Master Thesis

Definition of distribution archetypes of liquid dairy products using China and Sweden as model markets

Freyja Bordas Baca, Daniela Lazic

Abstract

This Master Thesis is a compulsory part of the Mechanical Engineering program and is written by two technological students at the Division of Packaging Logistics and at Tetra Pak Carton Economy.

With an encouragement from the Chinese government to drink more milk the dairy consumption in the country has increased. This makes China an interesting market to investigate. The purpose of this thesis work is to identify logistic/distribution archetypes for the package TFA by investigating China in five steps and to compare the results with Sweden and in some cases also Europe:
  - The cultural differences in handling equipment load and unload procedures in China.
  - The road conditions together with the vehicles that transports the packages.
  - The distribution flow by investigating the different steps in the chain.
  - The differences in the distributions to the shop (modern trade and traditional trade).
  - The relative humidity together with the temperature changes of the seasons.

The milk farms are mostly situated in the north, Inner Mongolia and the packages are then often transported on good highways to the major cities on the coastline.

With the help of different theories, internet sites and interviews the authors compared Europe with China and found a difference in handling, infrastructure and distribution. With this knowledge archetypes were mapped to get an overview of the transportation network. An archetype is another word to describe a logistical map or overview of the transportation from the production to the end retailers with all its stops on the way. The archetypes where continually improved throughout the investigation with the help from different corporations and academically found theories to reach the final edition. Figure 6.1 is a general view of Chinas distribution of aseptic milk today. To the authors surprise the distribution network for dairy products in China was similar to the Nordic countries. This resulted in the last edition archetypes, figure 6.1 which are very general and relevant in both Sweden and China.

The biggest found difference in handling when loading and unloading in China is the lack of managing equipment like fork-lift trucks throughout the supply chain. The producers are using pallets in production but the secondary packages are then manually placed on the trucks or trains. One way of minimising the manual handling could be to use swap body, also a good alternative when for example using the first train and then truck. The negative sides of manual handling are the low efficiency and that the loading isn't as accurate which easier results in leakage.

The humidity was investigated by randomly chosen cities scattered in China, figure 5.1. The cities were chosen to better understand the temperature and humidity changes throughout Chinas mainland. With the theory of how moisture changes react with the secondary packages and the knowledge of the changes in moister in the country, the primary package can be better protected. A good short time option would be to support each box with extra dividers of corrugated cardboard in between two layers of TFA or increase cardboard quality. Relative Humidity changes do affect the products therefore it is important to be aware of their journey geographically to know how to protect them.

Acknowledgement

Table of contents

1. Introduction

The introduction chapter is used to describe the background to provide the basic information to the reader. This together with the problem identification, delimitation and target group along with a small introduction of Tetra Pak is used to establish the guidelines of the report.

1.1. Background

Figure 1.1 *TFA. Tetra Pak*

Tetra Pak is a global packaging company present on more than 165 markets offering a selection of carton packaging systems. The Tetra Pak offer of low cost packaging systems targeting emerging markets are categorized as the Carton Economy portfolio including the packaging systems Tetra Carton Aseptic (TCA), Tetra Fino Aseptic (TFA) seen in figure 1.1 and Tetra Wedge Asetic (TWA). The TFA packaging system is the lowest cost offer the TFA package is described as a carton pillow package available in four different sizes: 200, 250, 500 and 1000ml.

The distribution, from warehouse to point of sales, for carton packaging on emerging markets are more complex than distribution on advanced markets. For example secondary packaging are manually loaded and unloaded several times along the distribution chain, pallets are utilised in warehouses / distributions centres but not normally on vehicles.

The logistics in the chosen market, China is different from the logistics in Europe. To better support their customers Tetra Pak would like to improve their understanding of the logistics and the problems that may occur. With this knowledge Tetra Pak would like to help their customers to excel on their individual market.

Tetra Pak has performed distribution chain analysis / audits for several customers on economy markets during the last 5 years, with the aim to optimise distribution as well as solve product waste problems. Our work is to generalise and define the distribution archetypes on selected market. The TFA package for aseptic milk is the highest growing product on the Chinese market in the carton economy portfolio and therefore prioritised to build the distribution archetypes around.[1]

1.2. Purpose

The purpose of this thesis work is to identify logistic/distribution archetypes for the package TFA by investigating China in five steps and if possible compare with Sweden and in some cases Europe.
- The cultural differences in handling equipment load and unload procedures in China.
- The road conditions together with the vehicles that transports the packages.
- The distribution flow by investigating the different steps in the chain.
- The differences in the distributions to the shop (modern trade and traditional trade).
- The relative humidity together with the temperature changes of the seasons.

---

[1] (Immelborn, 2007)

1.3. Delimitation and Focus

The search has been narrowed to one specific primary package, the TFA. This primary package has been selected due to its growth possibilities on the Chinese market. The transportation types, inland boat and air transports are not considered. The report will only view the transportation of milk. In China the aseptic milk is in focus but in Sweden the investigation also includes chilled milk transports. In some cases Europe and USA are included caused by the difference in size between China and Sweden and the possibility to find relevant facts.

1.4. Target Group

The target audience is Tetra Pak, co students and teachers at Packaging Logistics, Lund University, Faculty of Engineering. This Master Thesis is also written for everyone with an interest and some knowledge in the area packaging logistics.

1.5. Tetra Pak

Tetra Pak develop aseptic cartons which are made of three basic materials paper, polymer and aluminum foil which together result in a very efficient, safe and light-weight package that does not require chilled distribution.

Tetra Pak was founded in 1951 by Erik Wallenberg and Ruben Rausing. Tetra Pak was divided in three regions in 1992, Tetra Pak Europe/Middle East and Africa, Tetra Pak Americas and Tetra Pak Asia/Pacific. Each regional main office was tactically stationed to serve the local needs. The following year in 1993 the company created Tetra Laval together with Alfa Laval, which is one of the leading suppliers of plants and equipment to the food industry, processing industries and agriculture. The line sales more than doubled this year due to the incorporation. At that point Tetra Pak had a total production of packages which exceeded 60 billion units a year. Today more than 129 million packages are delivered per year.

Tetra Pak has over 20 000 employees in 165 different countries and more than 50 years experience in their specific area of aseptic packaging systems which makes them a leading company in the industry today.[1]
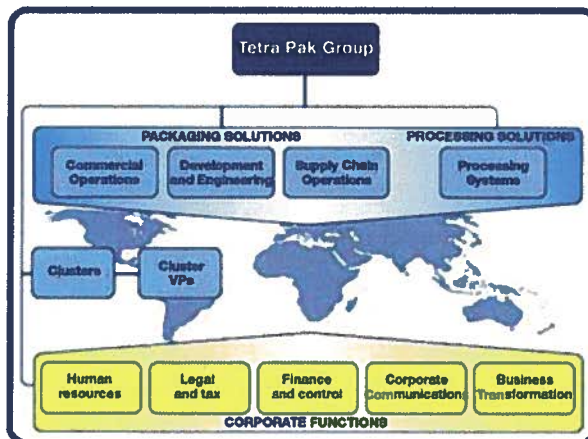

Figure 1.2 *Organization.*

---

[1] (Tetra Pak, 2007)

6

2. Methodology

This following chapter describes the choice of method made when finding the important guidelines to the structure of this Master Thesis. This chapter encloses subjects as different approaches, qualitative or quantitative as well as interviewing methods.

2.1. Different approaches

There are different approaches when doing research such as:

- The *describing* studies main purpose is to find out and describe how something works or has been performed.
- The *Exploratory* studies is to enter deeply in how something really works or has been performed
- The *Explanatory* studies seek causes and explanation to how something works or has been performed.
- The *Problem solving* studies find a solution to a defined problem.[1]

This Master Thesis is a describing study that aims to describe on a higher level how the transportation with all its variables works in China. The approach of the authors is to give a broader overview of distribution in China and to improve the ability to make accurate choices in other relevant issues.

2.2. Case studies

Two leading companies in Sweden were studied due to their knowledge in the transport- and the milk industry to get a better understanding of the transportation business. The chosen companies were Frigoscandia and Arla Food.

2.3. Qualitative and Quantitative methods

2.3.1. Quantitative method

Quantitative method is a method which is measurable with statistics. Statistics is a science that is used in different inquiries as a tool to rank, describe, and analyze data. Statistics can be divided in two different areas, the descriptive statistics and hypothesis-trial statistics. The descriptive theory is normally used to describe the collected material in numbers so that the research can be enlightened. The hypothesis-trial statistics s used to test statistics hypothesis.[2]

2.3.2. Qualitative method

The purpose of this method is to obtain a deeper understanding of the investigation than the knowledge which is achieved by the quantitative method. The aim is to understand and be able to analyze an overall picture of the problem. This method creates an understanding for the complex, such as associations and interactions.[3]

2.3.3. The approach of the authors

The authors' method is a qualitative method. Fig 2.1 explains further the path chosen for this thesis with an emphasis on the qualitative method.

---

[1] (Regnell, 2006)
[2] (Patel & Davidsson, 1994)
[3] (Wallèn, 1996)
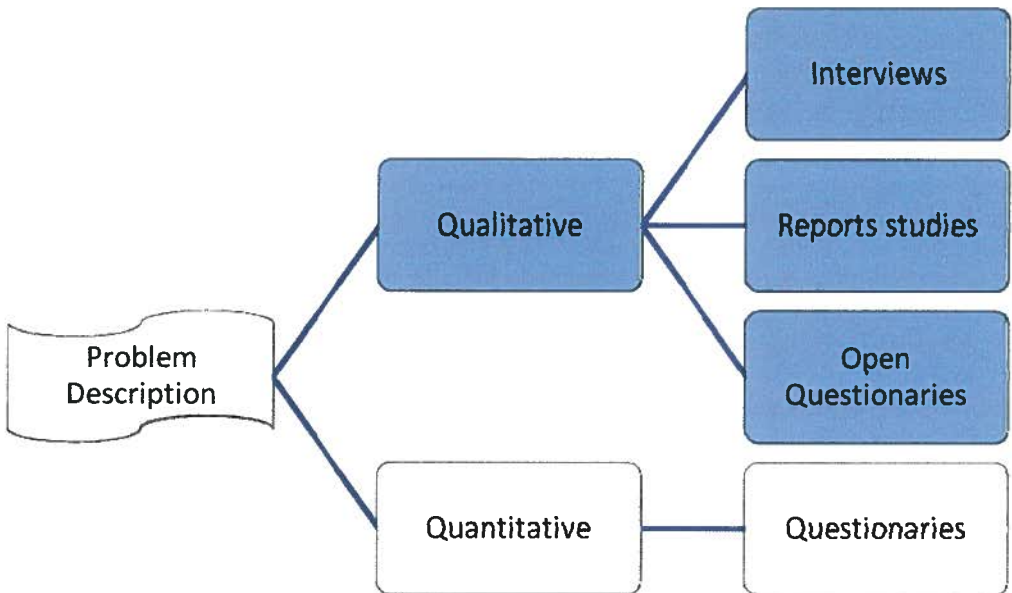
Figure 2.1 *The two diffrent paths to choose due to the complexitivity of the project. The darker path is chosen by the authors.*

2.4. Chosen method

When starting the project the aim was to investigate the transportation network in China and find archetypes. An archetype is a description of a logistical map or overview over the transportation of a product, from the production to the end retailers with all its stops on the way. With the help from external articles an overview was made of this large country. After some internal articles were read the interviews at Tetra Pak started. The first key people that were interviewed were selected through recommendations from the instructor at the company. After the first three interviews the authors together with the instructor at Tetra Pak changed the direction of the thesis work and more external knowledge were found to complement the existing internal at Tetra Pak. The report was first written with the intent to find detailed information through internal knowledge at Tetra Pak and with that information build an overview. The new direction became to find a more general overview of the Chinese market with the help of external and internal key persons that have great knowledge in the transportation industry both in Sweden and China. This was accomplished through interviews verbally, face to face, through workshops and in some cases through email. The first stage of the investigation was to interview key people at the university to get recommendations to companies and key people in the industry. Second the task was to get in touch with the key people and accumulate as much relevant information as possible. Through these interviews a number of archetypes were created. At a later stage of the thesis the established archetypes were matched with Tetra Pak's view of their customers' distribution and a number of different overviews were selected. The selection was made together with people in and outside of Tetra Pak

8
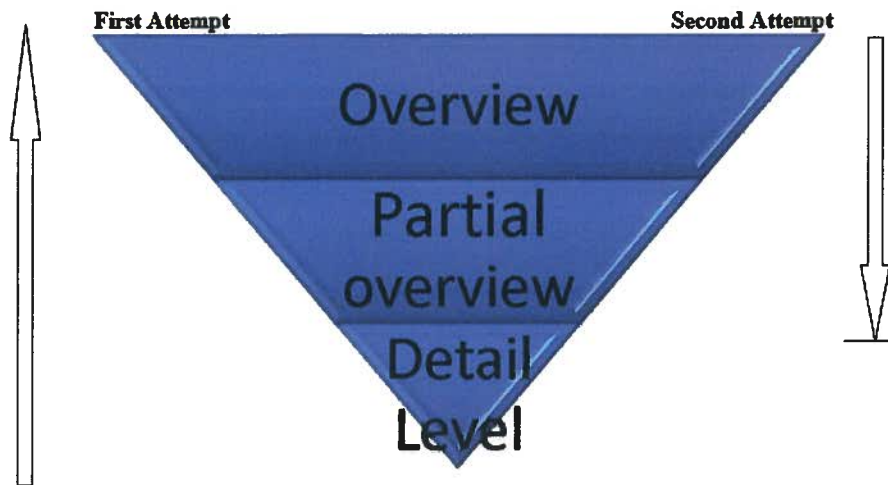
Figure 2.2 *The different approach of the authors.*

2.5. Criticism of the sources

None of the external interviewees would have any self interest in answering untruthfully, since they don't have any personal interest in the result. The risk of the interviewer to influence the interviewee has to be considered. When writing, the authors had the attitude to present an objective picture of the case. To not miss anything in the interviews an electronic recording device was used. This simplified the work so that there weren't questions to what was said.

In order to minimise the risk of inadequate information and increase the reliability, theories and literatures have been selected with great consideration to its source. Used literatures has mainly been course literature from LTH, articles received from Tetra Pak and external articles from well established and respected networks such as Pira, Planet retail and Infobank.

2.5.1. Validation

To ensure the quality of the report the search for the right person with the right information was considered when choosing interviewees. This was achieved through choosing the person that have the highest competes in the targeted area. Together with articles, interviews and theory an accurate picture of the transportation network could be created.

2.5.2. Verification

To secure the reliability it was important that the interviewed understood the questions and that the interviewer understood the answers to the questions. The data collected has been discussed between the authors to decrease the rum for error. In some interviews a recording device was used to verify the interview afterwards.

