized. Following the development of the problem discussion, specification of the problem, research questions, and purpose of this study is styled as well. Disposition is also enclose under this chapter to make a bird eye view for better understanding to this manuscript.

1.1. Background

The environmental aspect of transportation has got a lot of attention over the past years. It has its origin in the growing awareness of environmental problems such as the global warming. In Europe the transportation industry is responsible for 21 per cent of the total emission. While studies of the subject show that an environmental friendly distribution and transportation is considered a success reasons for many companies, there is a lack of interest from them to invest to obtain it.

1.1.1. Distribution System

There is an increasing amount of attention given to distribution management. In the U.S. the National Council of Physical Distribution Management is well established and is contributing annually to the body of knowledge rapidly accumulating there. In the U.K., the Centre for Physical Distribution Management was established under the wing of the British Institute of Management (Walters, 1972). The distribution system of the firm serves the combined objectives of storing the manufactured goods after production and transporting them to the final customers according to demand. Transportation is performed at least cost, while satisfying specific service of customers and quality requirements such as delivery delays. While serving its own objectives, the distribution system must contribute to the global optimisation of the firm and, in particular, ensure close co-ordination with its production and sales components (Crainic and Dejax, 1989).

In LaLonde and Auker’s research (1995), since over the past decade development of computer technology and its application to modern-day business problems, indications are that the computer has been used for some period of time as a computational device for routine tasks in distribution and transport. However, the full power of the computer in solving distribution problems and planning distribution systems has not been fully exploited even at the present time. And at the same time, House and Jackson (1995) also point out the changes
in the degree of computerization of distribution management which has taken place during the years between 1972 and 1975.

1.1.2. Transportation Management System

As we have entered 21st century, globalization has become more than just an economic concept or another piece of fancy jargon of the business lexicon (Rosenbloom et al., 2001). Many business breakthroughs in geographic and non-geographic boundaries have been made through advanced communication and transportation technology which have given a huge impact on global economic development in today’s business world. Business is no longer bound within a country but is expanded into diverse countries (Chen et al., 2006). As the third profit headspring, logistics has become one of important topic for supply chain (Hu-Cheng, 2006). More and more scholars begin to study it. Logistics functions packaging, handling, loading and unloading, transport, storage, distribution processing, distribution, information management and much more. Among these functions, transportation is a very critical part because it achieves the separation of places and satisfies the needs of customers. The value created by transportation is outstanding. So transportation management system becomes sizzling in logistics studies and it is also an important part of distribution system.

Coyle et al. (2003) pointed out that a supply chain is an extended enterprise that crosses over the boundaries of individual firms to span the logistical related activities of all the companies involved in the supply chain. In their study, the key factors which are deserved to be special considered have been described, including cost, inventory, information, customer service and collaborative relationships. Organizations today are looking for opportunities to improve operational efficiencies and reduce cost without having a negative effect on customer service levels (Vinod, 2009). Both Christopher (1998), Riggs & Robbins (1998) pointed out three key drivers for performance in the supply chain: better quality/service, lower transport costs, and faster transport time while considering the environmental impact.

Here, lower transport costs means cost efficient solutions, which could cut costs through larger volumes, lower use of fuel, lower demand for labour force etc. and lower external costs (recovered costs in the market are technically known as "external" costs (or "externalities"), since they represent a cost to society not recovered through conventional market mechanisms (Grian, 2010).
1.1.3. The Environmental Impact

The environmental aspect of transportation has got a lot of attention over the past years, but it is not a new phenomenon. Reese (2007) points out that Joseph R. Carter and Ram Narasimhan already put out their paper "Environmental Supply Chain Management" in 1998, and the phrase “greenness” became a buzzword already in the late 1980s and early 90’s. It has its origin in the growing awareness of environmental problems such as the global warming. Today the environmental aspect of transportation is widely discussed and is being recognized as a very important question to deal with for everyone involved. Some of the goals directly relate the impact on the environment from transportation and its emissions (Miljömål, 2009 quoted from Thomas, 2009).

By impact on the environment the researchers refer to the emissions of green-house gases (GHG), being Hydrocarbon (HC), Carbon monoxide (CO), nitrogen oxides (NO x ), and Carbon dioxide (CO 2 ). In terms of GHG the emissions from the transportation industry is significant and an issue more and more transportation providers and companies are forced to focus on. In Europe the transportation industry is responsible for 21 percent of the total emission of these GHG, while 93 percent of these come from road transportation, where the freight transport by road has increased by 51 percent between 1990 and 2003. The emissions from air transportation experienced the highest increase in terms of percentage with an increase of 86 percent between 1990 and 2004 (European Environment Agency, 2007). The statistics illustrate the overall increase of transportation in general and the associated emissions of GHG and the trend of continuous growth of the transportation industry.

While in general the growth of an industry is often positive, the growth of the transportation industry however has some unwanted side effects in the increase of emissions. For this matter reducing emissions is something to strive for and companies dependent on transportation in their business play an important role in settling on a goal to reduce the overall emissions. While studies of the subject show that an environmental friendly supply chain is considered a success factor for many companies, there is a lack of interest to accept any increased to obtain it? In addition, logistics managers share the view that any extra costs for a green supply chain should be paid for by the customers. The conclusion is that putting a lot of effort on being environmentally friendly is generally not a high priority if no apparent financial benefits can be associated to it (Preuss, 2005). The problem might especially be apparent in companies where a green logistics channel is not demanded by the customers.
1.1.4. Customer Services
From the business viewpoint, companies strive to achieve high customer service, low costs and low tied-up capital. Customer Service which means to provide kinds of service to different levels of customers, is a primary and important restriction that every company should retain in mind. It is also a prime objective of a distribution system. The obvious best measure of customer service is to satisfy different customers’ demands. However, most company didn’t consider the different customer levels and this will increase the cost of customer service. In another words, this will increase the total cost of distribution system (Jonsson, 2008)

According to Wu and Dunn (1995), the challenge of today’s logistics managers is to determine how to incorporate environmental management principles into their daily decision-making process. They should bear in mind the customer service as the restriction and at the same time balance the cost and environmental impacts.

The environmental consequences of the logistics system can in certain situations constitute part of customer service through customers making specific demands for environmentally friendly products and services. Environmental demands may become order qualifiers, i.e. to qualify as a supplier to a customer; a least demand may be that a company implements an environment management system or that certain demands for environmentally adapted products and services are fulfilled. Environmental impact may also be one part of total costs, but in many situations it is difficult to estimate financial consequences for the environment.

1.2. Problem Discussion
"The rapid development of transport systems, information technology, and just-in-time schemes leads to a high degree of integration and coupling of systems and the effects of a single decision can have dramatic effects that propagate rapidly and widely through the global society" (Rasmussen & Svedung, 2000).

1.2.1. Transportation and Distribution in China
According to Jeroen (2010), the various modes of transport (road, waterways, rail, air and sea) have responded to increasing demand in different ways and have grown fast. As Baseline (2004) explained that often where goods are moved by rail, water or air the road network forms an immediate extra link in the supply chain, besides, transport infrastructure that links virtually all possible points of collection or delivery of goods is the base for efficient
transportation. So to say, efficient transportation plays an essential role in logistics operations.

Eriksson et al. (2008) find that it is China who has caught most of the world’s attention and interest as if it has been described as the “factory of the world” with abundant amount of low-educated and low-paid workers. In the past years, China has undergone an economic and industrial changeover from an under-developed country with closed gate to the rest of the world to a country with big ambitions in involving in high standard technology. Low cost labour and sufficient man power and skill have attracted many foreign investments into China around the globe. Through these years, China has drastically turned into one of the world’s biggest producing and consuming countries, in which many companies around the world are there not only for the low production cost but also to be close to the large market (Chiang et al., 2010).

However, Jiang and Prater (2002) point out that most Chinese distributor are small and specialized in limited types of goods. Since China’s undeveloped infrastructure, government regulations and regional protectionism fragment distribution channels, the problems of distribution system in China are not only faced by foreign firms, but also by Chinese firms that operate nationwide. They claim that there are three main forces that are changing and modernizing China’s distribution system. These are the booming economy, entering the WTO and e-commerce. One force which should be mentioned here is that when China entered the WTO, Third-party Logistics companies, especially the international companies will penetrate into China and occupy the huge logistics markets in China. With the development, implementation of a series of distribution reform programs has drastically changed the entire distribution system in China and, consequently, a new pattern of multi-channel competition has taken shape (Luk, 1995).

When talking about the current situation of transportation in China, according to Chinese government figures, demand for freight transportation grew by 6. 1% a year between 1992 and 2002, reaching 678 billion (tkm, tonne/kilometre) annually and the volume of freight transportation increased at a faster rate with share of total freight transportation rising from 12.9% to 13.4% over the decade up to 2002. Additionally, under this circumstance, in future, the government expects that increasing freight movement will be throughout many parts of the country, due to the greater flexibility and responsiveness of transport to overall
transportation system needs in a market economy compared with other logistics operations (David, 2005).

1.2.2. The Environmental Impact of Transportation

According to Anarsson & Huge Brodin (2006), the environmental issues in general have received an increased attention during the last decade. There are two main domains of different actors, which can be elaborated for achieving environmental improvements; one is the macro domain (actions taken by governments and legislative authorities) and one is the micro domain (actions taken by companies). In the macro domain, it has been recognised for many years that the transport sector is one of the main sources of pressure on the environment, particularly regarding air pollution and noise.

Numerous measures have been taken in the past, such as encouraging the use of environmentally friendly fuels through lower taxation; it is true that notably road vehicles and aircraft today are substantially more energy-efficient and pollute less than they did 10 or 20 years ago. In most contexts, however, environmental measures failed to keep pace with growing transport volumes. In the logistics literature (the micro perspective) two methods to reduce the environmental impact of industry are to either introduce more energy efficient technology, or to organise logistics in a different way. However, it is not enough to introduce new technology to stop the development, e.g. more energy efficient engines. There is a need for larger structural changes in sourcing and distribution.

That is to say one of the major sources of environmental problems is transportation, expected to increase even faster than the general growth of Gross National Product (GNP) in the industrialised world. Due to an increase in demand, the transportation industry has grown to become immense. In Europe the transportation industry is responsible for 21 percent of the total emission (Eurostat, 2007). While studies of the subject show that an environmental friendly supply chain is considered a success factor for many companies, there is a lack of interest from them to invest to obtain it. So it is very necessary to highlight environment friendly supply chain by reducing its impact on companies.

1.3. Specification of the problem

An area of interest where the combinations of financial and environmental benefits might be possible is in the logistics function of a company. In logistics and mainly in the distribution function the impact on the environment is most evident. Distribution of products from a company to its customers usually involves a lot of transportation where emission of GHG
stands for the main concern when it comes to the negative environmental impact. To increase the level of interest for a company to centre on reducing its environmental impacts the necessary factors needs to be presented. This is a fundamental condition and without the right factors the interest to raise an issue remains low.

The question is what a company can do in terms of reducing transportation and its impact on the environment without making investments with an uncertain outcome and how the interest of reducing transportation and environmental impact be increased. In the intensified hunt for operational effectiveness, with a focus on lower costs and shorter lead times, environmental issues are often put aside. In effect, transportation and environmental aspects are at risk of becoming a future burden if their effects cannot be identified and quantified in the same way as time and costs.

When the company does all of those things above, customer service which means to provide kinds of service to different levels of customers, should bear in mind of company in whole delivery process. It is also a prime objective of a distribution system. When company try to reduce the transportation, it also should keep up the same customer service level. But in the practical situation, few companies considerate to keep up customer service level when reducing the transportation costs.

However, the role that the logistics system can play in reducing the environmental impact of industries has not been extensively researched, especially in Chinese medical equipment manufacturing industry. According to review the relative researches in the area of Chinese distribution system and transportation. We found that few of researches combine reducing transportation with environmental impacts and at the same time maintaining the customer service level, especially in the medical equipment manufacturing industry.

The thesis will focus on two Chinese companies in the medical equipment manufacturing industry and their method of distributing its products. The companies operate on local and mainly on the European market and are heavily reliant on transportation for their distribution. The distance to its customers is far and the distribution system plays an important role for the company. Studying these two companies in medical equipment manufacturing industry provides the opportunity to gain the deep understanding needed to find the possible financial incentives for reducing the environmental impact in this industry and at the same time maintain the customer service level.
Moreover, in the practical situation, a huge number of the manufacturing companies pay no attention on environmental impact. On the contrast, they more focus on reducing the transportation. Motivated by this, it is necessary to analysis the current distribution situation in the medical equipment manufacturing industry and factors that influence transportation and environmental impacts while maintaining the customer service level, and how these identified factors will reduce transportation and environmental impact in some Chinese medical instrument manufacturing companies.

1.4. Research Question
1. What is the current distribution situation in some Chinese medical instrument manufacturing companies, focusing on transportation and environmental impact?
2. What are the factors in distribution of products can influence transportation and environmental impacts while no trade-off customer service done?
3. How these identified factors will reduce transportation and environmental impact in some Chinese medical instrument manufacturing companies?

1.5. Purpose
The purpose of this paper is to find the current distribution situations and the factors that influence the transportation and environmental impacts while maintaining the same customer service level, as well as how these identified factors will reduce transportation and environmental impact in some Chinese medical instrument manufacturing companies.

1.6. Delimitation
In this thesis, we only choose two medical equipment manufacturing companies to do the deeply analysis of their distribution system and transportation as well as its impact in environment while maintain customer service level. The authors only go for qualitative analysis of transportation and environmental impact in this thesis not would not go far quantitative data analysis. Like the factor fill rate, to increase this factor would not mean the percentage of fill rate would be increased. In this thesis authors will just suggests the ways to increase this fill rate not how much percentage will affect this fill rate. We are reducing transportation and environmental impact through theory instead of graphical data. Therefore, the solutions and proposals about transportation as well as environmental impact might not be imitated by other companies in the whole medical equipment manufacturing or be applied to other parts of the supply chain, just as reference. Moreover, there are other theories can be used to study on distribution, transportation, environmental impact and customer service besides the theories used in this thesis, which are selected and applied from the authors point of view.
1.7. Disposition
To create a better understanding of the outline of the thesis the authors here present disposition of it. The thesis starts by introducing the reader into the subject and the background of it under the introduction. In this section presenting the problem discussion and the real problem that will guide the thesis. The following section will feature the method used in the performing and writing of the thesis. The next chapter will present the theoretical framework and feature different models and theories related to the work of the thesis. Subsequent part presents couple of empirical findings, what authors have found through their data collection. The findings then be analysed with help of the theoretical framework under the Within Case Company Analysis part for company A and for company B as well. Cross Within Case Company Analysis increase the understanding of the reader more to this proposition. The next part of the thesis will be suggestion and recommendations based on analysis. Conclusion, theoretical contribution, reflection and suggestion on further research presented to readers. Concluding remarks will be available at end of the chapter. The outline of the thesis is seen in figure, 1 below.

![Thesis Outline](image)

**Figure, 1- Thesis Outline**
Source: Own design (Muhammad & Zhe, 2011)
2. METHODOLOGY

This chapter explains the phenomenon of methodology. Case study is described as research strategy, research methods and approach is enclosed with as well. Multiple Case Study as a design is presented for this paper along with sample selection as well as procedures of the cases. Data construction technique would enhance the understanding of the reader to this paper more. Finally, it is presented how requirements on the scientific credibility will be fulfilled. At the end summary of the chapter is figured out to make it more clearly to reader.

2.1. Research Strategy

Mark et al. (2009) stated that there are many research strategies could be used for exploratory, descriptive and explanatory research, and some of these clearly belong to the deductive approach, others to the inductive approach. Golicic et al. (2005) consequently, what is most important is not the label that is attached to a particular research question(s) and meet your objectives, in a way the choice of your research strategy will be guided by your research question(s) and objectives, the extent of existing knowledge, the amount of time and other resources you have available, as well as your own philosophical underpinnings.

This section is written as an introductory part to provide the reader with a guide to the research process and with necessary theories and skills to undertake a piece of research from thinking of a research topic to writing this master thesis. Therefore, the authors of this paper discussed the various knowledge about methods, which includes interviews and data collection qualitative technique, is the focus of this chapter. Moreover, this research method is associated with deductive approach. Additionally, the qualitative method has been applied in the process of data collection. Defining a research question is an important step. It permitted to identify what organization should be approached and what evidence needed to be collected in a systematic way (Eisenhardt, 1989). So Chinese medical instruments manufacturing companies have been approached and case study is used as research strategy to our paper. The research question has been formulated with reference to existing theory related to distribution, transportation, environmental impact reduction while maintain customer services.

Furthermore, different theoretical framework about transportation in logistics operations will be discussed and expounded according to the reference books and materials. Case studies data which would be collected by interview and literature review will be explained and analysed. Finally, the conclusion is obtained based upon the combination of secondary data and case study findings.
2.2. Research Method-Qualitative

Researchers distinguish between two approaches to information gathering, namely qualitative and quantitative research. Generally, both methods used for data collection and researches (Gummesson, 2000). Bryman and Bell (2007) define that quantitative research is a distinctive research strategy that emphasizes quantification in the collection and analysis of data. In quantitative research, as the term suggests, data are collected and analysed in numeric form, which tends to emphasize relatively large-scale and representative sets of data, and is often, falsely in our view, presented or perceived as being about the gathering of facts.

Qualitative research will enable people to understand the meaning of what is going on since it primarily focuses on the kind of evidence, and it also offers an increased possibility of developing empirically-support new theories which would increase relevance and interest to practitioners (Näslund, 2002). According to Mark et al. (2007), qualitative data refers to all non-numeric data or data that have not been quantified and can be a product of all research strategies. It can range from a short list of responses to open-ended questions in an online questionnaire to more complex data such as transcripts of in-depth interviews or entire policy documents (Mark et al, 2009). To be useful these data need to be analysed and the meanings understood. Dey (1993), gives distinctions between quantitative and qualitative data.

<table>
<thead>
<tr>
<th>Quantitative data</th>
<th>Qualitative data</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Based on meanings derived from numbers</td>
<td>• Based on meanings expressed through words</td>
</tr>
<tr>
<td>• Collection results in numerical and standardized data</td>
<td>• Collection results in non-standardized data requiring classification into categories</td>
</tr>
<tr>
<td>• Analysis conducted by diagrams and statistics</td>
<td>• Analysis conducted by conceptualization</td>
</tr>
</tbody>
</table>

Table 1-Distinctions between quantitative and qualitative data

Source: Dey (1993)

This qualitative investigation entails the opportunity to probe how managers perceive cost reduction and environmental impact that enables us to reach beyond initial responses and rationales in conclusion writing. This is a multiple case studies of two companies, and the authors just focus on a study of distribution situations, factors for transportation and reduction of environmental impact for narrowing down the thesis. The focus of this type of study is on holistic situations in real-life context and is likely to have boundaries of interest such as an organization, a particular industry, or particular type of operation (Ellram, 1996). In this research report, secondary data provided by the literature review, companies sites and together with primary data, collected through research methods such as semi-interviews applied by the interviewers.
2.3. Research Approaches- Deduction
When performing a research one usually differ between two courses of action; deductive and inductive method. The deductive method described as the way of proof and is the most formalized of the two. It includes, through a coherent system deducting new hypothesis and tries these by means of empirical studies. The inductive method is usually described as the way of discovery and the result of this method would be formation of a new theory (Saunders, Lewis, & Thornhill, 2003).

![Diagram of research approaches]

**Figure, 2- Research Approaches**
Source: Mark et al. (2007)

The authors go for deductive approach because this approach will help authors to test the empirical findings in the form of within Within Case Company Analysis and cross-case analysis, and will also help to give some suggestions and recommendations. In other words, the deductive way has been chosen as the research approach of this thesis and with opinions and beliefs from our respondents the authors came up with knowledge about efficient distribution and its contribution to transportation and environmental impact reduction. This approach will help authors to test the empirical findings in the form of within Within-Case Analysis and cross-case analysis.

2.4. Research Design- Multiple Case Study
Maylor & Blackmoon, (2005) describes the case study method as not being ‘pure’ because the collection of data probably comes from multiple sources and using several methods. This is further strengthened by Creswell (1997) in his assumption that case studies are appropriate for developing an in-depth analysis of either single or multiple cases. A case study is research of a specific occurrence for instance an institution/organization, an events, program, person or social group. Roboson (2002) defines case study as ‘a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real
life context using multiple sources of evidence’. In deciding whether case study research method is appropriate or not; factors like degree of control, and how the results are envisioned should be considered important.

As Yin has famously said, case studies are a preferred approach when ‘how’ or ‘why’ questions are to be answered, when the researcher has little control over events and when the focus is on a current phenomenon in a real-life context (Yin, 1994). And moreover, if you want to gain a rich understanding of the context of the research and the processes being enacted, the case study strategy will be of particular interest to researchers (Mark et al., 2007).

Single case design represents replication that enables development of a rich theoretical framework. It enables to either demonstrate similar outcomes among replication, or to show contrasting results (Ellram, 1996). For the purpose of this thesis, multiple case study approach has been selected to identify our required case. Furthermore, another reason for why this approach has been used is that the analytic conclusions based on multiple case studies are more powerful than those spawned from single case (Yin, 2003).