2.5.3. Objectivity

In almost all the interviews throughout the report both the authors have participated, this to minimise the impact of the single persons in the results. In the interviews where there only was one interviewer a recording device was used to tape the interview. If there remained any misunderstandings after the interview the question was asked once again. If something could

not be answered an extra effort was made to find a different source both trough more interviews or literature.

2.5.4. Interviews

There are a number of different interview structures, the four mainly used are, open interview, semi-opened, semi-structured, structured. It was preferred to utilize semi-opened as a result of the configuration of the theory. The model captures the individuals experience within the aspects of what the interviewer believes important.[1] This model is a well suitable method for the writers to use to due to the complexity of the stated problem.

The questions asked were opened questions which mean that those who answered could speak openly about their experience in the matter with their own words. This helped the authors to get at larger picture and overview in the creation of the different archetypes.

The selection of people to interview were in the beginning mostly recommendation from the instructor at Tetra Pak due to the inquiry of persons in the company with specific knowledge and competence. When the person being interviewed couldn't answer the questions asked entirely they usually could suggest who the authors could turn to for answers as can be seen in figure 2.3.
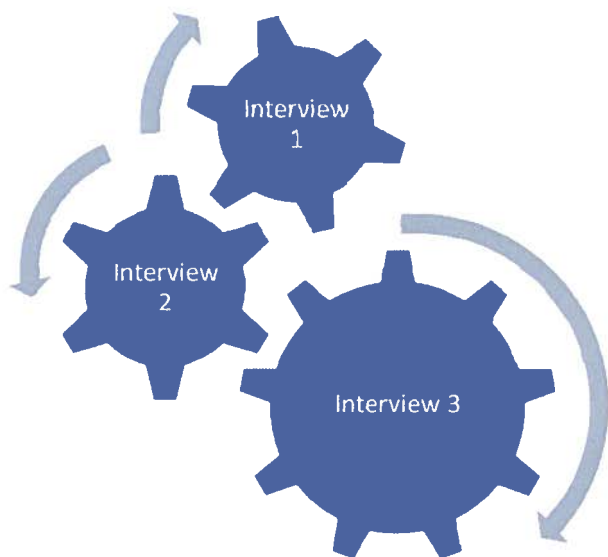
Figure 2.3 *Chain reaction of the interviewed.*

After the third interview the thesis became more complicated. The greater part of the detailed information was present at Tetra Pak's customers and they were reluctant to share due to the culture in the country. The direction of the thesis changed were the report instead used a more academic approach when creating an overview in collaboration with the knowledge at Tetra Pak. Instead of only focusing on Tetra Pak and their employees the focus was changed to the university and other companies which had a good knowledge in the matter of distribution.

---

[1] (Lantz, 1993)

The authors had some knowledge in the specific area and decided to start by interviewing a professor in technical logistics at LTH. He shared different inputs of whom to interview and who probably knew key persons to help the investigation. Among others his recommendation was to contact the Associate Prof. of packaging logistics at Packaging Logistics department at LTH because of his connections with others universities in China. He also recommended people outside the university how are working in the logistic industry. Some of these persons and suggestions were cul-de-sacs but others were good leads in the search of the end solution. The Associate Prof. at Packaging Logistics helped with a deeper, greater understanding in logistics and relative humidity.

A meeting with Prof. Lumsden the author of "*Logistikens grunder*", and one of the sources for collecting information regarding distribution logistics and therefore interesting in the growth of the report. Prof. Lumsden at Chalmers University shared his great knowledge and gave an idea of how to explain the complex distribution network. He did not have logistics experience in China, therefore he recommended a Chinese logistics professor at World Maritime University.

Two additional meetings were then established. The first meeting was with Frigoscandia in Helsingborg due to the company's knowledge within distribution and the second with Arla due to their knowledge in dairy products and in their distribution. The different contacts made and from whom they were recommended is explained in figure 2.4.
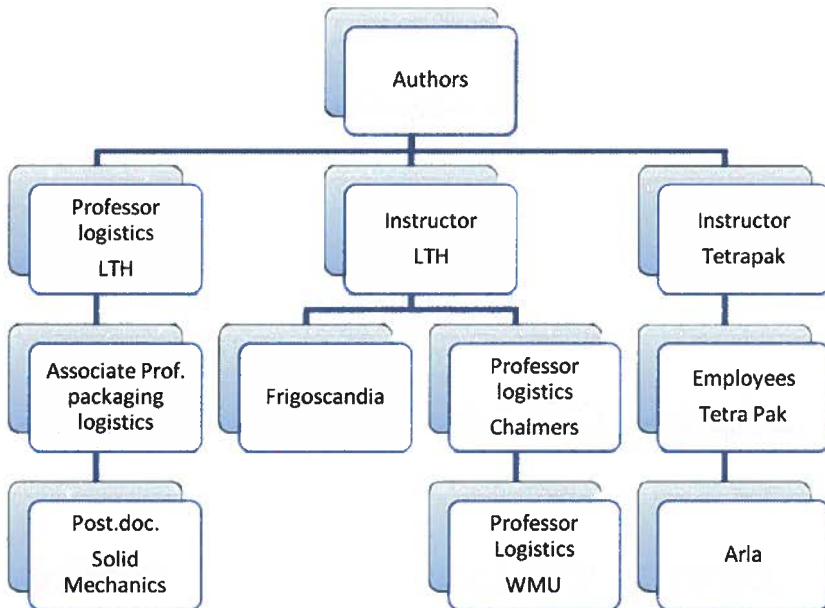
Figure 2.4 *How the collected information was made.*

2.5.5. Workshop

After brainstorming a number of different archetypes were constructed. With the newly produced archetypes at hand a visit was established with a doctor in logistics at World Maritime University in Malmö. Together with his knowledge in the distribution in China the

11

archetypes were changed. These were then overviewed in a workshop with eight employees at Tetra Pak that had a range of different experience in China. The workshop was an important input for the project, to be able to compare and apply the produced archetypes to Tetra Paks customers for more accurate results.

2.5.6. Analytic methods

The theories together with the empiric data was used to analyse all the different aspects of the theses work to answer the original problems. A SWOT – analysis tool was also used in order to analyze the different interviewees and their different areas of specific knowledge.

The SWOT analysis is a powerful tool that can be used in many different situations and environments. With the analysis's help, a company can create a clear picture over their competitive situation and how the present situation is today. It can also be used to investigate different strength, weaknesses, opportunities and threats in a range of different situations.[1]

S   = Strengths, microenvironment, which strength a company or source have
W   = Weaknesses, microenvironment, which weakness the company or source have
O   = Opportunities, macroenvironment, what possibilities the company or source have
T   = Threats, macroenvironment, which threats the company or source have

---

[1] (Johnson, Scholes, & Whittington, 2005)

3. Theory

This chapter describes the background needed to fully understand the complexity of the problem and to further understand the country. The chapter also describes the different theories behind the report to the reader.

3.1. China

China is today the fastest growing economy in the world with a predicted growth of seven percent. Outside of the major cities, the majority of the population remains poor and has been relatively unaffected by China's economical growth. Many people are immigrating to the cities to escape poverty while over one-third of the population already is urbanized.[1] China faces many challenges to sustain economic growth in the long term. These challenges are worsening unemployment, a fragile banking sector and a wide gap between the rich and the poor. The average household incomes are getting higher and young people are getting more used to paying with credit which is leading to a greater consumer demand, especially for products and services that earlier was considered as luxuries. Most of the demands are concentrated in east China and the demands in southwest China are growing as a result of tourism.[2] There are six important regions when discussing retailing Shanghai, Beijing, Anhui, Zhejiang, Yunnan and Jiangsu. Shanghai is ahead of the other regions in terms of retail development and has together with Beijing attracted the most interest from foreign and domestic retailers. Many retailers are now looking to expand into the cities in the East and South of the country.[3]

The SARS crisis 2003 helped the bigger stores, like hypermarkets and c-store chains, to get bigger and more popular because of its reputation for cleanliness and quality control. [4]The supermarkets/hypermarkets share continues growing in 2006.[5] Due to the rising incomes and demand for quality the demand for packaged food has grown rapidly in recent years.[6] The big stores like hypermarkets are usually situated in the centre of the cities unlike Europe and USA. This can mainly be explained with the different consuming and households standards in China. The lack of big home refrigerators and low car ownerships drives the Chinese consumers to visit the store around three times a week instead of one. The average consumer uses a bike, foot or public transportation from and to their homes which limits how much can be bought at once. The smaller amounts of food bought at a higher number of times are the way the Chinese can obtain fresh food for the households.[7]

The top three dairy companies are Inner Mongolia Yili Industrial Group Co Ltd, Inner Mongolia Mengniu Group and Shanghai Bright Dairy Co Ltd.[8]. The three leading players hold 90 percent share of the country's market.[9] Dairy products are growing on its market and this can mainly be explained by the Chinese government's promotion toward dairy products as a healthier food, and its encouragement to increase calcium intake in diets.[10]. Demand for

---

[1] (Planet Retail, 2007)
[2] (Euromonitor International, 2006)
[3] (Planet Retail, 2007)
[4] (Planet Retail, 2007)
[5] (Euromonitor International, 2007)
[6] (Euromonitor International, 2006)
[7] (Planet Retail, 2007)
[8] (Euromonitor International, 2007)
[9] (www.china.org)
[10] (Euromonitor International, 2006)

dairy products continues to rise. The profit margin on milk products is continuously being squeezed by the price war. [1]

Despite improvements, China's logistics market is still immensely underdeveloped. Logistics is a minor industry in terms of scale, and its level of development and efficiency is fairly low. There are a number of rail and road trunk lines linking different regions of the country that are insufficient and the major railway lines are over-loaded. The highway system connecting different parts of the country cannot meet the demand.[2]

3.2. Transportation network

There are three different levels of perspectives due to the torrent of products, the perspective of the trademark-owner, the perspective of the shipper and the infrastructure due to the transporters.

Type of Actors

Material — Goods Owner, Warehouse Owner

Transport-flow — Forwarder, Brokers, Operators, Load Unit Owners, Vehicle Owners, Terminal Owners

Infrastructure — Traffic Control, Physical Link Owner, Land Owner
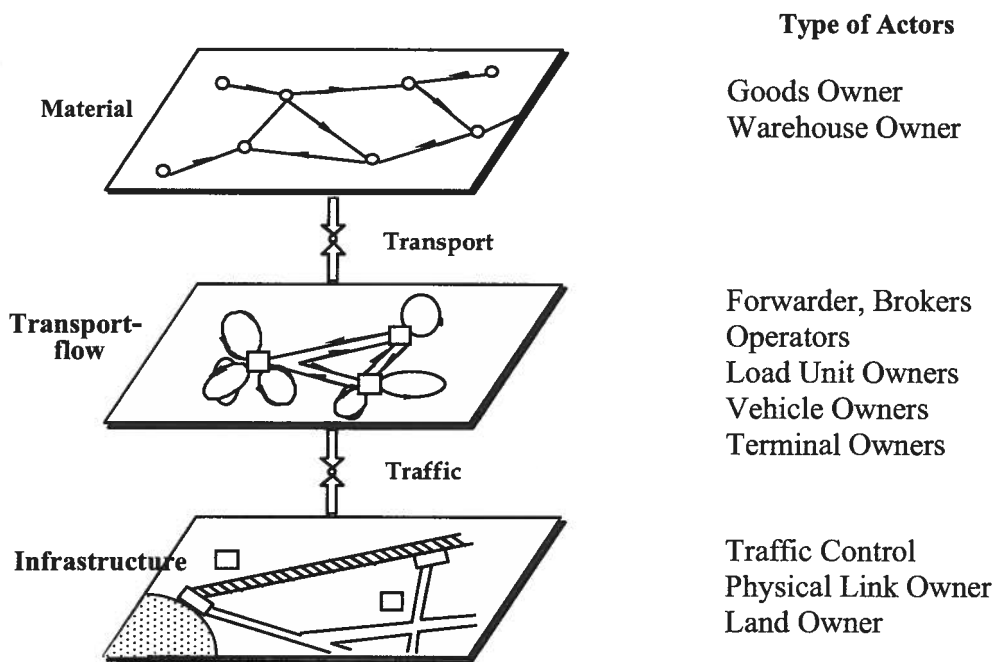
(Source: Ruijgrok, Wandel, Nemoto 1991)

Figure 3.1 *The three-level-model*[3].

The trademark-owner has the upper level of perspective and their most important viewpoint is to move the material from one point to another at the lowest price and highest service. This movement is a more complex viewpoint to the transporters because of the reloads and gatherings with different goods at their transport-network. At this midlevel the transportation is described in detail, how the goods, load carriers, container and euro-pallet are located and shipped. The lower level describes what the transport companies need to function, the infrastructure. To carry with trucks makes the roads important, to carry with train makes the railway a key factor and to carry by air the need of airports is the main issue. At this level

---

[1] (Euromonitor International, 2007)
[2] (Planet Retail, 2007)
[3] (Aronsson, Ekdahl, & Oscarsson, 2004)

there are many corporations that own the infrastructure required to do the necessary transportation.[1]