2.4.1. Sample Selection

The sample of the study is an important part of the research and the cataleptic people can lead to whole thesis inaccurate (Holme & Solvang, 1997). The purpose of this paper is to find the current distribution situations and the factors that influence the transportation and environmental impacts while maintaining the same customer service level, as well as how these factors influence distribution situation through efficiency in transportation in some Chinese medical instrument manufacturing companies. In order to get conclude, two Chinese companies have been selected. A company called CONTEC MEDICAL SYSTEM is selling medical instruments to distributors at home and abroad. At the same time, they also sell their products directly to hospitals in China. The other is LAND WIND MEDICAL CHINA is also provider of medical instruments in China and all over the world as well. Choosing two companies as our samples get empirical data on company’s distribution system, transportation, environmental impact and customer service will lead us to wrap up this thesis. We choose these two companies because firstly they are in the same industry. And both of them are medium companies. This will help authors to specify this paper. Secondly, the locations of these two companies are in China. We focus on Chinese companies to exclude the influence of geographical location of other countries. When choosing companies in China, one is from South of China and the other is from North of China. At the same time, south and north of China are the main markets. Therefore, it could stand for the whole
parts of medical manufacturing companies in some extent, comparing with only choose companies from same area.

2.4.2. Case Study Procedure
An existing theory related to cost reduction and environmental impact were studied not only to develop a theoretical framework to design the inquiry form and thus enhance the data collection but also to be able generalize the results of the case study. Analytical generalization has been applied as the previously developed theoretical framework served as a template with which the empirical results have been compared (Yin, 2003). Preliminary case study decorum based on previous research and existing literature has been developed. The protocol comprises of two parts; case study plan and interview guide. Case study plan includes procedures that need to be followed during conducting of case study. It comprise of research question, statement of the purpose of the thesis, unit of analysis, method, sample selection, basic outline of overall case study report, collecting evidence, data analysis and time table (Ellram, 1996) (see Appendix 1 for detail).

2.5. Data Collection
2.5.1. Primary Data
Primary data is new data collected by the authors themselves, something that can be made by the help of interviews, questionnaires or observations. Lee and Lings (2008) states that “There are four methods associated with qualitative research. These are observation, focus groups, reviewing documentary sources of data and interviewing.” The authors use reviewing documentary sources of data and interviewing. The data collected are then to be used for the analysis carried out in the thesis.

In this paper, the authors use semi-structured interview to collect the primary data. The interview questions would be translated from English into Chinese. And the interview answers would be translated from Chinese into English afterward as the primary data of this thesis. Before the interview, the interviewees will get the interview guide in advance to inform about the types of questions which are supposed to be answered.

2.5.2. Secondary Data
According to Rabianski (2003) Secondary data is the facts and information based on research of primary data which includes published and unpublished work. For instance, secondary data composed of written material such as researches, articles and books and one can access to this data and can be used for one’s research. There are two kinds of secondary data which are
internal and external secondary data. Internal secondary data is data that has already been produced by organizations and private individuals and gathered to constitute a veritable data source. External secondary data are studies that have been published or are in the process of being published within the studied research area and indispensable to the spread of the specific knowledge and evolution of the research (Thietart, 2001).

Using secondary data has lots of advantages. Those data can be to and find much more information. And what’s more important is when you are going to deeply understand and explain more clearly about the research question, secondary data is useful. The first and foremost advantage of utilizing secondary data is saving in time and money (Ghauri and Grønhaug, 2005).

In this thesis, the authors will also get the internal secondary data by reading annual report of companies as well as companies’ websites, and data approaching from the distribution department and logistics department. At the same time, we will get the external secondary data, through relevant journals, articles, and text books etcetera.

2.5.3. Interviews and Interview guide
According to Yin (2009), interviews are important sources of information in case studies. Interviews are a way of collecting primary data and are source of primary data (Ghauri & Grønhaug, 2005). Bryman and Bell (2007) divide qualitative and quantitative interviews into unstructured and semi-structured interviews. Both of these forms have flexible interview process. For unstructured interview, the interviewer does not have any pre-prepared questions but must have clear idea about the aim of the interview and the interviewee can freely express his or her opinion about a given topic (Saunders et al., 2003). While in semi-structured interview, the interviewer has a list of questions on specific topics to be covered. But the interviewee has a great deal of leeway of how to reply (Bryman and Bell, 2007).

Moreover, as Bryman and Bell (2007) discussed, the major characteristic of the semi-structured interview is that the researcher has a list of questions on a specific categories referred to as an interview guide (available in Appendix 2) and the interviewees have submissiveness for the answers. Semi-interview is more beneficial for our research not only because it provides the respondent a timidity to interviewed like the other type of qualitative interviews, but also distribution, transportation environment and customer services will be address during the interview spontaneously. We will conduct semi-structured interview at CONCTEC MEDICAL SYSTEM and LAND WIND MEDICAL in China, especially in logistics department. And we choose the manager of the department from each department to do this interview.
In this thesis, we think interview is better since it is real interaction between researchers and respondent with understanding of the respondent’s background, values and expectations. To collect empirical information in this thesis, we will conduct some interviews. Ghauri and Grønhaug (2005) distinguish between three different ways how to conduct interview: through mail, phone or personal face-to-face interview. Personal face-to-face interviews using video conversation through internet used to get the primary data. Because we want to get right data and motivate their ideas according to setup honest relationships and trust with interviewees. At the same time, the authors will use short telephone interviews to guarantee the meaning of previously collected data. All interviews would be recorded by the voice recording equipment (MP3).

Interview guides are commonly used in semi-structured interviews (Welman, Kruger and Mitchell, 2005). This means that we need to have some specific questions for the particular interviewees who have especial knowledge in particular area. In this thesis, we will make an interview guide with those specific questions are accessible in the Appendix 2.

Welman et al. (2005) points out the importance of the language used during the interview. There are only Chinese companies involving in interviews. Therefore, we will focus on using the Chinese in process of the interview and translate the interview answers into English, since it’s very easy for the interviewee to understand the interview questions and express themselves more clearly. The following table, 2 shows the information about interviewees and time edited of interview for this thesis. Further information about interview is available in Appendix 2 to make it more understand to reader.

<table>
<thead>
<tr>
<th>Interviewee’s Name</th>
<th>Contec Medical System</th>
<th>Landwind Medical</th>
<th>UPS (United Parcel Service)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>An Jianwei</td>
<td>Li Hong</td>
<td>Chang Jian</td>
</tr>
<tr>
<td>Interviewee’s position</td>
<td>Manager in logistic department</td>
<td>Director in logistic department</td>
<td>Manager in logistic department</td>
</tr>
<tr>
<td>Interview Date</td>
<td>2011-04-03</td>
<td>2011-04-11</td>
<td>2011-04-25</td>
</tr>
</tbody>
</table>

**Table 2- Interview information**

Source: Own design (Muhammad & Zhe, 2011)

### 2.6. Data Analysis

Mark et al. (2009) thought qualitative analysis generally involved one or more of: summarizing data, categorizing data and structuring data using narrative to recognize relationships, develop and test propositions and produce well-grounded conclusions, meanwhile, he thought the processes of data analysis and data collection were necessarily interactive. Also Nick and Ian (2008) said, as qualitative data for most intents and purposes is
that which was or could be transformed into words, the qualitative analysis process was generally that of reducing the vast amount of data to themes, ideas and concepts. Moreover, he emphasized that most qualitative and quantitative analysts should not ignore considerations of reliability and validity, although a number of different perspectives on these ideas. These two elements would be discussed in the next section.

After presenting the collected case study data from CONCTEC MEDICAL SYSTEM and LAND WIND MEDICAL CHINA in empirical findings, the authors will deal with within case analysis to associate relation between empirical findings with theoretical framework. Cross-case analysis is also used to analysis data. Cross case analysis used to find similarities and differences in case companies. Conclusion grounded on the answers of research questions will come out later. To end with, the further study in related field proposed.

2.7. Scientific Credibility
Yin (2009) claims that to test and judge quality of any research design, there are in general four tests construct validity, internal validity, external validity and reliability.

2.7.1. Construct Validity
Construct validity means how the researchers could develop sufficiently operational measures for their concepts and subjects to collect the data (Yin, 2009). There are three-way to increase the construct validity which are using multiple sources of evidence, establish chain of evidence, and have key informants review draft case study report.

In this paper, the authors use multiple sources of evidence to collect data, such as interviews, getting useful resource from books and websites used for getting information about companies’ background and the emission data in both China and whole world, and then join them together to construct the empirical findings. Key informants review draft case study report is also used to support the construct validity of this paper. Both of these two interviewees of medical instrument manufacturing companies asked to review and give some comments on case study description and to make sure and guarantee that all the empirical findings which the authors provide are totally correct.

2.7.2. Internal Validity
Internal validity invested the relationship between researchers’ observation and the theoretical ideas they develop (Bryman and Bell, 2007). The internal validity is used in explanatory case study which means the investor try to explain relation between two things and infer that a particular event resulted from some earlier occurrences (Yin, 2009). The aim of this paper is
to find the current distribution situations and the factors that influence the transportation and environmental impacts while maintaining the same customer service level, as well as how these identified factors will reduce transportation and environmental impact in some Chinese medical instrument manufacturing companies. So the researchers will infer that how factors from earlier findings resulted can influence current distribution situations. In order to achieve the internal validity, the authors build an explanation which may be beneficial to various companies for reduction in transportation and environmental impact in Within Case Company Analysis in order to explain the selected phenomenon.

### 2.7.3. External Validity

External validity means the extent to generalization of your study (Bryman and Bell, 2007). That means beyond the conclusions that getting from analyzing the selected cases, whether can make generalizations. Analytical generalization is regularly used when doing the case study (Yin, 2009). In this paper, some generalizations have been made by using multiple-case study instead of single-case study. According to our companies’ characters, At the same time, the generalizations of this paper can also be achieved by refer to and confirm the earlier theory within the distribution, transportation, environmental impacts and customer service as well.

### 2.7.4. Reliability

Reliability concerns the repeatability of the study, which means that if another researcher would conduct the same study the findings would be the same (Maylor & Blackmoon, 2005). When talking about reliability, there are two forms of reliability, which are external reliability and internal reliability. Bryman and Bell (2007) point out that for the external reliability, it means the degree to which a study can be replicated. However, the internal reliability means that whether or not, when there is more than one observer, researchers agree with what they see and hears. While Yin (2009) points out that to get a higher reliability, the need to the document of procedures in the earlier case is a requirement for other investigator to repeat this case again. There are two way to get this tactics which are using case study protocol and develop case study database (Yin, 2009).

In this thesis, to guarantee the high reliability, the authors use the same interview guide to do interviews used to get enough data in analysis part. The interviewee’s conversation recorded by the voice recording equipment (MP3) which can be used by other investigators for the further research. Besides this, during the interview, the authors also take some interview
notes to record some important parts. Both of these two things constitute of the case study database for the further study. The scientific credibility has been shown in table, 3 below.

<table>
<thead>
<tr>
<th>Case Study Tactic</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct Validity</td>
<td>• multiple sources of evidence: interviews, books and websites</td>
</tr>
<tr>
<td></td>
<td>• key informants review draft case study report: interviewees review and give comments of the case study description</td>
</tr>
<tr>
<td>Internal Validity</td>
<td>• build an explanation</td>
</tr>
<tr>
<td>External Validity</td>
<td>• multiple-case study: two medical instruments manufacturing companies</td>
</tr>
<tr>
<td></td>
<td>• refer to and confirm the earlier theory</td>
</tr>
<tr>
<td>Reliability</td>
<td>• using same interview guide</td>
</tr>
<tr>
<td></td>
<td>• case study database: audio-recorded and interview note</td>
</tr>
</tbody>
</table>

Table 3- Summary of Scientific Credibility
Source: Own design (Muhammad & Zhe, 2011)

As a matter of thesis validity by doing critically we hope to increase the level of validity. Ellram (1996) discussed that major criticism of case studies is the reluctant of getting the outcomes that may be generalized. Our objective is to find the current distribution situations and the factors that influence the transportation and environmental impacts while maintaining the same customer service level, as well as how these identified factors will reduce transportation and environmental impact in some Chinese medical instrument manufacturing companies. Hence this may be beneficial to various companies for reduction in transportation and environmental impact.

2.8. Methodology Model
This chapter covers the research method used in this paper. The summary model for this methodology chapter is as under,

<table>
<thead>
<tr>
<th>Research Strategy</th>
<th>Case Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Method</td>
<td>Qualitative</td>
</tr>
<tr>
<td>Research Approach</td>
<td>Deductive</td>
</tr>
<tr>
<td>Research Design</td>
<td>Multiple Case Study</td>
</tr>
<tr>
<td>Research Technique</td>
<td>Primary/Secondary</td>
</tr>
<tr>
<td>Scientific Credibility</td>
<td>• Construct Validity: Multiple sources of evidence</td>
</tr>
<tr>
<td></td>
<td>• Key informants review draft case study report</td>
</tr>
<tr>
<td></td>
<td>• Internal Validity: build an explanation</td>
</tr>
<tr>
<td></td>
<td>• External Validity: Multiple-case study</td>
</tr>
<tr>
<td></td>
<td>• Reliability: Same Semi-Structured Interview</td>
</tr>
</tbody>
</table>

Table 4- Methodology Model
Source: Own design (Muhammad & Zhe, 2011)
3. THEORETICAL FRAMEWORK

In this part, a theoretical framework is presented. To describe the factors for transportation and environmental impact in the distribution system, and give the suitable logistics solutions for the distribution of the products in Chinese medical equipment manufacturing company, the relevant theory related to the issue of distribution system will be studied from four perspectives; distribution, transportation, environment and customer services gradually.

3.1. Distribution System

Distribution means all the logistics operations involved in the management of finished goods from production plants to the final customers, including the physical distribution aspects. These operational activities can either be performed by the industrial production firm itself or by an independent commercial distribution and sales firm.

Distribution can be seen as part of the logistics system that enables a company to supply its customers with finished goods and services (Kohn, 2005). The basic function of distribution is to "add value" to the company's product or service by providing "place utility" to that product or service in gain a competitive advantage (Johnston, 1991). In specific terms, distribution must provide the optimal "balance" between maximum customer service and least distribution cost. This is done by providing a range of services, such as communications, transportation, warehousing, or inventory management. Therefore, CSCMP (Council of Supply Chain Management Professionals) gives a contemporary definition of distribution that is: “The activities associated with movement of material, usually finished goods or service parts, from the manufacturer to the customer. These activities encompass the functions of transportation, warehousing, inventory control, material handling, order administration, site and location analysis, industrial packaging, data processing, and the communications network necessary for the effective management. It includes all activities related to physical distribution, as well as the return of goods to the manufacturer” (CSCMP, 2005, p 36).

Attwood (1992) also states that since the distribution is a service and it costs money without directly producing an income, the primary aim for the distribution manager is to reduce the cost of supplying goods to customers while maintaining or improving the level of service provided. Consequently, any distribution system should place on minimizing costs for the level of customer service desired (Willis, 1977).
3.1.1. Types of Distribution Systems
Kumar and Arora (1990) state the point that distribution systems have two different types called single level system and two-level system. For the single level system, it means that manufacture’s facilities directly delivery the products to the end-users. While in the two-level system, distribution contains two steps. The company delivery the products to the dealers and then the dealers will take the responsible to distribute those products to the end-users. They also point out that most real life distribution systems are this two-level system instead of single level system (Ibid).

The same viewpoint has been explained in Kohn’s research (2005). He also mentioned two kinds of distribution system which are named as decentralized distribution system and centralized distribution system (Figure 3). Since the development of information technology and a tighter control of company, more and more companies consider to choosing centralized distribution system instead of the traditional decentralized distribution system. This change can also be explained as the reason of economies of scale and scope which means increasing in scale to reduce the average costs (Ibid). Kohn also points out that the one of benefits using centralised distribution system is that it helps company to explore new markets (2005).

![Decentralised and Centralised Distribution System](image)

**Figure, 3- Decentralised and Centralised Distribution System**
Source: Abrahamsson, 1992, p 2, quoted from Kohn 2005

3.1.2. Cost in Distribution System
In Attwood’s research (1992), he points out that except the overall objective of distribution, there are also secondary objective of distribution which can be associated with warehousing, delivering and planning the distribution system. All of these three objectives can be related to the costs of distribution, but because of different measurement standards, such as the number of warehouse or vehicle and so on, the cost of them will differ with each other (Ibid).
Transportation costs

Transportation, according to Gattorna and Walters (1996), is the linkage process in logistics and often consumes much of the resources provided to the logistics function. Since transportation possibly accounts for the largest resource commitment in the logistics activity, its relative cost profile must be established within the level of customer satisfaction that is being set as an objective. Riggs and Robbins (1998) pointed out one of the key drivers for performance which refer to the efficient transportation of logistics operations in the supply chain is lower transport costs. By meaning of lower transport costs, it stands for cost efficient solutions using such as larger volumes, lower use of fuel, lower demand for labour force and lower external costs (GRIAN, 2010).

In Shakantu et al. (2003) research, they come up different factors that can influence the total transportation costs.

- **Fuel price.** It always seems as the fixed cost. However, according to the inflation rate in the world economy and the limitation of fuel resource, the fuel price will go up and down. In addition, as the environment issues have become a harsh topic nowadays and large numbers of people begin to concern about the environmental problems, the environmental friendly fuel will become one substitutes of normal fuel. That will indicate the fuel price will get some adjustment.

- **Taxation (vehicle tax, road tax, licences, etc).** Direct taxation is on the one hand a means to raise finance to rebuild, improve or extend the road system. On the other hand, it also can be seen as the tool to limit the quantity loaded of car in the highway. Their cost is also considered as the fixed cost since the change of these kind costs will follow with rate of general inflation in the country or the government policy.

- **Maintenance.** To make sure the transport fleet works well during the devilry process, the regular maintenance of transport is necessary. Those kinds of costs are reducing because of better function of transport. On a year-to-year basis, maintenance and replacement costs are considered to be a fixed cost. However, from the long-term sustainability point of view; these costs are variable and in all probability will rise.

- **Infrastructure and environment costs.** According to the intensifying environmental problems, the environmental issues are enlarge from local factors such as noise, visual intrusion into the global environmental degradation which results into global warming, acid rain and a variety of pollution-induced diseases. It is time for government to make some policy or regulation on protecting environment. For example, in the European Community, there is a new policy to
develop a mechanism by which infrastructure and environmental costs of transport can be charged directly to the motorist.

3.2. Transportation System
The transportation system refers to the entire collection of labour, facilities, and resources that make up the movement capability in the economy. This capability refers to the movement of freight and people, although it may include the system for delivering intangibles such as telephone messages, electrical power, and medical services (Coyle et al., 2003). The bulk of the freight movement is handled by the five basic (Coyle et al., 2003) intercity modes of transportation (rail, truck, water, pipe, and air) (we are not including pipelines as it is not feasible mode for our thesis) and the various transportation agencies that facilitate and coordinate freight movement (freight forwarders, Bus Package Express, Parcel Post, Air Express, United Parcel Service, and shippers' associations). The figure below shows the structure of transportation for this thesis with primary modes, transport services, agencies their efficiency as well as their impact on environment and customers.

![Transportation System for Business Logistics](image)

**Figure, 4- Transportation System for Business Logistics**
Source: Quoted from Grant et al. 2006 (Own design (Muhammad & Zhe, 2011))
As illustrated in Figure 4, carriers and agencies often interact with each other, and carriers interact among themselves to form economical arrangements for moving freight. An example is a coordinated service such as piggyback (truck trailers shipped on rail flatcars) that results from truck-rail cooperation. Broadly viewed, the relative importance of the various transportation modes differs considerably at this point in time and, from the direction of current trends, it appears that the relative importance of each will continue to change in the future and available in next section (Grant et al. 2006).

3.2.1. Primary Modes of Transportation

There are different transportation modes truck, rail, water, and air (Coyle et al., 2003; Grant et al. 2006). Any one or more of five transportation modes - truck or road, rail, air, water may be selected to transport products. In addition, intermodal combinations are available: rail-motor, motor-water, motor-air and rail-water. Intermodal combinations offer specialized or lower-cost services not generally available when a single transport mode is used. A combination of these is called intermodal service. Every mode has its advantages respectively disadvantages. The different modes are further presented below.

- **Motor Carrier/Truck/Road**
  Motor carrier or Truck is part of most firms logistic supply chain since they almost always at some point need to transport their goods over the road network. The benefit of the truck mode is the high accessibility; the carriers can provide services to almost all locations and is the most accessible transport mode (Coyle et al., 2003).

  Many manufactured products are transported primarily by motor carriers, including amusement, sporting and athletic goods; toys; watches and clocks; farm machinery; radios and television sets; carpets and rugs; clothing; drugs; and office equipment and furniture. Most consumer goods are transported by motor carrier. Motor carriage offers fast, reliable service with little damage or loss in transit (Grant et al. 2006).

  Shipments transported by trucks are referred to as truckload TL or less-than-truckload (LTL). Smaller shipments transported by trucks are LTL, any quantity of freight weighing less than the amount required for the application of a truckload rate (Grant et al. 2006).

  The transport mode is characterized by high variable and low fixed costs; together with fact that the government maintains its links (roads), this has led to a large number of small carriers constitute the market. The transit time for trucks is rather low in the sense it can
operate independently from other shipments and hence reaches its destination faster. Other negative aspects are the reliability, which can exist because of dependency on weather conditions and the high costs being present. The goods being transported by trucks can be low valued, but most often being goods of rather high value with small size of the shipment (Coyle et al., 2003).

Efficient truck carriers can realize greater efficiencies in terminal, pick-up and delivery operations which enable them to compete with other modes on point-to-point service for any size of shipment if the distance involved is 500 kilometres or less. Point-to-point service refers to a single transport mode picking up products at origin and delivering them to their final destination. As no additional transport modes are necessary, truck carriers dominate the market for smaller shipments (Grant et al. 2006).

The amount of freight transported by trucks has increased since the 1980s by about 45 per cent, measured in tonne-kilometres. Truck carriage has become an important part of the logistics networks of most firms because the characteristics of the trucking industry are more compatible than other transport modes with service requirements of the firms' customers (Grant et al. 2006).

➢ Rail

The rail mode consist of a small number of large firms controlling the railroads, a mode requiring large investments in terminals and tracks before being able to begin operations. The railroads are mainly transporting large volume of low valued goods of high density, over large distances. This is to spread the fixed costs over greater distance and size of goods (Grant et al. 2006).

Truck trailers or containers are delivered to the rail terminals, where they are loaded on flatbed wagons. At the destination terminal, they are offloaded and delivered to the consignee, the customer who receives the shipment (Grant et al. 2006).

The major advantage of rail is the cost, which are relatively low, as well as the high capability being able to provide service to all shippers (Coyle et al., 2003). For many shipments, rail does not compare favourably with other modes in terms of loss and damage ratios. Compared to trucks, it has disadvantages in terms of transit time and frequency of service (Grant et al. 2006). The rail mode is also more environment friendly compared to many other modes due to contributing less to emissions (Pienaar, 2003) (see figure 6). On the
downside the low accessibility due to actual railroad have to be connected to a firm for the rail mode to be able to provide service there, and the rather long transit times for the mode (Coyle et al., 2003).

Rail transport lacks the versatility and flexibility of motor carriers because it is limited to fixed track facilities. As a result, railroads like air, water and pipeline transport provide terminal to terminal service rather than point-to-point service unless companies have a rail siding at their facility, in which case service would be point to point (Grant et al. 2006).

A problem for international shipment when it comes to railway might be different railway standards that sometimes differ between countries. Differences between countries in Europe and in the rest of the world is the rail gauge (distance between rail tracks), and an investigation shows that in Europe the former soviet states, Spain and Portugal are the ones that differ from the standard gauge that is used throughout the rest of Europe (Thomas, 2009).

Air
The freight shipment is only a very small part of the complete air carrier traffic, being the movement of passengers taking up the majority of it. The air industry consists of a limited number of carriers that are dominating the business. The air carrier mode is characterized by high cost, but also for a very short transit time. Hence the typical shipment or transfer is of high value and/or needs a fast delivery (Coyle et al., 2003). Although increasing numbers of shippers are using air freight for regular service, most view air transport as a premium, emergency service because of its higher cost. However, when an item must be delivered to a distant location quickly, air freight offers the quickest time-in-transit of any transport mode. For most shippers, however, these time-sensitive shipments are relatively few in number or frequency (Grant et al. 2006).

Air carriers generally handle high-value products — for example, Rolex watches or other jewellery. Air freight cannot usually be cost-justified for low-value items, because the high price of air freight would represent too large a percentage of the product cost. Customer service considerations may influence the choice of transport, but only if service issues are more important than cost issues (Grant et al. 2006).

Air transport provides frequent and reliable service and rapid time-in-transit, but terminal and delivery delays and congestion may appreciably reduce some of this advantage. Undoubtedly,
as customers demand higher levels of service and as global shipments increase, air freight will have a potentially greater role in the distribution plans of many firms (Grant et al. 2006).

To a great extent, air freight competes directly with trucks, and to a much lesser degree with rail. Where countries are separated by large expanses of water, the major competitor for international air freight is water carriage (Grant et al. 2006).

The accessibility of this mode is also rather limited, forcing either a presence to an airport or the use of a land carrier to transport the goods to and from an airport. Another negative aspect is the influence of weather conditions; meanwhile a positive feature is the high security associated with air transits (Coyle et al., 2003).

➢ Water

Another mode of importance is water, it is a mode characterized by rather low average cost (far lower compared to the other modes), primarily used for longer distances and with capacity for large shipments (Coyle et al., 2003). As Grant et al. (2006) Water carriage is perhaps the most inexpensive method of shipping high-bulk, low-value commodities.

Water transportation can be broken down into several distinct categories: (1) inland waterways, such as rivers and canals, (2) coastal and inter-coastal oceans, and (3) international deep sea. In Europe, water carriage competes primarily with rail and pipeline, since the majority of commodities carried by water are semi-processed or raw materials transported in bulk. It is concentrated in low-value items (e.g. iron ore, grains, pulpwood products, coal, limestone and petroleum) where speed is not critical (Grant et al. 2006).

However, because of the inherent limitations of water carriers, it is unlikely that water transport will gain a larger role in domestic commerce, although international developments have made marine shipping increasingly important (Grant et al. 2006). The development of very large crude carriers LCCs, or super tankers, has enabled marine shipping to assume a vital role in the transport of petroleum between oil-producing and oil-consuming countries. Because of the importance of energy resources to industrialized nations, water carriage will continue to play a significant role in the transportation of energy resources (Grant et al. 2006).

The downside to water carrier are the longer transit times it generates as well as being highly affected by weather conditions. Another negative aspect of the water carrier mode is the
limited accessibility due to requirement of presence next to water and a suitable harbour for being able to make use of it (Coyle et al., 2003).

The shipper in one country places cargo into an owned or leased container at its facility or at point of origin. Then the container is transported by rail or motor carriage to a water port for loading on to a container ship. After arrival at the destination port, it is unloaded and tendered to a rail or motor carrier in that country, and subsequently delivered to the customer or consignee. The shipment leaves the shipper and arrives at the customer's location with no or minimal handling of the items within the container (Grant et al. 2006).

Each mode transports a large amount of freight. The particular mode a shipper selects depends on the characteristics of the mode coupled with needs of the company and its customers. Figure 5 summarizes the economic and service characteristics of the four basic modes of transport.

<table>
<thead>
<tr>
<th>Economic Characteristics</th>
<th>Motor</th>
<th>Rail</th>
<th>Air</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Moderate</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Degree of competition (number of competitors)</td>
<td>Many</td>
<td>Few</td>
<td>Moderate</td>
<td>Few</td>
</tr>
<tr>
<td>Market coverage</td>
<td>Point-to-point</td>
<td>Terminal-to-terminal</td>
<td>Terminal-to-terminal</td>
<td>Terminal-to-terminal</td>
</tr>
<tr>
<td>Predominant traffic</td>
<td>All types</td>
<td>• Low-moderate value • Moderate high density</td>
<td>• High value • Low-moderate density</td>
<td>• Low value • High density</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Characteristics</th>
<th>Speed</th>
<th>Availability</th>
<th>Consistency (delivery time variability)</th>
<th>Loss and damage</th>
<th>Flexibility(adjustment to shipper’s need)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moderate to fast</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>Moderate</td>
<td>High</td>
<td>Low to moderate</td>
<td>Moderate to high</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>Moderate</td>
<td>Low</td>
<td>Low to moderate</td>
<td>Low to moderate</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>Moderate</td>
<td>Moderate to high</td>
<td>Low to moderate</td>
<td>Low to moderate</td>
</tr>
</tbody>
</table>

**Figure, 5- Comparisons between Modes of Transportations**
Source: Grant et al. (2006).

These different modes are what companies may need to take into consideration when deciding upon a specific mode.
Factors Affecting the Choice of Transport Selection

Slater (1990) suggests a very thorough approach to transport mode selection. He suggests a thorough approach for transportation mode selection where five factors are taken into consideration. These factors are: company characteristics and philosophy, market structure, product characteristics (current and future), customer characteristics and environmental issues.

The company characteristics and philosophy concern the company’s marketing, financial and operations strategies. The marketing strategy determines the parameters for the customer service offer. It influences the performance levels which need to correlate with service offer. The financial strategy reflects the view of how profit objectives are to be met. An issue here is the strategy to invest in core versus non-core capabilities. The operations strategy influence in terms of the characteristics of the company. Economical but effective deliveries are suitable when the production process results in high volume output, such companies are at an increasing rate centralizing their manufacturing which amplifies the service responsibility of the transport function (Slater, 1990).

The market structure of the company concerns two factors, the competitive structure and the geographical structure of the market. When selecting suppliers the customers consider delivery as a key factor, in highly competitive markets it is especially important to fulfill customer expectations in terms of transportation; otherwise the customer will be lost. The geographical structure considers the size of the market, where the market spans over large areas and even national borders, having a corresponding transportation structure is then of crucial importance to achieve customer satisfaction (Slater, 1990).

The product characteristics determine the appropriate type of transportation. What factors to consider depends on what type of product it is but examples of possible product characteristics factors to consider are weight, robustness, shelf-life, size and shape. A mismatch between the type of transportation and type of product can cause major problems when distributing the goods (Slater, 1990).

The customer characteristics involve the specific requirements of the customer. The transportation provider needs to fulfil the customer need and delivery specifications. The delivery specifications includes for example: time constrains, order cycle and customer availability expectations, customer capabilities and customer after sales requirements (Slater, 1990).

The environmental issues have the potential to influence the choice of transportation in various ways. Government regulations, infrastructure policy and subsidizing of specific
modes influences the selection and can make one alternative more attractive compared to another. Another factor is the continuous technology development, which in the short and long run can assist in the planning of transportation decisions. Some forms of transportation are more environmentally friendly compared to others (Slater, 1990).

3.2.2. Coordinated Transportation Services
In addition to the five basic modes of transport, a number of intermodal combinations are available to the shipper. The more popular combinations are trailer on flatcar (TOFC), container on flatcar (COFC) and rolling road trains. Intermodal movements combine the cost and/or service advantages of two or more modes in a single product movement (Grant et al. 2006).

Brewer et al. (2001) defines intermodal transportation as “those integrated movements involving at least two different modes of transport under a single through rate…where its goal is to provide a seamless transport system from point of origin to the final destination under one billing and with common liability” (Brewer et al., 2001, p. 142). Murphy Jr. and Wood (2004) define it as “two modes or more work closely together on a regular basis, utilizing the advantages of each” (Murphy Jr. & Wood, 2004, p. 162). Meanwhile Coyle et al. (2003) defines it as services using two or more carriers of different modes in the through movement of a shipment. These definitions correspond well with each other and explain the idea of intermodal transportation well.

3.2.3. Primary Transportation Agency
➢ Outsourcing of Logistic Functions
Outsourcing the logistics functions gives the company the possibility to focus on their core competences. The possibility to focus and spend resources on the core competence is one of the principal driving forces for outsourcing logistics activities according to Van, Berglund and Peters (2000). What type of logistics activities suitable for outsourcing differs between companies and depends on the type of operations the individual company is performing. The following examples of logistics activities are the most frequently outsourced and are ranked according to popularity. Most common is warehousing, followed by outbound transportation, freight bill auditing/payment, inbound transportation, freight consolidation/distribution and cross docking (Coyle et al., 2003).

A company can outsource its logistics functions to a logistics provider that offers a standardized solution or to a TPL which can provide a more customized service. If the company usually sends volumes which are less-than-truckload (LTL) the use of
transportation provider can lower the transportation costs. Doing so might have the advantage of the transportation provider being able to consolidate goods from its different customers to achieve a higher fill rate, which results in lower costs for transportation (Waters, 2003).

- **Carrier Selection Determinants**

What, then, are the criteria firms use to evaluate the alternative carriers? According to the carrier selection literature, the salient selection determinants are *carrier costs and service performance*. The relevant service performance determinants are *transit time, reliability, capability, accessibility, and security* (Coyle et al., 2003). The authors will now discuss how carrier cost and service determinants interact in the firm's logistics function.

*Transportation costs* were the predominant carrier selection determinant in early carrier selection works. The transportation costs includes the rates, least weights, loading and unloading facilities, packaging and blocking, damage in transit and special services available from a carrier for example, stopping in transit.

Transportation costs analysis is oriented toward evaluating alternative modes, since the rates, least weights, loading and unloading facilities, packaging, and blocking will vary from one mode to another. However, the importance of transportation costs has receded somewhat with advent of the business logistics concept, which now focuses attention upon the cost trade-offs existing between the service a carrier provides and facility operation costs. Even so, the transportation costs disparities prevalent in today's deregulated environment remain an important criterion in the carrier selection decision.

*Transit time* is the total time that elapses from the time the consignor makes goods available for dispatch until the carrier delivers same to the consignee. This includes the time required for pickup and delivery, for terminal handling, and for movement between origin and destination terminals. *Reliability* refers to the consistency of the transit time a carrier (the link supplier) provides. Transit time and reliability affect inventory and stock-out costs (which take the inventory and form of lost sales or forgone productivity).

Shorter transit times result in lower inventories, while more dependability causes lower inventories, levels or stock-out costs. With a given level of lead time, a firm can minimize inventories and consequently inventory carrying costs. But if the transit time is not consistent, the firm must increase inventories above the level that a consistent transit time would require.
More specifically, a facility now must hold larger amounts of inventory as a safety factor against stock-outs that could arise from inconsistent service.

The marketing implications of reliable transit time are product differentiation and a competitive advantage in the marketplace. Thus, if your firm can provide a customer with a shorter and more dependable transit time than your competitor, the customer can reduce inventory or stock-out costs and your firm can increase sales. Sales are quite sensitive to consistent service, and the logistics manager must concentrate on carrier transit time and reliability to differentiate a firm's product in the marketplace.

*Capability and accessibility* determine whether a particular carrier can physically perform the transport service desired. Capability refers to the carrier's ability to provide the equipment and facilities the movement of a particular commodity requires. Equipment that can provide controlled temperatures or humidity and special handling facilities are examples of capability factors. Accessibility considers the carrier's ability to provide service over the route in question. Accessibility refers to a carrier's physical access to facilities. The geographic limits of a carrier's route network (rail lines or waterways) and the operating scope that regulatory agencies authorize constrain a carrier's accessibility. A carrier's inability to meet the desired capability and availability service requirements can eliminate the carrier from consideration in the carrier selection decision.

Security concerns the arrival of goods in the same condition they were in when tendered to the carrier. Although the common carrier is held liable for all loss and damage, with limited exceptions, the firm does incur costs when the carrier loses goods or delivers them in a damaged condition. Unsafe service results in opportunity costs of forgone profits or productivity because the goods are not available for sale or use. To guard against these opportunity costs, a firm will increase inventory levels, with resulting increased inventory costs. The continued use of an unsafe carrier will adversely affect customer satisfaction and, consequently, sales.

A firm using a common carrier holds the carrier liable for damage to the lading. To recover the damage value, the shipping firm must file a claim with carrier. This entails a claim preparation and documentation cost, as well as legal fees if the firm has the claim settled through the courts. Therefore, frequent damage to the commodities also aggravates the cost associated with claim settlement.
The Third-Party Logistics

Many companies today do not hold their own transportation distribution department to carry out transportations. Even though some companies have the logistics department or distribution department, few of them have their own fleet of vehicles to do the transportations (Kohn, 2005). Consequently this demand has to be satisfied through the procurement of transport services on the transport market (Ibid). The penetration of logistics markets by logistics service providers (LSPs) is high: about 80 percent of industrial companies outsource logistics activities accounting for an average of 60 percent of their total logistics costs (Langley et al., 2007). That means that there is a great development prospects for the logistics service providers which can be called as third-party logistics.

The third-party logistics (TPL) is the management, control and delivery of logistics activities on behalf of a shipper by an external provider (Hertz and Alfredsson, 2003). Berglund et al. (1999) define TPL as activities carried out by a logistics service provider on behalf of a shipper and consisting of at least management and execution of transportation and warehousing (if warehousing is part of the process). All of these definitions imply that TPL’s responsible is to integrate more than one logistics functions. LSPs expand their service to include information systems, consulting, contract manufacturing and even purchasing and financial services, there is a low uptake of such services and buyers in general prefer to outsource transport- and warehouse-related functions (Selviaridis and Spring, 2007). They also claim that when choosing a suitable TPL, there are several criteria and typically, they are cost, service quality and reliability, flexibility, responsiveness to requests and financial stability (Ibid).

3.2.4. Efficiency in Transportation

This section presents the idea of efficiency in transportation to the reader. It provides some significant factors to consider in transportation. Efficiency in transportation comprises of fill rate, consolidation, standardization and postponement as well. However, first a definition of effectiveness and efficiency will be made.

Efficiencies are defined as fractions, or percentages. An efficiency of 100% means that the theoretical, ideal situation is attained. An efficiency above 100% means that theoretical, ideal situation is surpassed. Drucker (1994) identified efficiency is as doing things right. From this definition one can comprehend that efficiency is to execute the focal business in an actual best way possible. The best way would be to achieve a goal with least amount of inputs of resources as possible.
Efficiency in transportation has the starting point in a theoretical ideal situation of how goods are being transported from the origin to the destination. According to Samuelsson and Tilanus (1997) the theoretical maximum transportation output for goods is a “nonstop movement between point (A) and (B) and back, along a least distance route, at maximum speed, with a full load.” (Samuelsson & Tilanus, 1997, p.141)

According to Samuelsson & Tilanus (1997), the following formula explains the overall efficiency in goods transportation and factors like fill rate, consolidations, standardization and postponement indirectly related to this formula to help the manager to achieve efficiency in transportation. \[ E = T \times D \times S \times C \]. E represents the product of the other four factors in the formula which consists of time (T), distance (D), speed (S) and capacity (C).

Drucker (1994) and Samuelsson and Tilanus (1997) discuss efficiency in transportation reduce the transportation as well as amount of emissions from transportation of goods. European Commission (2001) point out the efficiency in transport and logistics systems leads to both positive environmental effects as well as decreased transportation costs for industry. Anarson and Broden (2006), point out that to reduce the impact on the environment is to increase the fill rate of transportation, standardisation of logistics resources and postponement which are the aspects of efficiency in transportation.

Besides fulfilling efficiency in transportation, increasing the fill rate will decrease the amount of transportation, something that will have a positive impact on the environment due to less emission (Samuelsson & Tilanus, 1997; Bjørnland, Persson, Virum, & Hultkratz, 2003). It can also be achieved by logistic consolidation (Glasserman, & Wang, 1999). Wu and Dunn (1995), mention freight consolidation is an important decision for the environmental performance of a logistics system. Postponement seems interesting to consider when it comes to efficiency in transportation that effect through consolidation and the fill rate of transports (Gourdin, 2001; Zinn and Bowersox, 1988). Shipments and deliveries can be standardized to save cost and improve the lead time that leads to aspect in efficiency in transportation (Brewer et al, 2001).

As mentioned above literature, it is clearly seen that fill rate, consolidation, standardization and postponement are four aspects that leads to efficiency in transportation. So the authors believe that description to these four aspects is very necessary to reader and they are the important factors to measure the efficiency in transportation.
Fill Rate

Thomas (2009) cited in their paper through striving for a high capacity efficiency rate is important, a challenge is the combination of capacity efficiency and time efficiency. This is referred to as true fill rate and illustrates how time efficiency and capacity efficiency interacts showing the true fills rate and utilization of a vehicle. Fill rate can further be described as how, by planning and conducting, space can be used more efficient and fewer trucks (or other modes) can carry out the same transport work (TFK, 1998, cited from Thomas and Anton, 2009). As illustrated below, in figure 6, the true fill rate is calculated by considering fill rate during transportation (capacity efficiency) and time efficiency.

Figure, 6- True fill rate (Schenker, 2008)

If the fill rate for a truck is 70 per cent, but the truck stands still (as a result of loading, unloading, traffic jams etcetera) for 20 per cent of the time, the true fill rate will be only 56 per cent (0,8 multiplied by 0,7) (Schenker, 2008).

Aronsson & Huge Brodin (2006) discusses in their paper the connection between logistics efficiency and a reduced stress on the environment. The key factor they identified to reduce the impact on the environment is to increase the fill rate of transportation. The increased fill rate would have a cost reducing effect on transportation costs, since the number of transports would be reduced.

Bjørnland et al. (2003) explain that a higher fill rate can be achieved by purchasing larger amounts less frequently and hence increase the fill rate (cited from Thomas and Anton,2009). While Glasserman, & Wang (1999) stated about increase in fill rate that it can also be achieved by logistic consolidation. An issue to consider while maximizing the fill rate is that the procurement of larger amounts can lead to larger inventories, a logistical cost many times tried to be kept low.
Logistical infrastructure, such as centralization of distribution, as well as reduction of number of warehouses can generate changes in fill rate (Aronsson, 2006). An increase of fill rate will lead to a decrease in kilometers run by vehicles as well as less fuel consumption. We have also found most of the literatures about fill rate focus on the truck mode, but it is important to understand that it can also be applied to the other modes of transportation as well.

**Consolidation**

Consolidation point (CP) is a network concept. It is a function to group LCL (Less Container Load) volume into FCL (Full Container Load). It could be a cross-docking point, warehouse or distribution center, etcetera (Dave, 2004). Hall (1987) defines consolidation as “the process of combining different items, produced and used at different locations and different times, into single vehicle loads” (Hall, 1987, p.57).

Brewer, Button, and Hencher (2001) define the phenomenon as “bundling flows of passengers or goods from different origins and/or different destinations on common parts of their routes” (Brewer et al, 2001, p 239). Consolidating transport is a common practice within transportation since larger shipment sizes in general leads to reduced cost. Consolidating small shipments into one larger will give a lower average cost per unit transported.