3.2.1. Terminal network

The terminals two main tasks are to collect and distribute goods from one mean of transport to another. There can be many reasons why a terminal is located in a specific place. One possible reason is the transportations limitations, they can not move further. The terminals are also an arrangement for collection of smaller shipments which are reloaded to larger means of transport and longer distances. Further these kinds of transports arrive to the same kind of terminals and are reloaded again to smaller terminals.[2]
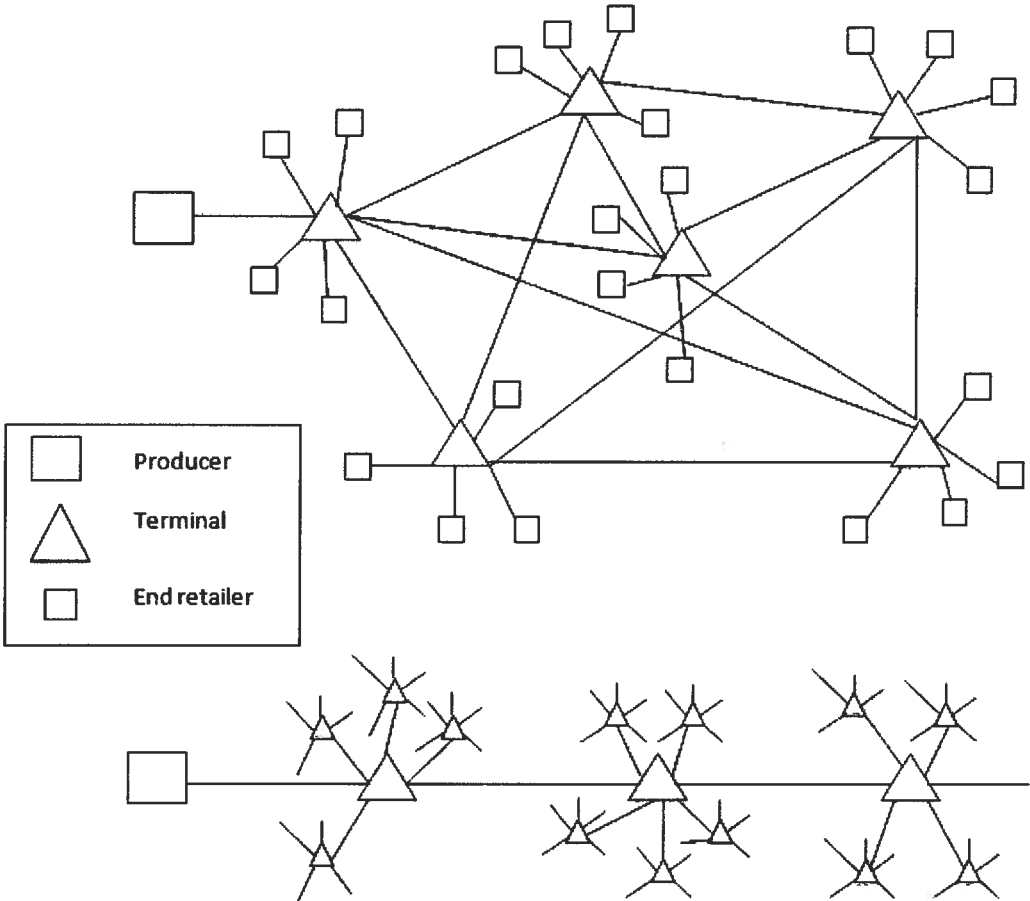
Figure 3.2 *Terminal network and hierarchy multiple network[3]. Modified figure*

3.2.2. Hierarchy multiple terminal-network

The network is based on the existence of a number of specific central-terminals and to each one of them a few smaller connecting terminals. The tasks of the smaller terminals are to collect and distribute the goods to the local areas that they are responsible for.[4]

---

[1] (Aronsson, Ekdahl, & Oscarsson, 2004)
[2] (person & Virum, 1999)
[3] (Lumsden, 2006)
[4] (Lumsden, 2006)

3.2.3. Different types of transportation

| Direct connection | Corridor | Hub-and-spoke | Fixed routes | Flexible routes |
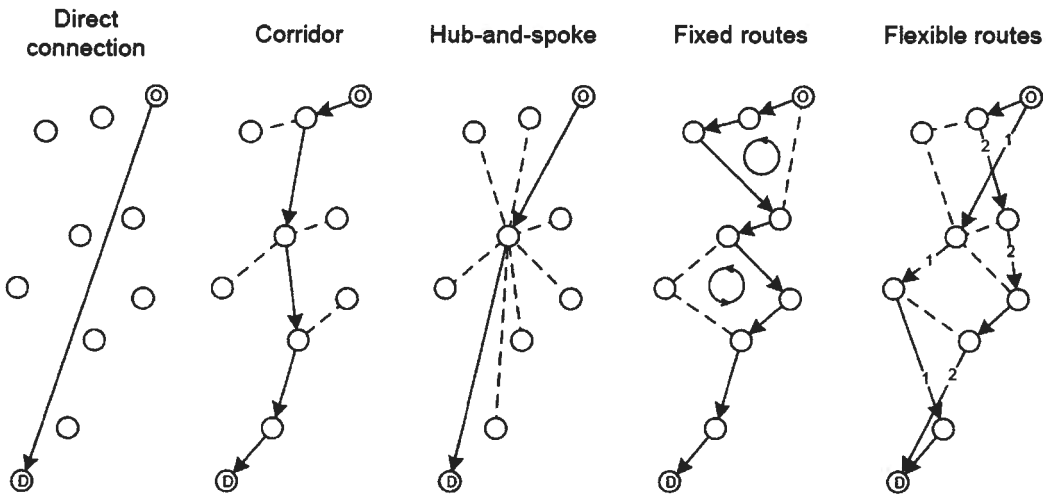
(Source: Woxenius 1998)

Figure 3.3 Different types of transportation.[1]

Direct connection is a solution when there is a desire of a high degree of flexibility with regard to time planning. There is a direct connection between the starting point and the receiver. The transportation can be tailored to fit the customers' needs exactly.

The transport flow is grouped at the terminals on the *corridor* line. This means that there is a smaller transportation from the different staring points to the nearest terminals. The goods is then continually transported along the corridor picking up or delivering goods at the various terminals on the way.

In the *hub-and-spoke* solution, one terminal in a city is selected as a hub and all transports pass through this terminal, even when starting point and receiver are located close to each other and far from the hub. Sensible handling at the hub and good utilisation of vehicles compensate for the longer transport distances.

When the distributor has decided to use *fixed routes* the transportation is set to go through different fixed terminals. The transportation stops along the way like a school bus picking up or dropping of children. In difference to the hub-and- spoke type of transportation, many terminals are used as transhipment points. It is important to plan the loading of the vehicle good due to its delivery order on the fixed route.

When choosing the *flexible routes* distribution type there is a lack of restrictions that can be popular in some cases. Routes are located depending on the demands and bookings, and if there are enough goods between the terminals the flexible routs distribution can be chosen. The information most therefore be current and accurate when planning the different routes.[2]

---

[1] (Woxelius, 1998)
[2] (Woxelius, 1998)

16

3.2.4. Multi part collaboration

One part logistics is when the producer, supplier or customer is handling the logistic functions. Just In Time (JIT) is a good example where the supplier is handling multiple functions as different controls, packaging, transports and more.

Two part logistics can be described as a traditional collaboration between a supplier and a buyer. The supplier produces the product and conducts test on them. When approved, the product is picked up by a transportation vehicle that overtakes the responsibility for the product. To be called a two part logistics the transportation has to be conducted by either the supplier or the buyer.

Three parts logistics describe the collaboration with three parties. There are many examples where there is collaboration between two and one outside party. A carrier can take part in a relationship between a supplier and a producer to handle all the transportation. The carrier can also increase the commitments through handling more functions like storage and minor processing.[1]

3.2.5. First in first out and Last in first out

What kind of goods being stored often defines the choice of first in first out (FIFO) or last in first out (LIFO). When choosing FIFO the product often has an expiration date which makes it important to always send the one with the earliest expiration date first. The product can also be of a high value and therefore have economical consequences when stored. The quality can deteriorate when stored and the articles may become obsolete. In LIFO this isn't an issue and the storage facilities can therefore be created in another way.[2]

3.2.6. Swap body
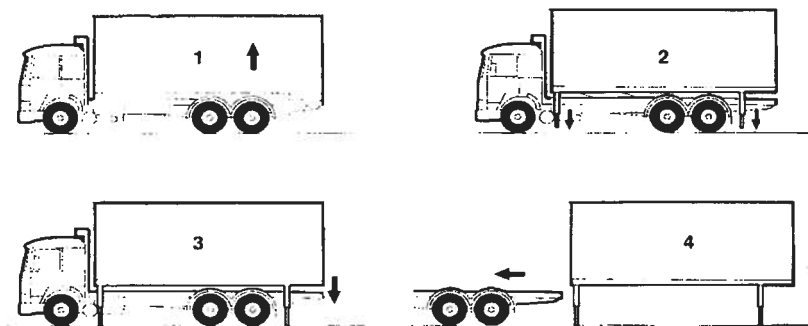
Figure 3.4Swap body[3]

A Swap body is a good example of a load carrier that can be used as a combined transportation with truck and train or bigger truck and smaller truck. The goods can change transportation vehicle without unnecessary handling due to the containers portability.[4]

---

[1] (Lumsden, 2006)
[2] (Lumsden, 2006)
[3] (Lumsden, 2006)
[4] (Lumsden, 2006)

3.2.7.   Distribution with different transportation
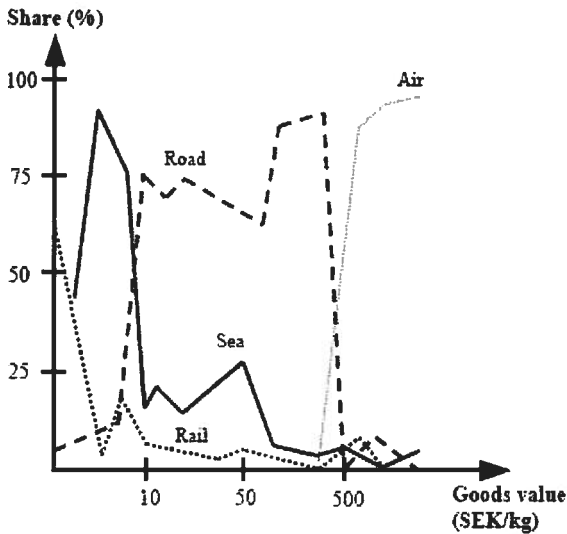
Figure 3.5*Different values for different kinds of goods.*[1]

The difference in goods value plays a big role in the selection of transportation. Every transportation type shows dominance in an explicit interval for goods with a specific value. There is an exception for railway and sea transports that have the same type of goods for transportation.[2]

3.2.8.   Road transports
The trucks increasing share of the distribution are explained by the companies increasing demands on fast and efficient transportations. The truck can transport the goods from door to door without any reloads. Reloads are costly and time consuming; they can also damage the goods if wrongly handled.

One of the trucks attributes is its flexibility with its capacity to change direction if the situation demands it and the possibility to combine with other transportation types. With the driver accompanying the goods the reliability and security is higher while the theft and damages are lower. The reliability is also higher due to the accompanying of the driver. The service opportunities and the adaptation possibility are also reasons for the popularity of the truck.[3]

3.2.9.   Railway transports
The railway transports have high fixed costs, low variable costs and shell economy.[4] As showed in figure 3.5 and 3.6 transportation with railway is more common with low goods value and with far distances.

---

[1] (Lumsden, 2006)
[2] (Lumsden, 2006)
[3] (Lumsden, 2006)
[4] (person & Virum, 1999)

When discussing the railway there is a separation between goods transport and passenger transportation. The trains carrying passengers are often faster than the goods transportation trains and therefore often incompatible. There is a difference in railway systems in the European countries this makes the transportation with train more expensive because of the time loss and high costs of reconnecting.[1]
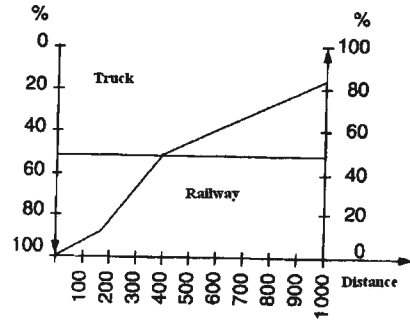
Figure 3.6 *Division between truck and railway viewed from the transport distances.*[1]
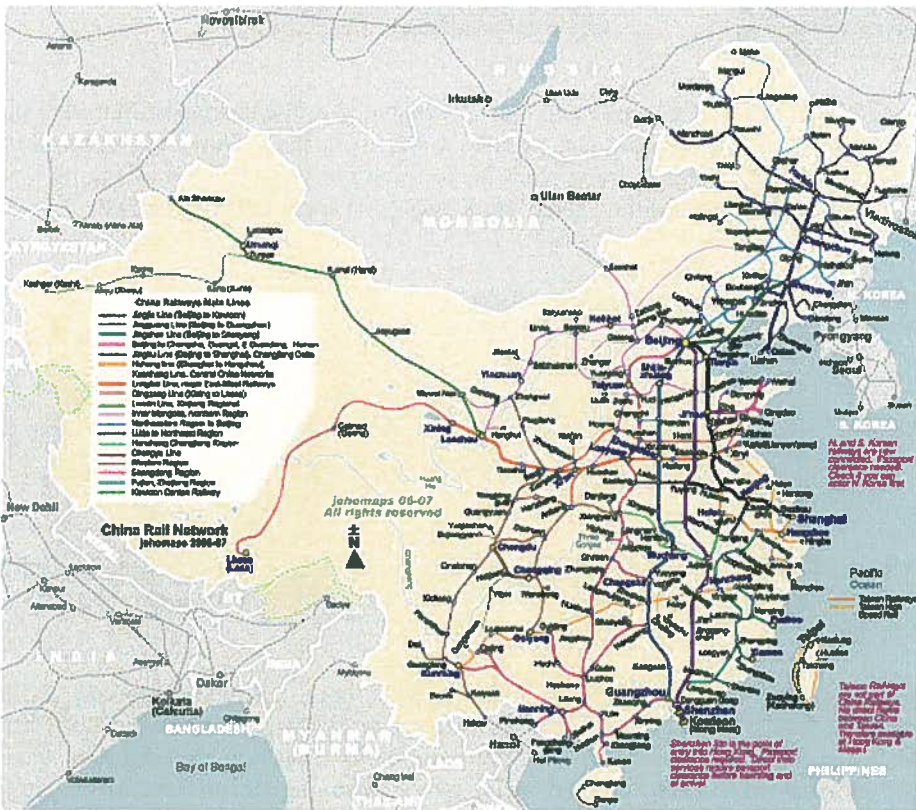
Figure 3.7The Train network in China.[2]

There is around 75 500 km of railway in China today and most of it is situated in the east of the country as can be seen in figure 3.7.

[1] (Lumsden, 2006)
[2] (johomaps)

19

3.3. Humidity

3.3.1. Effects of moisture

When Relative Humidity (RH) changes occur in the surroundings the moisture state of equilibrium of the paper changes, which leads to a change in the paper dimensions.[1]
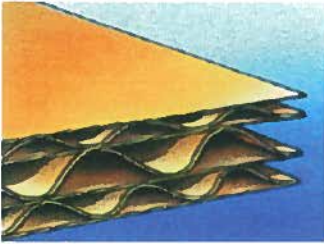
Figure 3.8 *Corrugated Cardboard.*

Corrugated cardboard boxes may crumple and then collapse due to the change of humidity in the environment. Paper is hygroscopic and absorbs water from the surrounding desorbs it when there are not in balance. Moisture content is specified normally by first weighing the corrugated fiberboard in an oven and then weighing it again in a specified environment.

$$\text{Moisture content} = \frac{\text{original weight} - \text{dry weight}}{\text{original weight}}$$

The moisture content that paper has when it reaches equilibrium in the atmosphere with a known temperature and humidity is the equilibrium moisture content. It is the papers balance state in its specific environment.[2]

When paper based packages like cardboard boxes are stacked they get exposed to pressure load and the material gradually start to creep, deform. When the deformation gets to a greater state the box collapses.[3]

When moisture in the cardboard box increases, the total load that it will be able to carry will decrease and the box will crumple faster. If the temperature on the environment suddenly fall it increases RH significantly, this means that the cardboards moisture concentration also increases. If the moisture in the box material varies by the changing RH in the surrounding, the box will be even more sensitive towards the load and collapse sooner.[4]

---

[1] (Fellers & Norrman, 1996)
[2] (Twede & Selke, 2005)
[3] (Twede & Selke, 2005)
[4] (Fellers & Norrman, 1996)
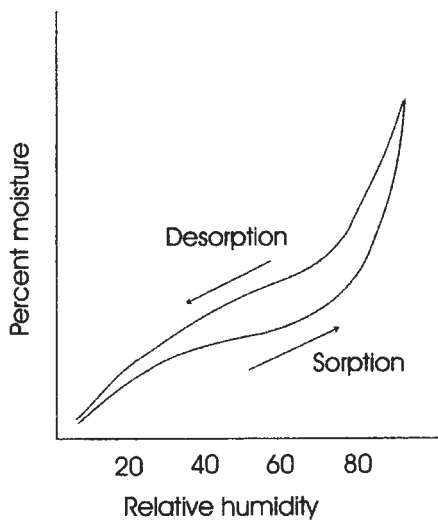
Figure 3.9 *A piece of papers sorption and desorption.*[1]

As figure 3.9 show, between 40-70 percent of RH on paper, no large changes in moisture content occur. When these levels are crossed the changes of moister content in the paper raises/drops easier, the paper will absorb or exude more water with just small changes. For example, if the Relative Humidity is approximately 60 percent, the fiberboard is in balance with its surroundings i.e. no water is absorbed or evaporated. If the RH rises over 60-70 percent the corrugated fiberboard boxes will absorb water from the ambient, but if the RH level goes down under the balanced state that it have at that specific time, the box will exude the water instead. If the RH is to low the board will be brittle and easy to tear and if RH is high the cardboard will get soft and elastic. Variation in relative humidity brakes down the fibers of cardboard material. To preserve the material properties it is better to have one high difference in humidity once than many small variations in humidity.[2]

The ideal moisture substance in paper is 3-7 percent. If less than 3 percent the paper becomes fragile and over 7 percent the paper loses stiffness and it becomes soft and spongy.[3] In figure 3.10 the affect different strengths and forces have due to the humidity in paper based materials is showed.

[1] (Twede & Selke, 2005)
[2] (Twede & Selke, 2005)
[3] (Twede & Selke, 2005)
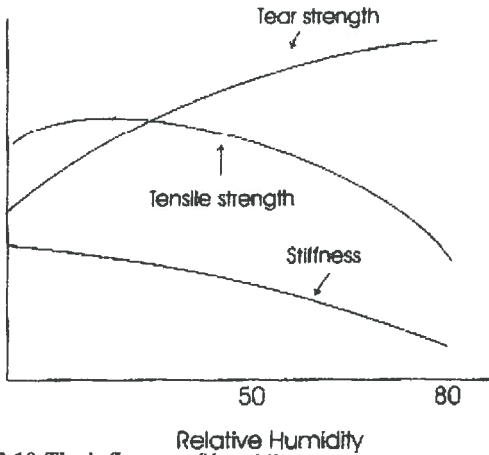
Figure 3.10 *The influence of humidity on papers tensue strengin, stiffness and tear strength.*[1]
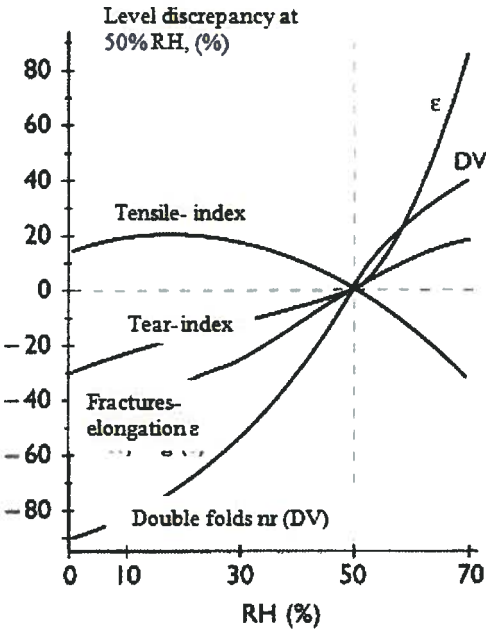
Figure 3.11 *Level discrepancy in percents of values at 50 percent RH.*[2]

Figure 3.11 demonstrates the change in percentage of papers' properties at different RH with 50% RH as reference. The papers internal tensions dissolve when moisture cycles occur, which results in a permanent crawling in the fiber of the paper.[3]

---

[1] (Twede & Selke, 2005)
[2] (Fellers & Norrman, 1996)
[3] (Fellers & Norrman, 1996)

4. Empiric

The empiric data mostly consists of different interviews done to further investigate and evaluate the different problems concerning the transport network and all its complexity.

4.1. Culture

An interview was made at Tetra Pak with Kent Severinson, Manager, distribution equipment at the company. Kent Severinsson has been at Tetra Pak, Carton Economy for three years at this point but earlier he lived in China for two years (1998-1999) while working for Tetra Pak at their market company there. The first year he was stationed in Hong Kong and the second in Shang Hai but he constantly traveled all over China. His main tasks were educating technical engineers, technical support, and finding new clients.

There are two kinds of channels to the end consumer, modern trade, with the multinational companies like Mengniu and Yili and then traditional trade with the smaller shops and corner shops. There is a difference between Swedish and Chinese work culture where the workers in China are not as encouraged to locate problems at the workplace and inform the authority due to the stricter work environment. China is growing economically but many people are still living in poverty which makes it possible to have very low salary to the non-educated. In Europe the big costs are the employments salary while in China the Chinese are known for their efficiency and inexpensiveness and that's why the big costs are material and knowledge.

China is a large country and the dairy farms are located were the cattle graze, this means that the production and packaging are located in a far distance from the cities. The end consumers are located in the larger cities mainly on the east part of the country by the Chinese coast which leads to large transport distances for the products. In China they only use pallets in the factory and from there to the trucks they handle the secondary package manually; this makes the individual handling important. It is unlikely that the worker at the lowest paid positions in a large company is employed daily but due to the low company faithfulness in China with the low paid workers some leave when they find better work. Therefore there can be a rotation of new people that aren't as good at the routines and handlings recommendations of the secondary packages.

The main transportation vehicles are trucks but the Chinese railway is a good option when possible. The trucks are close to European standard due to the Shang Hai motor corporation which is the largest truck producers in the country. They have produced most of the trucks which makes it easier to standardize the transportation. The Chinese infrastructure has a good standard compare to the European and they are developing rapidly. Traffic jams is an already existing problem and even more upcoming due to the increasing living standards of the Chinese population which results in more vehicles on the roads. On the countryside the road conditions are usually less developed and have a lower standard for transportation of goods.

4.2. Case studies

4.2.1. Frigoscandia

Frigoscandia was founded more than 50 years ago in 1950 with only one freezer house. The company developed a reputation of being experts in the areas of storing and delivering frozen goods. 2002 Frigoscandia changed their strategy, they wanted a new reputation to not only be experts in frozen goods but in provisions logistics in general.

Frigoscandia has a range of different large companies as their customers that need assistance in different areas. The organization focus is on three different areas of services which they can offer their clients, transportation, supply and storage. Within these areas the company has different aims depending of what their customers' need assistance with.

4.2.1.1. Frigoscandia Interview

Patrik Johnfors is director in the business area for the domestic transport at Frigoscandia in Helsingborg, Sweden. He was interviewed due to his expertise of the distribution in the Nordic countries. Frigoscandia is a leading company in Sweden in the areas of helping different corporations with their distribution and logistics services.

According to Patrik Johnfors there are two options for an organization when delivering their goods out to their customers, both globally as well as local:
A) Have ownership of the whole distribution chain, everything from planning the distribution routes to ownership of their own trucks and personnel.
B) The company has the option to buy some or all services from an already existing system.

In some countries, warehouse/storages fill their own trucks with goods and drive to smaller shops for delivery, occasionally they also deliver to larger customers. The driver "asks" at every stop on his journey how much the shop/supermarket needs, precisely like an ice-cream truck does. The delivery is not earlier ordered.

Frigoscandia offer their customers a difference in services depending on their needs:
- Network distribution according to timetable
- Direct distribution
- Cross-docking services (Terminals)
- Package services
- Charter services, the customer makes all the decisions. Frigoscandia offers only the transportation (trucks) and the chauffeurs.
- Administration services
- Pallet transfer's systems

Patrik Johnsfors explained how the Swedish Dairy Skånemejerier distributes their products. The orders to their customers are compounded already at their production center or storage. The transportation of goods is divided in three stages;
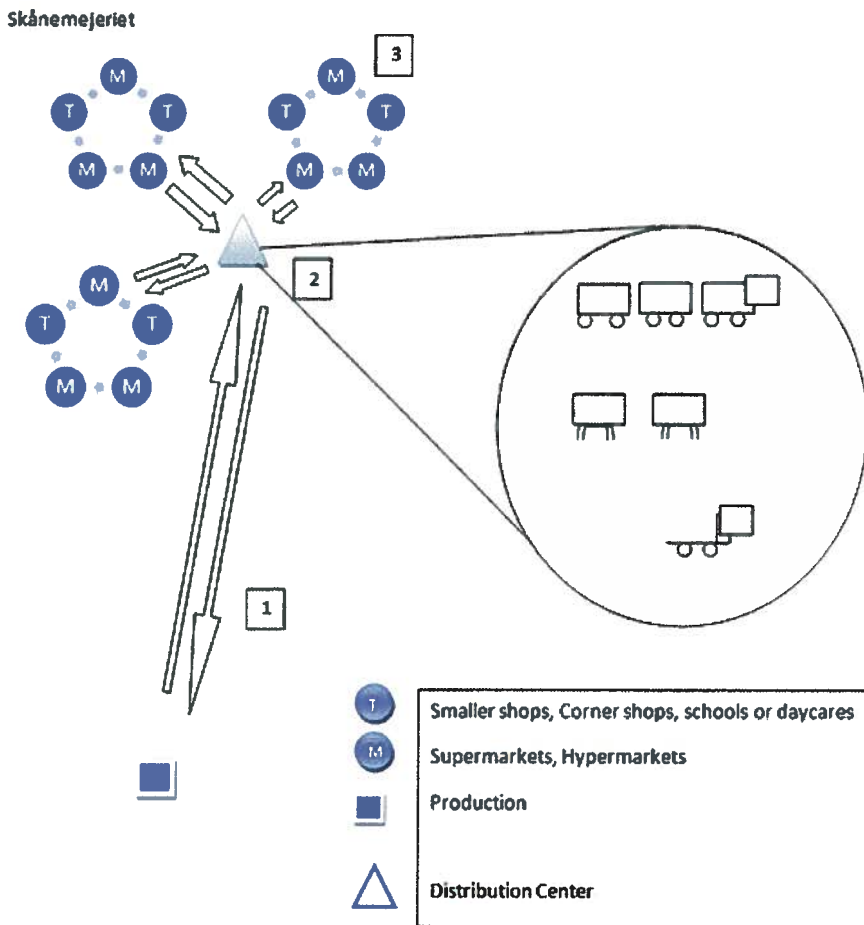
Figure 4.1 *Figoscandias view of how Skånemejerier distribute their goods.*

1. The longer distances are driven with one cockpit followed by two or three trailers to the different regions.
2. The swap bodies (loose trailers) are delivered to a parking spot or similar open spaces and the trailers are left there standing on metal legs.
3. Trucks from the region pick up the trailers, and together with a delivery route specification, distribute the goods to the different stops. The distribution has the First-In-Last-Out method in the trucks i.e. the orders that are deepest inside the trailers are the ones that are delivered at the last stop. The packaging pattern in every trailer depends on the end-route that it is going to have.

This is a good alternative, instead of owning buildings and storages for distribution. This option is only profitable until a certain point according to Patrik Johnsfors. When having larger deliveries and greater production storage would get more profitable.

25

4.2.2. Arla Food

In 1880 The Stockholm milk sales joint-stock company was founded by the brothers Wilhelm and Hildemar Albin Lindholm. In the year 2000 there was an important merger between MD Foods and Arla Food making Arla Foods the biggest dairy company in Europe.[1]

Arla Foods is a co-operative association that is owned by over nine thousand milk farmers in Sweden and Denmark. Together they deliver over six billion kilo milk to the company annually, which is around 80 percent of the total milk production in Sweden and Denmark.[2]

Arla Food is a global company with production in eleven countries: Sweden, Denmark, Great Britain, USA, Canada, Argentina, Brazil, Poland, Germany, Saudi Arabia and China. Arla Foods are represented in 24 countries and around one third of its turnover is outside of home markets Sweden, Denmark and Great Britain.[3]

4.2.2.1. Arla Foods interview

An interview was made at Arla with Johanna Dahlman, Production quality, CNO QEHS (Consumer Nordic, quality environment health and safety) for Sweden and Denmark.

Today the there is a lack of milk on earth, the demand from the consumers has increased over the last years and the production can not correspond the consumers needs. There is a dry spell in Australia and a large increasing demand of milk from Asia.

Arla has dairy production sites located all over Sweden and Denmark spread over the two countries. The company delivers a large part of their product by themselves, with their own trucks and employees. Every dairy has their own local market, but the dairies that produce special products have a nationwide market. All the dairy production sites produce milk which is distributed directly to their nearby customers but many also produce some special products. For example, Kelda is produced in a dairy in Denmark and Keso, another of Arlas products are produced only in Skövde, Sweden. Arlas goods are loaded by hand onto forklifts with different load carrier due to their different types of customers.

Arla has two important core tasks because of their delivery services is time management and internal transport. The deliveries are made to most places all from the big supermarkets and down to the small daycares. To get a delivery from Arla each organization has to make an order with a minimum order quantity.

The products leave the dairy and enter directly in to the Arla-terminals to be load into the trucks and mixed up with other Arla products from other dairies. From the terminals the trucks have a delivery route, the rote can occur in a big city with stops at small shops and big supermarkets. But Arla-trucks also deliver their goods to smaller villages and deep into the Swedish countryside. Arla has a delivery manual that puts customers in different groups depending on how much the customer consumes.

The *terminals* are used both as terminals and as distributions centers i.e. a place to reload and store some of the products for a short period of time. They are important core activity for Arla to get out all of their products at once and not drive to the same location twice with different

---

[1] (Arla)
[2] (Arla Foods)
[3] (Arla Foods)

products. Normally the milk and cream are only reloaded from the production into the terminals and send out to the trucks. This scenario happens rather fast and this kind of goods never has time to get storage due to their short lifecycles. Other goods like Keso and Kelda can get stored in the terminals but only for short periods. Arlas has average transports, in between the dairies/terminals that produce this kind of unique product. The terminals are normally placed in direct connection to the dairy, meaning that the products never leave a chilled edifice before getting loaded onto the trucks. In some cases the terminals are placed in another building not far from the dairy. In this cases the flow of product functions as good as the others and no specific problems have been noticed.