Ballou (2004) suggest that consolidation is usually achieved in any of the following four ways; inventory, warehouse, temporal and vehicle consolidation. Meanwhile Hall (1987) exclude temporal instead of warehouse introduces terminal consolidation as the equivalent.

*Inventory* consolidation allows for large or full vehicle loads to be made into the inventory which serves outgoing orders (Ballou, 2004). *Warehouse/terminal* consolidation is adopted when items from different origins are collected and taken to a single location where they are sorted, reloaded into new vehicles for transportation to its final destination (Hall, 1987).

*Temporal* consolidation involves holding customer orders to achieve fewer and larger shipments instead of many smaller shipments. There is a trade-off situation between cost saving and customer service using temporal consolidation where the cost saving advantages are evident but it might have a negative effect on the customer service level (Ballou, 2004).

*Vehicle* consolidation involves less-than-truckload pickups and deliveries. The smaller pickups are placed on the same transport for a more efficient transport. It requires vehicle routing and transport scheduling are tools to increase the efficiency of vehicle consolidation. These different types of consolidation can with benefit be further combined and used...
together. Successful consolidation moreover has a direct effect on the overall efficiency because it improves the capacity efficiency factor presented already above (Ballou, 2004).

Additionally terminal/warehouse consolidation requires the construction of terminals, extra time and personnel for sorting, and the extra loading and unloading process. For this matter consolidation has to find the balance between benefits and counter benefits (Hall, 1987).

➢ **Standardization**

Although specialized vehicles are often necessary to meet the shipping requirements of certain goods, the existence of standardized truck trailers, railcars, cargo ships, and air containers offer economical methods to transport products. Because of their general availability, capacity to handle a wide variety of products, and ability to be utilized for backhaul, standardized vehicles often can provide lowest cost transport. This principle also applies to the standardization of docking facilities, material handling equipment, and methods of operation (Walters, 1996).

Brewer et al., 2001 explains some of the most frequent standardizations include containers, pallets, and trailer measurement, the last applying only to trucks. While for the rail mode the gauge also can, and is standardized for to large parts of Europe. Shipments and deliveries can be standardized to save cost and improve the lead time (Brewer et al., 2001).

➢ **Postponement**

Gourdin (2001) suggests that “postponement involves modifying or customizing products after the main manufacturing process is complete. Final configuration of products can be delayed until the distribution cycle, or even performed after delivery”. Hensher & Brewer, (2001) describes postponement as a process where configuration of products through component assembly, testing, cleaning or packaging just before it is needed.

Zinn and Bowersox (1988) discuss five different types of postponement and what type of firms that might be interested in applying them to their organizations. The five different classifications of postponement are: *labelling, packaging, assembly, manufacturing and time*.

Labelling postponement starts with assumption that the same product is being marketed under different brand names. Hence, it is possible to delay the labelling of the products to match it against the current demand of the product. The products are being labelled as customer orders are placed which reduces the level of uncertainty in terms of quantity demanded. Another
benefit is the reduction of safety stock where duplication is not necessary as long as the products remain unlabelled.

**Packaging** postponement involves packaging of the products at a later stage where the benefits are a reduced number of stock keeping units. The idea is to keep the product in bulk for as long as possible. As the customer orders are placed the product is packaged according to the specifications.

**Assembly** postponement can be of interest if the products consist of a number of parts which are being assembled according to unique customer specifications. The customer specifications are small in comparison to the main manufacturing of the product. The biggest gain possible here, are cost reductions from inventory consolidation and reduced transportation costs since the products are shipped unassembled to the warehouse. Negative aspects of assembly postponement can be longer delivery times if the final assembly at the warehouse is complex.

**Manufacturing** postponement involves the assembly of different parts at a warehouse. Compared to assembly postponement the manufacturing postponement involves heavier assembly where the parts can come from multiple sources while in assembly postponement the parts come from the same source. The parts are shipped to the warehouse in anticipation of customer orders and then assembled.

**Time** postponement relies on forecasts which determine the scheduled distributions of the products. The products are being shipped from a centralized warehouse as orders are placed, which results in an increase of transportation costs since there is an increase of LTL transportation.

### 3.3. Environmental Aspects
The authors will now discuss different approaches on how companies and their transportation as well a distribution can become more environmental friendly. There are a lot of options and alternatives that one can bear in mind, all are to some extent contributed to a more environmental friendly transportation industry.

#### 3.3.1. Environmental Impact of the Logistics System
Environmental impact is one of the logistics system's performance variables and goals, but there are often trade-offs between traditional financial goals and environmental goals. For example, local and more frequent transportation may lead to lower costs, lower tied-up capital and a better delivery service, but at the same time it may involve more transport work,
since higher frequencies may mean that vehicles' fill rate is lower, with higher emissions per unit transported as a result (Jonsson, 2008).

The physical flow of materials influences the environment in different ways. The selection and performance of external transportation affects the environment through emissions, congestion, tyre wear, load on infrastructure, noise and so on. The form and characteristics of products and packages influence how transportation is carried out, as well as their impact on the environment when they become waste products after use (Jonsson, 2008).

3.3.2. Emissions in the Transportation Industry

As already stated above the transportation industry is responsible for a very big part of the emission to the environment. Meanwhile the emission from most sectors decreased after 1990, the emissions from the transportation industry instead increased, and quite a lot, because of the growth of the transportation industry. Even though the most harmful emissions are decreasing due to strict emission standards, the emissions are increasing (European Environment Agency, 2007). The emissions from the transportation industry consist of pollution in the form of Green House Gases (GHG) (Rushton et al., 2006).

Jonsson (2008) external transport involves direct impacts on the environment through exhaust emissions and evaporation/transfer of fuel into the air, water and ground. This type of emission spreads quickly over the earth, regardless of the source of emission, and gives rise to more long-term effects than regional emissions.

Road traffic accounts for a large proportion of transport emissions of carbon dioxide, nitrogen oxides, hydrocarbons and particles. Diesel and petrol engines produce emissions of nitrogen oxides and particles (soot, tyre particles, etc.) as well as carbon dioxide. Road transport may also cause noise problems (Jonsson, 2008).

The environmental impact of railways depends on whether the locomotives are diesel or electric. In some European countries most railways are electrified, but in Europe as a whole there are more diesel-driven locomotives. The use of electricity has an indirect impact on the environment through its production. Noise may also be a problem associated with rail traffic. In comparison with road traffic, however, rail traffic consumes less energy per trailer transported. The total consumption of energy per transported unit will depend on the fill rate, however (Jonsson, 2008).
Jonsson (2008) the emission of greenhouse gases is the most serious problem associated with *air transport*, but nitrogen oxides and noise are other environmental problems in this mode. In addition to the environmental impact of flights themselves, de-icing of runways and aircraft causes further negative consequences for the environment.

At low speeds, *sea transport* is a relatively low-energy method of transporting goods. Calculated per transported ton-kilometre, emissions are small. In relation to the consumption of energy, however, emissions are relatively high. Sea transport produces emissions of carbon dioxide, sulphur oxides and nitrogen oxides. Faster ships because more overload on the environment since fuel consumption increases dramatically at higher speeds. One environmental advantage of sea transport is that there is no exploitation of land, little congestion and noise in comparison with other modes of transport (Jonsson, 2008).

The negative influences from the emission of greenhouse gases include first and foremost an increased temperature in the world by because a phenomenon called the green-house effect. Other negative aspects from greenhouse gases are a thinning of the atmosphere (American Geophysical Union News Release, 2004), as well as the gradual diminishing of the polar ice (Revkin, 2006).

### 3.3.3. Green Approaches

An important part of green approaches when it comes to logistics is the transportation; green transportation. Transportation brings along several negative impacts on the environment, but there are ways to reduce them. Rushton et al. (2006) put forward several methods and techniques to achieve this. They suggest the importance to educate drivers in how to drive more fuel efficient (eco-driving).

According to a study made by Schenker, reductions of fuel consumption as a result of implementation of eco-driving can be as high as 17 per cent (Schenker, 2005). This is a good way to reduce the impact transportation has on the environment. Another option is the consideration of alternative fuels, which involves switching to a less polluting fuel for the truck, such as bio gas or new techniques in engine performance.

Further, one can monitor the fuel consumption of the vehicle and through feedback develop ways to improve excessive levels of fuel consumption. One can also use a more efficient fuel dispensing system, another way to reduce fuel consumption by introducing systems or techniques that diminish the fuel consumption, and hence consume less. It is also of importance to be thorough when carrying out the vehicle selection and selection of engines which are more modern, contribute less to emissions and in general are more environmental friendly.
ECR Europe (2007) also suggests that one can design vehicles to maximize carrying capacity and minimize fuel emission. This aspect is related to the one of maximizing fill rate in the sense to design the loading platform (or other form of transportation of goods) to be able to carry as much goods as possible. The same can be done in regard to the fuel emission, by designing the vehicle to consume less of this matter. Also one can consider alternative modes since different modes from an environmental aspect can be better compared to others, and hence favouring the use of more environmentally friendly modes is a good way to decrease the negative impact from transportation on the environment.

### 3.4. Customer Services

Customer service is gaining importance as a marketing instrument by manufacturers towards distributors in international marketing channels and global logistics (Churchill & Peter, 1994). One of approach to defining the objective of logistics could be in the term of customer service, simply amplification on the notion of “availability”- that stands for the right products in the right place at the right time to the right person at the least cost (Chistopher, 1985). Simchi-Levi et al claim that customer service level is usually related to the ability to satisfy a customer’s delivery time (2004). In logistics management the regular struggle for the logistics manager is to find the balance between a high customer service level and the benefits that can be gained from an increase of sales against the cost for providing the high level of customer service (Rushton, Croucher and Baker, 2006). In other words, customer service and its cost are aspects of measurements of distribution value and the value can be increased by providing suitable customer service or reducing the costs (Attwood, 1992).

There is a great deal of definitions on the customer service. In Emerson and Grimm’s research (1996), they make a distinction between marketing customer service and logistics service. Although both of them should be used to get the customer expectation, the logistics customer service mainly focuses on providing “place, time and form utility, by ensuring that the product is at the right place, at the right time the customer wants it, and in an undamaged condition” (Ibid).

#### 3.4.1. Elements of Customer Service

To measure the customer service, identifying the elements of customer service is the initial step that should be done (Collins et al, 2001). Gattorna and Walters (1996) have made the extensive range of customer service items which included Frequency of delivery, Order cycle time, Reliability of delivery, Flexibility in replenishment, Order fulfilment accuracy,
accuracy of documentation, Conformance of documentation to organizational requirements, Continuity of supply, Advice on supply problems, Quality of company sales, technical and service representation. Since diversity of customer needs and demands, the importance level of elements of customer service is different from each company. Lalonde and Zinszer (1976) categorized the elements of customer service into three groups which are the pre-transaction that all the elements are not specifically involved with logistics, transaction which elements have direct impact on the sales, and post-transaction. According to Murohy and Wood (2004), in the post-transaction elements of customer service, one of the important activities is the handling of the returned materials or merchandise in the contemporary logistics.

\[\text{Figure, 7- Customer service elements in each phase}\]
\[\text{Source: Jonsson (2008)}\]

In 2008, Jonsson mentioned that all the activities related to the customer service could be divided into four time phases of the business deal: pre-order, from order to delivery, at delivery and post-delivery (Figure 7). He also claimed that the service related to carrying out the order-to delivery process and taking place during the phase order-to delivery and delivery itself is usually called delivery service. The most common delivery service elements are the inventory service level, delivery precision, delivery reliability, delivery time and delivery flexibility (Jonsson, 2008).

3.4.2. Customer Service Environment

Attwood (1992) claims that cost of distribution should contribute to providing customer service. It is undoubted that providing service to the customer need to spend money. At the same time, the higher the level of service offered, the more it will be spent. However, some companies are not care about the level of customer service that they offer to their customers. That will result in the increasing of whole distribution cost. Therefore, to avoid this problem,
the distribution manager should find “the acceptable balance” between costs and benefits which emerging from customer service. Such balance can be achieved by choosing from cost-minimization approach or the service-maximization approach (Ibid). Cost-minimization approach should be used in the markets that the customer service is very competitive. However, if there is a need of tight budgets on the company resource, the service-maximization approach is the best choice for the company (Attwood, 1992).

In sum, when company considers which level of customer service should be offer to different types of customer, it is essential that both service benefits and service cost should be integrated into the business environment.

3.5. Summary of Theoretical Framework
To make this theoretical framework more clearly, the authors make the table 6 to show the most important theory that we will be used in the analysis part

<table>
<thead>
<tr>
<th>Titles</th>
<th>Theoretical Aspects</th>
<th>Discussion of Important Theories</th>
</tr>
</thead>
</table>
| Distribution System | 3.1.1 Types of distribution system | • Single level system  
• Two-level system  
• Decentralized distribution system  
• Centralized distribution system |
| | 3.1.2 Cost in distribution system | • Total distribution cost contains: total transportation cost, variable warehousing cost and cost of lost sales  
• Direct cost: physical handling cost, transportation and storage of goods cost, administration costs for planning and controlling the materials flow.  
• Indirect cost: capacity and shortage  
• Total logistic cost analysis: transportation cost  
Fuel price  
Taxation  
Maintenance  
Infrastructure and environment costs |
| Transportation System | 3.2.1 Primary Transport Mode | • Road, Rail, Air and Water  
• Company characteristics and philosophy, market structure, product characteristics (current and future), customer characteristics and environmental issues |
| | 3.2.2 Coordinated Transport Services | • Intermodal combinations |
| | 3.2.3 Primary Transportation Agency | Outsourcing of logistic functions  
Types of logistics activities suitable for outsourcing:  
Warehousing, outbound transportation, freight bill auditing/payment, inbound transportation, freight consolidation/distribution  
Different types of logistics providers:  
• A logistics provider that offers a standardized solution  
• TPL |
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<table>
<thead>
<tr>
<th>3.2.4 Efficiency in Transportation</th>
<th>The third-party logistics: is the management, control and delivery of logistics activities on behalf of a shipper by an external provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fill Rate</td>
<td></td>
</tr>
<tr>
<td>• Consolidation</td>
<td></td>
</tr>
<tr>
<td>• Standardization</td>
<td></td>
</tr>
<tr>
<td>• Postponement</td>
<td></td>
</tr>
</tbody>
</table>

Environmental Impact

<table>
<thead>
<tr>
<th>3.3.1 Environmental Impact of Logistics System</th>
<th>The form and characteristics of the products and packaging, low fill rate, higher emission per unit in transportation etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.2 Emission in Transportation</td>
<td>Hydro Carbon, Carbon monoxide, Nitrogen Oxide and Carbon Dioxide.</td>
</tr>
<tr>
<td>3.3.3 Green Approaches</td>
<td>Eco-driving, Usage of biogases instead of fuel or alternative, Fuel Dispensing System, Modern engines, and usage of alternative mode for transportation.</td>
</tr>
</tbody>
</table>

Customer Service

| 3.4.1 Elements of Customer Service | Frequency of delivery  
Flexibility in replenishment  
Order fulfillment accuracy  
Order cycle time  
Reliability of delivery  
Transaction: impact on the sales  
Post-transaction: handling of the returned materials  
Pre-order  
From order to delivery  
At delivery  
Post-delivery: handle of claims and returns  
Customer service items  
Delivery service:  
Inventory service level  
Delivery precision  
Delivery reliability  
Delivery time  
Delivery flexibility |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------|
| 3.4.2 Customer Service Environment | Find “the acceptable balance” between service costs and service benefits  
• Cost-minimization approach  
• Service-maximization approach |

Table 5- Summary of Theoretical Framework  
Source: Own design (Muhammad & Zhe, 2011)
4. EMPIRICAL FINDINGS

In this chapter the empirics are presented through couple of reserved companies. We have divided this chapter accordingly our companies. Initially an introduction of the Company A with its distribution system, transportation system, environmental impact as well as its customer service is presented. The next section allows the reader to get some knowledge about our Company B under surrogate headings.

4.1. Case Company A---Contec Medical System China

-General information of Contec Medical System

Contec Medical System is a high-tech medical instrument manufacturing company founded in 1992 and its registered capital is about 30.26 million Yuan. At present Contec Medical System have 33 branch offices in China and more than 1500 employees (http://www.contecmed.com/main/about.asp, 2011). The total sales amount has reached to 200 million Yuan in 2010.

Contec Medical system specialized in developing, production and selling the electronic medical instruments. There are variable kinds of products and its products cover a range of 13 categories. Some products are the superior detectors such as automatic electrolyte analyzer, medical image system. The other products are the smaller precision medical equipments such as pulse oximeter, patient monitor, fetal monitor. It also manufactures the accessories used in produce their own products and at the same time, these products put on the market or as the maintenance accessories to delivery to its customers. For examples the embedded CPU board, electrocardiogram chest electrodes, electroencephalogram cable. It has four advanced automatic production line to produce all these kinds of electronic medical equipment and accessories. The annual output is almost attained to 30 million medical instruments. There are 70% products used for export and 30% products are selling in the domestic market. In other words, these products distributed into more than 120 countries and regions.

Today, Contec Medical System has established a modern scientific and effective manufacture system and management system. It is specially designed around all the customers’ needs. It’s very simple mission is to insure every instrument’s quality, to treat every customer as a friend, to make every deal pleasure.
4.1.1. Distribution system in Contec Medical Systems
Contec Medical System in Hebei province located in the north of China. As it has 70% products used for export and 30% products are selling in the domestic market, it has to distribute its products both to international customers and to domestic customers. There are two large warehouses near its company and it only need about 10 minutes from manufacturing plant to its own warehouses. Therefore, according to its customer order, they produce the medical instruments and put the final products into their own warehouses are used as the central warehouse of Contec Medical System. All the final products are being in those two warehouses waiting to be transported to its international customers or to the domestic customers.

➢ Types of distribution system
In the domestic markets, although Contec Medical System has 33 branch offices locating in different provinces of China, none of them have their own local warehouse to store those products which are transporting from central warehouse in Hebei province. That is to say Contec Medical System should transport its products directly from its central warehouse to the domestic customers’ warehouse. While in the international market, since it doesn’t have its own overseas offices in any countries, the ordered products should have straight delivered to its customers’ warehouses. However, when the products arrive at the overseas countries, the customers come to the airport to get the products and transfer the products to their warehouses. The distribution system of Contec Medical System is seen in the figure, 8.

Figure, 8- Contec Medical Distribution System
Source: Own design (Muhammad & Zhe, 2011)

➢ Cost in distribution system
When Contec Medical System calculate the totally distribution costs, they mainly consider the transportation costs and insurance costs. They do not think about the warehouse cost
because they do not need to have amount of products in their warehouse. They only have some safety stock to deal with sudden events, such as the increase of customer order. Most of their products produced after they get the customer order and when they complete the order, also the products delivered at the same day or next day. In other words, the warehouse cost is not the primary factor influenced the total distribution cost. Insurance costs used for the international distribution. When Contec delivers the large number of instruments or high-value products, they will buy the insurance for all the products. This will spend a great deal of money, especially in international distribution. Comparing with those two costs above, other logistics costs, such as packaging costs or administrative costs, are only took a small part in Contec Medical System. The change of those will not get an obvious effect.

- **Delivery time**
In the domestic markets, Contec Medical System has mainly focused on the north of China, such as Beijing, Hebei province and Dongbei provinces. Meanwhile, in the global market, although it sells products in the world, the Americas and European countries are its premier markets. That means they regularly distribute its products to these two continents. Usually, it has contracts with its customers on the frequency of delivery. It is about once per half month to deliver instruments to the domestic customers. Comparing with domestic markets, it is much more common when delivering the products to Americas and European countries about once per week.

- **Transportation costs**
Transportation costs is the mainly cost in Contec Medical System’s distribution cost. Meanwhile, it is also the primary aspect that influences their choice of logistics service providers. However, in the domestic transportation and international transportation, the way to calculate transportation costs has a little different. In domestic transportation, since transportation cost calculated with actual weight of products and the price per ton is not such expensive comparing with international transportation price.

Contec Medical System does not chat with its customers and it affords the total cost of transportation in domestic case. Conversely, in international transportation, Contec Medical System confer the transportation costs with its customers first and when they agree on the transportation costs, Contec Medical System then negotiate with third-party logistics to decide the final transportation costs and contract with them. This finally transportation costs are the same with cost that Contec gets from its customers. Because this cost will be paid by customers.
However, without regard to the final destination of transportation, when Contec Medical System consult with logistics service providers about transportation costs, both concern about the fuel price, kinds of tax and maintenance fee of vehicle instruments. However, they focus on unit cost of products per ton and also the efficiency in transportation’s aspects.

### 4.1.2. Transportation in Contec Medical Systems

Qin Huangdao is the city in which Contec Medical System located. This city has convenient transport facilities. There is a famous natural ice-free port used for both shipping goods and passengers. All the important state roads and high-speed road of Beijing-Shenyang connected to almost important provinces in north of China are access to Qin Huangdao. Besides road transportation, the railway lines, such as Beijing-Ha’erbin railway line and Shanghai-Ha Erbin railway line have also linked the north of China, even spread to south of China. However, the air freight is not convenient for this city. The airports are normally used for passengers instead of goods.

- **Primary transport modes and coordinated transport services**

When choosing the transportation modes, Contec Medical System use road to deliver products to the domestic customers. For logistics service providers, Contec Medical System negotiates the carrier cost, transit time, service and security, such as the damage responsibility during the delivery with third-party logistics, and finally signs the contract with it about carrier costs, service and security. However, they focus on unit cost of products per ton and also the efficiency in transportation’s aspects.