Arla has *trucks* in different sizes and they can therefore deliver almost everywhere. In the large cities the trucks need to be smaller to function better in the traffic and to better reach the customers'. The deliveries to the larger supermarkets outside the cities are made by Arlas larger trucks to provide with more products. Some stores have a delivery from Arla once every two days others twice a day depending on the need and size of the customer. It's important for the delivery flow that the trucks return with empty pallets.

Stockholm is a limited area and the delivery *distances* are rather small compared to Jönköpings delivery district which has to cover an area as large as Denmark. Denmark has products from Arla that do not exist in Sweden because of the delivery distances between its cities and delivery stops. The distances in Denmark are short which means that the products can reach the customer faster. Arla in Denmark has for example "express milk", the concept is to have the milk at the consumers table 24 hours after production time. The different dairies that produces this milk has to manufacture as much as possible at a short period of time. To produce the amount of milk that is necessary to cover the demand of the 24 hour milk in Denmark, one dairy would be enough. Though only one would be sufficient it alone does not the capacity to manage a production of this kind of volume at once and therefore several dairies have to share the quantity.

The dairy market in Sweden was earlier divided geographically between the different dairy producers, but that gradually changed. Arla engages other dairy companies as logistics operators to distribute their special products to the dairy companies "old" geographic area and arla does the same for them. A good example is staged in the south region of Sweden. Arla do not deliver any milk or cream in this specific area, another company, Skånemejerier produces and delivers to the consumers. Arla only provides some of their special products such as Kelda and Keso in this area. For these products the arla hires Skånemejerier to deliver them in "their" region. This is only one example of the healthy collaboration that Arla have with other companies. Arla do not only collaborate with other dairies chains, they also have good collaboration with the wholesalers. Arla has a service in Denmark that does not exist in Sweden; they function as a distributor for other products and companies. They deliver not only their own dairy products but also other type of goods such as meat, vegetables and flowers.

The *climate* does not really affect Arlas production or distribution due to the standard of the trucks which are closed and chilled at all times. But the topic of the company affecting the environment and climate is an important issue for Arla. The company makes larges efforts to minimize their waste to the environment.

4.3. World Maritime University

An interview was made at World Maritime University in Malmö with Dr. Shuo Ma, a Chinese national working in the area of international transport and logistics. Today the Chinese logistics cost are much higher than in for example the US.
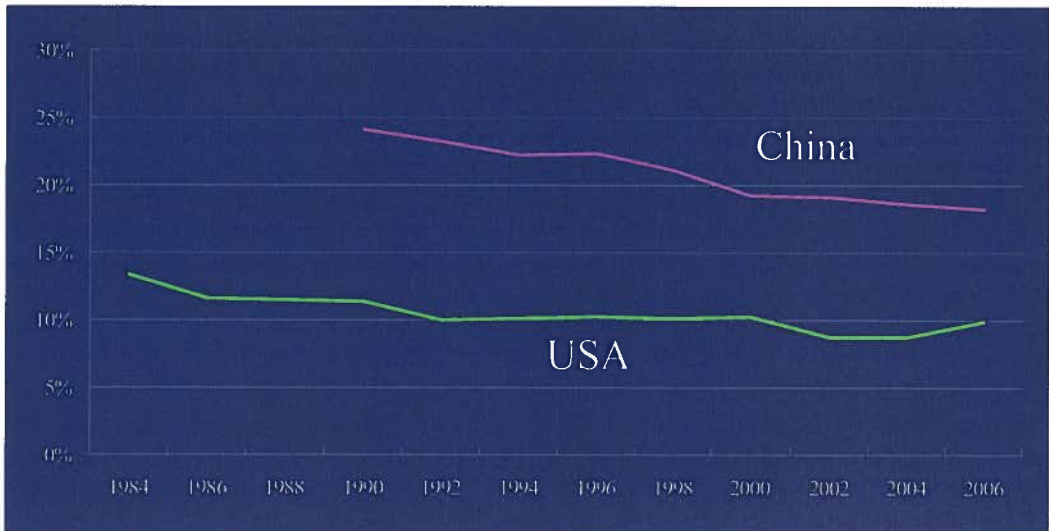

Figure 4.2 *Logistics Challenges, Logistics Cost as Percentage of GDP, Dr Shou Ma 071115.*

The figure 4.2 shows the difference in logistics costs in China verses the US. It was made by Dr Shuo Ma from the latest Chinese data and is therefore very relevant. There is a Chinese improvement every year and this is could be a result of the rapidly improving transport infrastructure during the last 2 decades. Every year for the last six to seven years China have produced an average five thousand kilometre highway every year, eg. 8,300 km of highway completed in 2007, this is equivalent to all existing highways in France. Today there is a quite good connection between Inner Mongolia and the rest of China. The highways are a result of private investments and therefore the vehicles have to pay a fee at a number of stops on their journey when driving on the segmented road. The Shanghai area and the southern part of China are more developed than the rest of the country. Right now some of these stops can be seen as terminal caused by the stops the drivers have to make to pay different kind of fees. The stops on the journey are quite many at the moment but the number is getting smaller. Dr Shuo Ma does not believe that there is a change of transportation vehicle, because all the stops undermine the efficiency. He believes that the truck often travels from production to the bigger cities directly and the bigger stores (modern trade) almost always get their goods directly from the production facilities with no bigger stops on the way. Dr Shuo Ma often sees trucks in for example Shanghai that are from far away.

The smaller stores like the corner shops (traditional trade) have to go through wholesalers when buying their goods. Dr Shuo Ma believes that the wholesalers are near their customers and therefore located near the big cities. Wholesalers are less expensive than supermarkets. The smaller stores go directly to the wholesaler with a smaller vehicle or a minivan, or they get the goods distributed to them. To sell the goods directly from the trucks is not legal in China.

The third part logistics that is commonly used in Europe and the US is not usually used in China. This is due to the lack of trust needed when giving the transport companies more responsibilities and no longer having all the control which makes it harder to collaborate with different shipments like they do at for example Frigoscandia in Sweden. Collaborating will increase the filling degree and therefore maximize the transports. Today the most common types of shipments are with a transport company that transports your goods or that you do it all yourself.

Today there are around 300 logistics parks that are used like distributions centres. These are occupied by different companies and sometimes there are different companies that are renting different parts of the centres. This is becoming more and more popular and can in some ways be seen as a way of becoming more opened to third part logistics. There are companies like Schenker in China but they have a relative small percentage of the logistics compared to the US and Europe. They also have a very small percentage of the total cargo that is transported in China. The logistical costs are higher in China than in the US partly due to the poor use of third part logistics. It is becoming more and more popular to create bigger distribution centres like hub and spokes instead of the traditional direct connection. The big chain stores buy their goods directly from the producers and do not use any middle hands to minimise the costs. There is a lack of trust for third part logistics due to the lack of control. There is a need for international players to come in and give an impact on the local distributors. The supermarkets concept is from the western countries but big supermarket chain like Wal-Mart and Carefour can be found in China. The Chinese people are very good at copying the methods that the west is using to grow even faster at the local market which will probably also happen with the transportation.

After viewing the figure 4.1 of the distribution types used by Skånemejerier the professor thought it was a great idea but that the situation today wasn't similar and did not correspond to China.

4.4. Workshop

Fifteen archetypes were established based of the interview with Prof. Lumsden and some brainstorming. Together with Doctor Shou Mas knowledge on the distribution in China the archetypes were changed and reduced from fifteen down to six. These six were then used in a workshop with eight employees at Tetra Pak that had a range of different experience in China.

The archetypes were discussed and analysed to find new ones and analyse if the already existing ones were accurate. The presentation started with an introduction of the assignment given from Tetra Pak and a further description of the six established archetypes. The original idea was to have a brainstorm with the employees at Tetra Pak and discuss the archetypes that already were established. If the results were accurate for their customers and if there was any important archetype missing.

There was a focus on these six questions:
1. Which of the archetypes are most likely to occur in China for your customers? Both in Traditional trade and Modern trade.
2. Are there some of the archetypes that are not applicable and if so how?
3. Is there something you want to add or take away from any of the archetypes?
4. Are there any archetypes that you think we have missed that are often used in China by your customers?

5. Who is usually the owner of the distribution the producers or do they use a distribution a company?
6. Are producers the owners of the transportation sometimes if so when?

After the meeting these questions together with the new archetypes were sent to Tetra Pak China to an employee with the right knowledge. He added further input from his point of view on the Chinese distribution network.

4.5.   Tetra Pak China

The answer from Tetra Pak China to the six questions was as followed.

China Dairy distribution network (Big Dairy manufacture)
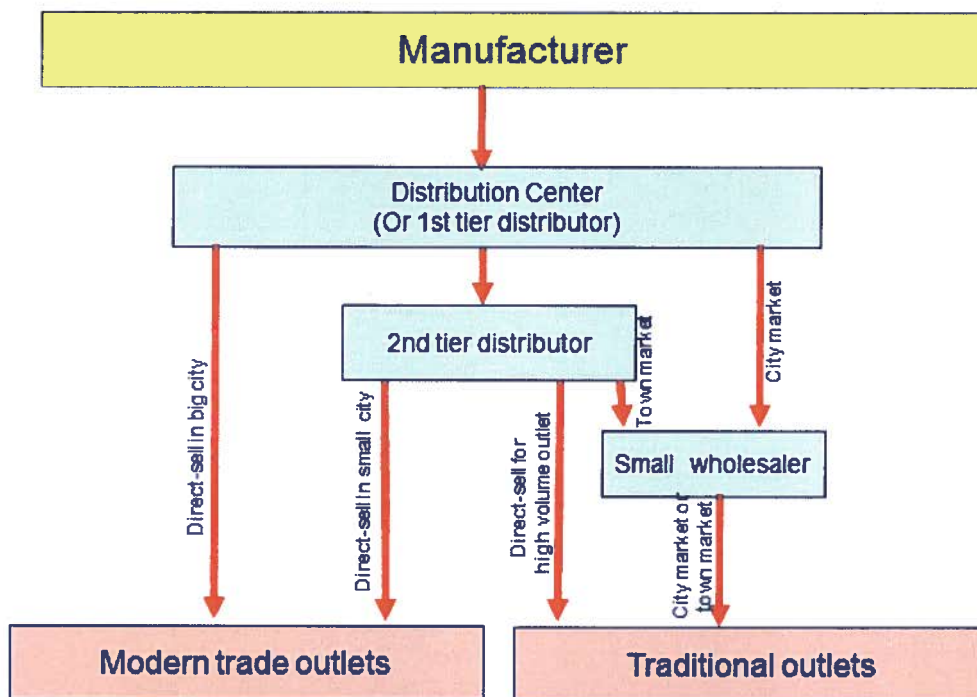
Figure 4.3 *Distribution network from Tetra Pak China*

Tetra Pak China specified the answers to the six questions further.

Distribution Center
Normally they are joint-operated sales unit with local capable distributor in province or large city market level. They have self-owned trucks and sales force. Their business is fully dedicated with large percentage reliance to manufacturer brand

Distributor
Run by local business owner but have sole distribution agent rights for assigned area. Their business´s largely relate to manufacturer brand

Wholesaler
Without sole distribution right but have regular business transaction with distributor. They are served and visited by manufacturer sales people but not only rely on one business.

Direct Selling
Use distributor self-owned truck for order delivery

Route Selling
No distributor or wholesaler normally run fixed route delivery in China.

4.6. Data of humidity

The data below is taken from a webpage of randomly scattered cities in China that can be seen in figure 5.1. They were chosen to better understand the temperature and humidity changes throughout Chinas mainland.

Guangzhou

2007	(°C)	Humidity (%)
January	15,1	57,7
February	18,5	68,1
March	18,8	75,3
April	21,1	72,5
May	27,1	68
June	29,2	75,3
July	31,1	67,1
August	29,8	70,5
September	28,7	64,4
October	26	57,1
November	20,4	48,5
December	17,8	59,8

Gulyang

2007	(°C)	Humidity (%)
January	2,94	74,9
February	10,7	63
March	12,3	68,3
April	14,7	65,2
May	20,6	57,8
June	22,1	70,8
July	23,2	72,3
August	23,6	67,9
September	18,9	71,5
October	15,6	74,1
November	12,1	55,8
December	6,39	75

Harbin

2007	(°C)	Humidity (%)
January	-12	72,8
February	-8,2	63,7
March	-3,9	59,4
April	6,11	59,7
May	14,1	60,4
June	22,2	55,8
July	21,9	84,7
August	21,6	83
September	15,7	78,4
October	6,33	58
November	-4,6	56
December	-11	68,6

Hohhot

2007	(°C)	Humidity (%)
January	-12	63,5
February	-4,6	60,2
March	0	56,5
April	7,78	35,3
May	16,3	32,4
June	21,7	46,1
July	22,9	52,9
August	21,7	53,8
September	16,4	52,7
October	6,94	59
November	-1,8	54
December	-8,9	61

Peking

2007	(°C)	Humidity (%)
January	-2,1	43,3
February	3,39	47,4
March	5,78	58,4
April	14,6	39,8
May	22	42
June	25,8	63,4
July	26,3	78,7
August	26,7	73,8
September	22,4	70,4
October	13,4	65,4
November	4,28	60,8
December	-0,7	57

Shanghai

2007	(°C)	Humidity (%)
January	5,33	71,2
February	9,78	70,3
March	11,9	70,4
April	15,6	64,4
May	22,6	66,1
June	25,1	78,5
July	30,1	74,4
August	29,8	72,7
September	24,9	74,6
October	20,1	68,9
November	13,3	65,5
December	8,61	73,9

Urumqi

2007	(°C)	Humidity (%)
January	-13	85,3
February	-6,9	89,1
March	1,17	67,5
April	14,8	41,3
May	18,2	49,9
June	24,1	37,8
July	25,8	45,3
August	23,8	44,5
September	20,1	38,2
October	9,44	51,4
November	1	65,6
December	-10	85,1

Xining

2007	(°C)	Humidity (%)
January	-7,2	35,2
February	-0,9	26,5
March	3,28	41,7
April	8	35,8
May	14,5	37,3
June	15,3	51,2
July	17,3	57,3
August	17,8	60,4
September	12,6	60,5
October	6,61	63
November	1,28	46
December	-4,2	41,8

Legend:
- <40%
- >65%

5. Analysis and Discussion

In this chapter the authors try to analyse and discuss the facts to find the answers to the problem discussion together with the composed theory and the empiric studies.