Even though the last choice of transportation mode belongs to third-party logistics when delivering products into Americans or European countries, Contec Medical System suggest them to use road combine with air to deliver the products.

- **Primary Transport Agencies**

Since Contec transport their products into both international markets and domestic market, meanwhile their logistic department does not have their own transports; they generally find the suitable logistics provider to transport their products. When outsourcing its logistics function to logistics services providers (LSPs) Contec have the criteria to select any LSP like company characteristics and philosophy, market structure, product characteristics (current and future), customer characteristics and environmental issues.

When delivering the products to Americans and European countries, they find third logistics party to afford all the services in transportation process, or use Express services to delivery
products directly to customers’ warehouses. While delivering within China, Contec Medical System does not catch the third-party logistics. It only finds the domestic logistics providers who only offer the transportation service. Almost every day, the logistics service providers come to Contec Medical System to get the products from warehouse and prepare to deliver them to the end customers, and the Contec Medical System pay the transportation fee to these logistics providers once every three months according to the contracts.

- **Logistic Service Providers**
  Contec use a transportation provider UPS for their deliveries. No cooperation with external transportation provider carried out to accomplish a better fill rate; hence this is left for the transportation provider to accomplish themselves. The criteria choosing a transportation provider for Contec based on a few characteristics. The most important aspects when selecting a transportation provider is satisfactory customer service followed by price. An environmental aspect is also of great importance, but not at the expense of customer service or price.

  - **Efficiency in transportation**
    Talking about the efficiency in transportation, Contec requires its logistics service providers have the high capability of load for the products and accurate delivery time. The most important thing is to reduce the damaged rate during the delivery process. However, one of the logistic service providers-UPS claims that when it offers the efficient transportation service to Contec Medical System, the fill rate, consolidation, standardization and postponement aspects are the important considerations.

    From the interview, the fill rate at Contec is rather low. The best fill rate been calculated for USA and EU and measured 60 per cent, meanwhile the general fill rate being slightly lower than that. A reason for the relative low fill rate is the short deliveries of goods that gives a much lower fill rate and hence decrease the average fill rate for all shipments. To increase the fill rate, USP had for the deliveries going to the foreign ports, if there is space available in the containers, decided to fill with deliveries for the following week. Holding back deliveries to increase the fill rate has never been considered. Preparations of the deliveries work in such a way that the outgoing goods are when finished put for storage until one day before, or for some specific occasions when possible, the same day as delivery day, and are placed on the loading platform together with other goods to the same destination. This is to ensure that the goods are ready for loading as the truck comes for the pickup.
The trailers pick up smaller shipments have specific times when they are to arrive and pick up a shipment. Larger shipments collected upon by trailers that also have more or less specified times, but can sometimes arrive at the same time and hence have to wait to load. The shipments are not being consolidated at Contec for international deliveries, but they presuppose that is done at the distribution centre of UPS. Due to this being made by UPS to Contec, they cannot answer how the consolidation process carried out. However Contec is working towards being able to consolidate with other organizations in business groups to able to achieve a better fill rate. For example by combine a shipment with relatively light weighted products of Contec with shipments of more heavy, safes from that another company in the business group. International shipments consolidated at the distribution centre of UPS, approximately 20 kilometres from the distribution centre of Contec.

Standardization of goods are accordingly packed on either euro pallets when possible, but more often custom made pallets due to the form of their goods. The goods put on smaller and longer pallets on its height and wrapped in plastic and additional boards for support added. The goods packed to take up as little space as possible. Most of the transports are different, but there are a few standardized solutions sent for deliveries and the necessary time for the loading process is different based on its size and its type of goods, but carried out as fast as possible.

Furthermore containers as a standardization process are not being used at or by Contec due to the fact that the size of the containers are smaller than to those of trucks and hence will lead to less amount being able to be shipped.

4.1.3. Environmental Impact at Contec Medical System
A problem for Contec Medical System in China is the far distance to its foreign market. To improve this Contec work more structured and implementing different set of regulations, structure the transportations with deliveries on specific days and so forth. Furthermore to reduce the transportation Contec try to optimize its transportation by working continuously with improving the fill rate of transports.

Contec think that it is important to use a transportation provider with high environmental standards. Alternatives to accomplish and/or support this could be the use of modern cars and engines, as well as less polluting fuels. The transportation provider of Contec has an expressed environmental profile, one of the reasons Contec choose this provider. Furthermore the transportation provider of Contec works actively with improving environmental factors
by working towards improved preparatory work with eco driving, lowered instantaneous velocity, new vehicles, new fuels, intermodal transportation, increased fill rate.

When asked about how Contec thinks a bigger priority of the environment would affect their operations, they start by pointing out that for Contec to hold down the expenses and delivery times are of most importance. A bigger priority of environment in the Contec, organization would only affect the cost. Furthermore other aspects would most likely not be affected as a result of such a priority. The transportation provider charge Contec based on trailer meter, and when a certain weight limit is reached, per ton. The choice of transportation provider based on a list of criteria, where cost, service and the environment are some ranked high.

When asked if there is anything else Contec thinks it could do to decrease the negative impact on the environment. They suggest that for Contec one of the most important aspects to work upon in this matter is the increase of efficiency in transportation. To be able to increase of the fill rate for their transports both the efficiency and the environmental aspect will be positively affected, and hence something that seen as very important to work with in the future.

### 4.1.4. Customer Services at Contec Medical System

To enlarge the profit, Contec, like other companies, has its regular way to satisfy their customers, especially in the post-delivery service. They constantly follow the customers’ order to produce and deliver the products. They deliver their products on time to their customers and delayed delivery only happens in a few situations, such as the natural causes.

- **The elements of customer service in different delivery phases**

When planning the budget of transportation costs, Contec Medical System always considers both the customer service’s level and cost. They try to balance these two things according to negotiate with their customer using MSN or telephone. At the same time, they also clarify quantity and the types of products with their customers. Although Contec Medical System has already checked the customer order with their customer before manufacturing, the employee of logistics department will also confirm the types and quantity of the products with their customers before they delivery them.

Contec Medical System thinks the delivery speed and on time delivery during the transportation process influences on their customer satisfaction quite much. In addition, the damage rate of products also takes an important position in delivery stage. In the post-delivery phase, they pay much more attention on handling of the returned products by finding
the returned reasons first. If it is because of Contec’s responsibility, like the damage when transporting these products or didn’t follow the customer’s order to deliver the products, it will afford the transportation costs and deliver the new one to their customers, or if customers get agree with Contec, they will combine the replaced new one with next order and deliver together to customers. On the contrast, if customer want to change the order or increase the order suddenly, the totally costs which are result by customers charged by customers themselves. The following table 6 is the summary of empirical finding of Contec Medical system.

4.1 Case Company A---Contec Medical System

<table>
<thead>
<tr>
<th>General information</th>
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</thead>
<tbody>
<tr>
<td>• Registered capital: 30.26 million Yuan</td>
</tr>
<tr>
<td>• Total sales amount in 2010: 200 million</td>
</tr>
<tr>
<td>• Products: superior detectors, smaller precision medical equipments and accessories</td>
</tr>
<tr>
<td>70% products used for export and 30% products used for domestic market</td>
</tr>
<tr>
<td>• Domestic Markets: 33 branch offices in China and focus on the north of China</td>
</tr>
<tr>
<td>• International Markets: 120 countries and regions, especially in Americans and European countries</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Distribution system in Contec Medical System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of distribution system</td>
</tr>
<tr>
<td>• 2 warehouses near manufacturing plants</td>
</tr>
<tr>
<td>• Delivery directly from 2 warehouses to both international and domestic customers’ warehouses</td>
</tr>
<tr>
<td>Costs in distribution system</td>
</tr>
<tr>
<td>• Domestic distribution system: transportation costs</td>
</tr>
<tr>
<td>• International distribution system: transportation costs and insurance costs</td>
</tr>
<tr>
<td>Delivery time: has a contracts with customers</td>
</tr>
<tr>
<td>• Domestic market: once per half month</td>
</tr>
<tr>
<td>• International market: once per week</td>
</tr>
</tbody>
</table>

| The general situation in Qin Huangdao where Contec Medical systems located |
|• A famous natural ice-free port |
|• Important state roads and high-speed road of Beijing-Shenyang connected almost important provinces in north of China are access to Qin Huangdao |
|• The railway lines which connect to the south and north of China |
|• Air freight: are normally used for passengers instead of goods |

<table>
<thead>
<tr>
<th>Transportation in Contec Medical Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation modes</td>
</tr>
<tr>
<td>• International distribution: road combine with air</td>
</tr>
<tr>
<td>• Domestic distribution: road</td>
</tr>
<tr>
<td>Different types of Logistic service provider</td>
</tr>
<tr>
<td>• International distribution: find TPL and contract with them about the transportation costs, delivery time, and responsibility of delivery process</td>
</tr>
<tr>
<td>• Domestic distribution: find the domestic logistics providers who only offer the transportation service and pay them once every</td>
</tr>
</tbody>
</table>
### Distribution Situations Concerning Transportation and Environmental Impact in China

**Muhammad Riaz Mughal & Zhe Zhao**

**Monday, 13 June 2011**

**Table 6- Summary of empirical finding of Contec Medical system**

Source: Muhammad Zhe

<table>
<thead>
<tr>
<th>Environmental Impact in Contec Medical System</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Efficiency of transportation</strong></td>
<td></td>
</tr>
<tr>
<td>Contec Medical System concerns</td>
<td></td>
</tr>
<tr>
<td>- High capability of load for the products</td>
<td></td>
</tr>
<tr>
<td>- Accurate delivery time</td>
<td></td>
</tr>
<tr>
<td>- Damaged rate during the delivery process</td>
<td></td>
</tr>
<tr>
<td>Logistics service providers (UPS) concerns</td>
<td></td>
</tr>
<tr>
<td>- Fill Rate: High fill rate best been calculated 60% for international and lower for domestics.</td>
<td></td>
</tr>
<tr>
<td>- Consolidation: domestics consolidation but not for international</td>
<td></td>
</tr>
<tr>
<td>- Standardization: Euro pallets, Custom made pallets.</td>
<td></td>
</tr>
<tr>
<td>- Postponement: Usage of small containers so less amount being able to shift.</td>
<td></td>
</tr>
</tbody>
</table>

| Environmental Impact of Logistics System    | Less effort in prioritizing environmental aspect but will to increase fill rate. |
| Emission in Transportation                   | No proper consideration of consequences but believes that the logistics service providers they choose have already attained as the exhaust emission standards. |

| Green Approaches                             |   |
| Selection of modern logistics services providers |   |
| Believes that the logistics service providers attain the national environment standards so no investments considering this issue. |   |

| Logistic Customer Services in Contec Medical Systems |   |
| The elements of customer service in different delivery phases |   |
| **Pre-order:** negotiate with its customers to balance customer service's level and cost. In addition, to clarify the quantity and types of products. |   |
| **Order to delivery and during the delivery:** Confirm the types and quantity with customer before delivery Delivery speed and on time delivery the damage rate of products |   |
| **Post-delivery:** handling of the returned products |   |

| Transportation Cost                          | three months |
| **Contec considers:**                        |   |
| - Unit cost of products per Ton              |   |
| - the efficiency of transportation           |   |
| - insurance cost                            |   |
| **Logistics service provider (UPS) considers:** |   |
| - Fuel price                                |   |
| - Different kinds of tax                     |   |
| - Maintenance fee                            |   |
| International distribution: the transportation costs paid by customers. Contec will confer the transportation costs with its customers first and then negotiate with TPL. |   |
| Domestic distribution: actual weight or the total density of products and Contec will afford transportation. |   |
4.2. Case Company B, Land Wind Medical China

- **General information of Landwind Medical**

Landwind Medical was establishes as a major distributor of international brands of premium medical diagnostic imaging equipment in China in 1994. However, after four years later, Landwind Medical has introduced proprietary Landwind Workstation to manufacture its own products. The milestone of production is to produce its own black and white ultrasound equipment on an Original Design Manufacture and successful entry into Japanese market in 2004. After this, based on the experience of catering for the diverse needs of over 6,000 healthcare establishments in China, Landwind Medical has expanded its markets into international markets. Until now, the total amount of global distribution partners of Landwind Medical has reached to 1,500 and over 80 different countries. There are 28 branch offices in China and more than 1,100 employees. The registered capital of Landwind Medical is nearly 1.5 billion Yuan. The total sales amount of Landwind in 2010 has accomplished to 10 billion (http://www.landwindmedical.com/AboutUs/CorporateProfile.html, 2011).

There are five main types of products that Landwind Medical produced. Four of them are large diagnosis and treatment instruments, such as colour Doppler, Ventilator and Anaesthesia machine. The other smaller instrument is auto chemistry analyser. However, with development of technology, Landwind Medical has made the product innovation on those four larger instruments. There are some new smaller substitutes for huge instruments and certainly the costs of them are higher than the huge ones. Landwind Medical also produces some accessories and semi-products both for sale and for producing final instruments. The annul amount of the products is nearly 25 million and 80% of them are distributing within China. Only 20% are delivered to the international markets.

4.2.1. **Distribution system in Landwind Medical**

Landwind Medical is an international medical instrument manufacturing company which located in Guangdong province. In the beginning of setting up Landwind Medical, it works as one of distributors of international brands of premium medical diagnostic in China. Nowadays, it becomes an international designer and manufacturer including 28 direct offices in China. Near the manufacturing plants, there are 3 warehouses being used to store the preparing final products or accessories. However, apart from these three warehouses there is also one warehouse near Beijing. That warehouse is not quite big and it is only used to store some normal products used as the emergent orders from northern part of China, and also some accessories for doing the after sale service.
➢ **Types of distribution system**
Since all the final products and accessories distributed into the global markets, in their international distribution system, Landwind Medical has delivered their products directly from their own warehouse in Shenzhen to their customer warehouses in different countries. However, in domestic distribution system, there are 28 direct offices and only one warehouse near Beijing. That means most of the time; Landwind Medical will distribute its product from warehouses in Shenzhen to their Chinese customers’ warehouse. Meanwhile, it also delivers some high demand products and accessories to its warehouse near Beijing to make its delivery more flexible. The distribution system of Landwind is found in figure 9 below.

![Figure 9- Landwind Distribution System](image_url)

**Source:** Own design (Muhammad & Zhe, 2011)

➢ **Cost in distribution system**
Talking about distribution cost, Landwind Medical separates the distribution cost into three phases the cost of taking delivery of products happened in logistics service providers come to pick up the products from the Landwind warehouses, transportation costs during the delivery, and handling cost when products arrive at the ending customers. In each phases, the main focuses are not the same. For example, in the first phase, labour cost and fuel cost are the most important considerations. In summary, Landwind Medical take transportation costs, handling cost and customer service cost into considering in its domestic distribution.

Since within China, they undertake the transportation fee calculated by the total quantity of the products. At the same time, customer service cost will also be considerate by Landwind medical,
even though this cost is not in the determining positions in the total distribution cost. In the international distribution cost, since it is not responsible for Landwind to pay for transportation costs, the distribution cost is a few about warehouse cost and customer service cost.

- **Delivery time**
  When products delivered within China, Landwind Medical has a wide range of customers groups from south of China to the north of China. That is to say when it delivers its products to south of China, it usually delivers once per week. While if it deliveries to north of China, it take once per 2 weeks to deliver products. For the international markets, it is focus on Europe, Middle East countries and Americans. If they use air to deliver smaller products or accessories, it has agreements with its customers to deliver products once per week. While Landwind use ships to deliver larger products, it spend almost one month to one and half months. Therefore, once per two months accepted to their international customers.

- **Transportation costs**
  In domestic delivery, the total transportation cost afforded by Landwind Medical. They also use quantity or the density to calculate the transportation costs. Therefore, they are more focus on the unit cost of products per Ton or total density of products. Landwind Medical is always pay attention on the damage compensation method and the efficiency of transportation when it contracts with their logistics service providers. That is to say the cost of insurance is also the aspect including in the total transportation costs.

  In the international delivery, the transportation cost paid by Landwind’s customer and Landwind medical helps their customers to find some suitable third logistics party as different optional. Then its customers directly pay the cost to third-party logistics. Therefore, for Landwind Medical, it does not focus on transportation costs in the international markets. The biggest of benefit that Landwind can get from helping their international customers find a third-party logistics is to increase their favourable impression and in the end to increase customer’s satisfaction.

4.2.2. **Transportation in Landwind Medical**
Shenzhen is a coastal city in the south of China, near Hong Kong. It is the city with largest number of ports. There are 17 ports used for leading to different countries. The amount of international container handled at ports has reached 13,659,000 TUE (twenty equivalent units) which ranks fourth in the world. Shenzhen airport ranked 46th in the world deliver goods worldwide. The road in Shenzhen is more developed. Until now, it has formed a sea,
road and air transportation net. It is very convenience from Shenzhen to other parts of China using truck to deliver products. There are lots of normal roads and also some high quality state roads and high-speed roads

➢ *Primary transport modes and coordinated transport services*

Deciding transportation mode, Landwind Medical suggest their logistics service providers to use road to delivery to their domestic customers. That because it is set to set transportation and does not need to handle the products many times. It also reduces the damaged rate during the delivery process. In the international delivery, their customers normally use air combining with road to transport the smaller size or smaller quantity products. In addition, if the products are high quality and in the urgent demand, they will consider using this kind of transportation. Another transport type is to combine the ship with road. This will spend lots of deliver time and the damaged rate will higher than last one because of moist environment. Landwind Medical’s international customers use this kind transportation type for delivering the huge quantity products and those products are usually the normal products which are not in an urgent demand.

➢ *Primary transport agencies*

Landwind Medical doesn’t have their own transportation to delivery their products. They find suitable logistic service provider to finish the ending delivery. In the domestic delivery, Landwind Medical finds the traditional logistic service providers which has only transport permit within China. In the international delivery, they help their customers to find the suitable third-party logistic to deliver their products. However, Landwind does not get transportation costs from their customers and they just give some options of different third-party logistics to their customers. The final decision of which TPL they choose is totally determined by their customers. Their customers pay the cost to the TPL.

*Logistic Service Providers*

Landwind Medical suggests transportation provider UPS for their deliveries. No cooperation with external transportation provider carried out to accomplish a better fill rate; hence this is left for the transportation provider to accomplish themselves. The criteria for choosing a transportation provider for Landwind based on a few characteristics. The most important aspects when selecting a transportation provider is satisfied customer service followed by price. An environmental aspect is also of great importance, but not at the expense of customer service or price.
Efficiency in transportation

Landwind Medical puts capability of their logistic service providers as the main element that affects the efficiency of transportation. If their logistics service providers don’t have enough carrier capability, such as the load capacity of the vehicle, it will influence the efficiency of transportation on delivering their products. Other considerations are the damage rate and the time of delivery.

UPS is also the one of logistic service providers of Landwind Medical. From UPS’s perspective, from the interview, the manager said that Landwind Medical’s fill rate is quite low. Best meet the fill rate for America and EU is 65 per cent of calculation, while the overall satisfaction rate is slightly lower. Relatively low fill rate due to the direct delivery of goods, reducing the average fill rate for all shipments. To improve Landwind's fill rates for the space available in the trucks and decided to fill the delivery next week. Holding Back to transport, to improve the occupancy rate has never been considered.

Preparation of delivery work in such a way that the outgoing goods after put in storage, until one month, or for some specific cases, where possible, one week as the day of delivery, and placed on the loading platform, together with other products for the same purpose. This is to ensure that the goods are ready for download as pickup truck comes. The trailers pick up smaller shipments have specific times when they are to arrive and pick up a shipment. Larger shipments collected upon by trailers that also have more or less specified times, but can sometimes arrive at the same time and hence have to wait to load. The shipments are not being consolidated at Landwind for international deliveries, but they presuppose that is done at the distribution centre of UPS.

Standardization of goods are accordingly packed on either euro pallets when possible, but more often custom made pallets due to the form of their goods. The goods put on smaller and longer pallets on its height and wrapped in plastic and additional boards for support added. The goods packed to take up as little space as possible. Most of the transports are different, but there are a few standardized solutions sent for deliveries and the necessary time for the loading process is different based on its size and its type of goods, but carried out as fast as possible.

Furthermore containers as a standardization process are not being used at or by Contec due to the fact that the size of the containers are smaller than to those of trucks and hence will lead to less amount being able to be shipped.
4.2.3. Environmental Impact in Landwind Medical
When Landwind Medical finds logistics service providers in China, it focuses on the lower transportation and higher efficiency. They don’t ask logistics service providers about their environmental issue at all. In other words, they don’t care about whether the fuel is environmental friendly or not, or other environmental impacts. However, they think that if the logistic service providers have sort of environmental policies or regulations, it is better for protecting or improving the environment condition, and it is better to choose environmental friendly logistic service even not the same transportation used.

In addition, because of huge quantity of products delivered in domestic market, Landwind sometimes think to use logistics service providers who has environmental friendly policies and also can give a discount on transportation prices if it use environmental friendly fuels or other methods. In the international delivery, when it helps their customer to find third-party logistics, they find that all of them want to find the internationally famous companies, such as UPS, TNT, DHL etc. Even though their customers are not focusing on the environmental impact when deciding transportation, they know that those international logistics providers have the environmental policy and regulations. Therefore, it will make a good impression to the ending customers when using environmental friendly fuel or other delivery methods.

4.2.4. Customer Services at Landwind Medical
When considering the customer service, Landwind medical puts customer service behind costs. They think cost is the pre-condition when they do everything to satisfy their customers. They help their international customers to find logistic service providers in China, and trying to keep all products delivering as right quantity, at right time and to the right customers. They think that on the post-delivery stage, handling the return products well will enhance the customer services. This is also what they are focus on.

➢ The elements of customer service in different delivery phases
Before the delivery, Landwind Medical will clarify the types of products and quantity of the products with their customers. Landwind Medical always delivers their products according to their customer order both on the quantity and the time. They think that getting the right products and right quantity on time will build a trust relationship with their customers. Therefore, they do not delay the delivery time to get a high fill rate during the order to delivery phase. Moreover, Landwind also thinks that the attitude of its logistics service providers is also an importation factor their customer satisfaction. If their logistic service providers don’t good attitude when delivering the products to customers, their customers will
complain to Landwind and ask to change the logistic service providers or they will not order any products from Landwind next time. When Landwind Medical gets the return products, they analyze the reasons why it happens. If the reason is quality of products itself, they give the new product to their customers and afford all the transportation costs. If it is not their responsible, they will also help their customers to repair the returning products, but the transportation costs belong to their customers or if the customers agree, they will deliver the fixed one with new products next time. The following table 7 is the summary of empirical finding in Landwind Medical.

<table>
<thead>
<tr>
<th>4.2 Case Company B---Landwind Medical</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General information</strong></td>
</tr>
<tr>
<td>• Registered capital: 1.5 billion Yuan</td>
</tr>
<tr>
<td>• Total sales amount in 2010: 10 billion Yuan</td>
</tr>
<tr>
<td>• Products: large diagnosis and treatment instruments, smaller instrument and some accessories and semi-products</td>
</tr>
<tr>
<td>20% products used for export and 80% products used for domestic market</td>
</tr>
<tr>
<td>• Domestic Markets: 28 branch offices in China and focus on both north and south of Chinese markets</td>
</tr>
<tr>
<td>International Markets: 80 countries and regions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Distribution system in Landwind Medical</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Types of distribution system</strong></td>
</tr>
<tr>
<td>• 3 warehouses near manufacturing plants and 1 small warehouse near Beijing</td>
</tr>
<tr>
<td>• International distribution: Delivery directly from 3 warehouses to international customers’ warehouses</td>
</tr>
<tr>
<td>• Domestic distribution: In south of China, it deliveries directly from 3 warehouses to customers’ warehouse. In north of China, it deliveries products from 2warehouses to its customers or delivery some high demand products and accessories to its warehouse near Beijing.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Cost in distribution system</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Domestic distribution system: transportation costs, handling cost, customer service cost</td>
</tr>
<tr>
<td>• International distribution system: customer service cost and inventory cost</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Delivery time: has a contracts with customers</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Domestic market: once per week to south of China and once per 2 weeks to north of China</td>
</tr>
<tr>
<td>• International market: once per week for delivering smaller products or accessories and one moth to one and half months for delivering larger products.</td>
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</table>

<table>
<thead>
<tr>
<th><strong>The general situation in Shenzhen where Landwind Medical located</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• The largest number of ports and 17 ports used for leading to different countries</td>
</tr>
<tr>
<td>• Shenzhen airport is used to deliver goods to the worldwide</td>
</tr>
<tr>
<td>• Lots of normal roads and also some high quality state roads and high-speed roads.</td>
</tr>
<tr>
<td>• Shenzhen has formed a sea, road and air transportation net</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Transportation modes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Domestic delivery: 80% using road and 20% using air or railway</td>
</tr>
<tr>
<td>• International delivery: Air combine with road to transport the smaller size or smaller quantity products and high quality products in the urgent</td>
</tr>
</tbody>
</table>
## Transportation in Landwind Medical

| Different types of Logistic service provider | Domestic delivery: traditional logistic service providers  
|                                           | International delivery: help their customers to find the suitable TPL |
| Transportation cost                        | Domestic delivery: Landwind affords the transportation costs and they also use quantity or density to calculate the transportation.  
| Landwind concerns:                         | International delivery: Landwind’s customers pay for the transportation costs and Landwind will help their customers to find different options of TPL in China. |
|                                           |                                                                 |
| Landwind concerns                         |                                                                 |
| Efficiency of transportation               |                                                                 |
| Landwind concerns                         |                                                                 |
| Logistics service provider (UPS) concerns|                                                                 |
|                                           |                                                                 |

## Environmental Impact in Landwind Medical

| Environmental Impact of Logistics System | Less effort in prioritizing environmental aspect but will to increase fill rate. |
| Emission in Transportation               | No proper consideration of consequences but believes that the logistics service providers they choose have already attained as the exhaust emission standards. |
| Green Approaches                         | Selection of modern logistics services providers  
|                                           | In domestic distribution, using logistics service providers who have environmental friendly policies and also can give a discount on transportation prices if it use environmental friendly fuels or other methods. |

## Logistic Customer Services in Landwind Medical

| The elements of customer service in different delivery phases | Pre-order: to clarify the quantity and types of products.  
|                                                             | Order to delivery and during the delivery:  
|                                                             | On time delivery  
|                                                             | Right quantity and right types  
|                                                             | The attitude of logistics service providers  
|                                                             | Post-delivery: handling of the returned products |

### Table 7 - Summary of empirical for Landwind Medical

Source: Own design (Muhammad & Zhe, 2011)
5. WITHIN CASE COMPANY ANALYSIS

In this Chapter analysis of our both companies are presented. Primarily part analysis about Company A is accessible by a figure analysis structure. Distribution system, transportation system, environmental impact and customer services about Company A are analysed. Subsequent part would give the analysis of Company B in the similar context. Meanwhile, according to the analysis, the current distribution situations of analysed companies found out.

The following Figure, 10 is the first part of analysis mode in this thesis. It can recognized that the Within Case Company Analysis (I) presented initially. Each case analysed for explanation of the phenomenon with help of theoretical framework. It used to prove that whether the phenomenon of distribution, transportation, environmental aspects and customer service in some Chinese medical instrument manufacturing companies are consistent with current theories and empirics. Meanwhile, according to the analysis, it also helps the authors to find out the current distribution situation in some Chinese medical instrument manufacturing companies, focusing on transportation and environmental impact.

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Theory</th>
<th>Empirical Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ 1: What is the current situation of distribution system in some Chinese medical instrument manufacturing companies, focusing on transportation and environmental impact?</td>
<td>bolts 3.1 Distribution System</td>
<td>Company A: Contec Medical System</td>
</tr>
<tr>
<td></td>
<td>3.2 Transportation System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.3 Environmental Aspects</td>
<td>Company B: Landwind Medical</td>
</tr>
<tr>
<td></td>
<td>3.4 Customer Services</td>
<td></td>
</tr>
</tbody>
</table>

Figure, 10- Analysis Structure
Source: Own design (Muhammad & Zhe, 2011)

5.1. Company A--- Contec Medical System China

5.1.1. Distribution System at Contec Medical System China
With a distribution centre Contec has the opportunity to hold a wider assortment of products in stock and the company can today in most cases guarantee its customers delivery within a week and month for the standard assortment of products which help in physical distribution making (Willis, 1977). These results coincide with earlier research of Johnston (1991) the basic function of distribution is to "add value" to the company's product or service by providing “time and place utility” to that product or service to gain a competitive advantage.
Contec Medical System had a centralized distribution system as indicated by the case description; the domestic customers supplied of the products to their warehouses from Contec’s warehouse and the same condition with international customers. They all received their products from the same supplier, namely the production unit in Contec satisfying what Kumar and Arora (1990) and Kohn’s (2005) found single-level system or centralized distribution system.

When Contec Medical System calculate the totally distribution costs, they mainly considerate the transportation costs and insurance costs. They do not think about the warehouse cost but according to Attwood’s research (1992), it is the secondary objective of distribution associated with, delivering and planning the distribution system. In other words, the warehouse cost is not the primary factor influenced the total distribution cost which means to neglect Attwood’s research (1992).

However, with regard to the final destination of transportation, when Contec Medical System consult with logistics service providers about transportation costs, their logistics service providers concern about the fuel price, kinds of tax and maintenance fee of vehicle instruments. However, they focus on unit cost of products per ton and also the efficiency of transportation for GRIAN (2010) by meaning of lower transport costs, it stands for cost efficient solutions using such as larger volumes, lower use of fuel, lower demand for labour force and lower external costs. In the same way by mean of lowering transport costs, Contec contracts with its customers on the frequency of delivery according to Gattorna and Walters (1996) are the extensive range of customer service item.

Insurance costs used for the international distribution an additional cost for Contec Medical System. Comparing with those two costs above, other logistics costs, such as packaging costs or administrative costs within direct cost (Jonsson, 2008), took a small part in Contec Medical System. The change of those will not get an obvious effect.

5.1.2. Transportation at Contec Medical System
When choosing the transportation modes, Contec Medical System only use the road to deliver products to the domestic customers but Coyle et al. (2003) argues rail, water and intermodal combinations offer specialized or lower-cost services. However, to decide upon choice of transport, Contec’s management decide on company characteristics and philosophy, market structure, product characteristics (current and future), customer characteristics and
environmental issues which fulfils Slater’s (1990) suggestion of factors affecting the choice of transport selection.

Third-party logistics when delivering products into Americans or European countries Contec just suggests them to use road and air mode of transportation. However the LSPs make the final decision about this delivery. Contec Medical System suggests them to use road combine with air to deliver the products but according to Grant et al. (2006) there are cheap intermodal combinations available: rail–motor, motor–water, motor–air and rail–water as well. Although its LSPs to select a mode whether to use only one single mode, or to use an intermodal service.

When outsourcing its logistics function to logistics services providers (LSPs), Contec have the criteria to select any LSP on the customer service, time-in-transit, pollution caused by transportation, carrier costs, service and security of logistics service providers which are the determinants according to Coyle et al. (2003) argument.

Since Contec Medical System transport their products into both international markets and domestic market, meanwhile their logistic department does not have their own transports; they generally find the suitable logistics provider to transport their products. This is what Van Laarhoven, Berglund and Peters (2000) detailed about outsourcing the logistics functions gives the company the possibility to focus on their core competences. And mean-while Jonsson (2008) suggests that if the company usually sends volumes which are less-than-truckload (LTL) the use of transportation provider can lower the transportation costs. When delivering the products to Americans and European countries, Contec send LTL volume and find third logistics party to afford all the services in transportation process, or use Express services to delivery products directly to customers’ warehouses.

For the third-party logistics service, Contec Medical System negotiates the transportation mode, cost, delivery time and the responsibility in delivery, such as the damage responsibility during the delivery, with third-party logistics, and finally signs the contract with it about cost and delivery items or responsibility according to Berglund et al. (1999) TPL’s responsibility is to integrate more than one logistics functions.

➢ Efficient in transportation

Talking about the efficiency of transportation, Contec requires its logistics service providers have the high capability of load for the products and accurate delivery time. The most important thing is to reduce the damaged rate during the delivery process. Samuelsson and Tilanus (1997) explain this situation that overall efficiency in a general freight context consists of the continuous product
of four-dimensional efficiencies with respect to time, distance, speed and capacity, while Contec requires capacity and time but one additional with accuracy.

The fill rate at Contec is rather low. The best fill rate been calculated for USA and EU and measured 60 per cent, meanwhile the general fill rate being slightly lower than that but according to Samuelsson and Tilanus (1997) the theoretical maximum transportation output for goods is a “nonstop movement between point (A) and (B) and back, along a least distance route, at maximum speed, with a full load” but this less load is the problem for Contec to decrease cost and environmental impact. A reason for the relative low fill rate is the short deliveries of goods but holding back deliveries to increase the fill rate has never been considered which are different from Aronsson (2006) and Glasserman & Wang (1999) logistical infrastructure, such as centralization of distribution, as well as reduction of number of warehouses, logistic consolidation and large inventories can generate high fill rate.

Consolidating small shipments into one larger will give a lower average cost per unit transported is what Ballou (2004) suggest that consolidation is usually achieved in any of the following four ways: inventory, warehouse, temporal and vehicle consolidation. The trailers pick up smaller shipments have specific times when they are to arrive and pick up a shipment is not what Brewer et al. (2001) wrote since larger shipment sizes in general leads to reduced cost. Being handed by UPS, Contec cannot answer how the consolidation process carried out totally different to Ballou’s (2004) suggestion that consolidation is usually achieved like inventory and temporal except warehouse and vehicle.

Goods accordingly packed on either euro pallets when possible, but more often on custom-made pallets due to the form of their goods. There are a few standardized solutions sent for delivery is a good act as Brewer et al. (2001) describe above.

Furthermore containers as a standardization process are not being used at or by Contec due to the fact that the size of the containers are smaller than to those of trucks and hence will lead to less amount being able to be shipped. But according to Zinn and Bowersox (1988) classifications of postponement are: labelling, packaging, assembly, manufacturing and time so Contec’s packaging and damage of products the reasons of postponement. In Contec, they delivery their products according to their customer order. In other words, they use manufacturing postponement to make distribution system more efficient.
5.1.3. Environmental Impact at Contec Medical System

A problem for Contec Medical System in China is far distance to its foreign market rise more environmental issue that is differ with Jonsson (2008), local and more frequent transportation may lead to lower costs, lower tied-up capital and a better delivery service low emission.

Contec think that it is important to use a transportation provider with high environmental standards good to know as Jonsson (2008) mention that the selection and performance of external transportation affects the environment through emissions, congestion, tyre wear, load on infrastructure, noise and so on. And Contec involve Jonsson (2008) external transport (external transport involves direct impacts on the environment through exhaust emissions and evaporation/transfer of fuel into the air, water and ground) perspective who directly impacts on the environment.

To accomplish and/or support environmental impact Contec ask their LSPs to use modern cars and engines, as well as less polluting fuels which are the reasons of pollution in the form of Green House Gases (GHG) (Rushton et al., 2006). Furthermore the transportation provider of Contec works actively with improving environmental factors by working towards improved preparatory work with eco driving, lowered instantaneous velocity, new vehicles, new fuels, intermodal transportation, increased fill rate and are also the methods and techniques to attain GHS and this is the reason that most harmful emissions are decreasing due to strict emission standards, the emission standards are increasing (European Environment Agency, 2007).

For Contec Medical System one of the most important aspects to work upon in this matter is the increase in fill rate in the sense of Rushton et al. (2006) to design the loading platform (or other form of transportation of goods) to be able to carry as much goods as possible.

5.1.4. Customer Services at Contec Medical System

The Contec Medical System which has the sound experience of deliveries proves that the customer service is Coherent due to mutual understanding and trust building. These relationship characteristics contribute to the reliable information flows between the logistic and the production units that in return lead to high customer satisfaction that is in Emerson and Grimm’s (1996) research about logistics customer service.

Although Contec Medical System has already checked the customer order with their customer before manufacturing, Contec Medical System thinks the delivery speed and on time delivery, handling of claims and returns during the transportation process influences on their customer
satisfaction are the identified elements of customer service by Collins et al (2001). In the customer services environment, when planning the budget of transportation costs, Contec Medical System always considers both the customer service’s level and costs which are the followings of Attwood (1992) cost-minimization approach or the service-maximization approach.

5.2. Company B----Landwind Medical China

5.2.1. Distribution System at Landwind Medical

Landwind Medical has delivered their products directly from their own warehouse in Shenzhen to their customer warehouses in different countries satisfying what Kumar and Arora (1990) and Kohn’s (2005) found single-level system or centralized distribution system. Landwind Medical distributes its product from warehouses in Shenzhen and Beijing for emergent orders and also some accessories for doing the after sale service to make its delivery more flexible which help in physical distribution making (Willis, 1977). These results coincide with earlier research of Johnston (1991).

Landwind Medical takes warehouse cost, transportation costs, handling cost and customer service cost into considering while delivering its products to customers that are fulfilling Willis (1977) considering about distribution cost and also Jonsson (2008) viewpoints except environmental consequence, low logistics costs.

With regard to the final destination of products, Landwind consult with logistics service providers about transportation costs, their logistics service providers concern about the fuel price, kinds of tax and maintenance fee of vehicle instruments. However, they focus on unit cost of products per ton and also the efficiency of transportation for GRIAN (2010) by meaning of lower transport costs, it stands for efficient solutions using such as larger volumes, lower use of fuel, lower demand for labour force and lower external costs. Landwind use ships to deliver larger products, once per two months and once per 2 weeks accepted to their international customers. Landwind contracts with its customers on the frequency of delivery according to Gattorna and Walters (1996) are the extensive range of customer service item.

5.2.2. Transportation System at Landwind Medical

Deciding on transportation mode, Landwind Medical suggest to mainly use road and air combining with road to deliver to their domestic and international customers but Coyle et al., (2003) argues rail, water are cheap mode available. They use road and air mode because they think there is no need to handle the products many times and less damage rates that are according to the Coyle et al., (2003) advantages of road and air transportation modes.
Third-party logistics when delivering products into Americans or European and Gulf countries Landwind suggests them to use road combine with air and sometimes road with water to deliver the products but according to Grant et al. (2006) there are cheap intermodal combinations available: rail-motor, and rail-water as well. Although its LSPs to select a mode whether to use only one single mode, or to use an intermodal service and to decide upon this transport mode Landwind’s management decide on the final choice of carrier selection by the determinants.

When outsourcing its logistics function to logistics services providers (LSPs) Landwind has the criteria to select any LSP on the customer service, time-in-transit, pollution caused by transportation, carrier costs, service and security of logistics service providers which are the determinants according to Coyle et al. (2003) argument.

When delivering their products into both international markets and domestic market, Landwind do not have their own transports; they generally find the suitable logistics provider to transport their products. This is what Van Laarhoven, Berglund and Peters (2000) detailed about Outsourcing the logistics functions gives the company the possibility to focus on their core competences. And meanwhile Jonsson (2008) suggests that if the company usually sends volumes which are less-than-truckload (LTL) the use of transportation provider can lower the transportation costs. When delivering the products to Americans and European and Gulf countries, Landwind send LTL volume and help their customers to find third logistics party to afford all the services in transportation process, or use Express services to delivery products directly to customers’ warehouses.

For the third-party logistics service, Landwind Medical is always pay attention on the damage compensation method and the efficiency of transportation when it contracts with their logistics service providers according to Berglund et al. (1999) TPL’s responsibility is to integrate more than one logistics functions.

➢ Efficiency in transportation

Landwind Medical puts capability of their logistic service providers as the main element that affects the efficiency of transportation and requires load capacity and the damage rate and the time of delivery in other considerations. While Samuelsson & Tilanus (1997) explain this situation that overall efficiency in a general freight context consists of four-dimensional efficiencies with respect to time, distance, speed and capacity to which Landwind miss distance.

From UPS’s perspective, Landwind Medical’s fill rate is quite low. Best meet the fill rate for America and EU is 65 per cent of calculation, while the overall satisfaction rate is slightly
lower and according to Samuelsson and Tilanus (1997) the theoretical maximum transportation output for goods is a “nonstop movement”. Relatively low fill rate due to the direct delivery of goods, holding back to transport, to improve the occupancy rate has never been considered and this is what Bjørnland et al. (2003) explain that a higher fill rate can be achieved by purchasing larger amounts less frequently deliveries as well as are different from Aronsson (2006) and Glasserman, & Wang (1999) logistical infrastructure.

Consolidating small shipments into one larger will give a lower average cost per unit transported is what Ballou (2004) suggest that consolidation is usually achieved in any of the following four ways: inventory, warehouse, temporal and vehicle consolidation. The trailers continuous pick up large shipments have specific times when they are to arrive and pick up a shipment is what Brewer et al., (2001) wrote since larger shipment sizes in general leads to reduced cost. Being handed by UPS, Landwind cannot answer how the consolidation process is carried out totally different to Ballou’s (2004) suggestion that consolidation is usually achieved like inventory and temporal except warehouse and vehicle.

Goods are accordingly packed on either euro pallets when possible, but more often on custom made pallets due to the form of their goods. There are a few standardized solutions sent for delivery is a good act as Brewer et al. (2001) describe above.

Furthermore containers as a standardization process are not being used at Landwind due to fact that the size of the containers are smaller than to those of trucks and hence will lead to less amount being able to be shipped. But according to Zinn and Bowersox (1988) classifications of postponement are: labelling, packaging, assembly, manufacturing and time and Landwind’s packaging, and damaging of products are reason for postponement.

5.2.3. Environmental Impact at Landwind Medical

A problem for Landwind Medical China is the far distance to its foreign market that is what Jonsson (2008) describes, local and more frequent transportation may lead to lower costs, lower tied-up capital and a better delivery service.

Landwind think that it is important to use a transportation provider with high environmental standards good to know as Jonsson (2008) mention that the selection and performance of external transportation affects the environment through emissions, congestion, tyre wear, load on infrastructure, noise and so on. And also Landwind involves Jonsson (2008) that external transport perspective who direct impacts on the environment.
Alternatives to accomplish and/or support environmental impact is the use of modern cars and engines, as well as less polluting fuels which are the reasons of pollution in the form of Green House Gases (GHG) (Rushton et al., 2006). Furthermore the logistics service provider for Landwind works actively with improving environmental factors by working towards improved preparatory work with eco driving, lowered instantaneous velocity, new vehicles, new fuels, intermodal transportation, increased fill rate are also the methods, techniques to attain GHG and strict emission standards (European Environment Agency, 2007).