5.1. Culture

China is the fastest growing economy in the world with over one third of the population urbanized. There is a wide gap between the rich and the poor today but the average households incomes are getting higher. This affects the consuming habits of the Chinese people. The most important regions in terms of retail are: Shanghai, Beijing, Anhui, Zhenjiang, Zunnan and Jaingsu. Especially in Shanghai and Beijing there is an expanded number of foreign and domestic retailers. The Shanghai area and the southern part of China are more developed than the rest of the country. In China like the European market there is a distinction between modern and traditional trade. Because of the better incomes and SARS there is a higher demand for quality packaged food and the large stores have increased rapidly. Unlike Europe and the USA the big stores are situated in the centre of the cities in China. A Chinese consumer visit the store around three times a week due to the lack of big refrigerators and the transportation being by foot, bike or buss makes the proximity to the store is important.

As a result of an encouragement from the Chinese government to drink more milk the dairy consumption has increased. The milk farms are mostly situated in the Inner Mongolia and then often transported on good highways to the major cities. The workers at the production facilities stack the secondary packages manually in the trucks or other vehicles. The Chinese workers are known for their efficiency, inexpensiveness, low company loyalty and unwillingness to question authority.

The manual handling has both positive and negative effects on the transportation. The positive is a higher flexibility and with the inexpensive workers it is more profitable with manual handling than to invest in the necessary equipment throughout the entire supply chain. The negative is that the distribution would be more exact and faster with the use of pallets and fork-lifts.

5.2. Transportation network

One part, two part and three part logistics are frequently used in Sweden and Europe. There is a smaller amount of third part logistics in China compared to Europe at the time but with the increasing number of foreign established companies engaging on the market today this will probably change. The lack of a third party use makes it harder to join transport operations and thereby save money on the logistics. The Chinese people are good at coping and adapting and will probably implement the European way of managing logistics if it benefits them. Today's road conditions are continuously improving and this with the help of private investors. By owning a section of the highway the transport route becomes segmented but this will probably improve in the near future to look more like the European standards. The railway is developed to the big consumer areas in China, the train usage could then increase and it's a good opportunity to reduce transportation cost due to its ability to transport a greater amount at once and it is a more environmental friendly choice. How much the train is used compared to the truck is not well established in this report but the truck has the advantage of being able to go from door to door. In Europe one of big transportation costs for trains are to reload and change trains at the different country borders because of a change in railway networks. This is

obviously not the case in China and as can be seen in figure 3.6 far distances are most cost efficient with train. In combination with the European swap body this would minimise the manual handling and thereby speed up the process. The swap body is already used in Sweden by Skånemejerier and can easily be copied in China but it can be costly to implement. Today's China is more used to the manual handling compared to the fork-lift truck and pallets used in Europe. This is because workers are less expensive than the implementing of fork-lift truck and new trucks throughout the entire supply chain. The manual handling makes the knowledge and exactness that the workers have important. With a machine the packaging and stacking of boxes are more precise and accurate. This will probably change with in the near future. The FIFO and LIFO terminology that are used in Europe are at most certainty used in China to avoid the deterioration of the product.

Figure 4.2 show how the logistics cost in China is higher compared to the US. This may be a result of not using a third party and thereby not maximizing the transportation vehicles when travelling from the producer to a customer. It can also be due to the continuous develop and constructing of new highway and infrastructure which in it self is a logistical difficulty.

5.3. Humidity

Trough the randomly chosen cities scattered around China that can be seen on the map below data was collected and used to find de difference in humidity.
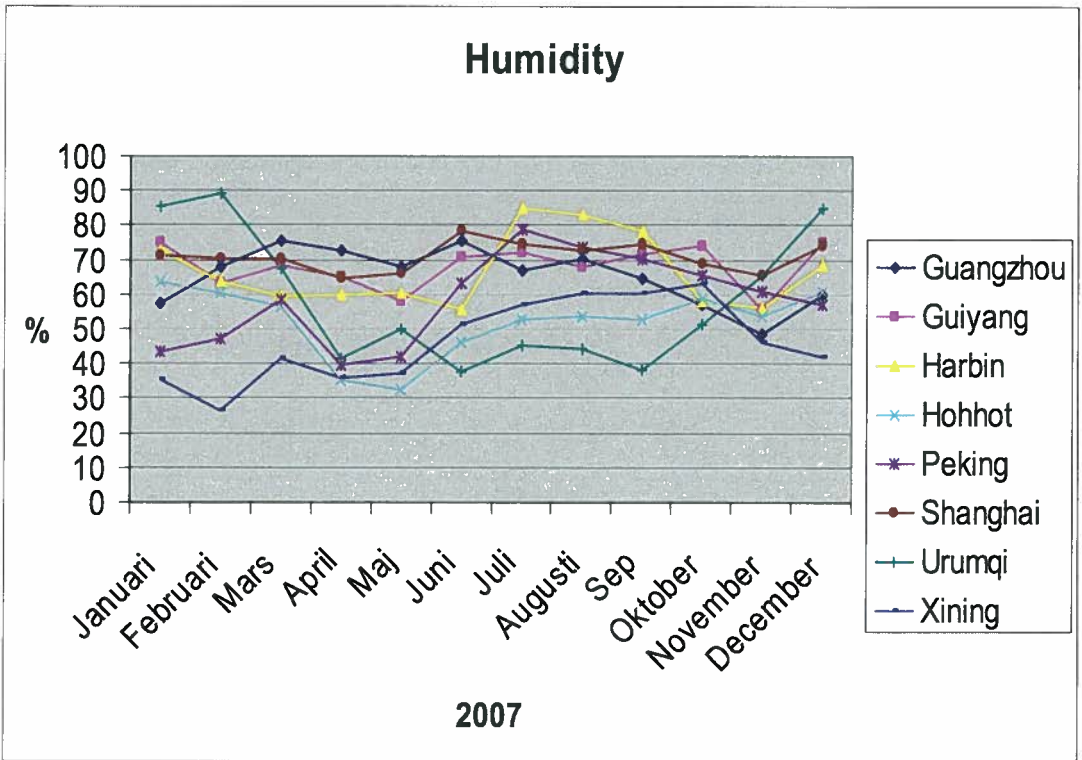

Figure 5.1 China Map

Figure 5.2 Humidity variations in the chosen cities.

When Tetra Paks products are transported from their customer to the end retailer they are stacked in secondary packages before being loaded into the delivery trucks. The secondary packages are normally made of corrugated cardboard.

In figure 5.1 the average variation of humidity for each month of 2007 in each one of the chosen cities appears. When RH-changes occur in the surrounding the moisture state of equilibrium of the paper/cardboard changes which leads to a change in the paper dimensions. Cardboard boxes may crumple and then collapse because of the *change* of humidity in the environment.

Example: If cardboard boxes traveled in April from the dairy in Hohhot which has a RH of 38% to a retailer in Shanghai which has a RH as high as 65%, the change in RH is large as the diagram shows. When the boxes travel this far through the country and the difference in RH from A to B is large, the risk of change in small variations throughout the journey is high. hen the moisture in the box material varies by the changing RH in the surrounding, the box will be even more sensitive towards the load that it carries and collapse sooner.

Some of the measurements show enormous difference in RH for some of the cities throughout the year. For example Urumqui has it lowest point of RH in June at a RH of 39% and it highest in February at 90%. The boxes will be affected without moving, just by being stored because of the large change in RH. This could be prevented by storing the boxes in a closed room, not affected by the outside surroundings.

35

5.4. Total Analysis

5.4.1. The initiative state

The understanding for Tetra Paks customers in China increased after the first interviews at Tetra Pak in Sweden together with different reports from the Chinese culture and Grocery markets. The initiative step was to find out how the Chinese life and market were connected so a cooperation difference between China and Europe could be established. The first view of how the distribution network could look like appears in figure 5.3 together with the complexity of the problem.
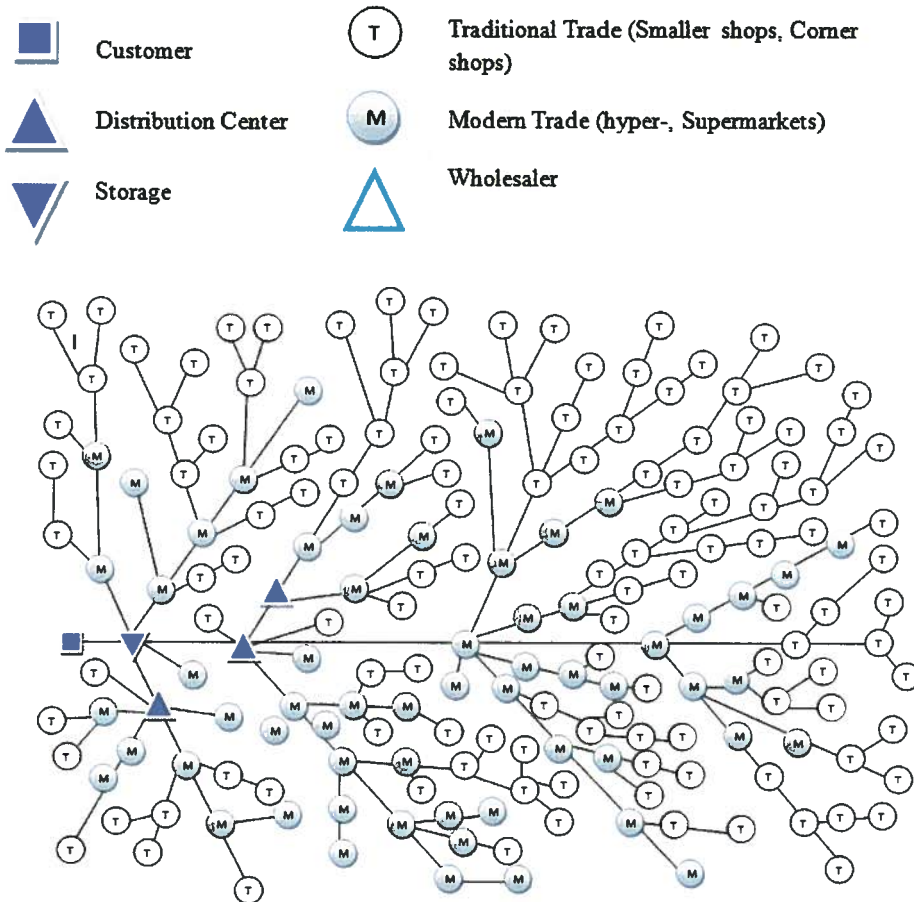

Figure 5.3 *Complex distribution network.*

5.4.2. Chalmers University

An important aspect was how to clarify the results of the investigation and at the same time minimizing the great complexity of the problem. After a conversation with the professor from Chalmers University and some brainstorming, fifteen archetypes were established, figure **5.2.3**. As the figure 5.4 shows, the start point of the distribution is at Tetra Paks customer. The chain starts when the product leaves the production area and ends at the end retailer. The explanation of what each stop stands for follows.
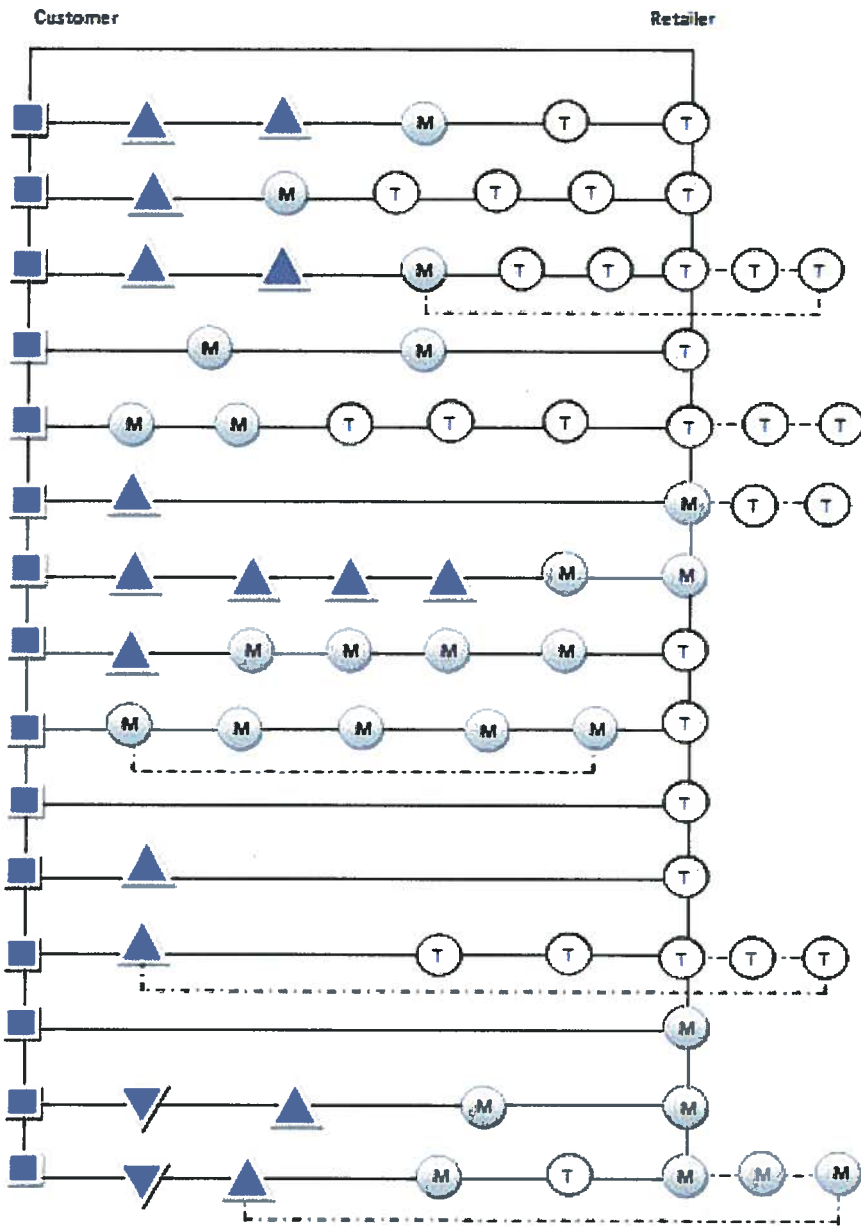
Figur 5.4 *First edition Archetypes.*