For Landwind Medical China one of the most important aspects to work upon in this matter is the increase in fill rate in Rushton et al. (2006) the sense to design the loading platform (or other form of transportation of goods) to be able to carry as much goods as possible.

5.2.4. Customer Services at Landwind Medical

Landwind Medical has the sound experience of deliveries prove that the customer service is Coherent due to mutual understanding and trust building quite satisfying Chistopher (1985) words that right place at the right time to the right person at the least cost. These relationship characteristics contribute to the reliable information flows between the logistic and the production units that in return lead to high customer satisfaction that is in Emerson and Grimm’s (1996) research about logistics customer service.

Though Landwind Medical has already checked the customer order with their customer before manufacturing, they think on time delivery, right quality and right types and also handle of claims and returns during the transportation process influence on their customer. In addition, Landwind also pays attention to the attitude of logistics service providers when they do the delivery service to its customers. Landwind thinks that this is one of the factors what will influence the customer satisfaction.

In the customer services environment, when planning the budget of transportation costs, Landwind always considers both the customer service’s level and costs which are the followings of Attwood (1992) cost-minimization approach or the service-maximization approach.

5.3. Summary of Analysis and RQ 1

In following analyses table, 8 summaries of the controversies between theory and empirics mentioned above are accessible to reader to get more clear depiction of this chapter. The authors used coherent terms mean current situations in our companies when relating to theory. The main divergences related to theoretical aspects found in this study are:
When it is talk about Contec Medical System it is evident that company performing rational in its distribution system but the cost of distribution is divergent in having cost efficient distribution system. And same condition with Landwind Medical China as it does not manage its distribution system well.

Efficiency in transportation’s factors have been mentioned in this chapter have fully Incoherent conditions for Contec Medical System and Landwind Medical China. Outsourcing to LSPs as well as standardization seems quite fair at both our respondents. The second last and last contents of this thesis as environmental impact and customer service are concern, both of respective companies have Incoherent situation except emission in transportation industry and customer service.

Regarding our cases companies’ analysis authors capable to response the current situation of distribution system in some Chinese medical instrument manufacturing companies, focusing on transportation and environmental impact. According to the cases companies’ analysis and the table 9, the RQ1 is developed and summarised as follow;

These two companies stand for some Chinese medical instrument manufacturing companies in some extent, especially the smaller medical instrument manufacturing companies.

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<th>Landwind Medical</th>
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</tr>
<tr>
<td>Types of distribution system</td>
<td>Incoherent</td>
<td>Incoherent</td>
<td>Incoherent</td>
</tr>
<tr>
<td>Cost in distribution system</td>
<td>Incoherent</td>
<td>Incoherent</td>
<td>Incoherent</td>
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<tr>
<td>Transportation costs</td>
<td>Incoherent</td>
<td>Incoherent</td>
<td>Incoherent</td>
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<tr>
<td>Transportation System</td>
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<td>Coherent</td>
<td>Coherent</td>
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<tr>
<td>Primary Transport Mode</td>
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<td>Incoherent</td>
<td>Incoherent</td>
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<tr>
<td>Coordinated Transport Service</td>
<td>Incoherent</td>
<td>Incoherent</td>
<td>Coherent</td>
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<tr>
<td>Primary Transport Agencies</td>
<td>Coherent</td>
<td>Coherent</td>
<td>Coherent</td>
</tr>
<tr>
<td>Efficiency in transportation</td>
<td></td>
<td>Incoherent</td>
<td>Incoherent</td>
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<tr>
<td>➢ Fill Rate</td>
<td>Incoherent</td>
<td>Incoherent</td>
<td>Incoherent</td>
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<tr>
<td>➢ Consolidation</td>
<td>Incoherent</td>
<td>Incoherent</td>
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<tr>
<td>➢ Standardization</td>
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<td>➢ Postponement</td>
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<td>Environmental Aspects</td>
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<td>Environmental impact of logistics system</td>
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<td>Incoherent</td>
<td>Incoherent</td>
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<tr>
<td>Emission in transportation industry</td>
<td>Coherent</td>
<td>Coherent</td>
<td></td>
</tr>
<tr>
<td>Green approaches</td>
<td>Incoherent</td>
<td>Incoherent</td>
<td>Incoherent</td>
</tr>
<tr>
<td>Customer Service</td>
<td>Customer service</td>
<td>Coherent</td>
<td>Coherent</td>
</tr>
</tbody>
</table>

Table 8- Case Company Analyses Summary
Source: Own design (Muhammad & Zhe, 2011)
These two medical instrument manufacturing companies have their own manufacturing plants and also the central warehouses near their manufacturing plants. No matter distributing to the domestic customers or international customers, they deliver the products directly from their central warehouses to the customers’ warehouse. When calculating the distribution cost, transportation costs accounts for the large part of the total distribution cost and then the warehouse cost if the company has some regional warehouses, like Landwind. If the company is focus on giving high level of customer service, the cost of loss is part of distribution cost. Picking out the transportation costs, Contec and Landwind outsource their transportation from LSPs. They care about the price per ton, while their LSPs focus on the fuel price, taxation and maintenance fee when making transportation price for the companies. With obvious increasing of fuel price in China, the transportation costs of companies will increase in the following years.

In order to focus on the core competence, most companies outsource some logistics functions to the LSPs. In Contec and Landwind, both of them outsource their transportation to LSPs. In the domestic distribution, they use common logistics service providers to afford normal delivery. However, in the international distribution, they use TPLs to have more adding service. There are also some interesting thing happened in the international distribution. That is in some medical manufacturing companies they don’t afford the transportation costs, which means their international customers will find the TPLs for delivering the products, like Landwind in the beginning of expanding international markets. On the other hand, some companies, like Contec sold lots of products to the international markets, charge the transportation costs from their international customers and then find suitable TPLs to deliver products.

Even though mostly companies outsource their transportation function to LSPs, they also give their suggestions of choosing the transportation mode. Both of these two companies use road mode as the main transportation mode. This situation also stands for most companies’ choice when delivering products within China. They want to delivery their products at the lower cost with lower damage rate. They also ask for the on time delivery and the keep the same level of customer service. Therefore, comparing with other transportation mode, road is much more suitable for them. Since the special character of medical instruments, the international transportation mode is air combining with road mode. It is efficient for them because of shorter time and lower damage rate.
To increase efficiency in transportation, there are four things done, fill rate, consolidation, standardization and postponement. For Contec and Landwind, the fill rate is quite low. It needs to improve according to different ways of consolidation. Moreover, both of these companies use postponement such as after getting the customer’s order, they begin to produce the products. This will cut the inventory cost and fulfil different customer’s orders.

For the environmental impact, it is the big problem in China. Because most companies, like Contec and Landwind, are not pay much attention on the emission of transportation or the noise making by the transportation like European companies. They believe that the LSPs have already met the national emission standards’ requirements. Therefore, they don’t need to pay attention to how much the emission is. In other words, most Chinese companies put cost in the first position which means most of them neglect the environmental issue.

However, as many LSPs have some discount on using environmental fuel nowadays, such as UPS, TNT, the medical instrument manufacturing companies begin to think about the environmental issue. At the same time, most Chinese medical instrument manufacturing companies have both domestic and international market, like Contec and Landwind. Even if their domestic customers don’t have more attention on the environmental issue, they will bear in mind the environmental issue when they do the international distribution. That because they want to leave the good corporate image for their international customers. Moreover, the Chinese government also has published some environmental policies to encourage companies using eco-fuel or new vehicles. All in all, the environmental issue has become increasingly concerned in Chinese medical instrument manufacturing companies.
6. CROSS CASE ANALYSIS

In this chapter the second part of the analysis is presented. The structure of general theory presented in Chapter 3 is used here as shown in cross case analysis figure structure. In this chapter the two case studies are analysed together, and differences and similarities are discussed. Finally identified factors would be available to reader.

The figure, 11 is continuation of the previous figure. Within Case Company Analysis (I) will be used to present cross-case analysis (II). It allows revealing similarities and differences among the cases. After cross-case analysis (II), the general factors in distribution of products influence transportation and environmental impacts while maintain the same customer service level are possibly judged. That is to say according to cross-case analysis (II), the more detail factors will be conduct out based on the empirical findings and Within Case Company Analysis. In the end of cross-case analysis, the factors that can influence transportation and environmental impacts while no trade-off customer service presented to reader.

![Figure 11 - Cross Case Analysis Structure](source: Own design (Muhammad & Zhe, 2011))

Generally, it is seen that there are many similarities among the case companies in terms of distribution system, transportation system, environmental impact and their customer service trade-offs. Both the case companies distribute their products to international market with varied ratio. Both companies use local transporter for domestic and UPS as LSP for their international deliveries.

Specifically, in case of Contec’s insurance cost thought as additional cost while in case of Landwind inventory cost and material handling cost create problems. The damage of products
cause heavy burden on both of companies. Especially, the large size of the products in both the cases of Contec and Landwind leads to some delivery postponement. Consequences are higher transport costs for international deliveries can’t take advantages of the water mode. Furthermore, absence of efficiency in transportation is the main important aspects that both of our respective companies are striving for. Both respective companies are participating in healthy atmosphere by having high environmental standard for their transporters. Both companies have Coherent level of customer services and are eager to increase this level by cost-minimization approach or the service-maximization approach.

The following Table, 9 summarizes the main similarities and differences among the two cases in terms of distribution system, transportation system, and environmental impact and customer service. The following table shows under which theoretical aspect our companies have both similar or different current distribution situations with each other and their effects related to theoretical aspects. In addition, in table, 9, positive means companies have good current distribution situations when comparing to theoretical aspects and negative means not good conditions of their current distribution situations.

<table>
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<th>Theoretical Aspects</th>
<th>Contec Current Situations</th>
<th>Effects</th>
<th>Landwind Current Situations</th>
<th>Effects</th>
<th>Situations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Distribution System</strong></td>
<td>Types of distribution system</td>
<td>Centralized</td>
<td>Positive</td>
<td>Centralized</td>
<td>Positive</td>
<td>Similar</td>
</tr>
<tr>
<td></td>
<td>Cost in distribution system</td>
<td>Transportation costs, Insurance cost, Customer service cost.</td>
<td>Negative</td>
<td>Transportation costs, Handling cost, Customer service cost, Inventory cost.</td>
<td>Negative</td>
<td>Different</td>
</tr>
<tr>
<td></td>
<td>Transportation costs</td>
<td>Insurance fee, Fuel price, Kinds of taxes, Maintenance fees.</td>
<td>Negative</td>
<td>Fuel price, Kinds of taxes, Maintenance fees</td>
<td>Negative</td>
<td>Different</td>
</tr>
<tr>
<td><strong>Transportation System</strong></td>
<td>Primary Transport Mode</td>
<td>Road</td>
<td>Negative</td>
<td>Road</td>
<td>Negative</td>
<td>Similar</td>
</tr>
<tr>
<td></td>
<td>Coordinated Transport Service</td>
<td>Road and Air</td>
<td>Negative</td>
<td>Road and air, Road and Water</td>
<td>Positive</td>
<td>Similar</td>
</tr>
<tr>
<td></td>
<td>Primary Transport Agencies</td>
<td>LPSs</td>
<td>Positive</td>
<td>LSPs</td>
<td>Positive</td>
<td>Similar</td>
</tr>
<tr>
<td></td>
<td>Efficiency in transportation</td>
<td>Low Capacity, Late Delivery time, High Damage rate</td>
<td>Negative</td>
<td>Low Capacity, Late Delivery time, High Damage rate</td>
<td>Negative</td>
<td>Similar</td>
</tr>
<tr>
<td></td>
<td>Fill Rate</td>
<td>Low</td>
<td>Negative</td>
<td>Low</td>
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<td>Similar</td>
</tr>
<tr>
<td></td>
<td>Consolidation</td>
<td>Large shipments</td>
<td>Negative</td>
<td>Large shipments</td>
<td>Negative</td>
<td>Similar</td>
</tr>
<tr>
<td></td>
<td>Standardization</td>
<td>Euro Pallets, Custom Made Pallets</td>
<td>Positive</td>
<td>Euro Pallets, Custom Made Pallets</td>
<td>Positive</td>
<td>Similar</td>
</tr>
<tr>
<td></td>
<td>Postponement</td>
<td>Packaging and Damage of products</td>
<td>Negative</td>
<td>Packaging and Damage of products</td>
<td>Negative</td>
<td>Similar</td>
</tr>
<tr>
<td>Environmental Aspects</td>
<td>Environmental impact of logistics system</td>
<td>Emission, Congestion, Load on infrastructure, Noise, Tyre wear</td>
<td>Negative</td>
<td>Emission, Congestion, Load on infrastructure, Noise, Tyre wear</td>
<td>Negative</td>
<td>Similar</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>----------------------------------------</td>
<td>---------------------------------------------------------------</td>
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<td>---------------------------------------------------------------</td>
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</tr>
<tr>
<td>Emission in transportation industry</td>
<td>Green House Gases, CO2</td>
<td>Negative</td>
<td>Green House Gases, CO2</td>
<td>Negative</td>
<td>Similar</td>
<td></td>
</tr>
<tr>
<td>Green approaches</td>
<td>Eco-driving, Less polluted oil, Fuel dispensing system</td>
<td>Negative</td>
<td>Eco-driving, Less polluted oil, Fuel dispensing system</td>
<td>Negative</td>
<td>Similar</td>
<td></td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Customer Service</th>
<th>Availability of products</th>
<th>Positive</th>
<th>Availability of products</th>
<th>Positive</th>
<th>Similar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elements of customer services</td>
<td>Order management, Handle of claim and returns</td>
<td>Positive</td>
<td>Order management, Handle of claim and returns</td>
<td>Positive</td>
<td>Similar</td>
</tr>
<tr>
<td>Customer service environment</td>
<td>Cost-minimization approach and service-maximization approach</td>
<td>Positive</td>
<td>Cost-minimization approach and service-maximization approach</td>
<td>Positive</td>
<td>Similar</td>
</tr>
</tbody>
</table>

**Table 9-Cross Case Analyses**

Source: Own design (Muhammad & Zhe, 2011)

According to the table, 9 above the main similarities and differences between two companies that has positive as well as negative effects on it-self related to theoretical aspects, are similar current centralized type of distribution system that positively influence as compare to couple of other aspects distribution cost and transport cost with different situations, since the centralised distribution system can help companies to explore new markets (Kohn, 2005). Insurance cost considered as additional cost when delivering the products for Contec medical while material handling and inventory cost thought as extra cost of Landwind’s delivery of the products.

Transportation system seems similar as most critical theoretical aspect with most critical factors in both of our companies. The theoretical aspects that have positive effects on transportation system hardly are the coordinated transportation service; transport agencies and standardization factor in names few. All other mentioned aspects and factors negatively influence both of companies. European Commission (2001) point out the efficiency in transport and logistics systems leads to both positive environmental effects as well as decreased transportation for industry. In other word, efficiency in transportation, which contains four factors- fill rate, consolidation, standardization and postponement, is the most important theoretical aspect that will influence both the transportation and environmental effects has similar situations.
When we come toward environmental impact, same conditions like transportation system seen here for both or our companies and also have similar situations. Congestion, CO2 and low emission standards are the reasons of negative influence. While Anarson and Broden (2006) point out that to reduce the impact on the environment is to increase the fill rate of transportation, standardisation of logistics resources and postponement. That is to say these negative influences relates with the efficiency in transportation.

The customer service has bit similar situations in both of respective companies. It is evident that their customers satisfied. As table, 9 shows that the customer service has positive effect on our companies mean that customer service is well organized. It is apparent from table, 9 that customer service is quite well therefore we will not focus on this content any more. However consider on critical factors like fill rate, consolidation, standardization and postponement do not negatively influence customer service rather they create a positive influence for customer service maximization.

Some the arguments above would be used in table, 10 for extraction and it also shows the factors in distribution of products influence transportation and environmental impacts while no trade-off customer service done. In this table below according to current situation, critical factors are identified and their effect on our respective companies mentioned. According to their negative influential effects they considered as most critical factors and these critical factors need to make more proficient for our company perspective. The theoretical aspects with negative and positive effects on our companies can be shown in table, 10.

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<th>Effect on Landwind</th>
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<td>Negative</td>
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<td>System</td>
<td>transportation</td>
<td>Consolidation</td>
<td>Negative</td>
<td>Negative</td>
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<tr>
<td></td>
<td></td>
<td>Standardization</td>
<td>Positive</td>
<td>Positive</td>
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<tr>
<td></td>
<td></td>
<td>Postponement</td>
<td>Negative</td>
<td>Negative</td>
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<tr>
<td>Environmental</td>
<td>Environmental impact</td>
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<td>Negative</td>
<td>Negative</td>
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<tr>
<td>Impact</td>
<td>of logistics system</td>
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<tr>
<td></td>
<td>Emission in</td>
<td></td>
<td>Negative</td>
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<tr>
<td></td>
<td>transportation</td>
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<tr>
<td></td>
<td>industry</td>
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<tr>
<td></td>
<td>Green approaches</td>
<td></td>
<td>Negative</td>
<td>Negative</td>
</tr>
</tbody>
</table>

Table 10-Influential Factors
Source: Own design (Muhammad & Zhe, 2011)
The main theoretical aspects that have negative effect on both of our companies are transportation and environmental impact. And from the literature it is evident that fill rate, consolidation, standardization as well as postponement are the possible factors that used to reduce transportation and environmental impact and the negative effects on our companies (Anarson and Broden, 2006; Samuelsson & Tilanus, 1997; Bjørnland, Persson, Virum, & Hultkratz, 2003; Glasserman, & Wang, 1999; Gourdin, 2001; Zinn and Bowersox, 1988; Brewer et al, 2001) support our findings. These references clearly show that in our theory part “Efficiency in Transportation” these are the four factors that help in reducing both transportation and environmental impact. These factors not only discuss transportation but also include environmental impact. That is to say these are the critical factors authors identified and the main benefits can be found in terms of reducing transportation and environmental impact from the company possible through fill rate, consolidations, and standardization and postponement factors as well.

It is apparent from table, 9 that customer service is quite well therefore we will not focus on this content any more. However consider on critical factors like fill rate, consolidation, standardization and postponement do not negatively influence customer service rather they create a positive influence for customer service maximization. Through literature it is marked that abstract in efficiency in transportation are the important factors in reducing transportation and environmental impact which also help in customer maximization (Brewer et al., 2001).

Based on the finding in our both Within Case Company Analysis and cross case analysis about first 2 research questions, the last question 3, how identified factors influence distribution situation in some Chinese medical instrument manufacturing companies is available to the reader in our next chapter, 7 in form of suggestion and recommendations.
7. SUGGESTION AND RECOMMENDATION

In this chapter, some suggestion based on the identified factors which are found from Within Case Company Analysis and cross-case analysis are given. At the same times, more recommendations about how these factors will influence distribution situation are applied to some Chinese medical instrument manufacturing companies.

Figure, 12 shows the structure of RQ#3. By means of comparing the theory, especially in “efficiency in transportation” with Within-Case Analysis and cross-case analysis, the authors suggest how these identified factors will reduce transportation and environmental impact in some Chinese medical instrument manufacturing companies focusing on transportation and environmental impact. It is apparent from table, 10 above that customer service is quite well therefore authors will not focus on this content any more. But consider on critical factors like fill rate, consolidation, standardization and postponement do not negatively influence customer services rather create a positive influence about customer service maximization.

![Figure 12- Structure of RQ#3](image)

As expected from the Analysis reviews and RQ#2, fill rate, consolidation, standardization and postponement are in both cases identifies as important factors for both transportation and environmental performance. The suggestions about how they use to reduce the negative influence from our companies, this section developed to provide on this question. The other theoretical aspects from the analysis review are all part of the cases studied, although we choose to stress
some critical factors, which we found more important or more closely specified according to Within Case Company Analysis table, 9 and cross case analysis table, 10.

**Fill Rate and Consolidation**

One of the key factors pointed out across the cases and in the literature, was importance of increasing the fill rate in transportation. In our both cases increased fill rates mean less environmental impact. At a strategic level, changes made to increase fill rates were to increase the size of warehouses, centralise distribution, reduce the number of warehouses, and change location of warehouses, which can all be described as changes to the logistics infrastructure. The restructuring of flows into one, centralized flow from the area of production to spot in the distribution area, i.e. main flow consolidation, is an additional concrete instance of structural consolidation. Such consolidations often involve changes of transportation modes as in the cases of both Contec Medical System and Landwind Medical, from trucks to rail transport; and from air to sea transport. These shifts in transport modes towards environmentally better transport modes and will help to increase customer satisfaction excessively.

Another method to increase fill rate is to work more actively with vehicle routing (all cases), to change storage strategies on a regular basis (Contec), and to minimise the number of deliveries, which in some instances meant increasing lead times. These changes all contribute to increased fill rates of vehicles and thus a decrease in vehicle kilometres and fuel consumption. These types of changes are tactical in their nature because they target parts of one market. Another tactical decision which affected vehicle fill rates is to coordinate transports with other suppliers who supply the same or similar customers in areas with few customers.

On the operational level the changes at both the strategic and tactical levels makes it possible to achieve a higher fill rate in the transport. Consolidation assists higher frequencies of transport, which in turn enables smaller deviations to delivery plans due to attempts to fill the transport. Some deliveries postponed until the next transport occasion, without the final customer experiencing any decrease in delivery service. There were also other types of changes that can be made independently of other decisions, such as the final repacking of goods by both companies done in such a way as to reduce the size of the goods. The effects of the changes were an increased fill rate and decreased transport work, and enabled a stable service level while environmental performance enhanced.