5.4.3. World Maritime University

After these results there still was a gap between how the distributions really functioned in China compared to the studied transportation in Europe. The logistics professor from China explained how the Chinese government affects the distribution, what the trucks and railway looks like and some other aspects of how the distribution works in this large country. The archetypes were reduced to the following relevant archetypes that appear in China, figure 5.5.
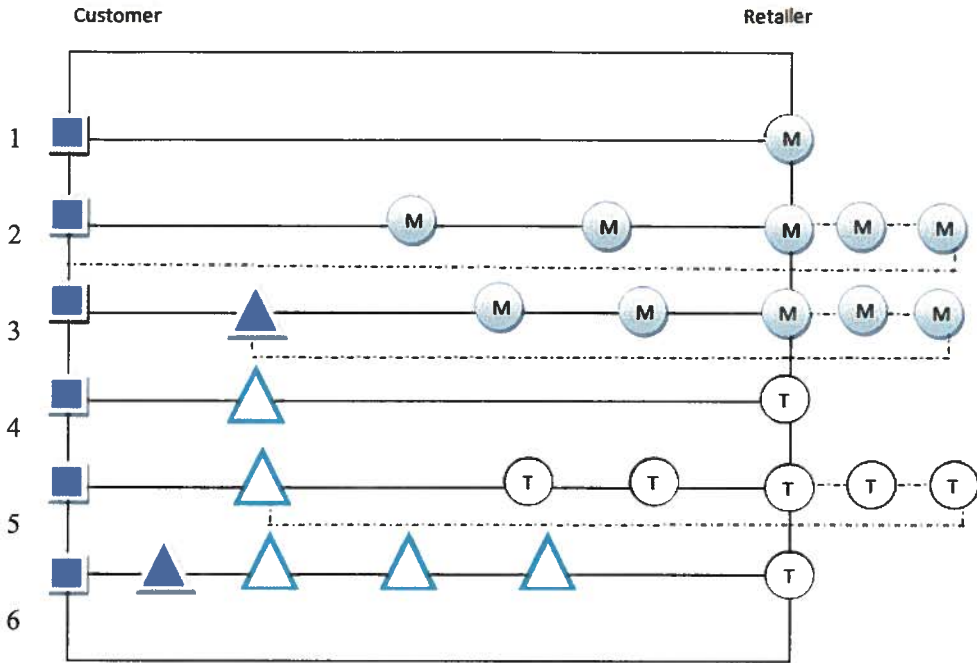
Figure 5.5 *Second Edition archetypes. The three first archetypes are modified to the modern trade market and the three last ones to the traditional trade.*

Modern Trade Archetypes
1. The goods have direct connection from the customer to the end retailer.
2. The delivery of goods travel from the customer in a fixed/flexible route to different end retailers.
3. The goods travel from the customer to a distribution centre and then travel further on in a fixed/flexible route to end retailer.

Traditional Trade Archetypes
4. The goods travel from the customer to a wholesaler and then further to the end retailer.
5. From the customer the delivery of goods transfers to a wholesaler and later in a fixed/flexible route to different end retailers.
6. The products begin their journey by traveling from the customer to a central positioned distribution centre and the further on to a large wholesaler. The next stop is a smaller wholesaler and from this wholesaler to an even smaller one and so far to the end retailer.

5.4.4. Workshop

These results were presented at Tetra Pak for further discussion and analysis. After a smaller discussion with the staff, they concurred with the existing archetypes but added two more due to the existence of more distribution centers in one distribution chain. The existence of one or two distributions center before the end retailer is common in China. None of the six established archetypes were change during the meeting.

The workshop resulted in a total of 8 archetypes. Number 4 and 7 was added.
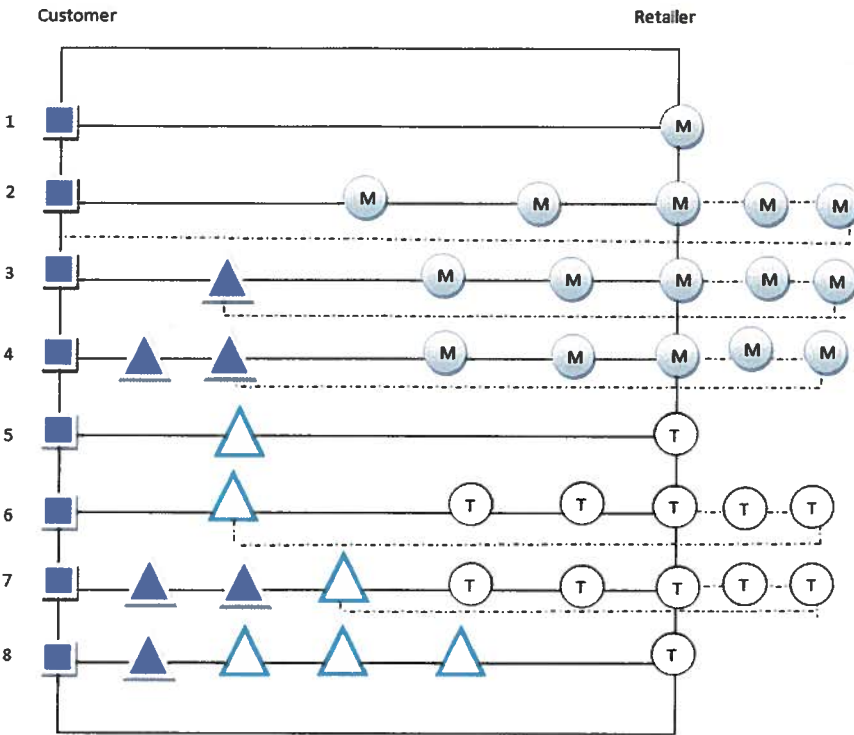
Figure 5.6 *Third edition archetypes.*

Modern Trade Archetypes
4. The travel of the goods starts with the delivery from the customer to a large distribution centre and from this point it travels further to a smaller, regional distribution centre. The delivery travels from the regional distribution centre in a fixed route to end retailer.

Traditional Trade Archetypes
1. The goods travel from the customer to a larger distribution centre and then travels further on to a smaller regional distribution centre. The delivery of goods moves from the distribution centre in a fixed route to end retailer.

5.4.5.   Arla

At the Arla interview a lot of questions around the dairy distribution business were answered. The eight established archetypes were showed and discussed. The employee at Arla concurred with the seven of the eight existing ones, all of them were relevant for the Arla distribution in Sweden and Denmark and it also corresponded with China. After a dialogue with her a ninth archetype was added, number 2 in the new figure 5.7. From the customer the product traveled to one distribution center and then further to retailers in modern trade, this could also be applied in China. Number nine was not applicable for the distribution in the Nordic countries.

The segregations between China and Sweden are smaller than at first glance in the distribution area. The interview at Arla made it very clear that modern- and traditional trade differences not only exists in China and developing countries but also in a well developed country such as Sweden.
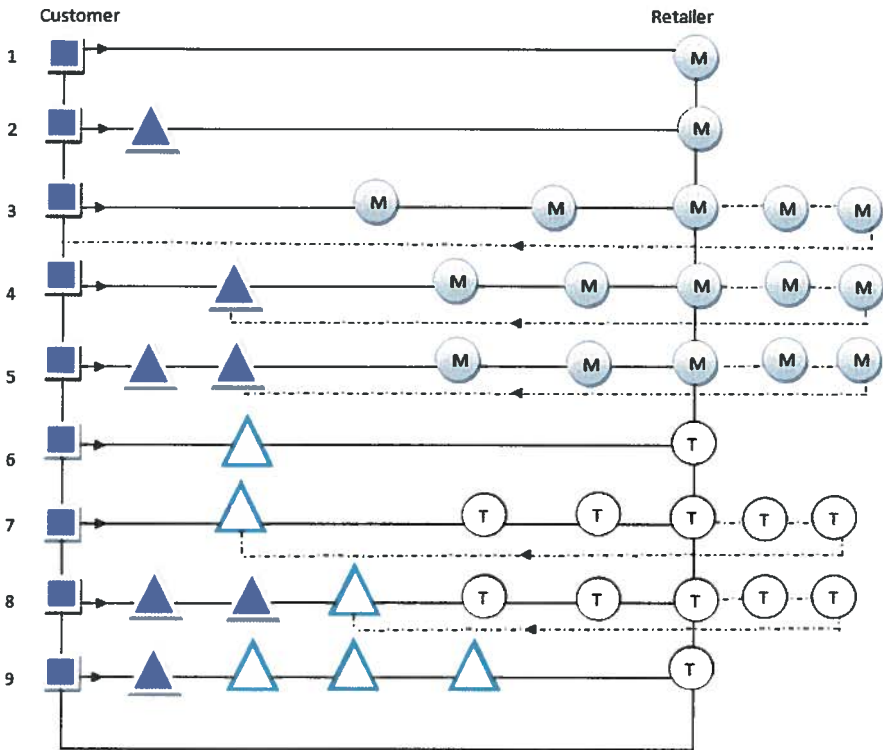
Figure 5.7 *Fourth and last edition of archetypes. Number 2 was added to the new figure. 2. The goods travel from the customer to a distribution center and then travel further to the end retailer.*

5.5. Analysis of the references

Since this work was mainly based on oral input from different sources a SWOT- Analysis was made to better understanding and to verify the accuracy and reliability of the sources.

	S	W	O	T
Frigoscandia	Experts in the areas of storing and delivering frozen goods.	No knowledge of Chinese distribution.	Overview of how the distribution in general works. Good understanding in other dairies' distribution. They are a third-part-logistics-company which probably will be China's future.	Presently third party's logistics is rarely used in China because of confidence difficulties.
Keneth Lumsden Professor logistics Chalmers	Knowledge of logistics ad author of "Logistikens Grunder".	No knowledge of China	Is possible to make a complex structure foreseeable. A large network of people with knowledge.	Book, aimed on Europe and not on China.
Shou Ma Professor Logistics WMU	Chinese professor in logistics	Aimed and focus on ship distribution	Has knowledge concerning law and decision making in China and an understanding in their culture and how they work	He does not see the large picture clearly, does not see to the general. Aim on ship transportation.
Tetra Pak Lund	Different experiences and opinions within the company. Have knowledge of the actual product.	Slight knowledge of their customers in China.	Possibility to check if the archetypes are applicable on Tetra Paks customers.	Does not see the general picture because they worked more on a detail level
Arla	Milk manufacturers and distributors	Large focus on their own chilled distributed products	Check existing archetypes in order to see if they are general enough to applied on other countries than China	No information about their Chinese distribution
Tetra Pak China	Great knowledge of China's distribution. Are in Tetra Pak China now. Works daily against Tetra Paks customers in the country.	Does not work mainly with Tetra Paks customers' distribution and therefore does not have the deeper more precise understanding.	Has another perspective of how the distribution functions in China	Possibility of miss interpretations when we did not get possibility to interview them in person only by mail.

6. Conclusions

The biggest difference in handling when loading and unloading in China is the lack of equipment like fork-lift and pallets throughout the supply chain. At the moment the producers are normally using pallets in production but the secondary packages are then manually placed on the trucks or train wagons. There is a big gap between the rich and poor that makes it possible for low paid jobs. The rich part of the population creates a higher demand for packaged food. With the spending habits of the Chinese increasing the need of higher efficiency on logistics to keep up with the rising demands grows. One of the positive sides to manual handling is the flexibility when changing routines. The negative side is that the workers aren't as precise as a machine and therefore some of the secondary packages may get placed slightly wrong and this might cause leakage to the primary package. The Chinese workers are known for their efficiency but at low paid positions in the companies they are changing workplace if given a better job opportunity. This isn't good for the exactness when placing the secondary packages on the transportation vehicles.

Today's China is experiencing a lot of change in their infrastructure which could make the implementing of fork-lift trucks and trucks throughout the entire supply chain hard and expensive. The workers in Sweden are unlike Chinese workers used to questioning the authority and encouraged to find faults and report them. This doesn't exist among the low paid workers in China were there are more discipline and rules. It is good to have rules and regulations but the encouragement to find faults and reporting them to the right people is vital for an evolving companies. This is important to minimize the problems in the handling and avoid future complications.

The Chinese road conditions are continuously improving in the country. Connections between Inner Mongolia and the bigger cities at the coast line are in good standards and the vehicles used are in relative good condition. There are many advantages when using truck transportation like door to door delivery and the security with having a driver accompanying the goods the entire supply chain. Because of Chinas distances in land area the usage of train is a good alternative both economically and environmentally. In Europe one of the big transportation costs for trains are to reload and the change of train network at the different country borders this evidently is not an issue in China. With the consuming habits of the Chinese people increasing the usage of cars also rises which lead to traffic jams. This can be avoided with a higher train usage and a train can transport more goods at once than a truck. There can be an existing problem with the railway system being overloaded but hopefully it is a part of the infrastructure that is evolving and getting better every year.

One of the big difficulties when planning the transportation in China is the big changes in infrastructure every year which in itself can be a logistical problem. In Europe there is an old and experienced logistical network that has been used for many years with well-tried connections between production sites and customers. This makes the planning of the transportation easier in Europe than in China and thereby hard to compare.

There is not as much third party usage in China as in Europe which makes the joining and maximizing the transportation harder. At the moment there is a hesitation toward third party logistics due to the trust needed when working with a third party. The Chinese are good at coping and adapting solutions that they can benefit from and with the increasing foreign transportation companies now situated in China they will probably start using third party logistics more in the future.
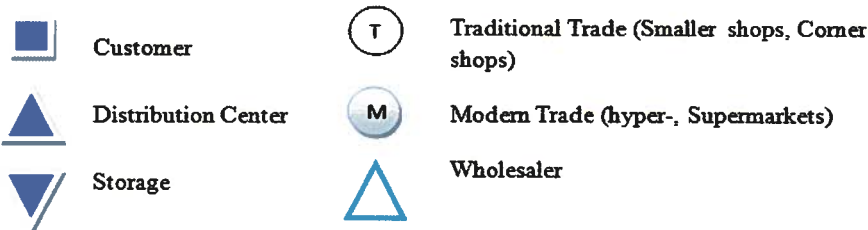
In China there is a big distinction between modern and traditional trade. The modern trade is becoming more popular with the customers' better incomes and demands for higher food safety and quality. The stores are situated in the centre of the cities close to the end customers while in Europe the big stores are usually situated at the outskirts of the city centres. The variation in placement is because of the difference in transportation and shopping habits of the European and Chinese customers. The modern trade shops often order their products directly from the producers this to get the best price and avoid the middle hands. The traditional trades go through a wholesaler where the owners themselves pick up the merchandise or get it delivered to the stores. In Europe the big supermarkets have the lowest prices and in China this is not the case though traditional trades are less expensive than modern trade.

The logistics professor at Chalmers University opened a new door for how to explain and structure the complex distribution network. The studied cases, in chapter 4.2 gave a deeper understanding for distribution of grocery and logistics in the European market. After a smaller discussion with employees at Tetra Pak, they concurred with the six first established archetypes but added two more. None of the six established archetypes were changed during the meeting. The professor at WMU together with employees at Tetra Pak had the key knowledge for how to narrow the archetypes to the core ones.

The interview at Arla gave a greater understanding for the dairy distribution in Sweden and Denmark. This approach made it very clear that the established archetypes were general not only for Tetra Paks customers or the Chinese distribution but also relevant for Arla and the Nordic distribution market.

The segmentation of modern trade and traditional trade are more present in Sweden and probably also in Europe than we thought. There is a clear difference between the two markets also in Sweden as noticed when a Swedish dairy producer who handle their own distribution was investigated.

The results after this investigation through the Chinese culture, case studies and logistics in general lead to a new way to structure the distribution logistics. The research also meant to give a deeper understanding to how the distribution in general functions for Tetra Paks customers in China. The archetypes also concur with the view that Tetra Pak China has of their customer distributions as clarified in chapter four.
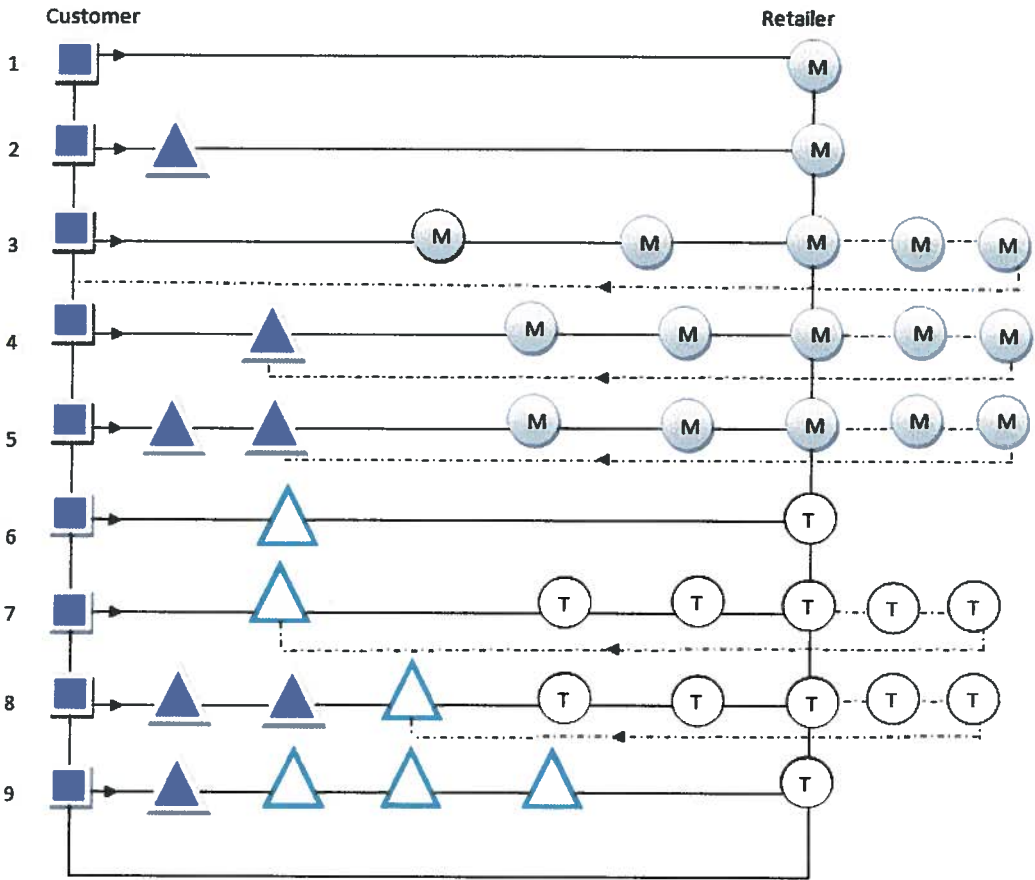
■	Customer	(T)	Traditional Trade (Smaller shops, Corner shops)
▲	Distribution Center	(M)	Modern Trade (hyper-, Supermarkets)
▼	Storage	△	Wholesaler

Figure 6.1 *The final results and closing number of archetypes.*

Modern Trade Archetypes
1. The goods have direct connection from the customer to the end retailer.
2. The goods travel from the customer to a distribution center and then travel further to the end retailer.
3. The delivery of goods travel from the customer in a fixed route to different end retailers.
4. The goods travel from the customer to a distribution centre and then travel further on in a fixed route to end retailer.
5. The travel of the goods starts with the delivery from the customer to a large distribution centre and from this point it travels further to a smaller, regional distribution centre. The delivery travels from the regional distribution centre in a fixed route to end retailer.

Traditional Trade Archetypes
6. The goods travel from the customer to a wholesaler and then further to the end retailer.
7. From the customer the delivery of goods transfers to a wholesaler and later in a fixed route to different end retailers.
8. The goods travel from the customer to a larger distribution centre and then travels further on to a smaller regional distribution centre. The delivery of goods moves from the distribution centre in a fixed route to end retailer.

45

9. The products begin their journey by traveling from the customer to a central positioned distribution centre and the further on to a large wholesaler. The next stop is a smaller wholesaler and from this wholesaler to an even smaller one and so far to the end retailer.

These archetypes are very general and of course the possibility of a combination of two or more is most likely. A mixture for example of nr 2 and nr 9 could be a possibility. The products could be transported from Tetra Paks customer and then (as in both cases) further to a distribution center. From the distribution center the goods travel to a supermarket (modern trade) or to a wholesaler (traditional trade). The opportunity to be able to combine the archetypes makes them flexible.

The *humidity* issue is a difficult matter. To prevent boxes from collapsing when humidity changes occur, it would be optimal to transport the goods in closed rooms, not affected by the outside surroundings. If such closed trucks do not exist in China it would be expensive to implement and not a very good current option with all changes in the country right now. New trucks and new standards will appear in this expanding country and this is a long time option. If the loading took place in a cooled environment, the container or truck should not be opened directly into hot environment without getting a big impact on the material. The container gets moister. Slow changes in temperature and moisture make the material last longer. A more short time option and smaller investment would be to support each box with extra dividers of corrugated cardboard in between two layers of TFA as the figure 1.1 shows or increase cardboard quality.

6.1. Future investigation

This Master Thesis is only a beginning, a ground setting report of how to simplify and structure archetypes for the distribution network in a certain area. The study could be more accurate if the researchers were from the studied country or made their study there. Interview people and investigate cases from the actual country would make the study even more accurate.

➢ The focus with the thesis was China which is an evolving country and therefore the found archetypes should be updated in the DCA audit template.

➢ Investigate the customers through case studies. The correct archetypes would in a next step be a support for Tetra Paks customers, to connect *their* customers (the retailers) with the right archetypes. This would make it easier to detect where the products flaw, why and how to prevent that. This could also give a deeper understanding of the retailers and more accurate recommendations from Tetra Pak and the producers.

➢ The report can be support for new studies in other countries to find their distribution patterns. The result from those studies would make it easier to find connections internal (in the investigated country and company) as well as external (between other companies, markets and countries). Proposal countries: India, Russia, South America and Indonesia.

➢ Investigate how to design corrugated cardboard properties for a specific distribution route including variations in temperature and relative humidity and develop a correct safety factor for compression. Proposal countries: China, India, Egypt and Indonesia.

- ➤ Understand the uses of smaller transportation methods, with shorter transportation distances, for example bikes.

- ➤ Communicate the results with internal and external distribution networks.
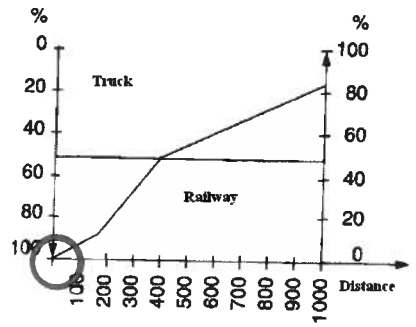
7. References

Arla. (n.d.). *Arla Homepage*. Retrieved November 14, 2007, from Näringslivshistoria: http://www.naringslivshistoria.se/templates/Arla/Article.aspx?id=1997&ArticleID=1932&CategoryID=322&epslanguage=SV

Arla Foods. (n.d.). *Arla Foods Hompage*. Retrieved November 14, 2007, from Arla Foods: http://www.arlafoods.se/templates/PlainPage2.aspx?id=6520

Arla Foods. (n.d.). *Arla Foods Hompage*. Retrieved November 14, 2007, from Arla Foods: http://www.arlafoods.se/templates/PlainPage.aspx?id=6507

Aronsson, H., Ekdahl, B., & Oscarsson, B. (2004). Modern Logistik. In H. Aronsson, B. Ekdahl, & B. Oscarsson, *Modern Logistik, upplaga 2* (pp. 118-120). Wallin & Dalholm tryckeri AB.

Euromonitor International. (2006). *China: Growth market for the future*. Euromonitor International.

Euromonitor International. (2007). *Inpulse food and drink channels Dairydrinks- China*. Euromonitor International.

Fellers, C., & Norrman, B. (1996). Pappersteknik 3:e upplagan. In C. Fellers, & B. Norrman, *Pappersteknik* (pp. 272-273, 343-345). Kungliga Tekniska Högskolan.

Immelborn, A. (2007, September 1).

Johnson, G., Scholes, K., & Whittington, R. (2005). Exploring Corporate Strategy 7:th edition. In G. Johnson, K. Scholes, & R. Whittington, *Exploring Corporate Strategy 7:th edition* (p. 148). Mateu Crono.

Lantz, A. (1993). Intervju metodik. In A. Lantz, *Intervju metodik* (p. 21). Studentliteratur.

Lumsden, K. (2006). Logistikens grunder. In K. Lumsden, *Logistikens grunder* (pp. 62-63, 107-108, 124-130, 138, 455, 631-633). studentliteratur.

Patel, & Davidsson. (1994). Forskningsmetodikens grunder. In Patel, & Davidsson, *Forskningsmetodikens grunder* (p. 90).

person, G., & Virum, H. (1999). Logistik för konkurrenskraft. In G. p. Virum, *Logistik för konkurrenskraft* (pp. 78, 149).

Planet Retail. (2007). *Grocery retailing in China*. Planet Retail.

Regnell, B. (2006). Att genomföra examensarbete. In P. R. Björn Regnell.

Tetra Pak. (2007, September 25). *www.tetrapak.com*. Retrieved September 25, 2007

Twede, D., & Selke, S. E. (2005). Carton, crates and corrugated Boards. In D. Twede, & S. E. Selke, *Carton, crates and corrugated Boards* (pp. 236-241). DEstech Publication Inc.

Wallèn, G. (1996). Vetenskapsteori och forskningsmetodik. In G. Wallèn, *Vetenskapsteori och forskningsmetodik* (p. 99).

Woxelius, J. (1998). *development of small-scale intermodal freight transportation in a systems context*. Chalmers University of Technology.

www.china.org. (n.d.). *www.china.org*. Retrieved october 3, 2007, from http://www.china.org.cn/english/business/218628.htm

8. Appendix

8.1. Tetra Pak Questions

Questions brought to Kent Severinson at Tetra Pak.

1. Vad har du gjort i Kina?
2. Hur länge har du varit där?
3. Var någonstans i Kina arbetade du huvudsakligen?
4. Vad har du för erfarenhet av den kinesiska kulturen?
5. Har du i allmänhet några kulturella skillnader som du vill dela med dig av?
6. Var ser du de största problemen med transporten i Kina i dag?
7. Hur många mellanstopp har de i genomsnitt vid en transport?
8. Hur kan dessa mellanstop se ut?
9. Hur anser du att de transportmedel som vi har i Europa skiljer sig från dem som används i Kina?
10. Hur långa avstånd kör lastbilarna i genomsnitt?
11. Har de en chaufför som följer med lasten hela vägen och ser till att den inte hanteras på ett felaktigt sett?
12. Hur ser transportnätverket ut i Kina?
    - Är den jätte komplex?
    - Vilka är de största flaskhalsarna?
    - Är trafikstockning en flaskhals?
    - Hur kan man undvika dessa?
13. Kan du uppskatta hur stor andel av transportvägarna som håller den europeiska standarden?
14. Hur kan människans roll vara en negativ del i hantering av godset?
15. Hur kan man minimera den?
16. De som har arbetsuppgiften att packa lastbilarna med sekundärförpackningarna är det alltid samma människor som har den positionen och om inte varför?
17. Vilka stora skillnader är det på hanteringen av gods i den europeiska marknaden jämfört med den kinesiska?
18. Affärerna är uppdelade i "traditional trade", och "modern trade". Finns det olika varianter av dessa och i så fall vilka?

Det kan tillkomma följdfrågor och ytterligare frågor

8.2. Frigoscandia and Arla Questions

Questions brought to Patrik Johnsfors at Frigoscandia and to Johanna Dahlman at Arla.
Vilken post har du på företaget? Har du kopplingar till utlandet, Asien?

Hur sköter ni distributions i Sverige? Är det skillnad på Distributionen i Sverige och resten av Europa/Världen?

Följer företaget några generella rekommendationer/regler för hur distributionen ska skötas. Vilka? Varför?

Använder ni någon form av arketyper för er logistik/distribution beroende på område/land/världsdel?
> o Efter vilka förutsättningar/krav är de uppbyggda?
> o Följer ni en mall?
> o Tar ni hänsyn till yttre påverkan typ klimat och kultur?
> o Vägar och avstånd?

Vad tror du kan vara de största skillnaderna distributionsmässigt på Europeiska och Asiatiska marknaderna?

Har du någon erfarenhet från Asien som du vill dela med dig av?

8.3. Chalmers University of Technology Questions

Questions to Kenth Lumsden at Chalmers University of Technology.
Logistik arketyper:
- Finns det något generellt tillvägagångssätt för att ta fram arketyper?
- Någon viktig röd tråd att följa?
- Finns det regler?
- Hur ritar man avstånd? Finns det något generellt sett för att skilja på längre, kortare och lokala avstånd?
- Järnväg, lastbil och mindre lastenheter, hur rekommenderar du att vi ritar upp det?
- Större och mindre leveranser, bör vi/hur kan vi skilja på dem?
- Godshanteringen/lastningen i de olika distributionscentrerna, bör man på något sätt skilja på dem, beroende på om det är modern, stort center eller ett litet traditionellt?
- Bör man skilja på en distributionsenhet och en affär/distributionsenhet?
- Hur kan/bör vi väga in vägstandarden? Är det möjligt?
- Vi ska även ta hänsyn till klimat i vår undersökning, hur föreslår du att vi får med det i de arketyper som vi bygger upp?
- Arketyper kan vara väldigt komplicerade till anledning av förgreningar osv. Hur ska man rita upp dem för att få dem så generella som möjligt utan att göra monstruösa nätverk? Har du förslag?

Har du någon erfarenhet från Asien som du vill dela med dig av?
Vad tror du kan vara de största skillnaderna distributionsmässigt på Europeiska och Asiatiska marknaderna?

8.4. China Train Network Figure

Map of China Railway Line

www.plog.lth.se

LUND UNIVERSITY