In both the case of Contec and Landwind, increased and centralised volumes made it possible to change mode of transportation. The first connection established between two of their main
warehouses for local, USA and Europe deliveries. There were several reasons for move to rail; cost considerations and the environmental impact are important, but also the increased volumes of goods due to the increasing establishment of new stores. Another important reason is congestion on the roads in China expected to grow, and this was also a main incentive for both to change their transportation mode.

However, in these cases, the move is geographically larger as they consolidated the flow of their goods and moved the flow from the continent to the Sea, and changed from road transport to ferry. Hence this change provides environmental improvement basically from modal change and centralization, as well as increased performance in terms of costs and delivery service.

A prerequisite for rail an alternative that is possible to buy a fixed timetable so that the train can run non-stop between the destinations. This has been and still is difficult to do, especially when the destinations are in different countries. In this respect both Contec and Landwind shared the same experience. The speed is essential because the fixed costs of buying a train set are high. With a higher speed the train can be better used.

➤ Standardization

Standardizations concern mainly two levels in our cases; transportation vehicles and load carriers. These two system levels are naturally intertwined, as the load carriers have to fit the vehicles. However, they discussed on different levels.

For Contec and Landwind, the load carriers had to be standardized to fit both the train system and the ferry. The load carriers can be loaded onto the vehicles in ways, which make full use of the vehicle capacity. A standardized load carrier also means the loading and handling equipment standardized. Another significant feature of standardized load carriers is that it decreases the total volume of carriers in system, as any carrier coming back is used for the following load. It also improves the manageability of the system.

For both Contec and Landwind their new transportation systems meant high involvement of the goods owners in the setting up of the new systems, although the systems were run by other parties or their own. This involvement included decisions on a strategic level. Further, operational level standardization implies easier handling procedures, which reduces costs as well as delivery times. The changes, resulting in rationalization of the activities on an operational level, also reduced uncertainties, which in turn affected the delivery accuracy vis-a-vis the customers.
Higher standardization in itself underwrites opportunities to increase the fill rates (as discussed above). A higher fill rate lessens the need for transport, in terms of vehicle-km, and thus reduces the environmental impact from companies.

- **Postponement**

The group of changes concerns how different parts of the system understood, and thereby considered in the distribution system. A definite function coupled with a range of characteristics and mechanisms. However, categorizing logistics strictly into precise functions (warehousing, transport, handling, etc.) causes deputize improvement. To overcome this problem, a more holistic view of the logistics functions applied, in which the clear division between the activities and how they grouped into functions erased. The analysis above is from distribution, and concerns distribution for both domestic and international. However, the same logic can very well be applied to both distributions, which was extensively discussed as an option in both of our case companies.

The aim for Contec and Landwind is to be able to control the goods after they have left the supplier and are already headed for a main destination area. The goods could be traced at an article level and in what container it loaded. The system makes it possible to manage and reroute the goods being transported, in cases of goods for USA, EU and Gulf.

Today for Contec, 70 percent of the goods shipped to USA and Europe by road and air. This means that about 0.8 million cubic meters is in storage on planes. Contec can change distribution structure from indirect transport to LSPs or its own into centralized transport to the continent, and this is from where the companies supplied. This also means the point where each shipment’s final destination decided is postponed in time.

Landwind’s 80 percent of the goods shipped to China by road. This means that about 0.9 million cubic meters is in storage on containers or trucks. Landwind can change distribution structure from direct transport to own transport or LSPs into centralized transport to the south and north, and this is from where the companies are supplied. This also means that the point where each container’s final destination is decided is postponed in time.

Although Contec & Landwind do not make use of this, might be an option for improved flexibility of the transport system. Orders that are couple days late could very well be made through redirected shipments, which in turn would reduce the need for express transports.
This should in general reduce environmental impact, as express deliveries are often carried out by transport modes with higher environmental stress than those for regular transport.

Since, the lead-time of sea transport is comparably long, it is then possible to load goods, which are not yet destined to a specific area, but can be forecasted for a larger region. This is not at all a new idea per se; many companies put on postponement strategy already. Generally, it is difficult to calculate environmental effects in accurate figures. But based on previous experience and knowledge it is expected to reduce the environmental impact, reduce transportation and increase delivery service.

Changes identified in the both cases can in different ways contribute to influence the environmental impact. It is also clear that they interconnected in many ways, i.e. they influence each other. Figure 13, the factors with characteristics and their interrelatedness illustrated. It is apparent that each change individually can drive a modification in the environmental performance of the system.

![Diagram](image)

**Figure 13- Suggested Efficient Logistic System**

Source: Own design (Muhammad & Zhe, 2011)

However, it is not important to hassle that they relate to each other, probably in more ways than those indicated above. Consequently, different decisions taken in improving situation can reinforce each other, and each other’s effect. It is important to note that factors might counteract the positive effect the factors described above might have the positive effect.
The table, 12 below presents recommendations on four factors with characteristics to get clearer to the readers. Already found out fill rate, consolidation, standardization and postponement in both cases identified are important factors for both transportation and environmental performance. These factors used in relation to transportation when dealing with environmental impact. Which factor with current situations used to reduce the negative influence from our companies, highlighted under recommendations column. The other theoretical aspects from the analysis review are all part of the cases studied, although we choose to stress some critical factors, which we found more important or more closely specified according to Within Case Company Analysis table, 8 and cross case analysis table, 9.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Context's Current Situation</th>
<th>Landwind's Current Situation</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill Rate</td>
<td>• Short deliveries of goods</td>
<td>• Direct deliveries of goods</td>
<td>• Increase the size of warehouses,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Further centralized distribution system,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Reduce the number of warehouses,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Change the location of warehouses,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increase lead time, Vehicle routing,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Coordinated transport,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Smaller change to delivery plans</td>
</tr>
<tr>
<td>Consolidation</td>
<td>• Road,</td>
<td>• Road,</td>
<td>• Trucks to rail transport;</td>
</tr>
<tr>
<td></td>
<td>• Road and Air</td>
<td>• Road and Air, Air and Water</td>
<td>• And from air to sea transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Increase lead time, Vehicle routing,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Coordinated transport,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Smaller change to delivery plans</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• And packaging to reduce the size of the products</td>
</tr>
<tr>
<td>Standardization</td>
<td>• Euro Pallets, Iso Pallets</td>
<td>• Euro Pallets, Custom made pallets</td>
<td>• Transportation vehicle and Load carriers has to be standardized</td>
</tr>
<tr>
<td></td>
<td>• Custom made pallets</td>
<td></td>
<td>• Involvement of goods owner</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Planning procedures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Handling process</td>
</tr>
<tr>
<td>Postponement</td>
<td>• Smaller size of containers</td>
<td>• Smaller size of containers</td>
<td>• Clear division between the activities,</td>
</tr>
<tr>
<td></td>
<td>• Packaging</td>
<td>• Packaging</td>
<td>• Tracking system</td>
</tr>
<tr>
<td></td>
<td>• Damage of products</td>
<td>• Damage of products</td>
<td>• Direct to LSPs warehouse</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Reduce the need for express transport</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Load goods of un-destined area</td>
</tr>
</tbody>
</table>

Table 11- Summarizing the Four Factors
Source: Own design (Muhammad & Zhe, 2011)

Table, 11-Identified Factors and literature cleared that fill rate, consolidation; standardization as well as postponement is possible abstracts used to reduce transportation and environmental impact. As these factors comprise both transportation and environmental impact so authors do not explain environmental aspect separate. It is apparent from table, 9 above that customer
service is quite well therefore we did not focus on this content here in this table. However considering more on critical factors like fill rate, consolidation, standardization and postponement do not negatively impact on customer services relatively create a positive influence for customer service maximization. These are the critical factors authors identified and the main benefits can be found in terms of reducing transportation and environmental impact from the companies.
8. CONCLUSIONS AND THEORY CONTRIBUTION

In this chapter the authors will present the conclusion they have come up with while working on this thesis. The conclusion will summarize the findings in relation to the stated purpose. In this chapter the authors will make theoretical contribution and also reflect on study implication. Finally suggestions on further research will be present.

8.1. Conclusion

As we are discussing two Chinese medical equipment manufacturing companies about their transportation as well as environmental impact reduction, their distribution situations, the factors for transportation and environment and how these factors influence distribution situation has been mentioned in last chapters. Now authors will present conclusion to this thesis to wrap up.

RQ# 1 What is the current distribution situation in some Chinese medical instrument manufacturing companies, focusing on transportation and environmental impact?

It is found out that the current distribution situations at both medical instrument manufacturing companies their own manufacturing plants and also the central warehouses near their manufacturing plants. No matter distributing to the domestic customers or international customers, they deliver the products directly from their central warehouses to the customers’ warehouse. When calculating the distribution cost, transportation cost accounts for the large part of the total distribution costs and then the warehouse cost if the company has some regional warehouses, like Landwind. Picking out the transportation, Contec and Landwind outsource their transportation from LSPs. They care about the price per ton, while their LSPs focus on the fuel price, taxation and maintenance fee when making transportation price for the companies. Both of our companies do not have much attention on environment except some rules. Customer service is at satisfactory level in both of respondent companies.

RQ# 2 What are the factors in distribution of products influence transportation and environmental impacts while no trade-off customer service done?

Factors in distribution of products that influence transportation and environmental impacts while no trade-off customer service done with respect to our companies have been found. The main critical theoretical aspects that have negative effect on both of our companies are
transportation system and environmental aspects. And from the literature it is clear that fill rate, consolidation, standardization as well as postponement are the possible factors that can reduce the negative effects from our companies. This is the situation where the authors have identified that the main benefits found in terms of reducing transportation and environmental impact from the company through these factors.

**RQ# 3 How these identified factors influence distribution situation in some Chinese medical instrument manufacturing companies.**

To influence on current distribution situations, there are four things done, which are fill rate, consolidation, standardization and postponement. For Contec and Landwind, the fill rate is quite low. In all our cases increased fill rates meant less environmental stress. At a strategic level, changes made to increase fill rates were to increase the size of warehouses, centralise distribution, reduce the number of warehouses, and change location of warehouses, which can all be described as changes to the logistics infrastructure. It can also be improved according to different ways of consolidation. Consolidations often involve changes of transportation modes as in the cases of both Contec Medical System and Landwind. Standardizations concern mainly two levels in our cases; transportation vehicles and load carriers. High involvement of the goods owners in the setting up of the new systems and standardized load carrier loaded onto the vehicles in ways, which make full use of the vehicle capacity. Moreover, both of these companies use postponement such as after getting the customer’s order, they begin to produce the products. This will reduce the inventory cost and fulfil different customer’s orders. The option for improved flexibility of the transport system since the lead-time of sea transport is comparably long, it is then possible to load goods, which are not yet destined to a specific area, but which can be forecasted for a larger region.

Doing so, the products are available to end-customer with low transportation which also affect in reducing environmental impact and increasing service-maximization. So far we have discussed different influential factors and related them to transportation and the environment. All factors led to positive environmental effects as well as to lower transportation.

**8.2. Theoretical Contribution**

Drucker (1994) and Samulesson and Tilanus (1997) discuss efficiency in transportation reduces the amount as well as amount of emissions from transportation of goods. European Commission (2001) point out the efficiency in transport and logistics systems leads to both positive environmental effects as well as decreased transportation for industries. The
reference to these literatures supports our arguments that companies should focus on efficiency in transportation aspect for their lower transportation as well as environmental impact. Efficiency in transportation comprises of fill rate, consolidation, standardization and postponement as well. In addition to achieve more efficiency in transportation, Logistics Services Providers should involve in the distribution process.

Further supporting Anarson and Broden (2006) to reduce the impact on the environment is to increase the fill rate of transportation, standardisation of logistics resources and postponement. Zinn & Bowersox (1988) would also have a cost reducing effect on transportation costs. Wu and Dunn (1995), mention freight consolidation as an important decision for the environmental performance of a logistics system.

Instead efficiency in transportation some other authors argued that local sourcing, larger and fewer shipments of goods, and local warehousing, are strategic decisions that will decrease the environmental impact are in some way closely relating to our findings (McKinnon, 1995; Wu and Dunn, 1995; Cooper et al., 1991).

There is large number of people who studied transportation. They emphasise that companies should focus on both transportation and their environmental impact to make transportation more efficient. However literature has few references to transportation and environmental impact.

The main findings and contribution of this thesis to the existing theory about the transportation and environmental impact in some medical instrument manufacturing companies that manufacturing companies are willing to provide cheap and better services to their customers so that it is crucial to implement identified factors instantaneously. In contrary to the above mentioned theory, based on the empirical evidence from two case companies, they understood that it is in their own interest to act on factors. It is too expensive to deliver with costly and ancient transportation as it leads to empty plant and lost customers. The efficiency in transportation enables to streamline the product flow from the manufacturer to customer’s warehouses and thus transportation and environmental impact decreased.

8.3. Reflections
The authors feel that they have fulfilled the purpose of the thesis and pleased with outcome. However they would have wanted to conduct additional interviews with more respondents to broaden the empirical findings. Attempts made to find more interview respondents, but unfortunately the attempts were unsuccessful. The limited amount of time was another reason
why not more respondents included, and the authors believe that if additional time was to be available, the chance to find further interview respondents would have been greater. The authors further believe that they in the early stage after agreeing on a final purpose could have conducted an introduction interview with a company representative to create a better understanding of what theories to include in the theoretical framework of the thesis.

8.4. Further Research Suggestions
During the writing of this thesis various suggestions and ideas on further research have emerged. One thing the authors find to be interesting would be to include reverse logistic, due to this being a very important part of logistics, a part with strong environmental connections. To include efficiency within reverse logistics, or investigate only this, the authors find to be a very interesting subject and something that could be useful for a range of companies applying some sort of reverse logistic processes.

Another topic to investigate would be that from a third-party perspectives investigate a logistics provider’s or a TPL’s role in finding efficient logistic solutions for distribution that would lead to a reduction of transportation as well as the environmental impacts. The authors have in this thesis investigated what a company can do in this matter. Doing the same from a transportation provider’s or a TPL’s perspective could lead to further and/or different conclusions and is also a very interesting area according to the authors.

9. CONCLUDING REMARKS
In order to summarize the presented empirical results beyond this multiple case study a rich theoretical framework has been developed. It has been found that some parts of the presented theory are supported by the empirical evidence while other parts are not. The theory has been tested by interviewing two Chinese manufacturers from Medical sector. It would be interesting to replicate the findings by testing the theory in other sectors as well. However, due to limited time frame available this could not have been done in scope of this thesis.

How companies can reduce transportation and environmental impact at the same time increase their competitiveness are important as these will influence the mind-set of managers and be beneficial to the environment. There is a need for a closer study of modern logistics practices, for instance efficiency in transportation, not only to evaluate their effects on transportation and delivery performance but also on the environment.
REFERENCE:


Others
APPENDIX A: CASE STUDY PLAN
I. Goal: 2 in-depth case study profiles

a) Research questions:
1. What is the current distribution situation in some Chinese medical instrument manufacturing companies, focusing on transportation and environmental impact?
2. What are the factors in distribution of products can influence transportation and environmental impacts while no trade-off customer service done?
3. How these identified factors will reduce transportation and environmental impact in some Chinese medical instrument manufacturing companies.

b) Statement of purpose:
The purpose of this paper is to find the current distribution situations and the factors that influence the transportation and environmental impacts while maintaining the same customer service level, as well as how these identified factors will reduce transportation and environmental impact in some Chinese medical instrument manufacturing companies.

c) Unit of analysis:
Each of the selected Chinese medical equipment manufacturing companies had to be part of the medical equipment manufacturing supply chains. They will use their own transportation mode to distribute their products or they will outsource their logistic functions to the logistics service providers.

II. Methodology:
a) Multiple case designs
b) Research strategy: qualitative
c) Research techniques: semi-interview
d) Case study protocol: case study plan, interview guide
e) Interviewees: 2 managers of logistic department in medical manufacturing company
   1 manager of logistic department in UPS
f) Data analysis: cross-case analysis
g) Scientific credibility: validity, reliability

III. Theoretical framework
There are a rich of development in theoretical framework regarding distribution such as types of distribution systems, customer service as the restriction in the distribution system, and cost in distribution system; transportation such as primary modes of transportation, coordinated transportation services, primary transportation agency and efficiency in transportation; environmental aspects such as environmental impact of logistics system, green approaches and emissions in the transportation industry.

III. Data analysis:

*Cross-case analysis:*

To expose whether these two cases share some similarities in terms of their current distribution system, transportation and the environmental impacts in China.

IV. Time table

PM0 – Master thesis proposition: 01/1 – 19/1/2010
PM1 – Introduction chapter, literature study, preparing interview questions: 19/1 – 16/2
PM2 – Method chapter, revising PM1, literature study, preparing interview questions: 17/2 – 28/2
PM3 - Theory chapter, revising PM2, conducting interviews: 01/3 – 28/3
PM4 - Empirical findings chapter, sending transcription of interviews back to key informants for revising: 31/3 – 15/4
PM5 - Analysis: 15/4 – 28/4
PM6 – Conclusion, theoretical contribution, concluding remarks, summary: 29/4 – 22/5
Hand-in of the final version: 23/5

Final seminar – presentation of the thesis and objection:
APPENDIX B – INTERVIEW GUIDE

Interview Questions for Contec and Landwind

This questionnaire is the data collection mechanism for aforementioned topic of Master Thesis administered by Muhammad Riaz Mughal and Zhe Zhao students of Master Programme in Business Process & Supply Chain Management at Linnaeus University. This interview question is designed to enable the authors to collect the data for efficient logistics operations. Moreover, it is used to interview the manager or the supervisor of the company's department and which covers: the brief information of Contec and Landwind China, distribution, transportation, environmental impact as well as customer service by optimized logistics operations. The data collected is strictly for academic purposes and no public disclosure of the company will be allowed in any form whatsoever.

The interview is going to follow a list of questions but it can be more flexible.

Basic Information about Interviewee:

<table>
<thead>
<tr>
<th>Interviewee’s Name</th>
<th>Contec Medical System</th>
<th>Landwind Medical</th>
<th>UPS (United Parcel Service)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview Date</td>
<td>2011-04-03</td>
<td>2011-04-11</td>
<td>2011-04-25</td>
</tr>
<tr>
<td>Interview Date</td>
<td>An Jianwei</td>
<td>Li Hong</td>
<td>Chang Jian</td>
</tr>
<tr>
<td>Interview Date</td>
<td>Manager in logistic department</td>
<td>Director in logistic department</td>
<td>Manager in logistic department</td>
</tr>
</tbody>
</table>

Reduction of cost and environmental impact in Contec and Landwind as well as in UPS China

Brief information about company:

General questions about manufacturer:
1) Name and location of the company
2) Number of employees
3) Annual sales
4) Number of customers (retailers)
5) Type of products

Distribution
1) How is the distribution structured?
2) How large is the volume of outbound goods?
3) How far are the distances for the outbound deliveries of the goods? What are the destinations for the outbound goods?
4) How often are there outbound deliveries of goods? What are the delivery times for the outbound goods?

5) What types of goods are delivered?

**Transportation**

1) What are the selection possibilities in terms of transportation mode?

2) What type of transportation mode/intermodal service are you using?

3) What is the role of efficient transportation in cost-saving strategy of your company?

4) Could you describe current situation and challenges of Company A in China’s transportation strategy?

5) What is your strategy of efficient transportation in logistics operations?

6) What kinds of logistics operations affect efficient transportation and how do you manage them? Especially from these different perspectives: Fill Rate, Consolidation point, packaging logistics and economics scale of transportation cost.

- **Efficiency**
  1) What is the current fill-rate?

  2) How are the outbound goods being prepared for loading? E.g. are the goods packaged in a way to make the loading procedures easier? Are all the transports different? Is it possible to plan the loading process considering the nature of the products? Are the products being packaged in a way to make consolidation easier? How long does the loading process take?

  3) Are the outbound goods being consolidated for transport?

  4) How are the transports being consolidated?

  5) Who consolidates the transports?

  6) Where are the transports being consolidated?

  7) Do you to any extent use containers?

  8) Do you or your transportation provider use any kind of delays to be able to accomplish a better fill rate?

- **Transportation provider**
  1) Do you use a TPL for your distribution?

  2) Do you to any extent cooperate with them (the transportation provider) in regard of fill rate?

  3) What are the criteria for choosing a transportation provider? (e.g. cost, delivery, environment, lead time etcetera)

  4) How does the transportation provider charge for its services? E.g. per delivery, volume, weight, or special agreements etcetera.
Environmental impact
1) What are your demands regarding the environment for your transportation provider?
2) Does your transportation provider have an expressed environmental profile? In what way? What aspects are touched upon?
3) How do you think a bigger priority of the environment would affect your operations? (Impacts on e.g. cost, lead time, quality etcetera)
4) Is there anything else you think Company could do to reduce the negative impact on the environment?

Customer service
1) How your customers reflection about the delivery service that they got from your companies?
2) Which factors do you think that have influenced customer satisfaction during the pre-order stage?
3) Which factors do you think that have much more influence on your customer service level during the delivering process?
4) Which factors do you think that have more influence impact of your customer satisfaction during the post-delivery stage?

Other
1) In one of your website one can read that you work towards reducing your transportation, how do you do that?
2) What will be your future directions considering the balance between the possible lowest cost and the best service?